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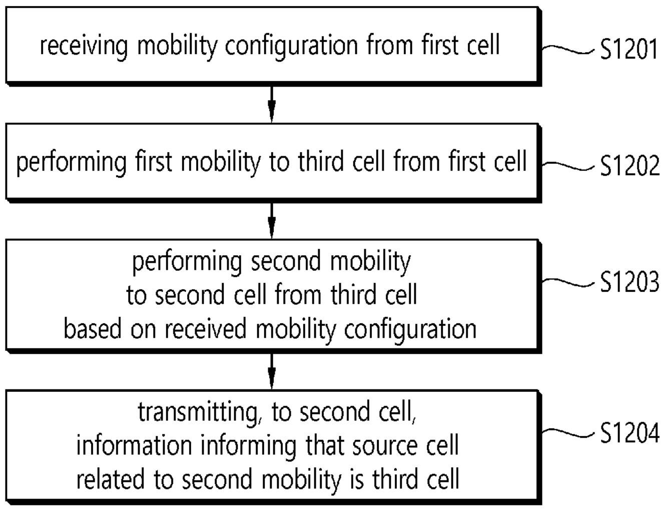
(54) **Title:** METHOD AND APPARATUS FOR MOBILITY BASED ON A STORED CONFIGURATION IN A WIRELESS COMMUNICATION SYSTEM



(57) **Abstract:** A method and apparatus for mobility based on a stored configuration in a wireless communication system is provided. A wireless device receives, from a first cell, a mobility configuration, wherein the mobility configuration includes information on a second cell. A wireless device performs a first mobility to a third cell from the first cell, wherein the third cell is different from the first cell and the second cell. A wireless device performs a second mobility to the second cell from the third cell based on the mobility configuration. A wireless device transmits, to the second cell, information informing that a source cell related to the second mobility is the third cell.

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Description

Title of Invention: METHOD AND APPARATUS FOR MOBILITY BASED ON A STORED CONFIGURATION IN A WIRELESS COMMUNICATION SYSTEM

Technical Field

[1] The present disclosure relates to a method and apparatus for mobility based on a stored configuration in a wireless communication system.

Background Art

[2] 3rd generation partnership project (3GPP) long-term evolution (LTE) is a technology for enabling high-speed packet communications. Many schemes have been proposed for the LTE objective including those that aim to reduce user and provider costs, improve service quality, and expand and improve coverage and system capacity. The 3GPP LTE requires reduced cost per bit, increased service availability, flexible use of a frequency band, a simple structure, an open interface, and adequate power consumption of a terminal as an upper-level requirement.

[3] Work has started in international telecommunication union (ITU) and 3GPP to develop requirements and specifications for new radio (NR) systems. 3GPP has to identify and develop the technology components needed for successfully standardizing the new RAT timely satisfying both the urgent market needs, and the more long-term requirements set forth by the ITU radio communication sector (ITU-R) international mobile telecommunications (IMT)-2020 process. Further, the NR should be able to use any spectrum band ranging at least up to 100 GHz that may be made available for wireless communications even in a more distant future.

[4] The NR targets a single technical framework addressing all usage scenarios, requirements and deployment scenarios including enhanced mobile broadband (eMBB), massive machine-type-communications (mMTC), ultra-reliable and low latency communications (URLLC), etc. The NR shall be inherently forward compatible.

Disclosure of Invention

Technical Problem

[5] If at least one CHO candidate cell satisfies the corresponding CHO execution condition, the UE detaches from the source gNB, applies the stored corresponding configuration for that selected candidate cell, synchronises to that candidate cell and completes the RRC handover procedure by sending RRCReconfigurationComplete message to the target gNB. The target gNB sends the HANDOVER SUCCESS message to the source gNB to inform that the UE has successfully accessed the target

cell. In return, the source gNB sends the SN STATUS TRANSFER message to the target gNB.

[6] If the subsequent CHO is supported, the UE considers the CHO configuration configured by the current serving gNB is still valid after moving to another gNB (for example, after handover from gNB1 to gNB2).

[7] If the execution condition of the CHO is met after moving to another gNB, the HO target gNB sends the HANDOVER SUCCESS message to the source gNB. However, the target gNB (for example, gNB3) considers gNB1 is the source gNB, since the CHO is prepared with gNB1, not gNB2. Then, the real source gNB (for example, gNB2) doesn't know the UE has successfully accessed the target gNB, and the target gNB cannot receive data forwarding from the source gNB.

[8] Even though the last source gNB (gNB2) tries to re-perform the preparation with the CHO target gNB, the subsequent execution condition of the CHO can be met before the preparation is completed. Then, the target gNB would consider the source gNB is the gNB which performed the handover preparation, and send the HANDOVER SUCCESS message to the wrong gNB.

[9] Therefore, studies for mobility based on a stored configuration in a wireless communication system are required.

Solution to Problem

[10] In an aspect, a method performed by a wireless device in a wireless communication system is provided. The method comprises: receiving, from a first cell, a mobility configuration, wherein the mobility configuration includes information on a second cell; performing a first mobility to a third cell from the first cell, wherein the third cell is different from the first cell and the second cell; performing a second mobility to the second cell from the third cell based on the mobility configuration; and transmitting, to the second cell, information informing that a source cell related to the second mobility is the third cell.

[11] In another aspect, an apparatus for implementing the above method is provided.

Advantageous Effects of Invention

[12] The present disclosure can have various advantageous effects.

[13] According to some embodiments of the present disclosure, a wireless device could efficiently perform the mobility based on the stored configuration.

[14] For example, the target gNB can know the right source gNB of the conditional mobility and can request the data forwarding to the right source gNB, by informing the proper source gNB during or after the conditional mobility.

[15] For example, the wireless device could save resources by performing mobility using the stored configuration. That is, the wireless device could use the stored mobility con-

figuration without deleting the stored configuration and receiving a new configuration.

[16] According to some embodiments of the present disclosure, a wireless communication system could provide an efficient solution for the mobility based on the stored configuration.

[17] Advantageous effects which can be obtained through specific embodiments of the present disclosure are not limited to the advantageous effects listed above. For example, there may be a variety of technical effects that a person having ordinary skill in the related art can understand and/or derive from the present disclosure. Accordingly, the specific effects of the present disclosure are not limited to those explicitly described herein, but may include various effects that may be understood or derived from the technical features of the present disclosure.

Brief Description of Drawings

[18] FIG. 1 shows an example of a communication system to which implementations of the present disclosure is applied.

[19] FIG. 2 shows an example of wireless devices to which implementations of the present disclosure is applied.

[20] FIG. 3 shows an example of a wireless device to which implementations of the present disclosure is applied.

[21] FIG. 4 shows another example of wireless devices to which implementations of the present disclosure is applied.

[22] FIG. 5 shows an example of UE to which implementations of the present disclosure is applied.

[23] FIGS. 6 and 7 show an example of protocol stacks in a 3GPP based wireless communication system to which implementations of the present disclosure is applied.

[24] FIG. 8 shows a frame structure in a 3GPP based wireless communication system to which implementations of the present disclosure is applied.

[25] FIG. 9 shows a data flow example in the 3GPP NR system to which implementations of the present disclosure is applied.

[26] FIGS. 10a and 10b shows an example of Intra-AMF/UPF Conditional Handover

[27] FIG. 11 shows a scenario for a mobility based on a stored configuration.

[28] FIG. 12 shows an example of a method for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure.

[29] FIG. 13 shows an example of a UE-based solution for a source cell indication for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure.

[30] FIG. 14 shows an example of a method for mobility based on a stored configuration,

according to some embodiments of the present disclosure.

[31] FIG. 15 shows an example of a network-based solution for a source cell indication for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure.

[32] FIG. 16 shows an example of a method for mobility based on a stored configuration, according to some embodiments of the present disclosure.

Mode for the Invention

[33] The following techniques, apparatuses, and systems may be applied to a variety of wireless multiple access systems. Examples of the multiple access systems include a code division multiple access (CDMA) system, a frequency division multiple access (FDMA) system, a time division multiple access (TDMA) system, an orthogonal frequency division multiple access (OFDMA) system, a single carrier frequency division multiple access (SC-FDMA) system, and a multicarrier frequency division multiple access (MC-FDMA) system. CDMA may be embodied through radio technology such as universal terrestrial radio access (UTRA) or CDMA2000. TDMA may be embodied through radio technology such as global system for mobile communications (GSM), general packet radio service (GPRS), or enhanced data rates for GSM evolution (EDGE). OFDMA may be embodied through radio technology such as institute of electrical and electronics engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, or evolved UTRA (E-UTRA). UTRA is a part of a universal mobile telecommunications system (UMTS). 3rd generation partnership project (3GPP) long term evolution (LTE) is a part of evolved UMTS (E-UMTS) using E-UTRA. 3GPP LTE employs OFDMA in DL and SC-FDMA in UL. LTE-advanced (LTE-A) is an evolved version of 3GPP LTE.

[34] For convenience of description, implementations of the present disclosure are mainly described in regards to a 3GPP based wireless communication system. However, the technical features of the present disclosure are not limited thereto. For example, although the following detailed description is given based on a mobile communication system corresponding to a 3GPP based wireless communication system, aspects of the present disclosure that are not limited to 3GPP based wireless communication system are applicable to other mobile communication systems.

[35] For terms and technologies which are not specifically described among the terms of and technologies employed in the present disclosure, the wireless communication standard documents published before the present disclosure may be referenced.

[36] In the present disclosure, "A or B" may mean "only A", "only B", or "both A and B". In other words, "A or B" in the present disclosure may be interpreted as "A and/or B". For example, "A, B or C" in the present disclosure may mean "only A", "only B",

"only C", or "any combination of A, B and C".

[37] In the present disclosure, slash (/) or comma (,) may mean "and/or". For example, "A/B" may mean "A and/or B". Accordingly, "A/B" may mean "only A", "only B", or "both A and B". For example, "A, B, C" may mean "A, B or C".

[38] In the present disclosure, "at least one of A and B" may mean "only A", "only B" or "both A and B". In addition, the expression "at least one of A or B" or "at least one of A and/or B" in the present disclosure may be interpreted as same as "at least one of A and B".

[39] In addition, in the present disclosure, "at least one of A, B and C" may mean "only A", "only B", "only C", or "any combination of A, B and C". In addition, "at least one of A, B or C" or "at least one of A, B and/or C" may mean "at least one of A, B and C".

[40] Also, parentheses used in the present disclosure may mean "for example". In detail, when it is shown as "control information (PDCCH)". "PDCCH" may be proposed as an example of "control information". In other words, "control information" in the present disclosure is not limited to "PDCCH", and "PDCCH" may be proposed as an example of "control information". In addition, even when shown as "control information (i.e., PDCCH)", "PDCCH" may be proposed as an example of "control information".

[41] Technical features that are separately described in one drawing in the present disclosure may be implemented separately or simultaneously.

[42] Although not limited thereto, various descriptions, functions, procedures, suggestions, methods and/or operational flowcharts of the present disclosure disclosed herein can be applied to various fields requiring wireless communication and/or connection (e.g., 5G) between devices.

[43] Hereinafter, the present disclosure will be described in more detail with reference to drawings. The same reference numerals in the following drawings and/or descriptions may refer to the same and/or corresponding hardware blocks, software blocks, and/or functional blocks unless otherwise indicated.

[44] FIG. 1 shows an example of a communication system to which implementations of the present disclosure is applied.

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

[46] Three main requirement categories for 5G include (1) a category of enhanced mobile broadband (eMBB), (2) a category of massive machine type communication (mMTC), and (3) a category of ultra-reliable and low latency communications (URLLC).

[47] Partial use cases may require a plurality of categories for optimization and other use cases may focus only upon one key performance indicator (KPI). 5G supports such

various use cases using a flexible and reliable method.

[48] eMBB far surpasses basic mobile Internet access and covers abundant bidirectional work and media and entertainment applications in cloud and augmented reality. Data is one of 5G core motive forces and, in a 5G era, a dedicated voice service may not be provided for the first time. In 5G, it is expected that voice will be simply processed as an application program using data connection provided by a communication system. Main causes for increased traffic volume are due to an increase in the size of content and an increase in the number of applications requiring high data transmission rate. A streaming service (of audio and video), conversational video, and mobile Internet access will be more widely used as more devices are connected to the Internet. These many application programs require connectivity of an always turned-on state in order to push real-time information and alarm for users. Cloud storage and applications are rapidly increasing in a mobile communication platform and may be applied to both work and entertainment. The cloud storage is a special use case which accelerates growth of uplink data transmission rate. 5G is also used for remote work of cloud. When a tactile interface is used, 5G demands much lower end-to-end latency to maintain user good experience. Entertainment, for example, cloud gaming and video streaming, is another core element which increases demand for mobile broadband capability. Entertainment is essential for a smartphone and a tablet in any place including high mobility environments such as a train, a vehicle, and an airplane. Other use cases are augmented reality for entertainment and information search. In this case, the augmented reality requires very low latency and instantaneous data volume.

[49] In addition, one of the most expected 5G use cases relates a function capable of smoothly connecting embedded sensors in all fields, i.e., mMTC. It is expected that the number of potential Internet-of-things (IoT) devices will reach 204 hundred million up to the year of 2020. An industrial IoT is one of categories of performing a main role enabling a smart city, asset tracking, smart utility, agriculture, and security infrastructure through 5G.

[50] URLLC includes a new service that will change industry through remote control of main infrastructure and an ultra-reliable/available low-latency link such as a self-driving vehicle. A level of reliability and latency is essential to control a smart grid, automatize industry, achieve robotics, and control and adjust a drone.

[51] 5G is a means of providing streaming evaluated as a few hundred megabits per second to gigabits per second and may complement fiber-to-the-home (FTTH) and cable-based broadband (or DOCSIS). Such fast speed is needed to deliver TV in resolution of 4K or more (6K, 8K, and more), as well as virtual reality and augmented reality. Virtual reality (VR) and augmented reality (AR) applications include almost immersive sports games. A specific application program may require a special network

configuration. For example, for VR games, gaming companies need to incorporate a core server into an edge network server of a network operator in order to minimize latency.

[52] Automotive is expected to be a new important motivated force in 5G together with many use cases for mobile communication for vehicles. For example, entertainment for passengers requires high simultaneous capacity and mobile broadband with high mobility. This is because future users continue to expect connection of high quality regardless of their locations and speeds. Another use case of an automotive field is an AR dashboard. The AR dashboard causes a driver to identify an object in the dark in addition to an object seen from a front window and displays a distance from the object and a movement of the object by overlapping information talking to the driver. In the future, a wireless module enables communication between vehicles, information exchange between a vehicle and supporting infrastructure, and information exchange between a vehicle and other connected devices (e.g., devices accompanied by a pedestrian). A safety system guides alternative courses of a behavior so that a driver may drive more safely drive, thereby lowering the danger of an accident. The next stage will be a remotely controlled or self-driven vehicle. This requires very high reliability and very fast communication between different self-driven vehicles and between a vehicle and infrastructure. In the future, a self-driven vehicle will perform all driving activities and a driver will focus only upon abnormal traffic that the vehicle cannot identify. Technical requirements of a self-driven vehicle demand ultra-low latency and ultra-high reliability so that traffic safety is increased to a level that cannot be achieved by human being.

[53] A smart city and a smart home/building mentioned as a smart society will be embedded in a high-density wireless sensor network. A distributed network of an intelligent sensor will identify conditions for costs and energy-efficient maintenance of a city or a home. Similar configurations may be performed for respective households. All of temperature sensors, window and heating controllers, burglar alarms, and home appliances are wirelessly connected. Many of these sensors are typically low in data transmission rate, power, and cost. However, real-time HD video may be demanded by a specific type of device to perform monitoring.

[54] Consumption and distribution of energy including heat or gas is distributed at a higher level so that automated control of the distribution sensor network is demanded. The smart grid collects information and connects the sensors to each other using digital information and communication technology so as to act according to the collected information. Since this information may include behaviors of a supply company and a consumer, the smart grid may improve distribution of fuels such as electricity by a method having efficiency, reliability, economic feasibility, production sustainability,

and automation. The smart grid may also be regarded as another sensor network having low latency.

[55] Mission critical application (e.g., e-health) is one of 5G use scenarios. A health part contains many application programs capable of enjoying benefit of mobile communication. A communication system may support remote treatment that provides clinical treatment in a faraway place. Remote treatment may aid in reducing a barrier against distance and improve access to medical services that cannot be continuously available in a faraway rural area. Remote treatment is also used to perform important treatment and save lives in an emergency situation. The wireless sensor network based on mobile communication may provide remote monitoring and sensors for parameters such as heart rate and blood pressure.

[56] Wireless and mobile communication gradually becomes important in the field of an industrial application. Wiring is high in installation and maintenance cost. Therefore, a possibility of replacing a cable with reconstructible wireless links is an attractive opportunity in many industrial fields. However, in order to achieve this replacement, it is necessary for wireless connection to be established with latency, reliability, and capacity similar to those of the cable and management of wireless connection needs to be simplified. Low latency and a very low error probability are new requirements when connection to 5G is needed.

[57] Logistics and freight tracking are important use cases for mobile communication that enables inventory and package tracking anywhere using a location-based information system. The use cases of logistics and freight typically demand low data rate but require location information with a wide range and reliability.

[58] Referring to FIG. 1, the communication system 1 includes wireless devices 100a to 100f, base stations (BSs) 200, and a network 300. Although FIG. 1 illustrates a 5G network as an example of the network of the communication system 1, the implementations of the present disclosure are not limited to the 5G system, and can be applied to the future communication system beyond the 5G system.

[59] The BSs 200 and the network 300 may be implemented as wireless devices and a specific wireless device may operate as a BS/network node with respect to other wireless devices.

[60] The wireless devices 100a to 100f represent devices performing communication using radio access technology (RAT) (e.g., 5G new RAT (NR)) or LTE) and may be referred to as communication/radio/5G devices. The wireless devices 100a to 100f may include, without being limited to, a robot 100a, vehicles 100b-1 and 100b-2, an extended reality (XR) device 100c, a hand-held device 100d, a home appliance 100e, an IoT device 100f, and an artificial intelligence (AI) device/server 400. For example, the vehicles may include a vehicle having a wireless communication function, an au-

tonomous driving vehicle, and a vehicle capable of performing communication between vehicles. The vehicles may include an unmanned aerial vehicle (UAV) (e.g., a drone). The XR device may include an AR/VR/Mixed Reality (MR) device and may be implemented in the form of a head-mounted device (HMD), a head-up display (HUD) mounted in a vehicle, a television, a smartphone, a computer, a wearable device, a home appliance device, a digital signage, a vehicle, a robot, etc. The hand-held device may include a smartphone, a smartpad, a wearable device (e.g., a smartwatch or a smartglasses), and a computer (e.g., a notebook). The home appliance may include a TV, a refrigerator, and a washing machine. The IoT device may include a sensor and a smartmeter.

[61] In the present disclosure, the wireless devices 100a to 100f may be called user equipments (UEs). A UE may include, for example, a cellular phone, a smartphone, a laptop computer, a digital broadcast terminal, a personal digital assistant (PDA), a portable multimedia player (PMP), a navigation system, a slate personal computer (PC), a tablet PC, an ultrabook, a vehicle, a vehicle having an autonomous traveling function, a connected car, an 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 FinTech device (or a financial device), a security device, a weather/environment device, a device related to a 5G service, or a device related to a fourth industrial revolution field.

[62] The UAV may be, for example, an aircraft aviated by a wireless control signal without a human being onboard.

[63] The VR device may include, for example, a device for implementing an object or a background of the virtual world. The AR device may include, for example, a device implemented by connecting an object or a background of the virtual world to an object or a background of the real world. The MR device may include, for example, a device implemented by merging an object or a background of the virtual world into an object or a background of the real world. The hologram device may include, for example, a device for implementing a stereoscopic image of 360 degrees by recording and reproducing stereoscopic information, using an interference phenomenon of light generated when two laser lights called holography meet.

