(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 June 2014 (12.06.2014)

(10) International Publication Number
WO 2014/085981 A1

(51) International Patent Classification: *H04W 52/00* (2009.01)

(21) International Application Number: PCT/CN2012/085849

(22) International Filing Date: 4 December 2012 (04.12.2012)

(25) Filing Language: English

(26) Publication Language: English

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(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, BN, BR, BW, BY, BZ, CA, CH, CL, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) Title: APPARATUS AND METHOD FOR ENHANCED MOBILE POWER MANAGEMENT

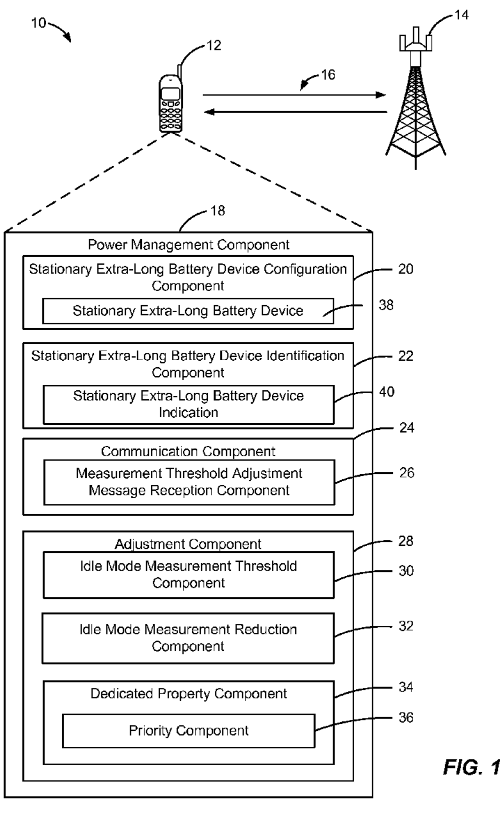

FIG. 1

(57) Abstract: Apparatus and method for power management in a wireless communication network include identifying a user equipment (UE) configuration as a stationary extra-long battery device configuration, receiving a measurement threshold adjustment message, and adjusting an idle mode cell measurement threshold based on the measurement threshold adjustment message.

WO 2014/085981 A1

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, 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, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

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

APPARATUS AND METHOD FOR ENHANCED MOBILE POWER MANAGEMENT

BACKGROUND

Field

[0001] Aspects of the present disclosure relate generally to wireless communication systems, and more particularly, to enhanced mobile power management.

Background

[0002] Wireless communication networks are widely deployed to provide various communication services such as telephony, video, data, messaging, broadcasts, and so on. Such networks, which are usually multiple access networks, support communications for multiple users by sharing the available network resources. One example of such a network is the UMTS Terrestrial Radio Access Network (UTRAN). The UTRAN is the radio access network (RAN) defined as a part of the Universal Mobile Telecommunications System (UMTS), a third generation (3G) mobile phone technology supported by the 3rd Generation Partnership Project (3GPP). The UMTS, which is the successor to Global System for Mobile Communications (GSM) technologies, currently supports various air interface standards, such as Wideband-Code Division Multiple Access (W-CDMA), Time Division–Code Division Multiple Access (TD-CDMA), and Time Division–Synchronous Code Division Multiple Access (TD-SCDMA). The UMTS also supports enhanced 3G data communications protocols, such as High Speed Packet Access (HSPA), which provides higher data transfer speeds and capacity to associated UMTS networks.

[0003] As the demand for mobile broadband access continues to increase, research and development continue to advance the UMTS technologies not only to meet the growing demand for mobile broadband access, but to advance and enhance the user experience with mobile communications.

[0004] It is noted that one problem with current implementations relates to the high power consumption in mobile devices caused by excessive measurements made during idle mode.

SUMMARY

[0005] Apparatus and method for power management in a wireless communication network include identifying a user equipment (UE) configuration as a stationary extra-

long battery device configuration, receiving a measurement threshold adjustment message, and adjusting an idle mode cell measurement threshold based on the measurement threshold adjustment message.

[0006] These and other aspects will become more fully understood upon a review of the detailed description, which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a schematic diagram of a user equipment performing a power management procedure in a network.

[0008] FIG. 2 is a chart illustrating conventional UE measurement characteristics.

[0009] FIG. 3 is a chart illustrating UE measurement characteristics using present aspects.

[0010] FIG 4. is a flow chart of an aspect of a method of power management

[0011] FIG. 5 is a block diagram illustrating an example of a hardware implementation for an apparatus employing a processing system.

[0012] FIG. 6 is a block diagram conceptually illustrating an example of a telecommunications system.

[0013] FIG. 7 is a conceptual diagram illustrating an example of an access network.

[0014] FIG. 8 is a conceptual diagram illustrating an example of a radio protocol architecture for the user and control plane.

[0015] FIG. 9 is a block diagram conceptually illustrating an example of a Node B in communication with a UE in a telecommunications system.

[0016] Appendix A presents supporting material for the present disclosure and is incorporated by reference.

DETAILED DESCRIPTION

[0017] The detailed description set forth below in connection with the appended drawings is intended as a description of various configurations and is not intended to represent the only configurations in which the concepts described herein may be practiced. The detailed description includes specific details for the purpose of providing a thorough understanding of various concepts. However, it will be apparent to those skilled in the art that these concepts may be practiced without these specific details. In some instances, well known structures and components are shown in block diagram form in order to avoid obscuring such concepts.

[0018] The present aspects generally relate to enhancing power management in a user equipment (UE) to provide greater battery duration to devices desiring long operation time. Various aspects of the disclosure address an issue relating to the excessive measurements conducted by UEs while in idle mode. Certain UEs may not desire the conventional or full range of measurements made during idle mode. For example, UEs identified as stationary extra-long battery devices may not desire the full range of idle mode measurements. Moreover, such measurements may be considered too frequent, and as a result, increase the rate of power consumption. UEs may desire a more efficient allocation of resources based on their respective operational parameters and/or current or expected state. That is, a UE identified as, or expected to remain stationary for a long duration, or even desiring longer operation time, may desire adjustment of conventional communication operation parameters. As such, in some aspects, the present apparatus and method may provide an efficient solution, as compared to current solutions, to adjust the triggering of idle mode measurements to relatively lower levels to assist in preserving mobile power.

[0019] Referring to FIG. 1, in an aspect, a wireless communication system 10 includes a UE 12 in communication coverage of at least one base station 14. In some examples, wireless communication between the UE 12 and the base station 14 may occur on one or more wireless link(s) 16. In one aspect, UE 12 may include a power management component 18 configured to provide efficient power management to the UE 12. For example, the power management component 18 may be configured to adjust an idle mode measurement threshold.

[0020] In an aspect, the power management component 18 may include a stationary extra-long battery device battery device configuration component, which may be operable to configure the UE 12 with a stationary extra-long battery device configuration 38. A stationary extra-long battery device configuration 38 means that the UE 12 will minimize a number of measurement(s), a frequency of given measurement(s), and/or a measurement threshold(s) during idle mode.

[0021] The UE 12 may be configured, for example but not limited hereto, with a stationary extra-long battery device configuration 38, by provisioning the UE 12 using at least one of provisioning via a user input and/or receiving an over-the-air message according to an open mobile alliance device management (OMA-DM) protocol. In further aspects, the UE 12 may be configured based on device type or international mobile subscriber identity (IMSI) provisioning at the core network or evolved packet core (EPC). As a further example, configuration of the UE 12 may be made based on the operating environment of the UE 12. For instance, the UE 12 may be utilizing a low capacity power supply (e.g., AA or AAA batteries) and as a result, desires a decreased frequency of measurements during idle mode. Moreover, for instance, the UE 12 may be located in areas where access to the UE 12 for power supply charging or replacement is very difficult (e.g., sensors located in container tanks). Further, in some aspects, a network operator, a network device, a UE manufacturer, or some other entity may pre-program (e.g., prior to UE operation) or program (e.g., based on UE operation) the UE 12 with the stationary extra-long battery device configuration 38. Also, in some aspects, UE 12 may configure itself with the stationary extra-long battery device configuration 38.

[0022] Additionally, power management component 18 may include a stationary extra-long battery device identification component 22, which may be configured to identify the UE 12 as operating according to stationary extra-long battery device configuration 38. The stationary extra-long battery device may be identified, for example but not limited hereto, based on device characteristics and/or thresholds. For example, the UE 12 may be identified as having extra-long battery device configuration 38 by a transmission or message to a network entity, such as base station 14, including a stationary extra-long battery device indication 40. For example, the transmission or message may be sent by a core network (CN) or the UE 12. For instance, the stationary extra-long battery device indication 40 may be a new UE capability bit or a designated signal that identifies the UE 12 as operating according to stationary extra-long battery device configuration 38. In other words, the stationary extra-long battery device indication 40 informs the network of a capability by the UE 12 to adjust idle mode measurements. As a further example, the UE 12 may be identified as operating according to stationary extra-long battery device configuration 38 based on a particular type or class associated with the UE 12. For instance, a machine type communication (MTC) device may be identified as operating according to the stationary extra-long battery device configuration 38. Furthermore, the UE 12 may be identified as a stationary extra-long battery device if a power level of the UE 12 falls below a threshold value. Further, for example, UEs desiring long battery operation time may be configured to include the power management component 18 in order to operate according to the stationary extra-long battery device configuration 38.

[0023] In further aspects, power management component 18 may include a communication component 24, which may be configured to communicate with the network, such as base station 14, via one or more wireless link(s) 16. For example, in an aspect, the communication component 24 may send the stationary extra-long battery device indication 40 to the base station 14 via one or more wireless links 16. Further, in some aspects, the communication component 24 may send the stationary extra-long battery device indication 40 in any plane (e.g., user plane) or physical layer (e.g., MAC, RLC, PDP and RRC). In an aspect, the communication component 24 may include a measurement threshold adjustment message reception component 26, which may be configured to receive a measurement threshold adjustment message. For example, the measurement threshold adjustment message reception component 26 may receive a system information block (SIB) from the network. The SIB may, for instance, include specific UE measurement or reselection parameters and may be transmitted to the UE 12 on a broadcast channel. The UE specific measurement or reselection parameters may include at least one of legacy cell reselection parameters, hierarchical cell structure (HCS) parameters, absolute priority reselection parameters and intra/inter-frequency parameters.

