



(51) International Patent Classification:

H04W 60/06 (2009.01) *H04W* 76/20 (2018.01)
H04W 76/34 (2018.01)

(21) International Application Number:

PCT/IN2024/050925

(22) International Filing Date:

26 June 2024 (26.06.2024)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

202321044331 03 July 2023 (03.07.2023) IN

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(54) Title: A SYSTEM AND METHOD FOR NETWORK INITIATED DE-REGISTRATION PROCESS FOR A USER EQUIP-
MENT TO ENABLE RECOVERY PROCEDURE

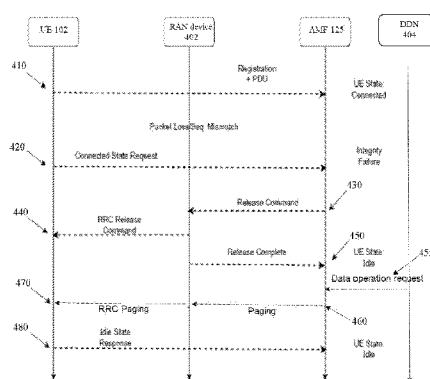


FIG. 4A

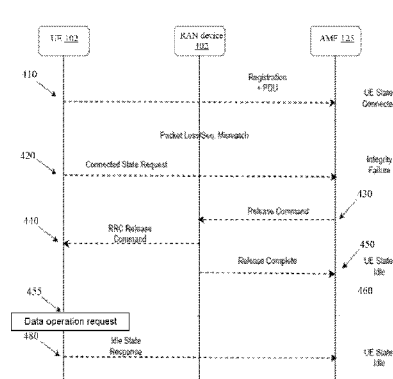


FIG. 4B

(57) Abstract: A system and a method for network initiated de-registration process for a User Equipment (UE) (102) to enable recovery procedure is described. The method comprises registering the UE (102) with an Access and Mobility Management Function (AMF) (125) based on a request received from the UE (102). The method further comprises receiving a connection state request, sent by the UE (102), at the AMF (125). The method further comprises releasing the connection between the AMF (125) and the UE (102), using a release procedure. The method further comprises receiving an idle state response at the AMF (125) sent by the UE (102). The idle state response is sent corresponding to a data operation request that is Mobile Originated (MO) or Mobile Terminated (MT). A network procedure is initiated by the AMF (125) based on the idle state response received from the UE (102).

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(81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

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

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

A SYSTEM AND METHOD FOR NETWORK INITIATED DE-REGISTRATION PROCESS FOR A USER EQUIPMENT TO ENABLE RECOVERY PROCEDURE

FIELD OF THE INVENTION

[0001] The present subject matter relates to communication procedures in communication networks including cellular communication networks and, more particularly, to integrity failure and recovery procedures in a communication network.

BACKGROUND OF THE INVENTION

[0002] The Registration procedure is a vital step in 5G networks where the User Equipment (UE) establishes initial access and connectivity with the core network by registering itself with the Access and Mobility Management Function (AMF). During registration, the UE provides essential information like identity, location, capabilities, and authentication credentials to the AMF. The AMF verifies these credentials and authorizes the UE's network access, enabling the establishment of a connection with the 5G core network. This connection allows the UE to engage in subsequent communication and access various services, indicating that the UE is in a connected state.

[0003] In the connected state, the UE transmits multiple data packets to the AMF for processing. Upon receiving a data packet, the AMF performs an integrity check on the packet. If the integrity check passes, the packet proceeds for further processing. However, if an integrity failure occurs and the check fails, indicating potential data corruption or tampering, the AMF discards the packet to prevent the propagation of compromised data throughout the network. One drawback is that in conventional integrity failure mechanisms, the UE may be configured to attempt a predetermined number of retransmissions to recover from the failure. This approach can be time-consuming, especially when a large number of retransmissions are attempted, leading to increased signaling overhead and related costs in the communication network.

[0004] Thus, there is a need for a solution which addresses the above mentioned shortcomings.

SUMMARY OF THE INVENTION

[0005] One or more embodiments of the present disclosure provide a system and method for performing recovery in a telecommunication network.

[0006] In one aspect of the present invention, a system for network initiated de-registration process for a user equipment (UE) to enable recovery procedure is disclosed. The system includes a registering unit configured to register the User Equipment (UE) with an Access and Mobility Management Function (AMF) based on a request received from the UE. The system further includes a transceiver unit configured to receive a connection state request at the AMF. The connection state request is sent by the UE. The system further includes a releasing unit configured to release connection between the AMF and the UE, using a release procedure. The system further includes the transceiver unit configured to receive an idle state response at the AMF sent by the UE. The idle state response is sent corresponding to a data operation request that is Mobile Originated (MO) or Mobile Terminated (MT). The system further includes an initiating unit configured to initiate a network procedure by the AMF based on the idle state response received from the UE.

[0007] In one aspect, receiving the idle state response by the receiving unit comprises at least one of Mobility Request (MR), Periodic registration Request (PR), Scheduling Request (SR), and Deregistration (DeReg) responses. Initiating the network procedure comprises a re-authentication procedure initiated by the AMF when the idle state response is MR/PR, or the network procedure is a re-registration procedure initiated by the AMF when the idle state response is SR. The system further comprises a paging unit configured to send a paging message from the AMF to the UE when the data operation request is MT. Receiving the connection state request comprises performing integrity check procedures to detect a packet loss, or a packet

sequence mismatch between the UE and the AMF. Releasing, by the releasing unit, comprises transmitting a release command to a Radio access network (RAN) device. The RAN device is configured to send a Radio Resource Control (RRC) release command to the UE. Releasing comprises terminating connection to the UE, further once the connection is terminated, the RAN device transmits a release complete message to the AMF. Subsequent to receiving, the connection state request, the transceiver is configured for transmitting protocol data units (PDUs) or data packets to the AMF from the UE.

[0008] In another aspect of the present invention, a method for network initiated de-registration process for a user equipment (UE) to enable recovery procedure is disclosed. The method includes the step of registering the UE with an Access and Mobility Management Function (AMF) based on a request received from the UE. The method further includes the step of receiving a connection state request at the AMF. The connection state request is sent by the UE. The method further includes the step of releasing the connection between the AMF and the UE, using a release procedure. The method further includes the step of receiving an idle state response at the AMF sent by the UE. The idle state response is sent corresponding to a data operation request that is Mobile Originated (MO) or Mobile Terminated (MT). The method further includes the step of initiating a network procedure by the AMF based on the idle state response received from the UE.

[0009] In one aspect, receiving the idle state response by the one or more processor comprises at least one of Mobility Request (MR), Periodic registration Request (PR), Scheduling Request (SR), and Deregistration (DeReg) response. Initiating the network procedure comprises a re-authentication procedure initiated by the AMF when the idle state response is MR/PR, or the network procedure is a re-registration procedure initiated by the AMF when the idle state response is SR. The method further comprises sending a paging message by the AMF to the UE when the data operation request is MT. Receiving the connection state request comprises performing integrity check procedures to detect a packet loss, or a packet sequence mismatch between the UE and

the AMF. Releasing comprises transmitting a release command to a Radio Access Network (RAN) device. The RAN device is configured to send a Radio Resource Control (RRC) release command to the UE. Releasing comprises terminating connection to the UE, further once the connection is terminated, the RAN device transmits a release complete message to the AMF. Subsequent to receiving the connection state request, the one or more processor is configured for transmitting protocol data units (PDUs) or data packets to the AMF from the UE.

[0010] Other features and aspects of this invention will be apparent from the following description and the accompanying drawings. The features and advantages described in this summary and in the following detailed description are not all-inclusive, and particularly, many additional features and advantages will be apparent to one of ordinary skill in the relevant art, in view of the drawings, specification, and claims hereof. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes and may not have been selected to delineate or circumscribe the inventive subject matter, resort to the claims being necessary to determine such inventive subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The accompanying drawings, which are incorporated herein, and constitute a part of this disclosure, illustrate exemplary embodiments of the disclosed methods and systems in which like reference numerals refer to the same parts throughout the different drawings. Components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present disclosure. Some drawings may indicate the components using block diagrams and may not represent the internal circuitry of each component. It will be appreciated by those skilled in the art that disclosure of such drawings includes disclosure of electrical components, electronic components or circuitry commonly used to implement such components.

[0012] **FIG. 1** illustrates a network architecture of a system for network initiated de-registration process for a user equipment (UE) to enable recovery procedure, according to one or more embodiments of the present disclosure;

[0013] **FIG. 2** illustrates a block diagram of the system for performing recovery in a telecommunication network, according to various embodiments of the present system;

[0014] **FIG. 3** illustrates a block diagram of the system and a UE communicating with each other for performing the recovery procedure, according to various embodiments of the present system;

[0015] **FIG. 4A** illustrates a first timing diagram showing steps performed during a recovery procedure, according to one or more embodiments of the present disclosure;

[0016] **FIG. 4B** illustrates a second timing diagram showing steps performed during a recovery procedure, according to one or more embodiments of the present disclosure; and

[0017] **FIG. 5** illustrates a flow chart of a method of performing recovery in a telecommunication network, according to one or more embodiments of the present disclosure.

[0018] The foregoing shall be more apparent from the following detailed description of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Some embodiments of the present disclosure, illustrating all its features, will now be discussed in detail. It must also be noted that as used herein and in the appended claims, the singular forms "a", "an" and "the" include plural references unless the context clearly dictates otherwise.

[0020] Various modifications to the embodiment will be readily apparent to those skilled in the art and the generic principles herein may be applied to other

embodiments. However, one of ordinary skill in the art will readily recognize that the present disclosure including the definitions listed here below are not intended to be limited to the embodiments illustrated but is to be accorded the widest scope consistent with the principles and features described herein.

