

(51) International Patent Classification:
H04W 8/18 (2009.01)(21) International Application Number:
PCT/IB2009/051178(22) International Filing Date:
20 March 2009 (20.03.2009)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).(71) Applicant (for LC only): **NOKIA INC.** [US/US]; 6021 Connection Drive, Irving, Texas 75039 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **KEKKI, Sami, Johannes** [FI/FI]; Vanhaistentie 4 B 23, FIN-00420 Helsinki (FI).(74) Agents: **LEYES, Charles, Andrew** et al.; Bank Of America Plaza, 101 South Tryon Street, Suite 4000, Charlotte, North Carolina 28280-4000 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

Published:

— with international search report (Art. 21(3))

(54) Title: SYSTEMS, METHODS, APPARATUSES, AND COMPUTER PROGRAM PRODUCTS FOR FACILITATING MANAGEMENT OF MEMBERSHIP IN A CLOSED SUBSCRIBER GROUP

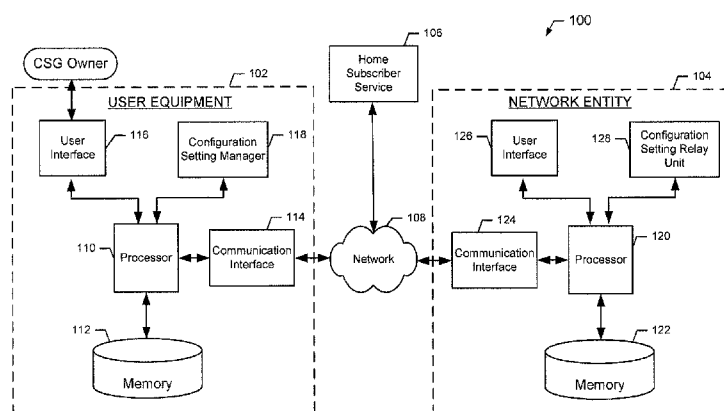


FIG. 1.

(57) **Abstract:** A method, apparatus, and computer program product are provided for facilitating management of membership in a closed subscriber group. A method may include receiving, at a user equipment device associated with an owner of a closed subscriber group cell, a configuration setting related to membership in a closed subscriber group permitted to access the closed subscriber group cell. The method may further include sending a configuration message comprising the configuration setting to a network entity on a network of an operator of the closed subscriber group cell to enable the network of the operator to implement the configuration setting. Corresponding computer program products and apparatuses are also provided.

SYSTEMS, METHODS, APPARATUSES, AND COMPUTER PROGRAM PRODUCTS FOR FACILITATING MANAGEMENT OF MEMBERSHIP IN A CLOSED SUBSCRIBER GROUP

TECHNOLOGICAL FIELD

Embodiments of the present invention relate generally to mobile communications technology and, more particularly, relate to systems, methods, apparatuses, and computer program products for facilitating management of membership in a closed subscriber group.

BACKGROUND

The modern communications era has brought about a tremendous expansion of wireline and wireless networks. Computer networks, television networks, and telephony networks are experiencing an unprecedented technological expansion, fueled by consumer demand. Wireless and mobile networking technologies have addressed related consumer demands, while providing more flexibility and immediacy of information transfer.

Current and future networking technologies continue to facilitate ease of information transfer and convenience to users. In order to provide easier or faster information transfer and convenience, telecommunication industry service providers are developing improvements to existing networks. In this regard, for example, improvements are being made to the universal mobile telecommunications system (UMTS) terrestrial radio access network (UTRAN). Further, for example, the evolved-UTRAN (E-UTRAN) is currently being developed. The E-UTRAN, which is also known as Long Term Evolution (LTE), is aimed at upgrading prior technologies by improving efficiency, lowering costs, improving services, making use of new spectrum opportunities, and providing better integration with other open standards.

One development in networks is the provision for localized base stations that may be individually owned and deployed in homes and businesses. These localized base stations are referred to as femtocells. Access to a network through a femtocell may be provided by a network operator, such as a public land mobile network (PLMN) operator. A femtocell may comprise a NodeB referred to as Home NodeB (HNB) in UTRAN and/or as a Home evolved NodeB (HeNB) in E-UTRAN. An HNB and/or an HeNB (H(e)NB) may be configured to operate as a closed subscriber group (CSG) cell, wherein the CSG cell is accessible only by members of a CSG to which the CSG cell is configured to provide access.

In this regard, only mobile devices having an identity included in the CSG may be allowed to camp on or otherwise utilize the CSG cell as an access point to the operator network.

Membership in the CSG, including temporary membership, is managed by both the registered owner of the CSG cell and the network operator. The CSG associated with a specific CSG cell may be updated upon request by the registered owner of the CSG cell, under the supervision of the network operator operating the CSG cell. When membership in the CSG is updated, the operator network may then update the affected user equipment devices (UEs). However, heretofore, CSG cell owners have not been provided with a convenient and location-independent way to update a CSG. In this regard, CSG cell owners may currently have to use the actual CSG cell equipment to update configuration settings related to CSG membership.

Accordingly, it may be desirable to provide systems, methods, apparatuses, and computer program products for facilitating management of membership in a closed subscriber group.

BRIEF SUMMARY OF SOME EXAMPLES OF THE INVENTION

A method, apparatus, and computer program product are therefore provided for facilitating management of membership in a closed subscriber group. In this regard, a method, apparatus, and computer program product are provided that may provide several advantages to computing devices, computing device users, and network operators. Embodiments of the invention provide for the ability of a CSG cell owner to manage membership in a CSG using a user equipment device even if not physically located in proximity of the CSG cell. In this regard, embodiments of the invention provide an interface enabling an owner of a CSG cell to enter configuration settings into a user equipment device associated with the CSG cell owner. Embodiments of the invention further provide for the user equipment device associated with the CSG cell owner to format a configuration message comprising a configuration setting and send the configuration message to a network entity configured to provide the configuration setting to a home subscriber service on the operator network to effect changes made to CSG membership by the CSG cell owner.

In a first exemplary embodiment, a method is provided, which includes receiving, at a user equipment device associated with an owner of a closed subscriber group cell, a configuration setting related to membership in a closed subscriber group permitted to access the closed subscriber group cell. The method of this embodiment further includes sending a configuration message comprising the configuration setting to a network entity on a network of an operator of the closed subscriber group cell to enable the network of the operator to implement the configuration setting.

In another exemplary embodiment, a computer program product is provided. The computer program product includes at least one computer-readable storage medium having computer-readable program instructions stored therein. The computer-readable program instructions may include a plurality of program instructions. Although in this summary, the program instructions are ordered, it will be appreciated that this summary is provided merely for purposes of example and the ordering is merely to facilitate summarizing the computer program product. The example ordering in no way limits the implementation of the associated computer program instructions. The first program instruction of this embodiment is for causing a configuration setting related to membership in a closed subscriber group permitted to access a closed subscriber group

cell to be received at a user equipment device associated with an owner of the closed subscriber group cell. The second program instruction of this embodiment is for causing a configuration message comprising the configuration setting to be sent to a network entity on a network of an operator of the closed subscriber group cell to enable the network of the operator to implement the configuration setting.

