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(54) Title: METHOD AND SYSTEM FOR RECOVERY OF SUBSCRIBER SERVICES

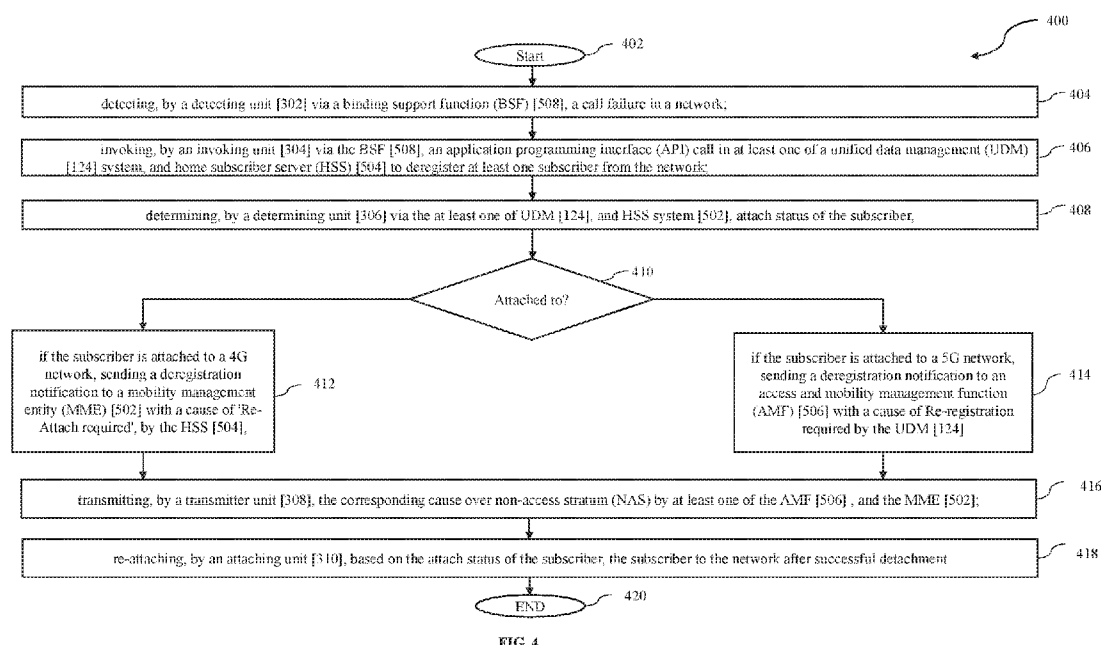


FIG. 4

(57) Abstract: The present disclosure relates to a method and a system for recovery of subscriber services. The method includes detecting, by a detecting unit [302] via BSF [508], a call failure in a network. Further invoking, by an invoking unit [304] via BSF [508], an API call in at least one of a unified data management (UDM) [124] system, and home subscriber server to deregister at least one subscriber from the network. Furthermore, determining, by a determining unit [306] via the at least one of UDM [124], and HSS, attach status of the subscriber. Furthermore, transmitting, by a transmitting unit [308], the corresponding cause over non-access stratum (NAS) by at least one of the AMF [506], and the MME [502]. Further re-attaching, by an attaching unit [310], based on the attach status of the subscriber, the subscriber to the network after successful detachment.

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METHOD AND SYSTEM FOR RECOVERY OF SUBSCRIBER SERVICES

FIELD OF THE DISCLOSURE

[001] The present disclosure generally relates to network performance management systems.
5 More particularly, relates to a method and system for the recovery of subscriber services.

BACKGROUND

[002] The following description of the related art is intended to provide background information
10 pertaining to the field of the disclosure. This section may include certain aspects of the art that may be related to various features of the present disclosure. However, it should be appreciated that this section is used only to enhance the understanding of the reader with respect to the present disclosure, and not as admissions of the prior art.

[003] Wireless communication technology has rapidly evolved over the past few decades, with
15 each generation bringing significant improvements and advancements. The first generation of wireless communication technology was based on analog technology and offered only voice services. However, with the advent of the second-generation (2G) technology, digital communication and data services became possible, and text messaging was introduced. 3G
20 technology marked the introduction of high-speed internet access, mobile video calling, and location-based services. The fourth-generation (4G) technology revolutionized wireless communication with faster data speeds, better network coverage, and improved security. Currently, the fifth-generation (5G) technology is being deployed, promising even faster data speeds, low latency, and the ability to connect multiple devices simultaneously. With each
25 generation, wireless communication technology has become more advanced, sophisticated, and capable of delivering more services to its users.

[004] Currently, whenever there is a network failure, users manually intervene to restore the
network and regain access to various network services. This process can be time-consuming and
30 prone to human error. Additionally, the current methods and systems lack mechanisms for immediate detection and recovery from network failures, such as failure of the network caused due to IP-CAN_Session_Not_Available (5065) error. This leads to service downtime, which can be highly inconvenient for users. Moreover, the existing systems do not provide any efficient way of handling subscriber deregistration and re-registration during network failures. The existing

systems handle network failures differently based on the type of subscriber, leading to inconsistent service quality. Consequently, there are no solutions for automatic recovery from specific network failures in the existing systems.

5 [005] Therefore, in light of the foregoing discussion, there exists a need to overcome the aforementioned drawbacks by providing an improved method and system that can efficiently handle network failures to ensure continuous and reliable network services for users.