[0024] Moreover, in an aspect, the power management component 18 may include an adjustment component 28, which may be configured to adjust an idle mode cell measurement threshold based on the measurement threshold adjustment message. The adjustment component 28 may include, for example, an idle mode measurement threshold component 30, which may be configured to decrease a value of the idle mode cell measurement threshold from a current measurement threshold value to a decreased idle mode measurement threshold value. Further, the adjustment component 28 may include, for example, an idle mode measurement reduction component 32, which may be configured to reduce a number or a frequency of cell measurements. In some aspects, the adjustment component 28 may further include a dedicated property component 34, which may be configured to adjust a dedicated property of the UE 12. For instance, the dedicated property component 34 may include a priority component 36 that may adjust at least one idle mode cell measurement or reselection priority. For instance, the priority component 36 may designate operation in UMTS as a higher priority than operation in LTE. As such, the UE 12 may only wirelessly communicate in UMTS based on the adjusted priority. As a further example, adjustment component 28, through any one of the subcomponents 30, 32, and 34, may control how often the UE 12 searches for the network. Further, it should be understood that the adjustment component 28, may be configured to adjust a plurality of idle mode cell measurement thresholds simultaneously. For instance, the received measurement threshold adjustment message may indicate to the UE 12 to adjust a plurality of idle mode cell measurement thresholds.

[0025] The following Table 1 lists example adjustable idle mode measurements and/or reselection parameters that could be adjusted by the UE 12 via adjustment component 28. It should be noted that Table 1 may be extended, as appropriate, to other communication technologies, such as but not limited to GSM and CDMA 1x/eHRPD.

Table 1: Example Adjustable Idle Mode Measurement/Reselection Parameters

UMTS	LTE
Sintrasearch	Sintrasearch
Sintersearch	Qhyst/Qoffset
SsearchRAT	Treselection_EUTRA
ShcsRAT	Snonintrasearch
Qhyst/Qoffset	Treselection_RAT
Treselection	
SsearcdHCS	
ShcsRAT	
Sprioritysearch1/2	

[0026] The implementation of the power management component 18 and its corresponding functions may, in some aspects, apply to numerous modes. For example, the cell reselection measurements may be used in various modes in RRC, such as, but not limited to, Idle, Forward Access Channel (CELL_FACH), Cell Paging Channel (CELL_PCH) and a UTRAN Registration Area (CELL_URA). The foregoing RRC modes operate at a lower power relative to CELL_DCH.

[0027] It should be understood that the cell measurement threshold adjustment may occur also in the active or connected state. That is, the UE 12 can adjust a connected mode measurement threshold based on the measurement threshold adjustment message. Moreover, in some aspects, the various threshold values, such as the idle mode measurement threshold value may be configurable. That is, the threshold values may be set by a network device (for example using RRC signaling messages), network operator (for example provisioning UE specific policies), or other entity communicating with the UE 12.

[0028] Further, it should be understood that the term “mode,” with respect to the various operational modes of the UE 12 mentioned in the foregoing aspects, can be used interchangeably with state and/or configuration.

[0029] Thus, when the UE 12 is identified as operating according to the stationary extra-long battery device configuration 38, the UE 12 may execute power management component 18 to enhance the power consumption efficiency and/or battery life by adjusting an idle mode cell measurement threshold based on the measurement threshold adjustment message.

[0030] Referring to FIG. 2, in an aspect, chart 50 illustrates a UE 12 measurement state prior to idle mode cell measurement threshold adjustment or UEs without power management component 18. In such a measurement state, the UE 12 engages in S_intrasearch 52 triggered measurements from time t_0 to t_1. At time t_0 the UE 12 radio strength level (RxLev) falls below measurement threshold 56 and coincidently triggers S_intrasearch criteria to become true. The intra-frequency measurement will occur until the UE 12 surpasses the measurement threshold at time t_1. In the foregoing time period 54, the UE 12 may engage in needless intra-frequency measurements 52 that drain the UE 12 power supply. S_intrasearch 52 is a parameter provided by the network that specifies the threshold below which intra-frequency measurements should be performed.

[0031] In contrast, referring to FIG. 3, chart 60 illustrates a UE 12 measurement state following idle mode cell measurement threshold adjustment. In such a measurement state, the UE 12 engages in S_intrasearch 62 triggered measurements from time t_0 to t_1. At time t_0 the UE 12 radio strength level (RxLev) falls below measurement threshold 66 and coincidently triggers S_intrasearch criteria to become true. The intra-frequency measurement will occur until the UE 12 surpasses the measurement threshold at time t_1. As a result of the adjusted measurement threshold 66, the duration 64 of intra-frequency measurements is significantly reduced, thereby reducing the power consumption and increasing power efficiency.

[0032] It should be understood that S_intrasearch 52 measurements have been used as an example, and that other idle mode measurement or reselection parameter thresholds may be used. For example, Table 1 lists a number of further idle mode measurement or reselection parameters that may have their thresholds adjusted.

[0033] Referring to FIG. 4, an example methodology 70 for enhanced mobile power management is disclosed. In an aspect, methodology 70 may be performed by components associated with a UE (e.g., UE 12). Additionally, while the methodology shown and described as a series of acts, as some acts may, in accordance with one or more aspects, occur in different orders and/or concurrently with other acts from that shown and described herein. For example, it is to be appreciated that a methodology could alternatively be represented as a series of interrelated states or events, such as in a state diagram. Moreover, not all illustrated acts may be required to implement a methodology in accordance with one or more aspects.

[0034] In an aspect, at block 72, the method 70 optionally configures a UE as a stationary extra-long battery device. For example, in an aspect, the UE 12 may execute the stationary extra-long battery device configuration component 20 to configure the UE 12 with stationary extra-long battery device configuration 38. For example, the UE 12 may be configured with a stationary extra-long battery device configuration 38 by provisioning the UE 12 using at least one of provisioning via a user input and/or receiving an over-the-air message according to an open mobile alliance device management (OMA-DM) protocol. In further aspects, the UE 12 may be configured based on device type or international mobile subscriber identity (IMSI) provisioning at the core network or evolved packet core (EPC). As a further example, configuration of the UE 12 may be made based on the operating environment of the UE 12. Further, in some aspects, a network operator, a network device, a UE manufacturer, or some other entity may pre-program (e.g., prior to UE operation) or program (e.g., based on UE operation) the UE 12 as a stationary extra-long battery device 38. Also, in some aspects, UE 12 may configure itself as a stationary extra-long battery device 38.

[0035] At block 74, the method 70 identifies the UE configuration as a stationary extra-long battery device configuration. For example, in an aspect, the UE 12 may execute the stationary extra-long battery device identification component 22 to identify the UE configuration as a stationary extra-long battery device configuration 38. For example, the UE 12 may be identified as operating according to extra-long battery device configuration 38 by transmitting, to a network entity such as base station 14, a stationary extra-long battery device indication 40 sent by a core network (CN) or the UE 12. The UE 12 may send stationary extra-long battery device indication 40 in the form of a new UE capability bit or signal designating the UE 12 as having stationary extra-long battery device configuration 38. The UE capability bit or signal informs the network of a capability by the UE 12 to adjust idle mode measurements. As a further example, the UE 12 may be identified as a stationary extra-long battery device 38 based on a particular type or class associated with the UE 12. For instance, a machine type communication (MTC) device may be identified as a stationary extra-long battery device 38. Furthermore, the UE 12 may be identified as a stationary extra-long battery device if a power level of the UE 12 falls below a threshold value. Further, for example, UEs desiring long battery operation time may be configured to include the power management component 18.

[0036] At block 76, the method 70 receives a measurement threshold adjustment message. For example, in an aspect, the UE 12 may execute communication component 28, and in additional aspects, the measurement threshold adjustment message reception component 26, to receive a measurement threshold adjustment message. For example, the UE 12 may receive a system information block (SIB) from the network. The SIB may, for instance, include specific UE measurement or reselection parameters and may be transmitted to the UE 12 on a broadcast channel. The UE specific measurement or reselection parameters may include at least one of legacy cell reselection parameters, hierarchical cell structure (HCS) parameters, absolute priority reselection parameters and intra/inter-frequency parameters. As such, in some aspect, the measurement threshold adjustment message may be a broadcast message. In another aspect, the UE 12 and/or communication component 28 may receive the measurement threshold adjustment in a dedicated RRC signaling message from a network. For instance, in this aspect, the network does not broadcast new parameters but assigns the new parameters specifically, e.g. in a one-to-one manner, to the UE 12 when the network identifies or is informed or provided with an indication (e.g., either by the UE or by the core network (CN) / evolved packet core (EPC)) that the UE 12 is stationary.

[0037] Finally, at block 78, the method 70 adjusts an idle mode cell measurement threshold based on the measurement threshold adjustment message. For example, in an aspect, the UE 12 may execute the adjustment component 28 to adjust an idle mode cell measurement threshold. In some aspects, adjusting the idle mode cell measurement thresholds includes decreasing a value of the idle mode cell measurement threshold from a current measurement threshold value to a decreased idle mode measurement threshold value. Further, adjusting the idle mode cell measurement thresholds includes reducing a number or a frequency of cell measurements. In further aspects, adjusting the idle mode cell measurement thresholds includes adjusting a dedicated property of the UE 12. For instance, the dedicated property adjustment may include adjusting at least one idle mode cell measurement or reselection priority.

[0038] Appendix A presents supporting material for the present disclosure and is incorporated by reference.

[0039] FIG. 5 is a block diagram illustrating an example of a hardware implementation for an apparatus 100 employing a processing system 114. In an aspect, any of UE 12, or the one or more network entities, such as base station 14, may be represented by a specially programmed or configured computer device 100. In this example, the processing system 114 may be implemented with a bus architecture, represented generally by the bus 102. The bus 102 may include any number of interconnecting buses and bridges depending on the specific application of the processing system 114 and the overall design constraints. The bus 102 links together various circuits including one or more processors, represented generally by the processor 104, and computer-readable media, represented generally by the computer-readable medium 106. The bus 102 may also link various other circuits such as timing sources, peripherals, voltage regulators, and power management circuits, which are well known in the art, and therefore, will not be described any further. A bus interface 108 provides an interface between the bus 102 and a transceiver 110. The transceiver 110 provides a means for communicating with various other apparatus over a transmission medium. Depending upon the nature of the apparatus, a user interface 112 (e.g., keypad, display, speaker, microphone, joystick) may also be provided.

[0040] The processor 104 is responsible for managing the bus 102 and general processing, including the execution of software stored on the computer-readable medium 106. The software, when executed by the processor 104, causes the processing system 114 to perform the various functions described infra for any particular apparatus. The computer-readable medium 106 may also be used for storing data that is manipulated by the processor 104 when executing software.

[0041] In an aspect, power management component 18 (Fig. 1) may be implemented by any one or any combination of processor 104 and computer-readable medium 106. For example, the processor 104 and/or computer readable medium 106 may be configured to, via the power management component 18, to adjust an idle mode cell measurement threshold value based on the measurement threshold adjustment message.

