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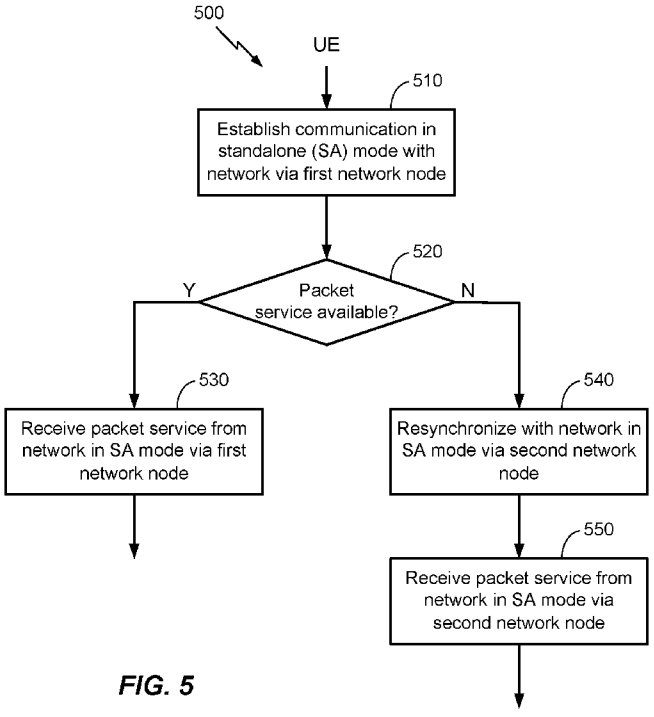

FIG. 5

(57) Abstract: Self-adaptation techniques to recover from packet service call failures due to network limitations in wireless network are disclosed.

[Continued on next page]

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SELF-ADAPTION IN WIRELESS NETWORK

TECHNICAL FIELD

[0001] Various aspects described herein generally relate to wireless communication systems, and more particularly, to self-adaptation in wireless network.

BACKGROUND

[0002] Wireless communication systems have developed through various generations, including a first-generation analog wireless phone service (1G), a second-generation (2G) digital wireless phone service (including interim 2.5G and 2.75G networks), a third-generation (3G) high speed data, Internet-capable wireless service and a fourth-generation (4G) service (e.g., Long Term Evolution (LTE) or WiMax). There are presently many different types of wireless communication systems in use, including Cellular and Personal Communications Service (PCS) systems. Examples of known cellular systems include the cellular Analog Advanced Mobile Phone System (AMPS), and digital cellular systems based on Code Division Multiple Access (CDMA), Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), the Global System for Mobile access (GSM) variation of TDMA, etc.

[0003] A fifth generation (5G) mobile standard calls for higher data transfer speeds, greater numbers of connections, and better coverage, among other improvements. The 5G standard, according to the Next Generation Mobile Networks Alliance, is designed to provide data rates of several tens of megabits per second to each of tens of thousands of users, with 1 gigabit per second to tens of workers on an office floor. Several hundreds of thousands of simultaneous connections should be supported in order to support large sensor deployments. Consequently, the spectral efficiency of 5G mobile communications should be significantly enhanced compared to the current 4G standard. Furthermore, signaling efficiencies should be enhanced and latency should be substantially reduced compared to current standards.

[0004] 5G New Radio (NR) connectivity, or simply NR connectivity, has gained significant commercial traction in recent time. Thus, to attract more users to their network, network operators would like to show NR connectivity to users most of the time on the user interface (UI) of the mobile device such as the user equipment (UE).

SUMMARY

[0005] This summary identifies features of some example aspects, and is not an exclusive or exhaustive description of the disclosed subject matter. Whether features or aspects are included in, or omitted from this summary is not intended as indicative of relative importance of such features. Additional features and aspects are described, and will become apparent to persons skilled in the art upon reading the following detailed description and viewing the drawings that form a part thereof.

[0006] An exemplary user equipment (UE) is disclosed. The UE may comprise a processor, a memory, and a transceiver. The processor, the memory, and/or the transceiver may be configured to determine whether or not packet service is available from a network while communicating in a standalone (SA) mode with the network via a first network node. The processor, the memory, and/or the transceiver may also be configured to resynchronize with the network via a second network node when it is determined that the packet service is not available from the network via the first network node. The second network node may be the same as or different from the first network node. The processor, the memory, and/or the transceiver may further be configured to receive the packet service from the network in the SA mode via the second network node subsequent to resynchronizing with the network.

[0007] An exemplary method performed by a user equipment (UE) is disclosed. The method may comprise determining whether or not packet service is available from a network while communicating in a standalone (SA) mode with the network via a first network node. The method may also comprise resynchronizing with the network via a second network node when it is determined that the packet service is not available from the network via the first network node. The second network node may be the same as or different from the first network node. The method may further comprise receiving the packet service from the network in the SA mode via the second network node subsequent to resynchronizing with the network.

[0008] Another exemplary user equipment (UE) configured to operate in first and second radio access technologies (RATs) is disclosed. The UE may comprise means for determining whether or not packet service is available from a network while communicating in a standalone (SA) mode with the network via a first network node. The UE may also comprise means for resynchronizing with the network via a second network node when it is determined that the packet service is not available from the network via the first

network node. The second network node may be the same as or different from the first network node. The UE may further comprise means for receiving the packet service from the network in the SA mode via the second network node subsequent to resynchronizing with the network.

[0009] A non-transitory computer-readable medium storing computer-executable instructions for a user equipment (UE) configured to operate in first and second radio access technologies (RATs) is disclosed. The executable instructions may comprise one or more instructions instructing the UE to determine whether or not packet service is available from a network while communicating in a standalone (SA) mode with the network via a first network node. The executable instructions may also comprise one or more instructions instructing the UE to resynchronize with the network via a second network node when it is determined that the packet service is not available from the network via the first network node. The second network node may be the same as or different from the first network node. The executable instructions may further comprise one or more instructions instructing the UE to receive the packet service from the network in the SA mode via the second network node subsequent to resynchronizing with the network.

[0010] Other objects and advantages associated with the aspects disclosed herein will be apparent to those skilled in the art based on the accompanying drawings and detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The accompanying drawings are presented to aid in the description of examples of one or more aspects of the disclosed subject matter and are provided solely for illustration of the examples and not limitation thereof:

[0012] FIG. 1 illustrates an exemplary wireless communications system in accordance with one or more aspects of the disclosure;

[0013] FIG. 2 is a simplified block diagram of several sample aspects of components that may be employed in wireless communication nodes and configured to support communication in accordance with one or more aspects of the disclosure;

[0014] FIG. 3 illustrates a flow of an example scenario that can occur between a user equipment and a 5G network node when there is a packet service call failure;

[0015] FIG. 4 illustrates a flow of an example scenario that can occur between a user equipment and network node in which the user equipment is able to recover from packet service call failure in accordance with one or more aspects of the disclosure;

[0016] FIGs. 5-9 illustrate flow charts of an exemplary self-adaptation method performed by a user equipment to recover from packet service failure while in standalone mode in accordance with one or more aspects of the disclosure; and

[0017] FIG. 10 illustrates a simplified block diagram of several sample aspects of an apparatus configured for self-adaption in accordance with one or more aspects of the disclosure.

DETAILED DESCRIPTION

[0018] Aspects of the subject matter are provided in the following description and related drawings directed to specific examples of the disclosed subject matter. Alternates may be devised without departing from the scope of the disclosed subject matter. Additionally, well-known elements will not be described in detail or will be omitted so as not to obscure the relevant details.

[0019] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any aspect described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other aspects. Likewise, the term "aspects" does not require that all aspects include the discussed feature, advantage, or mode of operation.

[0020] The terminology used herein describes particular aspects only and should not be construed to limit any aspects disclosed herein. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. Those skilled in the art will further understand that the terms "comprises," "comprising," "includes," and/or "including," as used herein, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0021] Further, various aspects may be described in terms of sequences of actions to be performed by, for example, elements of a computing device. Those skilled in the art will recognize that various actions described herein can be performed by specific circuits (e.g., an application specific integrated circuit (ASIC)), by program instructions being executed by one or more processors, or by a combination of both. Additionally,

these sequences of actions described herein can be considered to be embodied entirely within any form of non-transitory computer-readable medium having stored thereon a corresponding set of computer instructions that upon execution would cause an associated processor to perform the functionality described herein. Thus, the various aspects described herein may be embodied in a number of different forms, all of which have been contemplated to be within the scope of the claimed subject matter. In addition, for each of the aspects described herein, the corresponding form of any such aspects may be described herein as, for example, "logic configured to" and/or other structural components configured to perform the described action.

[0022] As used herein, the terms "user equipment" (UE) and "base station" are not intended to be specific or otherwise limited to any particular Radio Access Technology (RAT), unless otherwise noted. In general, such UEs may be any wireless communication device (e.g., a mobile phone, router, tablet computer, laptop computer, tracking device, Internet of Things (IoT) device, etc.) used by a user to communicate over a wireless communications network. A UE may be mobile or may (e.g., at certain times) be stationary, and may communicate with a Radio Access Network (RAN). As used herein, the term "UE" may be referred to interchangeably as an "access terminal" or "AT," a "client device," a "wireless device," a "subscriber device," a "subscriber terminal," a "subscriber station," a "user terminal" or UT, a "mobile terminal," a "mobile station," or variations thereof. Generally, UEs can communicate with a core network via a RAN, and through the core network the UEs can be connected with external networks such as the Internet and with other UEs. Of course, other mechanisms of connecting to the core network and/or the Internet are also possible for the UEs, such as over wired access networks, WiFi networks (e.g., based on Institute of Electrical and Electronics Engineers (IEEE) 802.11, etc.) and so on.

[0023] A base station may operate according to one of several RATs in communication with UEs depending on the network in which it is deployed, and may be alternatively referred to as an Access Point (AP), a Network Node, a NodeB, an evolved NodeB (eNB), a general Node B (gNodeB, gNB), etc. In addition, in some systems a base station may provide edge node signaling functions while in other systems it may provide additional control and/or network management functions.