SUMMARY

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[006] This section is provided to introduce certain aspects of the present disclosure in a simplified form that are further described below in the detailed description. This summary is not intended to identify the key features or the scope of the claimed subject matter.

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[007] An aspect of the present disclosure may relate to a method for recovery of subscriber services. The method includes detecting, by a detecting unit via a binding support function (BSF), a call failure in a network. Further, the method encompasses invoking, by an invoking unit via the BSF, an application programming interface (API) call in at least one of a unified data management (UDM) system, and home subscriber server (HSS) to deregister at least one subscriber from the network. The method further includes determining, by a determining unit via the at least one of UDM, and HSS systems, attach status of the subscriber. If the subscriber is attached to a 4G network, sending a deregistration notification to a mobility management entity (MME) with a cause of 'Re-Attach required', by the HSS, and wherein if the subscriber is attached to a 5G network, sending a deregistration notification to an access and mobility management function (AMF) with a cause of Re-registration required by the UDM. Furthermore, the method encompasses transmitting, by a transmitter unit, the corresponding cause over non-access stratum (NAS) by at least one of the AMF, and the MME. The method further includes re-attaching, by an attaching unit, based on the attach status of the subscriber, the subscriber to the network after successful detachment.

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[008] In an exemplary aspect of the present disclosure, the call failure occurs due to an error in an authorization and authentication (AA) ANSWER system from one or more network functions, detected at a binding support function (BSF) end.

[009] In an exemplary aspect of the present disclosure, the error is an IP-CAN_Session_Not_Available (5065) error.

[0010] In an exemplary aspect of the present disclosure, the one or more network functions
5 comprise at least one of a policy and charging rules function (PCRF), and policy control function (PCF).

[0011] In an exemplary aspect of the present disclosure, the method further includes restoring
10 high-speed internet (HSI) and voice video and multimedia (VVM) services by the network.

[0012] In an exemplary aspect of the present disclosure, the API call comprises at least one of a
subscription permanent identifier (SUPI), and international mobile subscriber identity (IMSI) as a
query parameter.

[0013] In an exemplary aspect of the present disclosure, if the subscriber is connected to the 4G
15 network, the HSS sends a cancel location request (CLR) to the MME.

[0014] In an exemplary aspect of the present disclosure, if the subscriber is attached to the 5G
20 network, the UDM sends the deregistration notification to the AMF.

[0015] In an exemplary aspect of the present disclosure, the determining the attach status of the
subscriber further comprises checking, by the determining unit, if a user equipment (UE)
associated with the subscriber is attached to at least one of 4G network, and 5G network.

[0016] In an exemplary aspect of the present disclosure, the call failure occurs due to establishment
25 or maintenance of a pre-established internet protocol connectivity access network (IP-CAN)
session.

[0017] Another aspect of the present disclosure may relate to a system for recovery of subscriber
30 services. The system includes a detecting unit configured to detect, via a binding support function (BSF), a call failure in a network. The system further includes an invoking unit configured to
invoke, via the BSF, an application programming interface (API) call in at least one of a Unified
Data Management (UDM) system and home subscriber server (HSS) to deregister at least one
subscriber from the network. Furthermore, the system includes a determining unit configured to
35 determine, via the at least one of UDM, and HSS system, attach status of the subscriber. If the

subscriber is attached to a 4G network, send a deregistration notification to a mobility management entity (MME) with a cause of 'Re-Attach required', by the HSS, and if the subscriber is attached to a 5G network, send a deregistration notification to an access and mobility management function (AMF) with a cause of re-registration required by the UDM. The system further includes a transmitting unit configured to transmit the corresponding cause over non-access stratum (NAS) by at least one of the AMF, and the MME. Furthermore, the system includes an attaching unit configured to re-attach the subscriber to the network based on the attach status of the subscriber after successful detachment.

[0018] Yet another aspect of the present disclosure may relate to a user equipment (UE). The UE includes a processing unit. The processing unit is configured to receive a request for deregistering of a subscriber based on detected call failure in a network, wherein if the subscriber is attached to a 4G network, a deregistration notification is sent to a mobility management entity (MME) with a cause of 're-Attach required', and wherein if the subscriber is attached to a 5G network, a deregistration notification is sent to an access and mobility management function (AMF) with a cause of re-registration required. The processing unit is further configured to receive the corresponding cause over non-access stratum (NAS) from at least one of the AMF, and the MME; re-attach the subscriber to the network based on an attach status of the subscriber after successful detachment.

[0019] Yet another aspect of the present disclosure may relate to a non-transitory computer-readable storage medium storing instruction, the storage medium comprising executable code which, when executed by one or more units of a system, causes: a detecting unit of the system to detect, via a binding support function (BSF), a call failure in a network; an invoking unit of the system to invoke, via the BSF, an application programming interface (API) call in at least one of a Unified Data Management (UDM) system and home subscriber server (HSS) to deregister at least one subscriber from the network; a determining unit configured to determine, via the at least one of UDM, and HSS system, attach status of the subscriber, wherein if the subscriber is attached to a 4G network, send a deregistration notification to a mobility management entity (MME) with a cause of 're-Attach required', by the HSS, and wherein if the subscriber is attached to a 5G network, send a deregistration notification to an access and mobility management function (AMF) with a cause of Re-registration required by the UDM; a transmitting unit configured to transmit the corresponding cause over non-access stratum (NAS) by at least one of the AMF, and the MME; and an attaching unit configured to re-attach the subscriber to the network based on the attach status of the subscriber after successful detachment.

