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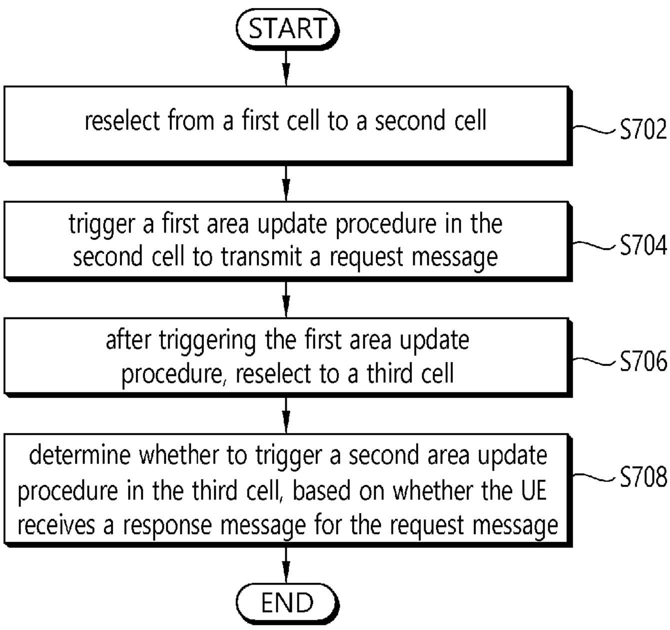

(57) Abstract: Provided are a method of performing RNAU procedure and a device supporting the method. According to one embodiment of the present invention, the method includes: reselecting from a first cell to a second cell; triggering a first area update procedure in the second cell to transmit a request message; after triggering the first area update procedure, reselecting to a third cell; and determining whether to trigger a second area update procedure in the third cell, based on whether the UE receives a response message for the request message.

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Description

Title of Invention: METHOD FOR PERFORMING RNAU PROCEDURE AND DEVICE SUPPORTING THE SAME

Technical Field

[1] The present invention relates to a wireless communication system, and more particularly, to a method for performing RNAU procedure and a device supporting the same.

Background Art

[2] Efforts have been made to develop an improved 5th-generation (5G) communication system or a pre-5G communication system in order to satisfy a growing demand on radio data traffic after commercialization of a 4th-generation (4G) communication system. A standardization act for a 5G mobile communication standard work has been formally started in 3GPP, and there is ongoing discussion in a standardization working group under a tentative name of a new radio access (NR).

[3] Meanwhile, an upper layer protocol defines a protocol state to consistently manage an operational state of a user equipment (UE), and indicates a function and procedure of the UE in detail. In the discussion on the NR standardization, an RRC state is discussed such that an RRC_CONNECTED state and an RRC_IDLE state are basically defined, and an RRC_INACTIVE state is additionally introduced.

[4] Meanwhile, RRC_INACTIVE state is newly introduced in NR. In RRC_INACTIVE state, a serving base station may still hold UE context. If the UE in RRC_INACTIVE state successfully accesses to a new base station, the UE context may be fetched to the new base station. If the RRC connection request to the new base station is rejected, the UE context may be remained in the previous base station.

Disclosure of Invention

Technical Problem

[5] According to a prior art, since the RRC connection request is triggered by upper layer, regardless of whether MSG4 is received by UE or not in response to the RRC connection request, the AS layer informs upper layers about a failure to resume the RRC connection. Then, the UE enters RRC_IDLE state, and the upper layer may perform NAS recovery procedure. That is, in case that the UE reselects the previous cell after the access to the new cell is rejected, the AS layer always performs RNAU procedure, even when the UE context is not fetched to the new base station.

Solution to Problem

[6] According to an embodiment of the present invention, a method performed by a user equipment (UE) in a wireless communication system is provided. The method may

comprise: reselecting from a first cell to a second cell; triggering a first area update procedure in the second cell to transmit a request message; after triggering the first area update procedure, reselecting to a third cell; and determining whether to trigger a second area update procedure in the third cell, based on whether the UE receives a response message for the request message.

[7] The UE may be in radio resource control (RRC) inactive state.

[8] The first area update procedure and the second area update procedure may be radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE.

[9] The response message may be a reject message in response to the request message transmitted via the second cell.

[10] It may be determined to trigger the second area update procedure, when the UE does not receive the response message from the second cell.

[11] It may be determined not to trigger the second area update procedure, when the UE receives the response message from the second cell, when the third cell belongs to an RNA area including the first cell, and when a triggering condition of the first area update procedure is mobility condition of the UE.

[12] The UE may communicate with at least one of a mobile terminal, a network or autonomous vehicles other than the UE.

[13] According to another embodiment of the present invention, a method performed by a user equipment (UE) in a wireless communication system is provided. The method may comprise: reselecting from a first cell to a second cell, triggering a first area update procedure in the second cell to transmit a request message; after triggering the first area update procedure, reselecting to a third cell; and determining whether to trigger a second area update procedure in the third cell, based on a triggering condition of the first area update procedure.

[14] The UE may be in radio resource control (RRC) inactive state.

[15] The first area update procedure and the second area update procedure may be radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE.

[16] The triggering condition of the first area update procedure may be at least one of expiry of timer for a periodic RNAU procedure, mobility condition of the UE and receiving RAN-initiated paging.

[17] It may be determined to trigger the second area update procedure, when the triggering condition of the first area update procedure is one of expiry of timer for a periodic RNAU procedure and receiving RAN-initiated paging.

[18] It may be determined not to trigger the second area update procedure, when the triggering condition of the first area update procedure is mobility condition of the UE,

when the third cell belongs to an RNA area including the first cell, and when the UE receives a response message for the request message.

[19] The UE may communicate with at least one of a mobile terminal, a network or autonomous vehicles other than the UE.

[20] According to another embodiment of the present invention, a processor for a wireless communication device in a wireless communication system is provided. The processor may be configured to control the wireless communication device to: reselect from a first cell to a second cell; trigger a first area update procedure in the second cell to transmit a request message; after triggering the first area update procedure, reselect to a third cell; and determine whether to trigger a second area update procedure in the third cell, based on whether the UE receives a response message for the request message.

Advantageous Effects of Invention

[21] According to embodiments of the present invention, the UE in RRC_NACTIVE state may not perform RNAU procedure after the UE returns back to a previous serving cell, when the UE recognize that the UE context is still stored in previous serving base station because the access to a new cell is rejected, and when a triggering event of the RNAU procedure is mobility condition of the UE. Thus, consumption of resource and time may be saved, because NAS recovery triggered by RNAU procedure is prevented.

Brief Description of Drawings

[22] FIG. 1 shows examples of 5G usage scenarios to which the technical features of the present invention can be applied.

[23] FIG. 2 shows an example of a wireless communication system to which the technical features of the present invention can be applied.

[24] FIG. 3 shows an example of a wireless communication system to which the technical features of the present invention can be applied.

[25] FIG. 4 shows another example of a wireless communication system to which the technical features of the present invention can be applied.

[26] FIG. 5 shows a block diagram of a user plane protocol stack to which the technical features of the present invention can be applied.

[27] FIG. 6 shows a block diagram of a control plane protocol stack to which the technical features of the present invention can be applied.

[28] FIG. 7 shows a method for performing RNAU procedure according to an embodiment of the present invention.

[29] FIG. 8 shows a method for performing RNAU procedure according to an embodiment of the present invention.

[30] FIG. 9 shows a method for performing RNAU procedure according to an embodiment of the present invention.

[31] FIG. 10 shows more detailed UE to implement an embodiment of the present invention.

[32] FIG. 11 shows an example of an AI device to which the technical features of the present invention can be applied.

[33] FIG. 12 shows an example of an AI system to which the technical features of the present invention can be applied.

Mode for the Invention

[34] The technical features described below may be used by a communication standard by the 3rd generation partnership project (3GPP) standardization organization, a communication standard by the institute of electrical and electronics engineers (IEEE), etc. For example, the communication standards by the 3GPP standardization organization include long-term evolution (LTE) and/or evolution of LTE systems. The evolution of LTE systems includes LTE-advanced (LTE-A), LTE-A Pro, and/or 5G new radio (NR). The communication standard by the IEEE standardization organization includes a wireless local area network (WLAN) system such as IEEE 802.11a/b/g/n/ac/ax. The above system uses various multiple access technologies such as orthogonal frequency division multiple access (OFDMA) and/or single carrier frequency division multiple access (SC-FDMA) for downlink (DL) and/or uplink (UL). For example, only OFDMA may be used for DL and only SC-FDMA may be used for UL. Alternatively, OFDMA and SC-FDMA may be used for DL and/or UL.

[35] In this document, the term "/" and ?," should be interpreted to indicate "and/or." For instance, the expression "A/B" may mean "A and/or B." Further, "A, B" may mean "A and/or B." Further, "A/B/C" may mean "at least one of A, B, and/or C." Also, "A, B, C" may mean "at least one of A, B, and/or C."

[36] Further, in the document, the term "or" should be interpreted to indicate "and/or." For instance, the expression "A or B" may comprise 1) only A, 2) only B, and/or 3) both A and B. In other words, the term "or" in this document should be interpreted to indicate "additionally or alternatively."

[37] FIG. 1 shows examples of 5G usage scenarios to which the technical features of the present invention can be applied.

[38] The 5G usage scenarios shown in FIG. 1 are only exemplary, and the technical features of the present invention can be applied to other 5G usage scenarios which are not shown in FIG. 1.

[39] Referring to FIG. 1, the three main requirements areas of 5G include (1) enhanced mobile broadband (eMBB) domain, (2) massive machine type communication (mMTC) area, and (3) ultra-reliable and low latency communications (URLLC) area. Some use cases may require multiple areas for optimization and, other use cases may

only focus on only one key performance indicator (KPI). 5G is to support these various use cases in a flexible and reliable way.

[40] eMBB focuses on across-the-board enhancements to the data rate, latency, user density, capacity and coverage of mobile broadband access. The eMBB aims ~10 Gbps of throughput. eMBB far surpasses basic mobile Internet access and covers rich interactive work and media and entertainment applications in cloud and/or augmented reality. Data is one of the key drivers of 5G and may not be able to see dedicated voice services for the first time in the 5G era. In 5G, the voice is expected to be processed as an application simply using the data connection provided by the communication system. The main reason for the increased volume of traffic is an increase in the size of the content and an increase in the number of applications requiring high data rates. Streaming services (audio and video), interactive video and mobile Internet connectivity will become more common as more devices connect to the Internet. Many of these applications require always-on connectivity to push real-time information and notifications to the user. Cloud storage and applications are growing rapidly in mobile communication platforms, which can be applied to both work and entertainment. Cloud storage is a special use case that drives growth of uplink data rate. 5G is also used for remote tasks on the cloud and requires much lower end-to-end delay to maintain a good user experience when the tactile interface is used. In entertainment, for example, cloud games and video streaming are another key factor that increases the demand for mobile broadband capabilities. Entertainment is essential in smartphones and tablets anywhere, including high mobility environments such as trains, cars and airplanes. Another use case is augmented reality and information retrieval for entertainment. Here, augmented reality requires very low latency and instantaneous data amount.

[41] mMTC is designed to enable communication between devices that are low-cost, massive in number and battery-driven, intended to support applications such as smart metering, logistics, and field and body sensors. mMTC aims ~10 years on battery and/or ~1 million devices/km2. mMTC allows seamless integration of embedded sensors in all areas and is one of the most widely used 5G applications. Potentially by 2020, internet-of-things (IoT) devices are expected to reach 20.4 billion. Industrial IoT is one of the areas where 5G plays a key role in enabling smart cities, asset tracking, smart utilities, agriculture and security infrastructures.

[42] URLLC will make it possible for devices and machines to communicate with ultra-reliability, very low latency and high availability, making it ideal for vehicular communication, industrial control, factory automation, remote surgery, smart grids and public safety applications. URLLC aims ~1ms of latency. URLLC includes new services that will change the industry through links with ultra-reliability / low latency, such as

remote control of key infrastructure and self-driving vehicles. The level of reliability and latency is essential for smart grid control, industrial automation, robotics, drones control and coordination.

[43] Next, a plurality of use cases included in the triangle of FIG. 1 will be described in more detail.

[44] 5G can complement fiber-to-the-home (FTTH) and cable-based broadband (or DOCSIS) as a means of delivering streams rated from hundreds of megabits per second to gigabits per second. This high speed can be required to deliver TVs with resolutions of 4K or more (6K, 8K and above) as well as virtual reality (VR) and augmented reality (AR). VR and AR applications include mostly immersive sporting events. Certain applications may require special network settings. For example, in the case of a VR game, a game company may need to integrate a core server with an edge network server of a network operator to minimize delay.

