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(54) Title of the Invention: **Network elements, cellular communication system and methods therefor**
Abstract Title: **Selecting one of several Home Node B Gateways through which to route communications between a User Equipment and a core network**

(57) A Home Node B (102) which supports a femto-cell (101) in a cellular communication system (100) is provided with a processor (113) for selecting one of several Home Node B Gateways (106, 107, 108) through which to route communications between a User Equipment (105) and a core network (103). The selection process can take into account various factors such as the current loading and functional status of the Home Node B Gateways (106, 107, 108).
It is able to distribute (UE) loading between several network controllers (HNB-GWs) and it provides the possibility to prioritise service to certain UEs. Furthermore, it allows continuity of service in the event of failure of a network controller or a luh connection and allows the UE to receive services from more than one network operator if at least some of the selectable network controllers are controlled by different operators.

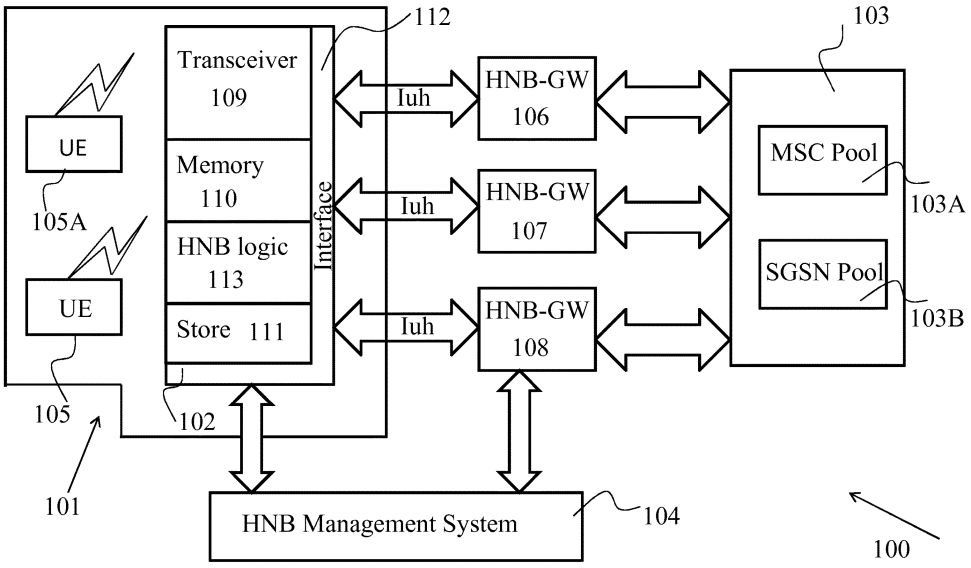

FIG. 1

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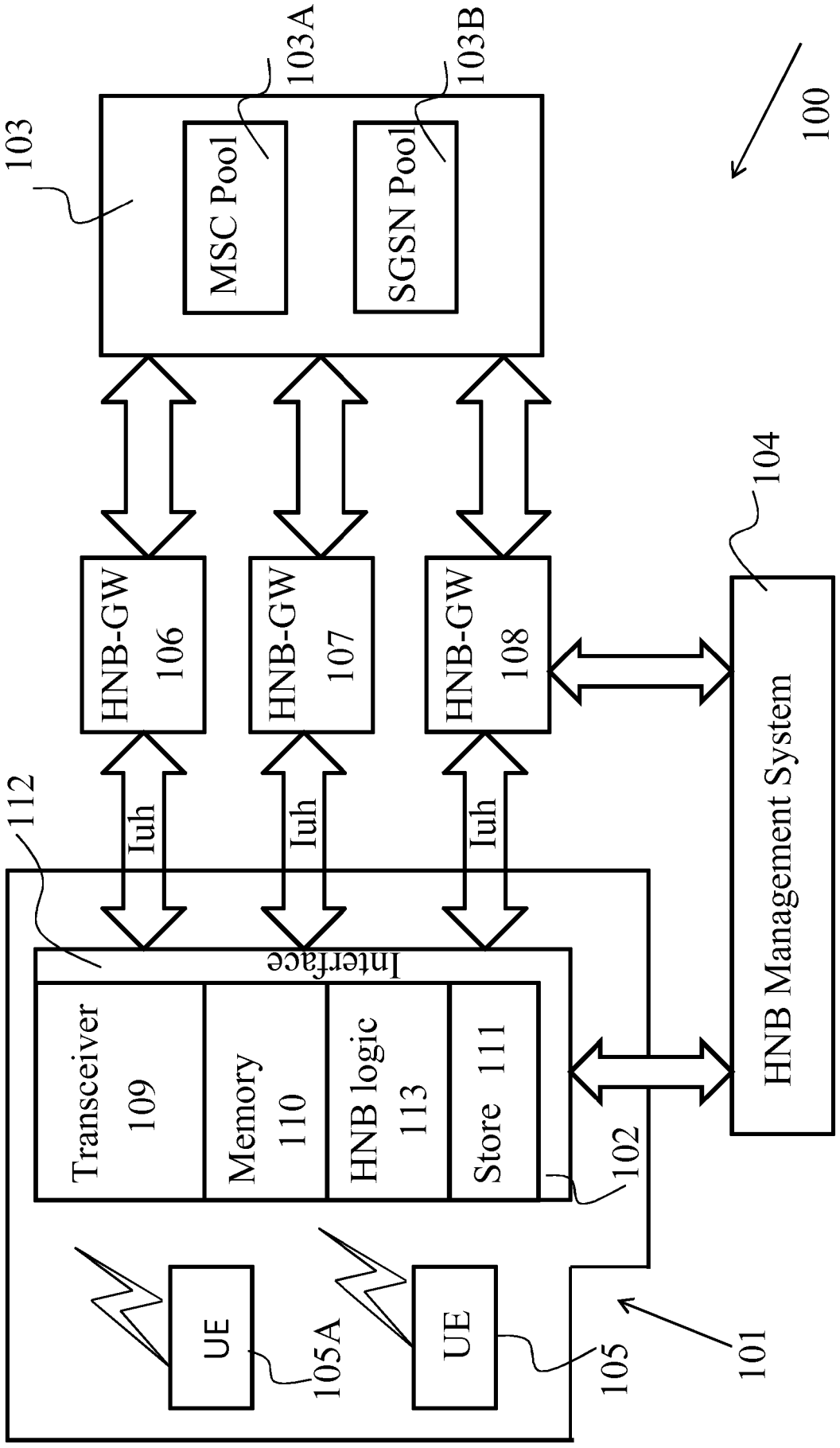
103
103A
MSC Pool
103B
SGSN Pool
100
HNB-GW 106
HNB-GW 107
HNB-GW 108
104
HNB Management System
112
Iuh
Iuh
Iuh
Interface
Transceiver 109
Memory 110
HNB logic 113
Store 111
102
UE
105A
UE
105
101