In another exemplary embodiment, an apparatus is provided. The apparatus of this embodiment includes a processor and a memory storing instructions that when executed by the processor cause the apparatus to receive a configuration setting related to membership in a closed subscriber group permitted to access a closed subscriber group cell. The apparatus of this embodiment is associated with an owner of the closed subscriber group cell. The instructions when executed by the processor further cause the apparatus of this embodiment to send a configuration message comprising the configuration setting to a network entity on a network of an operator of the closed subscriber group cell to enable the network of the operator to implement the configuration setting.

In another exemplary embodiment, an apparatus is provided, which includes means for receiving a configuration setting related to membership in a closed subscriber group permitted to access a closed subscriber group cell. The apparatus of this embodiment is associated with an owner of the closed subscriber group cell. The apparatus of this embodiment further includes means for sending a configuration message comprising the configuration setting to a network entity on a network of an operator of the closed subscriber group cell to enable the network of the operator to implement the configuration setting.

The above summary is provided merely for purposes of summarizing some example embodiments of the invention so as to provide a basic understanding of some aspects of the invention. Accordingly, it will be appreciated that the above described example embodiments are merely examples and should not be construed to narrow the scope or spirit of the invention in any way. It will be appreciated that the scope of the invention encompasses many potential embodiments, some of which will be further described below, in addition to those here summarized.

BRIEF DESCRIPTION OF THE DRAWING(S)

Having thus described embodiments of the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 illustrates a system for facilitating management of membership in a closed subscriber group according to an exemplary embodiment of the present invention;

FIG. 2 is a schematic block diagram of a mobile terminal according to an exemplary embodiment of the present invention; and

FIGs. 3-4 illustrate flowcharts according to exemplary methods for facilitating management of membership in a closed subscriber group according to exemplary embodiments of the invention.

DETAILED DESCRIPTION

Some embodiments of the present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, the invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like reference numerals refer to like elements throughout.

FIG. 1 illustrates a block diagram of a system 100 for facilitating management of membership in a closed subscriber group according to an exemplary embodiment of the present invention. As used herein, "exemplary" merely means an example and as such represents one example embodiment for the invention and should not be construed to narrow the scope or spirit of the invention in any way. It will be appreciated that the scope of the invention encompasses many potential embodiments in addition to those illustrated and described herein. As such, while FIG. 1 illustrates one example of a configuration of a system for facilitating management of membership in a closed subscriber group, numerous other configurations may also be used to implement embodiments of the present invention.

In at least some embodiments, the system 100 includes a user equipment device (UE) 102, network entity 104, and home subscriber service (HSS) 106, which are configured to communicate over a network 108. The network 108 may comprise a wireline network, wireless network, or some combination thereof. The network 108 may comprise a PLMN operated by a network operator. In this regard, the network 108 may, for example, comprise an operator network providing cellular network access in accordance with E-UTRAN and/or UTRAN standards. The network 108 may additionally or alternatively comprise the internet.

The UE 102 may comprise any computing device configured to access network services (e.g., cellular network services), such as may be provided by a network operator, such as an operator of at least a portion of the network 108. The UE 102 may be configured to access the network 108 through radio access that may be provided by a network access point or base station. The UE 102 may be associated with an owner of a CSG cell. In this regard, the UE 102 may comprise a computing device recognized by a network operator providing network access through the CSG cell owner's CSG cell, such as through an international mobile subscriber identity (IMSI) of the UE 102, as being a computing device belonging to, registered to, and/or used by an owner of a CSG cell. It will be appreciated that a CSG cell owner may not have legal ownership of the CSG cell, but rather may alternatively lease, borrow, and/or manage a CSG cell. In this regard, a CSG cell owner comprises an individual or entity recognized by a network operator as having authority recognized by the network operator providing network access through the CSG cell owner's CSG cell to manage CSG membership for a CSG permitted to access the CSG cell owner's CSG cell, such as by adding, removing, viewing, and/or otherwise modifying a CSG membership list.

The UE 102 may be embodied as a server, desktop computer, laptop computer, mobile terminal, mobile computer, mobile phone, mobile communication device, game device, digital

camera/camcorder, audio/video player, television device, radio receiver, digital video recorder, positioning device, any combination thereof, and/or the like. In an exemplary embodiment, the UE 102 is embodied as a mobile terminal, such as that illustrated in FIG. 2. In this regard, FIG. 2 illustrates a block diagram of a mobile terminal 10 representative of one embodiment of a UE 102 in accordance with embodiments of the present invention. It should be understood, however, that the mobile terminal 10 illustrated and hereinafter described is merely illustrative of one type of UE 102 that may implement and/or benefit from embodiments of the present invention and, therefore, should not be taken to limit the scope of the present invention. While several embodiments of the electronic device are illustrated and will be hereinafter described for purposes of example, other types of electronic devices, such as mobile telephones, mobile computers, portable digital assistants (PDAs), pagers, laptop computers, desktop computers, gaming devices, televisions, and other types of electronic systems, may employ embodiments of the present invention.

As shown, the mobile terminal 10 may include an antenna 12 (or multiple antennas 12) in communication with a transmitter 14 and a receiver 16. The mobile terminal may also include a controller 20 or other processor(s) that provides signals to and receives signals from the transmitter and receiver, respectively. These signals may include signaling information in accordance with an air interface standard of an applicable cellular system, and/or any number of different wireline or wireless networking techniques, comprising but not limited to Wireless-Fidelity (Wi-Fi), wireless local access network (WLAN) techniques such as Institute of Electrical and Electronics Engineers (IEEE) 802.11, and/or the like. In addition, these signals may include speech data, user generated data, user requested data, and/or the like. In this regard, the mobile terminal may be capable of operating with one or more air interface standards, communication protocols, modulation types, access types, and/or the like. More particularly, the mobile terminal may be capable of operating in accordance with various first generation (1G), second generation (2G), 2.5G, third-generation (3G) communication protocols, fourth-generation (4G) communication protocols, and/or the like. For example, the mobile terminal may be capable of operating in accordance with 2G wireless communication protocols IS-136 (Time Division Multiple Access (TDMA)), Global System for Mobile communications (GSM), IS-95 (Code Division Multiple Access (CDMA)), and/or the like. Also, for example, the mobile terminal may be capable of operating in accordance with 2.5G wireless communication protocols General Packet Radio Service (GPRS), Enhanced Data GSM Environment (EDGE), and/or the like. Further, for example, the mobile terminal may be capable of operating in accordance with 3G wireless communication protocols such as Universal Mobile Telecommunications System (UMTS), Code Division Multiple Access 2000 (CDMA2000), Wideband Code Division Multiple Access (WCDMA), Time Division-Synchronous Code Division Multiple Access (TD-SCDMA), and/or the like. The mobile terminal may be additionally capable of operating in accordance with 3.9G wireless communication protocols such as Long Term Evolution (LTE) or Evolved Universal Terrestrial Radio Access Network (E-UTRAN) and/or the like. Additionally, for example, the mobile terminal may be capable of operating in accordance with fourth-generation (4G) wireless communication protocols and/or the like as well as similar wireless communication protocols that may be developed in the future.