[45] Automotive is expected to become an important new driver for 5G, with many use cases for mobile communications to vehicles. For example, entertainment for passengers demands high capacity and high mobile broadband at the same time. This is because future users will continue to expect high-quality connections regardless of their location and speed. Another use case in the automotive sector is an augmented reality dashboard. The driver can identify an object in the dark on top of what is being viewed through the front window through the augmented reality dashboard. The augmented reality dashboard displays information that will inform the driver about the object's distance and movement. In the future, the wireless module enables communication between vehicles, information exchange between the vehicle and the supporting infrastructure, and information exchange between the vehicle and other connected devices (e.g. devices accompanied by a pedestrian). The safety system allows the driver to guide the alternative course of action so that he can drive more safely, thereby reducing the risk of accidents. The next step will be a remotely controlled vehicle or self-driving vehicle. This requires a very reliable and very fast communication between different self-driving vehicles and between vehicles and infrastructure. In the future, a self-driving vehicle will perform all driving activities, and the driver will focus only on traffic that the vehicle itself cannot identify. The technical requirements of self-driving vehicles require ultra-low latency and high-speed reliability to increase traffic safety to a level not achievable by humans.

[46] Smart cities and smart homes, which are referred to as smart societies, will be embedded in high density wireless sensor networks. The distributed network of intelligent sensors will identify conditions for cost and energy-efficient maintenance of a city or house. A similar setting can be performed for each home. Temperature sensors, windows and heating controllers, burglar alarms and appliances are all wirelessly

connected. Many of these sensors typically require low data rate, low power and low cost. However, for example, real-time high-definition (HD) video may be required for certain types of devices for monitoring.

[47] The consumption and distribution of energy, including heat or gas, is highly dispersed, requiring automated control of distributed sensor networks. The smart grid interconnects these sensors using digital information and communication technologies to collect and act on information. This information can include supplier and consumer behavior, allowing the smart grid to improve the distribution of fuel, such as electricity, in terms of efficiency, reliability, economy, production sustainability, and automated methods. The smart grid can be viewed as another sensor network with low latency.

[48] The health sector has many applications that can benefit from mobile communications. Communication systems can support telemedicine to provide clinical care in remote locations. This can help to reduce barriers to distance and improve access to health services that are not continuously available in distant rural areas. It is also used to save lives in critical care and emergency situations. Mobile communication based wireless sensor networks can provide remote monitoring and sensors for parameters such as heart rate and blood pressure.

[49] Wireless and mobile communications are becoming increasingly important in industrial applications. Wiring costs are high for installation and maintenance. Thus, the possibility of replacing a cable with a wireless link that can be reconfigured is an attractive opportunity in many industries. However, achieving this requires that wireless connections operate with similar delay, reliability, and capacity as cables and that their management is simplified. Low latency and very low error probabilities are new requirements that need to be connected to 5G.

[50] Logistics and freight tracking are important use cases of mobile communications that enable tracking of inventory and packages anywhere using location based information systems. Use cases of logistics and freight tracking typically require low data rates, but require a large range and reliable location information.

[51] FIG. 2 shows an example of a wireless communication system to which the technical features of the present invention can be applied.

[52] Referring to FIG. 2, the wireless communication system may include a first device 210 and a second device 220.

[53] The first device 210 includes a base station, a network node, a transmitting UE, a receiving UE, a wireless device, a wireless communication device, a vehicle, a vehicle equipped with an autonomous driving function, a connected car, a drone, an unmanned aerial vehicle (UAV), an artificial intelligence (AI) module, a robot, an AR device, a VR device, a mixed reality (MR) device, a hologram device, a public safety device, an

MTC device, an IoT device, a medical device, a fin-tech device (or, a financial device), a security device, a climate/environmental device, a device related to 5G services, or a device related to the fourth industrial revolution.

[54] The second device 220 includes a base station, a network node, a transmitting UE, a receiving UE, a wireless device, a wireless communication device, a vehicle, a vehicle equipped with an autonomous driving function, a connected car, a drone, a UAV, an AI module, a robot, an AR device, a VR device, an MR device, a hologram device, a public safety device, an MTC device, an IoT device, a medical device, a fin-tech device (or, a financial device), a security device, a climate/environmental device, a device related to 5G services, or a device related to the fourth industrial revolution.

[55] For example, the UE may include a mobile phone, a smart phone, a laptop computer, a digital broadcasting terminal, a personal digital assistant (PDA), a portable multimedia player (PMP), a navigation device, a slate personal computer (PC), a tablet PC, an ultrabook, a wearable device (e.g. a smartwatch, a smart glass, a head mounted display (HMD)) . For example, the HMD may be a display device worn on the head. For example, the HMD may be used to implement AR, VR and/or MR.

[56] For example, the drone may be a flying object that is flying by a radio control signal without a person boarding it. For example, the VR device may include a device that implements an object or background in the virtual world. For example, the AR device may include a device that implements connection of an object and/or a background of a virtual world to an object and/or a background of the real world. For example, the MR device may include a device that implements fusion of an object and/or a background of a virtual world to an object and/or a background of the real world. For example, the hologram device may include a device that implements a 360-degree stereoscopic image by recording and playing stereoscopic information by utilizing a phenomenon of interference of light generated by the two laser lights meeting with each other, called holography. For example, the public safety device may include a video relay device or a video device that can be worn by the user's body. For example, the MTC device and the IoT device may be a device that do not require direct human intervention or manipulation. For example, the MTC device and the IoT device may include a smart meter, a vending machine, a thermometer, a smart bulb, a door lock and/or various sensors. For example, the medical device may be a device used for the purpose of diagnosing, treating, alleviating, handling, or preventing a disease. For example, the medical device may be a device used for the purpose of diagnosing, treating, alleviating, or correcting an injury or disorder. For example, the medical device may be a device used for the purpose of inspecting, replacing or modifying a structure or function. For example, the medical device may be a device used for the purpose of controlling pregnancy. For example, the medical device may include a treatment

device, a surgical device, an (in vitro) diagnostic device, a hearing aid and/or a procedural device, etc. For example, a security device may be a device installed to prevent the risk that may occur and to maintain safety. For example, the security device may include a camera, a closed-circuit TV (CCTV), a recorder, or a black box. For example, the fin-tech device may be a device capable of providing financial services such as mobile payment. For example, the fin-tech device may include a payment device or a point of sales (POS). For example, the climate/environmental device may include a device for monitoring or predicting the climate/environment.

[57] The first device 210 may include at least one or more processors, such as a processor 211, at least one memory, such as a memory 212, and at least one transceiver, such as a transceiver 213. The processor 211 may perform the functions, procedures, and/or methods of the present invention described below. The processor 211 may perform one or more protocols. For example, the processor 211 may perform one or more layers of the air interface protocol. The memory 212 is connected to the processor 211 and may store various types of information and/or instructions. The transceiver 213 is connected to the processor 211 and may be controlled to transmit and receive wireless signals.

[58] The second device 220 may include at least one or more processors, such as a processor 221, at least one memory, such as a memory 222, and at least one transceiver, such as a transceiver 223. The processor 221 may perform the functions, procedures, and/or methods of the present invention described below. The processor 221 may perform one or more protocols. For example, the processor 221 may perform one or more layers of the air interface protocol. The memory 222 is connected to the processor 221 and may store various types of information and/or instructions. The transceiver 223 is connected to the processor 221 and may be controlled to transmit and receive wireless signals.

[59] The memory 212, 222 may be connected internally or externally to the processor 211, 212, or may be connected to other processors via a variety of technologies such as wired or wireless connections.

[60] The first device 210 and/or the second device 220 may have more than one antenna. For example, antenna 214 and/or antenna 224 may be configured to transmit and receive wireless signals.

[61] FIG. 3 shows an example of a wireless communication system to which the technical features of the present invention can be applied.

[62] Specifically, FIG. 3 shows a system architecture based on an evolved-UMTS terrestrial radio access network (E-UTRAN). The aforementioned LTE is a part of an evolved-UTMS (e-UMTS) using the E-UTRAN.

[63] Referring to FIG. 3, the wireless communication system includes one or more user equipment (UE) 310, an E-UTRAN and an evolved packet core (EPC). The UE 310

refers to a communication equipment carried by a user. The UE 310 may be fixed or mobile. The UE 310 may be referred to as another terminology, such as a mobile station (MS), a user terminal (UT), a subscriber station (SS), a wireless device, etc.

[64] The E-UTRAN consists of one or more evolved NodeB (eNB) 320. The eNB 320 provides the E-UTRA user plane and control plane protocol terminations towards the UE 10. The eNB 320 is generally a fixed station that communicates with the UE 310. The eNB 320 hosts the functions, such as inter-cell radio resource management (RRM), radio bearer (RB) control, connection mobility control, radio admission control, measurement configuration/provision, dynamic resource allocation (scheduler), etc. The eNB 320 may be referred to as another terminology, such as a base station (BS), a base transceiver system (BTS), an access point (AP), etc.

[65] A downlink (DL) denotes communication from the eNB 320 to the UE 310. An uplink (UL) denotes communication from the UE 310 to the eNB 320. A sidelink (SL) denotes communication between the UEs 310. In the DL, a transmitter may be a part of the eNB 320, and a receiver may be a part of the UE 310. In the UL, the transmitter may be a part of the UE 310, and the receiver may be a part of the eNB 320. In the SL, the transmitter and receiver may be a part of the UE 310.

[66] The EPC includes a mobility management entity (MME), a serving gateway (S-GW) and a packet data network (PDN) gateway (P-GW). The MME hosts the functions, such as non-access stratum (NAS) security, idle state mobility handling, evolved packet system (EPS) bearer control, etc. The S-GW hosts the functions, such as mobility anchoring, etc. The S-GW is a gateway having an E-UTRAN as an endpoint. For convenience, MME/S-GW 330 will be referred to herein simply as a "gateway," but it is understood that this entity includes both the MME and S-GW. The P-GW hosts the functions, such as UE Internet protocol (IP) address allocation, packet filtering, etc. The P-GW is a gateway having a PDN as an endpoint. The P-GW is connected to an external network.

[67] The UE 310 is connected to the eNB 320 by means of the Uu interface. The UEs 310 are interconnected with each other by means of the PC5 interface. The eNBs 320 are interconnected with each other by means of the X2 interface. The eNBs 320 are also connected by means of the S1 interface to the EPC, more specifically to the MME by means of the S1-MME interface and to the S-GW by means of the S1-U interface. The S1 interface supports a many-to-many relation between MMEs / S-GWs and eNBs.

[68] FIG. 4 shows another example of a wireless communication system to which the technical features of the present invention can be applied.

[69] Specifically, FIG. 4 shows a system architecture based on a 5G NR. The entity used in the 5G NR (hereinafter, simply referred to as "NR") may absorb some or all of the functions of the entities introduced in FIG. 3 (e.g. eNB, MME, S-GW). The entity used

in the NR may be identified by the name "NG" for distinction from the LTE/LTE-A.

[70] Referring to FIG. 4, the wireless communication system includes one or more UE 410, a next-generation RAN (NG-RAN) and a 5th generation core network (5GC). The NG-RAN consists of at least one NG-RAN node. The NG-RAN node is an entity corresponding to the eNB 320 shown in FIG. 3. The NG-RAN node consists of at least one gNB 421 and/or at least one ng-eNB 422. The gNB 421 provides NR user plane and control plane protocol terminations towards the UE 410. The ng-eNB 422 provides E-UTRA user plane and control plane protocol terminations towards the UE 410.

[71] The 5GC includes an access and mobility management function (AMF), a user plane function (UPF) and a session management function (SMF). The AMF hosts the functions, such as NAS security, idle state mobility handling, etc. The AMF is an entity including the functions of the conventional MME. The UPF hosts the functions, such as mobility anchoring, protocol data unit (PDU) handling. The UPF an entity including the functions of the conventional S-GW. The SMF hosts the functions, such as UE IP address allocation, PDU session control.

[72] The gNBs 421 and ng-eNBs 422 are interconnected with each other by means of the Xn interface. The gNBs 421 and ng-eNBs 422 are also connected by means of the NG interfaces to the 5GC, more specifically to the AMF by means of the NG-C interface and to the UPF by means of the NG-U interface.

[73] A protocol structure between network entities described above is described. On the system of FIG. 3 and/or FIG. 4, layers of a radio interface protocol between the UE and the network (e.g. NG-RAN and/or E-UTRAN) may be classified into a first layer (L1), a second layer (L2), and a third layer (L3) based on the lower three layers of the open system interconnection (OSI) model that is well-known in the communication system.

[74] FIG. 5 shows a block diagram of a user plane protocol stack to which the technical features of the present invention can be applied. FIG. 6 shows a block diagram of a control plane protocol stack to which the technical features of the present invention can be applied.

[75] The user/control plane protocol stacks shown in FIG. 5 and FIG. 6 are used in NR. However, user/control plane protocol stacks shown in FIG. 5 and FIG. 6 may be used in LTE/LTE-A without loss of generality, by replacing gNB/AMF with eNB/MME.

[76] Referring to FIG. 5 and FIG. 6, a physical (PHY) layer belonging to L1. The PHY layer offers information transfer services to media access control (MAC) sublayer and higher layers. The PHY layer offers to the MAC sublayer transport channels. Data between the MAC sublayer and the PHY layer is transferred via the transport channels. Between different PHY layers, i.e., between a PHY layer of a transmission side and a PHY layer of a reception side, data is transferred via the physical channels.

[77] The MAC sublayer belongs to L2. The main services and functions of the MAC sublayer include mapping between logical channels and transport channels, multiplexing/de-multiplexing of MAC service data units (SDUs) belonging to one or different logical channels into/from transport blocks (TB) delivered to/from the physical layer on transport channels, scheduling information reporting, error correction through hybrid automatic repeat request (HARQ), priority handling between UEs by means of dynamic scheduling, priority handling between logical channels of one UE by means of logical channel prioritization (LCP), etc. The MAC sublayer offers to the radio link control (RLC) sublayer logical channels.