FIG. 1

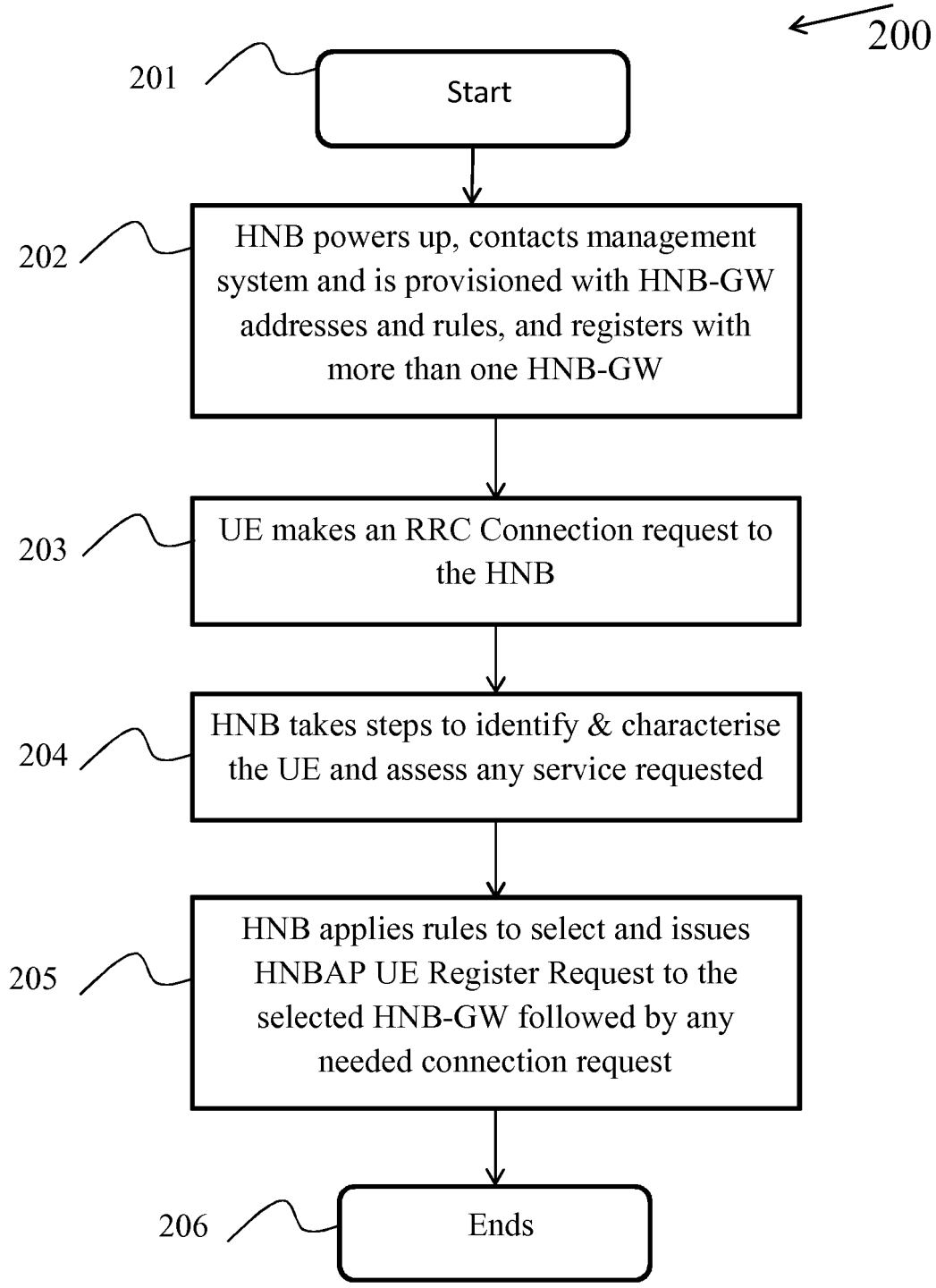
200
201
Start
202
HNB powers up, contacts management system and is provisioned with HNB-GW addresses and rules, and registers with more than one HNB-GW
203
UE makes an RRC Connection request to the HNB
204
HNB takes steps to identify & characterise the UE and assess any service requested
205
HNB applies rules to select and issues HNBAP UE Register Request to the selected HNB-GW followed by any needed connection request
206
Ends