[64] The public safety device may include, for example, an image relay device or an image device that is wearable on the body of a user.

[65] The MTC device and the IoT device may be, for example, devices that do not require direct human intervention or manipulation. For example, the MTC device and the IoT device may include smartmeters, vending machines, thermometers, smartbulbs, door locks, or various sensors.

[66] The medical device may be, for example, a device used for the purpose of di-

agnosing, treating, relieving, curing, or preventing disease. For example, the medical device may be a device used for the purpose of diagnosing, treating, relieving, or correcting injury or impairment. For example, the medical device may be a device used for the purpose of inspecting, replacing, or modifying a structure or a function. For example, the medical device may be a device used for the purpose of adjusting pregnancy. For example, the medical device may include a device for treatment, a device for operation, a device for (in vitro) diagnosis, a hearing aid, or a device for procedure.

[67] The security device may be, for example, a device installed to prevent a danger that may arise and to maintain safety. For example, the security device may be a camera, a closed-circuit TV (CCTV), a recorder, or a black box.

[68] The FinTech device may be, for example, a device capable of providing a financial service such as mobile payment. For example, the FinTech device may include a payment device or a point of sales (POS) system.

[69] The weather/environment device may include, for example, a device for monitoring or predicting a weather/environment.

[70] The wireless devices 100a to 100f may be connected to the network 300 via the BSs 200. An AI technology may be applied to the wireless devices 100a to 100f and the wireless devices 100a to 100f may be connected to the AI server 400 via the network 300. The network 300 may be configured using a 3G network, a 4G (e.g., LTE) network, a 5G (e.g., NR) network, and a beyond-5G network. Although the wireless devices 100a to 100f may communicate with each other through the BSs 200/network 300, the wireless devices 100a to 100f may perform direct communication (e.g., sidelink communication) with each other without passing through the BSs 200/network 300. For example, the vehicles 100b-1 and 100b-2 may perform direct communication (e.g., vehicle-to-vehicle (V2V)/vehicle-to-everything (V2X) communication). The IoT device (e.g., a sensor) may perform direct communication with other IoT devices (e.g., sensors) or other wireless devices 100a to 100f.

[71] Wireless communication/connections 150a, 150b and 150c may be established between the wireless devices 100a to 100f and/or between wireless device 100a to 100f and BS 200 and/or between BSs 200. Herein, the wireless communication/connections may be established through various RATs (e.g., 5G NR) such as uplink/downlink communication 150a, sidelink communication (or device-to-device (D2D) communication) 150b, inter-base station communication 150c (e.g., relay, integrated access and backhaul (IAB)), etc. The wireless devices 100a to 100f and the BSs 200/the wireless devices 100a to 100f may transmit/receive radio signals to/from each other through the wireless communication/connections 150a, 150b and 150c. For example, the wireless communication/connections 150a, 150b and 150c may transmit/receive signals through

various physical channels. To this end, at least a part of various configuration information configuring processes, various signal processing processes (e.g., channel encoding/decoding, modulation/demodulation, and resource mapping/de-mapping), and resource allocating processes, for transmitting/receiving radio signals, may be performed based on the various proposals of the present disclosure.

[72] Here, the radio communication technologies implemented in the wireless devices in the present disclosure may include narrowband internet-of-things (NB-IoT) technology for low-power communication as well as LTE, NR and 6G. For example, NB-IoT technology may be an example of low power wide area network (LPWAN) technology, may be implemented in specifications such as LTE Cat NB1 and/or LTE Cat NB2, and may not be limited to the above-mentioned names. Additionally and/or alternatively, the radio communication technologies implemented in the wireless devices in the present disclosure may communicate based on LTE-M technology. For example, LTE-M technology may be an example of LPWAN technology and be called by various names such as enhanced machine type communication (eMTC). For example, LTE-M technology may be implemented in at least one of the various specifications, such as 1) LTE Cat 0, 2) LTE Cat M1, 3) LTE Cat M2, 4) LTE non-bandwidth limited (non-BL), 5) LTE-MTC, 6) LTE Machine Type Communication, and/or 7) LTE M, and may not be limited to the above-mentioned names. Additionally and/or alternatively, the radio communication technologies implemented in the wireless devices in the present disclosure may include at least one of ZigBee, Bluetooth, and/or LPWAN which take into account low-power communication, and may not be limited to the above-mentioned names. For example, ZigBee technology may generate personal area networks (PANs) associated with small/low-power digital communication based on various specifications such as IEEE 802.15.4 and may be called various names.

[73] FIG. 2 shows an example of wireless devices to which implementations of the present disclosure is applied.

[74] Referring to FIG. 2, a first wireless device 100 and a second wireless device 200 may transmit/receive radio signals to/from an external device through a variety of RATs (e.g., LTE and NR). In FIG. 2, {the first wireless device 100 and the second wireless device 200} may correspond to at least one of {the wireless device 100a to 100f and the BS 200}, {the wireless device 100a to 100f and the wireless device 100a to 100f} and/or {the BS 200 and the BS 200} of FIG. 1.

[75] The first wireless device 100 may include one or more processors 102 and one or more memories 104 and additionally further include one or more transceivers 106 and/or one or more antennas 108. The processor(s) 102 may control the memory(s) 104 and/or the transceiver(s) 106 and may be configured to implement the descriptions,

functions, procedures, suggestions, methods and/or operational flowcharts described in the present disclosure. For example, the processor(s) 102 may process information within the memory(s) 104 to generate first information/signals and then transmit radio signals including the first information/signals through the transceiver(s) 106. The processor(s) 102 may receive radio signals including second information/signals through the transceiver(s) 106 and then store information obtained by processing the second information/signals in the memory(s) 104. The memory(s) 104 may be connected to the processor(s) 102 and may store a variety of information related to operations of the processor(s) 102. For example, the memory(s) 104 may store software code including commands for performing a part or the entirety of processes controlled by the processor(s) 102 or for performing the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts described in the present disclosure. Herein, the processor(s) 102 and the memory(s) 104 may be a part of a communication modem/circuit/chip designed to implement RAT (e.g., LTE or NR). The transceiver(s) 106 may be connected to the processor(s) 102 and transmit and/or receive radio signals through one or more antennas 108. Each of the transceiver(s) 106 may include a transmitter and/or a receiver. The transceiver(s) 106 may be interchangeably used with radio frequency (RF) unit(s). In the present disclosure, the first wireless device 100 may represent a communication modem/circuit/chip.

[76] The second wireless device 200 may include one or more processors 202 and one or more memories 204 and additionally further include one or more transceivers 206 and/or one or more antennas 208. The processor(s) 202 may control the memory(s) 204 and/or the transceiver(s) 206 and may be configured to implement the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts described in the present disclosure. For example, the processor(s) 202 may process information within the memory(s) 204 to generate third information/signals and then transmit radio signals including the third information/signals through the transceiver(s) 206. The processor(s) 202 may receive radio signals including fourth information/signals through the transceiver(s) 106 and then store information obtained by processing the fourth information/signals in the memory(s) 204. The memory(s) 204 may be connected to the processor(s) 202 and may store a variety of information related to operations of the processor(s) 202. For example, the memory(s) 204 may store software code including commands for performing a part or the entirety of processes controlled by the processor(s) 202 or for performing the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts described in the present disclosure. Herein, the processor(s) 202 and the memory(s) 204 may be a part of a communication modem/circuit/chip designed to implement RAT (e.g., LTE or NR). The transceiver(s) 206 may be connected to the processor(s) 202 and transmit and/or receive radio signals

through one or more antennas 208. Each of the transceiver(s) 206 may include a transmitter and/or a receiver. The transceiver(s) 206 may be interchangeably used with RF unit(s). In the present disclosure, the second wireless device 200 may represent a communication modem/circuit/chip.

[77] Hereinafter, hardware elements of the wireless devices 100 and 200 will be described more specifically. One or more protocol layers may be implemented by, without being limited to, one or more processors 102 and 202. For example, the one or more processors 102 and 202 may implement one or more layers (e.g., functional layers such as physical (PHY) layer, media access control (MAC) layer, radio link control (RLC) layer, packet data convergence protocol (PDCP) layer, radio resource control (RRC) layer, and service data adaptation protocol (SDAP) layer). The one or more processors 102 and 202 may generate one or more protocol data units (PDUs) and/or one or more service data unit (SDUs) according to the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure. The one or more processors 102 and 202 may generate messages, control information, data, or information according to the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure. The one or more processors 102 and 202 may generate signals (e.g., baseband signals) including PDUs, SDUs, messages, control information, data, or information according to the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure and provide the generated signals to the one or more transceivers 106 and 206. The one or more processors 102 and 202 may receive the signals (e.g., baseband signals) from the one or more transceivers 106 and 206 and acquire the PDUs, SDUs, messages, control information, data, or information according to the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure.

[78] The one or more processors 102 and 202 may be referred to as controllers, microcontrollers, microprocessors, or microcomputers. The one or more processors 102 and 202 may be implemented by hardware, firmware, software, or a combination thereof. As an example, one or more application specific integrated circuits (ASICs), one or more digital signal processors (DSPs), one or more digital signal processing devices (DSPDs), one or more programmable logic devices (PLDs), or one or more field programmable gate arrays (FPGAs) may be included in the one or more processors 102 and 202. descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure may be implemented using firmware or software and the firmware or software may be configured to include the modules, procedures, or functions. Firmware or software configured to perform the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in

the present disclosure may be included in the one or more processors 102 and 202 or stored in the one or more memories 104 and 204 so as to be driven by the one or more processors 102 and 202. The descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure may be implemented using firmware or software in the form of code, commands, and/or a set of commands.

[79] The one or more memories 104 and 204 may be connected to the one or more processors 102 and 202 and store various types of data, signals, messages, information, programs, code, instructions, and/or commands. The one or more memories 104 and 204 may be configured by read-only memories (ROMs), random access memories (RAMs), electrically erasable programmable read-only memories (EPROMs), flash memories, hard drives, registers, cash memories, computer-readable storage media, and/or combinations thereof. The one or more memories 104 and 204 may be located at the interior and/or exterior of the one or more processors 102 and 202. The one or more memories 104 and 204 may be connected to the one or more processors 102 and 202 through various technologies such as wired or wireless connection.

[80] The one or more transceivers 106 and 206 may transmit user data, control information, and/or radio signals/channels, mentioned in the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure, to one or more other devices. The one or more transceivers 106 and 206 may receive user data, control information, and/or radio signals/channels, mentioned in the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure, from one or more other devices. For example, the one or more transceivers 106 and 206 may be connected to the one or more processors 102 and 202 and transmit and receive radio signals. For example, the one or more processors 102 and 202 may perform control so that the one or more transceivers 106 and 206 may transmit user data, control information, or radio signals to one or more other devices. The one or more processors 102 and 202 may perform control so that the one or more transceivers 106 and 206 may receive user data, control information, or radio signals from one or more other devices.

[81] The one or more transceivers 106 and 206 may be connected to the one or more antennas 108 and 208 and the one or more transceivers 106 and 206 may be configured to transmit and receive user data, control information, and/or radio signals/channels, mentioned in the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure, through the one or more antennas 108 and 208. In the present disclosure, the one or more antennas may be a plurality of physical antennas or a plurality of logical antennas (e.g., antenna ports).

[82] The one or more transceivers 106 and 206 may convert received radio signals/channels, etc., from RF band signals into baseband signals in order to process received

user data, control information, radio signals/channels, etc., using the one or more processors 102 and 202. The one or more transceivers 106 and 206 may convert the user data, control information, radio signals/channels, etc., processed using the one or more processors 102 and 202 from the base band signals into the RF band signals. To this end, the one or more transceivers 106 and 206 may include (analog) oscillators and/or filters. For example, the transceivers 106 and 206 can up-convert OFDM baseband signals to a carrier frequency by their (analog) oscillators and/or filters under the control of the processors 102 and 202 and transmit the up-converted OFDM signals at the carrier frequency. The transceivers 106 and 206 may receive OFDM signals at a carrier frequency and down-convert the OFDM signals into OFDM baseband signals by their (analog) oscillators and/or filters under the control of the transceivers 102 and 202.

[83] In the implementations of the present disclosure, a UE may operate as a transmitting device in uplink (UL) and as a receiving device in downlink (DL). In the implementations of the present disclosure, a BS may operate as a receiving device in UL and as a transmitting device in DL. Hereinafter, for convenience of description, it is mainly assumed that the first wireless device 100 acts as the UE, and the second wireless device 200 acts as the BS. For example, the processor(s) 102 connected to, mounted on or launched in the first wireless device 100 may be configured to perform the UE behavior according to an implementation of the present disclosure or control the transceiver(s) 106 to perform the UE behavior according to an implementation of the present disclosure. The processor(s) 202 connected to, mounted on or launched in the second wireless device 200 may be configured to perform the BS behavior according to an implementation of the present disclosure or control the transceiver(s) 206 to perform the BS behavior according to an implementation of the present disclosure.

[84] In the present disclosure, a BS is also referred to as a node B (NB), an eNode B (eNB), or a gNB.

[85] FIG. 3 shows an example of a wireless device to which implementations of the present disclosure is applied.

[86] The wireless device may be implemented in various forms according to a use-case/service (refer to FIG. 1).

[87] Referring to FIG. 3, wireless devices 100 and 200 may correspond to the wireless devices 100 and 200 of FIG. 2 and may be configured by various elements, components, units/portions, and/or modules. For example, each of the wireless devices 100 and 200 may include a communication unit 110, a control unit 120, a memory unit 130, and additional components 140. The communication unit 110 may include a communication circuit 112 and transceiver(s) 114. For example, the communication circuit 112 may include the one or more processors 102 and 202 of FIG. 2 and/or the one or

more memories 104 and 204 of FIG. 2. For example, the transceiver(s) 114 may include the one or more transceivers 106 and 206 of FIG. 2 and/or the one or more antennas 108 and 208 of FIG. 2. The control unit 120 is electrically connected to the communication unit 110, the memory 130, and the additional components 140 and controls overall operation of each of the wireless devices 100 and 200. For example, the control unit 120 may control an electric/mechanical operation of each of the wireless devices 100 and 200 based on programs/code/commands/information stored in the memory unit 130. The control unit 120 may transmit the information stored in the memory unit 130 to the exterior (e.g., other communication devices) via the communication unit 110 through a wireless/wired interface or store, in the memory unit 130, information received through the wireless/wired interface from the exterior (e.g., other communication devices) via the communication unit 110.

[88] The additional components 140 may be variously configured according to types of the wireless devices 100 and 200. For example, the additional components 140 may include at least one of a power unit/battery, input/output (I/O) unit (e.g., audio I/O port, video I/O port), a driving unit, and a computing unit. The wireless devices 100 and 200 may be implemented in the form of, without being limited to, the robot (100a of FIG. 1), the vehicles (100b-1 and 100b-2 of FIG. 1), the XR device (100c of FIG. 1), the hand-held device (100d of FIG. 1), the home appliance (100e of FIG. 1), the IoT device (100f of FIG. 1), a digital broadcast terminal, a hologram device, a public safety device, an MTC device, a medicine device, a FinTech device (or a finance device), a security device, a climate/environment device, the AI server/device (400 of FIG. 1), the BSs (200 of FIG. 1), a network node, etc. The wireless devices 100 and 200 may be used in a mobile or fixed place according to a use-example/service.

[89] In FIG. 3, the entirety of the various elements, components, units/portions, and/or modules in the wireless devices 100 and 200 may be connected to each other through a wired interface or at least a part thereof may be wirelessly connected through the communication unit 110. For example, in each of the wireless devices 100 and 200, the control unit 120 and the communication unit 110 may be connected by wire and the control unit 120 and first units (e.g., 130 and 140) may be wirelessly connected through the communication unit 110. Each element, component, unit/portion, and/or module within the wireless devices 100 and 200 may further include one or more elements. For example, the control unit 120 may be configured by a set of one or more processors. As an example, the control unit 120 may be configured by a set of a communication control processor, an application processor (AP), an electronic control unit (ECU), a graphical processing unit, and a memory control processor. As another example, the memory 130 may be configured by a RAM, a DRAM, a ROM, a flash memory, a volatile memory, a non-volatile memory, and/or a combination thereof.

[90] FIG. 4 shows another example of wireless devices to which implementations of the present disclosure is applied.

[91] Referring to FIG. 4, wireless devices 100 and 200 may correspond to the wireless devices 100 and 200 of FIG. 2 and may be configured by various elements, components, units/portions, and/or modules.

[92] The first wireless device 100 may include at least one transceiver, such as a transceiver 106, and at least one processing chip, such as a processing chip 101. The processing chip 101 may include at least one processor, such a processor 102, and at least one memory, such as a memory 104. The memory 104 may be operably connectable to the processor 102. The memory 104 may store various types of information and/or instructions. The memory 104 may store a software code 105 which implements instructions that, when executed by the processor 102, perform the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure. For example, the software code 105 may implement instructions that, when executed by the processor 102, perform the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure. For example, the software code 105 may control the processor 102 to perform one or more protocols. For example, the software code 105 may control the processor 102 may perform one or more layers of the radio interface protocol.

[93] The second wireless device 200 may include at least one transceiver, such as a transceiver 206, and at least one processing chip, such as a processing chip 201. The processing chip 201 may include at least one processor, such a processor 202, and at least one memory, such as a memory 204. The memory 204 may be operably connectable to the processor 202. The memory 204 may store various types of information and/or instructions. The memory 204 may store a software code 205 which implements instructions that, when executed by the processor 202, perform the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure. For example, the software code 205 may implement instructions that, when executed by the processor 202, perform the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure. For example, the software code 205 may control the processor 202 to perform one or more protocols. For example, the software code 205 may control the processor 202 may perform one or more layers of the radio interface protocol.

[94] FIG. 5 shows an example of UE to which implementations of the present disclosure is applied.

[95] Referring to FIG. 5, a UE 100 may correspond to the first wireless device 100 of FIG. 2 and/or the first wireless device 100 of FIG. 4.

[96] A UE 100 includes a processor 102, a memory 104, a transceiver 106, one or more

antennas 108, a power management module 110, a battery 1112, a display 114, a keypad 116, a subscriber identification module (SIM) card 118, a speaker 120, and a microphone 122.

[97] The processor 102 may be configured to implement the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure. The processor 102 may be configured to control one or more other components of the UE 100 to implement the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure. Layers of the radio interface protocol may be implemented in the processor 102. The processor 102 may include ASIC, other chipset, logic circuit and/or data processing device. The processor 102 may be an application processor. The processor 102 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 102 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.

[98] The memory 104 is operatively coupled with the processor 102 and stores a variety of information to operate the processor 102. The memory 104 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, etc.) that perform the descriptions, functions, procedures, suggestions, methods and/or operational flowcharts disclosed in the present disclosure. The modules can be stored in the memory 104 and executed by the processor 102. The memory 104 can be implemented within the processor 102 or external to the processor 102 in which case those can be communicatively coupled to the processor 102 via various means as is known in the art.

[99] The transceiver 106 is operatively coupled with the processor 102, and transmits and/or receives a radio signal. The transceiver 106 includes a transmitter and a receiver. The transceiver 106 may include baseband circuitry to process radio frequency signals. The transceiver 106 controls the one or more antennas 108 to transmit and/or receive a radio signal.

[100] The power management module 110 manages power for the processor 102 and/or the transceiver 106. The battery 112 supplies power to the power management module 110.

[101] The display 114 outputs results processed by the processor 102. The keypad 116

receives inputs to be used by the processor 102. The keypad 16 may be shown on the display 114.

[102] The SIM card 118 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.

[103] The speaker 120 outputs sound-related results processed by the processor 102. The microphone 122 receives sound-related inputs to be used by the processor 102.