[78] The RLC sublayer belong to L2. The RLC sublayer supports three transmission modes, i.e. transparent mode (TM), unacknowledged mode (UM), and acknowledged mode (AM), in order to guarantee various quality of services (QoS) required by radio bearers. The main services and functions of the RLC sublayer depend on the transmission mode. For example, the RLC sublayer provides transfer of upper layer PDUs for all three modes, but provides error correction through ARQ for AM only. In LTE/LTE-A, the RLC sublayer provides concatenation, segmentation and reassembly of RLC SDUs (only for UM and AM data transfer) and re-segmentation of RLC data PDUs (only for AM data transfer). In NR, the RLC sublayer provides segmentation (only for AM and UM) and re-segmentation (only for AM) of RLC SDUs and reassembly of SDU (only for AM and UM). That is, the NR does not support concatenation of RLC SDUs. The RLC sublayer offers to the packet data convergence protocol (PDCP) sublayer RLC channels.

[79] The PDCP sublayer belong to L2. The main services and functions of the PDCP sublayer for the user plane include header compression and decompression, transfer of user data, duplicate detection, PDCP PDU routing, retransmission of PDCP SDUs, ciphering and deciphering, etc. The main services and functions of the PDCP sublayer for the control plane include ciphering and integrity protection, transfer of control plane data, etc.

[80] The service data adaptation protocol (SDAP) sublayer belong to L2. The SDAP sublayer is only defined in the user plane. The SDAP sublayer is only defined for NR. The main services and functions of SDAP include, mapping between a QoS flow and a data radio bearer (DRB), and marking QoS flow ID (QFI) in both DL and UL packets. The SDAP sublayer offers to 5GC QoS flows.

[81] A radio resource control (RRC) layer belongs to L3. The RRC layer is only defined in the control plane. The RRC layer controls radio resources between the UE and the network. To this end, the RRC layer exchanges RRC messages between the UE and the BS. The main services and functions of the RRC layer include broadcast of system information related to AS and NAS, paging, establishment, maintenance and release of

an RRC connection between the UE and the network, security functions including key management, establishment, configuration, maintenance and release of radio bearers, mobility functions, QoS management functions, UE measurement reporting and control of the reporting, NAS message transfer to/from NAS from/to UE.

[82] In other words, the RRC layer controls logical channels, transport channels, and physical channels in relation to the configuration, reconfiguration, and release of radio bearers. A radio bearer refers to a logical path provided by L1 (PHY layer) and L2 (MAC/RLC/PDCP/SDAP sublayer) for data transmission between a UE and a network. Setting the radio bearer means defining the characteristics of the radio protocol layer and the channel for providing a specific service, and setting each specific parameter and operation method. Radio bearer may be divided into signaling RB (SRB) and data RB (DRB). The SRB is used as a path for transmitting RRC messages in the control plane, and the DRB is used as a path for transmitting user data in the user plane.

[83] An RRC state indicates whether an RRC layer of the UE is logically connected to an RRC layer of the E-UTRAN. In LTE/LTE-A, when the RRC connection is established between the RRC layer of the UE and the RRC layer of the E-UTRAN, the UE is in the RRC connected state (RRC_CONNECTED). Otherwise, the UE is in the RRC idle state (RRC_IDLE). In NR, the RRC inactive state (RRC_INACTIVE) is additionally introduced. RRC_INACTIVE may be used for various purposes. For example, the massive machine type communications (MMTC) UEs can be efficiently managed in RRC_INACTIVE. When a specific condition is satisfied, transition is made from one of the above three states to the other.

[84] A predetermined operation may be performed according to the RRC state. In RRC_IDLE, public land mobile network (PLMN) selection, broadcast of system information (SI), cell re-selection mobility, core network (CN) paging and discontinuous reception (DRX) configured by NAS may be performed. The UE shall have been allocated an identifier (ID) which uniquely identifies the UE in a tracking area. No RRC context stored in the BS.

[85] In RRC_CONNECTED, the UE has an RRC connection with the network (i.e. E-UTRAN/NG-RAN). Network-CN connection (both C/U-planes) is also established for UE. The UE AS context is stored in the network and the UE. The RAN knows the cell which the UE belongs to. The network can transmit and/or receive data to/from UE. Network controlled mobility including measurement is also performed.

[86] Most of operations performed in RRC_IDLE may be performed in RRC_INACTIVE. But, instead of CN paging in RRC_IDLE, RAN paging is performed in RRC_INACTIVE. In other words, in RRC_IDLE, paging for mobile terminated (MT) data is initiated by core network and paging area is managed by core

network. In RRC_INACTIVE, paging is initiated by NG-RAN, and RAN-based notification area (RNA) is managed by NG-RAN. Further, instead of DRX for CN paging configured by NAS in RRC_IDLE, DRX for RAN paging is configured by NG-RAN in RRC_INACTIVE. Meanwhile, in RRC_INACTIVE, 5GC-NG-RAN connection (both C/U-planes) is established for UE, and the UE AS context is stored in NG-RAN and the UE. NG-RAN knows the RNA which the UE belongs to.

[87] NAS layer is located at the top of the RRC layer. The NAS control protocol performs the functions, such as authentication, mobility management, security control.

[88] The physical channels may be modulated according to OFDM processing and utilizes time and frequency as radio resources. The physical channels consist of a plurality of orthogonal frequency division multiplexing (OFDM) symbols in time domain and a plurality of subcarriers in frequency domain. One subframe consists of a plurality of OFDM symbols in the time domain. A resource block is a resource allocation unit, and consists of a plurality of OFDM symbols and a plurality of subcarriers. In addition, each subframe may use specific subcarriers of specific OFDM symbols (e.g. first OFDM symbol) of the corresponding subframe for a physical downlink control channel (PDCCH), i.e. L1/L2 control channel. A transmission time interval (TTI) is a basic unit of time used by a scheduler for resource allocation. The TTI may be defined in units of one or a plurality of slots, or may be defined in units of mini-slots.

[89] The transport channels are classified according to how and with what characteristics data are transferred over the radio interface. DL transport channels include a broadcast channel (BCH) used for transmitting system information, a downlink shared channel (DL-SCH) used for transmitting user traffic or control signals, and a paging channel (PCH) used for paging a UE. UL transport channels include an uplink shared channel (UL-SCH) for transmitting user traffic or control signals and a random access channel (RACH) normally used for initial access to a cell.

[90] Different kinds of data transfer services are offered by MAC sublayer. Each logical channel type is defined by what type of information is transferred. Logical channels are classified into two groups: control channels and traffic channels.

[91] Control channels are used for the transfer of control plane information only. The control channels include a broadcast control channel (BCCH), a paging control channel (PCCH), a common control channel (CCCH) and a dedicated control channel (DCCH). The BCCH is a DL channel for broadcasting system control information. The PCCH is DL channel that transfers paging information, system information change notifications. The CCCH is a channel for transmitting control information between UEs and network. This channel is used for UEs having no RRC connection with the network. The DCCH is a point-to-point bi-directional channel that transmits dedicated control information between a UE and the network. This channel is used by UEs having an

RRC connection.

[92] Traffic channels are used for the transfer of user plane information only. The traffic channels include a dedicated traffic channel (DTCH). The DTCH is a point-to-point channel, dedicated to one UE, for the transfer of user information. The DTCH can exist in both UL and DL.

[93] Regarding mapping between the logical channels and transport channels, in DL, BCCH can be mapped to BCH, BCCH can be mapped to DL-SCH, PCCH can be mapped to PCH, CCCH can be mapped to DL-SCH, DCCH can be mapped to DL-SCH, and DTCH can be mapped to DL-SCH. In UL, CCCH can be mapped to UL-SCH, DCCH can be mapped to UL- SCH, and DTCH can be mapped to UL-SCH.

[94] Meanwhile, RRC_INACTIVE state is newly introduced in NR. In RRC_INACTIVE state, a serving base station may still hold UE context. If the UE in RRC_INACTIVE state successfully accesses to a new base station, the UE context may be fetched to the new base station. If the RRC connection request to the new base station is rejected, the UE context may be remained in the previous base station. Further, upon rejection of the access, the UE in RRC_INACTIVE state may perform cell reselection. In case that the UE reselects the previous serving cell, it needs to be discussed whether to perform RNAU procedure.

[95] When the UE recognizes that the access to a new cell is rejected, the UE may not need to perform RNAU procedure in the previous serving cell, because the UE may consider the UE context is not fetched to a new base station.

[96] However, in prior art, since the RRC connection request is triggered by upper layer, regardless of whether MSG4 is received by UE or not in response to the RRC connection request, the AS layer informs upper layers about a failure to resume the RRC connection. Then, the UE enters RRC_IDLE state, and the upper layer may perform NAS recovery procedure. That is, in case that the UE reselects the previous cell after the access to the new cell is rejected, the AS layer always performs RNAU procedure, even when the UE context is not fetched to the new base station.

[97] Thus, it is required to specify the UE behavior when the cell reselection occurs after resume request transmitted due to AS triggered RAN-based notification area update (RNAU) procedure.

[98] In this description, RRC_INACTIVE may be INACTIVE state in NR, lightweight connection in LTE, IDLE with suspension, or INACTIVE state in eLTE (LTE connectivity to 5G-CN). Further, the AS triggered RNAU procedure may be at least one of periodic RNAU, event-triggered RNAU and response of RAN-initiated paging. The event-triggered RNAU procedure may be RNAU procedure triggered due to mobility of the UE.

[99] FIG. 7 shows a method for performing RNAU procedure according to an em-

bodiment of the present invention.

[100] In step S702, the UE may reselect from a first cell to a second cell. The UE may be in radio resource control (RRC) inactive state.

[101] In step S704, the UE may trigger a first area update procedure in the second cell to transmit a request message. The first area update procedure may be radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE.

[102] In step S706, after triggering the first area update procedure, the UE may reselect to a third cell. The third cell may belong to an RNA area which the first cell belongs. A triggering condition of the first area update procedure may be mobility condition of the UE.

[103] In step S708, the UE may determine whether to trigger a second area update procedure in the third cell, based on whether the UE receives a response message for the request message. The second area update procedure may be radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE. The response message may be a reject message in response to the request message transmitted via the second cell. The UE may determine to trigger the second area update procedure, when the UE does not receive the response message from the second cell. The UE may determine not to trigger the second area update procedure, when the UE receives the response message from the second cell, when the third cell belongs to an RNA area including the first cell, and when a triggering condition of the first area update procedure is mobility condition of the UE. The UE may determine not to trigger the second area update procedure when the UE recognizes that a UE context of the UE is still stored in a base station of the first cell.

[104] The UE may communicate with at least one of a mobile terminal, a network or autonomous vehicles other than the UE.

[105] According to embodiments of the present invention, the UE in RRC_NACTIVE state may not perform RNAU procedure after the UE returns back to a previous serving cell, when the UE recognize that the UE context is still stored in previous serving base station because the access to a new cell is rejected. Thus, consumption of resource and time may be saved, because NAS recovery triggered by RNAU procedure is prevented.

[106] FIG. 8 shows a method for performing RNAU procedure according to an embodiment of the present invention.

[107] In step S802, the UE may reselect from a first cell to a second cell. The UE may be in radio resource control (RRC) inactive state.

[108] In step S804, the UE may trigger a first area update procedure in the second cell to transmit a request message. The first area update procedure may be radio access network (RAN)-based notification area update (RNAU) procedure triggered by access

stratum (AS) layer of the UE.

[109] In step S806, after triggering the first area update procedure, the UE may reselect to a third cell. The third cell may be the first cell.

[110] In step S808, the UE may determine whether to trigger a second area update procedure in the third cell, based on a triggering condition of the first area update procedure. The second area update procedure may be radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE. The triggering condition of the first area update procedure may be at least one of expiry of timer for a periodic RNAU procedure, mobility condition of the UE and receiving RAN-initiated paging. The UE may determine to trigger the second area update procedure, when the triggering condition of the first area update procedure is one of expiry of timer for a periodic RNAU procedure and receiving RAN-initiated paging. The UE may determine not to trigger the second area update procedure, when the triggering condition of the first area update procedure is mobility condition of the UE, when the third cell belongs to an RNA area including the first cell, and when the UE receives a response message for the request message.

[111] The UE may communicate with at least one of a mobile terminal, a network or autonomous vehicles other than the UE.

[112] According to embodiments of the present invention, the UE in RRC_NACTIVE state may not perform RNAU procedure after the UE returns back to a previous serving cell, when the access to a new cell was triggered just because mobility condition of the UE. Thus, consumption of resource and time may be saved, because NAS recovery triggered by RNAU procedure is prevented.

[113] According to an embodiment of the present invention, following conditions are assumed.

[114] i) The UE in RRC_INATIVE may be camped on the cell A.

[115] ii) The UE may perform cell (re)selection, and be camped on the cell B not belonging to the previously configured RAN-based notification area.