FIG. 2

NETWORK ELEMENTS, CELLULAR COMMUNICATION SYSTEM AND METHODS THEREFOR

Field of the invention

The field of this invention relates to network elements, a cellular communication system and methods therefor. The invention is applicable to, but not limited to, network elements for supporting communication within at least one cell of a cellular communication system, and a method for routing connections between a wireless communications unit and a core network

Background of the Invention

Wireless communication systems, such as the 3rd Generation (3G) of mobile telephone standards and technology, are well known. An example of such 3G standards and technology is the Universal Mobile Telecommunications System (UMTS™), developed by the 3rd Generation Partnership Project (3GPP™) (www.3gpp.org). The 3rd generation of wireless communications has generally been developed to support macro-cell mobile phone communications. Such macro cells utilise high power base stations (NodeBs in 3GPP parlance) to communicate with wireless communication units within a relatively large geographical coverage area. Typically, wireless communication units, or User Equipment (UEs) as they are often referred to in 3G parlance, communicate with a Core Network (CN) of the 3G wireless communication system via a Radio Network Subsystem (RNS). A wireless communication system typically comprises a plurality of radio network subsystems, each radio network subsystem comprising one or more cells to which UEs may attach, and thereby connect to the network. Each macro-cellular RNS further comprises a controller, in a form of a Radio Network Controller (RNC), operably coupled to the one or more Node Bs, via a so-called Iub interface.

The second generation wireless communication system (2G), also known as GSM, is a well-established cellular, wireless communications technology whereby "base transceiver stations" (equivalent to the Node B's of the 3G system) and "mobile units" (user equipment) can transmit and receive voice and packet data. Several base transceiver stations are controlled by a Base Station Controller (BSC), equivalent to the RNC of 3G systems.

Lower power (and therefore smaller coverage area), sometimes referred to as femto- cells (or pico-cells) are a recent development within the field of wireless cellular communication systems. Femto- cells or pico-cells (with the term femto cells being used hereafter to encompass pico-cells or any cell of small coverage area) are effectively communication coverage areas supported by low power base stations (otherwise referred to as Access Points (APs) or Home Node B's (HNBs) or evolved Home Node B's (HeNB's). These femto- cells are intended to be able to be piggy-backed onto the more widely used macro-cellular network and support communications to UEs in a restricted, for example 'in-building', environment. Each femto-cell I served by one HNB.

Typical applications for such femto HNBs include, by way of example, residential and commercial (e.g. office) locations, communication 'hotspots', etc., whereby HNBs can be connected to

a core network via, for example, the Internet using a broadband connection or the like. In this manner, femto cells can be provided in a simple, scalable deployment in specific in-building locations where, for example, network congestion at the macro-cell level may be problematic.. Standard criteria for the functional components of a HNB complying to 3GPP standards may be found in 3GPP TS 25.467 Section 4.2, and such a 3G HNB has most of the functionality of Node-B combined with an RNC.

A HNB is an access point that provides a wireless interface for a user equipment connectivity. It provides a radio access network connectivity to a user equipment (UE) using the so-called Iuh interface to a network controller known as a Home Node B Gateway (HNB-GW). The HNG-GW provides network connectivity of the HNB to a core network. The core network can include, interalia, one Mobile Switching Centre (MSC) or a pool of MSC's. One proposal within the 3G Partnership Project has been the idea of MSC pooling whereby network controllers, for example base station controllers, are permitted to connect to alternative Mobile Switching Centres in cases where one Mobile Switching Centre should experience a failure. (see for example EP-A-2418890).