[104] FIGS. 6 and 7 show an example of protocol stacks in a 3GPP based wireless communication system to which implementations of the present disclosure is applied.

[105] In particular, FIG. 6 illustrates an example of a radio interface user plane protocol stack between a UE and a BS and FIG. 7 illustrates an example of a radio interface control plane protocol stack between a UE and a BS. The control plane refers to a path through which control messages used to manage call by a UE and a network are transported. The user plane refers to a path through which data generated in an application layer, for example, voice data or Internet packet data are transported. Referring to FIG. 6, the user plane protocol stack may be divided into Layer 1 (i.e., a PHY layer) and Layer 2. Referring to FIG. 7, the control plane protocol stack may be divided into Layer 1 (i.e., a PHY layer), Layer 2, Layer 3 (e.g., an RRC layer), and a non-access stratum (NAS) layer. Layer 1, Layer 2 and Layer 3 are referred to as an access stratum (AS).

[106] In the 3GPP LTE system, the Layer 2 is split into the following sublayers: MAC, RLC, and PDCP. In the 3GPP NR system, the Layer 2 is split into the following sublayers: MAC, RLC, PDCP and SDAP. The PHY layer offers to the MAC sublayer transport channels, the MAC sublayer offers to the RLC sublayer logical channels, the RLC sublayer offers to the PDCP sublayer RLC channels, the PDCP sublayer offers to the SDAP sublayer radio bearers. The SDAP sublayer offers to 5G core network quality of service (QoS) flows.

[107] In the 3GPP NR system, the main services and functions of the MAC sublayer include: mapping between logical channels and transport channels; multiplexing/de-multiplexing of MAC 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) (one HARQ entity per cell in case of carrier aggregation (CA)); priority handling between UEs by means of dynamic scheduling; priority handling between logical channels of one UE by means of logical channel prioritization; padding. A single MAC entity may support multiple numerologies, transmission

timings and cells. Mapping restrictions in logical channel prioritization control which numerology(ies), cell(s), and transmission timing(s) a logical channel can use.

[108] Different kinds of data transfer services are offered by MAC. To accommodate different kinds of data transfer services, multiple types of logical channels are defined, i.e., each supporting transfer of a particular type of information. 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. Control channels are used for the transfer of control plane information only, and traffic channels are used for the transfer of user plane information only. Broadcast control channel (BCCH) is a downlink logical channel for broadcasting system control information, paging control channel (PCCH) is a downlink logical channel that transfers paging information, system information change notifications and indications of ongoing public warning service (PWS) broadcasts, common control channel (CCCH) is a logical channel for transmitting control information between UEs and network and used for UEs having no RRC connection with the network, and dedicated control channel (DCCH) is a point-to-point bi-directional logical channel that transmits dedicated control information between a UE and the network and used by UEs having an RRC connection. Dedicated traffic channel (DTCH) is a point-to-point logical channel, dedicated to one UE, for the transfer of user information. A DTCH can exist in both uplink and downlink. In downlink, the following connections between logical channels and transport channels exist: BCCH can be mapped to broadcast channel (BCH); BCCH can be mapped to downlink shared channel (DL-SCH); PCCH can be mapped to paging channel (PCH); CCCH can be mapped to DL-SCH; DCCH can be mapped to DL-SCH; and DTCH can be mapped to DL-SCH. In uplink, the following connections between logical channels and transport channels exist: CCCH can be mapped to uplink shared channel (UL-SCH); DCCH can be mapped to UL-SCH; and DTCH can be mapped to UL-SCH.

[109] The RLC sublayer supports three transmission modes: transparent mode (TM), unacknowledged mode (UM), and acknowledged node (AM). The RLC configuration is per logical channel with no dependency on numerologies and/or transmission durations. In the 3GPP NR system, the main services and functions of the RLC sublayer depend on the transmission mode and include: transfer of upper layer PDUs; sequence numbering independent of the one in PDCP (UM and AM); error correction through ARQ (AM only); segmentation (AM and UM) and re-segmentation (AM only) of RLC SDUs; reassembly of SDU (AM and UM); duplicate detection (AM only); RLC SDU discard (AM and UM); RLC re-establishment; protocol error detection (AM only).

[110] In the 3GPP NR system, the main services and functions of the PDCP sublayer for the user plane include: sequence numbering; header compression and decompression

using robust header compression (ROHC); transfer of user data; reordering and duplicate detection; in-order delivery; PDCP PDU routing (in case of split bearers); retransmission of PDCP SDUs; ciphering, deciphering and integrity protection; PDCP SDU discard; PDCP re-establishment and data recovery for RLC AM; PDCP status reporting for RLC AM; duplication of PDCP PDUs and duplicate discard indication to lower layers. The main services and functions of the PDCP sublayer for the control plane include: sequence numbering; ciphering, deciphering and integrity protection; transfer of control plane data; reordering and duplicate detection; in-order delivery; duplication of PDCP PDUs and duplicate discard indication to lower layers.

[111] In the 3GPP NR system, the main services and functions of SDAP include: mapping between a QoS flow and a data radio bearer; marking QoS flow ID (QFI) in both DL and UL packets. A single protocol entity of SDAP is configured for each individual PDU session.

[112] In the 3GPP NR system, the main services and functions of the RRC sublayer include: broadcast of system information related to AS and NAS; paging initiated by 5GC or NG-RAN; establishment, maintenance and release of an RRC connection between the UE and NG-RAN; security functions including key management; establishment, configuration, maintenance and release of signaling radio bearers (SRBs) and data radio bearers (DRBs); mobility functions (including: handover and context transfer, UE cell selection and reselection and control of cell selection and reselection, inter-RAT mobility); QoS management functions; UE measurement reporting and control of the reporting; detection of and recovery from radio link failure; NAS message transfer to/from NAS from/to UE.

[113] FIG. 8 shows a frame structure in a 3GPP based wireless communication system to which implementations of the present disclosure is applied.

[114] The frame structure shown in FIG. 8 is purely exemplary and the number of subframes, the number of slots, and/or the number of symbols in a frame may be variously changed. In the 3GPP based wireless communication system, OFDM numerologies (e.g., subcarrier spacing (SCS), transmission time interval (TTI) duration) may be differently configured between a plurality of cells aggregated for one UE. For example, if a UE is configured with different SCSs for cells aggregated for the cell, an (absolute time) duration of a time resource (e.g., a subframe, a slot, or a TTI) including the same number of symbols may be different among the aggregated cells. Herein, symbols may include OFDM symbols (or CP-OFDM symbols), SC-FDMA symbols (or discrete Fourier transform-spread-OFDM (DFT-s-OFDM) symbols).

[115] Referring to FIG. 8, downlink and uplink transmissions are organized into frames. Each frame has T_f = 10ms duration. Each frame is divided into two half-frames, where each of the half-frames has 5ms duration. Each half-frame consists of 5 subframes,

where the duration T_{sf} per subframe is 1ms. Each subframe is divided into slots and the number of slots in a subframe depends on a subcarrier spacing. Each slot includes 14 or 12 OFDM symbols based on a cyclic prefix (CP). In a normal CP, each slot includes 14 OFDM symbols and, in an extended CP, each slot includes 12 OFDM symbols. The numerology is based on exponentially scalable subcarrier spacing $\triangle f = 2^u*15$ kHz.

[116] Table 1 shows the number of OFDM symbols per slot N^{slot}_{symb}, the number of slots per frame $N^{frame,u}_{slot}$, and the number of slots per subframe $N^{subframe,u}_{slot}$ for the normal CP, according to the subcarrier spacing $\triangle f = 2^u*15$ kHz.

[117] [Table 1]

u	N^{slot}_{symb}	$N^{frame,u}_{slot}$	$N^{subframe,u}_{slot}$
0	14	10	1
1	14	20	2
2	14	40	4
3	14	80	8
4	14	160	16

[118] Table 2 shows the number of OFDM symbols per slot N^{slot}_{symb}, the number of slots per frame $N^{frame,u}_{slot}$, and the number of slots per subframe $N^{subframe,u}_{slot}$ for the extended CP, according to the subcarrier spacing $\triangle f = 2^u*15$ kHz.

[119] [Table 2]

u	N^{slot}_{symb}	$N^{frame,u}_{slot}$	$N^{subframe,u}_{slot}$
2	12	40	4

[120] A slot includes plural symbols (e.g., 14 or 12 symbols) in the time domain. For each numerology (e.g., subcarrier spacing) and carrier, a resource grid of $N^{size,u}_{grid,x}*N^{RB}_{sc}$ subcarriers and $N^{subframe,u}_{symb}$ OFDM symbols is defined, starting at common resource block (CRB) $N^{start,u}_{grid}$ indicated by higher-layer signaling (e.g., RRC signaling), where $N^{size,u}_{grid,x}$ is the number of resource blocks (RBs) in the resource grid and the subscript x is DL for downlink and UL for uplink. N^{RB}_{sc} is the number of subcarriers per RB. In the 3GPP based wireless communication system, N^{RB}_{sc} is 12 generally. There is one resource grid for a given antenna port p, subcarrier spacing configuration u, and transmission direction (DL or UL). The carrier bandwidth $N^{size,u}_{grid}$ for subcarrier spacing configuration u is given by the higher-layer parameter (e.g., RRC parameter). Each element in the resource grid for the antenna port p and the subcarrier spacing configuration u is referred to as a resource element (RE) and one complex symbol may be mapped to each RE. Each RE in the resource grid is uniquely identified by an index k in the frequency domain and an index l representing a symbol location relative to a

reference point in the time domain. In the 3GPP based wireless communication system, an RB is defined by 12 consecutive subcarriers in the frequency domain.

[121] In the 3GPP NR system, RBs are classified into CRBs and physical resource blocks (PRBs). CRBs are numbered from 0 and upwards in the frequency domain for subcarrier spacing configuration *u*. The center of subcarrier 0 of CRB 0 for subcarrier spacing configuration *u* coincides with 'point A' which serves as a common reference point for resource block grids. In the 3GPP NR system, PRBs are defined within a bandwidth part (BWP) and numbered from 0 to $N^{size}_{BWP,i}-1$, where i is the number of the bandwidth part. The relation between the physical resource block n_{PRB} in the bandwidth part i and the common resource block n_{CRB} is as follows: $n_{PRB} = n_{CRB} + N^{size}_{BWP,i}$, where $N^{size}_{BWP,i}$ is the common resource block where bandwidth part starts relative to CRB 0. The BWP includes a plurality of consecutive RBs. A carrier may include a maximum of N (e.g., 5) BWPs. A UE may be configured with one or more BWPs on a given component carrier. Only one BWP among BWPs configured to the UE can active at a time. The active BWP defines the UE's operating bandwidth within the cell's operating bandwidth.

[122] The NR frequency band may be defined as two types of frequency range, i.e., FR1 and FR2. The numerical value of the frequency range may be changed. For example, the frequency ranges of the two types (FR1 and FR2) may be as shown in Table 3 below. For ease of explanation, in the frequency ranges used in the NR system, FR1 may mean "sub 6 GHz range", FR2 may mean "above 6 GHz range," and may be referred to as millimeter wave (mmW).

[123] [Table 3]

Frequency Range designation	Corresponding frequency range	Subcarrier Spacing
FR1	450MHz - 6000MHz	15, 30, 60kHz
FR2	24250MHz - 52600MHz	60, 120, 240kHz

[124] As mentioned above, the numerical value of the frequency range of the NR system may be changed. For example, FR1 may include a frequency band of 410MHz to 7125MHz as shown in Table 4 below. That is, FR1 may include a frequency band of 6GHz (or 5850, 5900, 5925 MHz, etc.) or more. For example, a frequency band of 6 GHz (or 5850, 5900, 5925 MHz, etc.) or more included in FR1 may include an unlicensed band. Unlicensed bands may be used for a variety of purposes, for example for communication for vehicles (e.g., autonomous driving).

[125] [Table 4]

Frequency Range designation	Corresponding frequency range	Subcarrier Spacing
FR1	410MHz – 7125MHz	15, 30, 60kHz
FR2	24250MHz – 52600MHz	60, 120, 240kHz

[126] In the present disclosure, the term "cell" may refer to a geographic area to which one or more nodes provide a communication system, or refer to radio resources. A "cell" as a geographic area may be understood as coverage within which a node can provide service using a carrier and a "cell" as radio resources (e.g., time-frequency resources) is associated with bandwidth which is a frequency range configured by the carrier. The "cell" associated with the radio resources is defined by a combination of downlink resources and uplink resources, for example, a combination of a DL component carrier (CC) and a UL CC. The cell may be configured by downlink resources only, or may be configured by downlink resources and uplink resources. Since DL coverage, which is a range within which the node is capable of transmitting a valid signal, and UL coverage, which is a range within which the node is capable of receiving the valid signal from the UE, depends upon a carrier carrying the signal, the coverage of the node may be associated with coverage of the "cell" of radio resources used by the node. Accordingly, the term "cell" may be used to represent service coverage of the node sometimes, radio resources at other times, or a range that signals using the radio resources can reach with valid strength at other times.

[127] In CA, two or more CCs are aggregated. A UE may simultaneously receive or transmit on one or multiple CCs depending on its capabilities. CA is supported for both contiguous and non-contiguous CCs. When CA is configured, the UE only has one RRC connection with the network. At RRC connection establishment/ re-establishment/handover, one serving cell provides the NAS mobility information, and at RRC connection re-establishment/handover, one serving cell provides the security input. This cell is referred to as the primary cell (PCell). The PCell is a cell, operating on the primary frequency, in which the UE either performs the initial connection establishment procedure or initiates the connection re-establishment procedure. Depending on UE capabilities, secondary cells (SCells) can be configured to form together with the PCell a set of serving cells. An SCell is a cell providing additional radio resources on top of special cell (SpCell). The configured set of serving cells for a UE therefore always consists of one PCell and one or more SCells. For dual connectivity (DC) operation, the term SpCell refers to the PCell of the master cell group (MCG) or the primary SCell (PSCell) of the secondary cell group (SCG). An SpCell supports PUCCH transmission and contention-based random access, and is always activated. The MCG is a group of serving cells associated with a master node, comprised of the SpCell (PCell) and optionally one or more SCells. The SCG is the subset of serving cells associated with a secondary node, comprised of the PSCell and zero or more SCells, for a UE configured with DC. For a UE in RRC_CONNECTED not configured with CA/DC, there is only one serving cell comprised of the PCell. For a UE in RRC_CONNECTED configured with CA/DC, the term "serving cells" is used

to denote the set of cells comprised of the SpCell(s) and all SCells. In DC, two MAC entities are configured in a UE: one for the MCG and one for the SCG.

[128] FIG. 9 shows a data flow example in the 3GPP NR system to which implementations of the present disclosure is applied.

[129] Referring to FIG. 9, "RB" denotes a radio bearer, and "H" denotes a header. Radio bearers are categorized into two groups: DRBs for user plane data and SRBs for control plane data. The MAC PDU is transmitted/received using radio resources through the PHY layer to/from an external device. The MAC PDU arrives to the PHY layer in the form of a transport block.

[130] In the PHY layer, the uplink transport channels UL-SCH and RACH are mapped to their physical channels PUSCH and PRACH, respectively, and the downlink transport channels DL-SCH, BCH and PCH are mapped to PDSCH, PBCH and PDSCH, respectively. In the PHY layer, uplink control information (UCI) is mapped to PUCCH, and downlink control information (DCI) is mapped to PDCCH. A MAC PDU related to UL-SCH is transmitted by a UE via a PUSCH based on an UL grant, and a MAC PDU related to DL-SCH is transmitted by a BS via a PDSCH based on a DL assignment.

[131] Hereinafter, technical features related to Conditional Reconfiguration (for example, Conditional Handover (CHO), Conditional PSCell Addition (CPA), Conditional PSCell Change (CPC)) are described. Section 5.3.5.13 of 3GPP TS 38.331 v17.2.0 may be referred.

[132] The network configures the UE with one or more candidate target SpCells in the conditional reconfiguration. The UE evaluates the condition of each configured candidate target SpCell. The UE applies the conditional reconfiguration associated with one of the target SpCells which fulfils associated execution condition. The network provides the configuration parameters for the target SpCell in the *ConditionalReconfiguration* IE.

[133] The UE performs the following actions based on a received *ConditionalReconfiguration* IE:

[134] 1> if the *ConditionalReconfiguration* contains the *condReconfigToRemoveList*:

[135] 2> perform conditional reconfiguration removal procedure;

[136] 1> if the *ConditionalReconfiguration* contains the *condReconfigToAddModList*:

[137] 2> perform conditional reconfiguration addition/modification;

[138] - Conditional reconfiguration addition/modification

[139] For each *condReconfigId* received in the *condReconfigToAddModList* IE the UE shall:

[140] 1> if an entry with the matching *condReconfigId* exists in the *condReconfigToAddModList* within the *VarConditionalReconfig*:

[141] 2> if the entry in *condReconfigToAddModList* includes an *condExecutionCond* or *condExecutionCondSCG*;

[142] 3> replace *condExecutionCond* or *condExecutionCondSCG* within the *VarConditionalReconfig* with the value received for this *condReconfigId*;

[143] 2> if the entry in *condReconfigToAddModList* includes an *condRRCReconfig*;

[144] 3> replace *condRRCReconfig* within the *VarConditionalReconfig* with the value received for this *condReconfigId*;

[145] 1> else:

[146] 2> add a new entry for this *condReconfigId* within the *VarConditionalReconfig*;

[147] 1> perform conditional reconfiguration evaluation;

[148] - Conditional reconfiguration evaluation

[149] The UE shall:

[150] 1> for each *condReconfigId* within the *VarConditionalReconfig*:

[151] 2> if the *RRCReconfiguration* within *condRRCReconfig* includes the *masterCellGroup* including the *reconfigurationWithSync*, consider the cell which has a physical cell identity matching the value indicated in the *ServingCellConfigCommon* included in the *reconfigurationWithSync* within the *masterCellGroup* in the received *condRRCReconfig* to be applicable cell;

[152] 2> if the *RRCReconfiguration* within *condRRCReconfig* includes the *secondaryCellGroup* including the *reconfigurationWithSync*, consider the cell which has a physical cell identity matching the value indicated in the *ServingCellConfigCommon* included in the *reconfigurationWithSync* within the *secondaryCellGroup* within the received *condRRCReconfig* to be applicable cell;

[153] 2> if *condExecutionCondSCG* is configured:

[154] 3> in the remainder of the procedures, consider each *measId* indicated in the *condExecutionCondSCG* as a *measId* in the *VarMeasConfig* associated with the SCG *measConfig*;

[155] 2> if *condExecutionCond* is configured:

[156] 3> if it is configured via SRB3 or configured within *nr-SCG* or within *nr- SecondaryCellGroupConfig* via SRB1:

[157] 4> in the remainder of the procedures, consider each *measId* indicated in the *condExecutionCond* as a *measId* in the *VarMeasConfig* associated with the SCG *measConfig*;

[158] 3> otherwise:

[159] 4> in the remainder of the procedures, consider each *measId* indicated in the *condExecutionCond* as a *measId* in the *VarMeasConfig* associated with the MCG *measConfig*;

[160] 2> for each *measId* included in the *measIdList* within *VarMeasConfig* indicated in the *condExecutionCond* or *condExecutionCondSCG* associated to *condReconfigId:*

[161] 3> if the *condEventId* is associated with condEventT1, and if the entry condition(s)

applicable for this event associated with the *condReconfigId*, i.e. the event corresponding with the *condEventId(s)* of the corresponding *condTriggerConfig* within *VarConditionalReconfig*, is fulfilled for the applicable cells; or

[162] 3> if the *condEventId* is associated with condEventD1, and if the entry condition(s) applicable for this event associated with the *condReconfigId*, i.e. the event corresponding with the *condEventId(s)* of the corresponding *condTriggerConfig* within *VarConditionalReconfig*, is fulfilled for the applicable cells during the corresponding *timeToTrigger* defined for this event within the *VarConditionalReconfig*; or

[163] 3> if the *condEventId* is associated with condEventA3, condEventA4 or condEventA5, and if the entry condition(s) applicable for this event associated with the *condReconfigId*, i.e. the event corresponding with the *condEventId(s)* of the corresponding *condTriggerConfig* within *VarConditionalReconfig*, is fulfilled for the applicable cells for all measurements after layer 3 filtering taken during the corresponding *timeToTrigger* defined for this event within the *VarConditionalReconfig*:

[164] 4> consider the event associated to that *measId* to be fulfilled;

[165] 3> if the *measId* for this event associated with the *condReconfigId* has been modified; or

[166] 3> if the *condEventId* is associated with condEventT1, and if the leaving condition(s) applicable for this event associated with the *condReconfigId*, i.e. the event corresponding with the *condEventId(s)* of the corresponding *condTriggerConfig* within *VarConditionalReconfig*, is fulfilled for the applicable cells; or

[167] 3> if the *condEventId* is associated with condEventD1, and if the leaving condition(s) applicable for this event associated with the *condReconfigId*, i.e. the event corresponding with the *condEventId(s)* of the corresponding *condTriggerConfig* within *VarConditionalReconfig*, is fulfilled for the applicable cells during the corresponding *timeToTrigger* defined for this event within the *VarConditionalReconfig*; or

[168] 3> if the *condEventId* is associated with condEventA3, condEventA4 or condEventA5, and if the leaving condition(s) applicable for this event associated with the *condReconfigId*, i.e. the event corresponding with the *condEventId(s)* of the corresponding *condTriggerConfig* within *VarConditionalReconfig*, is fulfilled for the applicable cells for all measurements after layer 3 filtering taken during the corresponding *timeToTrigger* defined for this event within the *VarConditionalReconfig*:

[169] 4> consider the event associated to that *measId* to be not fulfilled;

[170] 2> if event(s) associated to all *measId*(s) within *condTriggerConfig* for a target candidate cell within the stored *condRRCReconfig* are fulfilled:

[171] 3> consider the target candidate cell within the stored *condRRCReconfig*, associated to that *condReconfigId*, as a triggered cell;

[172] 3> initiate the conditional reconfiguration execution;

[173] Up to 2 *MeasId* can be configured for each *condReconfigId.* The conditional reconfiguration event of the 2 *MeasId* may have the same or different event conditions, triggering quantity, time to trigger, and triggering threshold.