[0042] The various concepts presented throughout this disclosure may be implemented across a broad variety of telecommunication systems, network architectures, and communication standards. By way of example and without limitation, the aspects of the present disclosure illustrated in FIG. 6 are presented with reference to a UMTS system 200 employing a W-CDMA air interface and including a UE 210 that may be the same as UE 12 (FIG. 1), e.g., power management component 18 (FIG> 1) as described herein. A UMTS network includes three interacting domains: a Core Network (CN) 204, a UMTS Terrestrial Radio Access Network (UTRAN) 202, and User Equipment (UE) 210. In this example, the UTRAN 202 provides various wireless services including telephony, video, data, messaging, broadcasts, and/or other services. The UTRAN 202 may include a plurality of Radio Network Subsystems (RNSs) such as an RNS 207, each controlled by a respective Radio Network Controller (RNC) such as an RNC 206. Here, the UTRAN 202 may include any number of RNCs 206 and RNSs 207 in addition to the RNCs 206 and RNSs 207 illustrated herein. The RNC 206 is an apparatus responsible for, among other things, assigning, reconfiguring and releasing radio resources within the RNS 207. The RNC 206 may be interconnected to other RNCs (not shown) in the UTRAN 202 through various types of interfaces such as a direct physical connection, a virtual network, or the like, using any suitable transport network.

[0043] Communication between a UE 210 and a Node B 208 may be considered as including a physical (PHY) layer and a medium access control (MAC) layer. Further, communication between a UE 210 and an RNC 206 by way of a respective Node B 208 may be considered as including a radio resource control (RRC) layer. In the instant specification, the PHY layer may be considered layer 1; the MAC layer may be considered layer 2; and the RRC layer may be considered layer 3. Information hereinbelow utilizes terminology introduced in the RRC Protocol Specification, 3GPP TS 25.331 v9.1.0, incorporated herein by reference.

[0044] The geographic region covered by the RNS 207 may be divided into a number of cells, with a radio transceiver apparatus serving each cell. A radio transceiver apparatus is commonly referred to as a Node B in UMTS applications, but may also be referred to by those skilled in the art as a base station (BS), a base transceiver station (BTS), a radio base station, a radio transceiver, a transceiver function, a basic service set (BSS), an extended service set (ESS), an access point (AP), or some other suitable terminology. For clarity, three Node Bs 208 are shown in each RNS 207; however, the RNSs 207 may include any number of wireless Node Bs. The Node Bs 208 provide wireless access points to a CN 204 for any number of mobile apparatuses. Examples of a mobile apparatus include a cellular phone, a smart phone, a session initiation protocol (SIP) phone, a laptop, a notebook, a netbook, a smartbook, a personal digital assistant (PDA), a satellite radio, a global positioning system (GPS) device, a multimedia device, a video device, a digital audio player (e.g., MP3 player), a camera, a game console, or any other similar functioning device. The mobile apparatus is commonly referred to as a UE in UMTS applications, but may also be referred to by those skilled in the art as a mobile station, a subscriber station, a mobile unit, a subscriber unit, a wireless unit, a remote unit, a mobile device, a wireless device, a wireless communications device, a remote device, a mobile subscriber station, an access terminal, a mobile terminal, a wireless terminal, a remote terminal, a handset, a terminal, a user agent, a mobile client, a client, or some other suitable terminology. In a UMTS system, the UE 210 may further include a universal subscriber identity module (USIM) 211, which contains a user's subscription information to a network. For illustrative purposes, one UE 210 is shown in communication with a number of the Node Bs 208. The DL, also called the forward link, refers to the communication link from a Node B 208 to a UE 210, and the UL, also called the reverse link, refers to the communication link from a UE 210 to a Node B 208.

[0045] The CN 204 interfaces with one or more access networks, such as the UTRAN 202. As shown, the CN 204 is a GSM core network. However, as those skilled in the art will recognize, the various concepts presented throughout this disclosure may be implemented in a RAN, or other suitable access network, to provide UEs with access to types of CNs other than GSM networks.

[0046] The CN 204 includes a circuit-switched (CS) domain and a packet-switched (PS) domain. Some of the circuit-switched elements are a Mobile services Switching Centre (MSC), a Visitor location register (VLR) and a Gateway MSC. Packet-switched elements include a Serving GPRS Support Node (SGSN) and a Gateway GPRS Support Node (GGSN). Some network elements, like EIR, HLR, VLR and AuC may be shared by both of the circuit-switched and packet-switched domains. In the illustrated example, the CN 204 supports circuit-switched services with a MSC 212 and a GMSC 214. In some applications, the GMSC 214 may be referred to as a media gateway (MGW). One or more RNCs, such as the RNC 206, may be connected to the MSC 212. The MSC 212 is an apparatus that controls call setup, call routing, and UE mobility functions. The MSC 212 also includes a VLR that contains subscriber-related information for the duration that a UE is in the coverage area of the MSC 212. The GMSC 214 provides a gateway through the MSC 212 for the UE to access a circuit-switched network 216. The GMSC 214 includes a home location register (HLR) 215 containing subscriber data, such as the data reflecting the details of the services to which a particular user has subscribed. The HLR is also associated with an authentication center (AuC) that contains subscriber-specific authentication data. When a call is received for a particular UE, the GMSC 214 queries the HLR 215 to determine the UE's location and forwards the call to the particular MSC serving that location.

[0047] The CN 204 also supports packet-data services with a serving GPRS support node (SGSN) 218 and a gateway GPRS support node (GGSN) 220. GPRS, which stands for General Packet Radio Service, is designed to provide packet-data services at speeds higher than those available with standard circuit-switched data services. The GGSN 220 provides a connection for the UTRAN 202 to a packet-based network 222. The packet-based network 222 may be the Internet, a private data network, or some other suitable packet-based network. The primary function of the GGSN 220 is to provide the UEs 210 with packet-based network connectivity. Data packets may be transferred between the GGSN 220 and the UEs 210 through the SGSN 218, which performs primarily the same functions in the packet-based domain as the MSC 212 performs in the circuit-switched domain.

[0048] An air interface for UMTS may utilize a spread spectrum Direct-Sequence Code Division Multiple Access (DS-CDMA) system. The spread spectrum DS-CDMA spreads user data through multiplication by a sequence of pseudorandom bits called chips. The "wideband" W-CDMA air interface for UMTS is based on such direct sequence spread spectrum technology and additionally calls for a frequency division duplexing (FDD). FDD uses a different carrier frequency for the UL and DL between a Node B 208 and a UE 210. Another air interface for UMTS that utilizes DS-CDMA, and uses time division duplexing (TDD), is the TD-SCDMA air interface. Those skilled in the art will recognize that although various examples described herein may refer to a W-CDMA air interface, the underlying principles may be equally applicable to a TD-SCDMA air interface.

[0049] An HSPA air interface includes a series of enhancements to the 3G/W-CDMA air interface, facilitating greater throughput and reduced latency. Among other modifications over prior releases, HSPA utilizes hybrid automatic repeat request (HARQ), shared channel transmission, and adaptive modulation and coding. The standards that define HSPA include HSDPA (high speed downlink packet access) and HSUPA (high speed uplink packet access, also referred to as enhanced uplink, or EUL).

[0050] HSDPA utilizes as its transport channel the high-speed downlink shared channel (HS-DSCH). The HS-DSCH is implemented by three physical channels: the high-speed physical downlink shared channel (HS-PDSCH), the high-speed shared control channel (HS-SCCH), and the high-speed dedicated physical control channel (HS-DPCCH).

[0051] Among these physical channels, the HS-DPCCH carries the HARQ ACK/NACK signaling on the uplink to indicate whether a corresponding packet transmission was decoded successfully. That is, with respect to the downlink, the UE 210 provides feedback to the node B 208 over the HS-DPCCH to indicate whether it correctly decoded a packet on the downlink.

[0052] HS-DPCCH further includes feedback signaling from the UE 210 to assist the node B 208 in taking the right decision in terms of modulation and coding scheme and precoding weight selection, this feedback signaling including the CQI and PCI.

[0053] "HSPA Evolved" or HSPA+ is an evolution of the HSPA standard that includes MIMO and 64-QAM, enabling increased throughput and higher performance. That is, in an aspect of the disclosure, the node B 208 and/or the UE 210 may have multiple antennas supporting MIMO technology. The use of MIMO technology enables the node B 208 to exploit the spatial domain to support spatial multiplexing, beamforming, and transmit diversity.

[0054] Multiple Input Multiple Output (MIMO) is a term generally used to refer to multi-antenna technology, that is, multiple transmit antennas (multiple inputs to the channel) and multiple receive antennas (multiple outputs from the channel). MIMO systems generally enhance data transmission performance, enabling diversity gains to reduce multipath fading and increase transmission quality, and spatial multiplexing gains to increase data throughput.

[0055] Spatial multiplexing may be used to transmit different streams of data simultaneously on the same frequency. The data steams may be transmitted to a single UE 210 to increase the data rate or to multiple UEs 210 to increase the overall system capacity. This is achieved by spatially precoding each data stream and then transmitting each spatially precoded stream through a different transmit antenna on the downlink. The spatially precoded data streams arrive at the UE(s) 210 with different spatial signatures, which enables each of the UE(s) 210 to recover the one or more the data streams destined for that UE 210. On the uplink, each UE 210 may transmit one or more spatially precoded data streams, which enables the node B 208 to identify the source of each spatially precoded data stream.

[0056] Spatial multiplexing may be used when channel conditions are good. When channel conditions are less favorable, beamforming may be used to focus the transmission energy in one or more directions, or to improve transmission based on characteristics of the channel. This may be achieved by spatially precoding a data stream for transmission through multiple antennas. To achieve good coverage at the edges of the cell, a single stream beamforming transmission may be used in combination with transmit diversity.

[0057] Generally, for MIMO systems utilizing n transmit antennas, n transport blocks may be transmitted simultaneously over the same carrier utilizing the same channelization code. Note that the different transport blocks sent over the n transmit antennas may have the same or different modulation and coding schemes from one another.

[0058] On the other hand, Single Input Multiple Output (SIMO) generally refers to a system utilizing a single transmit antenna (a single input to the channel) and multiple receive antennas (multiple outputs from the channel). Thus, in a SIMO system, a single transport block is sent over the respective carrier.

[0059] Referring to Fig. 7, an access network 300 in a UTRAN architecture is illustrated. The multiple access wireless communication system includes multiple cellular regions (cells), including cells 302, 304, and 306, each of which may include one or more sectors. The multiple sectors can be formed by groups of antennas with each antenna responsible for communication with UEs in a portion of the cell. For example, in cell 302, antenna groups 312, 314, and 316 may each correspond to a different sector. In cell 304, antenna groups 318, 320, and 322 each correspond to a different sector. In cell 306, antenna groups 324, 326, and 328 each correspond to a different sector. The cells 302, 304 and 306 may include several wireless communication devices, e.g., User Equipment or UEs, which may be in communication with one or more sectors of each cell 302, 304 or 306. For example, UEs 330 and 332 may be in communication with Node B 342, UEs 334 and 336 may be in communication with Node B 344, and UEs 338 and 340 can be in communication with Node B 346. Here, each Node B 342, 344, 346 is configured to provide an access point to a CN 204 (see FIG. 2) for all the UEs 330, 332, 334, 336, 338, 340 in the respective cells 302, 304, and 306. In an aspect, UEs 330, 332, 334, 336, 338 and 340 may include the power management component 18 (FIG. 1).