[0024] UEs can be embodied by any of a number of types of devices including but not limited to printed circuit (PC) cards, compact flash devices, external or internal modems,

wireless or wireline phones, smartphones, tablets, tracking devices, asset tags, and so on. A communication link through which UEs can send signals to a RAN is called an uplink channel (e.g., a reverse traffic channel, a reverse control channel, an access channel, etc.). A communication link through which the RAN can send signals to UEs is called a downlink or forward link channel (e.g., a paging channel, a control channel, a broadcast channel, a forward traffic channel, etc.). As used herein the term traffic channel (TCH) can refer to either an uplink / reverse or downlink / forward traffic channel.

[0025] FIG. 1 illustrates an exemplary wireless communications system 100 according to one or more aspects. The wireless communications system 100, which may also be referred to as a wireless wide area network (WWAN), may include various base stations 102 and various UEs 104. The base stations 102 may include macro cells (high power cellular base stations) and/or small cells (low power cellular base stations). The macro cells may include Evolved NodeBs (eNBs) where the wireless communications system 100 corresponds to an LTE network, gNodeBs (gNBs) where the wireless communications system 100 corresponds to a 5G network, and/or a combination thereof, and the small cells may include femtocells, picocells, microcells, etc.

[0026] The base stations 102 may collectively form a Radio Access Network (RAN) and interface with an Evolved Packet Core (EPC) or Next Generation Core (NGC) through backhaul links. In addition to other functions, the base stations 102 may perform functions that relate to one or more of transferring user data, radio channel ciphering and deciphering, integrity protection, header compression, mobility control functions (e.g., handover, dual connectivity), inter-cell interference coordination, connection setup and release, load balancing, distribution for non-access stratum (NAS) messages, NAS node selection, synchronization, RAN sharing, multimedia broadcast multicast service (MBMS), subscriber and equipment trace, RAN information management (RIM), paging, positioning, and delivery of warning messages. The base stations 102 may communicate with each other directly or indirectly (e.g., through the EPC / NGC) over backhaul links 134, which may be wired or wireless.

[0027] The base stations 102 may wirelessly communicate with the UEs 104. Each of the base stations 102 may provide communication coverage for a respective geographic coverage area 110. In an aspect, although not shown in FIG. 1, coverage areas 110 may be subdivided into a plurality of cells (e.g., three), or sectors, each cell corresponding to a

single antenna or array of antennas of a base station 102. As used herein, the term "cell" or "sector" may correspond to one of a plurality of cells of a base station 102, or to the base station 102 itself, depending on the context.

[0028] While neighbor macro cell geographic coverage areas 110 may partially overlap (e.g., in a handover region), some of the geographic coverage areas 110 may be substantially overlapped by a larger geographic coverage area 110. For example, a small cell base station 102' may have a coverage area 110' that substantially overlaps with the coverage area 110 of one or more macro cell base stations 102. A network that includes both small cell and macro cells may be known as a heterogeneous network. A heterogeneous network may also include Home eNBs (HeNBs) and/or Home gNodeBs, which may provide service to a restricted group known as a closed subscriber group (CSG). The communication links 120 between the base stations 102 and the UEs 104 may include uplink (UL) (also referred to as reverse link) transmissions from a UE 104 to a base station 102 and/or downlink (DL) (also referred to as forward link) transmissions from a base station 102 to a UE 104. The communication links 120 may use multiple input multiple output (MIMO) antenna technology, including spatial multiplexing, beamforming, and/or transmit diversity. The communication links may be through one or more carriers. Allocation of carriers may be asymmetric with respect to DL and UL (e.g., more or less carriers may be allocated for DL than for UL).

[0029] The wireless communications system 100 may further include a wireless local area network (WLAN) access point (AP) 150 in communication with WLAN stations (STAs) 152 via communication links 154 in an unlicensed frequency spectrum (e.g., 5 GHz). When communicating in an unlicensed frequency spectrum, the WLAN STAs 152 and/or the WLAN AP 150 may perform a clear channel assessment (CCA) prior to communicating in order to determine whether the channel is available.

[0030] The small cell base station 102' may operate in a licensed and/or an unlicensed frequency spectrum. When operating in an unlicensed frequency spectrum, the small cell base station 102' may employ LTE or 5G technology and use the same 5 GHz unlicensed frequency spectrum as used by the WLAN AP 150. The small cell base station 102', employing LTE / 5G in an unlicensed frequency spectrum, may boost coverage to and/or increase capacity of the access network. LTE in an unlicensed spectrum may be referred to as LTE-unlicensed (LTE-U), licensed assisted access (LAA), or MulteFire.

[0031] The wireless communications system 100 may further include a mmW base station 180 that may operate in mmW frequencies and/or near mmW frequencies in communication with a UE 182. Extremely high frequency (EHF) is part of the radio frequency (RF) range in the electromagnetic spectrum. EHF has a range of 30 GHz to 300 GHz and a wavelength between 1 millimeter and 10 millimeters. Radio waves in this band may be referred to as a millimeter wave. Near mmW may extend down to a frequency of 3 GHz with a wavelength of 100 millimeters. The super high frequency (SHF) band extends between 3 GHz and 30 GHz, also referred to as centimeter wave. Communications using the mmW/near mmW radio frequency band have high path loss and a relatively short range. The mmW base station 180 may utilize beamforming 184 with the UE 182 to compensate for the extremely high path loss and short range. Further, it will be appreciated that in alternative configurations, one or more base stations 102 may also transmit using mmW or near mmW and beamforming. Accordingly, it will be appreciated that the foregoing illustrations are merely examples and should not be construed to limit the various aspects disclosed herein.

[0032] The wireless communications system 100 may further include one or more UEs, such as UE 190, that connects indirectly to one or more communication networks via one or more device-to-device (D2D) peer-to-peer (P2P) links. In the embodiment of FIG. 1, UE 190 has a D2D P2P link 192 with one of the UEs 104 connected to one of the base stations 102 (e.g., through which UE 190 may indirectly obtain cellular connectivity) and a D2D P2P link 194 with WLAN STA 152 connected to the WLAN AP 150 (through which UE 190 may indirectly obtain WLAN-based Internet connectivity). In an example, the D2D P2P links 192-194 may be supported with any well-known D2D radio access technology (RAT), such as LTE Direct (LTE-D), WiFi Direct (WiFi-D), Bluetooth, and so on. Any of the base stations 102, 102', 180 may send measurement requests (e.g., measurement control order (MCO)) to the UEs 104, 182, 190, and the UE's 104, 182, 190 may respond with measurement reports accordingly.

[0033] FIG. 2 illustrates several sample components (represented by corresponding blocks) that may be incorporated into an apparatus 202 and an apparatus 204 (corresponding to, for example, a UE and a base station (e.g., eNB, gNB), respectively, to support the operations as disclosed herein. As an example, the apparatus 202 may correspond to a UE, and the apparatus 204 may correspond to a network node such as a gNB and/or an eNB. It will be appreciated that the components may be implemented in different types

of apparatuses in different implementations (e.g., in an ASIC, in a System-on-Chip (SoC), etc.). The illustrated components may also be incorporated into other apparatuses in a communication system. For example, other apparatuses in a system may include components similar to those described to provide similar functionality. Also, a given apparatus may contain one or more of the components. For example, an apparatus may include multiple transceiver components that enable the apparatus to operate on multiple carriers and/or communicate via different technologies.

[0034] The apparatus 202 and the apparatus 204 each may include at least one wireless communication device (represented by the communication devices 208 and 214) for communicating with other nodes via at least one designated RAT (e.g., LTE, NR). Each communication device 208 may include at least one transmitter (represented by the transmitter 210) for transmitting and encoding signals (e.g., messages, indications, information, and so on) and at least one receiver (represented by the receiver 212) for receiving and decoding signals (e.g., messages, indications, information, pilots, and so on). Each communication device 214 may include at least one transmitter (represented by the transmitter 216) for transmitting signals (e.g., messages, indications, information, pilots, and so on) and at least one receiver (represented by the receiver 218) for receiving signals (e.g., messages, indications, information, and so on).

[0035] A transmitter and a receiver may comprise an integrated device (e.g., embodied as a transmitter circuit and a receiver circuit of a single communication device) in some implementations, may comprise a separate transmitter device and a separate receiver device in some implementations, or may be embodied in other ways in other implementations. In an aspect, a transmitter may include a plurality of antennas, such as an antenna array, that permits the respective apparatus to perform transmit "beamforming," as described further herein. Similarly, a receiver may include a plurality of antennas, such as an antenna array, that permits the respective apparatus to perform receive beamforming, as described further herein. In an aspect, the transmitter and receiver may share the same plurality of antennas, such that the respective apparatus can only receive or transmit at a given time, not both at the same time. A wireless communication device (e.g., one of multiple wireless communication devices) of the apparatus 204 may also comprise a Network Listen Module (NLM) or the like for performing various measurements.

[0036] The apparatus 204 may include at least one communication device (represented by the communication device 220) for communicating with other nodes. For example, the communication device 220 may comprise a network interface (e.g., one or more network access ports) configured to communicate with one or more network entities via a wire-based or wireless backhaul connection. In some aspects, the communication device 220 may be implemented as a transceiver configured to support wire-based or wireless signal communication. This communication may involve, for example, sending and receiving messages, parameters, or other types of information. Accordingly, in the example of FIG. 2, the communication device 220 is shown as comprising a transmitter 222 and a receiver 224 (e.g., network access ports for transmitting and receiving).

[0037] The apparatuses 202 and 204 may also include other components used in conjunction with the operations as disclosed herein. The apparatus 202 may include a processing system 232 for providing functionality relating to, for example, communication with the network. The apparatus 204 may include a processing system 234 for providing functionality relating to, for example, communication with the UEs. In an aspect, the processing systems 232 and 234 may include, for example, one or more general purpose processors, multi-core processors, ASICs, digital signal processors (DSPs), field programmable gate arrays (FPGA), or other programmable logic devices or processing circuitry.