[174] - Conditional reconfiguration execution

[175] The UE shall:

[176] 1> if more than one triggered cell exists:

[177] 2> select one of the triggered cells as the selected cell for conditional reconfiguration execution;

[178] 1> else:

[179] 2> consider the triggered cell as the selected cell for conditional reconfiguration execution;

[180] 1> for the selected cell of conditional reconfiguration execution:

[181] 2> apply the stored *condRRCReconfig* of the selected cell and perform the actions;

[182] If multiple NR cells are triggered in conditional reconfiguration execution, it is up to UE implementation which one to select, e.g. the UE considers beams and beam quality to select one of the triggered cells for execution.

[183] - *ReportConfigNR*

[184] The IE *ReportConfigNR* specifies criteria for triggering of an NR measurement reporting event or of a CHO, CPA or CPC event. For events labelled AN with N equal to 1, 2 and so on, measurement reporting events and CHO, CPA or CPC events are based on cell measurement results, which can either be derived based on SS/PBCH block or CSI-RS.

[185] Event A1: Serving becomes better than absolute threshold;

[186] Event A2: Serving becomes worse than absolute threshold;

[187] Event A3: Neighbour becomes amount of offset better than PCell/PSCell;

[188] Event A4: Neighbour becomes better than absolute threshold;

[189] Event A5: PCell/PSCell becomes worse than absolute threshold1 AND Neighbour/SCell becomes better than another absolute threshold2;

[190] Event A6: N eighbour becomes amount of offset better than SCell;

[191] Event D1: Distance between UE and a reference location *referenceLocation1* becomes larger than configured threshold1 *Thresh1* and distance between UE and a reference location *referenceLocation2* becomes shorter than configured threshold *Thresh2*;

[192] CondEvent A3: Conditional reconfiguration candidate becomes amount of offset better than PCell/PSCell;

[193] CondEvent A4: Conditional reconfiguration candidate becomes better than absolute threshold;

[194] CondEvent A5: PCell/PSCell becomes worse than absolute threshold1 AND Con-

ditional reconfiguration candidate becomes better than another absolute threshold2;

[195] CondEvent D1: Distance between UE and a reference location *referenceLocation1* becomes larger than configured threshold *Thresh1* and distance between UE and a reference location *referenceLocation2* of conditional reconfiguration candidate becomes shorter than configured threshold *Thresh2*;

[196] CondEvent T1: Time measured at UE becomes more than configured threshold *Thresh1* but is less than *Thresh2*;

[197] Event X1: Seving L2 U2N Relay UE becomes worse than absolute threshold1 AND NR Cell becomes better than another absolute threshold2;

[198] Event X2: Serving L2 U2N Relay UE becomes worse than absolute threshold;

[199] For event I1, measurement reporting event is based on CLI measurement results, which can either be derived based on SRS-RSRP or CLI-RSSI.

[200] Event IL: Interference becomes higher than absolute threshold.

[201] Hereinafter, technical features related to Conditional Handover are described. Section 9.2.3.4 of 3GPP TS 38.300 v17.0.0 may be referred.

[202] A Conditional Handover (CHO) is defined as a handover that is executed by the UE when one or more handover execution conditions are met. The UE starts evaluating the execution condition(s) upon receiving the CHO configuration, and stops evaluating the execution condition(s) once a handover is executed.

[203] The following principles apply to CHO:

[204] - The CHO configuration contains the configuration of CHO candidate cell(s) generated by the candidate gNB(s) and execution condition(s) generated by the source gNB.

[205] - An execution condition may consist of one or two trigger condition(s) (CHO events A3/A5). Only single RS type is supported and at most two different trigger quantities (e.g. RSRP and RSRQ, RSRP and SINR, etc.) can be configured simultaneously for the evalution of CHO execution condition of a single candidate cell.

[206] - Before any CHO execution condition is satisfied, upon reception of HO command (without CHO configuration), the UE executes the HO procedure, regardless of any previously received CHO configuration.

[207] - While executing CHO, i.e. from the time when the UE starts synchronization with target cell, UE does not monitor source cell.

[208] CHO is also supported for the IAB-MT in context of intra- and inter-donor IAB-node migration and BH RLF recovery.

[209] CHO is not supported for NG-C based handover in this release of the specification.

[210] - C-plane handling

[211] As in intra-NR RAN handover, in intra-NR RAN CHO, the preparation and execution phase of the conditional handover procedure is performed without in-

volvement of the 5GC; i.e. preparation messages are directly exchanged between gNBs. The release of the resources at the source gNB during the conditional handover completion phase is triggered by the target gNB.

[212] FIGS. 10a and 10b shows an example of Intra-AMF/UPF Conditional Handover

[213] In particular, FIGS. 10a and 10b below depicts the basic conditional handover scenario where neither the AMF nor the UPF changes.

[214] 0. The UE context within the source gNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update.

[215] 1. The source gNB configures the UE measurement procedures and the UE reports according to the measurement configuration.

[216] 2. The source gNB decides to use CHO.

[217] 3. The source gNB requests CHO for one or more candidate cells belonging to one or more candidate gNBs. A CHO request message is sent for each candidate cell.

[218] 4. Admission Control may be performed by the target gNB. Slice-aware admission control shall be performed if the slice information is sent to the target gNB. If the PDU sessions are associated with non-supported slices the target gNB shall reject such PDU Sessions.

[219] 5. The candidate gNB(s) sends CHO response (HO REQUEST ACKNOWLEDGE) including configuration of CHO candidate cell(s) to the source gNB. The CHO response message is sent for each candidate cell.

[220] 6. The source gNB sends an *RRCReconfiguration* message to the UE, containing the configuration of CHO candidate cell(s) and CHO execution condition(s).

[221] - CHO configuration of candidate cells can be followed by other reconfiguration from the source gNB.

[222] - A configuration of a CHO candidate cell cannot contain a DAPS handover configuration.

[223] 7. The UE sends an *RRCReconfigurationComplete* message to the source gNB.

[224] 7a. If early data forwarding is applied, the source gNB sends the EARLY STATUS TRANSFER message.

[225] 8. The UE maintains connection with the source gNB after receiving CHO configuration, and starts evaluating the CHO execution conditions for the candidate cell(s). If at least one CHO candidate cell satisfies the corresponding CHO execution condition, the UE detaches from the source gNB, applies the stored corresponding configuration for that selected candidate cell, synchronises to that candidate cell and completes the RRC handover procedure by sending *RRCReconfigurationComplete* message to the target gNB. The UE releases stored CHO configurations after successful completion of RRC handover procedure.

[226] 8a/b. The target gNB sends the HANDOVER SUCCESS message to the source gNB to inform that the UE has successfully accessed the target cell. In return, the source gNB sends the SN STATUS TRANSFER message following the principles described in step 7 of Intra-AMF/UPF Handover.

[227] Late data forwarding may be initiated as soon as the source gNB receives the HANDOVER SUCCESS message.

[228] 8c. The source gNB sends the HANDOVER CANCEL message toward the other signalling connections or other candidate target gNBs, if any, to cancel CHO for the UE.

[229] - U-plane handling

[230] The U-plane handling for Conditional Handover follows the same principles for DAPS handover, if early data forwarding is applied, except that, in case of Full Configuration, HFN and PDCP SN are reset in the target gNB after the SN assignment is handed over to the target gNB. If late data forwarding is applied, the U-plane handling follows the RLC-AM or RLC-UM bearer principles.

[231] - Data Forwarding

[232] If late data forwarding is applied, the source NG-RAN node initiates data forwarding once it knows which target NG-RAN node the UE has successfully accessed. In that case the behavior of the Conditional Handover data forwarding follows the same behavior for the intra-system handover data forwarding, except the behavior for DRBs configured with DAPS handover.

[233] If early data forwarding is applied instead, the source NG-RAN node initiates data forwarding before the UE executes the handover, to a candidate target node of interest. The behavior of early data forwarding for the Conditional Handover follows the same principles for DRBs configured with DAPS handover in the intra-system handover.

[234] Meanwhile, if at least one CHO candidate cell satisfies the corresponding CHO execution condition, the UE detaches from the source gNB, applies the stored corresponding configuration for that selected candidate cell, synchronises to that candidate cell and completes the RRC handover procedure by sending RRCReconfigurationComplete message to the target gNB. The target gNB sends the HANDOVER SUCCESS message to the source gNB to inform that the UE has successfully accessed the target cell. In return, the source gNB sends the SN STATUS TRANSFER message to the target gNB.

[235] FIG. 11 shows a scenario for a mobility based on a stored configuration.

[236] If the subsequent CHO is supported, the UE considers the CHO configuration configured by the current serving gNB is still valid after moving to another gNB (for example, after handover from gNB1 to gNB2).

[237] If the execution condition of the CHO is met after moving to another gNB, the HO

target gNB sends the HANDOVER SUCCESS message to the source gNB. However, the target gNB (for example, gNB3) considers gNB1 is the source gNB, since the CHO is prepared with gNB1, not gNB2. Then, the real source gNB (for example, gNB2) doesn't know the UE has successfully accessed the target gNB, and the target gNB cannot receive data forwarding from the source gNB.

[238] Even though the last source gNB (gNB2) tries to re-perform the preparation with the CHO target gNB, the subsequent execution condition of the CHO can be met before the preparation is completed. Then, the target gNB would consider the source gNB is the gNB which performed the handover preparation, and send the HANDOVER SUCCESS message to the wrong gNB.

[239] Therefore, studies for mobility based on a stored configuration in a wireless communication system are required.

[240] Hereinafter, a method for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure, will be described with reference to the following drawings.

[241] The following drawings are created to explain specific embodiments of the present disclosure. The names of the specific devices or the names of the specific signals/messages/fields shown in the drawings are provided by way of example, and thus the technical features of the present disclosure are not limited to the specific names used in the following drawings. Herein, a wireless device may be referred to as a user equipment (UE).

[242] FIG. 12 shows an example of a method for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure.

[243] In particular, FIG. 12 shows an example of a method performed by a wireless device in a wireless communication system.

[244] In step S1201, a wireless device may receive, from a first cell, a mobility configuration.

[245] For example, the mobility configuration may include information on a second cell.

[246] For example, the mobility configuration may include a configuration of the second cell and an execution condition for a mobility to the second cell.

[247] For example, the mobility configuration received from the first cell may be valid after performing the first mobility to the third cell.

[248] In step S1202, a wireless device may perform a first mobility to a third cell from the first cell, wherein the third cell is different from the first cell and the second cell.

[249] For example, the first mobility may include a handover (HO), a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[250] For example, the wireless device may receive another configuration related to the third cell and perform the first mobility to the third cell based on the other configuration.

[251] For example, the wireless device may perform a handover to the third cell based on receiving a handover command.

[252] For example, the wireless device may perform an LTM to the third cell based on receiving a cell switch command for the LTM. For example, the lower layer triggered mobility (LTM) is triggered by an L1 layer (that is, a PHY layer) and/or an L2 layer (that is, a MAC layer).

[253] In step S1203, a wireless device may perform a second mobility to the second cell from the third cell based on the mobility configuration.

[254] For example, the second mobility may include a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[255] For example, the wireless device may store the mobility configuration, received from step S1201. The wireless device may apply the stored mobility configuration for the second mobility.

[256] For example, the wireless device may perform measurements for the second cell after performing the first mobility to the third cell. If the second cell satisfies the execution condition for the mobility to the second cell, the wireless device may perform the second mobility (for example, a CHO, a CPC, and/or a conditional LTM) to the third cell based on the stored configuration.

[257] For other example, the wireless device may receive a cell switch command for the LTM. The wireless device may perform the second mobility (for example, an LTM) based on the stored configuration based on the cell switch command.

[258] In step S1204, a wireless device may transmit, to the second cell, information informing that a source cell related to the second mobility is the third cell.

[259] For example, the information may include an identity (ID) of the third cell.

[260] For example, the information may include an ID of a next generation Node B (gNB) which serves the third cell.

[261] For example, the information may be included in a radio resource control (RRC) reconfiguration message.

[262] For example, the first cell may belong to a first gNB, the second cell may belong to a second gNB, and the third cell may belong to a third gNB. In this case, the first gNB may be different from the second gNB and the third gNB. The second gNB may be different from the third gNB.

[263] For example, the wireless device may be in communication with at least one of a user equipment, a network, or an autonomous vehicle other than the wireless device.

[264] Hereinafter, technical features related to a source cell indication for conditional mobility are described.

[265] **Alternative 1: UE-based solution**

[266] According to the present disclosure, if at least one candidate cell for conditional mobility satisfies the execution condition, UE applies the stored configuration of the candidate cell and informs the candidate cell/gNB (=new serving cell/gNB) of the identity of the mobility source cell/gNB (=previous serving cell/gNB).

[267] If PCell is changed by conditional mobility, the UE informs the mobility target PCell/gNB of the cell/gNB identity of the mobility source PCell.

[268] UE may include the cell/gNB identity of the mobility source cell in RRC reconfiguration complete message and transmits the message to the mobility target cell/gNB.

[269] The mobility target cell/gNB sends the HANDOVER SUCCESS message to the cell/gNB indicated by the UE, e.g. via RRC reconfiguration complete message.

[270] The conditional mobility configuration includes at least a target cell configuration and an associated execution condition.

[271] The conditional mobility may be a conditional handover (CHO) or a conditional PSCell change (CPC).

[272] UE informs the mobility target cell of the cell/gNB identity of the mobility source cell, if the mobility source cell is not identical with the cell which configured the conditional mobility.

[273] UE informs the mobility target cell of the cell/gNB identity of the mobility source cell, if the conditional mobility is not configured by the mobility source cell.

[274] UE inform the mobility target cell of the cell/gNB identity of the mobility source cell, if the cell which configured the conditional mobility and the mobility source cell belong to different gNBs.

[275] UE informs the mobility target cell of the cell/gNB identity of the mobility source cell, if the configured conditional mobility supports the subsequent conditional mobility, i.e. it is valid even after handover from a cell which configured the conditional mobility.

[276] UE doesn't inform the mobility target cell of the cell/gNB identity of the mobility source cell, if the conditional mobility is configured by the mobility source cell.

[277] UE doesn't inform the mobility target cell of the cell/gNB identity of the mobility source cell, if the cell which configured the conditional mobility and the mobility source cell belong to the same gNB.

[278] UE doesn't inform the mobility target cell of the cell/gNB identity of the mobility source cell, if the configured conditional mobility doesn't support the subsequent conditional mobility, i.e. it is not valid after handover from a cell which configured the conditional mobility.

[279] FIG. 13 shows an example of a UE-based solution for a source cell indication for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure.

[280] In step S1301, a UE receives a conditional mobility configuration.

[281] UE receives a conditional handover configuration from network while PCell is cell 'a' which belongs to gNB 'A'. The conditional handover configuration includes an execution condition and a target cell configuration for cell 'b' which belongs to gNB 'B'. The network informs the UE that the conditional handover configuration is valid even after handover to another cell, i.e. subsequent CHO is supported for the conditional handover configuration.

[282] In step S1302, a UE performs handover to cell 'c'

[283] UE is handed over to cell 'c' which belongs to gNB 'C'.

[284] In step S1303, a UE evaluates whether the execution condition is met.

[285] Since the conditional handover configuration configured by cell 'a' is still valid after handover to cell 'c', UE performs measurement for the target cell 'b' and evaluates whether the measurement results of cell 'b' satisfies the associated execution condition.

[286] In step S1304, a UE applies the target cell configuration.

[287] If the execution condition is met for the target cell 'b', UE initiates the conditional reconfiguration execution. I.e. UE applies the configuration of cell 'b' received in step1.

[288] In step S1305, a UE informs the target gNB, i.e. new serving gNB, of the cell identity/gNB identity of the previous serving cell.

[289] UE may determine whether to inform the target gNB of the source cell/gNB identity.

[290] UE informs the target gNB, i.e. cell 'b', that the previous PCell is 'c' (or previous gNB is 'C') via RRC reconfiguration complete message.

[291] In step S1306, the target gNB sends HANDOVER SUCCESS to the gNB indicated by the UE.

[292] gNB 'B' performed the handover preparation with gNB 'A'. I.e. gNB 'B' received HANDOVER REQUEST from gNB 'A' and transmitted HANDOVER REQUEST ACK to gNB 'A'. However, gNB 'B' sends the HANDOVER SUCCESS to gNB 'C', not gNB 'A', since UE indicated that the mobility source is gNB 'C'.

[293] FIG. 14 shows an example of a method for mobility based on a stored configuration, according to some embodiments of the present disclosure.

[294] gNB A may prepare mobility based on a pre-configuration for a UE. gNB A may transmit a handover request to gNB B. gNB A may receive a handover request from gNB B. gNB A may transmit a handover request to gNB C. gNB A may receive a handover request from gNB C.

[295] gNB A may transmit, to the UE, an RRC reconfiguration including a mobility configuration (for example, a pre-configuration for mobility such as a CHO con-

figuration). gNB A may receive, from the UE, an RRC reconfiguration complete message.

[296] The UE may perform a mobility from gNB A to gNB B. After the mobility, the UE may transmit an RRC reconfiguration complete message to gNB B. Then, gNB B may transmit, to gNB A, a handover success message. gNB B may receive, from gNB A, an SN status transfer message.

[297] After the mobility to gNB B from gNB A, the UE keep the mobility configuration (for example, a CHO configuration to gNB C). Then, the UE evaluate whether cell C which belongs to gNB C satisfies the execution condition.