[0060] As the UE 334 moves from the illustrated location in cell 304 into cell 306, a serving cell change (SCC) or handover may occur in which communication with the UE 334 transitions from the cell 304, which may be referred to as the source cell, to cell 306, which may be referred to as the target cell. Management of the handover procedure may take place at the UE 334, at the Node Bs corresponding to the respective cells, at a radio network controller 206 (see FIG. 2), or at another suitable node in the wireless network. For example, during a call with the source cell 304, or at any other time, the UE 334 may monitor various parameters of the source cell 304 as well as various parameters of neighboring cells such as cells 306 and 302. Further, depending on the quality of these parameters, the UE 334 may maintain communication with one or more of the neighboring cells. During this time, the UE 334 may maintain an Active Set, that is, a list of cells that the UE 334 is simultaneously connected to (i.e., the UTRA cells that are currently assigning a downlink dedicated physical channel DPCH or fractional downlink dedicated physical channel F-DPCH to the UE 334 may constitute the Active Set).

[0061] The modulation and multiple access scheme employed by the access network 300 may vary depending on the particular telecommunications standard being deployed. By way of example, the standard may include Evolution-Data Optimized (EV-DO) or Ultra Mobile Broadband (UMB). EV-DO and UMB are air interface standards promulgated by the 3rd Generation Partnership Project 2 (3GPP2) as part of the CDMA2000 family of standards and employs CDMA to provide broadband Internet access to mobile stations. The standard may alternately be Universal Terrestrial Radio Access (UTRA) employing Wideband-CDMA (W-CDMA) and other variants of CDMA, such as TD-SCDMA; Global System for Mobile Communications (GSM) employing TDMA; and Evolved UTRA (E-UTRA), Ultra Mobile Broadband (UMB), IEEE 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, and Flash-OFDM employing OFDMA. UTRA, E-UTRA, UMTS, LTE, LTE Advanced, and GSM are described in documents from the 3GPP organization. CDMA2000 and UMB are described in documents from the 3GPP2 organization. The actual wireless communication standard and the multiple access technology employed will depend on the specific application and the overall design constraints imposed on the system.

[0062] The radio protocol architecture may take on various forms depending on the particular application. An example for an HSPA system will now be presented with reference to FIG. 8.

[0063] Referring to Fig. 8 an example radio protocol architecture 400 relates to the user plane 402 and the control plane 404 of a user equipment (UE) or node B/base station. For example, architecture 400 may be included in a UE such as UE 12 (Fig. 1). The radio protocol architecture 400 for the UE and node B is shown with three layers: Layer 1 406, Layer 2 408, and Layer 3 410. Layer 1 406 is the lowest lower and implements various physical layer signal processing functions. As such, Layer 1 406 includes the physical layer 407. Layer 2 (L2 layer) 408 is above the physical layer 407 and is responsible for the link between the UE and node B over the physical layer 407. Layer 3 (L3 layer) 410 includes a radio resource control (RRC) sublayer 415. The RRC sublayer 415 handles the control plane signaling of Layer 3 between the UE and the UTRAN. Further, UE(s) in Fig. 8 may include the power management component 18 of Fig. 1.

[0064] In the user plane, the L2 layer 408 includes a media access control (MAC) sublayer 409, a radio link control (RLC) sublayer 411, and a packet data convergence protocol (PDCP) 413 sublayer, which are terminated at the node B on the network side. Although not shown, the UE may have several upper layers above the L2 layer 408 including a network layer (e.g., IP layer) that is terminated at a PDN gateway on the network side, and an application layer that is terminated at the other end of the connection (e.g., far end UE, server, etc.).

[0065] The PDCP sublayer 413 provides multiplexing between different radio bearers and logical channels. The PDCP sublayer 413 also provides header compression for upper layer data packets to reduce radio transmission overhead, security by ciphering the data packets, and handover support for UEs between node Bs. The RLC sublayer 411 provides segmentation and reassembly of upper layer data packets, retransmission of lost data packets, and reordering of data packets to compensate for out-of-order reception due to hybrid automatic repeat request (HARQ). The MAC sublayer 409 provides multiplexing between logical and transport channels. The MAC sublayer 409 is also responsible for allocating the various radio resources (e.g., resource blocks) in one cell among the UEs. The MAC sublayer 409 is also responsible for HARQ operations.

[0066] FIG. 9 is a block diagram of a Node B 510 in communication with a UE 550, where the Node B 510 may be the Node B 208 in FIG. 6, and the UE 550 may be the UE 210 in FIG. 6, or UE 12 in FIG. 1. In the downlink communication, a transmit processor 520 may receive data from a data source 512 and control signals from a controller/processor 540. The transmit processor 520 provides various signal processing functions for the data and control signals, as well as reference signals (e.g., pilot signals). For example, the transmit processor 520 may provide cyclic redundancy check (CRC) codes for error detection, coding and interleaving to facilitate forward error correction (FEC), mapping to signal constellations based on various modulation schemes (e.g., binary phase-shift keying (BPSK), quadrature phase-shift keying (QPSK), M-phase-shift keying (M-PSK), M-quadrature amplitude modulation (M-QAM), and the like), spreading with orthogonal variable spreading factors (OVSF), and multiplying with scrambling codes to produce a series of symbols. Channel estimates from a channel processor 544 may be used by a controller/processor 540 to determine the coding, modulation, spreading, and/or scrambling schemes for the transmit processor 520. These channel estimates may be derived from a reference signal transmitted by the UE 550 or from feedback from the UE 550. The symbols generated by the transmit processor 520 are provided to a transmit frame processor 530 to create a frame structure. The transmit frame processor 530 creates this frame structure by multiplexing the symbols with information from the controller/processor 540, resulting in a series of frames. The frames are then provided to a transmitter 532, which provides various signal conditioning functions including amplifying, filtering, and modulating the frames onto a carrier for downlink transmission over the wireless medium through antenna 534. The antenna 534 may include one or more antennas, for example, including beam steering bidirectional adaptive antenna arrays or other similar beam technologies.

[0067] At the UE 550, a receiver 554 receives the downlink transmission through an antenna 552 and processes the transmission to recover the information modulated onto the carrier. The information recovered by the receiver 554 is provided to a receive frame processor 560, which parses each frame, and provides information from the frames to a channel processor 594 and the data, control, and reference signals to a receive processor 570. The receive processor 570 then performs the inverse of the processing performed by the transmit processor 520 in the Node B 510. More specifically, the receive processor 570 descrambles and despreads the symbols, and then determines the most likely signal constellation points transmitted by the Node B 510 based on the modulation scheme. These soft decisions may be based on channel estimates computed by the channel processor 594. The soft decisions are then decoded and deinterleaved to recover the data, control, and reference signals. The CRC codes are then checked to determine whether the frames were successfully decoded. The data carried by the successfully decoded frames will then be provided to a data sink 572, which represents applications running in the UE 550 and/or various user interfaces (e.g., display). Control signals carried by successfully decoded frames will be provided to a controller/processor 590. When frames are unsuccessfully decoded by the receiver processor 570, the controller/processor 590 may also use an acknowledgement (ACK) and/or negative acknowledgement (NACK) protocol to support retransmission requests for those frames.

[0068] In the uplink, data from a data source 578 and control signals from the controller/processor 590 are provided to a transmit processor 580. The data source 578 may represent applications running in the UE 550 and various user interfaces (e.g., keyboard). Similar to the functionality described in connection with the downlink transmission by the Node B 510, the transmit processor 580 provides various signal processing functions including CRC codes, coding and interleaving to facilitate FEC, mapping to signal constellations, spreading with OVSFs, and scrambling to produce a series of symbols. Channel estimates, derived by the channel processor 594 from a reference signal transmitted by the Node B 510 or from feedback contained in the midamble transmitted by the Node B 510, may be used to select the appropriate coding, modulation, spreading, and/or scrambling schemes. The symbols produced by the transmit processor 580 will be provided to a transmit frame processor 582 to create a frame structure. The transmit frame processor 582 creates this frame structure by multiplexing the symbols with information from the controller/processor 590, resulting in a series of frames. The frames are then provided to a transmitter 556, which provides various signal conditioning functions including amplification, filtering, and modulating the frames onto a carrier for uplink transmission over the wireless medium through the antenna 552.

[0069] The uplink transmission is processed at the Node B 510 in a manner similar to that described in connection with the receiver function at the UE 550. A receiver 535 receives the uplink transmission through the antenna 534 and processes the transmission to recover the information modulated onto the carrier. The information recovered by the receiver 535 is provided to a receive frame processor 536, which parses each frame, and provides information from the frames to the channel processor 544 and the data, control, and reference signals to a receive processor 538. The receive processor 538 performs the inverse of the processing performed by the transmit processor 580 in the UE 550. The data and control signals carried by the successfully decoded frames may then be provided to a data sink 539 and the controller/processor, respectively. If some of the frames were unsuccessfully decoded by the receive processor, the controller/processor 540 may also use an acknowledgement (ACK) and/or negative acknowledgement (NACK) protocol to support retransmission requests for those frames.

[0070] The controller/processors 540 and 590 may be used to direct the operation at the Node B 510 and the UE 550, respectively. For example, the controller/processors 540 and 590 may provide various functions including timing, peripheral interfaces, voltage regulation, power management, and other control functions. The computer readable media of memories 542 and 592 may store data and software for the Node B 510 and the UE 550, respectively. A scheduler/processor 546 at the Node B 510 may be used to allocate resources to the UEs and schedule downlink and/or uplink transmissions for the UEs.

[0071] Several aspects of a telecommunications system have been presented with reference to a W-CDMA system. As those skilled in the art will readily appreciate, various aspects described throughout this disclosure may be extended to other telecommunication systems, network architectures and communication standards.

[0072] By way of example, various aspects may be extended to other UMTS systems such as TD-SCDMA, High Speed Downlink Packet Access (HSDPA), High Speed Uplink Packet Access (HSUPA), High Speed Packet Access Plus (HSPA+) and TD-CDMA. Various aspects may also be extended to systems employing Long Term Evolution (LTE) (in FDD, TDD, or both modes), LTE-Advanced (LTE-A) (in FDD, TDD, or both modes), CDMA2000, Evolution-Data Optimized (EV-DO), Ultra Mobile Broadband (UMB), IEEE 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, Ultra-Wideband (UWB), Bluetooth, and/or other suitable systems. The actual telecommunication standard, network architecture, and/or communication standard employed will depend on the specific application and the overall design constraints imposed on the system.