Conventionally, in a femto-cell network, each HNB has an Iuh connection to a single HNB-GW. This can cause loading problems on the HNB-GW which can lead to service outage if there is a failure of the HNB-GW. This situation is clearly an undesirable one and therefore it would be advantageous if such a situation could be avoided.

Summary of the invention

Accordingly, the invention seeks to mitigate, alleviate or eliminate the above-mentioned disadvantage.

Aspects of the invention provide network elements, a cellular communication system and methods therefor as described in the appended claims.

According to a first aspect of the invention, there is provided a method for enabling communication between a wireless communication unit and a core network via any one of a plurality of selectable network controllers, wherein the wireless communication unit operates in a communication cell which is supported by a network element, the method comprising the steps of; at the network element, registering with each of the selectable network controllers, on receipt of a request from the wireless communication unit for connection with the core network, routing communications between the core network and the wireless communication unit through a selected one of the plurality of selectable network controllers, said selected one of the plurality of selectable network controllers having been selected by reference to at least one criterion from a list of predetermined criteria.

The list of predetermined criteria may comprise at least one of the following;

whether a network controller is in or out of service,

compatibility of the wireless communication unit with the radio access technology supported by a network controller,

capabilities of the wireless communication unit,

a wireless communication unit priority,

the identity of the network operator to which the wireless communication unit is a subscriber,

current loading of each of the network controllers,

accessibility of a network controller to mobile switching centre pools,

wireless communication unit preferences,

network element capabilities.

a round robin selection process,

a random selection process.

the subscription of the wireless communication user subscriber to a particular service.

In one embodiment of the invention, the network element is pre-programmed with the addresses of selectable network controllers.

In an alternative embodiment, the network element may perform a discovery procedure for finding network controllers which can service the network element.

In one embodiment of the invention, the network element registers with each of the selectable network controllers using a Home Node B Application Part registration request message (HNBAP).

In one exemplary embodiment of the invention, the selection of one of the plurality of selectable network controllers is performed by the network element itself.

In an alternative exemplary embodiment of the invention, the selection of one of the plurality of selectable network controllers is performed by a separate management module which conveys the identity of the selected network controller to the network element.

The invention provides the advantage of being able to distribute (UE) loading between several network controllers (fHome Node B Gateways in the case of femto-cell networks, for example). Further, the invention provides the possibility to prioritise service to certain user equipments. Differentiated service levels can be provided by routing different user equipments to different network controllers or security gateways.

Another advantage of the invention is that it allows continuity of service in the event of failure of a network controller or an Iuh connection. The invention can also permit a user equipment to receive services from more than one network operator if at least some of the selectable network controllers are controlled by different operators (ie a shared network environment).

According to a second aspect of the invention, there is provided processing logic for supporting communications between a wireless communication unit and a core network via any one of a plurality of selectable network controllers, the processing logic being adapted to select one of the plurality of selectable network controllers for routing said communications based on at least one criterion from a list of pre-determined criteria.

In one embodiment of the invention, the processing logic may be implemented in an integrated circuit.

The list of predetermined criteria used by the processing logic for selecting a network controller may include at least one of the following;

whether a network controller is in or out of service,

compatibility of the wireless communication unit with the radio access technology supported by a network controller,

capabilities of the wireless communication unit,

a wireless communication unit priority,

the identity of the network operator to which the wireless communication unit is a subscriber,

current loading of each of the network controllers,

accessibility of a network controller to mobile switching centre pools,

wireless communication unit preferences,

network element capabilities,

a round robin selection process,

a random selection process,

the subscription of the wireless communication unit subscriber to a particular service.

According to a third aspect of the invention, there is provided a network element for supporting communication in a femto-cell of a cellular communication system, wherein the cellular communication system includes a core network and a plurality of network controllers, the network element comprising;

a transceiver for facilitating communication with a wireless communication unit located within the femto-cell, and processing logic for selecting one of the plurality of network controllers for routing communications between the wireless communication unit and the core network based on at least one of several pre-determined criteria,

In one embodiment, the network element further includes a memory coupled to the processing logic for storing a list of said predetermined criteria.

In one embodiment of the invention, the network element further includes a store for storing addresses of selectable network controllers.

According to a fourth aspect of the invention, there is provided a wireless communication system adapted to support the aforementioned method or adapted to support the aforementioned processing logic or adapted to support the aforementioned network element.

According to a fifth aspect of the invention, there is provided a tangible computer program product having executable program code stored thereon for programming processing logic to perform a method for enabling communication between a wireless communication unit and a core network, the tangible computer product comprising code for selecting one of a plurality of network controllers through which to route communications between the wireless communication unit and the core network based on at least one of several pre-determined criteria.