[0038] The apparatuses 202 and 204 may include measurement components 252 and 254 that may be used to obtain channel related measurements. The measurement component 252 may measure one or more downlink (DL) signals such as channel state information reference signal (CSI-RS), phase tracking reference signal (PTRS), primary synchronization signal (PSS), secondary synchronization signal (SSS), demodulation reference signal (DMRS), etc. The measurement component 254 may measure one or more uplink (UL) signals such as DMRS, sounding reference signal (SRS), etc.

[0039] The apparatuses 202 and 204 may include memory components 238 and 240 (e.g., each including a memory device), respectively, for maintaining information (e.g., information indicative of reserved resources, thresholds, parameters, and so on). In various implementations, memory 238 can comprise a computer-readable medium storing one or more computer-executable instructions for a user equipment (UE) where the one or more instructions instruct apparatus 202 (e.g., processing system 232 in

combination with communications device 208 and/or other aspects of apparatus 202) to perform any of the functions of FIGs. 3, 4, and 5. In addition, the apparatuses 202 and 204 may include user interface devices 244 and 246, respectively, for providing indications (e.g., audible and/or visual indications) to a user and/or for receiving user input (e.g., upon user actuation of a sensing device such a keypad, a touch screen, a microphone, and so on).

[0040] The apparatus 202 may include a timer 256 and a counter. The timer 256 may be configured to measure or otherwise determine one or more time durations. The counter 258 may be configured to count or otherwise determine occurrences of one or more events.

[0041] For convenience, the apparatuses 202 and 204 are shown in FIG. 2 as including various components that may be configured according to the various examples described herein. It will be appreciated, however, that the illustrated blocks may have different functionality in different designs. The components of FIG. 2 may be implemented in various ways. In some implementations, the components of FIG. 2 may be implemented in one or more circuits such as, for example, one or more processors and/or one or more ASICs (which may include one or more processors). Here, each circuit may use and/or incorporate at least one memory component for storing information or executable code used by the circuit to provide this functionality. For example, some or all of the functionality represented by blocks 208, 232, 238, and 244 may be implemented by processor and memory component(s) of the apparatus 202 (e.g., by execution of appropriate code and/or by appropriate configuration of processor components). Similarly, some or all of the functionality represented by blocks 214, 220, 234, 240, and 246 may be implemented by processor and memory component(s) of the apparatus 204 (e.g., by execution of appropriate code and/or by appropriate configuration of processor components).

[0042] In an aspect, the apparatus 204 may correspond to a "small cell" or a Home gNodeB. The apparatus 202 may transmit and receive messages via a wireless link 260 with the apparatus 204, the messages including information related to various types of communication (e.g., voice, data, multimedia services, associated control signaling, etc.). The wireless link 260 may operate over a communication medium of interest, shown by way of example in FIG. 2 as the medium 262, which may be shared with other communications as well as other RATs. A medium of this type may be composed

of one or more frequency, time, and/or space communication resources (e.g., encompassing one or more channels across one or more carriers) associated with communication between one or more transmitter / receiver pairs, such as the apparatus 204 and the apparatus 202 for the medium 262.

[0043] In general, the apparatus 202 and the apparatus 204 may operate via the wireless link 260 according to one or more radio access types, such as LTE, LTE-U, or NR, depending on the network in which they are deployed. These networks may include, for example, different variants of CDMA networks (e.g., LTE networks, NR networks, etc.), TDMA networks, FDMA networks, Orthogonal FDMA (OFDMA) networks, Single-Carrier FDMA (SC-FDMA) networks, and so on.

[0044] A UE may be capable of operating in multiple radio access technologies (RATs). For example, a UE may be capable of operating in a first RAT (e.g., NR) and in a second RAT (e.g., LTE). These are merely examples, and first and second RATs may be any of the RATs currently known (e.g., WiMax, CDMA, WCDMA, UTRA, Evolved Universal Terrestrial Radio Access (E-UTRA), GSM, FDMA, GSM, TDMA, etc.).

[0045] Also, a UE may be may be capable of operating in multiple RATs at the same time. For example, a UE that can operate in both LTE and NR simultaneously is an E-UTRA-New Radio Dual Connectivity (ENDC) capable UE. Note that ENDC is an example of Multi-RAT DC (MRDC) capability. In general, when an MRDC capable UE is operating in two RATs, it may be communicating with a base station (e.g., eNB) of a first RAT (e.g., LTE) and with a base station (e.g., gNB) of a second RAT (e.g., NR). When the UE operates in the first RAT, it may communicate with a network node (e.g., base station, gNB, etc.) of the first RAT. Similarly, when the UE operates in the second RAT, it may communicate with a network node (e.g., base station, eNB, etc.) of the second RAT.

[0046] The UE may be capable of operating in a standalone (SA) or in a non-standalone (NSA) mode within a given RAT. When operating in the SA mode, the UE is able to exchange both control and data plane (also referred to as user plane) information with the network node and/or the core network of the given RAT (e.g., NR). When operating in the NSA mode, the UE is communicating with network nodes of the first and second RATs. In the NSA mode, the UE can exchange data plane information with the network nodes of both the first RAT (e.g., NR) and the second RAT (e.g., LTE). However, the control

plane information is exchanged only with the network node of the second RAT (e.g., LTE).

[0047] When a UE is registered in a 5G network in the SA mode, a user of the UE may attempt to open up applications/services that require packet services (PS) such as a browser, Twitter™, Facebook™, etc. In some instances, when the UE is out of sync with the 5G session management function, the UE may be released from packet data unit (PDU) session and thus may not receive PS call failures, and may not recover from the failure for a long time.

[0048] FIG. 3 illustrates an example flow of a scenario 300 that can occur between a UE and an NR node (e.g., gNB) operating in 5G SA mode when there is a PS call failure – i.e., when the UE is unable to receive packet service from the network via the NR node. The sequence in scenario 300 is as follows:

1. UE is registered to network in 5G SA;
2. UE sends packet data unit (PDU) session establishment request for data service;
3. Network sends PDU session establishment accept;
4. Network sends very quickly sends PDU session release command (cause #36 regular deactivation) causing the UE data call to be terminated without ;
5. UE responds to complete the release of PDU session;
6. Repeat steps 2-5.

Steps 2-5 can be repeated many times meaning that the packet service is unavailable to the UE for a very long time. It should be noted that the time between steps 3 and 4 may be extremely short such that no packet service is provided.

[0049] To address such issues, it is proposed to incorporate an automatic recovery mechanism when packet service call failures are encountered. Generally, the proposed automatic recovery mechanism may enable the UE to recover from PS call failures (e.g., when PDU session is released) when in the SA mode by resynchronizing with the 5G SA network. For example, the UE may trigger deregistration from the network. When the UE is deregistered, context between the UE and the network can be cleared. Thereafter, the UE may register with the network again, and new context may be established between the UE and the network. With the new context which should be correct, the UE may correctly synchronize with the network, and thereby receive packet service from the network.

[0050] FIG. 4 illustrates an example of a scenario 400 in which the proposed automatic recovery mechanism is incorporated into a UE. The sequence in scenario 400 may be as follows:

A. UE registers to network in 5G SA;

B. While registered in SA mode with 5G NR, UE maintains a counter to record number of PDU session release (e.g., number of #36 regular deactivation) commands received from network (see upper dashed box):

- UE sends PDU session establishment request to gNB;
- UE receives PDU session establishment accept from gNB;
- UE receives PDU session release command from gNB – counter is incremented;
- UE completes PDU session release;
- Repeat;

C. If the counter reaches MAX COUNT during period T_PDU_REL, conclude packet service is not available from gNB;

D. UE triggers clearing old context with the network (old context may be in error):

- UE sends deregistration request to gNB;
- UE receives deregistration accept from gNB;

E. UE triggers establishing new context with the network (e.g., in SA mode):

- UE sends registration request to gNB (same or different from gNB of step D);
- UE receives registration accept from gNB;

F. UE triggers packet session to receive packet service:

- UE sends PDU session establishment request to gNB;
- UE receives PDU session establishment accept from gNB.
- UE receives packet service (can send packets and/or receive packets) from network.

[0051] FIG. 5 illustrates a flow chart of an exemplary self-adaptation method performed by a UE, e.g., to recover from packet service failure while in standalone (SA) mode in accordance with one or more aspects of the disclosure. FIG. 5 may be viewed as a generalization of the flow of FIG. 4. Here, the UE (such as the UE 202) may be capable of operating in multiple radio access technologies (RATs) including first (e.g., 5G NR) and second (e.g., 4G LTE) RATs. The memory component 238 may be viewed as an

example of a non-transitory computer-readable medium that stores computer-executable instructions to operate components of the UE 202 such as the transceiver 208 (including transmitter 210 and receiver 212), the processing system 232 (including one or more processors), memory component 238, etc.

[0052] In block 510, the UE may establish communication in the SA mode with the network via a first network node (e.g., gNB) operating in a radio access technology (e.g., 5G NR). For example, the UE may send a registration request to the first network node, and may receive a corresponding registration acceptance from the first network node. Means for performing block 510 may include the processing system 232, the memory component 238 and/or the transceiver 208 of the UE 202.

[0053] In block 520, while communicating in the SA mode with the network via the first network node, the UE may determine whether or not packet service (PS) is available from the network. Means for performing block 520 may include the processing system 232, the memory component 238, the timer 256 and/or the counter 258 of the UE 202.

[0054] FIG. 6 illustrates a flow chart of an example process that may be performed by the UE to implement block 520. As seen in FIG. 6, the UE may determine that packet service is not available if a count of failures to establish packet session (e.g., packet session establish failure count) within a set time duration (e.g., packet session establish duration) exceeds a set number (e.g., max packet session establish failure count).