OBJECTS OF THE INVENTION

5 [0020] Some of the objects of the present disclosure, which at least one embodiment disclosed herein satisfies are listed herein below.

[0021] It is an object of the present disclosure to provide a method and system for recovery subscriber services upon failure detection at network end.

10 [0022] It is another object of the present disclosure to provide a method and system for recovery of subscriber services upon failure detection at network end that provides automated recovery in the event of a call failure. This can significantly reduce downtime and improve service availability.

15 [0023] It is another object of the present disclosure to provide a method and system for recovery of subscriber services recovery upon failure detection at the network end that provides a standardized approach to deregistering and re-registering subscribers across different network types (4G and 5G). This could lead to improved consistency in handling network failures.

20 [0024] It is another object of the present disclosure to provide a method and system for recovery of subscriber services recovery upon failure detection at network end that enable real-time detection of the network failure and prompt recovery. This could minimize service disruptions for subscribers.

25 [0025] It is another object of the present disclosure to provide a method and system for recovery of subscriber services recovery upon failure detection at network end that minimizes the disruption to the user and to make the recovery process seamless from the user's perspective.

30 [0026] It is another object of the present disclosure to provide a method and system for recovery of subscriber services recovery upon failure detection at network end that aims to manage network resources efficiently by introducing a new API to handle deregistration and re-registration tasks during network failures. This could potentially reduce system overhead and improve overall network performance.

35 [0027] It is yet another object of the present disclosure to provide a method and system for recovery of subscriber services recovery upon failure detection at network end that by

incorporating automated recovery process into network standards allow for uniformity in approach across different networks and systems.

DESCRIPTION OF THE DRAWINGS

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[0028] 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. Also, the embodiments shown in the figures are not to be construed as limiting the disclosure, but the possible variants of the method and system according to the disclosure are illustrated herein to highlight the advantages of the disclosure. It will be appreciated by those skilled in the art that disclosure of such drawings includes disclosure of electrical components or circuitry commonly used to implement such components.

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[0029] FIG. 1 illustrates an exemplary block diagram representation of 5th generation core (5GC) network architecture.

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[0030] FIG. 2 illustrates an exemplary block diagram of a computing device upon which the features of the present disclosure may be implemented in accordance with exemplary implementation of the present disclosure.

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[0031] FIG. 3 illustrates an exemplary block diagram of a system for recovery of subscriber services, in accordance with exemplary implementations of the present disclosure.

[0032] FIG. 4 illustrates a method flow diagram for recovery of subscriber services in accordance with exemplary implementations of the present disclosure.

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[0033] FIG. 5 illustrates an exemplary process flow diagram for automated subscriber services recovery upon failure detection at network end, in accordance with exemplary embodiments of the present disclosure.

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[0034] The foregoing shall be more apparent from the following more detailed description of the disclosure.

DETAILED DESCRIPTION

[0035] In the following description, for the purposes of explanation, various specific details are set forth in order to provide a thorough understanding of embodiments of the present disclosure.

5 It will be apparent, however, that embodiments of the present disclosure may be practiced without these specific details. Several features described hereafter may each be used independently of one another or with any combination of other features. An individual feature may not address any of the problems discussed above or might address only some of the problems discussed above.

10 [0036] The ensuing description provides exemplary embodiments only, and is not intended to limit the scope, applicability, or configuration of the disclosure. Rather, the ensuing description of the exemplary embodiments will provide those skilled in the art with an enabling description for implementing an exemplary embodiment. It should be understood that various changes may be made to the function and arrangement of elements without departing from the spirit and scope of
15 the disclosure as set forth.

[0037] Specific details are given in the following description to provide a thorough understanding of the embodiments. However, it will be understood by one of ordinary skill in the art that the embodiments may be practiced without these specific details. For example, circuits, systems,
20 processes, and other components may be shown as components in block diagram form in order not to obscure the embodiments in unnecessary detail.

[0038] Also, it is noted that individual embodiments may be described as a process which is depicted as a flowchart, a flow diagram, a data flow diagram, a structure diagram, or a block
25 diagram. Although a flowchart may describe the operations as a sequential process, many of the operations may be performed in parallel or concurrently. In addition, the order of the operations may be rearranged. A process is terminated when its operations are completed but could have additional steps not included in a figure.

30 [0039] The word “exemplary” and/or “demonstrative” is used herein to mean serving as an example, instance, or illustration. For the avoidance of doubt, the subject matter disclosed herein is not limited by such examples. In addition, any aspect or design described herein as “exemplary” and/or “demonstrative” is not necessarily to be construed as preferred or advantageous over other aspects or designs, nor is it meant to preclude equivalent exemplary structures and techniques
35 known to those of ordinary skill in the art. Furthermore, to the extent that the terms “includes,”

“has,” “contains,” and other similar words are used in either the detailed description or the claims, such terms are intended to be inclusive—in a manner similar to the term “comprising” as an open transition word—without precluding any additional or other elements.

5 **[0040]** As used herein, a “processing unit” or “processor” or “operating processor” includes one or more processors, wherein processor refers to any logic circuitry for processing instructions. A processor may be a general-purpose processor, a special purpose processor, a conventional processor, a digital signal processor, a plurality of microprocessors, one or more microprocessors in association with a (Digital Signal Processing) DSP core, a controller, a micro controller, 10 Application Specific Integrated Circuits, Field Programmable Gate Array circuits, any other type of integrated circuits, etc. The processor may perform signal coding data processing, input/output processing, and/or any other functionality that enables the working of the system according to the present disclosure. More specifically, the processor or processing unit is a hardware processor.