[116] iii) RNAU update procedure may be triggered in the UE, the UE may send MSG3 (i.e. ResumeRequest message) to the network, start T300X timer and wait MSG4 from the network. A RRC Connection Activation procedure (i.e. RRC Connection Resume procedure) may be protected by a T300X timer. The UE may consider resume failure upon the T300X expiry (similar to T300 for connection establishment procedure).

[117] On the bases of this assumption, following cases may be considered.

[118] Firstly, as case A, the UE may receive reject message with wait timer as the MSG4 and then, start the wait timer. The UE may perform cell reselection while the wait timer in reject message is running. Then the UE may select a cell C and camped on the cell C.

[119] In case A, the UE shall as follow:

[120] 1) if the MSG4 is the reject message and the MSG3 (i.e. ResumeRequest message) was triggered due to either expiry of periodic RNAU timer (Periodic RNAU case) or due to RAN paging (RAN-initiated paging):

[121] 2) resend the pending AS message;

[122] 1) else if the MSG4 is the reject message and the MSG3 (i.e. ResumeRequest message) was triggered due to event-triggered RNAU (Mobility RNAU case):

[123] 2) if the cell C is equal to the cell A, (i.e. UE returns back to the previously configured RAN-based notification are):

[124] 3) remove the pending AS message (i.e., the UE does not send pending AS message);

[125] 2) else:

[126] 3) resend the pending AS message;

[127] Secondly, as case B, the UE may perform cell reselection while the T300X is running without receiving any MSG4. The UE may select a cell C and be camped on the cell C.

[128] In case B, the UE may shall as follow:

[129] 1) if the MSG3 (i.e. ResumeRequest message) was triggered due to expiry of periodic RNAU timer (Periodic RNAU case):

[130] 2) resend the pending AS message;

[131] 1) else if the MSG3 of the assumption (i.e. ResumeRequest message) was triggered due to either event-triggered RNAU (Event-triggered RNAU case) or due to RAN paging (RAN-initiated paging):

[132] - Option 1: the UE may resend the pending AS message.

[133] - Option 2: the UE may send pending AS message based on the validity check. If the cell C is equal to the cell A, (i.e. UE returns back to the previously configured RAN-based notification are), then the UE does not need to send pending AS message. Else, the UE may send the pending AS message.

[134] - Option 3: the UE may send the pending AS message with new cause value for confirming that UE is in INACTIVE with old AS context.

[135] - Option 4: the UE may send the AS message other than resume request message (e.g., new message or RRCConnectionReestablishmentRequest message).

[136] While pending AS message, more than one event have been triggered. Then, the UE shall send the pending AS message. Further, the UE may set the resumeCause to 'mt-access' which means RAN-initiated paging response, if among the events, RNAU for RAN-initiated paging was included. Or, the UE may set the resumeCause to 'RLAU', else if the events were Event-triggered RNAU and Periodic RNAU.

[137] According to embodiments of the present invention, the UE in RRC_NACTIVE state may not perform RNAU procedure after the UE returns back to a previous serving cell, when the UE recognize that the UE context is still stored in previous serving base

station because the access to a new cell is rejected, and when a triggering event of the RNAU procedure is mobility condition of the UE. Thus, consumption of resource and time may be saved, because NAS recovery triggered by RNAU procedure is prevented.

[138] FIG. 9 shows a method for performing RNAU procedure according to an embodiment of the present invention.

[139] In step S902, the UE may be camped on cell A. The UE may be in RRC_INACTIVE state. A UE context of the UE may be still stored in a base station of cell A.

[140] In step S904, the UE may perform cell reselection. The UE may reselect cell B. The cell B may not belong to a same RAN-based notification area with the cell A. That is, cell A and cell B belong to different RAN-based notification areas.

[141] In step S906, a RNAU procedure may be triggered in the UE. The RNAU procedure may be triggered due to AS triggered event. For example, The RNAU procedure may be one of triggered by expiry of timer for periodic RNAU (triggering condition 1), event-triggered RNAU (mobility based RNAU, triggering condition 2) and RAN-initiated paging (triggering condition 3). In this step, the UE may send message 3 (MSG 3) to the network, and start timer (T300X). The MSG 3 may be resume request message. Then the UE may wait for receiving MSG 4 from the network while the timer is running.

[142] In step S908, the UE may receive MSG 4 while the timer is running. The MSG 4 may be a RRC connection reject message. When the UE receives the MSG 4, the UE may recognize that the UE context is not fetched to a new base station of cell. On the other hand, the UE may not always receive the MSG 4, because cell reselection may be performed prior to receiving the MSG 4.

[143] In step S910, the UE may reselect cell C, upon receiving MSG 4.

[144] In step S912, the UE may determine whether cell C is cell A, and whether RNAU procedure is triggered by mobility condition of the UE.

[145] In step S914, when cell C is cell A, that is the UE returns back to cell A from cell B, and when the RNAU procedure in cell B was triggered by mobility of the UE, then the UE may not perform RNAU procedure in cell C (e.g. cell A).

[146] If cell C is not cell A, then the UE may perform RNAU procedure in the new cell. Further, when triggering event of RNAU in cell B is RAN-initiated paging, the UE may perform RNAU procedure because the UE has informed that there is data to be transmitted. Thus, the UE may transmit pending AS message to request RRC connection resume for cell C.

[147] In step S916, the UE may reselect cell C, before receiving MSG 4. In this case, the UE may not know whether UE context is successfully fetched to new base station of cell B or not.

[148] In step S918, the UE may resend the pending AS message, because the UE is not

sure if previous serving base station still stores the UE context or not. When the UE does not receive MSG 4, several options to trigger RNAU procedure may be considered.

[149] - Option 1: the UE may resend the pending AS message.

[150] - Option 2: the UE may send pending AS message based on the validity check. If the cell C is equal to the cell A, (i.e. UE returns back to the previously configured RAN-based notification are), then the UE does not need to send pending AS message. Else, the UE may send the pending AS message.

[151] - Option 3: the UE may send the pending AS message with new cause value for confirming that UE is in RRC_INACTIVE state with old AS context.

[152] - Option 4: the UE may send the AS message other than resume request message (e.g., new message or RRCConnectionReestablishmentRequest message).

[153] According to embodiments of the present invention, the UE in RRC_NACTIVE state may not perform RNAU procedure after the UE returns back to a previous serving cell, when the UE recognize that the UE context is still stored in previous serving base station because the access to a new cell is rejected, and when a triggering event of the RNAU procedure is mobility condition of the UE. Thus, consumption of resource and time may be saved, because NAS recovery triggered by RNAU procedure is prevented.

[154] FIG. 10 shows more detailed UE to implement an embodiment of the present invention. The present invention described above for UE side may be applied to this embodiment.

[155] A UE includes a processor 1010, a power management module 1011, a battery 1012, a display 1013, a keypad 1014, a subscriber identification module (SIM) card 1015, a memory 1020, a transceiver 1030, one or more antennas 1031, a speaker 1040, and a microphone 1041.

[156] The processor 1010 may be configured to implement proposed functions, procedures and/or methods described in this description. Layers of the radio interface protocol may be implemented in the processor 1010. The processor 1010 may include ASIC, other chipset, logic circuit and/or data processing device. The processor 1010 may be an application processor (AP). The processor 1010 may include at least one of a digital signal processor (DSP), a central processing unit (CPU), a graphics processing unit (GPU), a modem (modulator and demodulator). An example of the processor 1010 may be found in SNAPDRAGON™ series of processors made by Qualcomm®, EXYNOS™ series of processors made by Samsung®, A series of processors made by Apple®, HELIO™ series of processors made by MediaTek®, ATOM™ series of processors made by Intel® or a corresponding next generation processor.

[157] According to an embodiment of the present invention, the processor 1010 may be configured to reselect from a first cell to a second cell. The UE may be in radio

resource control (RRC) inactive state.

[158] The processor 1010 may be configured to trigger a first area update procedure in the second cell to transmit a request message. The first area update procedure may be radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE.

[159] After triggering the first area update procedure, the processor 1010 may be configured to reselect to a third cell. The third cell may be the first cell. A triggering condition of the first area update procedure may be mobility condition of the UE.

[160] The processor 1010 may be configured to determine whether to trigger a second area update procedure in the third cell, based on whether the UE receives a response message for the request message. The second area update procedure may be radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE. The response message may be a reject message in response to the request message transmitted via the second cell. The processor 1010 may be configured to determine to trigger the second area update procedure, when the UE does not receive the response message from the second cell. The processor 1010 may be configured to determine not to trigger the second area update procedure, when the UE receives the response message from the second cell, when the third cell belongs to an RNA area including the first cell, and when a triggering condition of the first area update procedure is mobility condition of the UE. The processor 1010 may be configured to determine not to trigger the second area update procedure when the UE recognizes that a UE context of the UE is still stored in a base station of the first cell. The processor 1010 may be configured to determine not to trigger the second area update procedure when the UE recognizes that a UE context of the UE is still stored in a base station of the first cell.

[161] The processor 1010 may be configured to may communicate with at least one of a mobile terminal, a network or autonomous vehicles other than the UE

[162] According to another embodiment of the present invention, the processor 1010 may be configured to reselect from a first cell to a second cell. The UE may be in radio resource control (RRC) inactive state.

[163] The processor 1010 may be configured to trigger a first area update procedure in the second cell to transmit a request message. The first area update procedure may be radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE.

[164] After triggering the first area update procedure, the processor 1010 may be configured to reselect to a third cell. The third cell may be the first cell.

[165] The processor 1010 may be configured to determine whether to trigger a second area update procedure in the third cell, based on a triggering condition of the first area

update procedure. The second area update procedure may be radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE. The triggering condition of the first area update procedure may be at least one of expiry of timer for a periodic RNAU procedure, mobility condition of the UE and receiving RAN-initiated paging. The processor 1010 may be configured to trigger the second area update procedure, when the triggering condition of the first area update procedure is one of expiry of timer for a periodic RNAU procedure and receiving RAN-initiated paging. The processor 1010 may be configured to determine not to trigger the second area update procedure, when the triggering condition of the first area update procedure is mobility condition of the UE, when the third cell belongs to an RNA area including the first cell, and when the UE receives a response message for the request message.

[166] The processor 1010 may be configured to communicate with at least one of a mobile terminal, a network or autonomous vehicles other than the UE.

[167] The power management module 1011 manages power for the processor 1010 and/or the transceiver 1030. The battery 1012 supplies power to the power management module 1011. The display 1013 outputs results processed by the processor 1010. The keypad 1014 receives inputs to be used by the processor 1010. The keypad 1014 may be shown on the display 1013. The SIM card 1015 is an integrated circuit that is intended to securely store the international mobile subscriber identity (IMSI) number and its related key, which are used to identify and authenticate subscribers on mobile telephony devices (such as mobile phones and computers). It is also possible to store contact information on many SIM cards.

[168] The memory 1020 is operatively coupled with the processor 1010 and stores a variety of information to operate the processor 1010. The memory 1020 may include ROM, RAM, flash memory, memory card, storage medium and/or other storage device. When the embodiments are implemented in software, the techniques described herein can be implemented with modules (e.g., procedures, functions, and so on) that perform the functions described herein. The modules can be stored in the memory 1020 and executed by the processor 1010. The memory 1020 can be implemented within the processor 1010 or external to the processor 1010 in which case those can be communicatively coupled to the processor 1010 via various means as is known in the art.

[169] The transceiver 1030 is operatively coupled with the processor 1010, and transmits and/or receives a radio signal. The transceiver 1030 includes a transmitter and a receiver. The transceiver 1030 may include baseband circuitry to process radio frequency signals. The transceiver 1030 controls the one or more antennas 1031 to transmit and/or receive a radio signal.

[170] The speaker 1040 outputs sound-related results processed by the processor 1010. The microphone 1041 receives sound-related inputs to be used by the processor 1010.

[171] According to embodiments of the present invention, the UE in RRC_NACTIVE state may not perform RNAU procedure after the UE returns back to a previous serving cell, when the UE recognize that the UE context is still stored in previous serving base station because the access to a new cell is rejected, and when a triggering event of the RNAU procedure is mobility condition of the UE. Thus, consumption of resource and time may be saved, because NAS recovery triggered by RNAU procedure is prevented.

[172] The present invention may be applied to various future technologies, such as AI, robots, autonomous-driving/self-driving vehicles, and/or extended reality (XR).

[173] AI refers to artificial intelligence and/or the field of studying methodology for making it. Machine learning is a field of studying methodologies that define and solve various problems dealt with in AI. Machine learning may be defined as an algorithm that enhances the performance of a task through a steady experience with any task.

[174] An artificial neural network (ANN) is a model used in machine learning. It can mean a whole model of problem-solving ability, consisting of artificial neurons (nodes) that form a network of synapses. An ANN can be defined by a connection pattern between neurons in different layers, a learning process for updating model parameters, and/or an activation function for generating an output value. An ANN may include an input layer, an output layer, and optionally one or more hidden layers. Each layer may contain one or more neurons, and an ANN may include a synapse that links neurons to neurons. In an ANN, each neuron can output a summation of the activation function for input signals, weights, and deflections input through the synapse. Model parameters are parameters determined through learning, including deflection of neurons and/or weights of synaptic connections. The hyper-parameter means a parameter to be set in the machine learning algorithm before learning, and includes a learning rate, a repetition number, a mini batch size, an initialization function, etc. The objective of the ANN learning can be seen as determining the model parameters that minimize the loss function. The loss function can be used as an index to determine optimal model parameters in learning process of ANN.