[0055] In block 610, the UE may determine packet session establish failure count over packet session establish duration. Means for performing block 610 may include the processing system 232, the memory component 238, the timer 256 and/or the counter 258 of the UE 202.

[0056] FIG. 7 illustrates a flow chart of an example process that may be performed by the UE to implement block 610. As seen in FIG. 7, the UE may count receipt of packet session release command as a failure to establish packet session with the first network node. In block 710, the UE may send a packet session request (e.g., PDU session establishment request) to the first network node (e.g., gNB) in an attempt to establish a packet session (e.g., PDU session) with the network. In block 720, the UE may receive a packet session acceptance (e.g., PDU session establishment accept) from the first network node. Means for performing block 710 and means for performing block 720 may include the processing system 232, the memory component 238 and/or the transceiver 208 of the UE 202.

[0057] Subsequently in block 730, the UE may receive a packet session release command (e.g., PDU session release command with cause #36 regular deactivation) from the first network node. As indicated, this may be considered as a failure to establish packet session. Thus, in block 740, the UE may increment the packet session establish failure count. Means for performing block 730 may include the processing system 232, the memory component 238 and/or the transceiver 208 of the UE 202. Means for performing block 740 may include the processing system 232, the memory component 238 and/or the counter 258 of the UE 202.

[0058] When packet session establish failure is encountered, the UE may repeat attempting to establish the packet session with the network until the packet session establish duration (e.g., T_PDU_REL) passes. Thus, in block 750, the UE may determine whether or not the packet session establish duration has passed. If not (N branch from block 750), the UE may proceed to block 710. If so (Y branch from block 750), the UE need not repeat attempting to establish the packet session.

[0059] The packet session establish duration (e.g., T_PDU_REL) may be a fixed duration (e.g., 60 sec), and may start after the UE establishes communication in the SA mode with the network via the first network node (e.g., after block 510). The packet session establish duration may be preset within the UE. Alternatively or in addition thereto, the packet session establish duration may be set through a configuration message (e.g., radio resource control (RRC) configuration message) from the network.

[0060] Referring back to FIG. 6 (after Y branch from block 750), in block 620, the UE may determine whether or not the count of packet session establish failures over the packet session establish duration is equal to or greater than a max packet session establish failure count. If so (Y branch from block 620), the UE may determine that the packet service is not available. Otherwise (N branch from block 620), the UE may determine that the packet service is available. Means for performing block 620 may include the processing system 232 and/or the memory component 238 of the UE 202.

[0061] The max packet session establish failure count may be preset within the UE. Alternatively or in addition thereto, the max packet session establish failure count may be set through a configuration message (e.g., radio resource control (RRC) configuration message) from the network.

[0062] Referring back to FIG. 5, if it is determined that the packet service is available in the SA mode (Y branch from block 520), then in block 530, the UE may receive packet

services from the network via the first network node. Means for performing block 530 may include the processing system 232, the memory component 238, and/or the transceiver 208 of the UE 202.

[0063] On the other hand, if it is determined that the packet service is not available in the SA mode (N branch from block 520), then in block 540, the UE may resynchronize with the network via a second network node (e.g., gNB) operating in the same RAT (e.g., 5G NR). The second network node may the same as the first network node. That is, the UE may resynchronize with the network through the same network node. Alternatively, the first and second network nodes may be different, i.e., the UE may resynchronize through a different network node. Network nodes may be different if they are physically different nodes. But in another aspect, they may be different logically (e.g., different cell IDs). Means for performing block 540 may include the processing system 232, the memory component 238 and/or the transceiver 208 of the UE 202.

[0064] FIG. 8 illustrates a flow chart of an example process that may be performed by the UE to implement block 540. As seen, resynchronizing with the network may be accomplished by deregistering from the network, and then registering with the network again. Recall from above that deregistering and reregistering can reset the context of the UE with the network.

[0065] In block 810, the UE may send a deregistration request (e.g., 5G deregistration request) to the first network node, and in block 820, the UE may receive a corresponding deregistration accept (e.g., 5G deregistration accept) from the first network node. In block 830, the UE may send a registration request (e.g., 5G registration request) to the second network node, and in block 840, the UE may receive a corresponding registration accept (e.g., 5G registration accept) from the second network node. Again, the first and second network nodes may be the same or different.

[0066] Referring back to FIG. 5, subsequent to resynchronizing with the network, in block 550, the UE may receive packet service from the network via the second network node. Means for performing block 550 may include the processing system 232, the memory component 238 and/or the transceiver 208 of the UE 202.

[0067] FIG. 9 illustrates a flow chart of an example process that may be performed by the UE to implement block 550. In block 910, the UE may send a packet session request (e.g., 5G PDU session establishment request) to the second network node. In block 920, the UE may receive a corresponding packet session accept (e.g., 5G PDU session

establishment accept) from the second network. Thereafter, in block 930, the UE may send one or more packets to the second network node. Alternatively or in addition thereto, the UE may receive one or more packets from the second network node.

[0068] It should be noted that not all illustrated blocks of FIGs. 5-9 need to be performed, i.e., some blocks may be optional. Also, the numerical references to the blocks in FIGs. 5-9 should not be taken as requiring that the blocks should be performed in a certain order. Indeed, some blocks may be performed concurrently.

[0069] FIG. 10 illustrates an example user equipment apparatus 1000 represented as a series of interrelated functional modules connected by a common bus. Each of the modules may be implemented in hardware or as a combination of hardware and software. For example, the modules may be implemented as any combination of the modules of the apparatus 202 of FIG. 2. A module for establishing communication with network 1010 may correspond at least in some aspects to a communication device (e.g., communication device 208), a processing system (e.g., processing system 232), and/or a memory component (e.g., memory component 238). A module for ceasing communication with network 1020 may correspond at least in some aspects to a communication device (e.g., communication device 208), a processing system (e.g., processing system 232), and/or a memory component (e.g., memory component 238). A module for determining whether packet service is available 1030 may correspond at least in some aspects to a processing system (e.g., processing system 232), a memory component (e.g., memory component 238), a timing system (e.g., timer 256) and/or a counting system (e.g., counter 258). A module for resynchronizing 1040 may correspond at least in some aspects to a communication device (e.g., communication device 208), a processing system (e.g., processing system 232), a memory component (e.g., memory component 238), a timing system (e.g., timer 256) and/or a counting system (e.g., counter 258). A module for receiving packet services 1050 may correspond at least in some aspects to a communication device (e.g., communication device 208), a processing system (e.g., processing system 232), a memory component (e.g., memory component 238), a timing system (e.g., timer 256) and/or a counting system (e.g., counter 258).

[0070] The functionality of the modules of FIG. 10 may be implemented in various ways consistent with the teachings herein. In some designs, the functionality of these modules may be implemented as one or more electrical components. In some designs,

the functionality of these blocks may be implemented as a processing system including one or more processor components. In some designs, the functionality of these modules may be implemented using, for example, at least a portion of one or more integrated circuits (e.g., an ASIC). As discussed herein, an integrated circuit may include a processor, software, other related components, or some combination thereof. Thus, the functionality of different modules may be implemented, for example, as different subsets of an integrated circuit, as different subsets of a set of software modules, or a combination thereof. Also, it will be appreciated that a given subset (e.g., of an integrated circuit and/or of a set of software modules) may provide at least a portion of the functionality for more than one module.

[0071] In addition, the components and functions represented by FIG. 10, as well as other components and functions described herein, may be implemented using any suitable means. Such means also may be implemented, at least in part, using corresponding structure as taught herein. For example, the components described above in conjunction with the "module for" components of FIG. 10 also may correspond to similarly designated "means for" functionality. Thus, in some aspects one or more of such means may be implemented using one or more of processor components, integrated circuits, or other suitable structure as taught herein.

[0072] Those of skill in the art will appreciate that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0073] Further, those of skill in the art will appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the aspects disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such

implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

[0074] The various illustrative logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented or performed with a general purpose processor, a DSP, an ASIC, an FPGA, or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0075] The methods, sequences and/or algorithms described in connection with the aspects disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in random access memory (RAM), flash memory, read-only memory (ROM), erasable programmable ROM (EPROM), electrically erasable programmable ROM (EEPROM), registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor such that the processor can read information from, and write information to, 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. The ASIC may reside in a user terminal (e.g., UE). In the alternative, the processor and the storage medium may reside as discrete components in a user terminal.

[0076] In one or more exemplary aspects, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media may be any available media that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage

devices, or any other medium that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

[0077] While the foregoing disclosure shows illustrative aspects of the disclosure, it should be noted that various changes and modifications could be made herein without departing from the scope of the disclosure as defined by the appended claims. The functions, steps and/or actions of the method claims in accordance with the aspects of the disclosure described herein need not be performed in any particular order. Furthermore, although elements of the disclosure may be described or claimed in the singular, the plural is contemplated unless limitation to the singular is explicitly stated.

CLAIMS

WHAT IS CLAIMED IS:

1. A user equipment (UE), comprising:

a processor;

a memory; and

a transceiver,

wherein the processor, the memory, and/or the transceiver are configured to:

determine whether or not packet service is available from a network while communicating in a standalone (SA) mode with the network via a first network node;

resynchronize with the network via a second network node when it is determined that the packet service is not available from the network via the first network node, the second network node being same as or different from the first network node; and

receive the packet service from the network in the SA mode via the second network node subsequent to resynchronizing with the network.

2. The UE of claim 1, wherein the network is a 5G New Radio (NR) network.

3. The UE of claim 1, wherein when determining whether or not the packet service is available from the network while in the SA mode, the processor, the memory, and/or the transceiver are configured to:

determine a count of packet session establish failures over a packet session establish duration, each packet session failure count being a failure to establish a packet session with the network via the first network node; and

determine that the packet service is not available when the count of packet session establish failures over the packet session establish duration is equal to or greater than a max packet session establish failure count.

4. The UE of claim 3, wherein the packet session establish duration and/or the max packet session establish failure count are preset in the UE.