[0021] A person of ordinary skill in the art will readily ascertain that the illustrated steps detailed in the figures and here below are set out to explain the exemplary embodiments shown, and it should be anticipated that ongoing technological development will change the manner in which particular functions are performed. These examples are presented herein for purposes of illustration, and not limitation. Further, the boundaries of the functional building blocks have been arbitrarily defined herein for the convenience of the description. Alternative boundaries can be defined so long as the specified functions and relationships thereof are appropriately performed. Alternatives (including equivalents, extensions, variations, deviations, etc., of those described herein) will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. Such alternatives fall within the scope and spirit of the disclosed embodiments.

[0022] The Registration procedure is an essential process in communication networks, such as 5G networks, where the User Equipment (UE) establishes initial access and connectivity with the core network. The UE initiates the Registration procedure to register itself with the Access and Mobility Management Function (AMF), which is a component of the 5G core network.

[0023] During the Registration procedure, the UE provides necessary information to the AMF, such as its identity, location, capabilities, and authentication credentials. The AMF verifies the UE's credentials and initiates the necessary procedures to authorize the UE's access to the network. This process allows the UE to establish a connection with the 5G core network and enables subsequent communication and services. After successful registration, the UE is said to be in a connected state.

[0024] Post establishment of the connection between the UE and the AMF, the UE in the connected state may transmit a plurality of data packets to the AMF, which are processed by the AMF. At the AMF, as and when a data packet is received an integrity check on the data packet is performed. In case the integrity check is passed, the data packet is processed further. Whereas, in case the integrity check is failed, in other words, an integrity failure occurs, the packet at the AMF is dropped.

[0025] In the conventional integrity failure mechanisms, the UE may be configured to attempt a predetermined number of retransmissions of the data packet in order to recover. As may be understood, the same may be a time-consuming task, for example, when the UE is configured to attempt lets, say, a large number of retransmissions in the event of a integrity failure at the AMF. Furthermore, such large number of retransmissions may also increase the signaling overheads and relates costs in the communication network.

[0026] According to an embodiment of the present subject matter, the AMF may be configured to put the UE in an Idle state when a packet integrity failure occurs at the AMF. Now, when the AMF pages the UE during a data operation, such as an MT data operation, and the UE responds with an idle procedure request, such as Mobility Request (MR), Periodic registration Request (PR), Scheduling Request (SR), and Deregistration (DeReg) request, the integrity failure will occur and the state of the UE would be idle. Based on the idle procedure request received from the UE, the AMF may be configured to initiate re-authentication procedure or a registration procedure.

[0027] The aforementioned procedures initiated by the AMF may subsequently result in recovery of the UE. Thus, the scenario where large number of retransmissions occur are avoided. As a result, signaling overheads and related operations costs are also reduced.

[0028] **FIG. 1** illustrates a network architecture of a system for network initiated de-registration process for a user equipment (UE) to enable recovery procedure. The network architecture comprises a plurality of User Equipment (UE) **102-1, 102-**

2,.....,102-n. At least one of the UE **102-1** through **102-n** may be configured to connect to a server **105**. For ease of disclosure, the plurality of UE **102-1** through **102-n** is referred as a UE **102**.

[0029] The UE **102** may comprise a memory such as a volatile memory (e.g., RAM), a non-volatile memory (e.g., disk memory, FLASH memory, EPROMs, etc.), an unalterable memory, and/or other types of memory. In one implementation, the memory might be configured or designed to store data. The UE **102** may be configured to connect with the server **105** through a communication network **110** for enabling a recovery procedure. The communication network **110** may use one or more communication interfaces/protocols such as, for example, VoIP, 802.11 (Wi-Fi), 802.15 (including Bluetooth™), 802.16 (Wi-Max), 802.22, Cellular standards such as CDMA, CDMA2000, WCDMA, Radio Frequency (e.g., RFID), Infrared, laser, Near Field Magnetics, etc.

[0030] The server **105** may include by way of example but not limitation, one or more of a standalone server, a server blade, a server rack, a bank of servers, a business telephony application server (BTAS), a server farm, hardware supporting a part of a cloud service or system, a home server, hardware running a virtualized server, one or more processors executing code to function as a server, one or more machines performing server-side functionality as described herein, at least a portion of any of the above, some combination thereof. In an embodiment, the entity may include, but is not limited to, a vendor, a network operator, a company, an organization, a university, a lab facility, a business enterprise, a defence facility, or any other facility that provides content.

[0031] Further, the server **105** may be communicably connected to a system **125**, via the communication network **110**. The system **125** may be configured to access services subscribed by enterprises, and additional services as mentioned above.

[0032] The UE **102** or wireless device may include, but are not limited to, a handheld wireless communication device (e.g., a mobile phone, a smart phone, a phablet device,

and so on), a wearable computer device (e.g., a head-mounted display computer device, a head-mounted camera device, a wristwatch computer device, and so on), a Global Positioning System (GPS) device, a laptop computer, a tablet computer, or another type of portable computer, a media playing device, a portable gaming system, and/or any other type of computer device with wireless communication capabilities, and the like. In an embodiment, the UE **102** may communicate with the system **125** via set of executable instructions residing on any operating system. In an embodiment, the UE **102** may include, but are not limited to, any electrical, electronic, electro-mechanical or an equipment or a combination of one or more of the above devices such as virtual reality (VR) devices, augmented reality (AR) devices, laptop, a general-purpose computer, desktop, personal digital assistant, tablet computer, mainframe computer, or any other computing device, wherein the computing device may include one or more in-built or externally coupled accessories including, but not limited to, a visual aid device such as camera, audio aid, a microphone, a keyboard, input devices for receiving input from a user such as touch pad, touch enabled screen, electronic pen and the like. It may be appreciated that the UE **102** may not be restricted to the mentioned devices and various other devices may be used.

[0033] The communication network **110** includes, by way of example but not limitation, one or more of a wireless network, a wired network, an internet, an intranet, a public network, a private network, a packet-switched network, a circuit-switched network, an ad hoc network, an infrastructure network, a Public-Switched Telephone Network (PSTN), a cable network, a cellular network, a satellite network, a fiber optic network, or some combination thereof. The communication network **110** may include, but is not limited to, a Third Generation (3G), a Fourth Generation (4G), a Fifth Generation (5G), a Sixth Generation (6G), a New Radio (NR), a Narrow Band Internet of Things (NB-IoT), an Open Radio Access Network (O-RAN), and the like.

[0034] The communication network **110** may also include, by way of example but not limitation, at least a portion of one or more networks having one or more nodes that transmit, receive, forward, generate, buffer, store, route, switch, process, or a

combination thereof, etc. one or more messages, packets, signals, waves, voltage or current levels, some combination thereof, or so forth. The network may also include, by way of example but not limitation, one or more of a wireless network, a wired network, an internet, an intranet, a public network, a private network, a packet-switched network, a circuit-switched network, an ad hoc network, an infrastructure network, a Public-Switched Telephone Network (PSTN), a cable network, a cellular network, a satellite network, a fiber optic network, a VOIP or some combination thereof.

[0035] The system **125** (alternatively referred as an Access and Mobility Management Function (AMF) **125**) is communicably coupled to the server **105** and each of the first UE **102-1**, the second UE **102-2**, and the third UE **102-n** via the communication network **110**. The system/AMF **125** is configured to handle recovery procedure for the UE **102**. The system **125** is adapted to be embedded within the server **105** or is embedded as an individual entity. However, for the purpose of description, the system **125** is described as an integral part of the server **105**, without deviating from the scope of the present disclosure.

[0036] In various embodiments, the system **125** may be generic in nature and may be integrated with any application including a System Management Facility (SMF), an Access and Mobility Management Function (AMF), a Business Telephony Application Server (BTAS), a Converged Telephony Application Server (CTAS), any SIP (Session Initiation Protocol) Application Server which interacts with core Internet Protocol Multimedia Subsystem (IMS) on Industrial Control System (ISC) interface as defined by Third Generation Partnership Project (3GPP) to host a wide array of cloud telephony enterprise services, a System Information Blocks (SIB)/ and a Mobility Management Entity (MME).

[0037] Session Management Function (SMF) is a control function that manages user sessions including establishment, modification and release of sessions, and allocates IP addresses for IP PDU sessions. The SMF communicates indirectly with the UE

through the AMF that relays session-related messages between the devices and the SMF..

[0038] Access and Mobility Management Function (AMF) is a key component in 5G mobile networks, responsible for managing access to the network and handling mobility-related functions for user equipment (UE), such as smartphones, tablets, and IoT devices. AMF works closely with other network functions to facilitate seamless connectivity, mobility, and quality of service for mobile users.

[0039] Business Telephony Application Server (BTAS) is a server-based system that provides telephony services and applications for businesses. It serves as a central platform for managing and delivering various voice communication services, such as voice calls, voicemail, conferencing, and interactive voice response (IVR) systems.

[0040] Converged Telephony Application Server (CTAS) is a server-based system that integrates various telephony and communication services into a single platform, enabling businesses to streamline their communication infrastructure and offer a wide range of communication features. CTAS combines traditional telephony services with advanced IP-based communication capabilities to provide a unified and cohesive communication experience.

[0041] SIP (Session Initiation Protocol) application server is a server-based system that facilitates the establishment, management, and termination of communication sessions using the SIP protocol. SIP application servers play a central role in IP-based telecommunications networks, enabling a wide range of real-time communication services, including voice calls, video calls, instant messaging, presence, and multimedia conferencing.

[0042] Internet Protocol Multimedia Subsystem (IMS) is a standardized architecture that enables the delivery of multimedia communication services over IP networks, including voice, video, messaging, and presence services. IMS is designed to provide a framework for delivering real-time communication services in a flexible, scalable, and interoperable manner.