Some Narrow-band Advanced Mobile Phone System (NAMPS), as well as Total Access Communication System (TACS), mobile terminals may also benefit from embodiments of this invention, as should dual or higher mode phones (e.g., digital/analog or TDMA/CDMA/analog phones). Additionally, the mobile terminal 10 may be capable of operating according to Wireless Fidelity (Wi-Fi) or Worldwide Interoperability for Microwave Access (WiMAX) protocols.

It is understood that the controller 20 may comprise circuitry for implementing audio/video and logic functions of the mobile terminal 10. For example, the controller 20 may comprise a digital signal processor device, a microprocessor device, an analog-to-digital converter, a digital-to-analog converter, and/or the like. Control and signal processing functions of the mobile terminal may be allocated between these devices according to their respective capabilities. The controller may additionally comprise an internal voice coder (VC) 20a, an internal data modem (DM) 20b, and/or the like. Further, the controller may comprise functionality to operate one or more software programs, which may be stored in memory. For example, the controller 20 may be capable of operating a connectivity program, such as a web browser. The connectivity program may allow the mobile terminal 10 to transmit and receive web content, such as location-based content, according to a protocol, such as Wireless Application Protocol (WAP), hypertext transfer protocol (HTTP), and/or the like. The mobile terminal 10 may be capable of using a Transmission Control Protocol/Internet Protocol (TCP/IP) to transmit and receive web content across the internet or other networks.

The mobile terminal 10 may also comprise a user interface including, for example, an earphone or speaker 24, a ringer 22, a microphone 26, a display 28, a user input interface, and/or the like, which may be operationally coupled to the controller 20. Although not shown, the mobile terminal may comprise a battery for powering various circuits related to the mobile terminal, for example, a circuit to provide mechanical vibration as a detectable output. The user input interface may comprise devices allowing the mobile terminal to receive data, such as a keypad 30, a touch display (not shown), a joystick (not shown), and/or other input device. In embodiments including a keypad, the keypad may comprise numeric (0-9) and related keys (#, *), and/or other keys for operating the mobile terminal.

As shown in FIG. 2, the mobile terminal 10 may also include one or more means for sharing and/or obtaining data. For example, the mobile terminal may comprise a short-range radio frequency (RF) transceiver and/or interrogator 64 so data may be shared with and/or obtained from electronic devices in accordance with RF techniques. The mobile terminal may comprise other short-range transceivers, such as, for example, an infrared (IR) transceiver 66, a BluetoothTM (BT) transceiver 68 operating using BluetoothTM brand wireless technology developed by the BluetoothTM Special Interest Group, a wireless universal serial bus (USB) transceiver 70 and/or the like. The BluetoothTM transceiver 68 may be capable of operating according to ultra-low power BluetoothTM technology (e.g., WibreeTM) radio standards. In this regard, the mobile terminal 10 and, in particular, the short-range transceiver may be capable of transmitting data to and/or receiving data from electronic devices within a proximity of the mobile terminal, such as within 10 meters, for example. Although not shown, the mobile terminal may be capable of transmitting

and/or receiving data from electronic devices according to various wireless networking techniques, including Wireless Fidelity (Wi-Fi), WLAN techniques such as IEEE 802.11 techniques, and/or the like.

The mobile terminal 10 may comprise memory, such as a subscriber identity module (SIM) 38, a removable user identity module (R-UIM), and/or the like, which may store information elements related to a mobile subscriber. In addition to the SIM, the mobile terminal may comprise other removable and/or fixed memory. The mobile terminal 10 may include volatile memory 40 and/or non-volatile memory 42. For example, volatile memory 40 may include Random Access Memory (RAM) including dynamic and/or static RAM, on-chip or off-chip cache memory, and/or the like. Non-volatile memory 42, which may be embedded and/or removable, may include, for example, read-only memory, flash memory, magnetic storage devices (e.g., hard disks, floppy disk drives, magnetic tape, etc.), optical disc drives and/or media, non-volatile random access memory (NVRAM), and/or the like. Like volatile memory 40 non-volatile memory 42 may include a cache area for temporary storage of data. The memories may store one or more software programs, instructions, pieces of information, data, and/or the like which may be used by the mobile terminal for performing functions of the mobile terminal. For example, the memories may comprise an identifier, such as an international mobile equipment identification (IMEI) code, capable of uniquely identifying the mobile terminal 10.

Referring again to FIG. 1, in an exemplary embodiment, the UE 102 includes various means, such as a processor 110, memory 112, communication interface 114, user interface 116, and configuration setting manager 118 for performing the various functions herein described. These means of the UE 102 as described herein may be embodied as, for example, hardware elements (e.g., a suitably programmed processor, combinational logic circuit, and/or the like), a computer program product comprising computer-readable program instructions (e.g., software or firmware) stored on a computer-readable medium (e.g. memory 112) that is executable by a suitably configured processing device (e.g., the processor 110), or some combination thereof.

The processor 110 may, for example, be embodied as various means including one or more microprocessors with accompanying digital signal processor(s), one or more processor(s) without an accompanying digital signal processor, one or more coprocessors, one or more controllers, processing circuitry, one or more computers, various other processing elements including integrated circuits such as, for example, an ASIC (application specific integrated circuit) or FPGA (field programmable gate array), or some combination thereof. Accordingly, although illustrated in FIG. 1 as a single processor, in some embodiments the processor 110 comprises a plurality of processors. In an exemplary embodiment, the processor 110 is configured to execute instructions stored in the memory 112 or otherwise accessible to the processor 110. These instructions, when executed by the processor 110, may cause the UE 102 to perform one or more of the functionalities of the UE 102 as described herein. As such, whether configured by hardware or software methods, or by a combination thereof, the processor 110 may represent an entity capable of performing operations according to embodiments of the present invention when configured accordingly. Thus, for example, when the processor 110 is embodied as an ASIC,

FPGA or the like, the processor 110 may comprise specifically configured hardware for conducting one or more operations described herein. Alternatively, as another example, when the processor 110 is embodied as an executor of instructions, the instructions may specifically configure the processor 110, which may otherwise be a general purpose processing element if not for the specific configuration provided by the instructions, to perform one or more algorithms and operations described herein.

The memory 112 may include, for example, volatile and/or non-volatile memory. Although illustrated in FIG. 1 as a single memory, the memory 112 may comprise a plurality of memories. The memory 112 may comprise volatile memory, non-volatile memory, or some combination thereof. In this regard, the memory 112 may comprise, for example, a hard disk, random access memory, cache memory, flash memory, a compact disc read only memory (CD-ROM), digital versatile disc read only memory (DVD-ROM), an optical disc, circuitry configured to store information, or some combination thereof. The memory 112 may be configured to store information, data, applications, instructions, or the like for enabling the UE 102 to carry out various functions in accordance with exemplary embodiments of the present invention. For example, in at least some embodiments, the memory 112 is configured to buffer input data for processing by the processor 110. Additionally or alternatively, in at least some embodiments, the memory 112 is configured to store program instructions for execution by the processor 110. The memory 112 may store information in the form of static and/or dynamic information. This stored information may be stored and/or used by the configuration setting manager 118 during the course of performing its functionalities.