5. The UE of claim 3, wherein when determining the number of packet session establish failures over the packet session establish duration, the processor, the memory, and/or the transceiver are configured to:

send a packet session request to the first network node; and

increment the count of packet session establish failures when a packet session release command corresponding to the sent packet session request is received from the first network node,

wherein the UE loops through sending the packet session request, and incrementing the count of packet session establish failures during the packet session establish duration.

6. The UE of claim 5, wherein the packet session request is 5G packet data unit (PDU) session establishment request.

7. The UE of claim 6, wherein the packet session release command is 5G packet data unit (PDU) session release command with cause #36 regular deactivation.

8. The UE of claim 1, wherein when resynchronizing with the network via the second network node, the processor, the memory, and/or the transceiver are configured to:

send a deregistration request to the first network node;

receive a deregistration accept corresponding to the deregistration request from the first network node.

send a registration request to the second network node; and

receive a registration accept corresponding to the registration request from the second network node.

9. The UE of claim 8,

wherein the deregistration request and accept are 5G deregistration request and accept, and

wherein the registration request and accept are 5G registration request and accept.

10. The UE of claim 1, wherein when receiving the packet service from the network subsequent to resynchronizing with the network, the processor, the memory, and/or the transceiver are configured to:

send a packet session request to the second network node;

receive a packet session accept corresponding to the packet session request from the second network node; and

send one or more packets to and/or receive one or more packets from the second network node subsequent to receiving the packet session accept.

11. The UE of claim 10, wherein the packet session request and accept are respectively 5G packet data unit (PDU) session establishment request and 5G PDU session establishment accept.

12. A method of a user equipment (UE), the method comprising:

determining whether or not packet service is available from a network while communicating in a standalone (SA) mode with the network via a first network node;

resynchronizing with the network via a second network node when it is determined that the packet service is not available from the network via the first network node, the second network node being same as or different from the first network node; and

receive the packet service from the network in the SA mode via the second network node subsequent to resynchronizing with the network.

13. The method of claim 12, wherein the network is a 5G New Radio (NR) network.

14. The method of claim 12, wherein determining whether or not the packet service is available from the network comprises:

determining a count of packet session establish failures over a packet session establish duration, each packet session failure count being a failure to establish a packet session with the network via the first network node; and

determining that the packet service is not available when the count of packet session establish failures over the packet session establish duration is equal to or greater than a max packet session establish failure count.

15. The method of claim 14, wherein the packet session establish duration and/or the max packet session establish failure count are preset in the UE.

16. The method of claim 14, wherein determining the number of packet session establish failures over the packet session establish duration comprises:

sending a packet session request to the first network node; and

incrementing the count of packet session establish failures when a packet session release command corresponding to the sent packet session request is received from the first network node,

wherein the UE loops through sending the packet session request, and incrementing the count of packet session establish failures during the packet session establish duration.

17. The method of claim 16, wherein the packet session request is 5G packet data unit (PDU) session establishment request.

18. The method of claim 17, wherein the packet session release command is 5G packet data unit (PDU) session release command with cause #36 regular deactivation.

19. The method of claim 12, wherein resynchronizing with the network via the second network node comprises:

sending a deregistration request to the first network node;

receiving a deregistration accept corresponding to the deregistration request from the first network node.

sending a registration request to the second network node; and

receiving a registration accept corresponding to the registration request from the second network node.

20. The method of claim 19,

wherein the deregistration request and accept are 5G deregistration request and accept, and

wherein the registration request and accept are 5G registration request and accept.

21. The method of claim 12, wherein receiving the packet service from the network comprises:

sending a packet session request to the second network node;

receiving a packet session accept corresponding to the packet session request from the second network node; and

sending one or more packets to and/or receiving one or more packets from the second network node subsequent to receiving the packet session accept.

22. The method of claim 21, wherein the packet session request and accept are respectively 5G packet data unit (PDU) session establishment request and 5G PDU session establishment accept.

23. A user equipment (UE), comprising:

means for determining whether or not packet service is available from a network while communicating in a standalone (SA) mode with the network via a first network node;

means for resynchronizing with the network via a second network node when it is determined that the packet service is not available from the network via the first network node, the second network node being same as or different from the first network node; and

means for receive the packet service from the network in the SA mode via the second network node subsequent to resynchronizing with the network.

24. A non-transitory computer-readable medium storing computer-executable instructions for a user equipment (UE), the computer-executable instructions comprising:

one or more instructions instructing the UE to determine whether or not packet service is available from a network while communicating in a standalone (SA) mode with the network via a first network node;

one or more instructions instructing the UE to resynchronize with the network via a second network node when it is determined that the packet service is not available from the network via the first network node, the second network node being same as or different from the first network node; and

one or more instructions instructing the UE to receive the packet service from the network in the SA mode via the second network node subsequent to resynchronizing with the network.

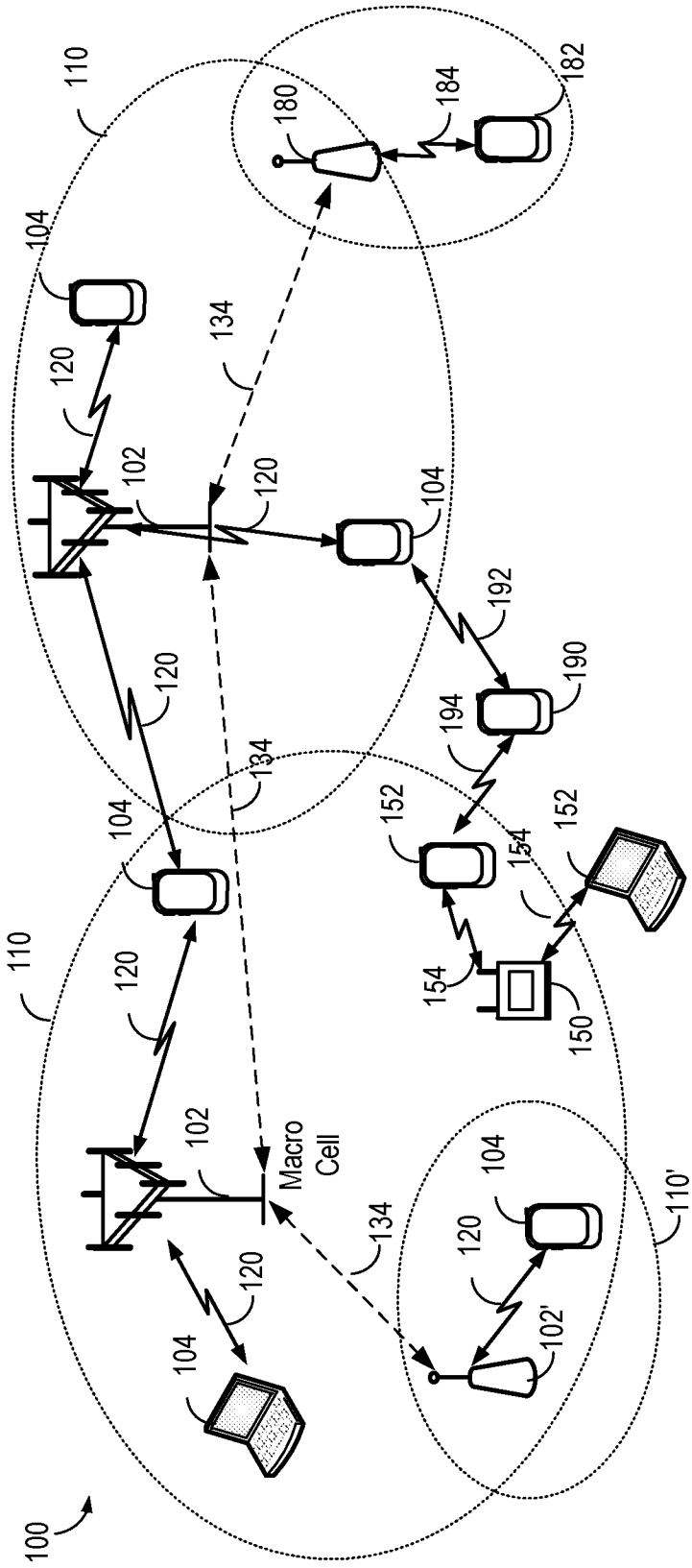
100
110
110'
102
102'
104
120
134
150
152
154
180
182
184
190
192
194
Macro Cell