[0043] Cloud telephony enterprise services refer to communication solutions delivered over the cloud that cater specifically to the needs of businesses and organizations. These services leverage cloud technology to provide scalable, flexible, and cost-effective communication solutions, including voice calls, messaging, collaboration tools, and contact center capabilities.

[0044] System Information Blocks (SIBs) are messages broadcast by a base station (eNodeB in LTE, NodeB in UMTS, or eNB in 5G) to provide essential information to mobile devices (UEs) in a cellular network. SIBs contain network-related information necessary for UEs to access and operate within the network efficiently. These blocks are periodically transmitted over broadcast channels, allowing UEs to receive and decode them even when they are not actively engaged in communication.

[0045] In the context of mobile networks, specifically in the LTE (Long-Term Evolution) and 5G architectures, the Mobility Management Entity (MME) is a key network element responsible for managing mobility-related functions for user equipment (UE) or mobile devices. The MME is part of the Evolved Packet Core (EPC) network in LTE and the 5G Core (5GC) network in 5G, serving as a control plane entity that handles signaling and control procedures for mobility management.

[0046] Operational and construction features of the system **125** will be explained in detail successively with respect to different figures. **FIG. 2** illustrates a block diagram of the system **125** for performing recovery in a telecommunication network, according to one or more embodiments of the present disclosure.

[0047] As per the illustrated embodiment, the system **125** includes one or more processors **205**, a memory **210**, and an input/output interface unit **215**. The one or more processors **205**, hereinafter referred to as the processor **205**, may be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, single board computers, and/or any devices that manipulate signals based on operational instructions. As per the illustrated embodiment, the system **125** includes the processor **205**. However, it is to be noted that the system **125** may include multiple processors

as per the requirement and without deviating from the scope of the present disclosure. Among other capabilities, the processor **205** is configured to fetch and execute computer-readable instructions stored in the memory **210**. The memory **210** may be configured to store one or more computer-readable instructions or routines in a non-transitory computer-readable storage medium, which may be fetched and executed to create or share data packets over a network service. The memory **210** may include any non-transitory storage device including, for example, volatile memory such as RAM, or non-volatile memory such as EPROM, flash memory, and the like.

[0048] In an embodiment, the input/output (I/O) interface unit **215** includes a variety of interfaces, for example, interfaces for data input and output devices, referred to as Input/Output (I/O) devices, storage devices, and the like. The I/O interface unit **215** facilitates communication of the system **125**. In one embodiment, the I/O interface unit **215** provides a communication pathway for one or more components of the system **125**. Examples of such components include, but are not limited to, the UE **102**, a database **220**, and a distributed cache **225**.

[0049] The database **220** is one of, but is not limited to, a centralized database, a cloud-based database, a commercial database, an open-source database, a distributed database, an end-user database, a graphical database, a No-Structured Query Language (NoSQL) database, an object-oriented database, a personal database, an in-memory database, a document-based database, a time series database, a wide column database, a key value database, a search database, a cache database, and so forth. The foregoing examples of the database **220** types are non-limiting and may not be mutually exclusive e.g., a database can be both commercial and cloud-based, or both relational and open-source, etc.

[0050] The distributed cache **225** is a pool of Random-Access Memory (RAM) of multiple networked computers into a single in-memory data store for use as a data cache to provide fast access to data. The distributed cache **225** is essential for applications that need to scale across multiple servers or are distributed

geographically. The distributed cache **225** ensures that data is available close to where it's needed, even if the original data source is remote or under heavy load.

[0051] Further, the processor **205**, in an embodiment, may be implemented as a combination of hardware and programming (for example, programmable instructions) to implement one or more functionalities of the processor **205**. In the examples described herein, such combinations of hardware and programming may be implemented in several different ways. For example, the programming for the processor **205** may be processor-executable instructions stored on a non-transitory machine-readable storage medium and the hardware for the processor **205** may comprise a processing resource (for example, one or more processors), to execute such instructions. In the present examples, the memory **210** may store instructions that, when executed by the processing resource, implement the processor **205**. In such examples, the system **125** may comprise the memory **210** storing the instructions and the processing resource to execute the instructions, or the memory **210** may be separate but accessible to the system **125** and the processing resource. In other examples, the processor **205** may be implemented by electronic circuitry.

[0052] For the system/AMF **125** to perform recovery procedure, the processor **205** includes a registering unit **230** communicably coupled to the UE **102**. The registering unit **230** registers the UE **102** with the system/AMF **125** based on a request received from the UE **102**. The processor **205** further includes a transceiver unit **235** communicably coupled to the registering unit **230** for receiving a connection state request at the system/AMF **125**. The connection state request is sent by the UE **102**. While receiving the connection state request, integrity check procedures are performed to detect packet loss, or packet sequence mismatch between the UE **102** and the system/AMF **125**. The processor **205** further includes a releasing unit **240** communicably coupled to the transceiver unit **235** for releasing the connection between the system/AMF **125** and the UE **102**, using a release procedure. While releasing the connection, a release command is transmitted to a Radio Access Network (RAN) device configured to send a Radio Resource Control (RRC) release command

to the UE **102**. Based on the release command, connection to the UE **102** is terminated, and the RAN device transmits a release complete message to the system/AMF **125**.

[0053] The processor **205** further includes a transceiver unit **250** communicably coupled to the releasing unit **240** for receiving an idle state response at the system/AMF **125** sent by the UE **102**. The idle state response is sent corresponding to a data operation request that is Mobile Originated (MO) or Mobile Terminated (MT). Receiving the idle state response comprises at least one of Mobility Request (MR), Periodic registration Request (PR), Scheduling Request (SR), and Deregistration (DeReg) response. The processor **205** further includes a paging unit **245** communicably coupled to the transceiver unit **250** for sending a paging message from the AMF **125** to the UE **102** when the data operation request is MT. The processor **205** further includes an initiating unit **255** communicably coupled to the transceiver unit **250** for initiating a network procedure by the system/AMF **125** based on the idle state response received from the UE **102**. To initiate the network procedure, a re-authentication procedure is initiated by the system/AMF **125** when the idle state response is MR/PR, the network procedure is a re-registration procedure initiated by the system/AMF **125** when the idle state response is SR, and an integrity failure may occur again at the AMF **125** when the network idle response is DeReg.

[0054] Referring to **FIG. 3** illustrating a block diagram of the system **125** and the first UE **102-1** communicating with each other for performing the recovery procedure, a preferred embodiment of the system **125** is described. It is to be noted that the embodiment with respect to **FIG. 3** will be explained with respect to the first UE **102-1** for the purpose of description and illustration and should nowhere be construed as limited to the scope of the present disclosure.

[0055] The first UE **102-1** includes one or more primary processors **305** communicably coupled to the processor **205** of the system **125**. The one or more primary processors **305** are coupled with a memory unit **310** storing instructions which are executed by the one or more primary processors **305**. Execution of the stored instructions by the one or more primary processors **305** enables the first UE **102-1** to

send a request for registration, connection state request, and idle state response to the system/AMF **125**. The first UE **102-1** further includes a kernel **315** which is a core component serving as the primary interface between hardware components of the first UE **102-1** and the plurality of services at the database **220**. The kernel **315** is configured to provide the plurality of services on the first UE **102-1** to resources available in the communication network **110**. The resources include one of a Central Processing Unit (CPU), memory components such as Random Access Memory (RAM) and Read Only Memory (ROM).

[0056] In the preferred embodiment, the registering unit **230** of the processor **205** is communicably connected to the kernel **315** of the first UE **102-1**. The registering unit **230** is configured to register the UE **102** with the system/AMF **125** based on a request received at a transceiver unit **235** from the UE **102**. The processor **205** further includes the transceiver unit **235** communicably coupled to the registering unit **230** for receiving a connection state request at the system/AMF **125**. The connection state request is sent by the UE **102**. While receiving the connection state request, integrity check procedures are performed to detect packet loss, or packet sequence mismatch between the UE **102** and the system/AMF **125**. The processor **205** further includes a releasing unit **240** communicably coupled to the transceiver unit **235** for releasing the connection between the system/AMF **125** and the UE **102**, using a release procedure. While releasing the connection, a release command is transmitted to a Radio Access Network (RAN) device configured to send a Radio Resource Control (RRC) release command to the UE **102**. Based on the release command, connection to the UE **102** is terminated, and the RAN device transmits a release complete message to the system/AMF **125**.

[0057] The processor **205** further includes a transceiver unit **250** communicably coupled to the releasing unit **240** for receiving an idle state response at the system/AMF **125** sent by the UE **102**. Receiving the idle state response comprises at least one of Mobility Request (MR), Periodic registration Request (PR), Scheduling Request (SR), and Deregistration (DeReg) response. The idle state response is sent

corresponding to a data operation request that is Mobile Originated (MO) or Mobile Terminated (MT). The processor **205** further includes a paging unit **245** communicably coupled to the transceiver unit **250** for sending a paging message from the AMF **125** to the UE **102** when the data operation request is MT. The processor **205** further includes an initiating unit **255** communicably coupled to the transceiver unit **250** for initiating a network procedure by the system/AMF **125** based on the idle state response received from the UE **102**. To initiate the network procedure, a re-authentication procedure is initiated by the system/AMF **125** when the idle state response is MR/PR, or the network procedure is a re-registration procedure initiated by the system/AMF **125** when the idle state response is SR.

[0058] FIG. 4A illustrates a first timing diagram showing steps performed during a recovery procedure, according to one or more embodiments of the present disclosure. The steps have been described henceforth with reference to the communication occurring between the UE **102**, the AMF **125**, and a Radio Access Network (RAN) device **402**.

[0059] At step **410**, the UE **102** performs a registration procedure for registering itself with the AMF **125**. The process of registration of the UE **102** with the AMF **125** typically involves several steps, ensuring authentication, authorization, and establishing a session for the UE to access network services. Typically, one or more of the below mentioned steps are involved.