The communication interface 114 may be embodied as any device or means embodied in hardware, a computer program product comprising computer readable program instructions stored on a computer readable medium (e.g., the memory 112) and executed by a processing device (e.g., the processor 110), or a combination thereof that is configured to receive and/or transmit data from/to a remote device over the network 108. In this regard, the communication interface 114 may be configured to transceive data over a PLMN network (e.g., a cellular network implementing UTRAN and/or E-UTRAN standards) operated by a network operator. In at least one embodiment, the communication interface 114 is at least partially embodied as or otherwise controlled by the processor 110. In this regard, the communication interface 114 may be in communication with the processor 110, such as via a bus. The communication interface 114 may include, for example, an antenna, a transmitter, a receiver, a transceiver and/or supporting hardware or software for enabling communications with other entities of the system 100. The communication interface 114 may be configured to receive and/or transmit data using any protocol that may be used for communications between computing devices of the system 100. The communication interface 114 may additionally be in communication with the memory 112, user interface 116, and/or configuration setting manager 118, such as via a bus.

The user interface 116 may be in communication with the processor 110 to receive an indication of a user input and/or to provide an audible, visual, mechanical, or other output to a user, such as the CSG owner associated with the UE 102. As such, the user interface 116 may

include, for example, a keyboard, a mouse, a joystick, a display, a touch screen display, a microphone, a speaker, and/or other input/output mechanisms. The user interface 116 may provide an interface allowing a user to enter one or more configuration settings for managing membership in a CSG. The user interface 116 may be in communication with the memory 112, communication interface 114, and/or configuration setting manager 118, such as via a bus.

The configuration setting manager 118 may be embodied as various means, such as hardware, a computer program product comprising computer readable program instructions stored on a computer readable medium (e.g., the memory 112) and executed by a processing device (e.g., the processor 110), or some combination thereof and, in one embodiment, is embodied as or otherwise controlled by the processor 110. In embodiments where the configuration setting manager 118 is embodied separately from the processor 110, the configuration setting manager 118 may be in communication with the processor 110. The configuration setting manager 118 may further be in communication with the memory 112, communication interface 114, and/or user interface 116, such as via a bus.

The network entity 104 may comprise one or more computing devices managed by and/or otherwise residing on the network of the operator of a CSG cell (the operator network). In this regard, the network entity 104 may comprise, for example, a mobility management entity (MME), a mobile switching center (MSC), a configuration server, and/or the like. In an exemplary embodiment, the network entity 104 includes various means, such as a processor 120, memory 122, communication interface 124, user interface 126, and configuration setting relay unit 128 for performing the various functions herein described. These means of the network entity 104 as described herein may be embodied as, for example, hardware elements (e.g., a suitably programmed processor, combinational logic circuit, and/or the like), a computer program product comprising computer-readable program instructions (e.g., software or firmware) stored on a computer-readable medium (e.g. memory 122) that is executable by a suitably configured processing device (e.g., the processor 120), or some combination thereof.

The processor 120 may, for example, be embodied as various means including one or more microprocessors with accompanying digital signal processor(s), one or more processor(s) without an accompanying digital signal processor, one or more coprocessors, one or more controllers, processing circuitry, one or more computers, various other processing elements including integrated circuits such as, for example, an ASIC (application specific integrated circuit) or FPGA (field programmable gate array), or some combination thereof. Accordingly, although illustrated in FIG. 1 as a single processor, in some embodiments the processor 120 comprises a plurality of processors. The plurality of processors may be embodied on a single computing device or distributed among a plurality of computing devices. The plurality of processors may be in operative communication with each other and may be collectively configured to perform one or more functionalities of the network entity 104 as described herein. In an exemplary embodiment, the processor 120 is configured to execute instructions stored in the memory 122 or otherwise accessible to the processor 120. These instructions, when executed by the processor 120, may cause the network entity 104 to perform one or more of the functionalities of the network entity 104

as described herein. As such, whether configured by hardware or software methods, or by a combination thereof, the processor 120 may represent an entity capable of performing operations according to embodiments of the present invention when configured accordingly. Thus, for example, when the processor 120 is embodied as an ASIC, FPGA or the like, the processor 120 may comprise specifically configured hardware for conducting one or more operations described herein. Alternatively, as another example, when the processor 120 is embodied as an executor of instructions, the instructions may specifically configure the processor 120, which may otherwise be a general purpose processing element if not for the specific configuration provided by the instructions, to perform one or more algorithms and operations described herein.

The memory 122 may include, for example, volatile and/or non-volatile memory. Although illustrated in FIG. 1 as a single memory, the memory 122 may comprise a plurality of memories, which may be embodied on a single computing device or distributed across a plurality of computing devices. The memory 122 may comprise volatile memory, non-volatile memory, or some combination thereof. In this regard, the memory 122 may comprise, for example, a hard disk, random access memory, cache memory, flash memory, a compact disc read only memory (CD-ROM), digital versatile disc read only memory (DVD-ROM), an optical disc, circuitry configured to store information, or some combination thereof. The memory 122 may be configured to store information, data, applications, instructions, or the like for enabling the network entity 104 to carry out various functions in accordance with exemplary embodiments of the present invention. For example, in at least some embodiments, the memory 122 is configured to buffer input data for processing by the processor 120. Additionally or alternatively, in at least some embodiments, the memory 122 is configured to store program instructions for execution by the processor 120. The memory 122 may store information in the form of static and/or dynamic information. This stored information may be stored and/or used by the configuration setting relay unit 128 during the course of performing its functionalities.

The communication interface 124 may be embodied as any device or means embodied in hardware, a computer program product comprising computer readable program instructions stored on a computer readable medium (e.g., the memory 122) and executed by a processing device (e.g., the processor 120), or a combination thereof that is configured to receive and/or transmit data from/to a remote device over the network 108. In at least one embodiment, the communication interface 124 is at least partially embodied as or otherwise controlled by the processor 120. In this regard, the communication interface 124 may be in communication with the processor 120, such as via a bus. The communication interface 124 may include, for example, an antenna, a transmitter, a receiver, a transceiver and/or supporting hardware or software for enabling communications with other entities of the system 100. The communication interface 124 may be configured to receive and/or transmit data using any protocol that may be used for communications between computing devices of the system 100. The communication interface 124 may additionally be in communication with the memory 122, user interface 126, and/or configuration setting relay unit 128, such as via a bus.