FIG. 1

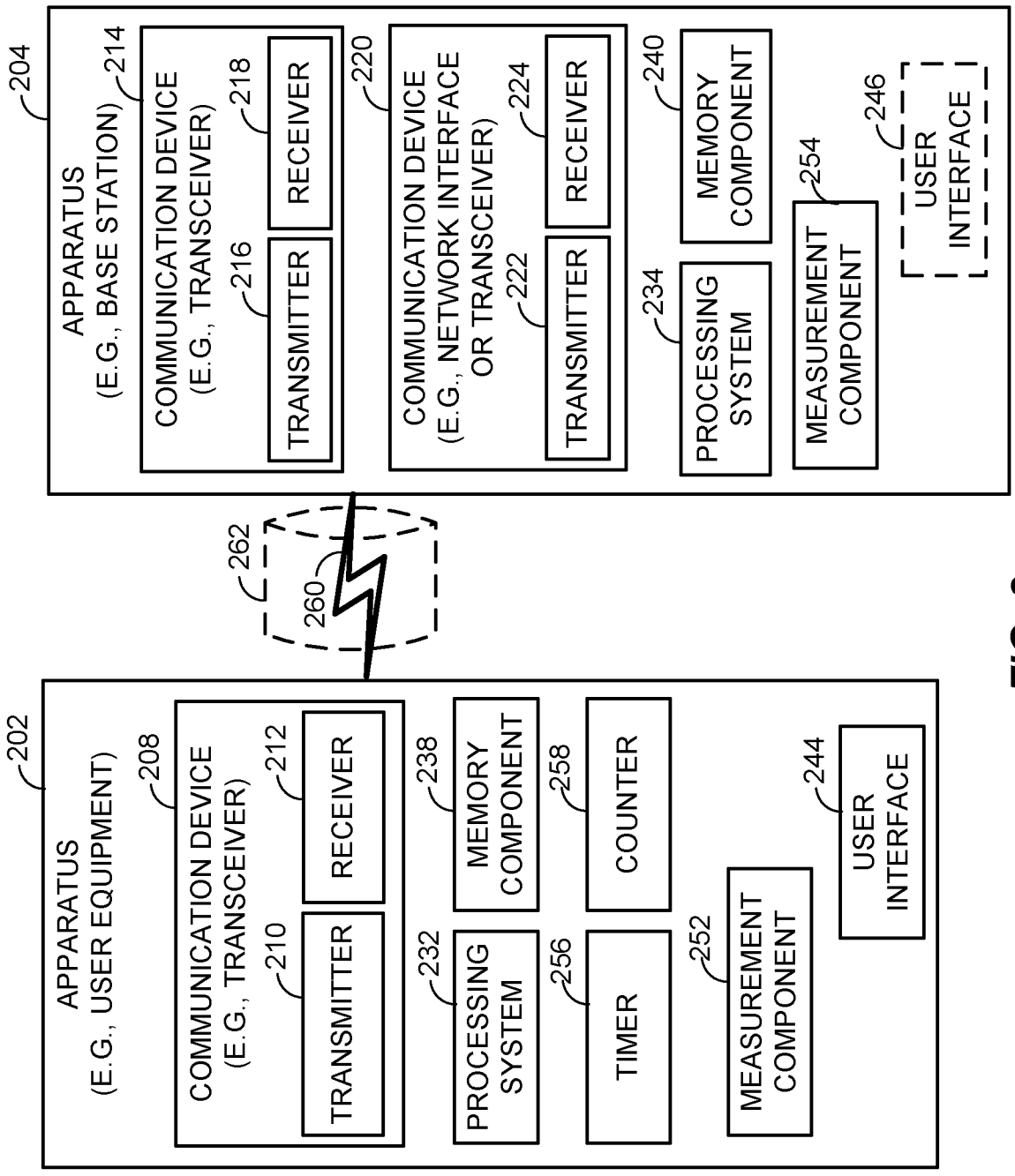
204
APPARATUS
(E.G., BASE STATION)
214
COMMUNICATION DEVICE
(E.G., TRANSCEIVER)
218
RECEIVER
216
TRANSMITTER
220
COMMUNICATION DEVICE
(E.G., NETWORK INTERFACE
OR TRANSCEIVER)
224
RECEIVER
222
TRANSMITTER
240
MEMORY
COMPONENT
234
PROCESSING
SYSTEM
254
MEASUREMENT
COMPONENT
246
USER
INTERFACE
262
260
202
APPARATUS
(E.G., USER EQUIPMENT)
208
COMMUNICATION DEVICE
(E.G., TRANSCEIVER)
212
RECEIVER
210
TRANSMITTER
238
MEMORY
COMPONENT
258
COUNTER
232
PROCESSING
SYSTEM
256
TIMER
252
MEASUREMENT
COMPONENT
244
USER
INTERFACE

FIG. 2

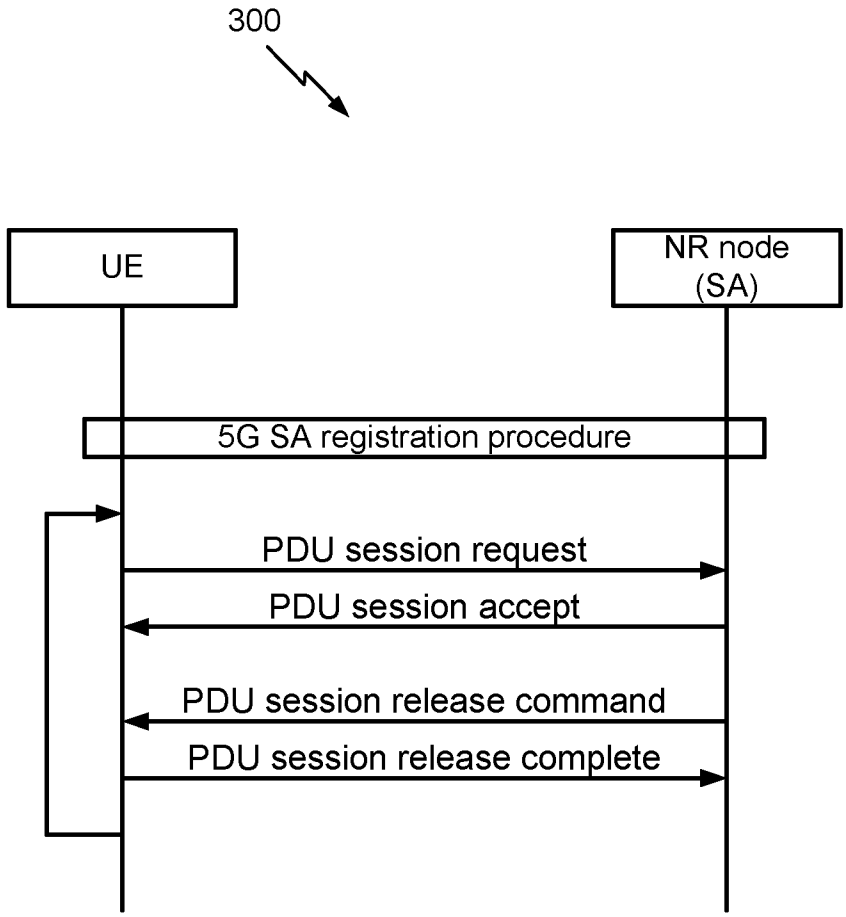
300
UE
NR node
(SA)
5G SA registration procedure
PDU session request
PDU session accept
PDU session release command
PDU session release complete

FIG. 3

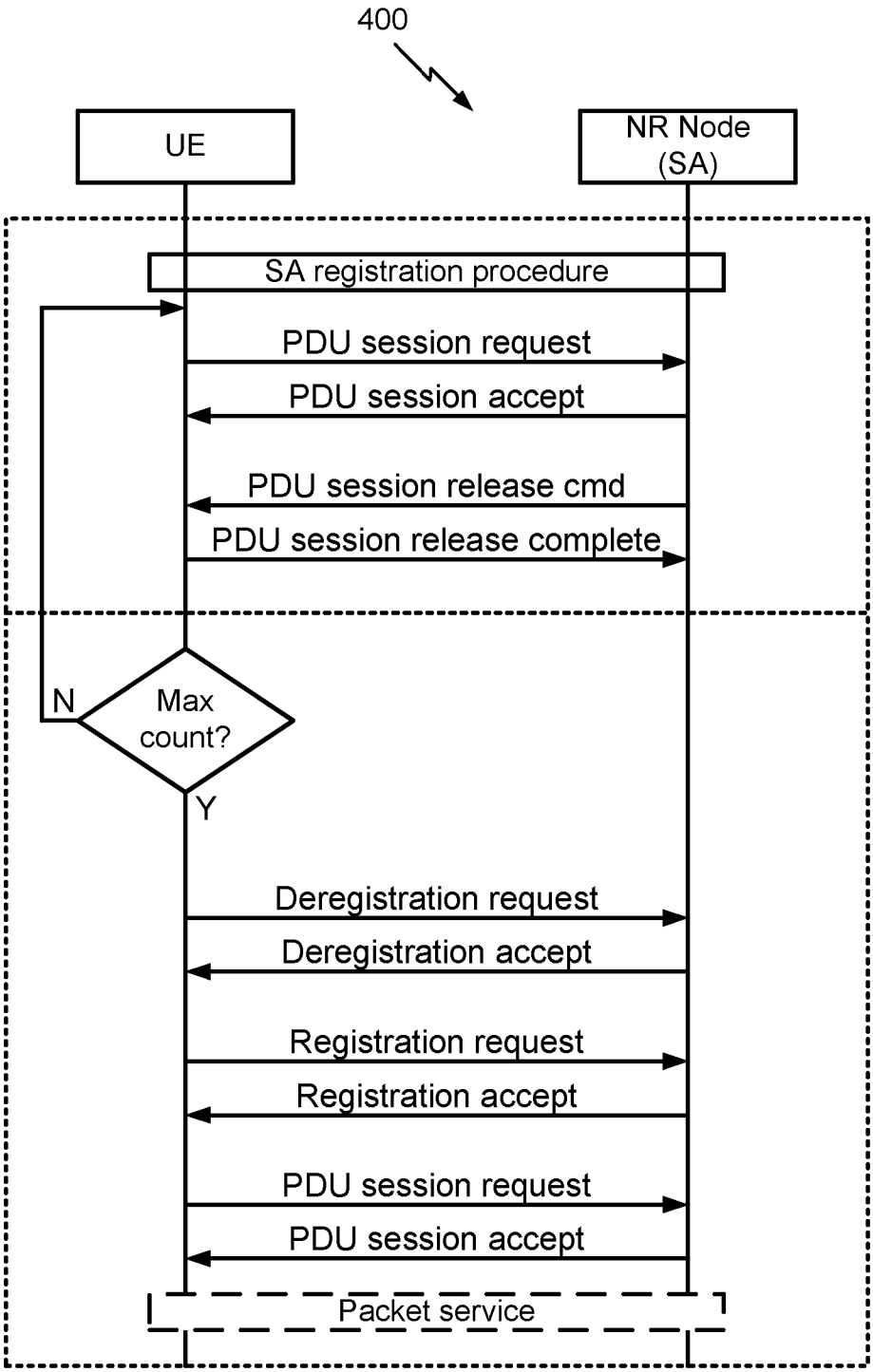
400
UE
NR Node (SA)
SA registration procedure
PDU session request
PDU session accept
PDU session release cmd
PDU session release complete
N
Max count?
Y
Deregistration request
Deregistration accept
Registration request
Registration accept
PDU session request
PDU session accept
Packet service