- a) Random access procedure: The UE **102** sends a random access request to the nearest base station (gNB in 5G), indicating its desire to access the network. This request includes information like the UE's identity and capabilities.
- b) RACH procedure: The gNB receives the random access request and allocates resources for the UE **102** to transmit its registration request.
- c) Registration request: The UE **102** sends a registration request message, typically referred to as an Initial Registration Setup Request, to the gNB. This message contains

essential information about the UE, such as its identity, capabilities, and requested services.

d) Authentication and security: The gNB forwards the registration request to the AMF **125** in the core network. The AMF **125** authenticates the UE **102** using authentication mechanisms such as the Authentication and Key Agreement (AKA) protocol.

e) Subscription check: The AMF **125** verifies the UE's subscription information to ensure that it is authorized to access the requested services using one or more core network node.

f) Session establishment: If authentication and authorization are successful, the AMF **125** initiates the session establishment process using the session management function (SMF). This involves allocating resources and establishing context for the UE **102** within the network.

g) Registration acceptance: The AMF **125** sends a registration acceptance message back to the gNB, indicating that the registration process was successful.

[0060] Once the UE **102** is successfully registered, the UE **102** is said to be in a connected state. Subsequently, the UE **102** may transmit Protocol Data Units (PDUs) or data packets to the AMF **125**, which are subsequently processed by the AMF **125**.

[0061] In one scenario, some packet loss and/or some uplink sequence number mismatch may occur between the UE **102** and the AMF **125**. Accordingly, at step **420**, when the UE **102** transmits a connected state request to the AMF **125**, an integrity failure occurs at the AMF **125**. For example, the UE **102** may transmit an Uplink NAS transport request to the AMF **125**. On receiving the request, the AMF **125** may perform an integrity check, and determine a packet loss/mismatch, which results in integrity failure.

[0062] At step **430**, the AMF **125** transmits a release command to the RAN device **402**. Subsequently, the RAN device **402** may transmit a Radio Resource Control (RRC) release command to the UE **102**, at step **440**. In response to receiving the RRC release command, the UE **102** may release the connection with the network. Once the

UE **102** releases the connection with the network, the RAN device **402** may transmit a release complete message to the AMF **125**. In an example, the AMF **106** may receive the release complete message, at step **450**. Thus, a state of the UE **102** at the AMF **125** is registered as idle.

[0063] Although the release procedure for releasing the connection between the AMF **125** and the UE **102** is described briefly above, typically the procedure involves one or more of the below steps.

- a) UE initiation: The UE **102** initiates the release process by sending a request to release the connection to the network. This could be triggered by the user powering off the device, moving out of coverage, or explicitly terminating a session.
- b) Release request: The UE **102** sends a release request message to the AMF **125**, indicating its intention to terminate the connection. This message typically includes information about the reason for the release.
- c) Context release: The AMF **125** receives the release request and initiates the context release procedure. This involves releasing the resources allocated for the UE **102** session and removing its context from the network.
- d) Session termination: The AMF **125** sends messages to relevant network elements, such as the serving gateway (SGW) and packet data network gateway (PGW), to release the session and associated resources.
- e) Release acknowledgment: Once the context release procedure is completed, the AMF sends a release acknowledgment message back to the UE **102**, confirming that the connection has been terminated successfully.
- f) UE cleanup: Upon receiving the release acknowledgment, the UE **102** performs any necessary cleanup actions, such as releasing radio resources and closing network interfaces.
- g) User notification: If necessary, the UE **102** may notify the user about the successful release of the connection.

h) Network cleanup: The network elements involved in the UE **102** session release process perform cleanup actions to release any remaining resources associated with the session.

i) Session deletion: The AMF **125** removes the UE's session context from its databases, ensuring that no further communication is possible with the released UE **102**.

j) Idle state: After the release process is completed, the UE **102** enters an idle state, where it may remain until it initiates a new connection or moves to a new location requiring network access.

[0064] Successively, the AMF **125** may receive a data operation request, at step **455**. The data operation request may be Mobile Terminated (MT) and issued by a Digital Data Network (DDN) **404**. An MT data operation refers to the process of transmitting data from a network server or application to a user equipment. This data transmission is typically initiated by a network entity and terminated at the mobile device. MT data operation is commonly used for various applications and services, including messaging, push notifications, remote device management, software updates, and real-time data delivery.

[0065] In response to the data operation request, the AMF **125** sends a paging message to the RAN device **402**, at step **460**. Accordingly, the RAN device **402** transmits a RRC paging message to the UE **102**, at step **470**.

[0066] Paging involves the process of locating and notifying the UE **102** when there is incoming data or a call directed to it. This is managed by the AMF **125** in 5G Core network. Typically, a paging procedure involves one or more of the below steps:

a) Paging decision: Based on the UE's recorded location and the area where the data or call needs to be delivered, the AMF **125** decides which cell(s) need to be paged to reach the UE **102**.

- b) **Paging message generation:** The AMF **125** generates paging messages containing information about the UE and the reason for paging (e.g., incoming data, incoming call).
- c) **Paging transmission:** The generated paging messages are sent to the base stations (gNBs) serving the identified cells where the UE **102** might be located.
- d) **Paging broadcast:** The base stations broadcast the paging messages over the air interface within their coverage area.
- e) **UE Monitoring:** The UE **102** monitors the broadcasted paging messages while in its idle state, periodically waking up to check for incoming pages.
- f) **UE Response:** If the UE **102** detects a paging message addressed to it, it responds by initiating a service request procedure to establish the necessary connection with the network.
- g) **Service Establishment:** Upon receiving the UE's service request, the network establishes the necessary session and delivers the requested service (e.g., data transfer, call setup).
- h) **Confirmation:** The network confirms the successful establishment of the requested service to both the UE **102** and the originating entity (e.g., another UE, application server).

[0067] In another scenario, the data operation request may be Mobile Originated (MO), at step **455**, as shown in **FIG. 4B** illustrating a second timing diagram. An MO data operation refers to the process of transmitting data from a user equipment to a network server. This data transmission is typically initiated by the user equipment and terminated at the network entity. MO data operation is commonly used for various applications and services, including messaging, push notifications, remote device management, software updates, and real-time data delivery. When the data operation request is MO, the AMF **125** is not required to send any paging message.

[0068] Corresponding to the data operation request, the UE **102** sends an idle state response to the AMF **125**, at step **480**. The idle state response may be an MR/PR/SR/DeReg. The idle state response sent by the UE **102** is received by the AMF **125**. At the AMF **125**, an integrity failure may occur again during the idle state response. In such condition, since the UE **102** is in an idle state, based on the idle state response, the AMF **125** may initiate a network procedure. For instance, in an example where the network idle response is MR or PR, the AMF **125** may initiate a re-authentication procedure. In another example, where the network idle response is SR, the AMF **125** may initiate a re-registration procedure. In yet another instance, where the network idle response is DeReg, an integrity failure may occur again at the AMF **125**.

[0069] Upon initiation of the aforementioned procedures, recovery of the UE **102** is also triggered. Thus, the cumbersome and time consuming UE dependent recovery procedure, which entails large number of retransmissions, is averted. Further, overhead signaling is also reduced as less number of messages are required for recovery.

[0070] **FIG. 5** illustrates a flow chart of a method **500** of performing recovery in a telecommunication network, according to one or more embodiments of the present disclosure. For the purpose of description, the method **500** is described with the embodiments as illustrated in **FIGS. 1** and **4** and should nowhere be construed as limiting the scope of the present disclosure. A person of ordinary skill in the art will readily ascertain that the illustrated steps are set out to explain the exemplary embodiments shown, and it should be anticipated that ongoing technological development will change the manner in which particular functions are performed. These examples are presented herein for purposes of illustration, and not limitation. Further, the boundaries of the functional building blocks have been arbitrarily defined herein for the convenience of the description. Alternative boundaries can be defined so long as the specified functions and relationships thereof are appropriately performed. Alternatives (including equivalents, extensions, variations, deviations,

etc., of those described herein) will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. Such alternatives fall within the scope and spirit of the disclosed embodiments.

[0071] At step **505**, the method **500** includes the step of registering a UE by an AMF based on a request received from the UE. In an example, the UE may seek to get into a connected mode and may accordingly send the request to the network. The request may include particulars or identifiers of the UE, amongst other things. The request may be processed by the AMF and after verification, the UE may be registered and may be said to be in a connected state. In an example, post the connection, there may occur a packet loss or sequence mismatch between the UE and the AMF.

[0072] At step **510**, the method **500** includes the step of receiving, by the AMF, a connected state request sent by the UE. In an example, the connected state request may be an uplink NAS transport request. On receiving the request, the AMF may be configured to perform routine integrity check procedures. Now, since there has been a packet loss or sequence mismatch between the UE and the AMF, the integrity check procedure fails, resulting in an integrity failure at the AMF.

[0073] At step **515**, the method **500** includes the step of initiating, by the AMF, a release procedure to release the connection with the UE. In an example, the AMF may transmit a release command to a RAN device. The RAN device in response may send a RRC release command to the UE. On receiving the RRC release command, the UE terminates the connection. Once the connection is terminated, the RAN device transmits a release complete message to the AMF.

[0074] At step **520**, the method **500** includes the step of receiving a data operation request. The data operation request may be Mobile Originated (MO) or Mobile Terminated (MT). Paging procedure may be performed additionally when the data operation request is MT.

[0075] At step **525**, the method **500** includes the step of receiving, by the AMF, an idle state response sent by the UE, corresponding to the data operation request. The idle state response may be an MR/PR/SR/DeReg response. At the AMF, again an integrity failure occurs when the idle state response is received and the method proceeds to step **530**.