[175] Machine learning can be divided into supervised learning, unsupervised learning, and reinforcement learning, depending on the learning method. Supervised learning is a method of learning ANN with labels given to learning data. Labels are the answers (or result values) that ANN must infer when learning data is input to ANN. Unsupervised learning can mean a method of learning ANN without labels given to learning data. Reinforcement learning can mean a learning method in which an agent defined in an environment learns to select a behavior and/or sequence of actions that maximizes cumulative compensation in each state.

[176] Machine learning, which is implemented as a deep neural network (DNN) that includes multiple hidden layers among ANN, is also called deep learning. Deep learning is part of machine learning. In the following, machine learning is used to mean deep learning.

[177] A robot can mean a machine that automatically processes or operates a given task by its own abilities. In particular, a robot having a function of recognizing the environment and performing self-determination and operation can be referred to as an intelligent robot. Robots can be classified into industrial, medical, household, military, etc., depending on the purpose and field of use. The robot may include a driving unit including an actuator and/or a motor to perform various physical operations such as moving a robot joint. In addition, the movable robot may include a wheel, a break, a propeller, etc., in a driving unit, and can travel on the ground or fly in the air through the driving unit.

[178] The autonomous-driving refers to a technique of self-driving, and an autonomous vehicle refers to a vehicle that travels without a user's operation or with a minimum operation of a user. For example, autonomous-driving may include techniques for maintaining a lane while driving, techniques for automatically controlling speed such as adaptive cruise control, techniques for automatically traveling along a predetermined route, and techniques for traveling by setting a route automatically when a destination is set. The autonomous vehicle may include a vehicle having only an internal combustion engine, a hybrid vehicle having an internal combustion engine and an electric motor together, and an electric vehicle having only an electric motor, and may include not only an automobile but also a train, a motorcycle, etc. The autonomous vehicle can be regarded as a robot having an autonomous driving function.

[179] XR are collectively referred to as VR, AR, and MR. VR technology provides real-world objects and/or backgrounds only as computer graphic (CG) images, AR technology provides CG images that is virtually created on real object images, and MR technology is a computer graphics technology that mixes and combines virtual objects in the real world. MR technology is similar to AR technology in that it shows real and virtual objects together. However, in the AR technology, the virtual object is used as a complement to the real object, whereas in the MR technology, the virtual object and the real object are used in an equal manner. XR technology can be applied to HMD, head-up display (HUD), mobile phone, tablet PC, laptop, desktop, TV, digital signage. A device to which the XR technology is applied may be referred to as an XR device.

[180] FIG. 11 shows an example of an AI device to which the technical features of the present invention can be applied.

[181] The AI device 1100 may be implemented as a stationary device or a mobile device, such as a TV, a projector, a mobile phone, a smartphone, a desktop computer, a

notebook, a digital broadcasting terminal, a PDA, a PMP, a navigation device, a tablet PC, a wearable device, a set-top box (STB), a digital multimedia broadcasting (DMB) receiver, a radio, a washing machine, a refrigerator, a digital signage, a robot, a vehicle, etc.

[182] Referring to FIG. 11, the AI device 1100 may include a communication part 1110, an input part 1120, a learning processor 1130, a sensing part 1140, an output part 1150, a memory 1160, and a processor 1170.

[183] The communication part 1110 can transmit and/or receive data to and/or from external devices such as the AI devices and the AI server using wire and/or wireless communication technology. For example, the communication part 1110 can transmit and/or receive sensor information, a user input, a learning model, and a control signal with external devices. The communication technology used by the communication part 1110 may include a global system for mobile communication (GSM), a code division multiple access (CDMA), an LTE/LTE-A, a 5G, a WLAN, a Wi-Fi, Bluetooth™, radio frequency identification (RFID), infrared data association (IrDA), ZigBee, and/or near field communication (NFC).

[184] The input part 1120 can acquire various kinds of data. The input part 1120 may include a camera for inputting a video signal, a microphone for receiving an audio signal, and a user input part for receiving information from a user. A camera and/or a microphone may be treated as a sensor, and a signal obtained from a camera and/or a microphone may be referred to as sensing data and/or sensor information. The input part 1120 can acquire input data to be used when acquiring an output using learning data and a learning model for model learning. The input part 1120 may obtain raw input data, in which case the processor 1170 or the learning processor 1130 may extract input features by preprocessing the input data.

[185] The learning processor 1130 may learn a model composed of an ANN using learning data. The learned ANN can be referred to as a learning model. The learning model can be used to infer result values for new input data rather than learning data, and the inferred values can be used as a basis for determining which actions to perform. The learning processor 1130 may perform AI processing together with the learning processor of the AI server. The learning processor 1130 may include a memory integrated and/or implemented in the AI device 1100. Alternatively, the learning processor 1130 may be implemented using the memory 1160, an external memory directly coupled to the AI device 1100, and/or a memory maintained in an external device.

[186] The sensing part 1140 may acquire at least one of internal information of the AI device 1100, environment information of the AI device 1100, and/or the user information using various sensors. The sensors included in the sensing part 1140 may

include a proximity sensor, an illuminance sensor, an acceleration sensor, a magnetic sensor, a gyro sensor, an inertial sensor, an RGB sensor, an IR sensor, a fingerprint recognition sensor, an ultrasonic sensor, an optical sensor, a microphone, a light detection and ranging (LIDAR), and/or a radar.

[187] The output part 1150 may generate an output related to visual, auditory, tactile, etc. The output part 1150 may include a display unit for outputting visual information, a speaker for outputting auditory information, and/or a haptic module for outputting tactile information.

[188] The memory 1160 may store data that supports various functions of the AI device 1100. For example, the memory 1160 may store input data acquired by the input part 1120, learning data, a learning model, a learning history, etc.

[189] The processor 1170 may determine at least one executable operation of the AI device 1100 based on information determined and/or generated using a data analysis algorithm and/or a machine learning algorithm. The processor 1170 may then control the components of the AI device 1100 to perform the determined operation. The processor 1170 may request, retrieve, receive, and/or utilize data in the learning processor 1130 and/or the memory 1160, and may control the components of the AI device 1100 to execute the predicted operation and/or the operation determined to be desirable among the at least one executable operation. The processor 1170 may generate a control signal for controlling the external device, and may transmit the generated control signal to the external device, when the external device needs to be linked to perform the determined operation. The processor 1170 may obtain the intention information for the user input and determine the user's requirements based on the obtained intention information. The processor 1170 may use at least one of a speech-to-text (STT) engine for converting speech input into a text string and/or a natural language processing (NLP) engine for acquiring intention information of a natural language, to obtain the intention information corresponding to the user input. At least one of the STT engine and/or the NLP engine may be configured as an ANN, at least a part of which is learned according to a machine learning algorithm. At least one of the STT engine and/or the NLP engine may be learned by the learning processor 1130 and/or learned by the learning processor of the AI server, and/or learned by their distributed processing. The processor 1170 may collect history information including the operation contents of the AI device 1100 and/or the user's feedback on the operation, etc. The processor 1170 may store the collected history information in the memory 1160 and/or the learning processor 1130, and/or transmit to an external device such as the AI server. The collected history information can be used to update the learning model. The processor 1170 may control at least some of the components of AI device 1100 to drive an application program stored in memory 1160. Furthermore, the

processor 1170 may operate two or more of the components included in the AI device 1100 in combination with each other for driving the application program.

[190] FIG. 12 shows an example of an AI system to which the technical features of the present invention can be applied.

[191] Referring to FIG. 12, in the AI system, at least one of an AI server 1220, a robot 1210a, an autonomous vehicle 1210b, an XR device 1210c, a smartphone 1210d and/or a home appliance 1210e is connected to a cloud network 1200. The robot 1210a, the autonomous vehicle 1210b, the XR device 1210c, the smartphone 1210d, and/or the home appliance 1210e to which the AI technology is applied may be referred to as AI devices 1210a to 1210e.

[192] The cloud network 1200 may refer to a network that forms part of a cloud computing infrastructure and/or resides in a cloud computing infrastructure. The cloud network 1200 may be configured using a 3G network, a 4G or LTE network, and/or a 5G network. That is, each of the devices 1210a to 1210e and 1220 consisting the AI system may be connected to each other through the cloud network 1200. In particular, each of the devices 1210a to 1210e and 1220 may communicate with each other through a base station, but may directly communicate with each other without using a base station.

[193] The AI server 1200 may include a server for performing AI processing and a server for performing operations on big data. The AI server 1200 is connected to at least one or more of AI devices constituting the AI system, i.e. the robot 1210a, the autonomous vehicle 1210b, the XR device 1210c, the smartphone 1210d and/or the home appliance 1210e through the cloud network 1200, and may assist at least some AI processing of the connected AI devices 1210a to 1210e. The AI server 1200 can learn the ANN according to the machine learning algorithm on behalf of the AI devices 1210a to 1210e, and can directly store the learning models and/or transmit them to the AI devices 1210a to 1210e. The AI server 1200 may receive the input data from the AI devices 1210a to 1210e, infer the result value with respect to the received input data using the learning model, generate a response and/or a control command based on the inferred result value, and transmit the generated data to the AI devices 1210a to 1210e. Alternatively, the AI devices 1210a to 1210e may directly infer a result value for the input data using a learning model, and generate a response and/or a control command based on the inferred result value.

[194] Various embodiments of the AI devices 1210a to 1210e to which the technical features of the present invention can be applied will be described. The AI devices 1210a to 1210e shown in FIG. 12 can be seen as specific embodiments of the AI device 1100 shown in FIG 11.

[195] In this document, the term "/" and ?," should be interpreted to indicate "and/or." For

instance, the expression "A/B" may mean "A and/or B." Further, "A, B" may mean "A and/or B." Further, "A/B/C" may mean "at least one of A, B, and/or C." Also, "A, B, C" may mean "at least one of A, B, and/or C."

[196] Further, in the document, the term "or" should be interpreted to indicate "and/or." For instance, the expression "A or B" may comprise 1) only A, 2) only B, and/or 3) both A and B. In other words, the term "or" in this document should be interpreted to indicate "additionally or alternatively."

[197] In view of the exemplary systems described herein, methodologies that may be implemented in accordance with the disclosed subject matter have been described with reference to several flow diagrams. While for purposed of simplicity, the methodologies are shown and described as a series of steps or blocks, it is to be understood and appreciated that the claimed subject matter is not limited by the order of the steps or blocks, as some steps may occur in different orders or concurrently with other steps from what is depicted and described herein. Moreover, one skilled in the art would understand that the steps illustrated in the flow diagram are not exclusive and other steps may be included or one or more of the steps in the example flow diagram may be deleted without affecting the scope of the present disclosure.

[198] What has been described above includes examples of the various aspects. It is, of course, not possible to describe every conceivable combination of components or methodologies for purposes of describing the various aspects, but one of ordinary skill in the art may recognize that many further combinations and permutations are possible. Accordingly, the subject specification is intended to embrace all such alternations, modifications and variations that fall within the scope of the appended claims.

Claims

[Claim 1] A method performed by a user equipment (UE) in a wireless communication system, the method comprising:
reselecting from a first cell to a second cell;
triggering a first area update procedure in the second cell to transmit a request message;
after triggering the first area update procedure, reselecting to a third cell; and
determining whether to trigger a second area update procedure in the third cell, based on whether the UE receives a response message for the request message.

[Claim 2] The method of claim 1, wherein the UE is in radio resource control (RRC) inactive state.

[Claim 3] The method of claim 1, wherein the first area update procedure and the second area update procedure are radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE.

[Claim 4] The method of claim 1, wherein the response message is a reject message in response to the request message transmitted via the second cell.

[Claim 5] The method of claim 1, wherein it is determined to trigger the second area update procedure, when the UE does not receive the response message from the second cell.

[Claim 6] The method of claim 1, wherein it is determined not to trigger the second area update procedure, when the UE receives the response message from the second cell, when the third cell belongs to an RNA area including the first cell, and when a triggering condition of the first area update procedure is mobility condition of the UE.

[Claim 7] The method of claim 1, wherein the UE communicates with at least one of a mobile terminal, a network or autonomous vehicles other than the UE.

[Claim 8] A method performed by a user equipment (UE) in a wireless communication system, the method comprising:
reselecting from a first cell to a second cell,
triggering a first area update procedure in the second cell to transmit a request message;
after triggering the first area update procedure, reselecting to a third

cell; and
determining whether to trigger a second area update procedure in the third cell, based on a triggering condition of the first area update procedure.

[Claim 9] The method of claim 8, wherein the UE is in radio resource control (RRC) inactive state.

[Claim 10] The method of claim 8, wherein the first area update procedure and the second area update procedure are radio access network (RAN)-based notification area update (RNAU) procedure triggered by access stratum (AS) layer of the UE.

[Claim 11] The method of claim 8, wherein the triggering condition of the first area update procedure is at least one of expiry of timer for a periodic RNAU procedure, mobility condition of the UE and receiving RAN-initiated paging.