FIG. 4

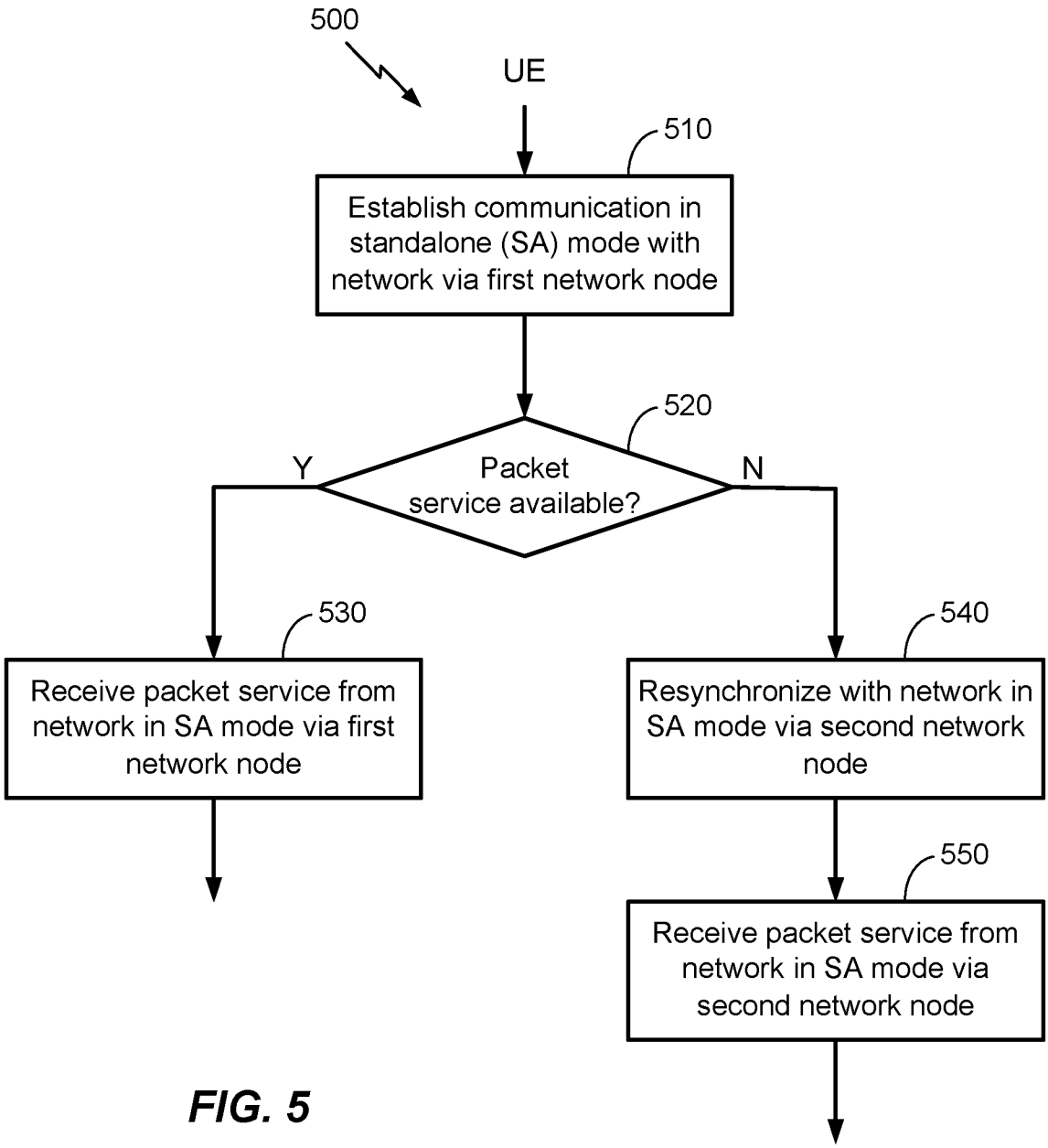
500
UE
510
Establish communication in standalone (SA) mode with network via first network node
520
Packet service available?
Y
N
530
Receive packet service from network in SA mode via first network node
540
Resynchronize with network in SA mode via second network node
550
Receive packet service from network in SA mode via second network node

FIG. 5

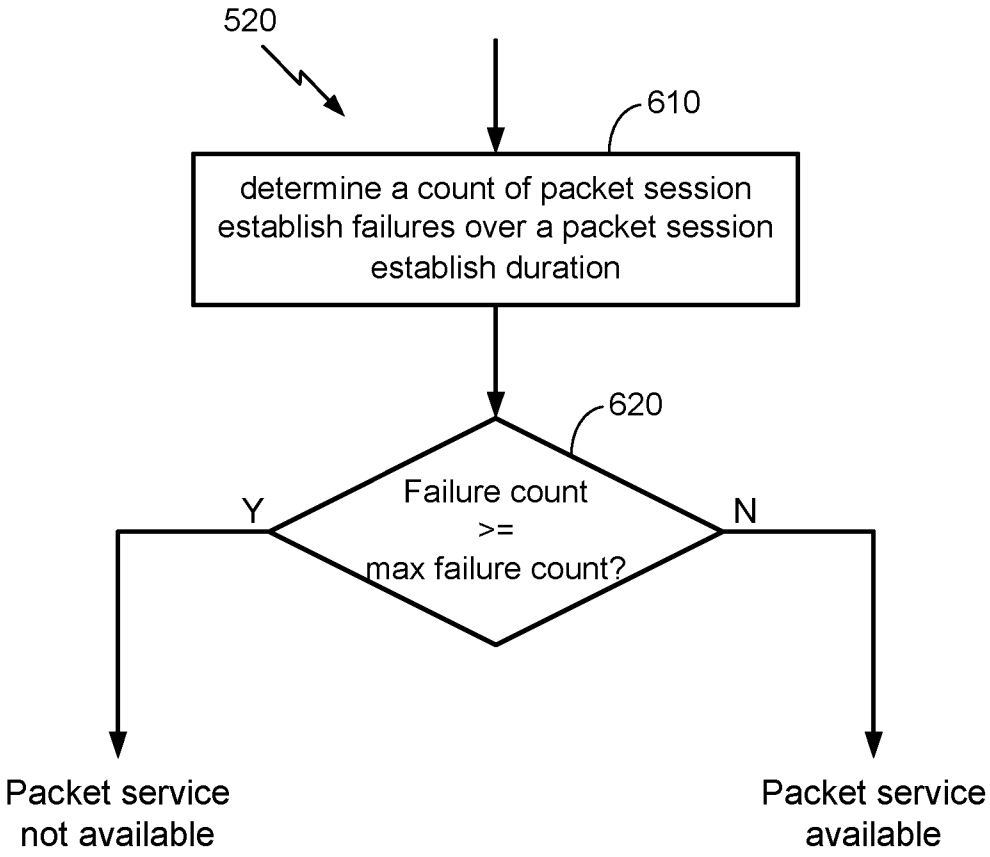
520
610
determine a count of packet session establish failures over a packet session establish duration
620
Failure count >= max failure count?
Y
N
Packet service not available
Packet service available

FIG. 6

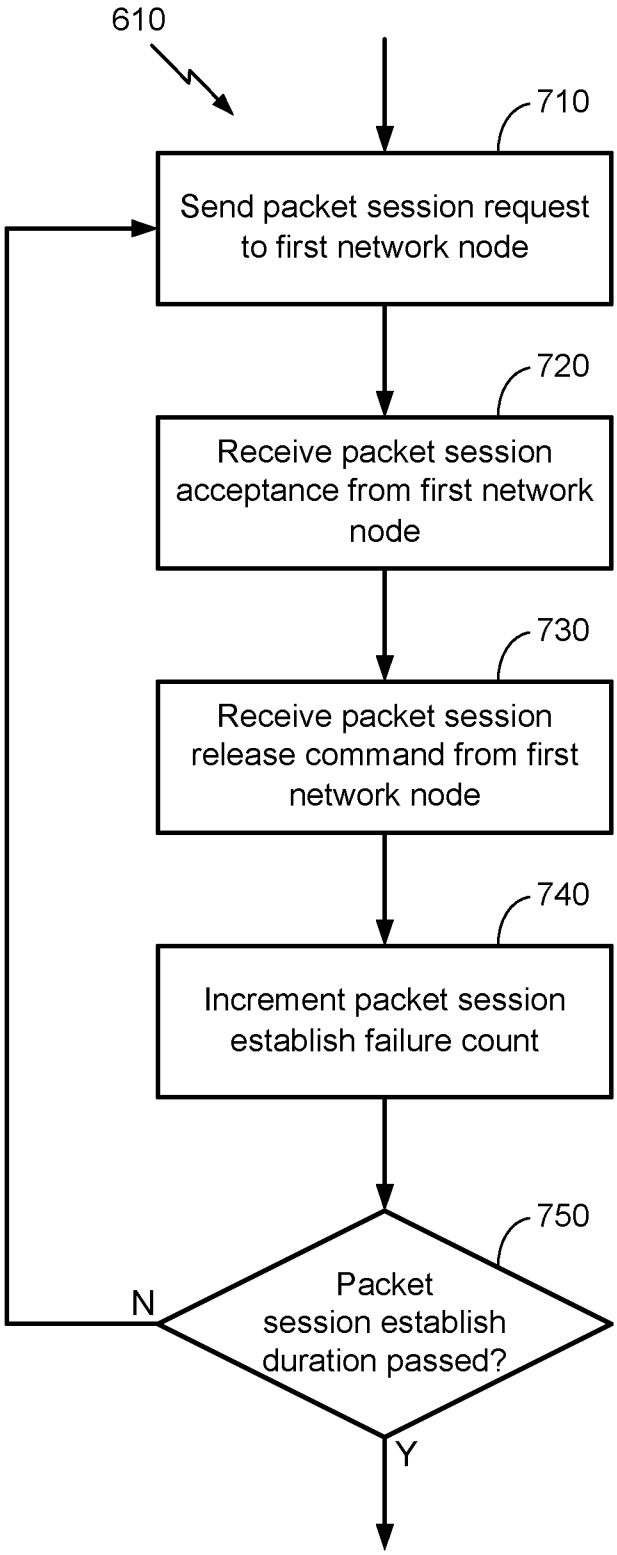
610
710
Send packet session request to first network node
720
Receive packet session acceptance from first network node
730
Receive packet session release command from first network node
740
Increment packet session establish failure count
750
Packet session establish duration passed?
N
Y