The tangible computer program product may comprise at least one from a group consisting of: a hard disk, a CD-ROM, an optical storage device, a magnetic storage device, a Read Only Memory, a Programmable Read Only Memory, an Erasable Programmable Read Only Memory, EPROM, an Electrically Erasable Programmable Read Only Memory and a Flash memory

These and other aspects, features and advantages of the invention will be apparent from, and elucidated with reference to, the embodiments described hereinafter.

Brief Description of the Drawings

Further details, aspects and embodiments of the invention will be described, by way of example only, with reference to the drawings. Elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. Like reference numerals have been included in the respective drawings to ease understanding.

FIG. 1 illustrates a part of a cellular communication system operating in accordance with an example embodiment;

FIG.2 is a flow diagram of an example of a method for enabling communication between a wireless communication unit and a core network.

Detailed Description

The inventive concept finds particular applicability in a cellular communication system that supports any number of overlapping coverage areas, particularly femto-cells. Those skilled in the art, however, will recognise and appreciate that the specifics of this example are merely illustrative of some embodiments and that the teachings set forth herein are applicable to a variety of alternative settings. As such, other alternative implementations within cellular communication networks conforming to different standards are contemplated and are within the scope of the various teachings described.

With reference to FIG. 1, a part of a cellular communication system 100 includes a femto-cell 101, which is served by an access point comprising a Home Node B (HNB) 102.

Also comprising the system 100 is a core network 103 which includes a Mobile Switching Centre (MSC) pool 103A for handling circuit-switched communications and a Serving GPRS (Global Packet Switched Network System) Support Node SGSN pool 103B for handling packet-switched communications. A Home node B Management System 104 provides configuration data to the HNB 102. Typically, the core network 103 includes many other network sub-systems with which the skilled artisan will be familiar but these are not illustrated for the sake of clarity.

The HNB 102 provides a link between one or more user equipments 105, 105A which are located in the femto-cell 101 and the core network 103 via Iuh links to three Home Node B Gateways (HNB-GW) 106, 107, 108. Each HNB-GW is linked to the core network. The HNB-GW's 106, 107, 109 may also be linked to the HNB management system, as is conventional. Three HNB-GW's are shown in this example but there may be only 2 or there may be more than 3. In these alternative cases, each

HNB-GW has its own individual links to both the HNB 102, the core network 103 and the HNB management system 104.

Referring now to the HNB 102 in more detail, this includes a transceiver module 109 for communicating wirelessly with the UE 105, a memory 110 in which is stored a list of pre-determined criteria, a store 111, in which is stored the addresses of the three HNB-GW's 106, 107, 108, an interface module 112 for communicating with each HNB-GW 106, 107, 108 and the HNB management system 104, and a logic module 113, which can access the memory 110, the store 111 and communicate with the interface module 112.

Each HNB-GW 106, 107, 108 is provided with configuration data relating to the HNB 102. This configuration data can be provided by the HNB management system 104.

The HNB 102 registers with each HNB-GW 106, 107, 108 by communicating through the interface module 112 and over their respective Iuh links. The HNB 102 uses the conventional HNBAP message to perform this registration process, having obtained the addresses of each HNB-GW from the store 111. In one embodiment, the addresses and routing criteria are included in configuration data supplied to the HNB 102 by the HNB Management System 104.

Each time a UE 105, 105A connects with the HNB 102 so that it may access services from the core network 103, the HNB 102 has the option of routing communications to and from the UE via any one of the three HNB-GW's 106, 107, 108. A decision is made concerning which HNB-GW to use by carrying out a selection process in the logic module 113.

The logic module 113 bases its selection of an appropriate HNB-GW on at least one criterion from a list of criteria. The criteria list is contained in the memory 110. In one embodiment, configuration data provided to the HNB 102 from the HNB management system 104 may include instructions concerning which of several stored criteria to use in the selection process.

Some examples of criteria on which the choice of HNB-GW to use are based are as follows.

If the link to one of the HNB-GW's is down, then routing communications through that particular HNB-GW should be avoided.

Depending on the particular 3 GPP release of the UE 105, different HNB-GW's may be selected. For example, legacy release 5 UE's could be sent to one HNB-GW 106 and release 8 UE's could be sent to a different HNB-GW 107.

The HNB 102 may have, additionally, in its memory 110, a configured list of MSC's and associated priority levels. The HNB 102 then selects one of the HNB-GW's 106, 107, 108 based on the priority of the UE that requests network services.

The HNB 102 may use the IMSI of the UE 105 or information contained within a location or routing area update message to determine the network operator to which the UE subscribes and any priority that the operator has provided to the IMSI subscriber. The HNB 102 then selects a HNB-GW as appropriate to that operator and priority.