15 **[0041]** As used herein, “a user equipment”, “a user device”, “a smart-user-device”, “a smart-device”, “an electronic device”, “a mobile device”, “a handheld device”, “a wireless communication device”, “a mobile communication device”, “a communication device” may be any electrical, electronic and/or computing device or equipment, capable of implementing the features of the present disclosure. The user equipment/device may include, but is not limited to, a 20 mobile phone, smart phone, laptop, a general-purpose computer, desktop, personal digital assistant, tablet computer, wearable device or any other computing device which is capable of implementing the features of the present disclosure. Also, the user device may contain at least one input means configured to receive an input from at least one of a transceiver unit, a processing unit, a storage unit, a detection unit and any other such unit(s) which are required to implement 25 the features of the present disclosure.

30 **[0042]** As used herein, “storage unit” or “memory unit” refers to a machine or computer-readable medium including any mechanism for storing information in a form readable by a computer or similar machine. For example, a computer-readable medium includes read-only memory (“ROM”), random access memory (“RAM”), magnetic disk storage media, optical storage media, flash memory devices or other types of machine-accessible storage media. The storage unit stores at least the data that may be required by one or more units of the system to perform their respective functions.

[0043] As used herein “interface” or “user interface” refers to a shared boundary across which two or more separate components of a system exchange information or data. The interface may also be referred to as set of rules or protocols that define communication or interaction of one or more modules or one or more units with each other, which also includes the methods, functions, or procedures that may be called.

[0044] As used herein, Authorization and Authentication (AA) ANSWER refers to a response message in the Diameter protocol for providing the necessary information regarding the authentication and authorization status of a user or device. The AA-ANSWER indicates whether a user or device has been successfully authenticated and authorized to access specific network services or resources. It also conveys any errors or issues encountered during the authentication and authorization process, such as the IP-CAN_Session_Not_Available (5065) error, which can trigger further network actions to maintain service continuity and network integrity.

[0045] As used herein, an AA-Request (AAR) refers to a message sent within the Diameter protocol that initiates the processes of Authentication, Authorization, and Accounting in the network. The request is used by the Dynamic Resource Allocation (DRA) to communicate with the Binding Support Function (BSF), such that the subscriber's identity and permissions are verified and the resource usage is tracked.

[0046] All modules, units, components used herein, unless explicitly excluded herein, may be software modules or hardware processors, the processors being a general-purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASIC), Field Programmable Gate Array circuits (FPGA), any other type of integrated circuits, etc.

[0047] In the current situation, network failures might require manual intervention for recovery. This process could be time-consuming and prone to human errors. This leads to service downtime, which can be costly and inconvenient for users. Furthermore, the existing systems fail to provide an efficient way of handling subscriber deregistration and re-registration during network failures. For instance, the existing systems might handle network failure differently based on whether the user is on a 4G or 5G network, leading to inconsistent service quality.

[0048] As discussed in the background section, the existing solutions have several shortcomings. The present disclosure aims to overcome the above-mentioned and other existing problems in this field of technology by providing a method and system for efficient recovery of subscriber services.

5 [0049] FIG. 1 illustrates an exemplary block diagram representation of 5th generation core (5GC) network architecture, in accordance with exemplary implementation of the present disclosure. As shown in FIG. 1, the 5GC network architecture [100] includes a user equipment (UE) [102], a radio access network (RAN) [104], an access and mobility management function (AMF) [106], a Session Management Function (SMF) [108], a Service Communication Proxy (SCP) [110], an
10 Authentication Server Function (AUSF) [112], a Network Slice Specific Authentication and Authorization Function (NSSAAF) [114], a Network Slice Selection Function (NSSF) [116], a Network Exposure Function (NEF) [118], a Network Repository Function (NRF) [120], a Policy Control Function (PCF) [122], a Unified Data Management (UDM) [124], an application function (AF) [126], a User Plane Function (UPF) [128], a data network (DN) [130], wherein all the
15 components are assumed to be connected to each other in a manner as obvious to the person skilled in the art for implementing features of the present disclosure.

[0050] Radio Access Network (RAN) [104] is the part of a mobile telecommunications system that connects user equipment (UE) [102] to the core network (CN) and provides access to different
20 types of networks (e.g., 5G network). It consists of radio base stations and the radio access technologies that enable wireless communication.

[0051] Access and Mobility Management Function (AMF) [106] is a 5G core network function responsible for managing access and mobility aspects, such as UE registration, connection, and
25 reachability. It also handles mobility management procedures like handovers and paging.

[0052] Session Management Function (SMF) [108] is a 5G core network function responsible for managing session-related aspects, such as establishing, modifying, and releasing sessions. It coordinates with the User Plane Function (UPF) for data forwarding and handles IP address
30 allocation and QoS enforcement.

[0053] Service Communication Proxy (SCP) [110] is a network function in the 5G core network that facilitates communication between other network functions by providing a secure and efficient messaging service. It acts as a mediator for service-based interfaces.

[0054] Authentication Server Function (AUSF) [112] is a network function in the 5G core responsible for authenticating UEs during registration and providing security services. It generates and verifies authentication vectors and tokens.

5 [0055] Network Slice Specific Authentication and Authorization Function (NSSAAF) [114] is a network function that provides authentication and authorization services specific to network slices. It ensures that UEs can access only the slices for which they are authorized.