[0073] In accordance with various aspects of the disclosure, an element, or any portion of an element, or any combination of elements may be implemented with a "processing system" that includes one or more processors. Examples of processors include microprocessors, microcontrollers, digital signal processors (DSPs), field programmable gate arrays (FPGAs), programmable logic devices (PLDs), state machines, gated logic, discrete hardware circuits, and other suitable hardware configured to perform the various functionality described throughout this disclosure. One or more processors in the processing system may execute software. Software shall be construed broadly to mean instructions, instruction sets, code, code segments, program code, programs, subprograms, software modules, applications, software applications, software packages, routines, subroutines, objects, executables, threads of execution, procedures, functions, etc., whether referred to as software, firmware, middleware, microcode, hardware description language, or otherwise. The software may reside on a computer-readable medium. The computer-readable medium may be a non-transitory computer-readable medium. A non-transitory computer-readable medium includes, by way of example, a magnetic storage device (e.g., hard disk, floppy disk, magnetic strip), an optical disk (e.g., compact disk (CD), digital versatile disk (DVD)), a smart card, a flash memory device (e.g., card, stick, key drive), random access memory (RAM), read only memory (ROM), programmable ROM (PROM), erasable PROM (EPROM), electrically erasable PROM (EEPROM), a register, a removable disk, and any other suitable medium for storing software and/or instructions that may be accessed and read by a computer. The computer-readable medium may also include, by way of example, a carrier wave, a transmission line, and any other suitable medium for transmitting software and/or instructions that may be accessed and read by a computer. The computer-readable medium may be resident in the processing system, external to the processing system, or distributed across multiple entities including the processing system. The computer-readable medium may be embodied in a computer-program product. By way of example, a computer-program product may include a computer-readable medium in packaging materials. Those skilled in the art will recognize how best to implement the described functionality presented throughout this disclosure depending on the particular application and the overall design constraints imposed on the overall system.

[0074] It is to be understood that the specific order or hierarchy of steps in the methods disclosed is an illustration of exemplary processes. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the methods may be rearranged. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented unless specifically recited therein.

[0075] The previous description is provided to enable any person skilled in the art to practice the various aspects described herein. Various modifications to these aspects will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects. Thus, the claims are not intended to be limited to the aspects shown herein, but is to be accorded the full scope consistent with the language of the claims, wherein reference to an element in the singular is not intended to mean “one and only one” unless specifically so stated, but rather “one or more.” Unless specifically stated otherwise, the term “some” refers to one or more. A phrase referring to “at least one of” a list of items refers to any combination of those items, including single members. As an example, “at least one of: a, b, or c” is intended to cover: a; b; c; a and b; a and c; b and c; and a, b and c. All structural and functional equivalents to the elements of the various aspects described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed under the provisions of 35 U.S.C. §112, sixth paragraph, unless the element is expressly recited using the phrase “means for” or, in the case of a method claim, the element is recited using the phrase “step for.”

CLAIMS

1. A method of power management in a wireless communication network, the method comprising:

identifying a user equipment (UE) configuration as a stationary extra-long battery device configuration;

receiving a measurement threshold adjustment message; and

adjusting an idle mode cell measurement threshold value based on the measurement threshold adjustment message.

2. The method of claim 1, wherein adjusting the idle mode cell measurement threshold comprises decreasing a value of the idle mode cell measurement threshold from a current measurement threshold value to a decreased idle mode measurement threshold value.

3. The method of claim 1, wherein adjusting the idle mode cell measurement threshold comprises reducing a number or a frequency of cell measurements.

4. The method of claim 1, wherein adjusting the idle mode cell measurement threshold comprises adjusting a dedicated property of the UE.

5. The method of claim 4, wherein adjusting the dedicated property comprises adjusting at least one idle mode cell measurement or reselection priority.

6. The method of claim 1, wherein receiving the measurement threshold adjustment message comprises receiving in a system information block (SIB) from a network.

7. The method of claim 6, wherein receiving the SIB from the network comprises receiving UE specific measurement or reselection configuration parameters.

8. The method of claim 7, wherein receiving UE specific measurement or reselection configuration parameters comprises receiving at least one of legacy cell reselection parameters, HCS parameters, absolute priority reselection parameters and intra/inter-frequency parameters.

9. The method of claim 7, wherein the unique measurement or selection configuration parameters comprises idle mode measurement or reselection configuration parameters.

10. The method of claim 1, wherein receiving the measurement threshold adjustment message further comprises receiving in a dedicated RRC signaling message from a network.

11. The method of claim 1, wherein identifying the UE device configuration as the stationary extra-long battery device configuration comprises transmitting, to a network, a stationary extra-long battery device indication sent by a core network (CN) or the UE.

12. The method of claim 1, further comprising configuring the UE as a stationary extra-long battery device.

13. The method of claim 12, wherein configuring the UE as a stationary extra-long battery device comprises provisioning the UE using at least one of provisioning via a user input and receiving an over-the-air message according to a open mobile alliance device management (OMA-DM) protocol.

14. A computer program product, comprising:

a computer-readable medium, including:

at least one instruction executable to cause the computer to identify a user equipment (UE) configuration as a stationary extra-long battery device configuration;

at least one instruction executable to cause the computer to receive a measurement threshold adjustment message; and

at least one instruction executable to cause the computer to adjust an idle mode cell measurement threshold value based on the measurement threshold adjustment message.

15. The computer program product of claim 14, further comprising at least one instruction executable to cause the computer to perform the method of any of claims 2-13.

16. A user equipment, comprising:

means for identifying a user equipment (UE) configuration as a stationary extra-long battery device configuration;

means for receiving a measurement threshold adjustment message; and

means for adjusting an idle mode cell measurement threshold value based on the measurement threshold adjustment message.

17. The user equipment of claim 16, further comprising at least one means for performing the method of any of claims 2-13.

18. A user equipment apparatus, comprising:

a memory storing executable instructions;

and a processor in communication with the memory, wherein the processor is configured to execute the instructions to:

identify a user equipment (UE) configuration as a stationary extra-long battery device configuration;

receive a measurement threshold adjustment message; and

adjust an idle mode cell measurement threshold value based on the measurement threshold adjustment message.

19. The user equipment apparatus of claim 18, further comprising at least one means for performing the method of any of claims 2-13.

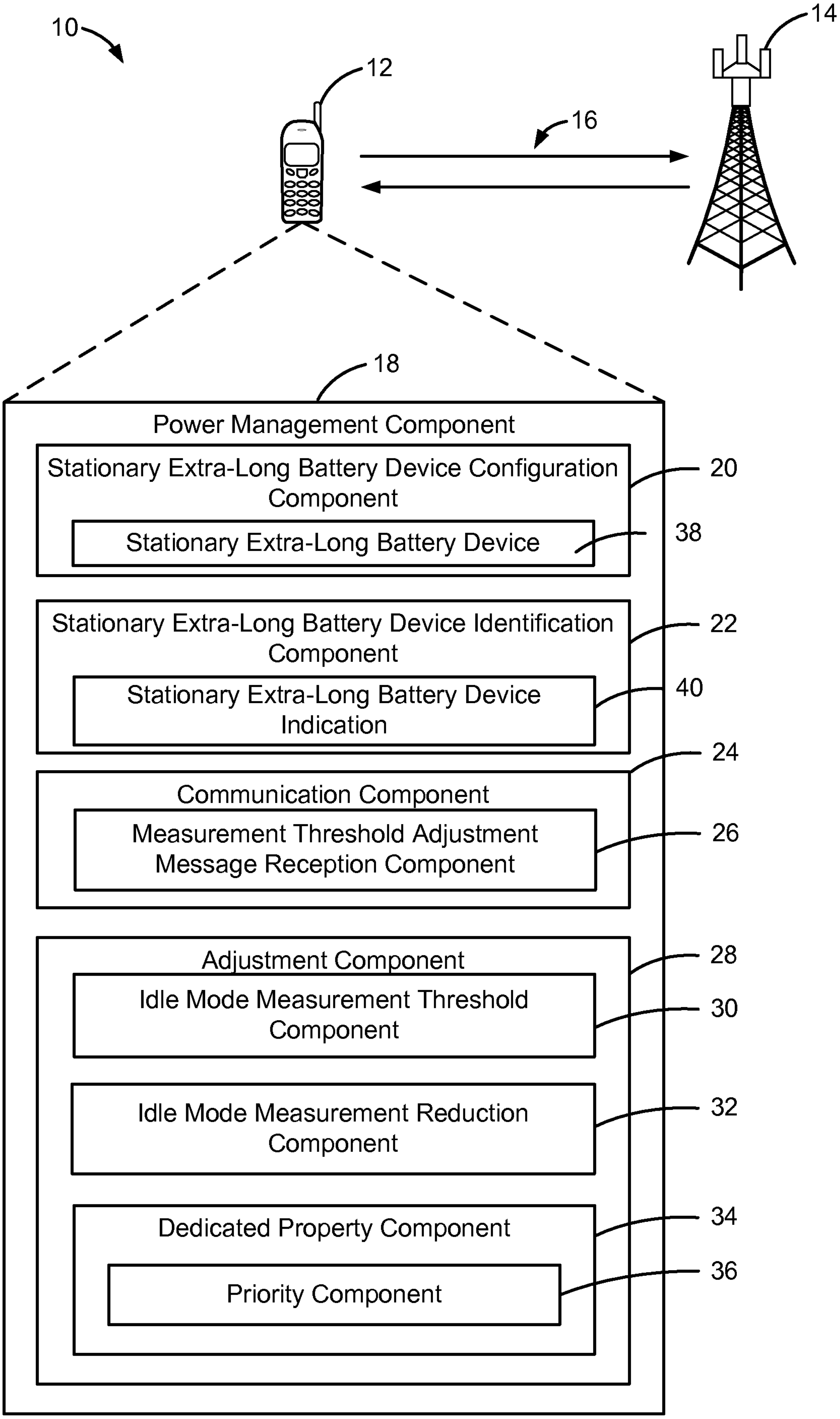
10
12
14
16
18
Power Management Component
Stationary Extra-Long Battery Device Configuration Component
20
Stationary Extra-Long Battery Device
38
Stationary Extra-Long Battery Device Identification Component
22
Stationary Extra-Long Battery Device Indication
40
24
Communication Component
Measurement Threshold Adjustment Message Reception Component
26
Adjustment Component
28
Idle Mode Measurement Threshold Component
30
Idle Mode Measurement Reduction Component
32
Dedicated Property Component
34
Priority Component
36