[0076] At step **530**, the method **500** includes the step of initiating, by the AMF, a network procedure based on the idle state response received from the UE. In an example, the network procedure may be a re-authentication procedure initiated by the AMF when the idle state response is MR/PR. In another example, the network procedure may be a re-registration procedure initiated by the AMF when the idle state response is SR. An integrity failure may occur again at the AMF when the network idle response is DeReg. As a result of these procedures, the UE is recovered.

[0077] The present invention further discloses a non-transitory computer-readable medium having stored thereon computer-readable instructions. The computer-readable instructions are executed by the processor **205**. The processor **205** is configured to register the UE with an Access and Mobility Management Function (AMF) based on a request received from the UE. The processor **205** is further configured to receive a connection state request, sent by the UE, at the AMF. The processor **205** is further configured to release the connection between the AMF and the UE, using a release procedure. The processor **205** is further configured to receive an idle state response at the AMF sent by the UE. The idle state response is sent in response to a data operation request that is Mobile Originated (MO) or Mobile Terminated (MT). The processor **205** is further configured to initiate a network procedure by the AMF based on the idle state response received from the UE.

[0078] A person of ordinary skill in the art will readily ascertain that the illustrated embodiments and steps in description and drawings (**FIGS.1-5**) are set out to explain the exemplary embodiments shown, and it should be anticipated that ongoing technological development will change the manner in which particular functions are performed. These examples are presented herein for purposes of illustration, and not

limitation. Further, the boundaries of the functional building blocks have been arbitrarily defined herein for the convenience of the description. Alternative boundaries can be defined so long as the specified functions and relationships thereof are appropriately performed. Alternatives (including equivalents, extensions, variations, deviations, etc., of those described herein) will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. Such alternatives fall within the scope and spirit of the disclosed embodiments.

[0079] The above described techniques (of performing recovery in a telecommunication network) of the present invention provide multiple advantages, including providing an improved recovery mechanism for integrity failures between the UE and AMF. Instead of relying on a time-consuming and potentially excessive number of retransmissions, the AMF is designed to transition the UE to an Idle state upon encountering an integrity failure. Subsequently, when the AMF initiates paging to the UE during a data operation, such as an MT (Mobile Terminated) or MO (Mobile Originated) data operation, and the UE responds with an idle procedure request, the AMF can trigger re-authentication or registration procedures. This innovative approach minimizes the occurrence of a large number of retransmissions, reducing signaling overhead and associated operational costs while ensuring efficient recovery of the UE.

[0080] Overall, the present invention introduces a more effective recovery mechanism for integrity failures, leading to improved network performance, reduced signaling overhead, and optimized operational costs in communication networks.

[0081] The present invention offers multiple advantages over the prior art and the above listed are a few examples to emphasize on some of the advantageous features. The listed advantages are to be read in a non-limiting manner.

[0082] Server: A server may include or comprise, by way of example but not limitation, one or more of a standalone server, a server blade, a server rack, a bank of servers, a server farm, hardware supporting a part of a cloud service or system, a home server, hardware running a virtualized server, one or more processors executing code

to function as a server, one or more machines performing server-side functionality as described herein, at least a portion of any of the above, some combination thereof. In an embodiment, the entity may include, but is not limited to, a vendor, a network operator, a company, an organization, a university, a lab facility, a business enterprise, a defence facility, or any other facility that provides content.

[0083] Network: A network may include, by way of example but not limitation, at least a portion of one or more networks having one or more nodes that transmit, receive, forward, generate, buffer, store, route, switch, process, or a combination thereof, etc. one or more messages, packets, signals, waves, voltage or current levels, some combination thereof, or so forth. The network may also include, by way of example but not limitation, one or more of a wireless network, a wired network, an internet, an intranet, a public network, a private network, a packet-switched network, a circuit-switched network, an ad hoc network, an infrastructure network, a Public-Switched Telephone Network (PSTN), a cable network, a cellular network, a satellite network, a fiber optic network, or some combination thereof.

[0084] UE/ Wireless Device: A wireless device or a user equipment (UE) may include, but are not limited to, a handheld wireless communication device (e.g., a mobile phone, a smart phone, a phablet device, and so on), a wearable computer device (e.g., a head-mounted display computer device, a head-mounted camera device, a wristwatch computer device, and so on), a Global Positioning System (GPS) device, a laptop computer, a tablet computer, or another type of portable computer, a media playing device, a portable gaming system, and/or any other type of computer device with wireless communication capabilities, and the like. In an embodiment, the UEs may communicate with the system via set of executable instructions residing on any operating system. In an embodiment, the UEs may include, but are not limited to, any electrical, electronic, electro-mechanical or an equipment or a combination of one or more of the above devices such as virtual reality (VR) devices, augmented reality (AR) devices, laptop, a general-purpose computer, desktop, personal digital assistant, tablet computer, mainframe computer, or any other computing device, wherein the

computing device may include one or more in-built or externally coupled accessories including, but not limited to, a visual aid device such as camera, audio aid, a microphone, a keyboard, input devices for receiving input from a user such as touch pad, touch enabled screen, electronic pen and the like. It may be appreciated that the UEs may not be restricted to the mentioned devices and various other devices may be used.

[0085] System (for example, computing system): A system may include one or more processors coupled with a memory, wherein the memory may store instructions which when executed by the one or more processors may cause the system to perform offloading/unloading of broadcasting or multicasting content in networks. An exemplary representation of the system for such purpose, in accordance with embodiments of the present disclosure. In an embodiment, the system may include one or more processor(s). The one or more processor(s) may be implemented as one or more microprocessors, microcomputers, microcontrollers, edge or fog microcontrollers, digital signal processors, central processing units, logic circuitries, and/or any devices that process data based on operational instructions. Among other capabilities, the one or more processor(s) may be configured to fetch and execute computer-readable instructions stored in a memory of the system. The memory may be configured to store one or more computer-readable instructions or routines in a non-transitory computer readable storage medium, which may be fetched and executed to create or share data packets over a network service. The memory may comprise any non-transitory storage device including, for example, volatile memory such as Random-Access Memory (RAM), or non-volatile memory such as Electrically Erasable Programmable Read-only Memory (EPROM), flash memory, and the like. In an embodiment, the system may include an interface(s). The interface(s) may comprise a variety of interfaces, for example, interfaces for data input and output devices, referred to as input/output (I/O) devices, storage devices, and the like. The interface(s) may facilitate communication for the system. The interface(s) may also provide a communication pathway for one or more components of the system. Examples of such components include, but are not limited to, processing unit/engine(s) and a database.

The processing unit/engine(s) may be implemented as a combination of hardware and programming (for example, programmable instructions) to implement one or more functionalities of the processing engine(s). In examples described herein, such combinations of hardware and programming may be implemented in several different ways. For example, the programming for the processing engine(s) may be processor executable instructions stored on a non-transitory machine-readable storage medium and the hardware for the processing engine(s) may comprise a processing resource (for example, one or more processors), to execute such instructions. In the present examples, the machine-readable storage medium may store instructions that, when executed by the processing resource, implement the processing engine(s). In such examples, the system may include the machine-readable storage medium storing the instructions and the processing resource to execute the instructions, or the machine-readable storage medium may be separate but accessible to the system and the processing resource. In other examples, the processing engine(s) may be implemented by electronic circuitry. In an aspect, the database may comprise data that may be either stored or generated as a result of functionalities implemented by any of the components of the processor or the processing engines.

[0086] Computer System: A computer system may include an external storage device, a bus, a main memory, a read-only memory, a mass storage device, communication port(s), and a processor. A person skilled in the art will appreciate that the computer system may include more than one processor and communication ports. The communication port(s) may be any of an RS-232 port for use with a modem-based dialup connection, a 10/100 Ethernet port, a Gigabit or 10 Gigabit port using copper or fiber, a serial port, a parallel port, or other existing or future ports. The communication port(s) may be chosen depending on a network, such a Local Area Network (LAN), Wide Area Network (WAN), or any network to which the computer system connects. The main memory may be random access memory (RAM), or any other dynamic storage device commonly known in the art. The read-only memory may be any static storage device(s) including, but not limited to, a Programmable Read Only Memory (PROM) chips for storing static information e.g., start-up or basic

input/output system (BIOS) instructions for the processor. The mass storage device may be any current or future mass storage solution, which may be used to store information and/or instructions. The bus communicatively couples the processor with the other memory, storage, and communication blocks. The bus can be, e.g. a Peripheral Component Interconnect (PCI) / PCI Extended (PCI-X) bus, Small Computer System Interface (SCSI), universal serial bus (USB), or the like, for connecting expansion cards, drives, and other subsystems as well as other buses, such a front side bus (FSB), which connects the processor to the computer system. Optionally, operator and administrative interfaces, e.g. a display, keyboard, and a cursor control device, may also be coupled to the bus to support direct operator interaction with the computer system. Other operator and administrative interfaces may be provided through network connections connected through the communication port(s). In no way should the aforementioned exemplary computer system limit the scope of the present disclosure.

REFERENCE NUMERALS

- [0087] User Equipment – 102;
- [0088] Server – 105;
- [0089] Communication network - 110;
- [0090] AMF/System - 125;
- [0091] One or more processors -205;
- [0092] Memory – 210;
- [0093] Input/output interface unit – 215;
- [0094] Database – 220;
- [0095] Distributed cache – 225;
- [0096] Registering unit – 230;

- [0097] Transceiver unit – 235;
- [0098] Releasing unit– 240;
- [0099] Paging unit– 245;
- [00100] Transceiver unit– 250;
- [00101] Initiating unit – 255;
- [00102] Primary processor of first node - 305;
- [00103] Memory unit of first node – 310;
- [00104] Kernel of the first node – 315;
- [00105] RAN device – 402; and
- [00106] Digital Data Network – 404.