FIG. 7

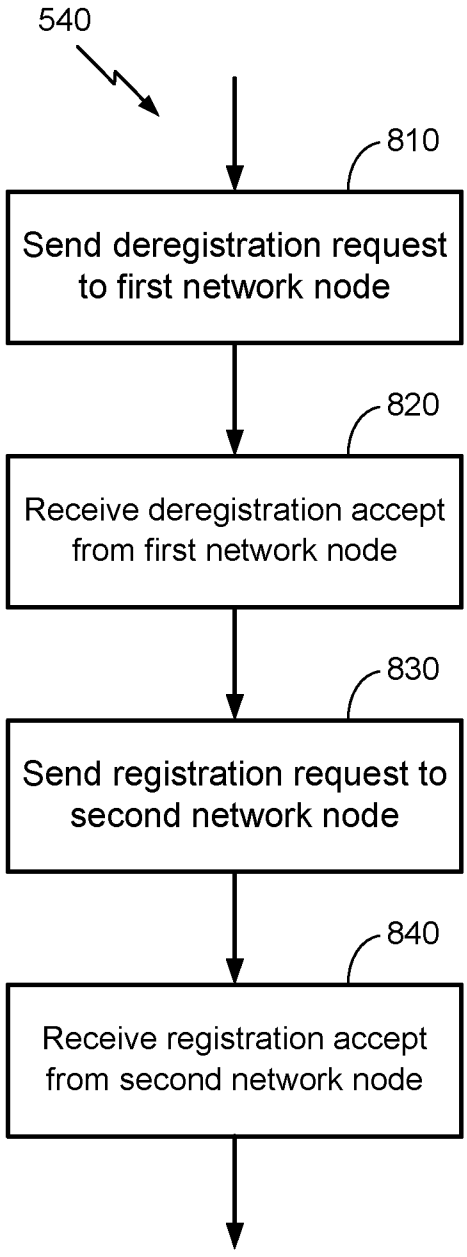
540
810
Send deregistration request to first network node
820
Receive deregistration accept from first network node
830
Send registration request to second network node
840
Receive registration accept from second network node

FIG. 8

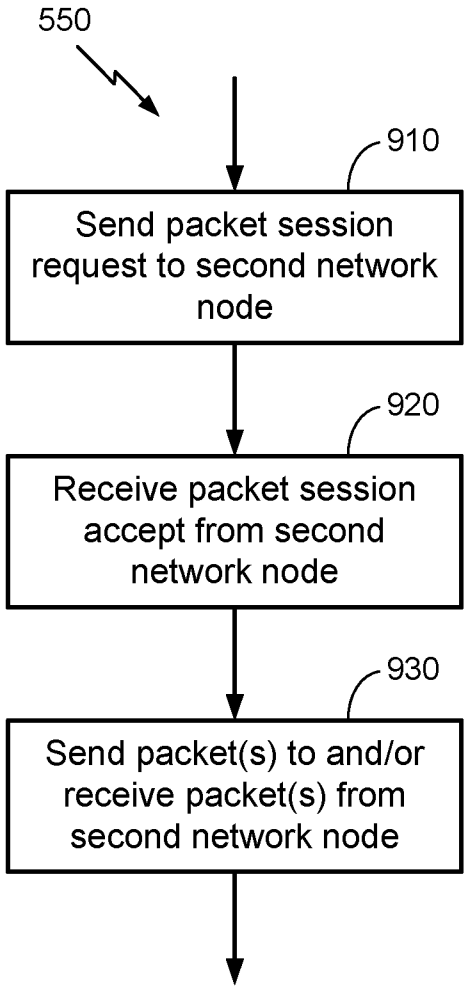
550
910
Send packet session request to second network node
920
Receive packet session accept from second network node
930
Send packet(s) to and/or receive packet(s) from second network node

FIG. 9

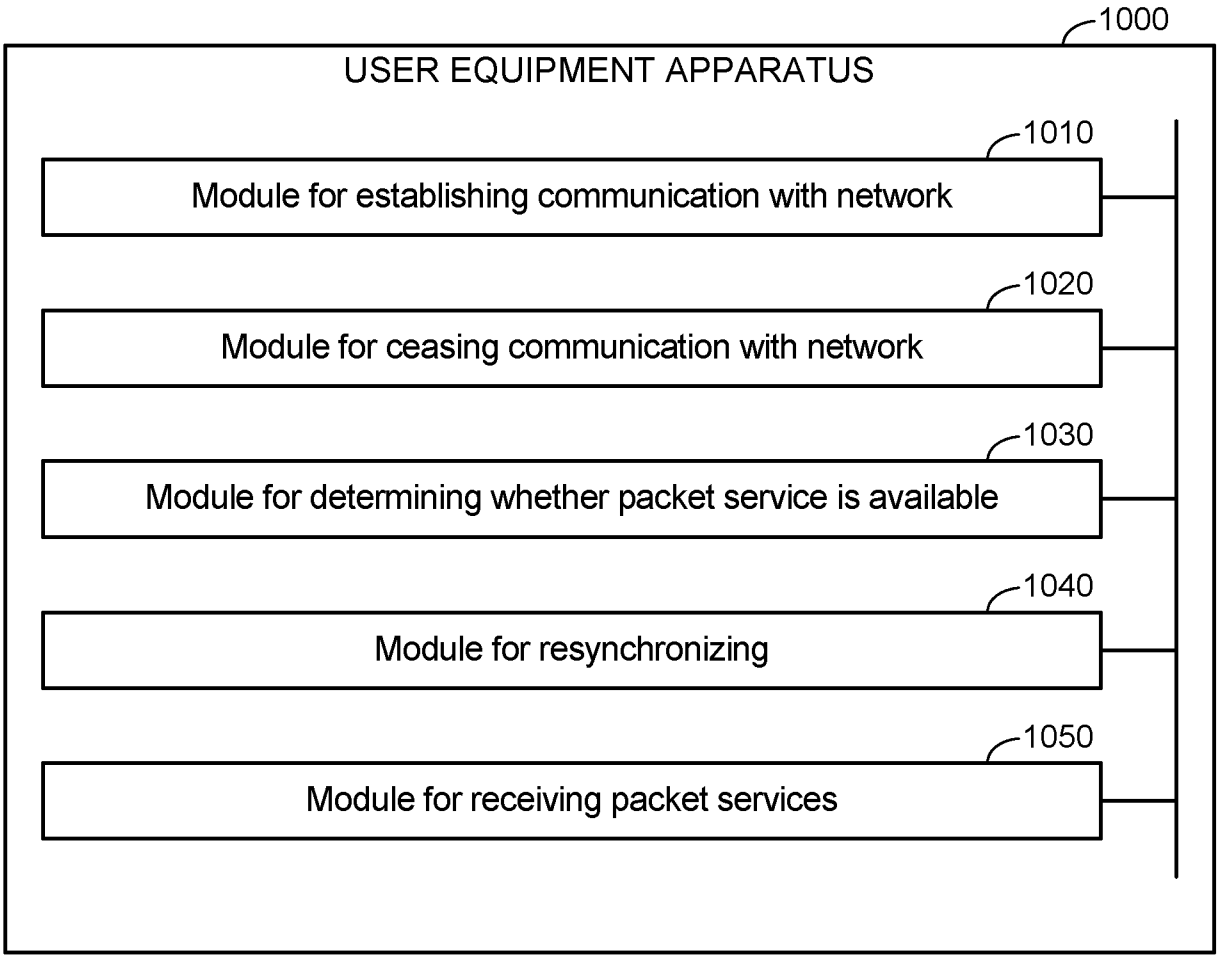
1000
USER EQUIPMENT APPARATUS
1010
Module for establishing communication with network
1020
Module for ceasing communication with network
1030
Module for determining whether packet service is available
1040
Module for resynchronizing
1050
Module for receiving packet services

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/093370

A. CLASSIFICATION OF SUBJECT MATTER

H04W 36/30(2009.01)i; H04W 36/16(2009.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W

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

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

EPODOC,WPI,CNPAT,CNKI,3GPP: 5G, NR, SA, standalone, stand-alone, packet, handover, switch, resynchronize, registration, failure, fail,session

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 110944369 A (HUAWEI TECHNOLOGIES CO., LTD.) 31 March 2020 (2020-03-31) claims 8-16, description, paragraphs [0113]-[0231], figures 2-12	1-24
A	WO 2019096328 A1 (HUAWEI TECHNOLOGIES CO., LTD.) 23 May 2019 (2019-05-23) the whole document	1-24
A	CN 109451549 A (CHINA UNITED NETWORK COMMUNICATIONS GROUP CO., LTD.) 08 March 2019 (2019-03-08) the whole document	1-24
A	CN 110430610 A (HUAWEI TECHNOLOGIES CO., LTD.) 08 November 2019 (2019-11-08) the whole document	1-24

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
05 February 2021	**01 March 2021**

Name and mailing address of the ISA/CN	Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/093370

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	110944369	A	31 March 2020	None			
WO	2019096328	A1	23 May 2019	US	2020288428	A1	10 September 2020
				EP	3713258	A1	23 September 2020
				KR	20200086731	A	17 July 2020
				CN	109819392	A	28 May 2019
				VN	72634	A	25 August 2020
				IN	202017024198	A	02 October 2020
CN	109451549	A	08 March 2019	None			
CN	110430610	A	08 November 2019	None			