FIG. 1

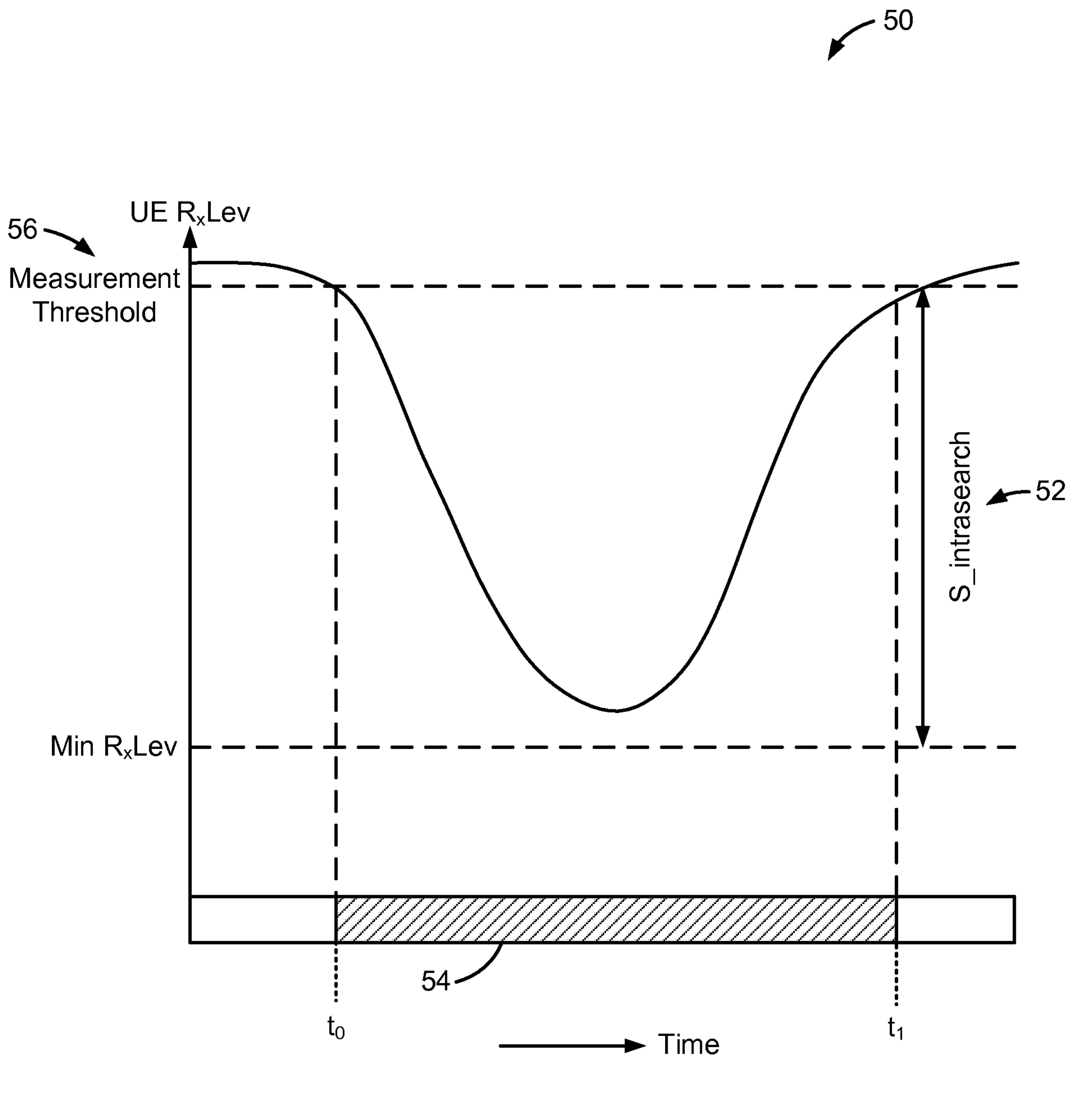
50
56
UE RxLev
Measurement
Threshold
S_intrasearch
52
Min RxLev
54
t0
t1
Time

FIG. 2

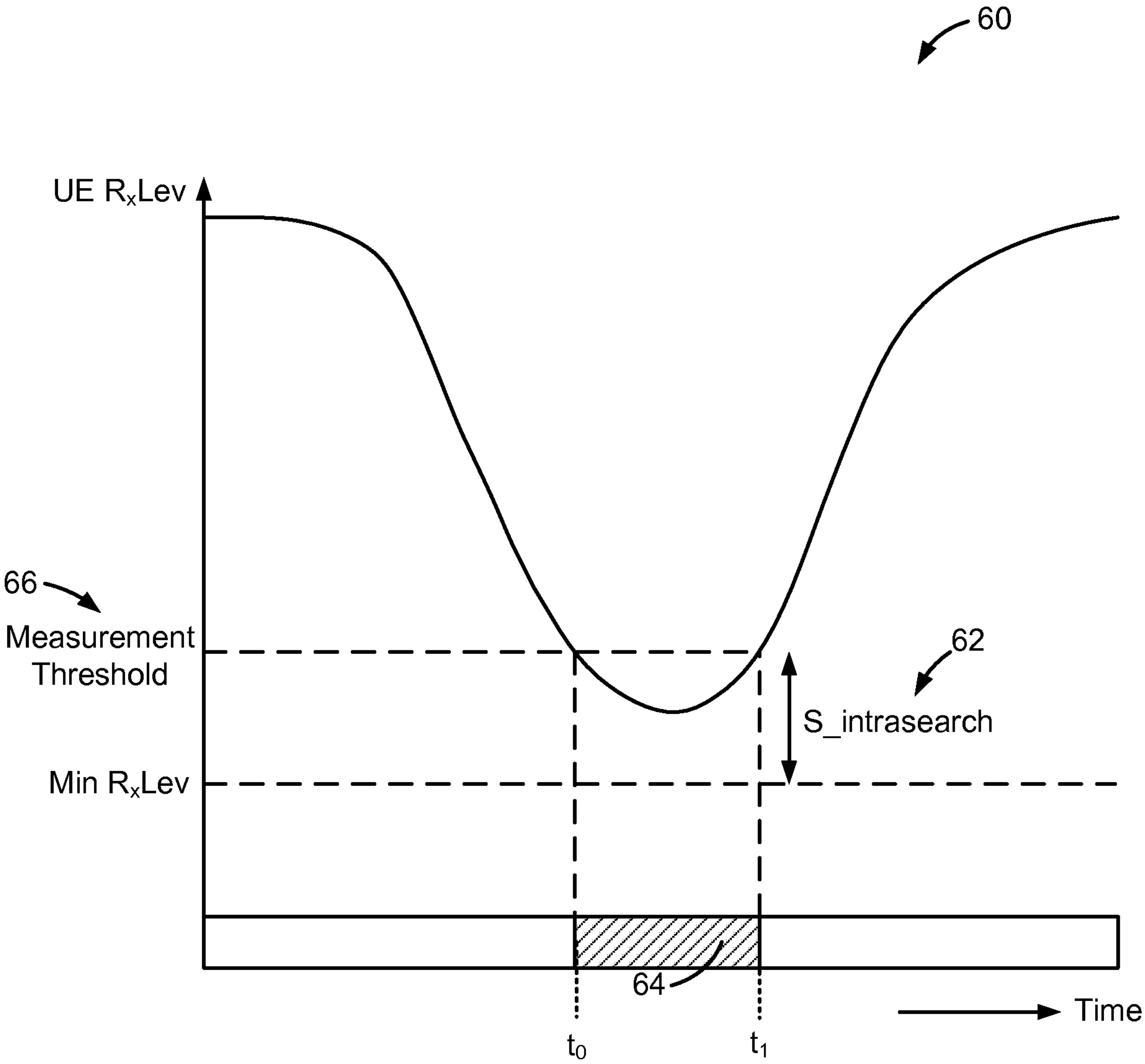
60
UE RxLev
66
Measurement Threshold
62
S_intrasearch
Min RxLev
64
Time
t0
t1

FIG. 3

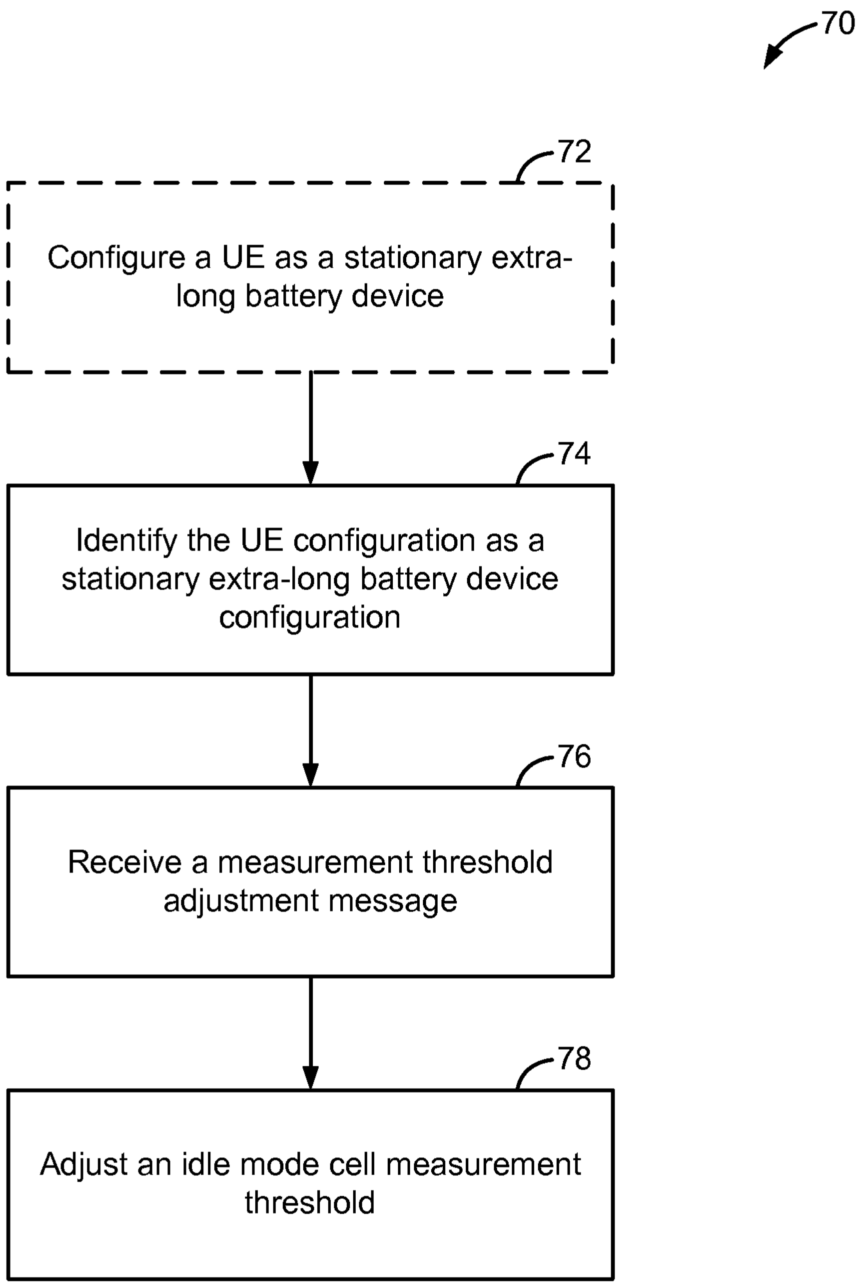
70
72
Configure a UE as a stationary extra-long battery device
74
Identify the UE configuration as a stationary extra-long battery device configuration
76
Receive a measurement threshold adjustment message
78
Adjust an idle mode cell measurement threshold