[298] The UE may perform a mobility based on the kept mobility configuration. For example, when the cell C satisfies the execution condition, the UE may perform the mobility to the cell C based on the stored CHO configuration. The UE may transmit, to gNB C (that is, the cell C), an RRC reconfiguration complete message including information on a source cell related to the mobility (for example, gNB ID or cell ID).

[299] In this case, the target cell (that is, gNB C) could transmit the handover success message to gNB B. Then, gNB C may receive an SN status transfer message from gNB B.

[300] **Alternative 2: NW-based solution**

[301] If the first gNB receives HANDOVER SUCCESS for a conditional mobility and if the first gNB is not source gNB of the UE of the conditional mobility, the first gNB forward the HANDOVER SUCCESS to the second gNB to which the first gNB sent SN STATUS TRANSFER for the UE.

[302] FIG. 15 shows an example of a network-based solution for a source cell indication for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure.

[303] In step S1501, gNB performs handover preparation with neighbour gNBs.

[304] gNB A performs handover preparation with gNB B and C.

[305] In step S1502, gNB configures conditional mobility to an UE.

[306] gNB A configures two conditional mobility configuration to an UE. The target cell of the conditional mobility belongs to gNB B and gNB C, respectively.

[307] In step S1503, gNB receives HANDOVER SUCCESS.

[308] gNB A receives HANDOVER SUCCESS from gNB B for the UE. gNB considers the UE is handed over to gNB B.

[309] In step S1504, gNB transmits SN STSTUS TRANSFER.

[310] For the UE, gNB A transmits SN STSTUS TRANSFER to gNB B and initiating data forwarding to gNB B if needed.

[311] In step S1505, gNB receives HANDOVER SUCCESS.

[312] gNB A receives HANDOVER SUCCESS from gNB B for the UE.

[313] In step S1506, gNB forwards HANDOVER SUCCESS.

[314] Since gNB A is not source gNB of the UE, gNB A forwards the HANDOVER SUCCESS received from gNB C to gNB B. gNB A informs gNB B that this HANDOVER SUCCESS is transmitted from gNB C. Upon receiving HANDOVER SUCCESS, gNB B sends SN STATUS TRANSFER to gNB C for the UE.

[315] FIG. 16 shows an example of a method for mobility based on a stored configuration, according to some embodiments of the present disclosure.

[316] gNB A may prepare mobility based on a pre-configuration for a UE. gNB A may transmit a handover request to gNB B. gNB A may receive a handover request from gNB B. gNB A may transmit a handover request to gNB C. gNB A may receive a handover request from gNB C.

[317] gNB A may transmit, to the UE, an RRC reconfiguration including a mobility configuration (for example, a pre-configuration for mobility such as a CHO configuration). gNB A may receive, from the UE, an RRC reconfiguration complete message.

[318] The UE may perform a mobility from gNB A to gNB B. After the mobility, the UE may transmit an RRC reconfiguration complete message to gNB B. Then, gNB B may transmit, to gNB A, a handover success message. gNB B may receive, from gNB A, an SN status transfer message.

[319] After the mobility to gNB B from gNB A, the UE keep the mobility configuration (for example, a CHO configuration to gNB C). Then, the UE evaluate whether cell C which belongs to gNB C satisfies the execution condition.

[320] The UE may perform a mobility based on the kept mobility configuration. For example, when the cell C satisfies the execution condition, the UE may perform the mobility to the cell C based on the stored CHO configuration. The UE may transmit, to gNB C (that is, the cell C), an RRC reconfiguration complete message.

[321] In this case, the target cell (that is, gNB C) could transmit the handover success message to gNB A. Since, gNB C may receive the handover request from gNB A.

[322] Then, gNB A may forward the handover success to gNB B. gNB B may transmit, to gNB C, an SN status transfer message.

[323] Some of the detailed steps shown in the examples of FIGS. 12, 13, 14, 15, and 16 may not be essential steps and may be omitted. In addition to the steps shown in FIGS. 12, 13, 14, 15, and 16 other steps may be added, and the order of the steps may vary. Some of the above steps may have their own technical meaning.

[324] Hereinafter, an apparatus for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure, will be described. Herein, the apparatus may be a wireless device (100 or 200) in FIGS. 2, 3, and 5.

[325] For example, a wireless device may perform methods described above. The detailed description overlapping with the above-described contents could be simplified or omitted.

[326] Referring to FIG. 5, a wireless device 100 may include a processor 102, a memory 104, and a transceiver 106.

[327] According to some embodiments of the present disclosure, the processor 102 may be configured to be coupled operably with the memory 104 and the transceiver 106.

[328] The processor 102 may be adapted to receive, from a first cell, a mobility configuration. For example, the mobility configuration may include information on a second cell. The processor 102 may be adapted to perform a first mobility to a third cell from the first cell, wherein the third cell is different from the first cell and the second cell. The processor 102 may be adapted to perform a second mobility to the second cell from the third cell based on the mobility configuration. The processor 102 may be adapted to transmit, to the second cell, information informing that a source cell related to the second mobility is the third cell.

[329] For example, the first mobility may include a handover (HO), a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[330] For example, the second mobility may include a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[331] For example, the information may include an identity (ID) of the third cell.

[332] For example, the information may include an ID of a next generation Node B (gNB) which serves the third cell.

[333] For example, the information may be included in a radio resource control (RRC) reconfiguration message.

[334] For example, the first cell may belong to a first gNB, the second cell may belong to a second gNB, and the third cell may belong to a third gNB. The first gNB may be different from the second gNB and the third gNB. The second gNB may be different from the third gNB.

[335] For example, the processor 102 may be adapted to store the mobility configuration. The processor 102 may be adapted to apply the stored mobility configuration for the second mobility.

[336] For example, the mobility configuration may include a configuration of the second cell and an execution condition for a mobility to the second cell.

[337] For example, the mobility configuration received from the first cell may be valid after performing the first mobility to the third cell.

[338] For example, the processor 102 may be adapted to perform measurements for the

second cell after performing the first mobility to the third cell.

[339] For example, the processor 102 may be adapted to control the transceiver 106 to be in communication with at least one of a user equipment, a network, or an autonomous vehicle other than the wireless device.

[340] Hereinafter, a processor for a wireless device for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure, will be described.

[341] The processor may be adapted to control the wireless device to receive, from a first cell, a mobility configuration. For example, the mobility configuration may include information on a second cell. The processor may be adapted to control the wireless device to perform a first mobility to a third cell from the first cell, wherein the third cell is different from the first cell and the second cell. The processor may be adapted to control the wireless device to perform a second mobility to the second cell from the third cell based on the mobility configuration. The processor may be adapted to control the wireless device to transmit, to the second cell, information informing that a source cell related to the second mobility is the third cell.

[342] For example, the first mobility may include a handover (HO), a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[343] For example, the second mobility may include a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[344] For example, the information may include an identity (ID) of the third cell.

[345] For example, the information may include an ID of a next generation Node B (gNB) which serves the third cell.

[346] For example, the information may be included in a radio resource control (RRC) reconfiguration message.

[347] For example, the first cell may belong to a first gNB, the second cell may belong to a second gNB, and the third cell may belong to a third gNB. The first gNB may be different from the second gNB and the third gNB. The second gNB may be different from the third gNB.

[348] For example, the processor may be adapted to control the wireless device to store the mobility configuration. The processor may be adapted to control the wireless device to apply the stored mobility configuration for the second mobility.

[349] For example, the mobility configuration may include a configuration of the second cell and an execution condition for a mobility to the second cell.

[350] For example, the mobility configuration received from the first cell may be valid after performing the first mobility to the third cell.

[351] For example, the processor may be adapted to control the wireless device to perform measurements for the second cell after performing the first mobility to the third cell.

[352] For example, the processor may be configured to control the wireless device to be in communication with at least one of a user equipment, a network, or an autonomous vehicle other than the wireless device.

[353] Hereinafter, a non-transitory computer-readable medium has stored thereon a plurality of instructions for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure, will be described.

[354] According to some embodiment of the present disclosure, the technical features of the present disclosure could be embodied directly in hardware, in a software executed by a processor, or in a combination of the two. For example, a method performed by a wireless device in a wireless communication may be implemented in hardware, software, firmware, or any combination thereof. For example, a software may reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard disk, a removable disk, a CD-ROM, or any other storage medium.

[355] Some example of storage medium is coupled to the processor such that the processor can read information from the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. For another example, the processor and the storage medium may reside as discrete components.

[356] The computer-readable medium may include a tangible and non-transitory computer-readable storage medium.

[357] For example, non-transitory computer-readable media may include random access memory (RAM) such as synchronous dynamic random access memory (SDRAM), read-only memory (ROM), non-volatile random access memory (NVRAM), electrically erasable programmable read-only memory (EEPROM), FLASH memory, magnetic or optical data storage media, or any other medium that can be used to store instructions or data structures. Non-transitory computer-readable media may also include combinations of the above.

[358] In addition, the method described herein may be realized at least in part by a computer-readable communication medium that carries or communicates code in the form of instructions or data structures and that can be accessed, read, and/or executed by a computer.

[359] According to some embodiment of the present disclosure, a non-transitory computer-readable medium has stored thereon a plurality of instructions. The stored a plurality of instructions may be executed by a processor of a wireless device.

[360] The stored a plurality of instructions may cause the wireless device to receive, from a

first cell, a mobility configuration. For example, the mobility configuration may include information on a second cell. The stored a plurality of instructions may cause the wireless device to perform a first mobility to a third cell from the first cell, wherein the third cell is different from the first cell and the second cell. The stored a plurality of instructions may cause the wireless device to perform a second mobility to the second cell from the third cell based on the mobility configuration. The stored a plurality of instructions may cause the wireless device to transmit, to the second cell, information informing that a source cell related to the second mobility is the third cell.

[361] For example, the first mobility may include a handover (HO), a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[362] For example, the second mobility may include a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[363] For example, the information may include an identity (ID) of the third cell.

[364] For example, the information may include an ID of a next generation Node B (gNB) which serves the third cell.

[365] For example, the information may be included in a radio resource control (RRC) reconfiguration message.

[366] For example, the first cell may belong to a first gNB, the second cell may belong to a second gNB, and the third cell may belong to a third gNB. The first gNB may be different from the second gNB and the third gNB. The second gNB may be different from the third gNB.

[367] For example, the stored a plurality of instructions may cause the wireless device to store the mobility configuration. The stored a plurality of instructions may cause the wireless device to apply the stored mobility configuration for the second mobility.

[368] For example, the mobility configuration may include a configuration of the second cell and an execution condition for a mobility to the second cell.

[369] For example, the mobility configuration received from the first cell may be valid after performing the first mobility to the third cell.

[370] For example, the stored a plurality of instructions may cause the wireless device to perform measurements for the second cell after performing the first mobility to the third cell.

[371] For example, the stored a plurality of instructions may cause the wireless device to be in communication with at least one of a user equipment, a network, or an autonomous vehicle other than the wireless device.

[372] Hereinafter, a method performed by a base station (BS) for mobility based on a stored configuration in a wireless communication system, according to some em-

bodiments of the present disclosure, will be described.

[373] The BS may receive, from a second base station, a handover request message. The BS may transmit, to the second base station, a handover request acknowledgement message. The BS may receive, from a wireless device, a radio resource control (RRC) reconfiguration complete message including information informing that a source cell related to a mobility is the third base station. The BS may transmit, to the third base station, a handover success message.

[374] Hereinafter, a base station (BS) for mobility based on a stored configuration in a wireless communication system, according to some embodiments of the present disclosure, will be described.

[375] The BS may include a transceiver, a memory, and a processor operatively coupled to the transceiver and the memory.

[376] The processor may be adapted to receive, from a second base station, a handover request message. The processor may be adapted to transmit, to the second base station, a handover request acknowledgement message. The processor may be adapted to receive, from a wireless device, a radio resource control (RRC) reconfiguration complete message including information informing that a source cell related to a mobility is the third base station. The processor may be adapted to transmit, to the third base station, a handover success message.

[377] The present disclosure can have various advantageous effects.

[378] According to some embodiments of the present disclosure, a wireless device could efficiently perform the mobility based on the stored configuration.

[379] For example, the target gNB can know the right source gNB of the conditional mobility and can request the data forwarding to the right source gNB, by informing the proper source gNB during or after the conditional mobility.

[380] For example, the wireless device could save resources by performing mobility using the stored configuration. That is, the wireless device could use the stored mobility configuration without deleting the stored configuration and receiving a new configuration.

[381] According to some embodiments of the present disclosure, a wireless communication system could provide an efficient solution for the mobility based on the stored configuration.

[382] Advantageous effects which can be obtained through specific embodiments of the present disclosure are not limited to the advantageous effects listed above. For example, there may be a variety of technical effects that a person having ordinary skill in the related art can understand and/or derive from the present disclosure. Accordingly, the specific effects of the present disclosure are not limited to those explicitly described herein, but may include various effects that may be understood or derived from the technical features of the present disclosure.

[383] Claims in the present disclosure can be combined in a various way. For instance, technical features in method claims of the present disclosure can be combined to be implemented or performed in an apparatus, and technical features in apparatus claims can be combined to be implemented or performed in a method. Further, technical features in method claim(s) and apparatus claim(s) can be combined to be implemented or performed in an apparatus. Further, technical features in method claim(s) and apparatus claim(s) can be combined to be implemented or performed in a method. Other implementations are within the scope of the following claims.

Claims

[Claim 1] A method performed by a wireless device in a wireless communication system, the method comprising:
receiving, from a first cell, a mobility configuration,
wherein the mobility configuration includes information on a second cell;
performing a first mobility to a third cell from the first cell, wherein the third cell is different from the first cell and the second cell;
performing a second mobility to the second cell from the third cell based on the mobility configuration; and
transmitting, to the second cell, information informing that a source cell related to the second mobility is the third cell.

[Claim 2] The method of claim 1,
wherein the first mobility includes a handover (HO), a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[Claim 3] The method of claim 1,
wherein the second mobility includes a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[Claim 4] The method of claim 1,
wherein the information includes an identity (ID) of the third cell.

[Claim 5] The method of claim 1,
wherein the information includes an ID of a next generation Node B (gNB) which serves the third cell.

[Claim 6] The method of claim 1,
wherein the information is included in a radio resource control (RRC) reconfiguration message.

[Claim 7] The method of claim 1,
wherein the first cell belongs to a first gNB, the second cell belongs to a second gNB, and the third cell belongs to a third gNB.

[Claim 8] The method of claim 7,
wherein the first gNB is different from the second gNB and the third gNB, and
wherein the second gNB is different from the third gNB.

[Claim 9] The method of claim 1, wherein the method further comprises,
storing the mobility configuration; and

applying the stored mobility configuration for the second mobility.

[Claim 10] The method of claim 1,
wherein the mobility configuration includes a configuration of the second cell and an execution condition for a mobility to the second cell.

[Claim 11] The method of claim 1,
wherein the mobility configuration received from the first cell is valid after performing the first mobility to the third cell.

[Claim 12] The method of claim 1, wherein the method further comprises,
performing measurements for the second cell after performing the first mobility to the third cell.

[Claim 13] The method of claim 1,
wherein the wireless device is in communication with at least one of a user equipment, a network, or an autonomous vehicle other than the wireless device.

[Claim 14] A wireless device in a wireless communication system comprising:
a transceiver;
a memory; and
at least one processor operatively coupled to the transceiver and the memory, and adapted to:
receive, from a first cell, a mobility configuration,
wherein the mobility configuration includes information on a second cell;
perform a first mobility to a third cell from the first cell, wherein the third cell is different from the first cell and the second cell;
perform a second mobility to the second cell from the third cell based on the mobility configuration; and
transmit, to the second cell, information informing that a source cell related to the second mobility is the third cell.

[Claim 15] The wireless device of claim 14,
wherein the first mobility includes a handover (HO), a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[Claim 16] The wireless device of claim 14,
wherein the second mobility includes a conditional handover (CHO), a conditional PSCell change (CPC), a lower layer triggered mobility (LTM), and/or a conditional LTM.

[Claim 17] The wireless device of claim 14,
wherein the information includes an identity (ID) of the third cell.

[Claim 18] The wireless device of claim 14,
wherein the information includes an ID of a next generation Node B (gNB) which serves the third cell.

[Claim 19] The wireless device of claim 14,
wherein the information is included in a radio resource control (RRC) reconfiguration message.

[Claim 20] The wireless device of claim 14,
wherein the first cell belongs to a first gNB, the second cell belongs to a second gNB, and the third cell belongs to a third gNB.

[Claim 21] The wireless device of claim 20,
wherein the first gNB is different from the second gNB and the third gNB, and
wherein the second gNB is different from the third gNB.

[Claim 22] The wireless device of claim 14, wherein the at least one processor is further adapted to,
store the mobility configuration; and
apply the stored mobility configuration for the second mobility.

[Claim 23] The wireless device of claim 14,
wherein the mobility configuration includes a configuration of the second cell and an execution condition for a mobility to the second cell.

[Claim 24] The wireless device of claim 14,
wherein the mobility configuration received from the first cell is valid after performing the first mobility to the third cell.

[Claim 25] The wireless device of claim 14, wherein the at least one processor is further adapted to,
perform measurements for the second cell after performing the first mobility to the third cell.

[Claim 26] The wireless device of claim 14,
wherein the wireless device is in communication with at least one of a user equipment, a network, or an autonomous vehicle other than the wireless device.

[Claim 27] A processor for a wireless device in a wireless communication system, wherein the processor is configured to control the wireless device to perform operations comprising:
receiving, from a first cell, a mobility configuration,
wherein the mobility configuration includes information on a second cell;
performing a first mobility to a third cell from the first cell, wherein the

third cell is different from the first cell and the second cell;
performing a second mobility to the second cell from the third cell based on the mobility configuration; and
transmitting, to the second cell, information informing that a source cell related to the second mobility is the third cell.