The user interface 126 may be in communication with the processor 120 to receive an indication of a user input and/or to provide an audible, visual, mechanical, or other output to the user. As such, the user interface 126 may include, for example, a keyboard, a mouse, a joystick, a display, a touch screen display, a microphone, a speaker, and/or other input/output mechanisms. In an exemplary embodiment in which the network entity 104 is embodied as one or more servers, the user interface 126 may be limited, or even eliminated. The user interface 126 may be in communication with the memory 122, communication interface 124, and/or configuration setting relay unit 128, such as via a bus.

The configuration setting relay unit 128 may be embodied as various means, such as hardware, a computer program product comprising computer readable program instructions stored on a computer readable medium (e.g., the memory 122) and executed by a processing device (e.g., the processor 120), or some combination thereof and, in one embodiment, is embodied as or otherwise controlled by the processor 120. In embodiments where the configuration setting relay unit 128 is embodied separately from the processor 120, the configuration setting relay unit 128 may be in communication with the processor 120. The configuration setting relay unit 128 may further be in communication with the memory 122, communication interface 124, and/or user interface 126, such as via a bus.

The configuration setting manager 118 may be configured to provide or otherwise control an interface on the UE 102 enabling the CSG cell owner to manage membership in a CSG permitted to access the CSG cell. In this regard, the configuration setting manager 118 may be configured to cause a graphical interface to be displayed on a display of the user interface 116. The configuration setting manager 118 may be configured to display a list of members of the CSG. The configuration setting manager 118 may be further configured to prompt the CSG cell owner to enter one or more configuration settings related to management of the CSG. A configuration setting may comprise, for example, an indication of an identity of a computing device and/or an identity of an end user of a computing device, such as may be a subscriber of an operator network to add to or remove from the CSG. In some embodiments, the indication may comprise an international mobile subscriber identity (IMSI), which may identify a subscription of an end user that is being added to or removed from the CSG.

The CSG cell owner may further provide a configuration setting defining a duration of a grant of membership in the CSG, such as for temporary members of the CSG. In this regard, configuration settings may facilitate the addition of a temporary member to the CSG and/or removal of a temporary member from the CSG. Further, the duration of a grant of membership to an existing member of the CSG may be altered, such as by extending or reducing the duration of a grant of membership to an existing member of the CSG. Additionally or alternatively, the CSG cell owner may provide configuration information defining use permissions of an existing member of or a member to be added to the CSG. In this regard, the use permissions may, for example, define services that the user is allowed to use, services that the user is explicitly prohibited from using, and/or the like. For example a configuration setting may define whether a CSG member is allowed

internet access, voice communication access, text messaging access, email access, and/or the like.

The configuration setting manager 118 may be further configured to receive a configuration setting provided by the CSG cell owner. If a configuration setting provided by the CSG cell owner is incomplete or invalid in some way, the configuration setting manager 118 may be configured to determine the incomplete or invalid nature of the configuration setting and may be configured to alert the CSG cell owner, such as over the user interface 116 so that the CSG cell owner may enter valid configuration setting(s). The configuration setting manager 118 may then format a configuration message comprising one or more configuration settings provided by the CSG cell owner such that the configuration setting(s) are formatted in accordance with an appropriate syntax understandable by the network operator and send the configuration setting(s) to the network entity 104 to enable the network operator to implement the configuration setting(s) contained in the configuration message to effect the CSG cell owner-defined changes to the CSG membership. The configuration message may comprise an indication of an identity of the UE 102, such as the IMSI of the UE 102, so that the network entity 104 may verify the CSG owner associated with the UE 102. The configuration message may additionally or alternatively comprise an indication of the identity of the CSG cell for which CSG membership is to be modified, such as in case the CSG owner has multiple CSG cells in his control.

In some embodiments wherein the network entity 104 comprises an MME, the configuration setting manager 118 may be configured to send a configuration message to the network entity 104 using non-access stratum (NAS) signaling. In this regard, the NAS signaling may terminate at the MME and the MME may then forward information (e.g., configuration setting(s)) included in the received NAS signaling, directly to the HSS 106 or to an appropriate entity, such as a configuration server or other relay that may then forward the information to the HSS 106. In some embodiments wherein the network entity 104 is embodied as a configuration server, the configuration message sent by the configuration setting manager 118 may comprise a short message service (SMS) message, instant message (IM), email message, multimedia messaging service (MMS) message, and/or the like. Additionally or alternatively, the configuration setting manager 118 may be configured to send the configuration message to the network entity 104 using user plane (UP) signaling in some embodiments wherein the network entity 104 is embodied as a configuration server. The configuration message may be sent in accordance with Open Mobile Alliance (OMA) Device Management protocol.

The configuration setting relay unit 128 of the network entity 104 may be configured to receive a configuration message sent by the UE 102. The configuration setting relay unit 128 may then authenticate that the UE 102 that sent the configuration message is associated with an approved CSG cell owner, such as based at least in part upon the IMSI of the UE 102. Additionally or alternatively, the configuration setting relay unit 128 may determine a CSG cell for which the configuration setting(s) included in the configuration message affect the CSG membership. The configuration setting relay unit 128 may further extract configuration setting(s)

included in the configuration message and forward them to the HSS 106 to enable implementation of the configuration setting(s).

The configuration setting relay unit 128, HSS 106, or other entity of the operator network may be configured to send a confirmation and/or error message to the UE 102 indicating a status of whether the network operator has implemented the configuration setting(s) included in a configuration message sent by the UE 102. Further, the HSS 106 or other entity of the operator network may be configured to send information to a computing device added or removed from the CSG membership so that the white list of the computing device that identifies CSG cells which the computing device is permitted to access may be updated.

FIG. 3 illustrates a flowchart according to an exemplary method for facilitating management of membership in a closed subscriber group according to an exemplary embodiment of the invention. In this regard, FIG. 3 illustrates operations that may occur at a UE 102. The method may include the configuration setting manager 118 providing an interface enabling the owner of a CSG cell to manage membership in a CSG, at operation 300. Operation 310 may comprise the configuration setting manager 118 to receive one or more configuration settings related to membership in the CSG. The received one or more configuration settings may be provided by the CSG owner using the provided interface. Operation 320 may comprise the configuration setting manager 118 formatting a configuration message comprising the one or more received configuration settings. The configuration setting manager 118 may then send the configuration message to the network entity 104, at operation 330.

FIG. 4 illustrates a flowchart according to an exemplary method for facilitating management of membership in a closed subscriber group according to an exemplary embodiment of the invention. In this regard, FIG. 4 illustrates operations that may occur at a network entity 104. The method may include the configuration setting relay unit 128 receiving a configuration message sent by the UE 102, at operation 400. Operation 410 may comprise the configuration setting relay unit 128 authenticating that the UE 102 is associated with a registered or recognized CSG cell owner, such as based upon the IMSI of the UE 102. The configuration setting relay unit 128 may then extract configuration setting(s) from the configuration message, at operation 420. Operation 430 may then comprise the configuration setting relay unit 128 sending the extracted configuration setting(s) to the home subscriber service 106 for implementation.