We Claim:

1. A method for network initiated de-registration process for a user equipment (UE) (102) to enable recovery procedure, the method comprising the steps of:
 - registering, by one or more processor (205), the UE (102) with an Access and Mobility Management Function (AMF) (125) based on a request received from the UE (102);
 - receiving, by the one or more processor (205), a connection state request at the AMF (125), wherein the connection state request is sent by the UE (102);
 - releasing, by the one or more processor (205), the connection between the AMF (125) and the UE (102), using a release procedure;
 - receiving, by the one or more processor (205), an idle state response at the AMF (125) sent by the UE (102), wherein the idle state response is sent corresponding a data operation request that is Mobile Originated (MO) or Mobile Terminated (MT); and
 - initiating, by the one or more processor (205), a network procedure by the AMF (125) based on the idle state response received from the UE (102).
2. The method as claimed in claim 1, wherein receiving the idle state response by the one or more processor (205) comprises at least one of Mobility Request (MR), Periodic registration Request (PR), Scheduling Request (SR), and Deregistration (DeReg) response.
3. The method as claimed in claim 1, wherein initiating, by the one or more processor (205), the network procedure comprises a re-authentication procedure initiated by the AMF (125) when the idle state response is MR/PR, or the network procedure is a re-registration procedure initiated by the AMF (125) when the idle state response is SR.

4. The method as claimed in claim 1, wherein the method further comprises, sending, by the one or more processor (205), a paging message by the AMF (125) to the UE (102) when the data operation request is MT.
5. The method as claimed in claim 1, wherein receiving the connection state request comprises performing, by the one or more processor (205), integrity check procedures to detect a packet loss, or a packet sequence mismatch between the UE (102) and the AMF (125).
6. The method as claimed in claim 1, wherein releasing, comprises transmitting, by the one or more processor (205), a release command to a Radio Access Network (RAN) device (402), wherein the RAN device (402) is configured to send a Radio Resource Control (RRC) release command to the UE (102).
7. The method as claimed in claim 6, wherein releasing, comprises terminating, by the one or more processor (205), connection to the UE (102), further once the connection is terminated, the RAN device (402) transmits a release complete message to the AMF (125).
8. The method as claimed in claim 1, wherein subsequent to receiving, the connection state request, the one or more processor (205) is configured for transmitting protocol data units (PDUs) or data packets to the AMF (125) from the UE (102).
9. A system for network initiated de-registration process for a user equipment (UE) to enable recovery procedure, the system comprising:
 - a registering unit (230) configured to register the User Equipment (UE) (102) with an Access and Mobility Management Function (AMF) (125) based on a request received from the UE (102);
 - a transceiver unit (235) configured to receive a connection state request at the AMF (125), wherein the connection state request is sent by the UE (102);

a releasing unit (240) configured to release connection between the AMF (125) and the UE (102), using a release procedure;

a transceiver unit (250) configured to receive an idle state response at the AMF (125) sent by the UE (102), wherein the idle state response is sent corresponding to a data operation request that is Mobile Originated (MO) or Mobile Terminated (MT); and

an initiating unit (255) configured to initiate a network procedure by the AMF (125) based on the idle state response received from the UE (102).

10. The system as claimed in claim 9, wherein receiving the idle state response by the transceiver unit (250) comprises at least one of Mobility Request (MR), Periodic registration Request (PR), Scheduling Request (SR), and Deregistration (DeReg) responses.
11. The system as claimed in claim 9, wherein initiating the network procedure comprises a re-authentication procedure initiated by the AMF (125) when the idle state response is MR/PR, or the network procedure is a re-registration procedure initiated by the AMF (125) when the idle state response is SR.
12. The system as claimed in claim 9, further comprises a paging unit (245) configured to send a paging message from the AMF (125) to the UE (102) when the data operation request is MT.
13. The system as claimed in claim 9, wherein receiving the connection state request comprises performing integrity check procedures to detect a packet loss, or a packet sequence mismatch between the UE (102) and the AMF (125).
14. The system as claimed in claim 9, wherein releasing by the releasing unit (240), comprises transmitting, a release command to a Radio access network (RAN)

device (402), wherein the RAN device (402) is configured to send a Radio Resource Control (RRC) release command to the UE (102).

15. The system as claimed in claim 14, wherein releasing, comprises terminating, connection to the UE (102), further once the connection is terminated, the RAN device (402) transmits a release complete message to the AMF (125).
16. The system as claimed in claim 9, wherein subsequent to receiving, the connection state request, the transceiver (250) is configured for transmitting protocol data units (PDUs) or data packets to the AMF (125) from the UE (102).
17. A network operated equipment (102) comprising:
 - one or more primary processors (305) communicatively coupled to one or more processors (205), the one or more primary processors (305) coupled with a memory (310), wherein said memory (310) stores instructions which when executed by the one or more primary processors (205) causes the network operated equipment (102) to:
 - transmit, a registration request to the one or more processors (205), the registration request enables sending a connection state request and initiating a network procedure, wherein the one or more processors (205) is configured to perform the steps as claimed in claim 1.
18. A non-transitory computer-readable medium having stored thereon computer-readable instructions that, when executed by a processor, cause the processor to:
 - register the User Equipment (UE) (102) with an Access and Mobility Management Function (AMF) (125) based on a request received from the UE (102);
 - receive a connection state request at the AMF (125), wherein the connection state request is sent by the UE (102);

release connection between the AMF (125) and the UE (102), using a release procedure;

receive an idle state response at the AMF (125) sent by the UE (102), wherein the idle state response is sent corresponding to a data operation request that is Mobile Originated (MO) or Mobile Terminated (MT); and

initiate a network procedure by the AMF (125) based on the idle state response received from the UE (102).