FIG. 4

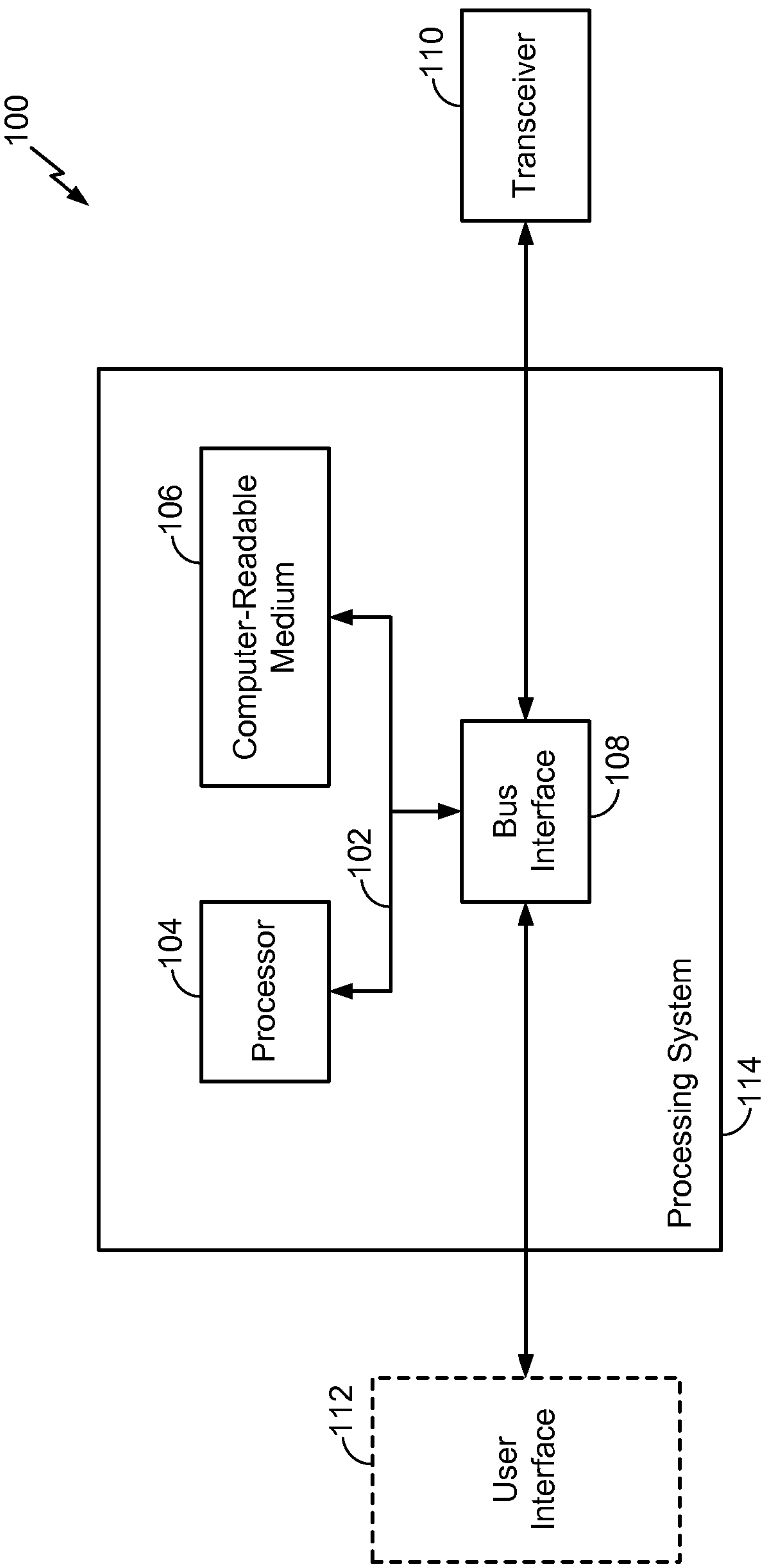
100
Transceiver
110
Computer-Readable Medium
106
Processor
104
102
Bus Interface
108
Processing System
114
User Interface
112

FIG. 5

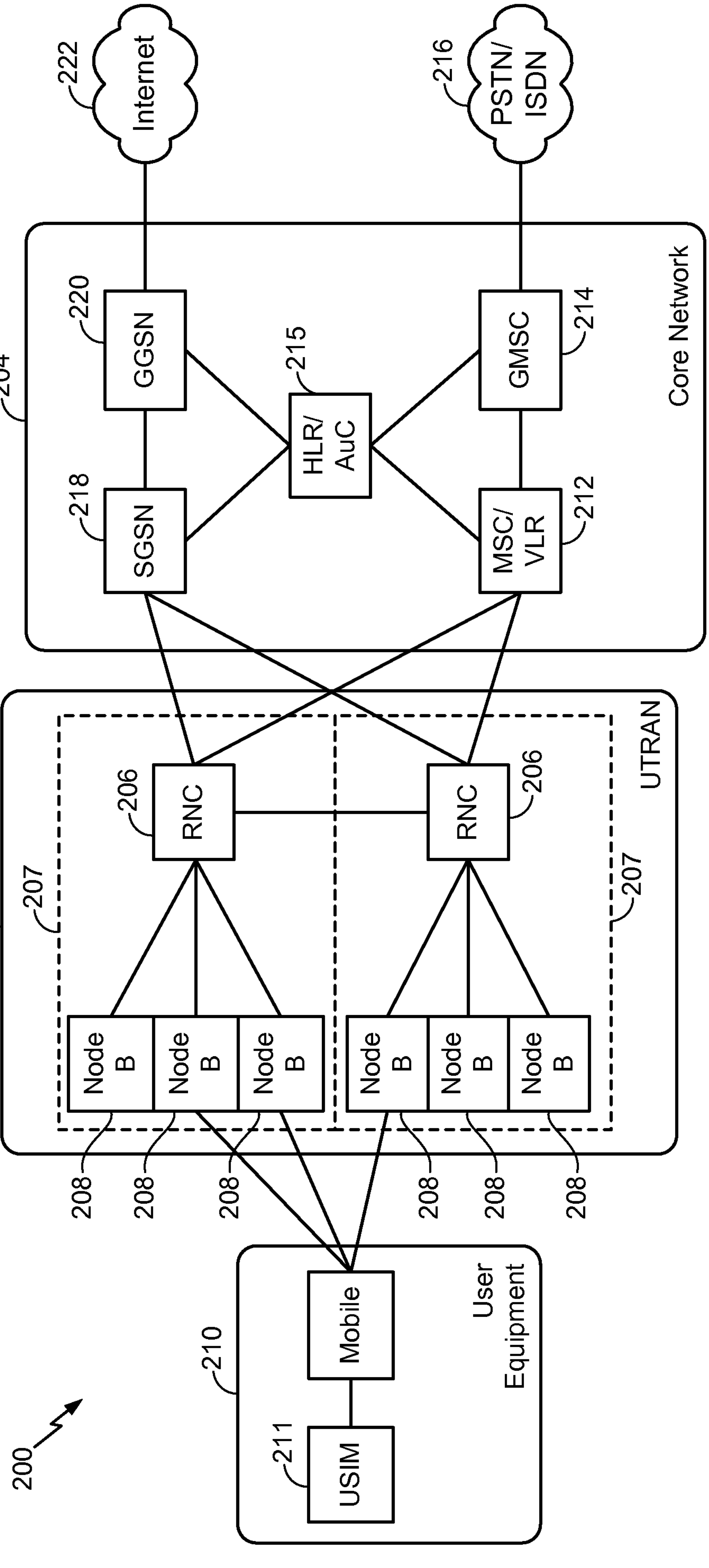
Internet
222
PSTN/
ISDN
216
GGSN
220
SGSN
218
HLR/
AuC
215
GMSC
214
MSC/
VLR
212
Core Network
204
RNC
206
RNC
206
UTRAN
202
207
207
Node
B
208
User
Equipment
Mobile
USIM
211
210
200

FIG. 6

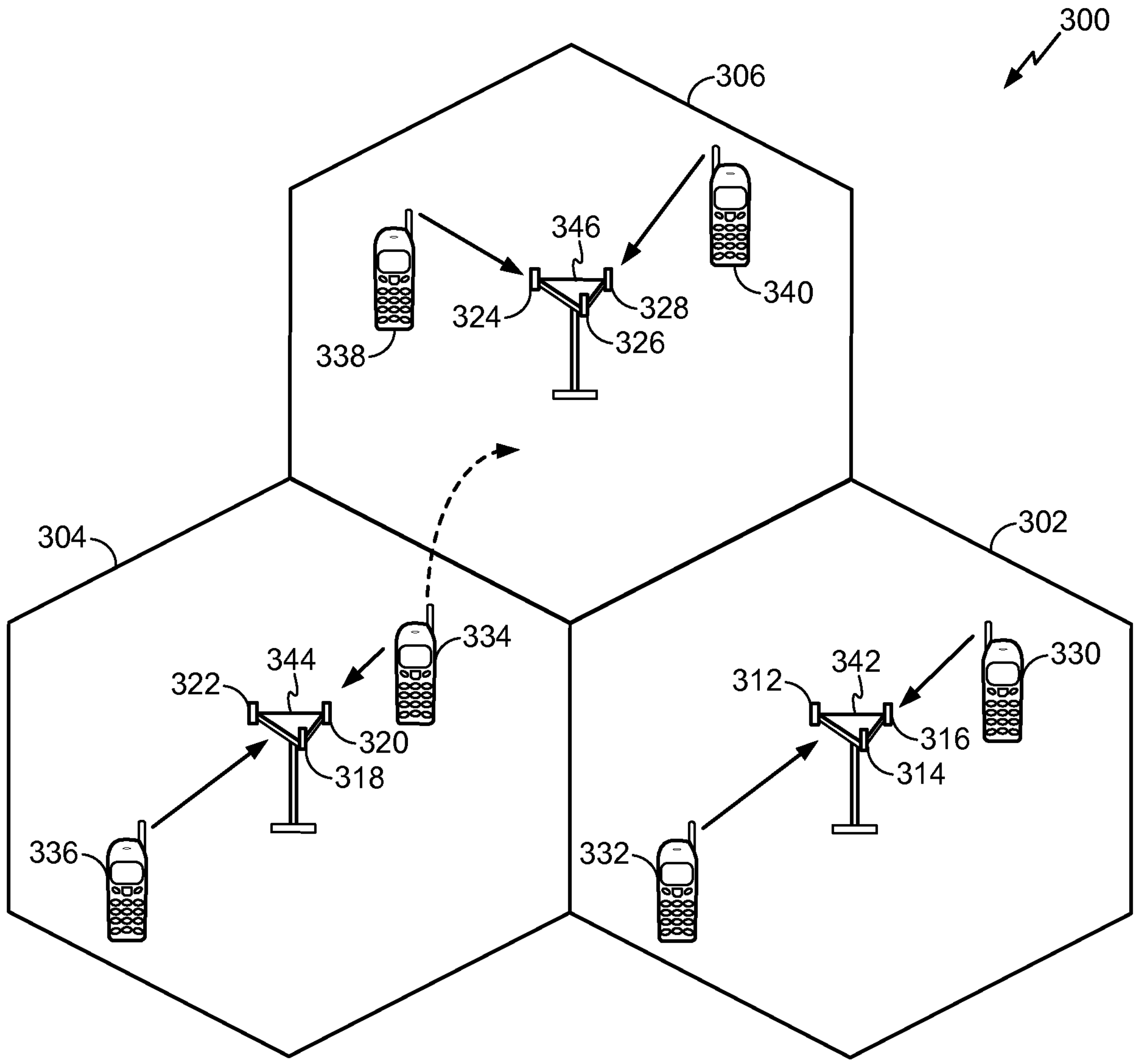
300
306
346
324
328
326
338
340
304
302
344
334
322
320
318
336
342
330
312
316
314
332