FIGs. 3-4 are flowcharts of a system, method, and computer program product according to exemplary embodiments of the invention. It will be understood that each block or step of the flowcharts, and combinations of blocks in the flowcharts, may be implemented by various means, such as hardware and/or a computer program product comprising one or more computer-readable mediums having computer readable program instructions stored thereon. For example, one or more of the procedures described herein may be embodied by computer program instructions of a computer program product. In this regard, the computer program product(s) which embody the procedures described herein may be stored by one or more memory devices of a mobile terminal, server, or other computing device and executed by a processor in the computing device. In some embodiments, the computer program instructions comprising the computer program product(s)

which embody the procedures described above may be stored by memory devices of a plurality of computing devices. As will be appreciated, any such computer program product may be loaded onto a computer or other programmable apparatus to produce a machine, such that the computer program product including the instructions which execute on the computer or other programmable apparatus creates means for implementing the functions specified in the flowchart block(s) or step(s). Further, the computer program product may comprise one or more computer-readable memories on which the computer program instructions may be stored such that the one or more computer-readable memories can direct a computer or other programmable apparatus to function in a particular manner, such that the computer program product comprises an article of manufacture which implements the function specified in the flowchart block(s) or step(s). The computer program instructions of one or more computer program products may also be loaded onto a computer or other programmable apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer-implemented process such that the instructions which execute on the computer or other programmable apparatus provide steps for implementing the functions specified in the flowchart block(s) or step(s).

Accordingly, blocks or steps of the flowcharts support combinations of means for performing the specified functions and combinations of steps for performing the specified functions. It will also be understood that one or more blocks or steps of the flowcharts, and combinations of blocks or steps in the flowcharts, may be implemented by special purpose hardware-based computer systems which perform the specified functions or steps, or combinations of special purpose hardware and computer program product(s).

The above described functions may be carried out in many ways. For example, any suitable means for carrying out each of the functions described above may be employed to carry out embodiments of the invention. In one embodiment, a suitably configured processor may provide all or a portion of the elements of the invention. In another embodiment, all or a portion of the elements of the invention may be configured by and operate under control of a computer program product. The computer program product for performing the methods of embodiments of the invention includes a computer-readable storage medium, such as the non-volatile storage medium, and computer-readable program code portions, such as a series of computer instructions, embodied in the computer-readable storage medium.

As such, then, some embodiments of the invention provide several advantages to computing devices, computing device users, and network operators. Embodiments of the invention provide for the ability of a CSG cell owner to manage membership in a CSG using a user equipment device even if not physically located in proximity of the CSG cell. In this regard, embodiments of the invention provide an interface enabling an owner of a CSG cell to enter configuration settings into a user equipment device associated with the CSG cell owner. Embodiments of the invention further provide for the user equipment device associated with the CSG cell owner to format a configuration message comprising a configuration setting and send the configuration message to a network entity configured to provide the configuration setting to a home

subscriber service on the operator network to effect changes made to CSG membership by the CSG cell owner. Embodiments of the invention further provide for secure submission of configuration settings to the network operator and for reliable authentication of a CSG cell owner by the network operator.

Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the embodiments of the invention are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Moreover, although the foregoing descriptions and the associated drawings describe exemplary embodiments in the context of certain exemplary combinations of elements and/or functions, it should be appreciated that different combinations of elements and/or functions may be provided by alternative embodiments without departing from the scope of the appended claims. In this regard, for example, different combinations of elements and/or functions than those explicitly described above are also contemplated as may be set forth in some of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

WHAT IS CLAIMED IS:

1. A method comprising:
receiving, at a user equipment device associated with an owner of a closed subscriber group cell, a configuration setting related to membership in a closed subscriber group permitted to access the closed subscriber group cell; and
sending a configuration message comprising the configuration setting to a network entity on a network of an operator of the closed subscriber group cell to enable the network of the operator to implement the configuration setting.
2. The method of Claim 1, further comprising providing an interface on the user equipment device allowing the owner of the closed subscriber group cell to manage membership in a closed subscriber group; and
wherein receiving the configuration setting comprises receiving a configuration setting provided by the owner of the closed subscriber group using the interface.
3. The method of Claim 1, wherein the configuration setting comprises one or more of an international mobile subscriber identity of a computing device or duration of a grant of membership in the closed subscriber group.
4. The method of Claim 1, wherein the configuration setting comprises a configuration setting for one or more of adding a temporary member to the closed subscriber group, removing a temporary member from the closed subscriber group, altering a duration of grant of membership to a member of the closed subscriber group, or defining use permissions for a member of the closed subscriber group.
5. The method of Claim 1, wherein sending the configuration message to the network entity comprises sending a configuration message comprising the configuration setting to a mobility management entity using non-access stratum signaling.
6. The method of Claim 1, wherein sending the configuration message to the network entity comprises sending a short message service message, instant message message, email message, or multimedia messaging service message comprising the configuration setting to a configuration server.
7. The method of Claim 1, wherein sending the configuration message to the network entity comprises sending a configuration message comprising the configuration setting to a configuration server using user plane signaling.

8. A computer program product comprising at least one computer-readable storage medium having computer-readable program instructions stored therein, the computer-readable program instructions comprising:

a program instruction for causing a configuration setting related to membership in a closed subscriber group permitted to access a closed subscriber group cell to be received at a user equipment device associated with an owner of the closed subscriber group cell; and

a program instruction for causing a configuration message comprising the configuration setting to be sent to a network entity on a network of an operator of the closed subscriber group cell to enable the network of the operator to implement the configuration setting.

9. The computer program product of Claim 8, further comprising a program instruction for providing an interface on the user equipment device allowing the owner of the closed subscriber group cell to manage membership in a closed subscriber group; and

wherein the program instruction for causing the configuration setting to be received comprises instructions for receiving a configuration setting provided by the owner of the closed subscriber group using the interface.

10. The computer program product of Claim 8, wherein the configuration setting comprises one or more of an international mobile subscriber identity of a computing device or duration of a grant of membership in the closed subscriber group.

11. The computer program product of Claim 8, wherein the configuration setting comprises a configuration setting for one or more of adding a temporary member to the closed subscriber group, removing a temporary member from the closed subscriber group, altering a duration of grant of membership to a member of the closed subscriber group, or defining use permissions for a member of the closed subscriber group.

12. The computer program product of Claim 8, wherein the program instruction for causing the configuration message to be sent to the network entity comprises instructions for causing a configuration message comprising the configuration setting to be sent to a mobility management entity using non-access stratum signaling.

13. The computer program product of Claim 8, wherein the program instruction for causing the configuration message to be sent to the network entity comprises instructions for causing a short message service message, instant message message, email message, or multimedia messaging service message comprising the configuration setting to be sent to a configuration server.

14. The computer program product of Claim 8, wherein the program instruction for causing the configuration message to be sent to the network entity comprises instructions for

causing a configuration message comprising the configuration setting to be sent to a configuration server using user plane signaling.

15. An apparatus comprising a processor and a memory storing instructions that when executed by the processor cause the apparatus to at least:

receive a configuration setting related to membership in a closed subscriber group permitted to access a closed subscriber group cell, wherein the apparatus is associated with an owner of the closed subscriber group cell; and

send a configuration message comprising the configuration setting to a network entity on a network of an operator of the closed subscriber group cell to enable the network of the operator to implement the configuration setting.