10 [0056] Network Slice Selection Function (NSSF) [116] is a network function responsible for selecting the appropriate network slice for a UE based on factors such as subscription, requested services, and network policies.

15 [0057] Network Exposure Function (NEF) [118] is a network function that exposes capabilities and services of the 5G network to external applications, enabling integration with third-party services and applications.

20 [0058] Network Repository Function (NRF) [120] is a network function that acts as a central repository for information about available network functions and services. It facilitates the discovery and dynamic registration of network functions.

[0059] Policy Control Function (PCF) [122] is a network function responsible for policy control decisions, such as QoS, charging, and access control, based on subscriber information and network policies.

25 [0060] Unified Data Management (UDM) [124] is a network function that centralizes the management of subscriber data, including authentication, authorization, and subscription information.

30 [0061] Application Function (AF) [126] is a network function that represents external applications interfacing with the 5G core network to access network capabilities and services.

[0062] User Plane Function (UPF) [128] is a network function responsible for handling user data traffic, including packet routing, forwarding, and QoS enforcement.

[0063] Data Network (DN) [130] refers to a network that provides data services to user equipment (UE) in a telecommunications system. The data services may include but are not limited to Internet services, private data network related services.

5 [0064] FIG. 2 illustrates an exemplary block diagram of a computing device [1000] (also referred to herein as a computer system [1000]) upon which the features of the present disclosure may be implemented in accordance with exemplary implementation of the present disclosure. In an implementation, the computing device [1000] may also implement a method for recovery of subscriber services utilising the system. In another implementation, the computing device [1000]
10 itself implements the method for recovery of subscriber services using one or more units configured within the computing device [1000], wherein said one or more units are capable of implementing the features as disclosed in the present disclosure.

[0065] The computing device [1000] encompasses a wide range of electronic devices capable of
15 processing data and performing computations. Examples of computing device [1000] include, but are not limited only to, personal computers, laptops, tablets, smartphones, servers, and embedded systems. The devices may operate independently or as part of a network and can perform a variety of tasks such as data storage, retrieval, and analysis. Additionally, computing device [1000] may include peripheral devices, such as monitors, keyboards, and printers, as well as integrated
20 components within larger electronic systems, showcasing their versatility in various technological applications.

[0066] The computing device [1000] may include a bus [1002] or other communication mechanism for communicating information, and a hardware processor [1004] coupled with bus
25 [1002] for processing information. The hardware processor [1004] may be, for example, a general-purpose microprocessor. The computing device [1000] may also include a main memory [1006], such as a random-access memory (RAM), or other dynamic storage device, coupled to the bus [1002] for storing information and instructions to be executed by the processor [1004]. The main memory [1006] also may be used for storing temporary variables or other intermediate information
30 during execution of the instructions to be executed by the processor [1004]. Such instructions, when stored in non-transitory storage media accessible to the processor [1004], render the computing device [1000] into a special-purpose machine that is customized to perform the operations specified in the instructions. The computing device [1000] further includes a read only memory (ROM) [1008] or other static storage device coupled to the bus [1002] for storing static
35 information and instructions for the processor [1004].

[0067] A storage device [1010], such as a magnetic disk, optical disk, or solid-state drive is provided and coupled to the bus [1002] for storing information and instructions. The computing device [1000] may be coupled via the bus [1002] to a display [1012], such as a cathode ray tube (CRT), Liquid crystal Display (LCD), Light Emitting Diode (LED) display, Organic LED (OLED) display, etc. for displaying information to a computer user. An input device [1014], including alphanumeric and other keys, touch screen input means, etc. may be coupled to the bus [1002] for communicating information and command selections to the processor [1004]. Another type of user input device may be a cursor controller [1016], such as a mouse, a trackball, or cursor direction keys, for communicating direction information and command selections to the processor [1004], and for controlling cursor movement on the display [1012]. This input device typically has two degrees of freedom in two axes, a first axis (e.g., x) and a second axis (e.g., y), that allow the device to specify positions in a plane.

[0068] The computing device [1000] may implement the techniques described herein using customized hard-wired logic, one or more ASICs or FPGAs, firmware and/or program logic which in combination with the computing device [1000] causes or programs the computing device [1000] to be a special-purpose machine. According to one implementation, the techniques herein are performed by the computing device [1000] in response to the processor [1004] executing one or more sequences of one or more instructions contained in the main memory [1006]. Such instructions may be read into the main memory [1006] from another storage medium, such as the storage device [1010]. Execution of the sequences of instructions contained in the main memory [1006] causes the processor [1004] to perform the process steps described herein. In alternative implementations of the present disclosure, hard-wired circuitry may be used in place of or in combination with software instructions.

[0069] The computing device [1000] also may include a communication interface [1018] coupled to the bus [1002]. The communication interface [1018] provides a two-way data communication coupling to a network link [1020] that is connected to a local network [1022]. For example, the communication interface [1018] may be an integrated services digital network (ISDN) card, cable modem, satellite modem, or a modem to provide a data communication connection to a corresponding type of telephone line. As another example, the communication interface [1018] may be a local area network (LAN) card to provide a data communication connection to a compatible LAN. Wireless links may also be implemented. In any such implementation, the

communication interface [1018] sends and receives electrical, electromagnetic or optical signals that carry digital data streams representing various types of information.