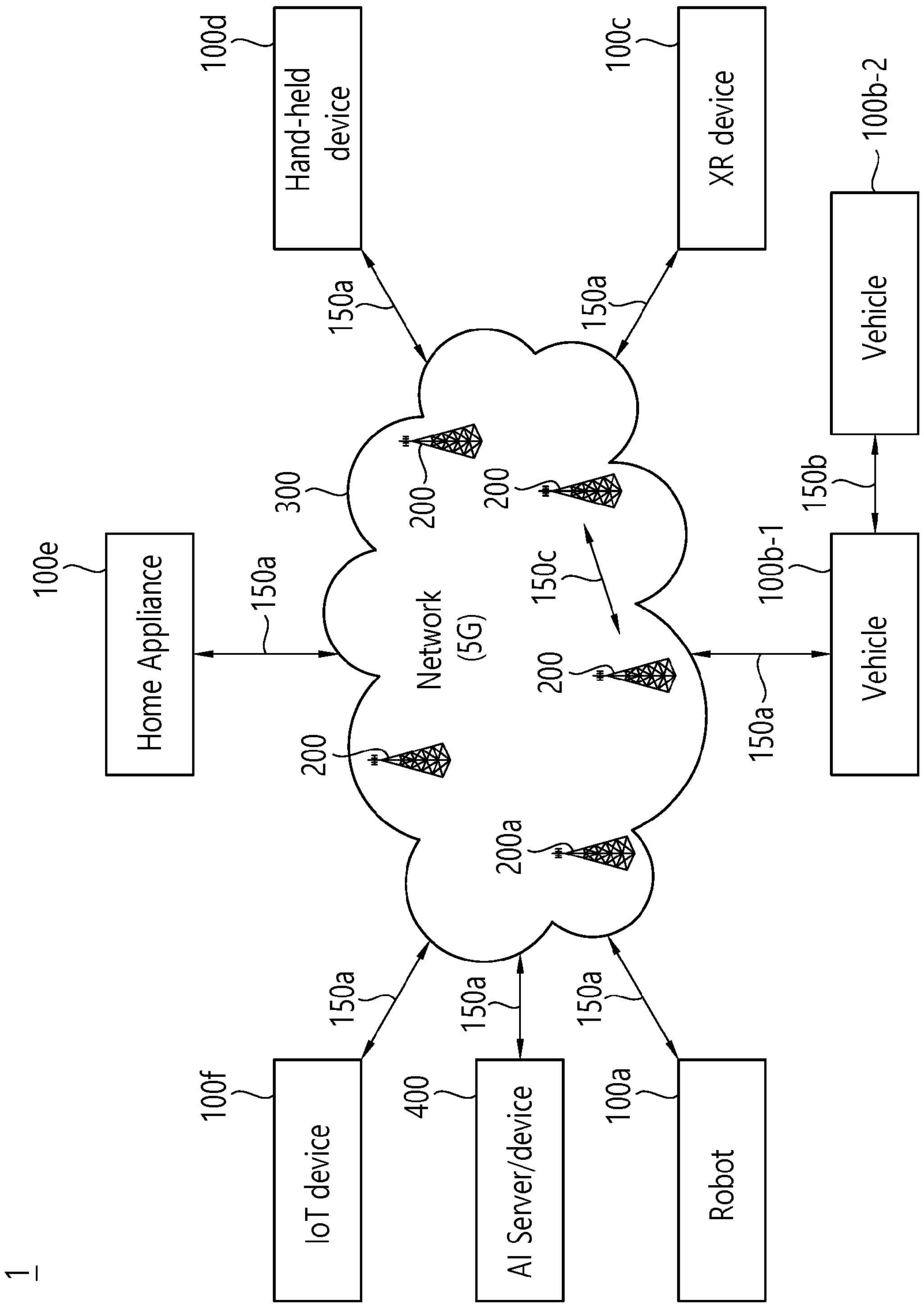
[Claim 28] A non-transitory computer-readable medium having stored thereon a plurality of instructions, which, when executed by a processor of a wireless device, cause the wireless device to perform operations, the operations comprises,
receiving, from a first cell, a mobility configuration,
wherein the mobility configuration includes information on a second cell;
performing a first mobility to a third cell from the first cell, wherein the third cell is different from the first cell and the second cell;
performing a second mobility to the second cell from the third cell based on the mobility configuration; and
transmitting, to the second cell, information informing that a source cell related to the second mobility is the third cell.

[Claim 29] A method performed by a first base station in a wireless communication system, the method comprising,
receiving, from a second base station, a handover request message;
transmitting, to the second base station, a handover request acknowledgement message;
receiving, from a wireless device, a radio resource control (RRC) reconfiguration complete message including information informing that a source cell related to a mobility is the third base station; and
transmitting, to the third base station, a handover success message.

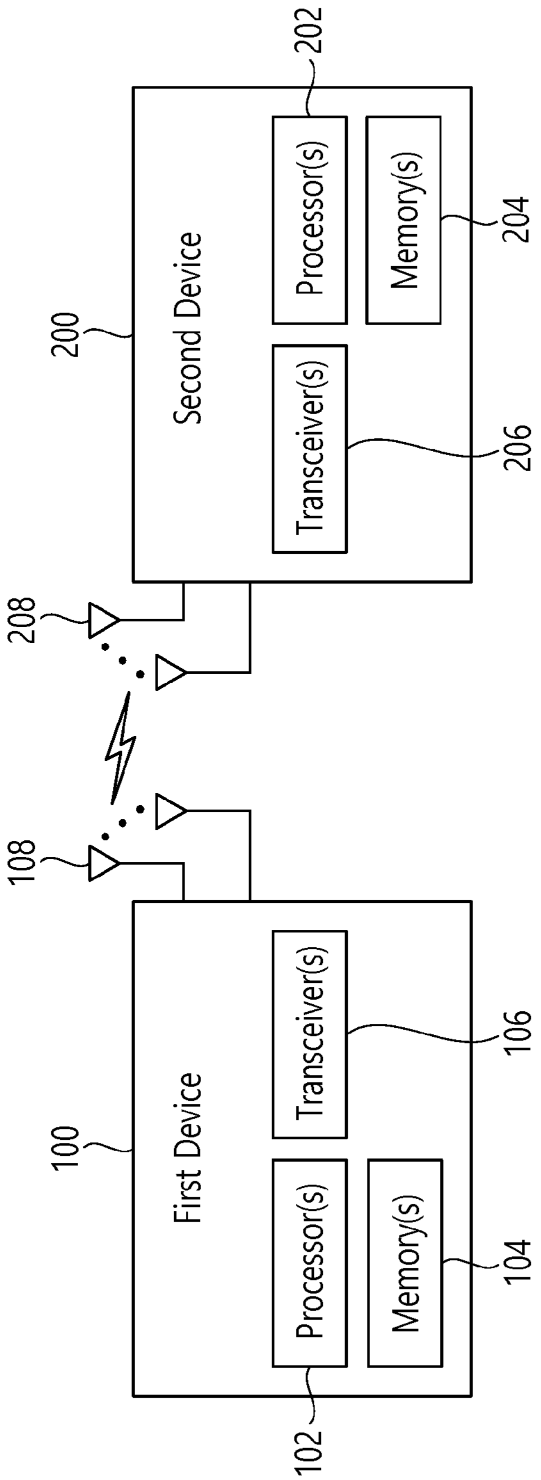
[Claim 30] A base station in a wireless communication system comprising:
a transceiver;
a memory; and
a processor operatively coupled to the transceiver and the memory, and adapted to:
receive, from a second base station, a handover request message;
transmit, to the second base station, a handover request acknowledgement message;
receive, from a wireless device, a radio resource control (RRC) reconfiguration complete message including information informing that a source cell related to a mobility is the third base station; and

transmit, to the third base station, a handover success message.

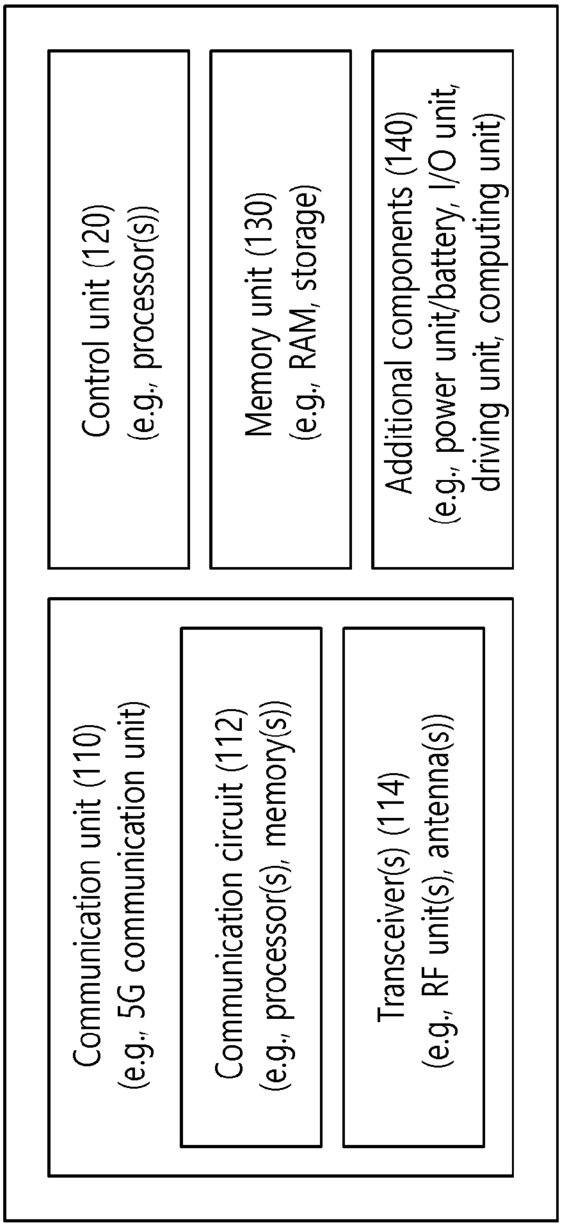
[Fig. 1]


1
100d
Hand-held device
100c
XR device
100b-2
Vehicle
150a
150a
150b
300
200
200
100e
Home Appliance
150a
Network (5G)
150c
100b-1
Vehicle
200
150a
200
200a
150a
150a
150a
100f
IoT device
400
AI Server/device
100a
Robot

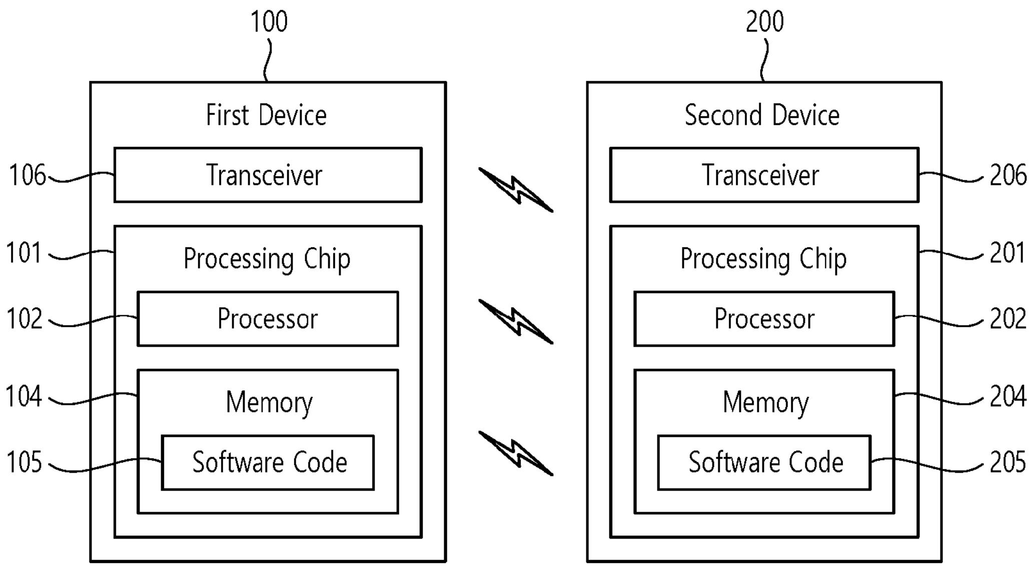
[Fig. 2]


200
Second Device
202
Processor(s)
Memory(s)
204
Transceiver(s)
206
208
108
100
First Device
Transceiver(s)
106
Processor(s)
Memory(s)
104
102

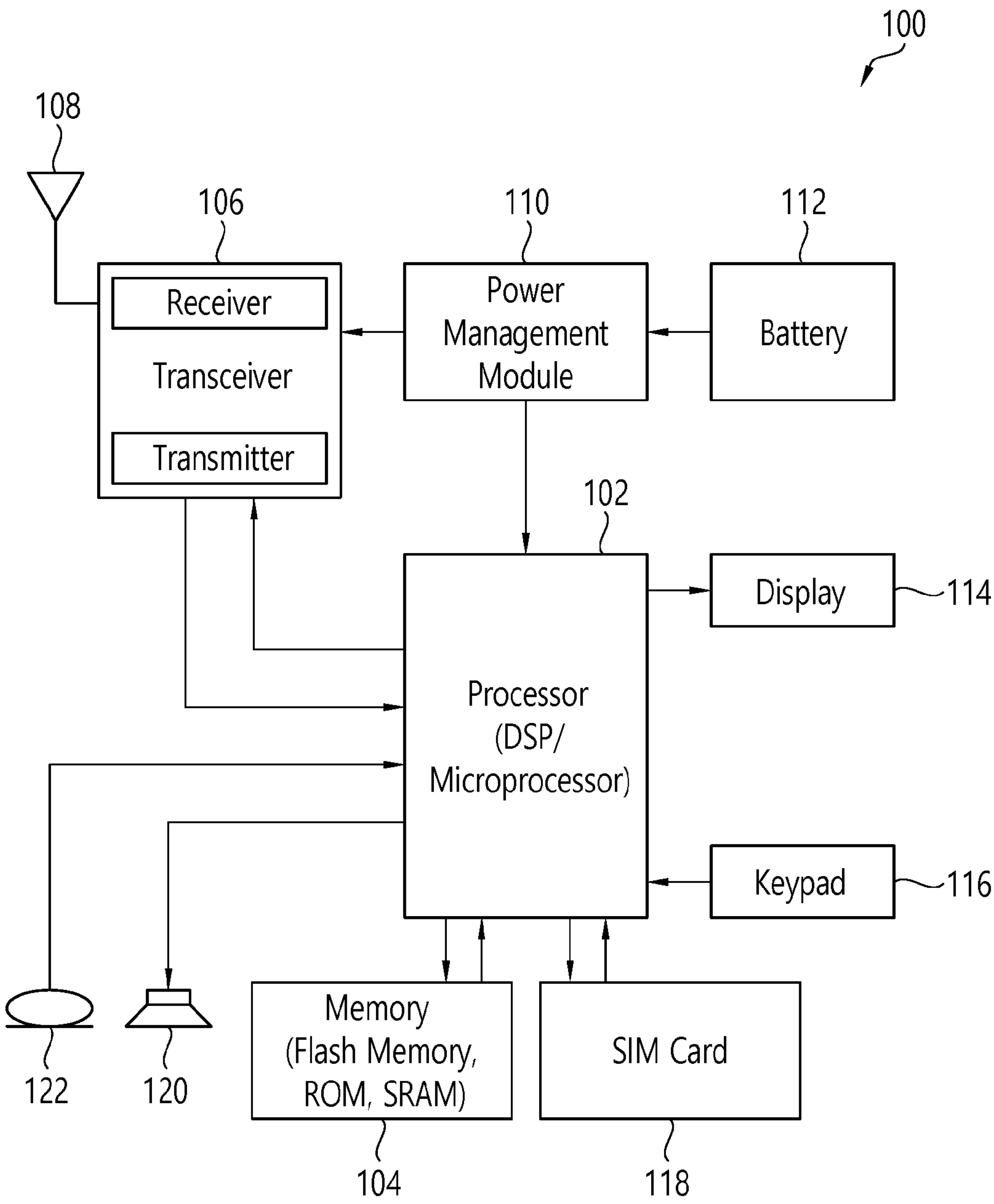
[Fig. 3]


Device (100,200)
Communication unit (110)
(e.g., 5G communication unit)
Communication circuit (112)
(e.g., processor(s), memory(s))
Transceiver(s) (114)
(e.g., RF unit(s), antenna(s))
Control unit (120)
(e.g., processor(s))
Memory unit (130)
(e.g., RAM, storage)
Additional components (140)
(e.g., power unit/battery, I/O unit,
driving unit, computing unit)

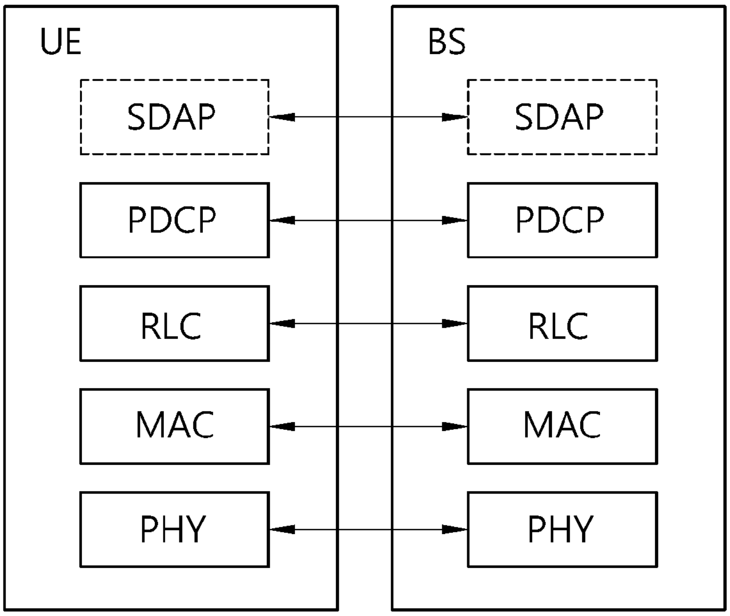
[Fig. 4]


100
200
First Device
Second Device
Transceiver
Transceiver
106
206
Processing Chip
Processing Chip
101
201
Processor
Processor
102
202
Memory
Memory
104
204
Software Code
Software Code
105
205

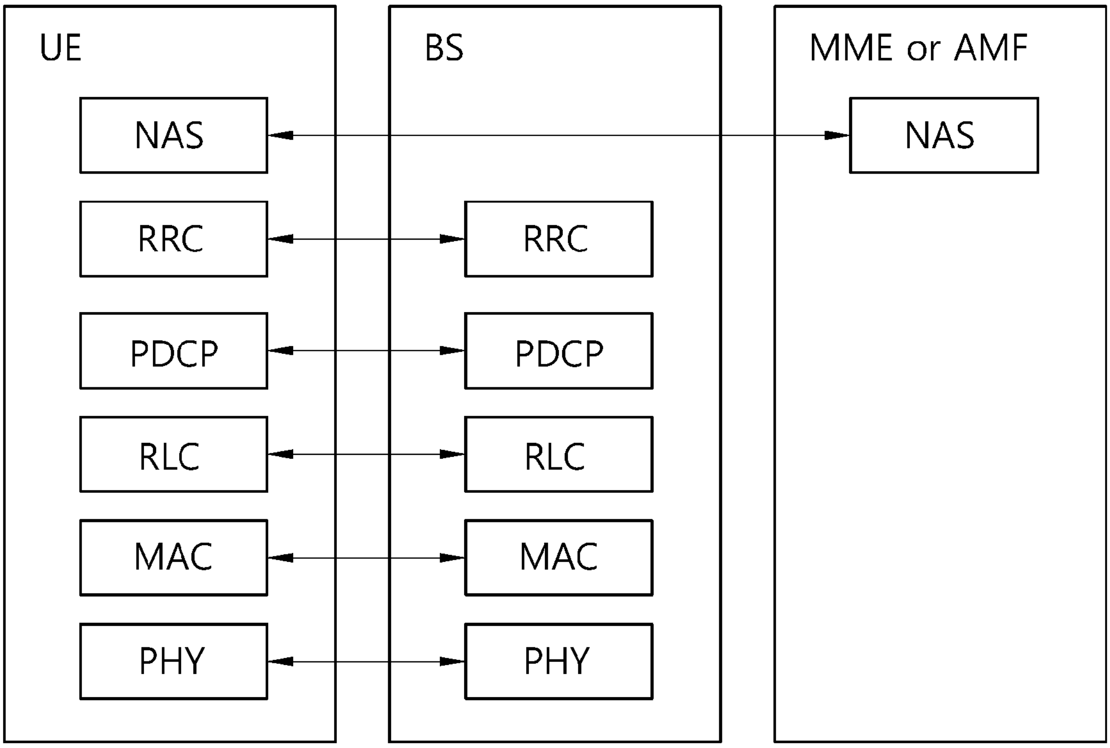
[Fig. 5]


100
108
106
110
112
Receiver
Transceiver
Transmitter
Power
Management
Module
Battery
102
Display
114
Processor
(DSP/
Microprocessor)
Keypad
116
Memory
(Flash Memory,
ROM, SRAM)
SIM Card
122
120
104
118