FIG. 7

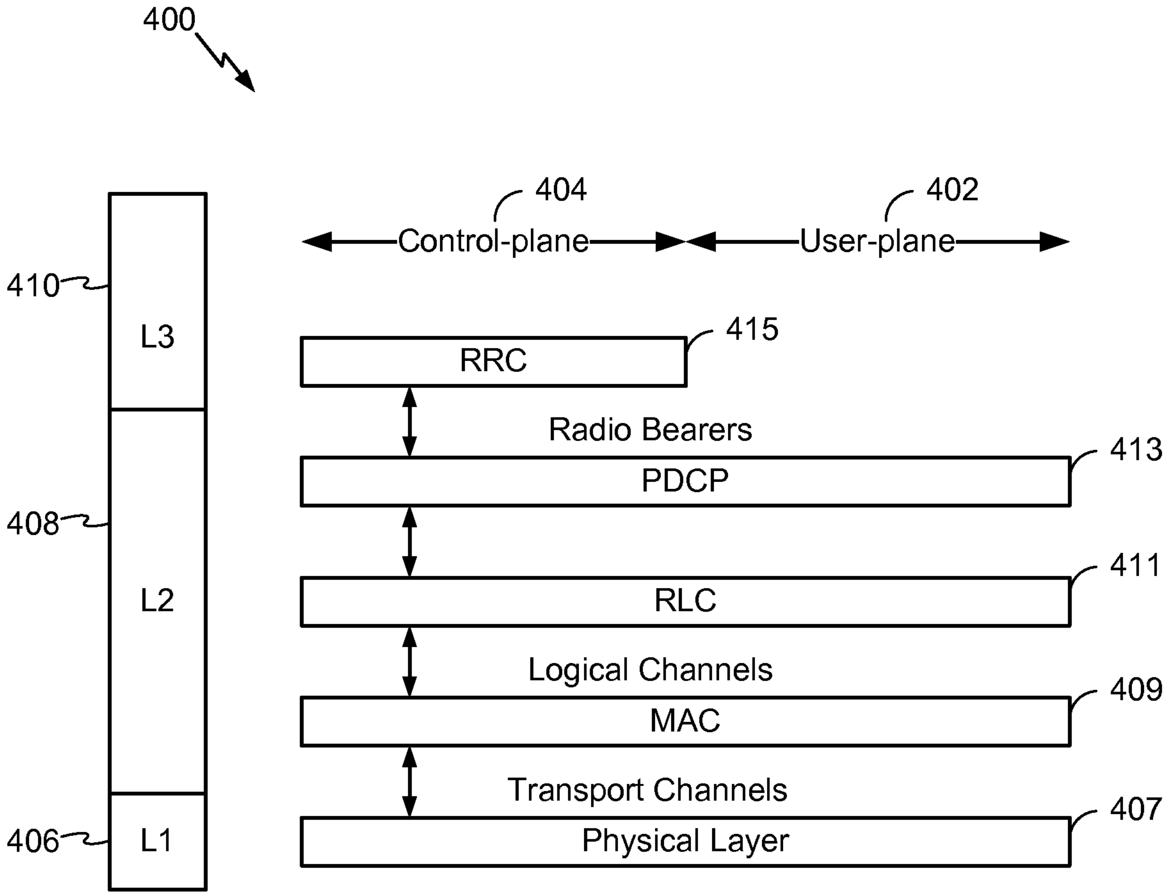
400
404
402
Control-plane
User-plane
410
L3
408
L2
406
L1
RRC
415
Radio Bearers
PDCP
413
RLC
411
Logical Channels
MAC
409
Transport Channels
Physical Layer
407

FIG. 8

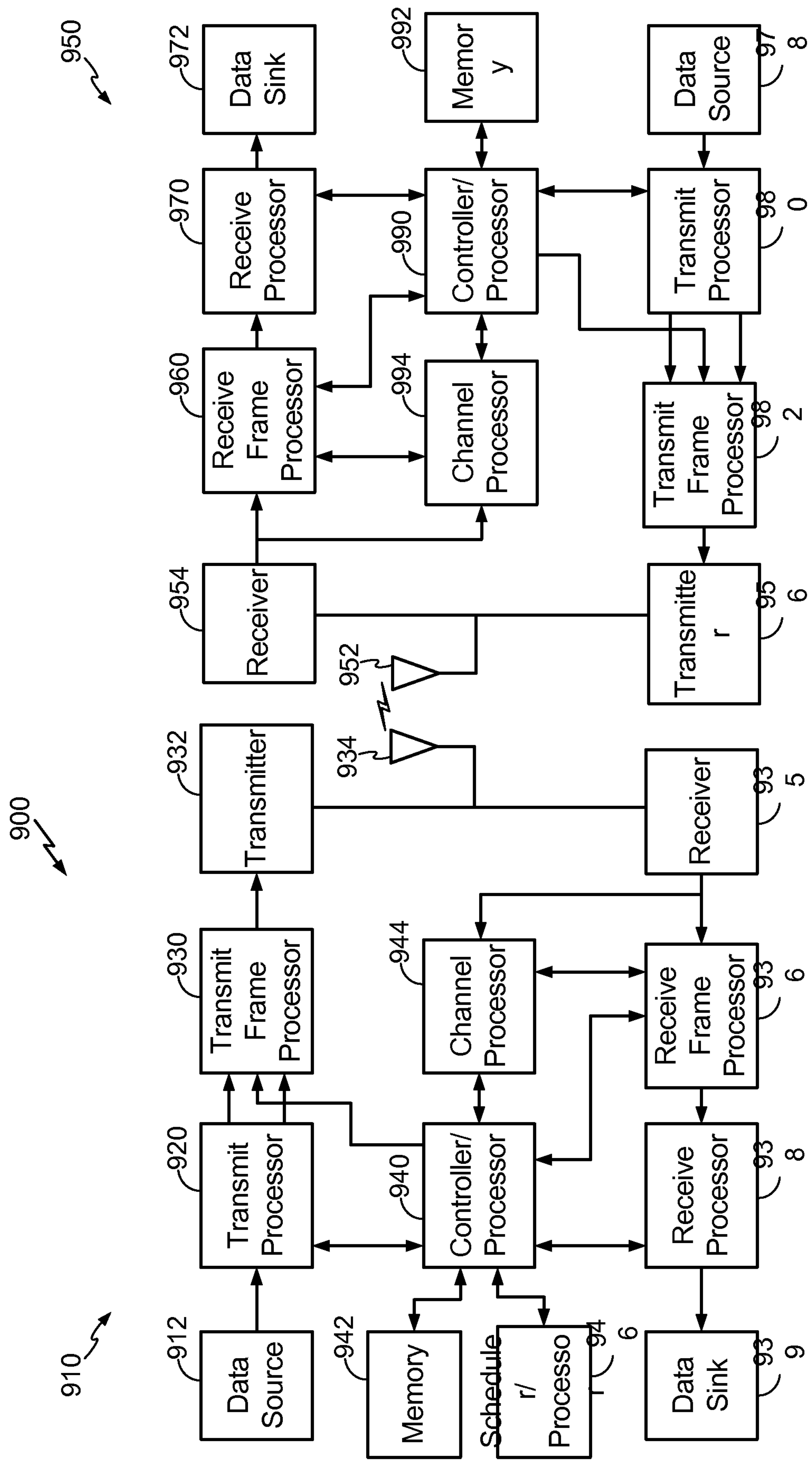
950
972
Data Sink
992
Memory
Data Source
978
970
Receive Processor
990
Controller/ Processor
Transmit Processor
980
960
Receive Frame Processor
994
Channel Processor
Transmit Frame Processor
982
954
Receiver
952
Transmitter
956
932
Transmitter
934
Receiver
935
900
930
Transmit Frame Processor
944
Channel Processor
Receive Frame Processor
936
920
Transmit Processor
940
Controller/ Processor
Receive Processor
938
910
912
Data Source
942
Memory
Scheduler/ Processor
946
Data Sink
939

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/085849

A. CLASSIFICATION OF SUBJECT MATTER

H04W 52/00 (2009.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04W, H04Q

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

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

CPRSABS, CNABS, VEN, CPRS, CNKI: cell, power, manag+, radio, wireless, threshold, message, information, cell, battery, measur+, sleep+, idle, sav+, detect+, monitor+, test+, adjust+, chang+, alter+, reduc+, increas+, decreas+, mode, state, stage

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 101444021 A (ERICSSON TELEFON AB L M) 27 May 2009 (27.05.2009) description page 2, line 19 to page 3, line 17, pages 6, 7, 10 and 14 to 16, figures 1 to 6	1-5, 10-19
Y		6-9
Y	CN 101207885 A (HUAWEI TECHNOLOGIES CO., LTD.) 25 June 2008 (25.06.2008) the abstract, claims 1 to 6	6-9

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
23 August 2013 (23.08.2013)	**05 Sep. 2013 (05.09.2013)**

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INTERNATIONAL SEARCH REPORT	International application No. PCT/CN2012/085849

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