The HNB 102 may use the IMEI of the UE 105 to infer some capabilities of the UE The HNB 102 then selects a HNB-GW as appropriate for those capabilities

The HNB 102 may use a standard load balancing algorithm such as a "round-robin" or random selection process in order to load-balance between the HNB-GW's 106, 107, 108.

In instances where the HNB-GW's 106, 107, 108 have access to different MSC pools and the store 111 contains this information, then the HNB 102 uses the Intra Domain Non Access Stratum Node Selector (IDNNS) received from the UE to select the HNB-GW which has access to the appropriate MSC pool.

The connection request from a UE 105, 105A to the HNB 102 may contain a UE capability indication. Such information is included in a Radio Resource Control (RRC) connect message request for support of High Speed Downlink Shared Channel (HS-DSCH), Extended Uplink Dedicated Channel (E-DCH) or Multimedia Broadcast/Multicast Services (MB/MS) selected services. From this UE capability indication information, the HNB can infer what possible services the UE might require from the network. Similar UE capability indication information can also be gained by way of the (known) location update process.

Influences of the capabilities of the different HNB-GW's can be gained from messages received by the HNB 102 over the Iuh link. Examples of such messages are RRC connection request, LAU (Location Area Update) and RAU (Routing Area Update).

Once the HNB-Gateway selection process has been completed by the logic module 113, the HNB 102 initiates HNBAP UE registration via the selected HNB-GW using a comparable mechanism to that described in 3GPP TS 25.467.

The selected HNB-GW does not need to be made aware of the load balancing. The selected HNB-GW just "sees" a standard HNB that appears to be lightly loaded ie the selected HNB-GW sees only a subset of the UE's that are in the femto-cell 101 and being served by the HNB 102.

In an alternative embodiment, the HNB –GW selection process is not performed in the HNB 102 but carried out remotely; in the HNB Management system, for example.. In such a case, the logic element 113 and conveniently the memory 113 also are located in the HNB Management System 104. In this example, communication between the HNB 102 and the HNB Management System 104 ican be done using Domain Name Service (DNS). The HNB constructs a FQDN using the UE's IMSI and other relevant information and receives an IP address of the selected HNB-GW 106, 107, 108 in the DNS response.

Referring now to FIG.2, there is illustrated a flow chat 200 of a method for enabling communication between a wireless communication unit and a core network. The exemplary method begins at 201 and ends at 206.

At 202, a Home Node B powers up, contacts a Home Node B Management System and is provisioned with Home Node B Gateways' (HNB-GW) addresses and rules concerning which criteria are to be applied to a selection process for selecting a particular HNB-GW for routing communication through from a UE to a core network).

At 203, a User Equipment (UE) makes a Radio Resource Control connection request to the Home Node B.

At 204, the HNB identifies and characterises the UE and assess any service that it has requested. For example, the HNB may determine the type or capabilities of the UE or whether the subscriber of the UE is entitled to or has requested any particular services.

At 205, the HNB applies the rules to select an appropriate HNB-GW though which to route communications to and from the UE. The selection process is done with reference to at least one criterion included in a list of criteria which is accessible to the HNB. Once a HNB-GW has been selected, the HNB issues a HNBAP UE Register Request to the selected HNB-GW. Subsequently, it sends any needed connection request in order to establish the communication link between the UE and the core network via the selected HNB-GW.

The signal processing functionality of the embodiments of the invention, particularly the processing logic of the module 113 may be achieved using computing systems or architectures known to those who are skilled in the relevant art. Computing systems such as, a desktop, laptop or notebook computer, hand-held computing device (PDA, cell phone, palmtop, etc.), mainframe, server, client, or any other type of special or general purpose computing device as may be desirable or appropriate for a given application or environment can be used. The computing system can include one or more processors which can be implemented using a general or special-purpose processing engine such as, for example, a microprocessor, microcontroller or other control module.

The computing system can also include a main memory, such as random access memory (RAM) or other dynamic memory, for storing information and instructions to be executed by a processor. Such a main memory also may be used for storing temporary variables or other intermediate information during execution of instructions to be executed by the processor. The computing system may likewise include a read only memory (ROM) or other static storage device for storing static information and instructions for a processor.

The computing system may also include an information storage system which may include, for example, a media drive and a removable storage interface. The media drive may include a drive or other mechanism to support fixed or removable storage media, such as a hard disk drive, a floppy disk drive, a magnetic tape drive, an optical disk drive, a compact disc (CD) or digital video drive (DVD) read or write drive (R or RW), or other removable or fixed media drive. Storage media may include, for example, a hard disk, floppy disk, magnetic tape, optical disk, CD or DVD, or other fixed or removable medium that is read by and written to by media drive. The storage media may include a computer-readable storage medium having particular computer software or data stored therein.