[0070] The computing device [1000] can send messages and receive data, including program code, through the network(s), the network link [1020] and the communication interface [1018]. In the Internet example, a server [1030] might transmit a requested code for an application program through the Internet [1028], the ISP [1026], the host [1024], the local network [1022] and the communication interface [1018]. The received code may be executed by the processor [1004] as it is received, and/or stored in the storage device [1010], or other non-volatile storage for later execution.

[0071] Referring to **FIG. 3**, an exemplary block diagram of a system [300] for recovery of subscriber services, is shown, in accordance with the exemplary implementations of the present disclosure. The system [300] comprises at least one detecting unit [302], at least one invoking unit [304], at least one determining unit [306], at least one transmitting unit [308], and at least one attaching unit [310]. Also, all of the components/ units of the system [300] are assumed to be connected to each other unless otherwise indicated below. As shown in the figures all units shown within the system should also be assumed to be connected to each other. Also, in FIG. 3 only a few units are shown, however, the system [300] may comprise multiple such units or the system [300] may comprise any such numbers of said units, as required to implement the features of the present disclosure. Further, in an implementation, the system [300] may reside in a server or a network entity to implement the features of the present disclosure. In another implementation, the system [300] may be present in a user device. The system [300] may be a part of the user device / or may be independent of but in communication with the user device (may also referred to herein as a UE). In yet another implementation, the system [300] may reside partly in the server/ network entity and partly in the user device.

[0072] The system [300] is configured to perform recovery of subscriber services, with the help of the interconnection between the components/units of the system [300]. Further, reference to the components depicted in FIG. 5 is made to explain the FIG. 3.

[0073] The system [300] includes a detecting unit [302] configured to detect, via a binding support function (BSF) [508], a call failure in a network. As used herein, the BSF stores the binding information for a certain Protocol Data Unit (PDU) session and discovers the binding information (e.g., the address information of the selected Policy Control Function). The BSF allows network

function service consumers (e.g., PCF) to register, update and remove the binding information, and allows other service consumers (e.g., Application Function, Network Exposure Function) to discover the binding information (e.g., the address information of the selected PCF). In an example, the call failure occurs due to an error in an authorization and authentication (AA) ANSWER system from one or more network functions, which is detected at the binding support function (BSF) [508] end. The one or more network functions comprise at least one of a policy and charging rules function (PCRF) [510] and policy control function (PCF) [510]. The call failure occurs due to issues in either the establishment, or maintenance of a pre-established internet protocol connectivity access network (IP-CAN) session. Failure in establishing or maintaining the IP-CAN session leads to an occurrence of IP-CAN_Session_Not_Available (5065) error.

[0074] In an exemplary embodiment of the present disclosure, the Binding Support Function (BSF) [508] may constantly monitor the network to detect a call failure. The network may be a 4th Generation network or a 5th Generation core network. The call failure may be due to an error verifying the identity and permissions of the users involved. For example, the error may include, but are not limited to, the establishment or maintenance of a pre-established internet protocol connectivity access network (IP-CAN). As used herein, IP-CAN refers to a connection that can be set up in advance to provide a user with access to the internet or other IP-based services.

[0075] The determining unit [306] determines the cause of the call failure. For example, the failure of the call may have occurred due to the IP-CAN_Session_Not_Available (5065) error.

[0076] As used herein, "CAN_Session_Not_Available (5065)" error is a specific error code indicating a failure to establish a multimedia session, such as a voice or video call, within an IP Multimedia Subsystem (IMS) network or Voice over Internet Protocol (VoIP) service. The error can then be sent from the Policy and Charging Rules Function (PCRF) [510] or the Policy Control Function (PCF) [510] to the BSF whenever the error is detected in the AA-Answer, a

[0077] message in the Diameter protocol, which is used in network signalling and management.

[0078] The system [300] includes an invoking unit [304] configured to invoke, via the BSF [508], an application programming interface (API) call in at least one of a Unified Data Management (UDM) [124] system and home subscriber server (HSS) to deregister at least one subscriber from the network. The API call comprises at least one of a subscription permanent identifier (SUPI), and international mobile subscriber identity (IMSI) as a query parameter.

[0079] In an implementation of the present disclosure, once this error is detected, the BSF [508], through an invoking unit [304] invokes the Application Programming Interface (API) call in the Unified Data Management (UDM) [124] system. The API call may include, but are not limited to subscription permanent identifier (SUPI), international mobile subscriber identity (IMSI). As used herein, the SUPI refers to a unique identifier associated with a subscriber's account, whereas IMSI refers to a unique identifier associated with the subscriber's SIM. These parameters may help in identifying the subscriber that needs to be deregistered. The API call may deregister the subscriber from the network. The reason for this deregistration is stated as 're-registration required,' indicating the subscriber needs to reconnect to the network.

[0080] The system [300] includes a determining unit [306] configured to determine, via the at least one of UDM [124], and HSS system, attach status of the subscriber. If the subscriber is attached to a 4G network, send a deregistration notification to a mobility management entity (MME) [502] with a cause of 're-Attach required', by the HSS. If the subscriber is connected to the 4G network, the HSS sends a cancel location request (CLR) to the MME [502]. As used herein, the CLR refers to a signaling message or command within a telecommunications network to terminate the ongoing tracking of the subscriber's location. If the subscriber is attached to a 5G network, send a deregistration notification to an access and mobility management function (AMF) [506] with a cause of re-registration required by the UDM [124].

[0081] In an implementation of the present disclosure, the determining unit [306] may determine if the subscriber is attached to a 4th Generation network or a 5th Generation core network. When the subscriber is attached to the 4th Generation network, the deregistration notification is sent to the MME [502]. The notification message may give a reason as 're-attach required'. Where the subscriber is determined to be attached to the 5th Generation Core network, the deregistration notification message may be sent to the AMF [506]. The message may include 're-registration required'.