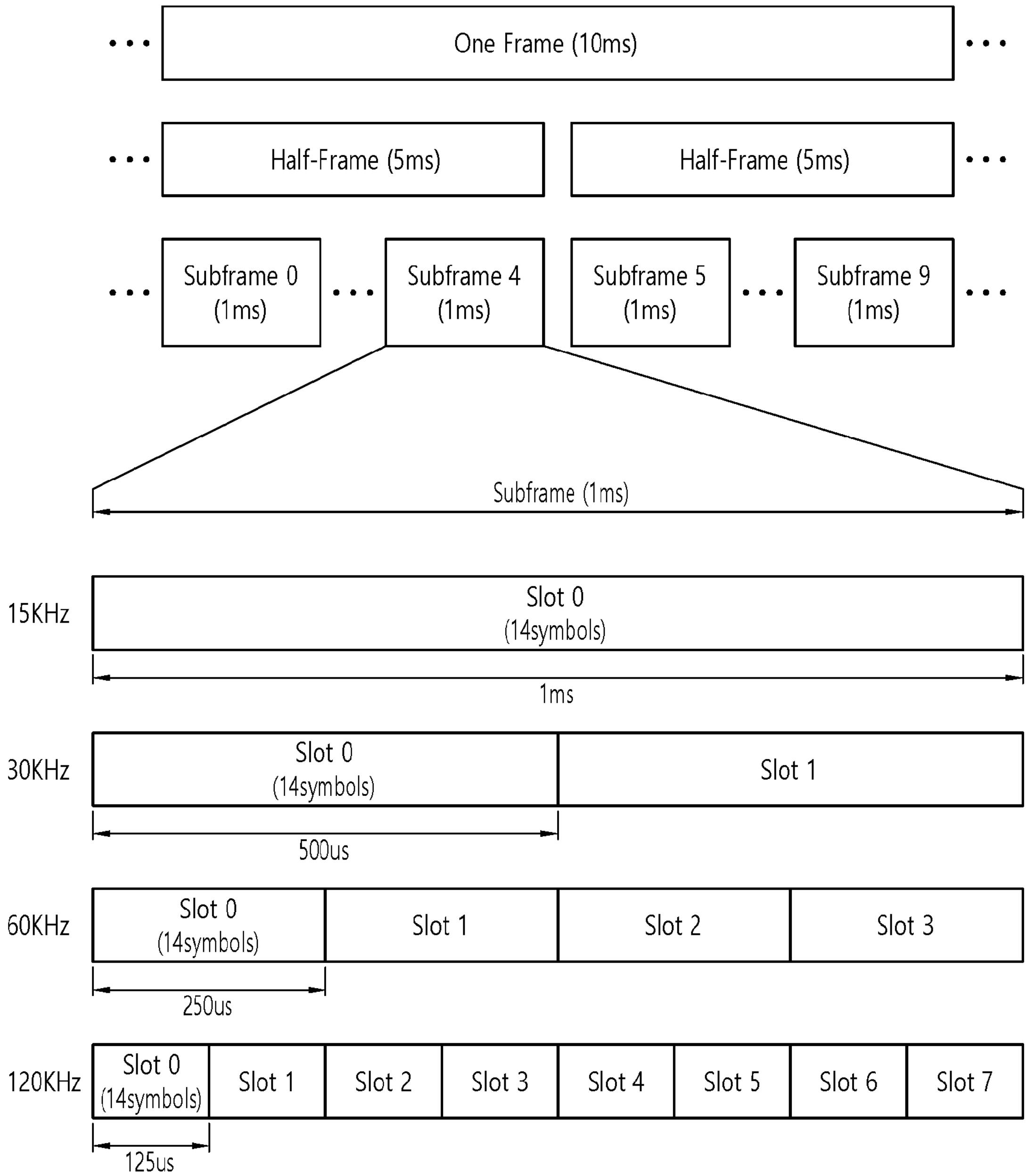
[Fig. 6]


UE
SDAP
PDCP
RLC
MAC
PHY
BS
SDAP
PDCP
RLC
MAC
PHY

[Fig. 7]


UE
NAS
RRC
PDCP
RLC
MAC
PHY
BS
RRC
PDCP
RLC
MAC
PHY
MME or AMF
NAS

[Fig. 8]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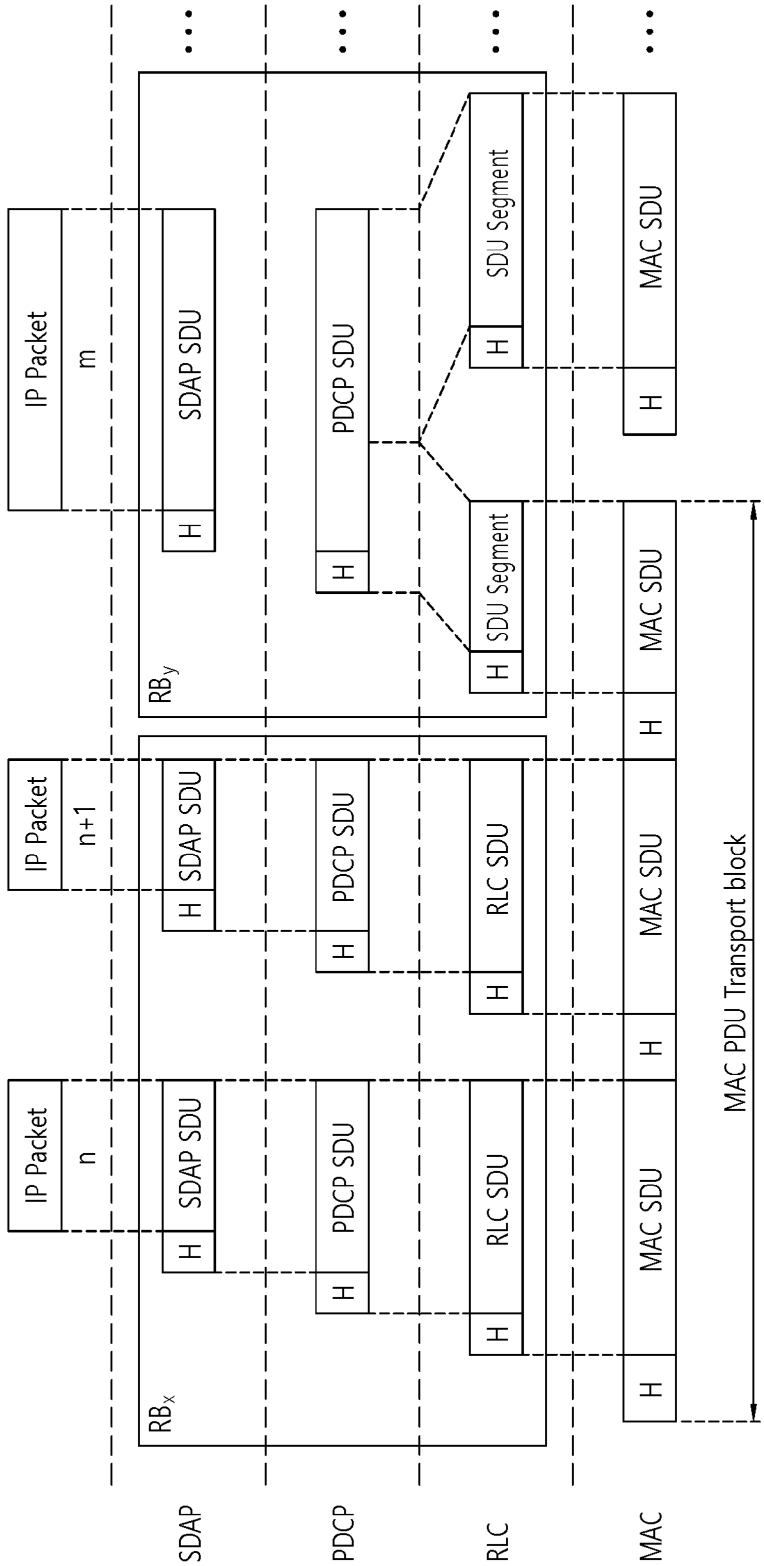
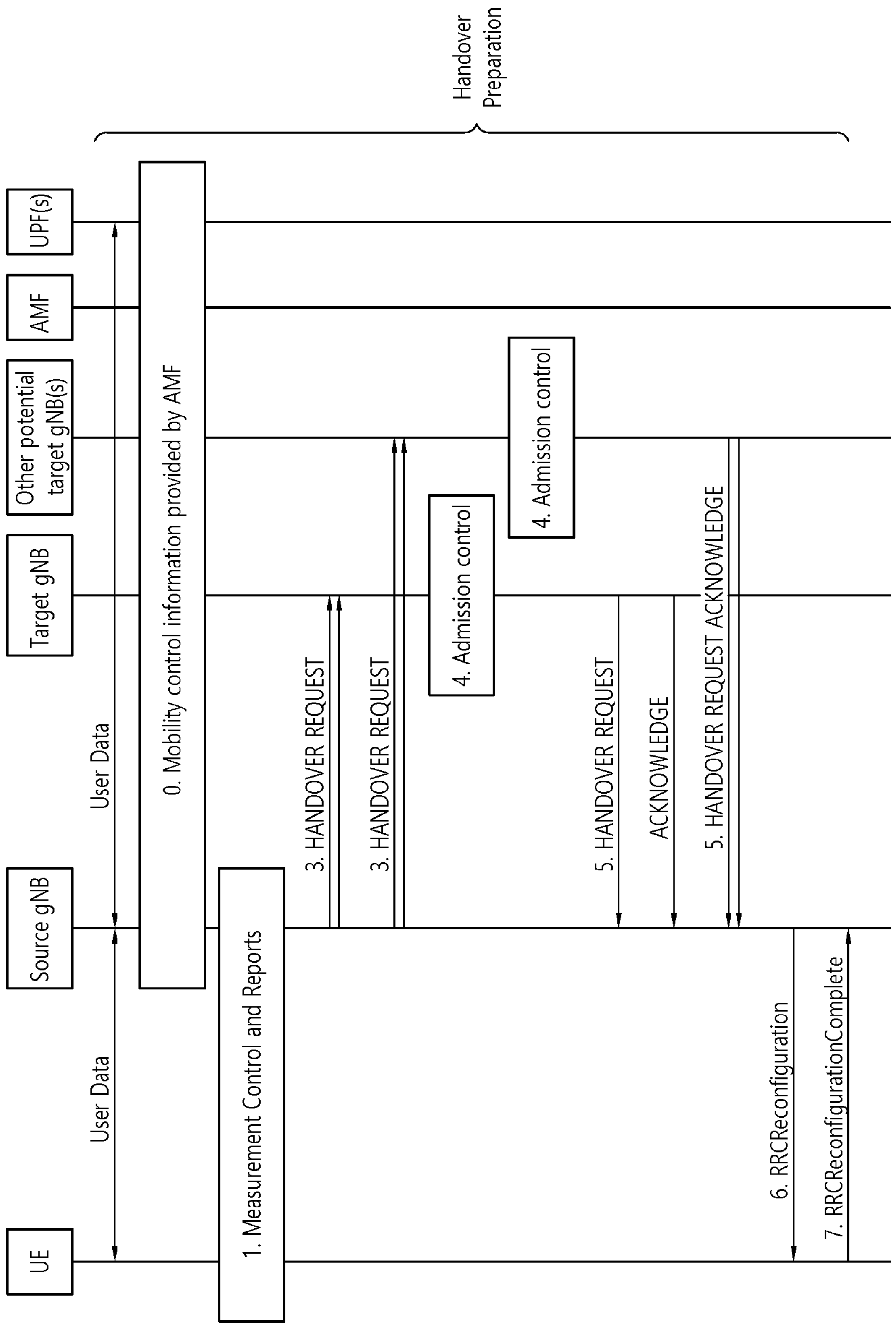
Half-Frame (5ms)
Half-Frame (5ms)
Subframe 0 (1ms)
Subframe 4 (1ms)
Subframe 5 (1ms)
Subframe 9 (1ms)
Subframe (1ms)
15KHz
Slot 0 (14symbols)
1ms
30KHz
Slot 0 (14symbols)
Slot 1
500us
60KHz
Slot 0 (14symbols)
Slot 1
Slot 2
Slot 3
250us
120KHz
Slot 0 (14symbols)
Slot 1
Slot 2
Slot 3
Slot 4
Slot 5
Slot 6
Slot 7
125us

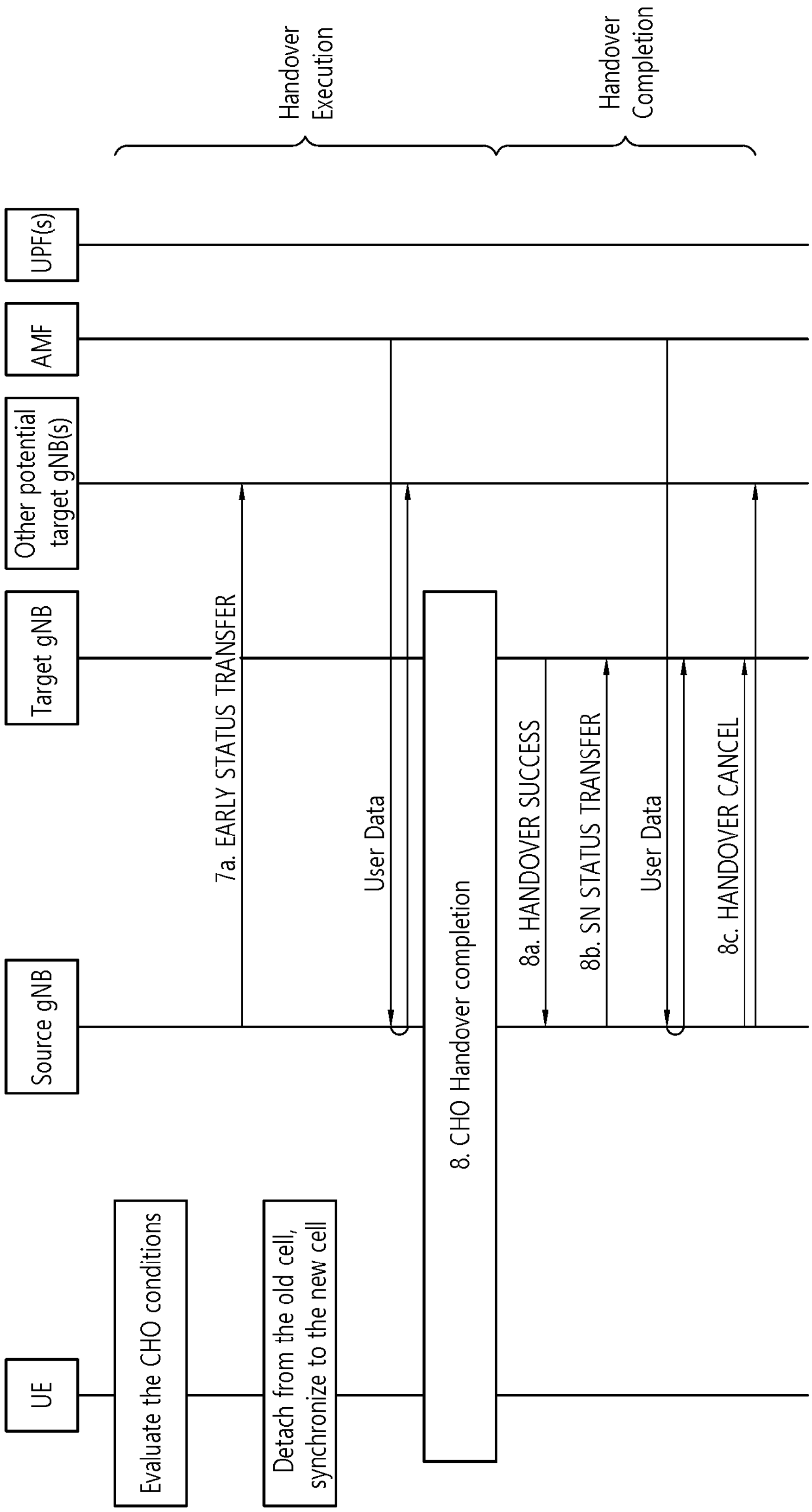
[Fig. 9]


SDAP
PDCP
RLC
MAC
RBx
RBy
IP Packet
n
IP Packet
n+1
IP Packet
m
SDAP SDU
PDCP SDU
RLC SDU
SDU Segment
MAC SDU
H
MAC PDU Transport block

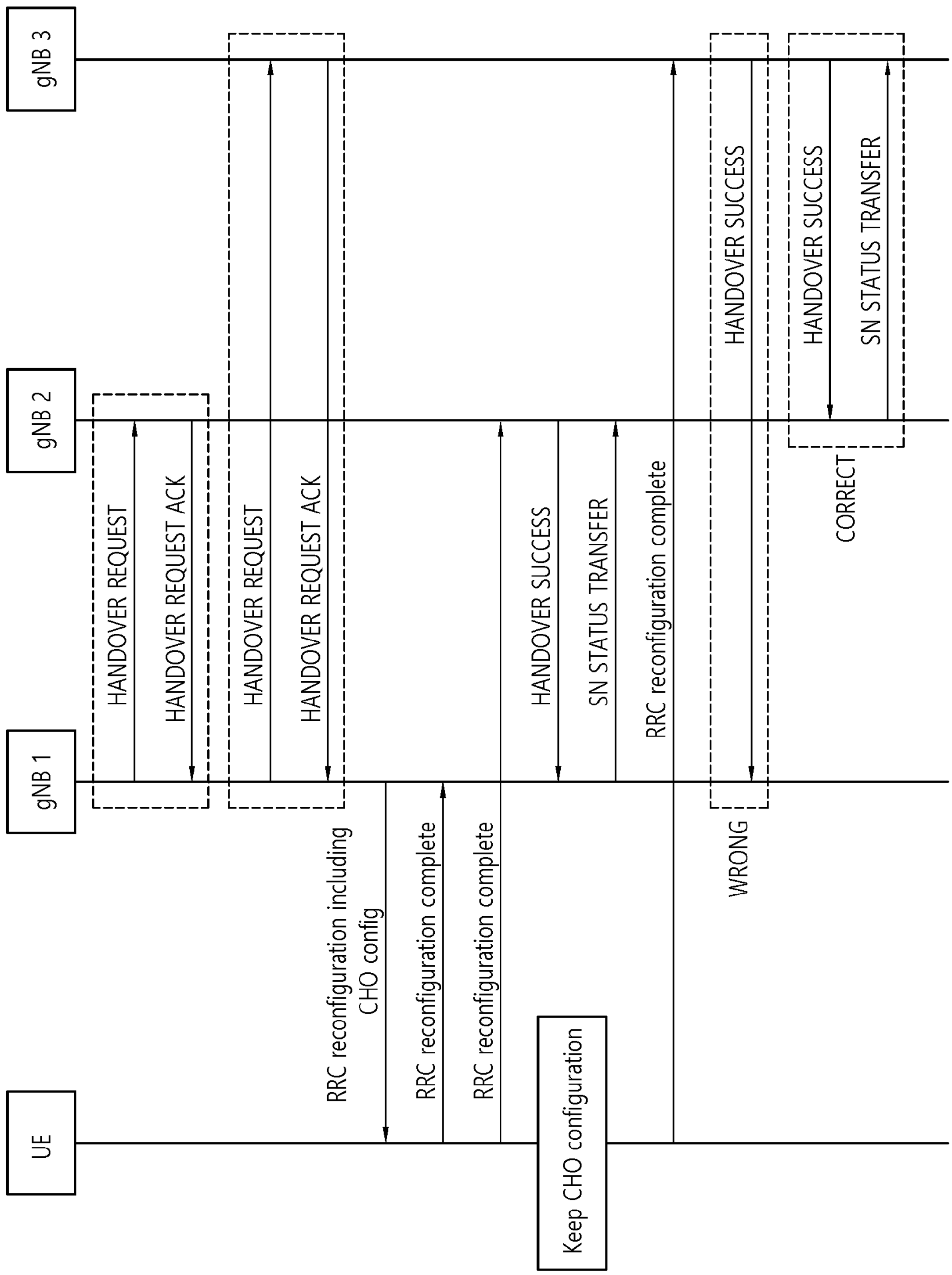
[Fig. 10a]


Handover Preparation
UE
Source gNB
Target gNB
Other potential target gNB(s)
AMF
UPF(s)
User Data
User Data
0. Mobility control information provided by AMF
1. Measurement Control and Reports
3. HANDOVER REQUEST
3. HANDOVER REQUEST
4. Admission control
4. Admission control
5. HANDOVER REQUEST
ACKNOWLEDGE
5. HANDOVER REQUEST ACKNOWLEDGE
6. RRCReconfiguration
7. RRCReconfigurationComplete