In alternative embodiments, an information storage system may include other similar components for allowing computer programs or other instructions or data to be loaded into the computing system. Such components may include, for example, a removable storage unit and an interface , such as a program cartridge and cartridge interface, a removable memory (for example, a flash memory or other removable memory module) and memory slot, and other removable storage units and interfaces that allow software and data to be transferred from the removable storage unit to computing system.

The computing system can also include a communications interface. Such a communications interface can be used to allow software and data to be transferred between a computing system and external devices. Examples of communications interfaces can include a modem, a network interface (such as an Ethernet or other NIC card), a communications port (such as for example, a universal serial bus (USB) port), a PCMCIA slot and card, etc. Software and data transferred via a

communications interface are in the form of signals which can be electronic, electromagnetic, and optical or other signals capable of being received by a communications interface medium.

In this document, the terms 'computer program product', 'computer-readable medium' and the like may be used generally to refer to tangible media such as, for example, a memory, storage device, or storage unit. These and other forms of computer-readable media may store one or more instructions for use by the processor comprising the computer system to cause the processor to perform specified operations. Such instructions, generally referred to as 'computer program code' (which may be grouped in the form of computer programs or other groupings), when executed, enable the computing system to perform functions of embodiments of the present invention. Note that the code may directly cause a processor to perform specified operations, be compiled to do so, and/or be combined with other software, hardware, and/or firmware elements (e.g., libraries for performing standard functions) to do so.

In an embodiment where the elements are implemented using software, the software may be stored in a computer-readable medium and loaded into computing system using, for example, removable storage drive. A control module (in this example, software instructions or executable computer program code), when executed by the processor in the computer system, causes a processor to perform the functions of the invention as described herein.

Furthermore, the inventive concept can be applied to any circuit for performing signal processing functionality within a network element. It is further envisaged that, for example, a semiconductor manufacturer may employ the inventive concept in a design of a stand-alone device, such as a microcontroller of a digital signal processor (DSP), or application-specific integrated circuit (ASIC) and/or any other sub-system element.

It will be appreciated that, for clarity purposes, the above description has described embodiments of the invention with reference to a single processing logic. However, the inventive concept may equally be implemented by way of a plurality of different functional units and processors to provide the signal processing functionality. Thus, references to specific functional units are only to be seen as references to suitable means for providing the described functionality, rather than indicative of a strict logical or physical structure or organisation.

Aspects of the invention may be implemented in any suitable form including hardware, software, firmware or any combination of these. The invention may optionally be implemented, at least partly, as computer software running on one or more data processors and/or digital signal processors or configurable module components such as FPGA devices. Thus, the elements and components of an embodiment of the invention may be physically, functionally and logically implemented in any suitable way. Indeed, the functionality may be implemented in a single unit, in a plurality of units or as part of other functional units.

Although the present invention has been described in connection with some embodiments, it is not intended to be limited to the specific form set forth herein. Rather, the scope of the present invention is limited only by the accompanying claims. Additionally, although a feature may appear to be described in connection with particular embodiments, one skilled in the art would recognize that

various features of the described embodiments may be combined in accordance with the invention. In the claims, the term 'comprising' does not exclude the presence of other elements or steps.

Furthermore, although individually listed, a plurality of means, elements or method steps may be implemented by, for example, a single unit or processor. Additionally, although individual features may be included in different claims, these may possibly be advantageously combined, and the inclusion in different claims does not imply that a combination of features is not feasible and/or advantageous. Also, the inclusion of a feature in one category of claims does not imply a limitation to this category, but rather indicates that the feature is equally applicable to other claim categories, as appropriate.

Furthermore, the order of features in the claims does not imply any specific order in which the features must be performed and in particular the order of individual steps in a method claim does not imply that the steps must be performed in this order. Rather, the steps may be performed in any suitable order. In addition, singular references do not exclude a plurality. Thus, references to 'a', 'an', 'first', 'second', etc. do not preclude a plurality.

Thus, an improved method and apparatus for facilitating routing of communications within a cellular communication system have been described, wherein the aforementioned disadvantages with prior art arrangements have been substantially alleviated.

Claims

1. A method for enabling communication between a wireless communication unit (105) and a core network (103) via any one of a plurality of selectable network controllers (106, 107, 108), wherein the wireless communication unit operates in a communication cell (101) which is supported by a network element (102), the method comprising the steps of;
at the network element (102),
registering with each of the selectable network controllers (106, 107, 108),
on receipt of a request from the wireless communication unit (105) for connection with the core network (103),
routing communications between the core network (103) and the wireless communication unit (105) through a selected one of the plurality of selectable network controllers (106, 107, 108),
said selected one of the plurality of selectable network controllers having been selected by reference to at least one criterion from a list of predetermined criteria.