16. The apparatus of Claim 15, wherein the instructions when executed by the processor further cause the apparatus to:

provide an interface on the user equipment device allowing the owner of the closed subscriber group cell to manage membership in a closed subscriber group; and

wherein the instructions when executed by the processor cause the apparatus to receive the configuration setting by receiving a configuration setting provided by the owner of the closed subscriber group using the interface.

17. The apparatus of Claim 15, wherein the configuration setting comprises one or more of an international mobile subscriber identity of a computing device or duration of a grant of membership in the closed subscriber group.

18. The apparatus of Claim 15, wherein the configuration setting comprises a configuration setting for one or more of adding a temporary member to the closed subscriber group, removing a temporary member from the closed subscriber group, altering a duration of grant of membership to a member of the closed subscriber group, or defining use permissions for a member of the closed subscriber group

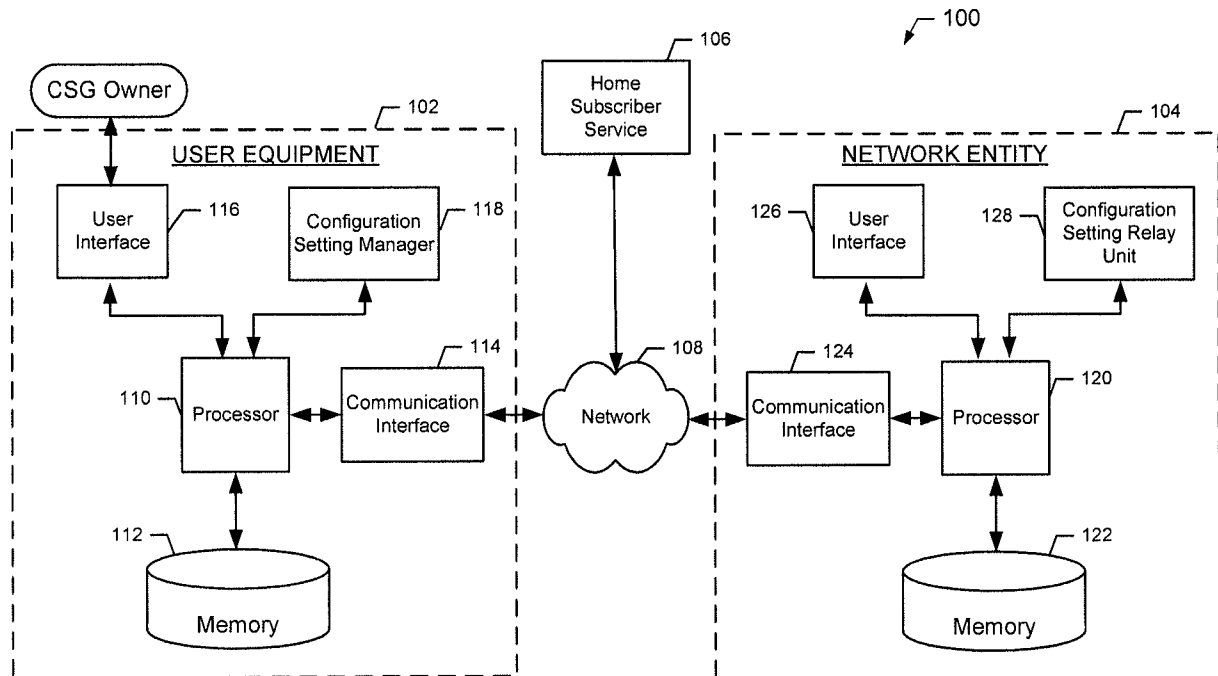
19. The apparatus of Claim 15, wherein the instructions when executed by the processor cause the apparatus to send the configuration message to the network entity by sending a configuration message comprising the configuration setting to a mobility management entity using non-access stratum signaling.

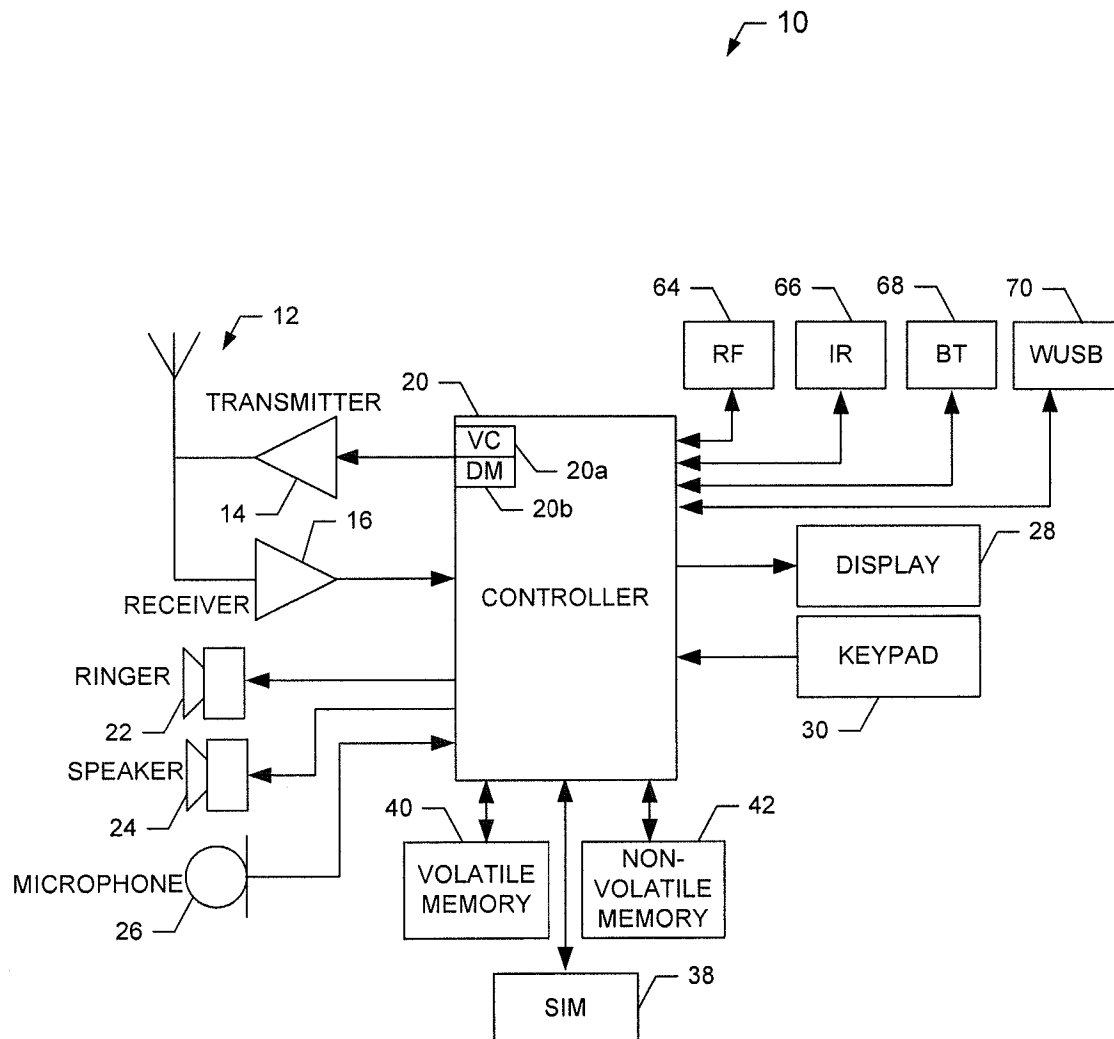
20. The apparatus of Claim 15, wherein the instructions when executed by the processor cause the apparatus to send the configuration message to the network entity by sending a short message service message, instant message message, email message, or multimedia messaging service message comprising the configuration setting to a configuration server.