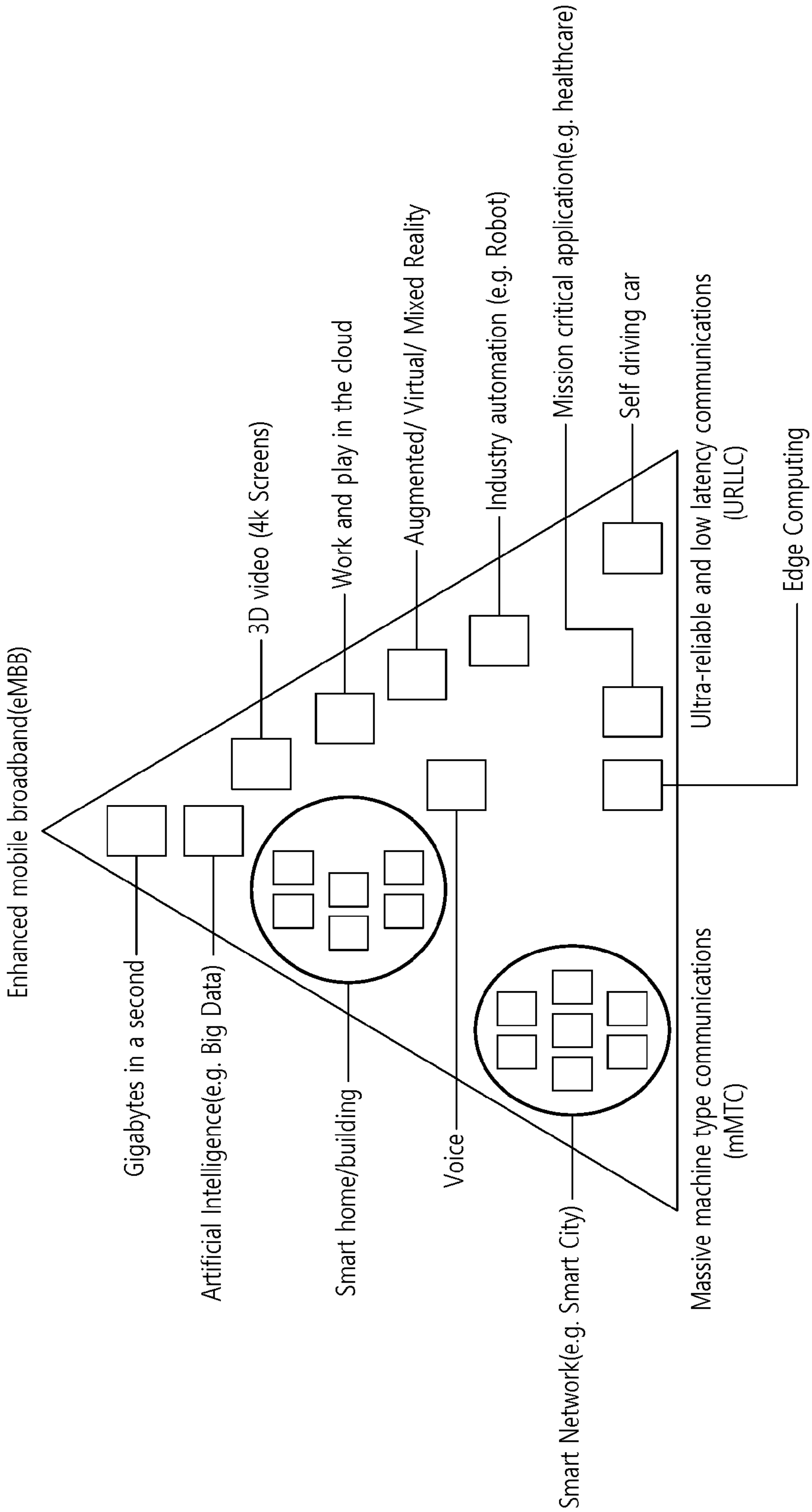
[Claim 12] The method of claim 8, wherein it is determined to trigger the second area update procedure, when the triggering condition of the first area update procedure is one of expiry of timer for a periodic RNAU procedure and receiving RAN-initiated paging.

[Claim 13] The method of claim 8, wherein it is determined not to trigger the second area update procedure, when the triggering condition of the first area update procedure is mobility condition of the UE, when the third cell belongs to an RNA area including the first cell, and when the UE receives a response message for the request message.

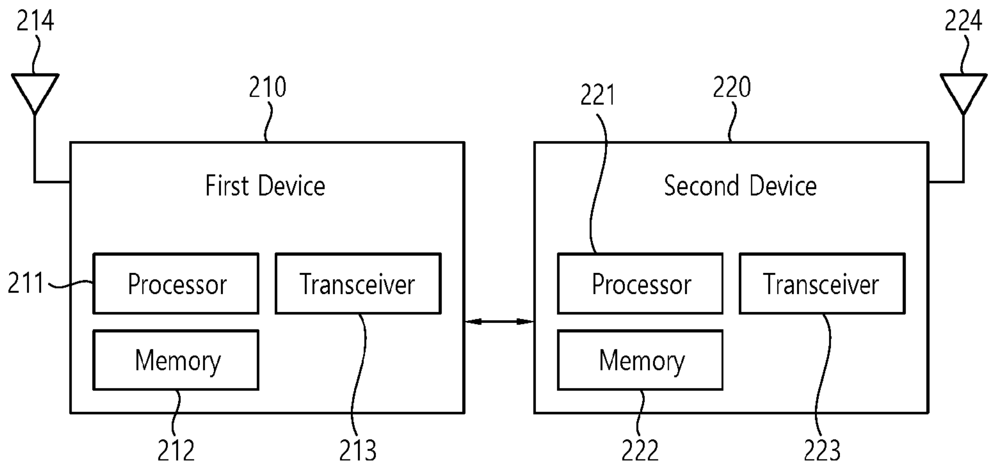
[Claim 14] The method of claim 8, wherein the UE communicates with at least one of a mobile terminal, a network or autonomous vehicles other than the UE.

[Claim 15] A processor for a wireless communication device in a wireless communication system,
wherein the processor is configured to control the wireless communication device to:
reselect from a first cell to a second cell;
trigger a first area update procedure in the second cell to transmit a request message;
after triggering the first area update procedure, reselect to a third cell; and
determine whether to trigger a second area update procedure in the third cell, based on whether the UE receives a response message for the request message.

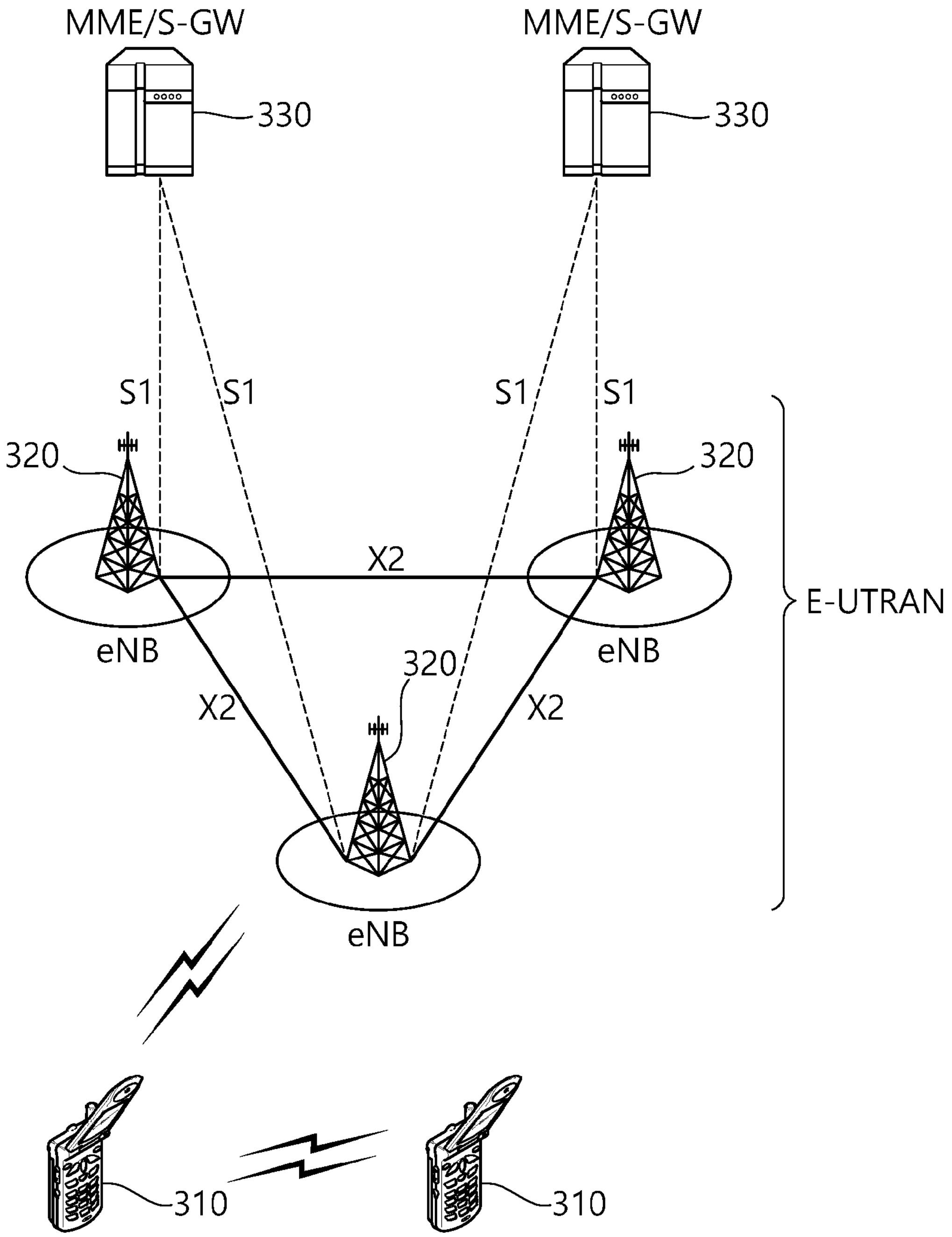
[Fig. 1]


Enhanced mobile broadband(eMBB)
Gigabytes in a second
Artificial Intelligence(e.g. Big Data)
Smart home/building
Voice
Smart Network(e.g. Smart City)
Massive machine type communications
(mMTC)
3D video (4k Screens)
Work and play in the cloud
Augmented/ Virtual/ Mixed Reality
Industry automation (e.g. Robot)
Mission critical application(e.g. healthcare)
Self driving car
Ultra-reliable and low latency communications
(URLLC)
Edge Computing

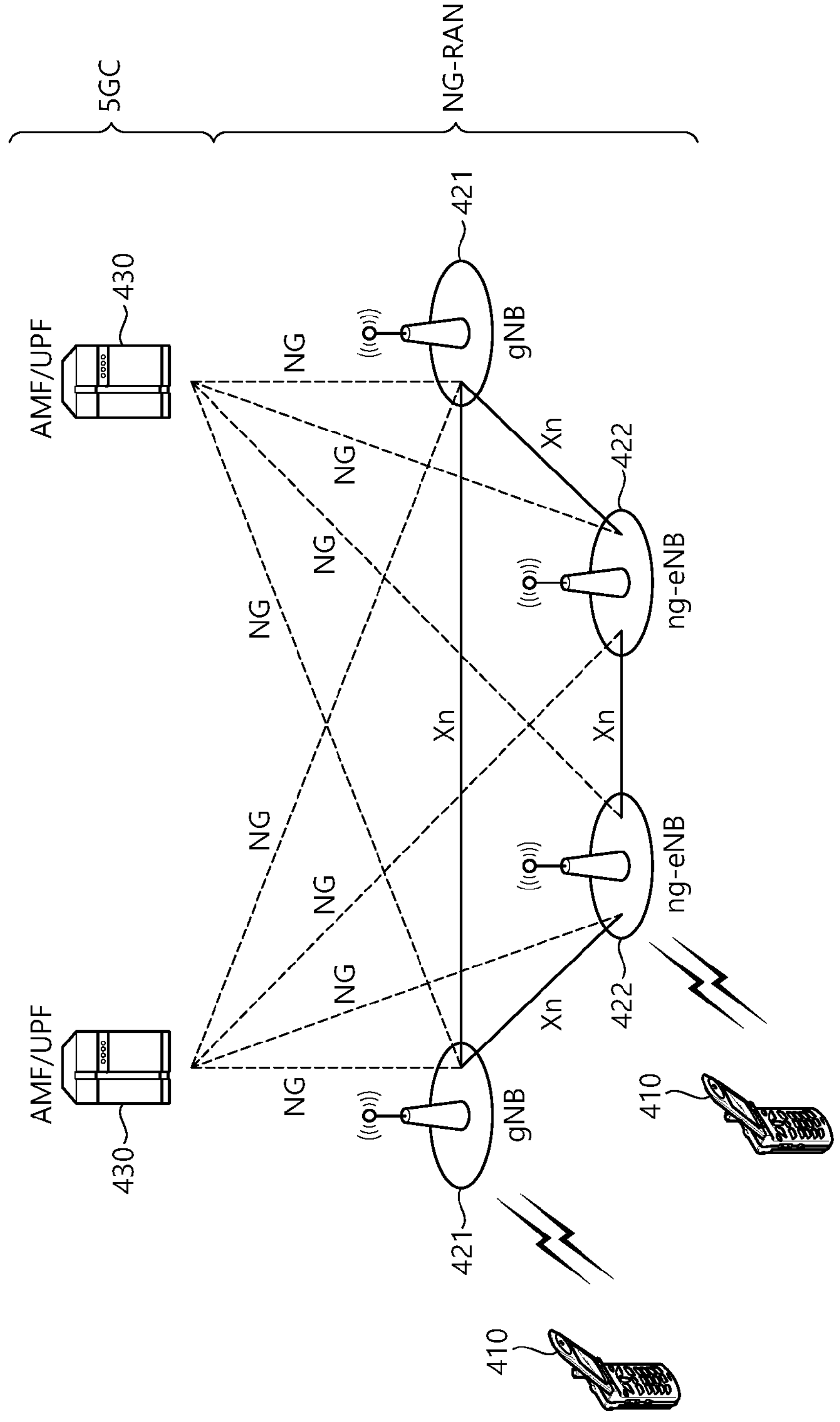
[Fig. 2]