2. The method according to claim 1 wherein the list of predetermined criteria comprises at least one of the following;
whether a network controller (106, 107, 108) is in or out of service,
compatibility of the wireless communication unit (105) with the radio access technology supported by a network controller,
capabilities of the wireless communication unit,
a wireless communication unit priority,
the identity of the network operator to which the wireless communication unit (105) is a subscriber,
current loading of each of the network controllers (106, 107, 108),
accessibility of a network controller to mobile switching centre pools,
wireless communication unit preferences,
network element capabilities,
a round robin selection process,
a random selection process,
the subscription of a wireless communication unit subscriber to a particular service.

3. The method according to either of claims 1 or 2 wherein the network element (102) is pre-programmed with the addresses of selectable network controllers (106, 107, 108).

4. The method according to either of claims 1 or 2 wherein the network element (102) performs a discovery procedure for finding network controllers which can serve the network element (102).

5. The method according to any preceding claim in which the network element (102) registers with each of the selectable network controllers (106, 107, 108) using a Home Node B Application Part registration request message.

6. The method according to any of claims 1 to 5 in which a process for selecting one of the plurality of selectable network controllers (106, 107, 108) is performed by the network element (102).

7. The method according to any of claims 1 to 6 wherein a process for selecting one of the plurality of selectable network controllers (106, 107, 108) is performed by a module remote from the network element (102) and wherein the address of the selected network controller is conveyed from the remote module to the network element (102).

8. Processing logic (113) for supporting communications between a wireless communication unit (105) and a core network (103) and any one of a plurality of selectable network controllers (106, 107, 108), the processing logic (113) being adapted to select one of the plurality of selectable network controllers (106, 107, 108) for routing said communications, based on at least one criterion from a list of predetermined criteria.

9. An integrated circuit comprising the processing logic of claim 8.

10. The processing logic of claim 8 in which the list of predetermined criteria includes at least one of the following;
whether a network controller (106, 107, 108) is in or out of service,
compatibility of the wireless communication unit (105) with the radio access technology supported by a network controller (106, 107, 108),
capabilities of the wireless communication unit (105),
a wireless communication unit priority,
the identity of the network operator to which the wireless communication unit (105) is a subscriber,
current loading of each of the network controllers (106, 107, 108),
accessibility of a network controller to mobile switching centre pools,
wireless communication unit preferences,
network element capabilities,
a round robin process,
a random selection process,
the subscription of a wireless communication unit subscriber to a particular service.

11. A network element (102) for supporting communication in a femto-cell (101) of a cellular communication system (100), wherein the cellular communication system includes a core network (103) and a plurality of network controllers (106, 107, 108), the network element (102) comprising a transceiver (109) for facilitating communication with a wireless communication unit (105) located within the femto-cell (101), and processing logic (113) for selecting one of the plurality of network controllers (106, 107, 108) for routing communications between the wireless communication unit (105) and the core network (103), based on at least one of several predetermined criteria.

12. The network element of claim 11 in which the network element (102) further includes a memory (110), coupled to the processing logic (113) for storing a list of said predetermined criteria.

13. The network element of either of claims 11 or 12 wherein the network element (102) further includes a store (111) for storing addresses of selectable network controllers (106, 107, 108).

14. A wireless communication system (100) adapted to support the method according to any of claims 1 to 7, or the processing logic according to either of claims 8 or 10, or the network element according to any of claims 11, 12 or 13.

15. A tangible computer program product (113) having executable programme code stored thereon for programming processing logic to perform a method for enabling communication between a wireless communication unit (105) and a core network (103), the tangible computer program product comprising code for selecting one of a plurality of network controllers (106, 107, 108) through which to route communications between the wireless communication unit (105) and the core network (103), based on at least one of several predetermined criteria.

16. The tangible computer program product (113) of claim 15 comprising at least one from a group consisting of: a hard disk, a CD-ROM, an optical storage device, a magnetic storage device, a Read Only Memory, a Programmable Read Only Memory, an Erasable Programmable Read Only Memory, EPROM, an Electrically Erasable Programmable Read Only Memory and a Flash memory

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Claims searched:	All	**Date of search:**	8 December 2012

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-16	US2012/026865 A1 (AT & T): Whole document relevant, esp paragraphs 0003-0008.
X	1-16	WO2011/029319 A1 (ZTE CORP): Whole document relevant, esp translated abstract.
X	1-16	US2011/066875 A1 (AT&T): Whole document relevant, Fig 1, 3, 7 and paragraphs 0017, 0018, 0019, 0021-0022.
X	1-16	EP2367377 A1 (FUJITSU LTD): Whole document relevant, esp paragraph 0014, Figs 1-3 and related passages.
X	1-16	CN101640892 A (HANGHZOU H3C TECH CO LTD): Whole document relevant, esp translated abstract.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

H04W

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI, TXTE

International Classification:

Subclass	Subgroup	Valid From
H04W	0084/04	01/01/2009
H04W	0040/02	01/01/2009
H04W	0088/16	01/01/2009