21. The apparatus of Claim 15, wherein the instructions when executed by the processor cause the apparatus to send the configuration message to the network entity by sending a configuration message comprising the configuration setting to a configuration server using user plane signaling.

22. An apparatus comprising:
means for receiving a configuration setting related to membership in a closed subscriber group permitted to access a closed subscriber group cell, wherein the apparatus is associated with an owner of the closed subscriber group cell; and

means for sending a configuration message comprising the configuration setting to a network entity on a network of an operator of the closed subscriber group cell to enable the operator to implement the configuration setting.

FIG. 1.

**FIG. 2.**

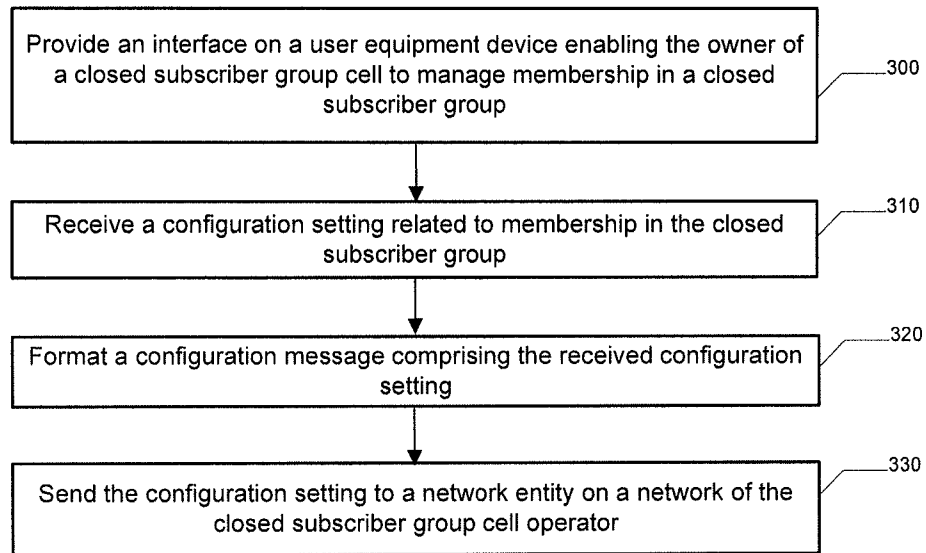


FIG. 3.

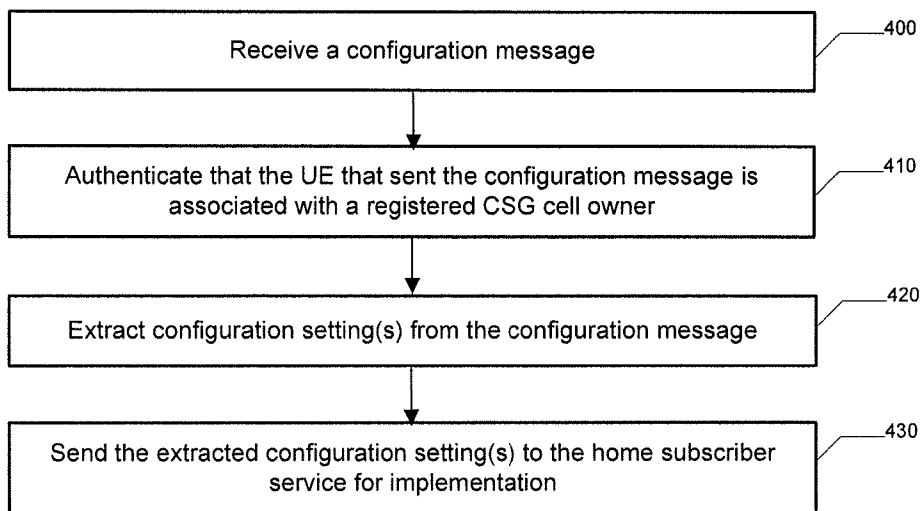


FIG. 4.

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2009/051178

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04W8/18

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 H04L

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/054668 A1 (SCHEINERT STEFAN [US] ET AL) 8 March 2007 (2007-03-08) abstract paragraphs [0002], [0003], [0007] - [0010], [0014], [0023] - [0026], [0052] - [0060] claims 1-19	1-22
A	WO 2007/040449 A (ERICSSON TELEFON AB L M [SE]) 12 April 2007 (2007-04-12) the whole document ----- -/--	1-22

☒ 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 document 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.

G document member of the same patent family

Date of the actual completion of the international search

25 November 2009

Date of mailing of the international search report

09/12/2009

Name and mailing address of the ISA/

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

Authorized officer

Manuel, Grégory

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2009/051178

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Service accessibility (Release 8)" 3GPP TS 22.011 V8.3.0., [Online] vol. 22.011, no. V8.3.0, 1 March 2008 (2008-03-01), pages 1-25, XP002510874 Retrieved from the Internet: URL: http://www.3gpp.org [retrieved on 2008-03-25] pages 6,7 pages 20-22 -----	1-22
A	CHINA MOBILE ET AL: "Mobility and Access Control Requirements for LTE Home-eNodeB" 3GPP DRAFT; R3-070674, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG3, no. St. Julian, Malta; 20070323, 23 March 2007 (2007-03-23), XP050161572 [retrieved on 2007-03-23] the whole document -----	1-22

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2009/051178

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007054668	A1	08-03-2007	NONE
WO 2007040449	A	12-04-2007	EP 1932385 A1 18-06-2008
			EP 1932377 A1 18-06-2008
			EP 1932378 A1 18-06-2008
			EP 1932386 A1 18-06-2008
			EP 1932379 A2 18-06-2008
			EP 1941764 A2 09-07-2008
			JP 2009510969 T 12-03-2009
			JP 2009510970 T 12-03-2009
			JP 2009510971 T 12-03-2009
			JP 2009510972 T 12-03-2009
			JP 2009510973 T 12-03-2009
			WO 2007040450 A1 12-04-2007
			WO 2007040451 A1 12-04-2007
			WO 2007040452 A1 12-04-2007
			WO 2007040453 A2 12-04-2007
			WO 2007040454 A2 12-04-2007