[0082] The system [300] further includes a transmitting unit [308] configured to transmit the corresponding cause over non-access stratum (NAS) by at least one of the AMF [506], and the MME [502].

[0083] In an implementation of the present disclosure, in the 5th Generation core network and the 4th Generation mobile network, when an error occurs that affects the connection between a user equipment (UE) [102] and the corresponding network, the transmitting unit [308] may transmit

the cause of the error. The AMF [506] for the 5th Generation subscriber and the MME [502] for the 4th generation subscriber, sends out the error cause over non-access stratum. As used herein, the Non-Access Stratum (NAS) is a layer of communication procedure to handle signalling and control functions for establishment and maintenance of connection between the user equipment [102] and corresponding core network (e.g., 4G network or 5G network).

[0084] The system [300] includes an attaching unit [310] configured to re-attach the subscriber to the network based on the attach status of the subscriber after successful detachment.

[0085] In an implementation of the present disclosure, in the telecommunication network, once the deregistration is completed, an attaching unit [310] may re-attach the subscriber to the corresponding network. The network may be a 4th generation network or a 5th generation core network which is defined based on the subscriber details. The re-attachment may be performed on a confirmation of the successful detachment of the subscriber.

[0086] The system [300] comprising a restoring unit [312] configured to restore, via the network, high-speed internet (HSI) and voice video and multimedia (VVM) services for the users. In an implementation of the present disclosure, after the subscriber is successfully reattached to the network, the restoring unit [312] restores high speed internet and voice video and multimedia services on the subscriber's UE [102].

[0087] Referring to FIG. 4, an exemplary method flow diagram [400] for recovery of subscriber services, in accordance with exemplary implementations of the present disclosure is shown. In an implementation the method [400] is performed by the system [300]. Further, in an implementation, the system [300] may be present in a server to implement the features of the present disclosure. Also, as shown in FIG. 4, the method [400] starts at step [402].

[0088] At step [404], the method comprises detecting, by a detecting unit [302] via a binding support function (BSF) [508], a call failure in a network. In an example, the call failure occurs due to an error in an authorization and authentication (AA) ANSWER system from one or more network functions which is detected at the binding support function (BSF) [508] end. The one or more network functions comprise at least one of a policy and charging rules function (PCRF) [510], and policy control function (PCF) [510]. The call failure occurs due to issues in either the establishment or maintenance of a pre-established internet protocol connectivity access network

(IP-CAN) session. In a non-limiting embodiment of the present disclosure, the error is referred to as IP-CAN_Session_Not_Available (5065) error.

[0089] In an exemplary embodiment of the present disclosure, the Binding Support Function (BSF) [508] may constantly monitor the network to detect a call failure. The network may be a 4th Generation network or a 5th Generation core network. The call failure may be due to an error verifying the identity and permissions of the users involved. For example, the error may include, but are not limited to establishment or maintenance of a pre-established internet protocol connectivity access network (IP-CAN). A call fail error is determined as IP-CAN_Session_Not_Available (5065) error by the determining unit [306]. The error can then be sent from the Policy and Charging Rules Function (PCRF) [510] or the Policy Control Function (PCF) [510] to the BSF whenever the error is detected in the AA-Answer, a message in the Diameter protocol, which is used in network signalling and management.

[0090] At step [406], the method comprises invoking, by an invoking unit [304] via the BSF [508], an application programming interface (API) call in at least one of a unified data management (UDM) [124] system, and home subscriber server (HSS) to deregister at least one subscriber from the network. the API call comprises at least one of a subscription permanent identifier (SUPI), and international mobile subscriber identity (IMSI) as a query parameter.

[0091] In an implementation of the present disclosure, once this error is detected, invoking of the Application Programming Interface (API) call in the Unified Data Management (UDM) [124] system may be performed by the BSF [508], through an invoking unit [304]. The API call may include, but are not limited to subscription permanent identifier (SUPI), international mobile subscriber identity (IMSI). The SUPI refers to a unique identifier associated with a subscriber's account, whereas IMSI refers to a unique identifier associated with the subscriber's SIM. These parameters may help in identifying the subscriber that needs to be deregistered. The API call may deregister the subscriber from the network. The reason for this deregistration is stated as 're-registration required,' indicating the subscriber needs to reconnect to the network.

[0092] At step [408], the method comprises determining, by a determining unit [306] via the at least one of UDM [124], and HSS, attach status of the subscriber. Determining the attach status of the subscriber comprises checking, by the determining unit [306], if a user equipment (UE) [102] associated with the subscriber is attached to at least one of 4G network, and 5G network.

[0093] At step [410], the method comprises determining the network to which the subscriber is attached or connected. For example, the subscriber may be connected or attached to a 4G network or a 5G network.

5 [0094] At step [412], the method comprises, if the subscriber is attached to a 4G network, sending a deregistration notification to a mobility management entity (MME) [502] with a cause of 're-Attach required', by the HSS. More particularly, if the subscriber is connected to the 4G network, the HSS sends a cancel location request (CLR) to the MME [502].