214
210
221
220
224
First Device
Second Device
211
Processor
Transceiver
Processor
Transceiver
Memory
Memory
212
213
222
223

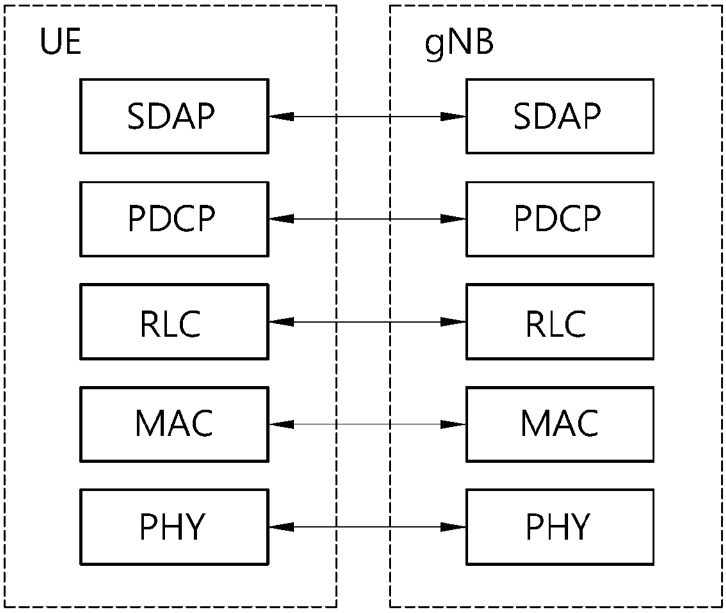
[Fig. 3]


MME/S-GW
330
MME/S-GW
330
S1
S1
S1
S1
320
320
X2
E-UTRAN
eNB
eNB
320
X2
X2
eNB
310
310

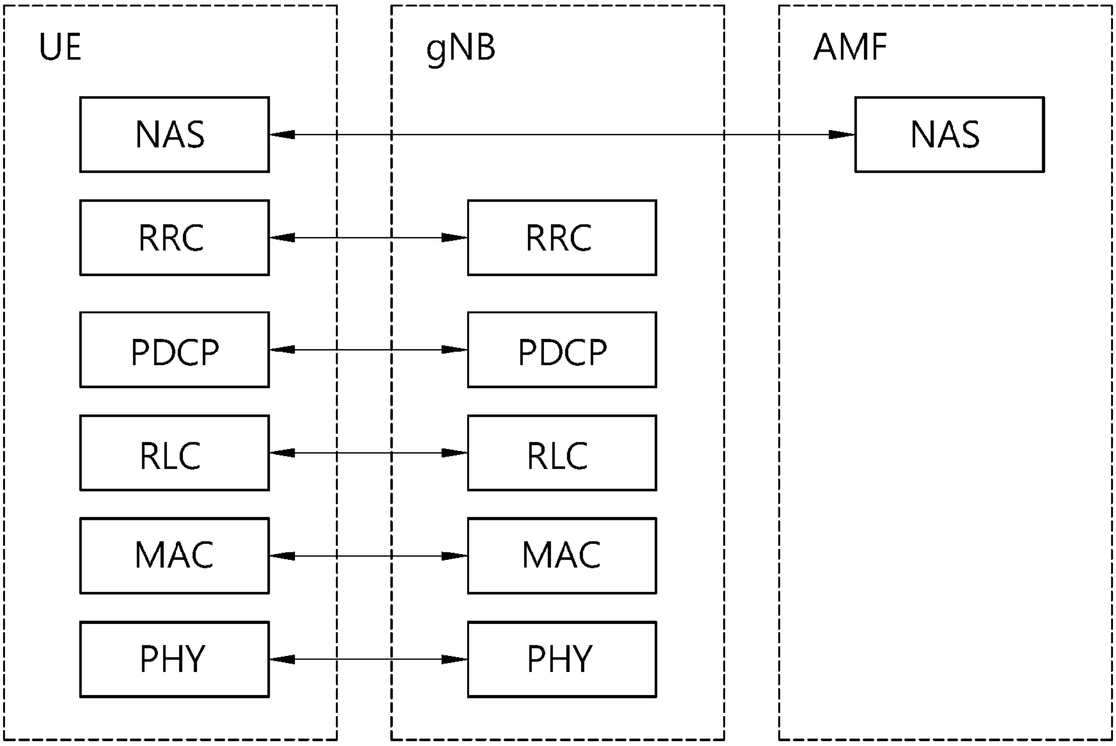
[Fig. 4]


5GC
NG-RAN
AMF/UPF
430
AMF/UPF
430
gNB
421
gNB
421
ng-eNB
422
ng-eNB
422
NG
Xn
410
410

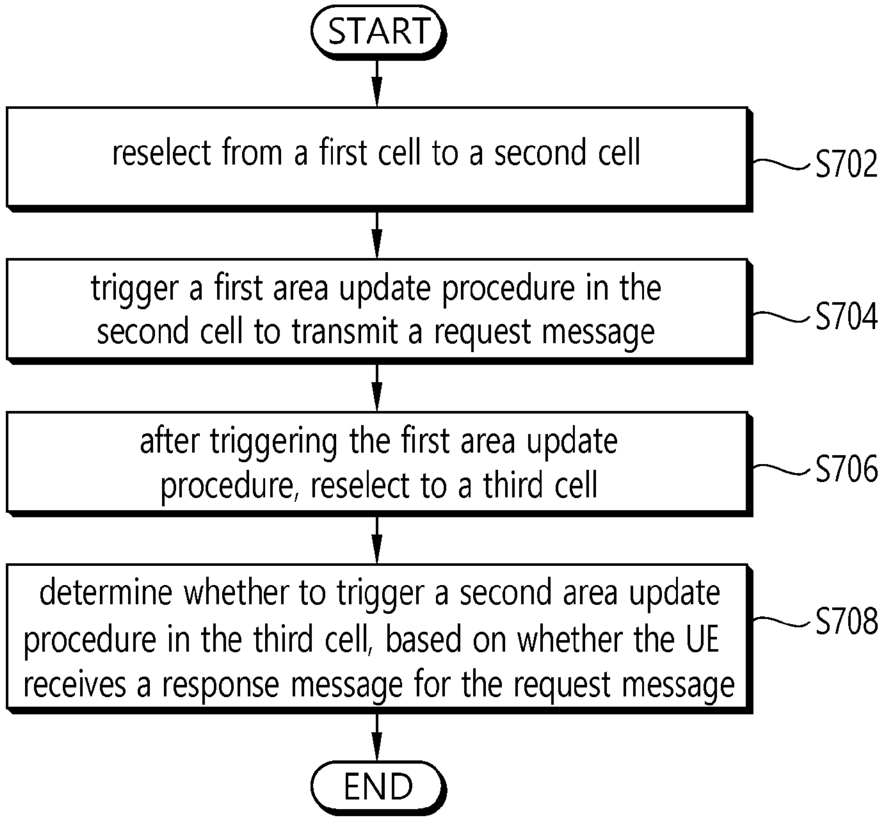
[Fig. 5]


UE
gNB
SDAP
SDAP
PDCP
PDCP
RLC
RLC
MAC
MAC
PHY
PHY

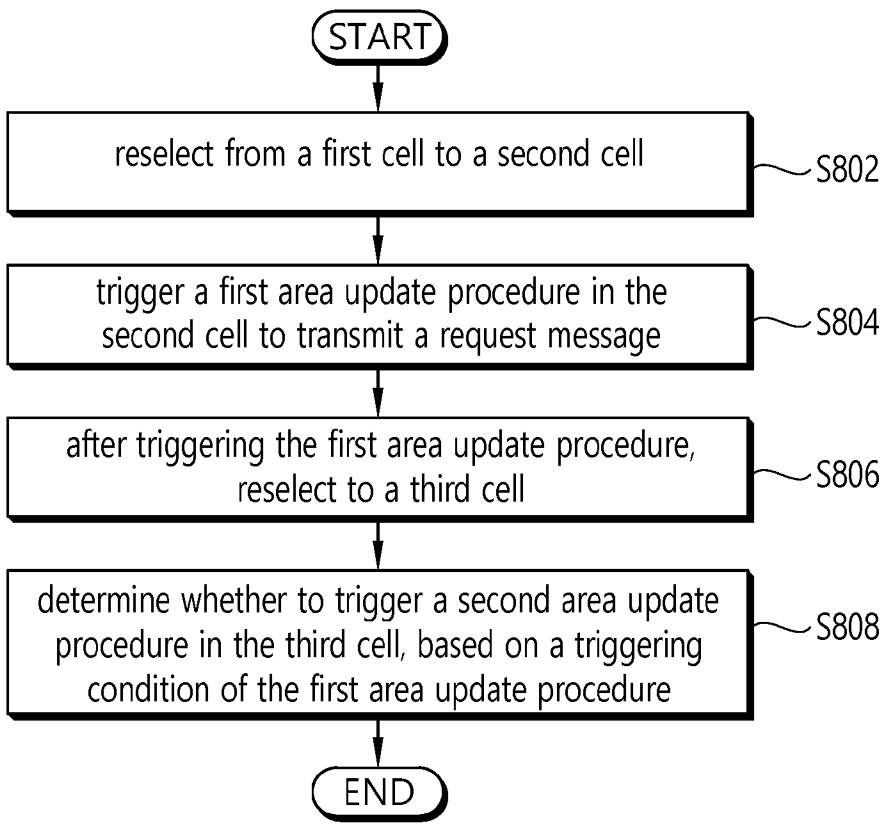
[Fig. 6]


UE
gNB
AMF
NAS
NAS
RRC
RRC
PDCP
PDCP
RLC
RLC
MAC
MAC
PHY
PHY

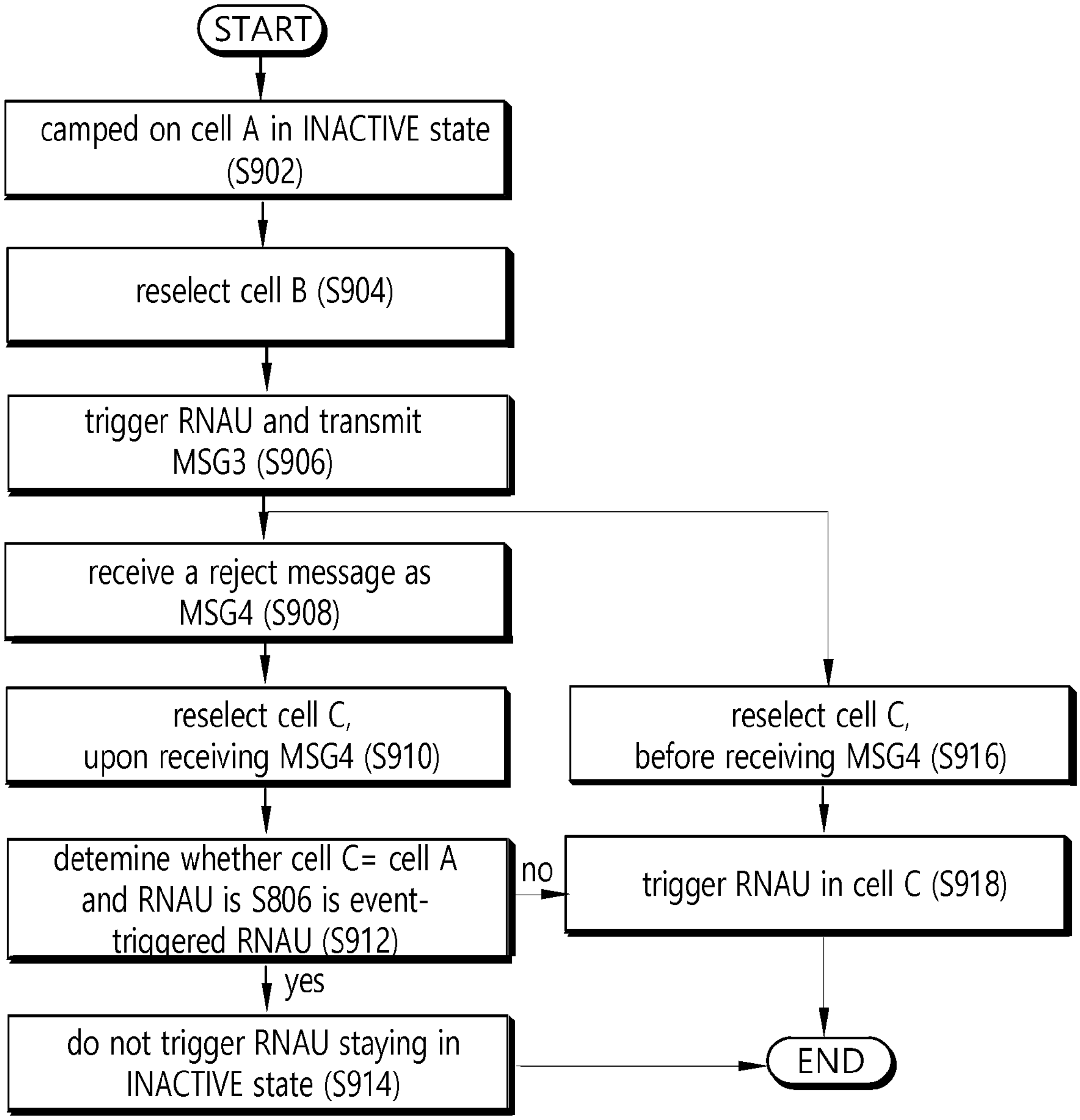
[Fig. 7]