1/6

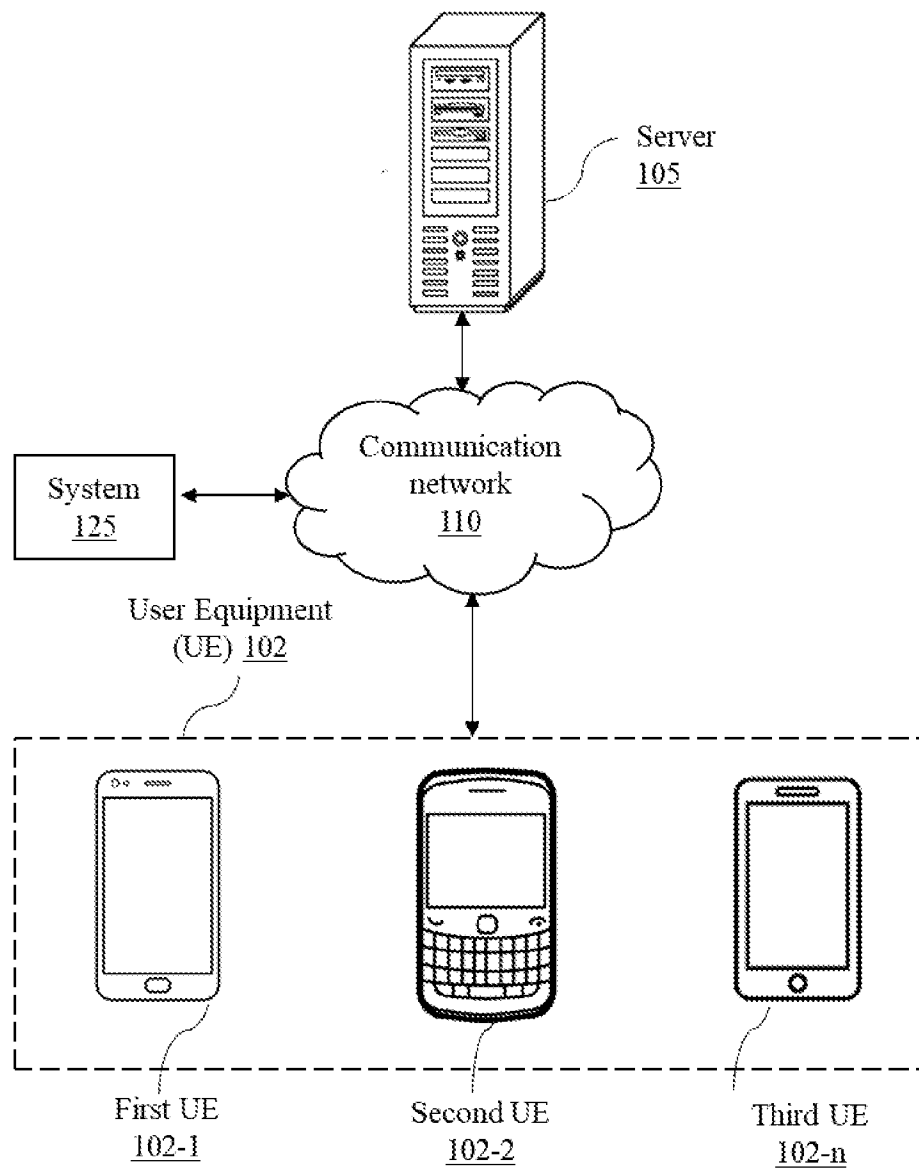


FIG. 1

2/6

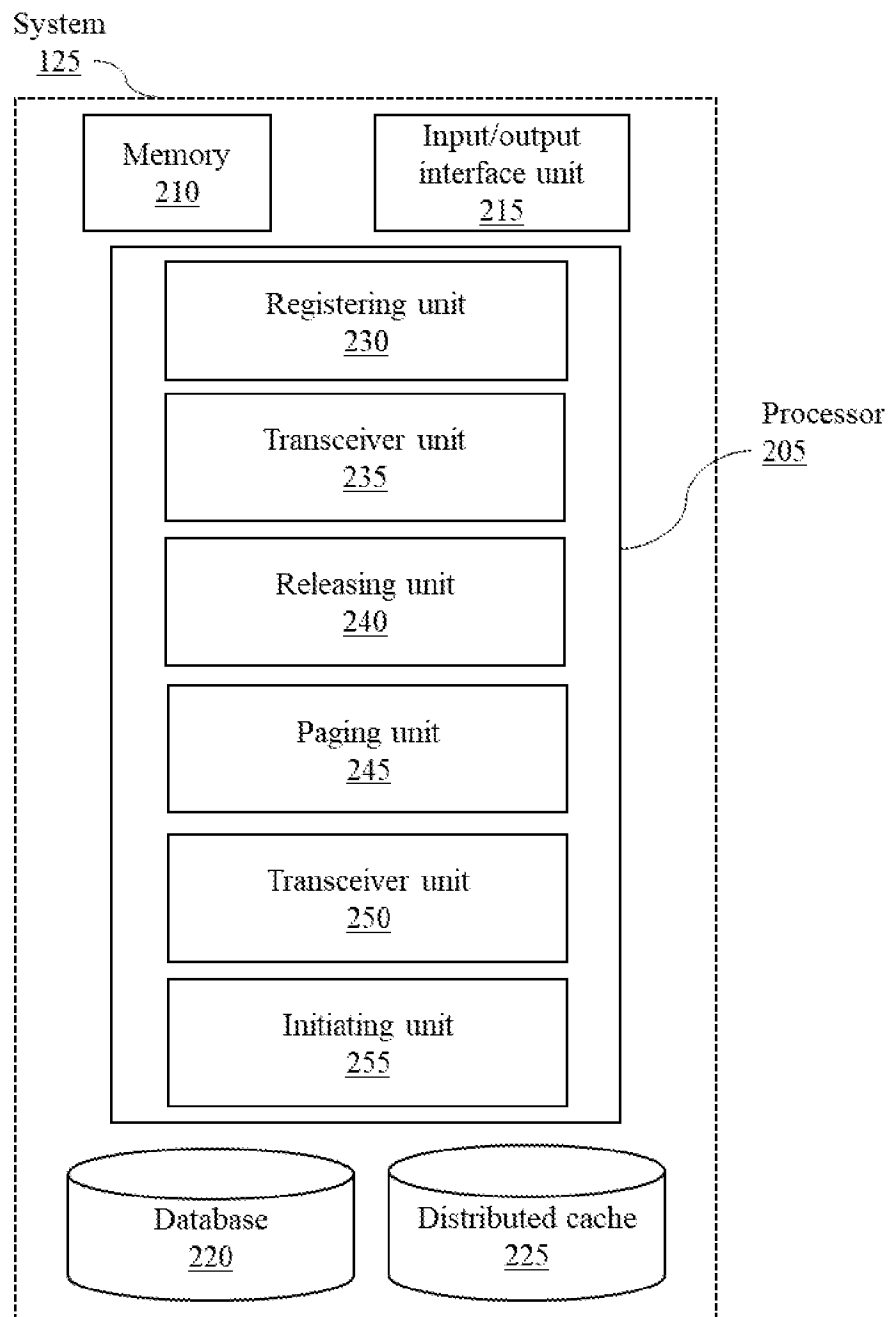


FIG. 2

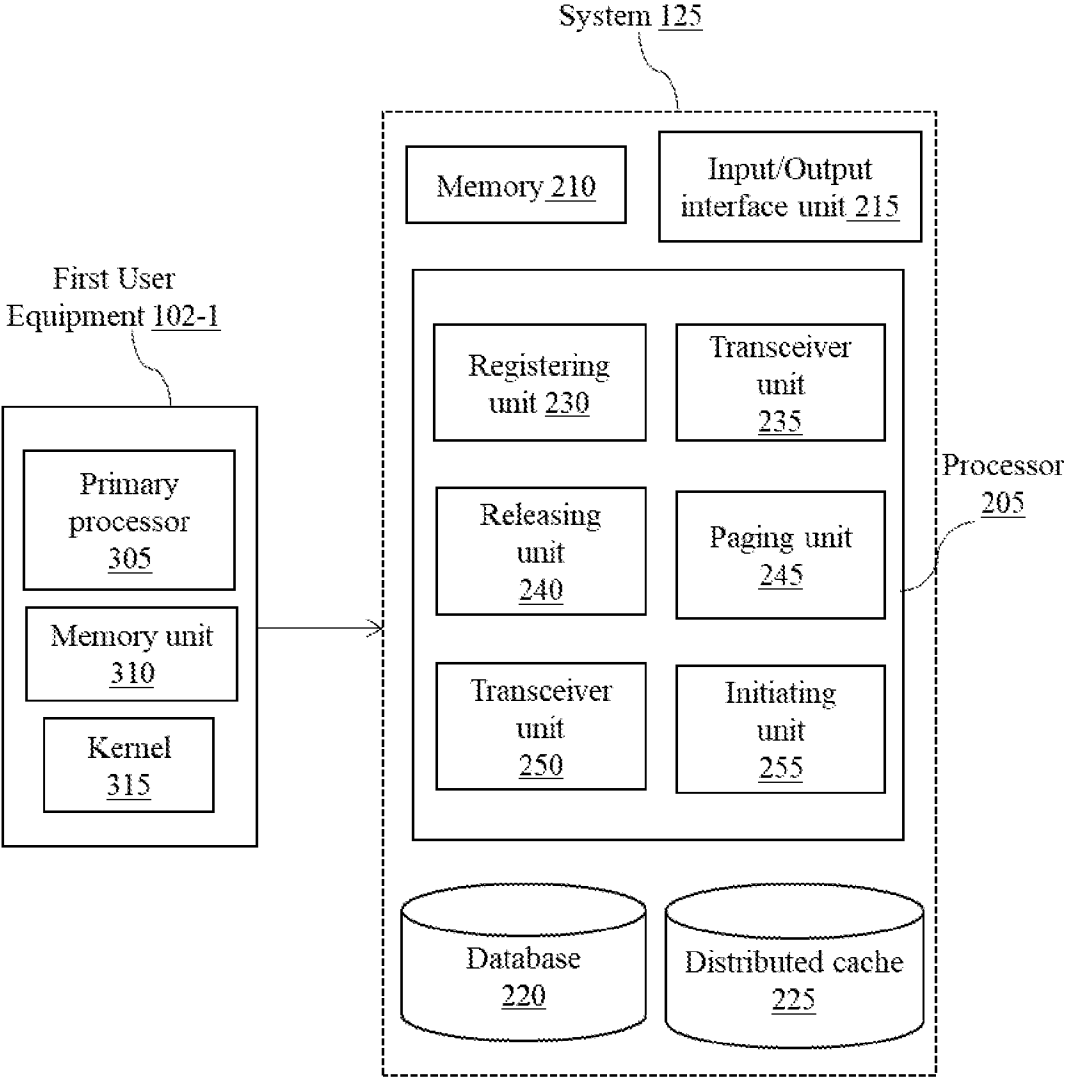


FIG. 3

4/6

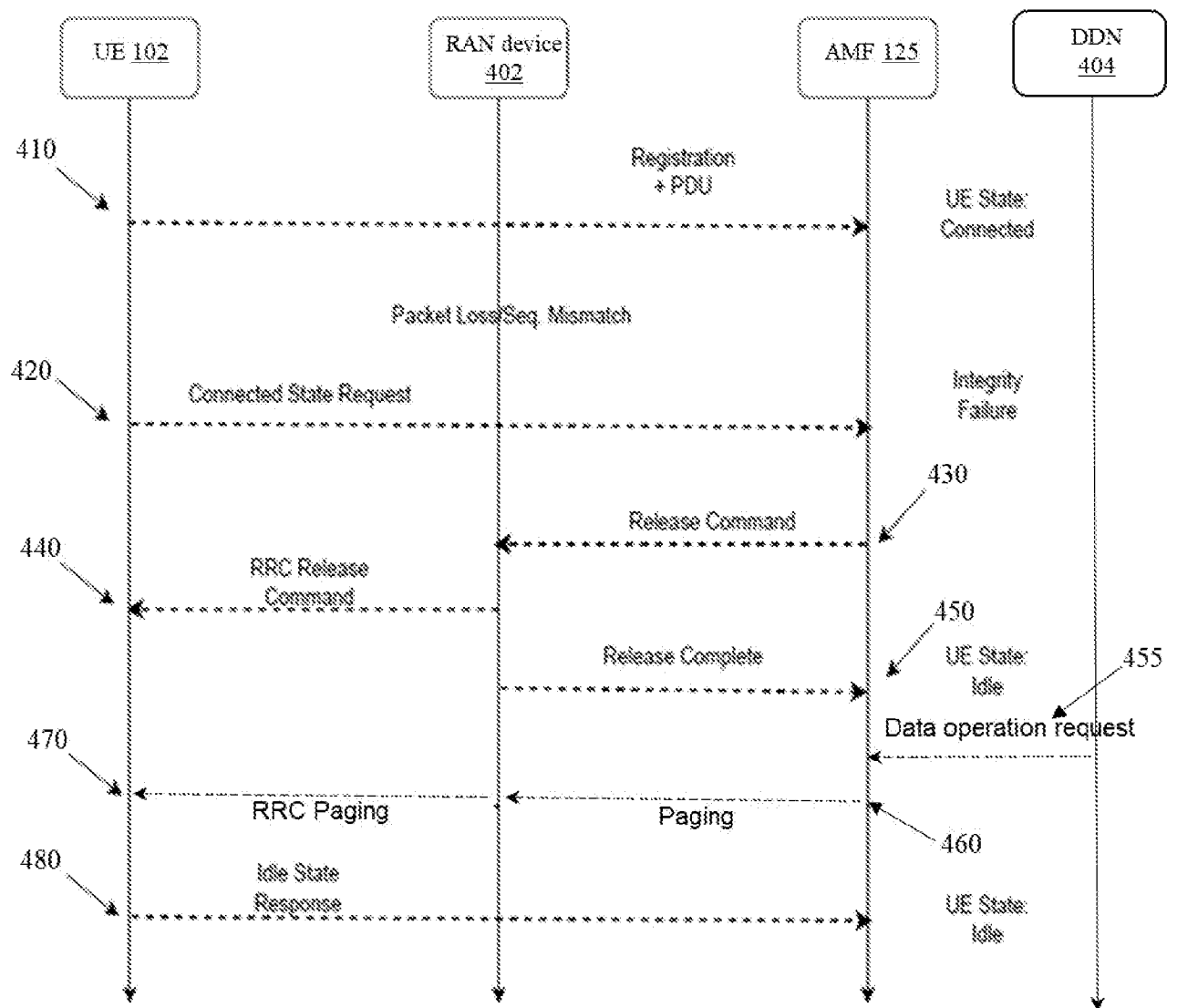


FIG. 4A

5/6

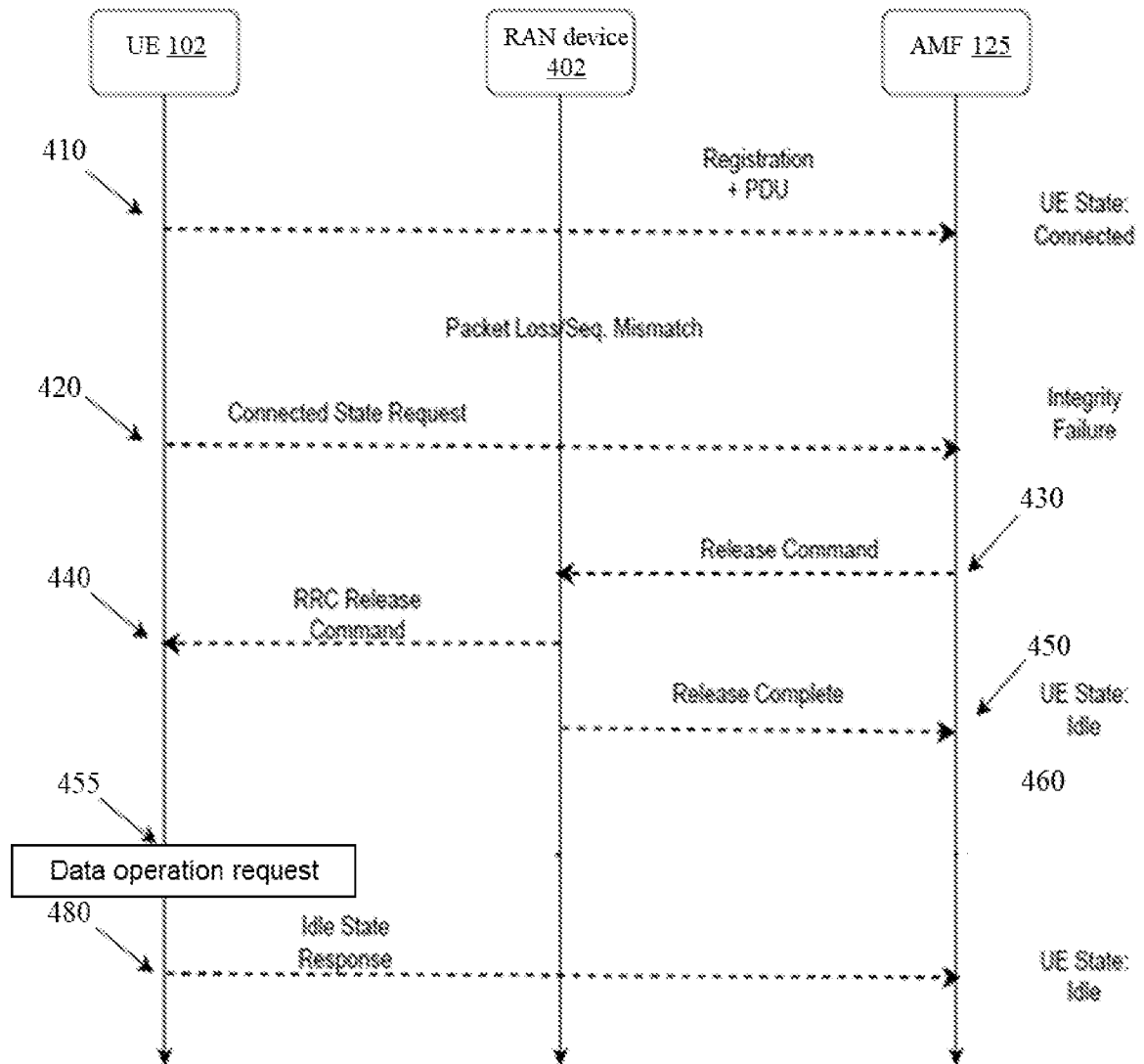


FIG. 4B

6/6

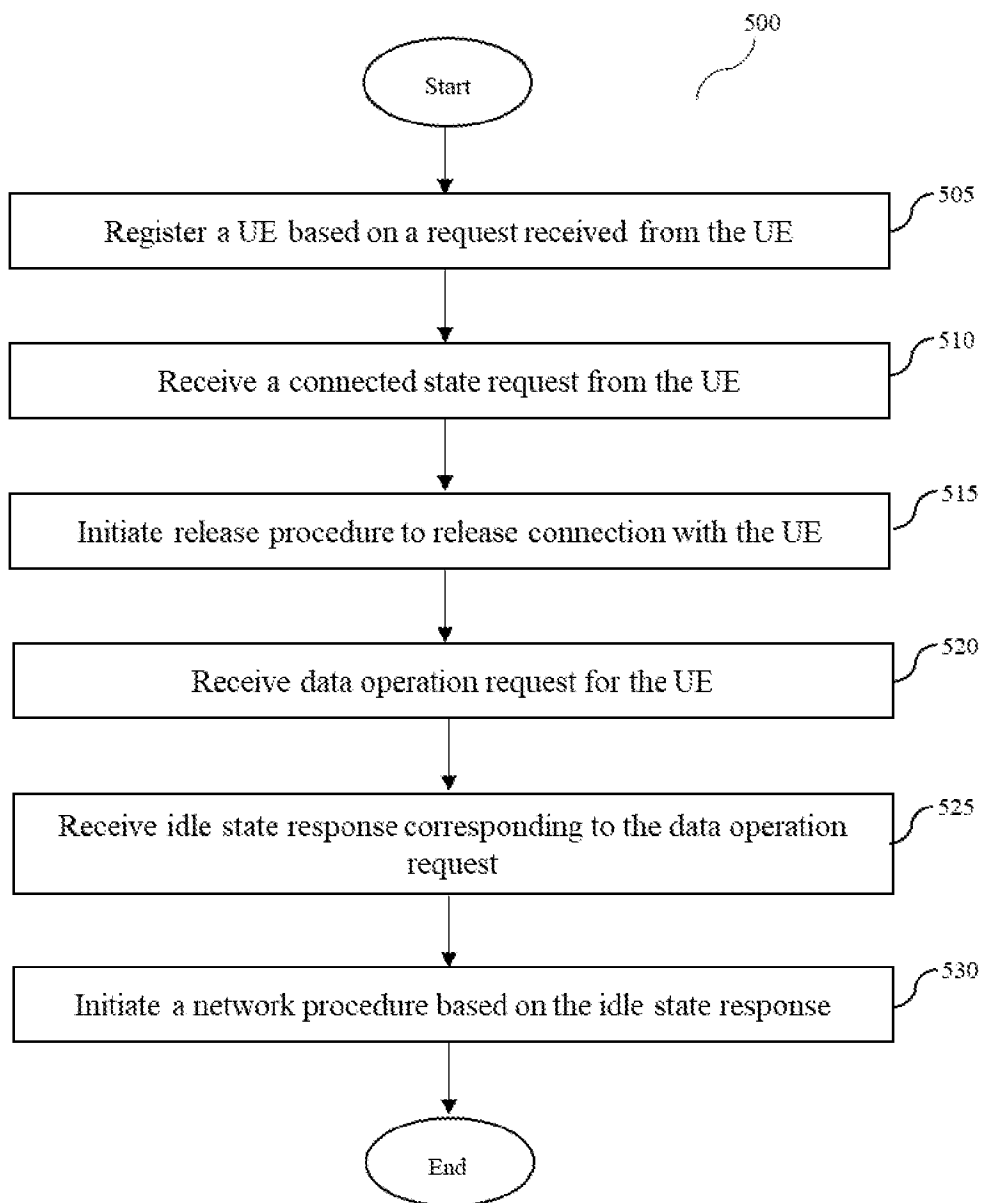


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2024/050925

A. CLASSIFICATION OF SUBJECT MATTER
H04W60/06, H04W76/34, H04W76/20 Version=2024.01

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 database consulted during the international search (name of database and, where practicable, search terms used)

Databases- Patseer, IPO Internal Database
Keywords- Network-initiated de-registration, AMF

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 3547790 B1 (LG ELECTRONICS INC.) (14.04.2021). Abstract, Description (Paragraphs [0005]-[0291]), Claims 1-15, Figures 1-18.	1-18

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

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"&" document member of the same patent family

Date of the actual completion of the international search

28-10-2024

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IN2024/050925

Citation	Pub.Date	Family	Pub.Date
EP 3547790 B1	14-04-2021	US 10736072 B2	04-08-2020
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		CN 108702723 B	08-10-2021
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		JP 6705941 B2	03-06-2020
		CN 108702724 B	15-06-2021
		WO 2018097601 A1	31-05-2018
		US 10687300 B2	16-06-2020
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		US 10932219 B2	23-02-2021
		JP 6947878 B2	13-10-2021
		US 11076376 B2	27-07-2021