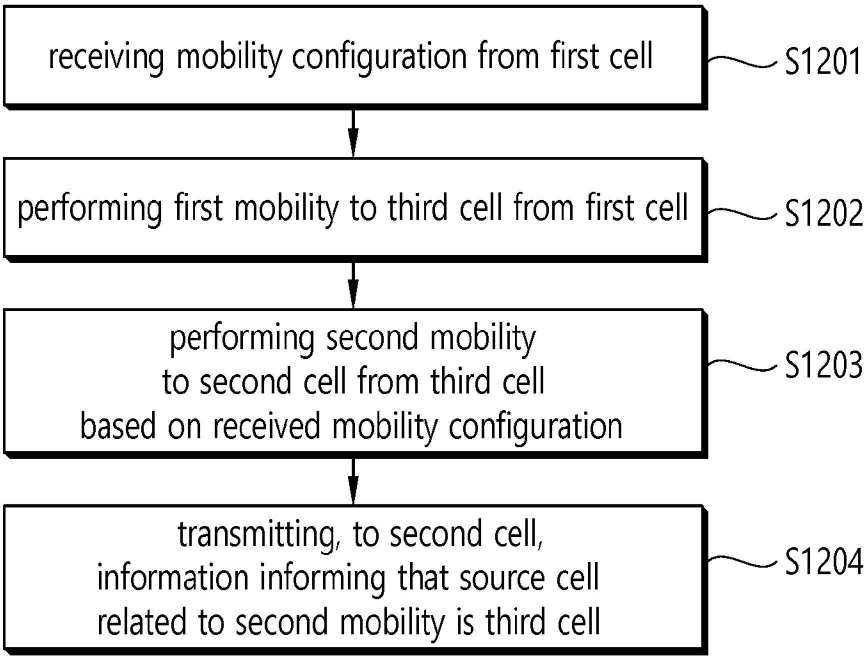
[Fig. 10b]


Handover Execution
Handover Completion
UE
Source gNB
Target gNB
Other potential target gNB(s)
AMF
UPF(s)
Evaluate the CHO conditions
Detach from the old cell, synchronize to the new cell
7a. EARLY STATUS TRANSFER
User Data
8. CHO Handover completion
8a. HANDOVER SUCCESS
8b. SN STATUS TRANSFER
User Data
8c. HANDOVER CANCEL

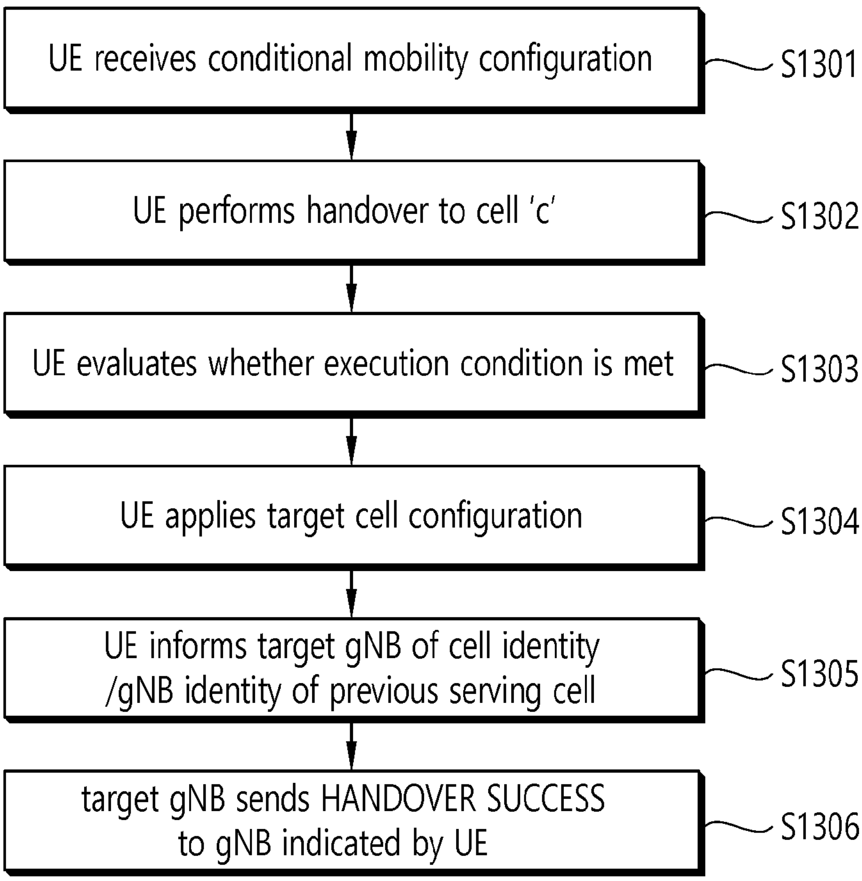
[Fig. 11]


gNB 3
gNB 2
gNB 1
UE
HANDOVER REQUEST
HANDOVER REQUEST ACK
HANDOVER REQUEST
HANDOVER REQUEST ACK
RRC reconfiguration including CHO config
RRC reconfiguration complete
RRC reconfiguration complete
Keep CHO configuration
HANDOVER SUCCESS
SN STATUS TRANSFER
RRC reconfiguration complete
HANDOVER SUCCESS
WRONG
HANDOVER SUCCESS
SN STATUS TRANSFER
CORRECT

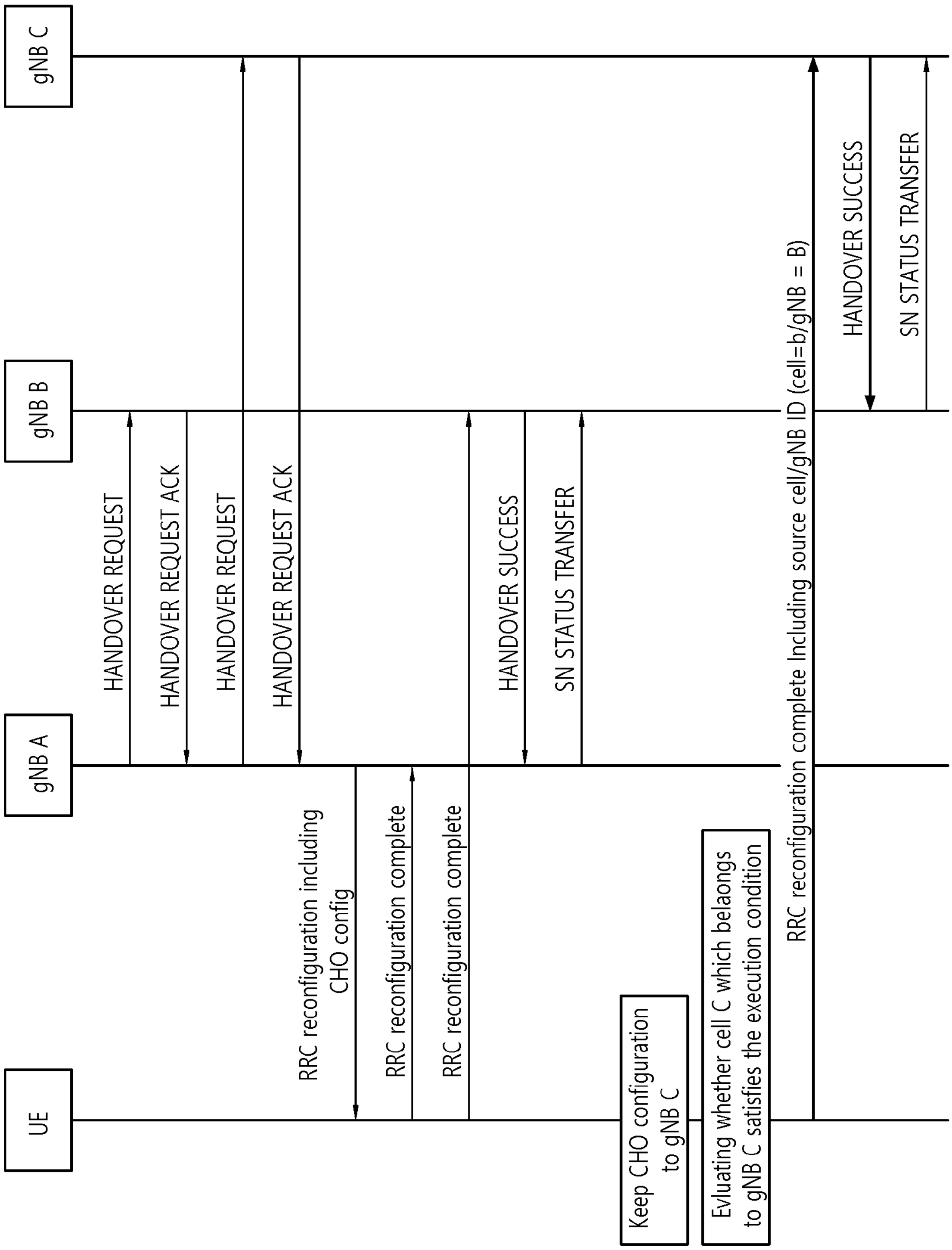
[Fig. 12]


receiving mobility configuration from first cell
S1201
performing first mobility to third cell from first cell
S1202
performing second mobility to second cell from third cell based on received mobility configuration
S1203
transmitting, to second cell, information informing that source cell related to second mobility is third cell
S1204

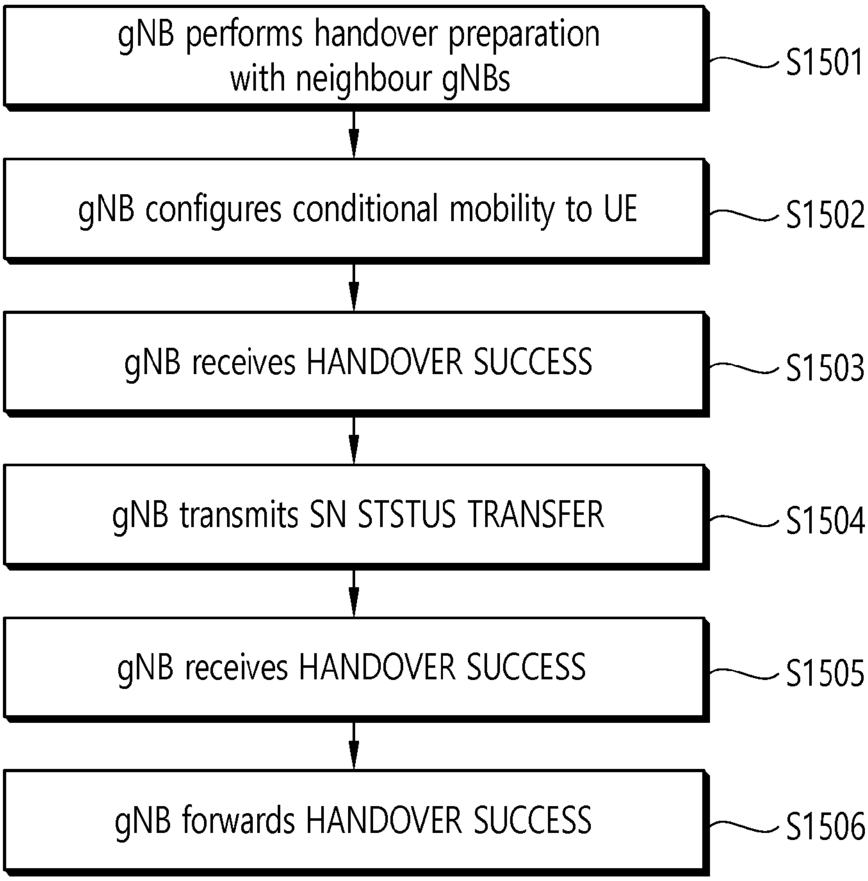
[Fig. 13]


UE receives conditional mobility configuration
S1301
UE performs handover to cell 'c'
S1302
UE evaluates whether execution condition is met
S1303
UE applies target cell configuration
S1304
UE informs target gNB of cell identity /gNB identity of previous serving cell
S1305
target gNB sends HANDOVER SUCCESS to gNB indicated by UE
S1306

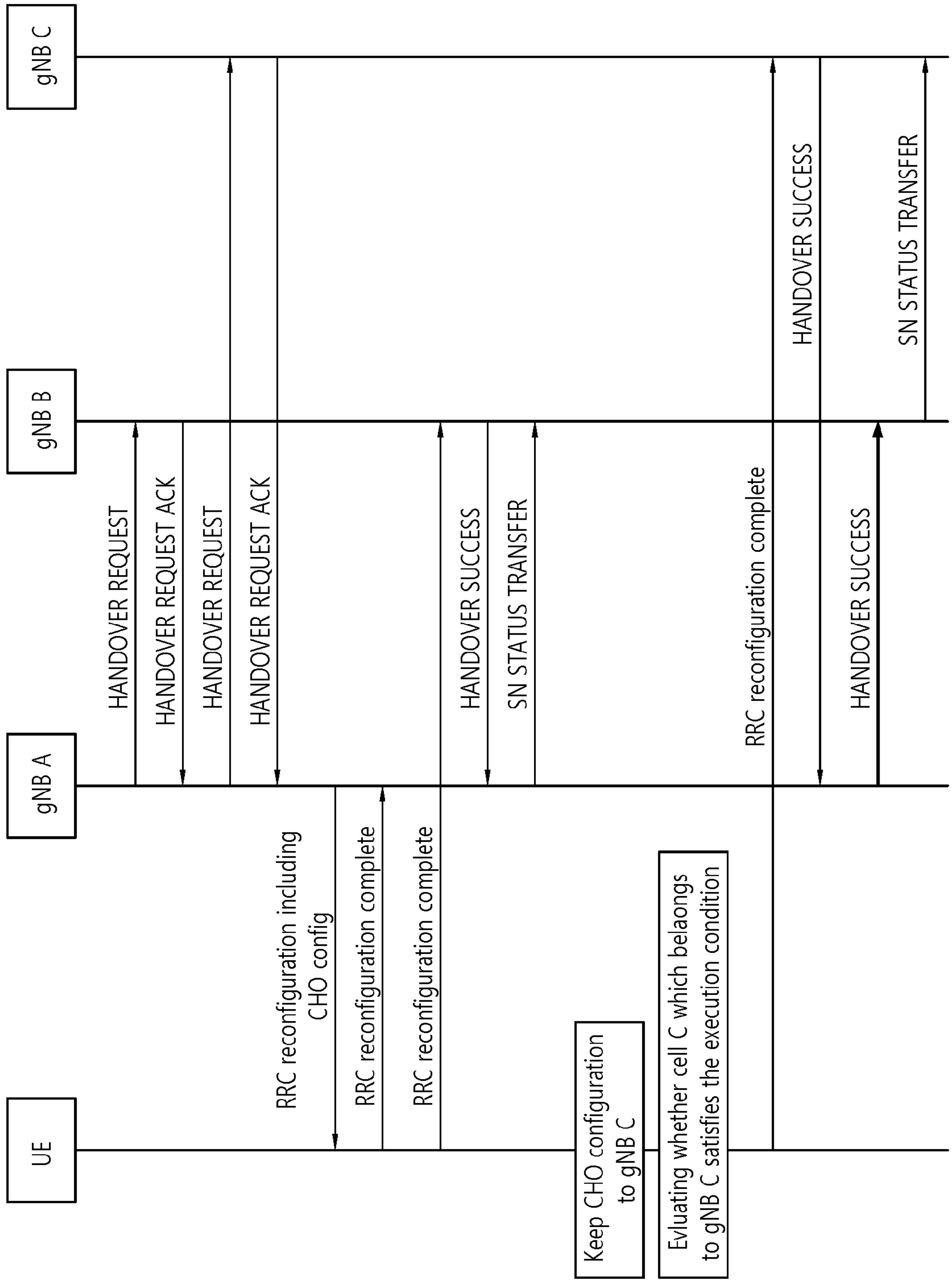
[Fig. 14]


UE
gNB A
gNB B
gNB C
HANDOVER REQUEST
HANDOVER REQUEST ACK
HANDOVER REQUEST
HANDOVER REQUEST ACK
RRC reconfiguration including CHO config
RRC reconfiguration complete
RRC reconfiguration complete
HANDOVER SUCCESS
SN STATUS TRANSFER
Keep CHO configuration to gNB C
Evluating whether cell C which belaongs to gNB C satisfies the execution condition
RRC reconfiguration complete Including source cell/gNB ID (cell=b/gNB = B)
HANDOVER SUCCESS
SN STATUS TRANSFER

[Fig. 15]


gNB performs handover preparation with neighbour gNBs
S1501
gNB configures conditional mobility to UE
S1502
gNB receives HANDOVER SUCCESS
S1503
gNB transmits SN STSTUS TRANSFER
S1504
gNB receives HANDOVER SUCCESS
S1505
gNB forwards HANDOVER SUCCESS
S1506

[Fig. 16]


UE
gNB A
gNB B
gNB C
HANDOVER REQUEST
HANDOVER REQUEST ACK
HANDOVER REQUEST
HANDOVER REQUEST ACK
RRC reconfiguration including CHO config
RRC reconfiguration complete
RRC reconfiguration complete
HANDOVER SUCCESS
SN STATUS TRANSFER
Keep CHO configuration to gNB C
Evluating whether cell C which belaongs to gNB C satisfies the execution condition
RRC reconfiguration complete
HANDOVER SUCCESS
HANDOVER SUCCESS
SN STATUS TRANSFER

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2024/000211

A. CLASSIFICATION OF SUBJECT MATTER

H04W 36/08(2009.01)i; **H04W 36/00**(2009.01)i; **H04W 36/36**(2009.01)i; **H04W 4/40**(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 36/08(2009.01); H04W 36/00(2009.01); H04W 36/18(2009.01); H04W 36/30(2009.01)

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: cell, mobility, configuration, gNB, user equipment (UE), CHO (conditional handover), HO (handover), CPC (conditional PSCell change), inform, RRC reconfiguration complete, handover success

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
DY	'3GPP; TSG RAN; NR; NR and NG-RAN Overall Description; Stage 2 (Release 17)', 3GPP TS 38.300 V17.2.0, 29 September 2022 section 9.2.3.4.2; and figure 9.2.3.4.2-1	1-30
Y	US 2022-0078684 A1 (FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.) 10 March 2022 (2022-03-10) paragraphs [0043]-[0390]; and figure 9	1-30
A	US 2020-0008113 A1 (FG INNOVATION COMPANY LIMITED) 02 January 2020 (2020-01-02) paragraphs [0044]-[0118]; and figures 1-6	1-30
A	QUALCOMM INCORPORATED, `CHO including target MCG and candidate SCGs`, R2-2208144, 3GPP TSG-RAN WG2 Meeting #119-e, E-meeting, 10 August 2022 section 2	1-30
A	CMCC, `Discussion on CHO including target MCG and candidate SCGs forCPC/CPA`, R2-2212633, 3GPP TSG-RAN WG2 Meeting #120, Toulouse, France, 04 November 2022 section 2	1-30

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

* Special categories of cited documents:
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"D" document cited by the applicant in the international application
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"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
03 April 2024	**03 April 2024**

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2024/000211

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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		EP 3970410 A1	23 March 2022
		JP 2022-532631 A	15 July 2022
		JP 7434363 B2	20 February 2024
		KR 10-2022-0009421 A	24 January 2022
		WO 2020-229552 A1	19 November 2020
US 2020-0008113 A1	02 January 2020	CN 112352451 A	09 February 2021
		EP 3815427 A1	05 May 2021
		EP 3815427 A4	29 June 2022
		EP 4221346 A2	02 August 2023
		EP 4221346 A3	06 March 2024
		US 11071025 B2	20 July 2021
		US 2021-0306917 A1	30 September 2021
		WO 2020-001615 A1	02 January 2020