START
reselect from a first cell to a second cell
S702
trigger a first area update procedure in the second cell to transmit a request message
S704
after triggering the first area update procedure, reselect to a third cell
S706
determine whether to trigger a second area update procedure in the third cell, based on whether the UE receives a response message for the request message
S708
END

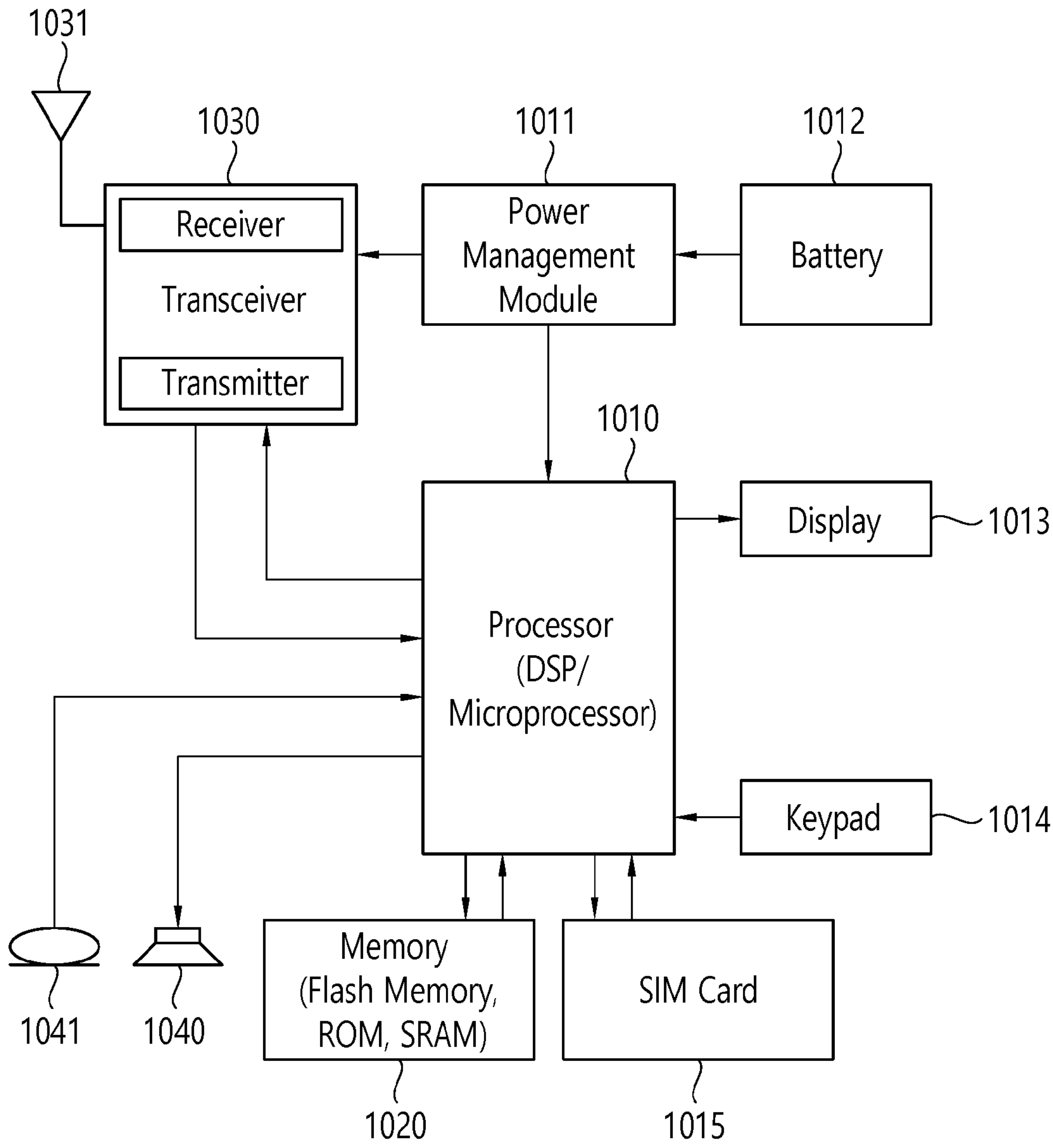
[Fig. 8]


START
reselect from a first cell to a second cell
S802
trigger a first area update procedure in the second cell to transmit a request message
S804
after triggering the first area update procedure, reselect to a third cell
S806
determine whether to trigger a second area update procedure in the third cell, based on a triggering condition of the first area update procedure
S808
END

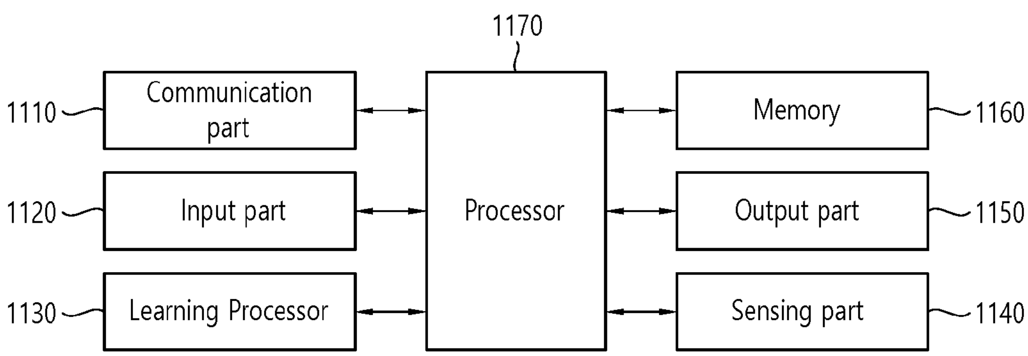
[Fig. 9]


START
camped on cell A in INACTIVE state (S902)
reselect cell B (S904)
trigger RNAU and transmit MSG3 (S906)
receive a reject message as MSG4 (S908)
reselect cell C, upon receiving MSG4 (S910)
detemine whether cell C= cell A and RNAU is S806 is event-triggered RNAU (S912)
yes
do not trigger RNAU staying in INACTIVE state (S914)
reselect cell C, before receiving MSG4 (S916)
no
trigger RNAU in cell C (S918)
END

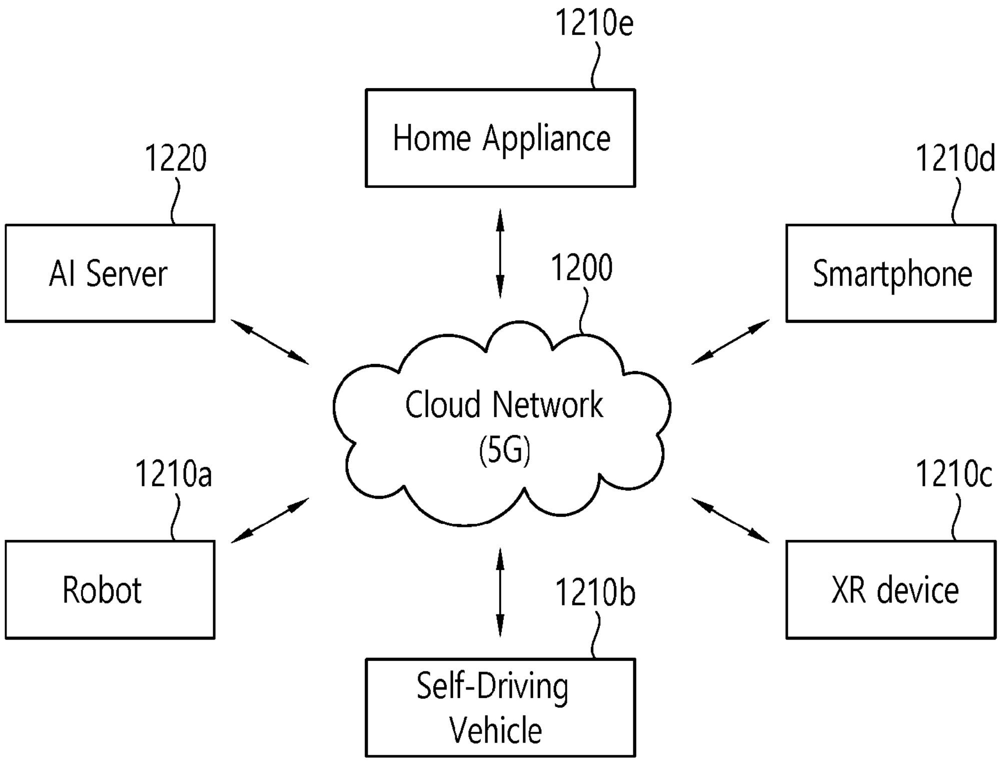
[Fig. 10]


1031
1030
1011
1012
Receiver
Transceiver
Transmitter
Power Management Module
Battery
1010
Display
1013
Processor (DSP/ Microprocessor)
Keypad
1014
Memory (Flash Memory, ROM, SRAM)
SIM Card
1041
1040
1020
1015

[Fig. 11]


1170
1110
Communication part
Processor
Memory
1160
1120
Input part
Output part
1150
1130
Learning Processor
Sensing part
1140

[Fig. 12]


1210e
Home Appliance
1220
AI Server
1210d
Smartphone
1200
Cloud Network
(5G)
1210a
Robot
1210c
XR device
1210b
Self-Driving
Vehicle

INTERNATIONAL SEARCH REPORT

International application No. **PCT/KR2019/006237**

A. CLASSIFICATION OF SUBJECT MATTER

H04W 48/02(2009.01)i, H04W 48/18(2009.01)i, H04W 76/27(2018.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W 48/02; H04W 28/02; H04W 36/00; H04W 4/22; H04W 8/08; H04W 48/18; H04W 76/27

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: reselecting, area update procedure, radio access network (RAN)-based notification area update (RANU) procedure, RRC inactive state, timer, expiry

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	'3GPP; Technical Specification Group Radio Access Network; NR; NR and NG-RAN Overall Description; Stage 2 (Release 15)', 3GPP TS 38.300 V15.1.0, 02 April 2018 See sections 9.2.1.2, 9.2.2.1-9.2.2.3, 9.2.2.5.	1-2,4-5,7-9,11-12,14-15
A		3,6,10,13
Y	US 2012-0238236 A1 (CHING-YU LIAO) 20 September 2012 See paragraph [0022]; and claims 10-13.	1-2,4-5,7-9,11-12,14-15
A	US 2015-0245258 A1 (LG ELECTRONICS INC.) 27 August 2015 See paragraph [0125]; and claims 1-4.	1-15
A	HUAWEI et al., 'Discussion on CN location Update and RNA Update for inactive state', R2-1805313, 3GPP TSG-RAN WG2 101-bis, Sanya, China, 05 April 2018 See section 2.2.	1-15
A	INTEL CORPORATION, 'Interaction between RNAU and Registration Update', R2-1805014, 3GPP TSG RAN WG2 Meeting#101 bis, Sanya, China, 06 April 2018 See section 2.	1-15

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 August 2019 (22.08.2019)	**22 August 2019 (22.08.2019)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-481-8578

Authorized officer
LEE, Seoung Young
Telephone No. +82-42-481-3535

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		CN 102638780 B	25/11/2015
		CN 102724704 A	10/10/2012
		CN 102724704 B	11/03/2015
		CN 102769839 A	07/11/2012
		CN 102769839 B	04/11/2015
		EP 2451228 A1	09/05/2012
		EP 2451228 B1	03/08/2016
		EP 2487954 A2	15/08/2012
		EP 2487954 A3	29/08/2012
		EP 2487954 B1	02/01/2019
		EP 2501191 A1	19/09/2012
		EP 2501191 B1	23/10/2013
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		JP 2012-170082 A	06/09/2012
		JP 2012-195939 A	11/10/2012
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		JP 5347009 B2	20/11/2013
		JP 5415573 B2	12/02/2014
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		KR 10-1275036 B1	17/06/2013
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