10 [0095] At step [414], the method comprises, if the subscriber is attached to a 5G network, sending a deregistration notification to an access and mobility management function (AMF) [506] with a cause of re-registration required by the UDM [124]. More particularly, if the subscriber is attached to the 5G network, the UDM [124] sends the deregistration notification to the AMF [506]. In an implementation of the present disclosure, the determining unit [306] may determine if the
15 subscriber is attached to a 4th Generation network or a 5th Generation core network. When the subscriber is attached to the 4th Generation network, the deregistration notification is sent to the MME [502]. The notification message may give a reason as 're-attach required'. Where the subscriber is determined to be attached to the 5th Generation Core network, the deregistration notification message may be sent to the AMF [506]. The message may include 're-registration
20 required'.

[0096] At step [416], the method comprises transmitting, by a transmitting unit [308], the corresponding cause over non-access stratum (NAS) by at least one of the AMF [506], and the MME [502]. In an implementation of the present disclosure, in the 5th Generation core network
25 and the 4th Generation mobile network, when an error occurs that affects the connection between a user equipment (UE) [102] and the corresponding network, the cause of the error may be transmitted by a transmitting unit [308]. The AMF [506] for the 5th Generation subscriber and the MME [502] for the 4th generation subscriber, sends out the error cause over a non-access stratum. The Non-Access Stratum is a layer of communication procedure to handle signaling and control
30 functions for establishment and maintenance of connected between the user equipment [102] and corresponding core network (e.g., 4G network or 5G network).

[0097] Further at step [418], the method comprises re-attaching, by an attaching unit [310], based on the attach status of the subscriber, the subscriber to the network after successful detachment.
35 The method comprises restoring high-speed internet (HSI) and voice video and multimedia (VVM)

services by the network. In an implementation of the present disclosure, in the telecommunication network, once the deregistration is completed, re-attaching the UE [102] of the subscriber to the network may be performed by the attaching unit [310]. The network may be a 4th generation network or a 5th generation core network. The re-attachment may be performed on a confirmation of the successful detachment of the subscriber. In an implementation of the present disclosure, after the subscriber is successfully reattached to the network, restoring of the high-speed internet and voice video and multimedia services on the subscriber's UE [102] is performed by a restoring unit [312]. The method terminates at step [420].

[0098] Referring to FIG. 5, an exemplary process flow [500] for automated subscriber services recovery upon failure detection at network end is shown, in accordance with exemplary embodiments of the present disclosure. The system 300 depicted in FIG. 3 may be utilized for executing several specific steps of FIG. 5 for automated subscriber services recovery upon failure detection at network end:

[0099] The Binding Support Function (BSF) [508] is constantly monitoring the network. At step 1, if a call fails, it will detect this failure and associated error or reason of the failure. For example, IP-CAN_Session_Not_Available (5065) error may be indicated as a cause of the failure of the call. The error can then be sent from the Policy and Charging Rules Function (PCRF) [510] or the Policy Control Function (PCF) [510], which is detected in the AA-Answer, a message in the Diameter protocol, which is used in network signalling and management.

[00100] At step 2, once this error is detected, the BSF [508] responds by invoking an Application Programming Interface (API) in the Unified Data Management (UDM)/ HSS (504). This API is designed to deregister the subscriber from the network. The reason for this deregistration is stated as 're-registration required,' indicating the subscriber needs to reconnect to the network.

[00101] The API call contains either the Subscription Permanent Identifier (SUPI) or the International Mobile Subscriber Identity (IMSI) as a query parameter. These parameters identify the subscriber that needs to be deregistered.

[00102] The API request is then received by the UDM Provisioning Server (PS). This server checks the exact status of the subscriber, meaning it verifies whether the subscriber is currently connected to the network and on which type of network (4G or 5G) they are attached.

[00103] If the subscriber is connected to a 4G network, the Home Subscriber Server (HSS) sends a Cancel Location Request (CLR) to the Mobility Management Entity (MME) [502]. The reason given for this request is 're-attach required,' signaling that the subscriber should be reconnected to the network.

[00104] If the subscriber is attached to a 5G network, the UDM sends a deregistration notification to the Access and Mobility Management Function (AMF) [506]. This notification also contains the cause 'Re-Registration required,' asking the AMF [506] to disconnect the subscriber and allow them to reconnect.

[00105] Next, the AMF [506] or MME [502] (depending on whether the subscriber is on a 5G or 4G network, respectively) will transmit the cause for deregistration over the Non-Access Stratum (NAS), which is a functional layer in the mobile communication system that carries non-radio-related signaling between the UE (User Equipment) [102] and the core network.

[00106] Finally, after being successfully disconnected from the network, the User Equipment (UE) [102], which could be a smartphone or other mobile device, will try to reconnect or 're-attach' to the network. This reconnection completes the process and restores network services for the subscriber.

[00107] The DRA [512] monitors resource usage across the network and detects inefficiencies or potential bottlenecks. If the DRA [512] identifies that a call failure is due to resource constraints, it can trigger an API call to the Unified Data Management (UDM) [124] or Home Subscriber Server (HSS) through the BSF [508].

[00108] The PCS CF [514] enforces policies related to subscriber services, such as quality of service (QoS) and access controls such that the subscribers receive services according to their subscription plans and network policies. Additionally, the PCS CF [514] applies charging rules to the services used by subscribers, calculating charges based on usage and ensuring accurate billing. When a call failure occurs, the PCS CF [514] communicates with the BSF [508], providing details on policy enforcement status and any charging issues that might have contributed to the failure.

[00109] The present disclosure further discloses a user equipment (UE) [102]. The UE [102] comprises a processing unit or processor [1004] to receive a request for deregister of a subscriber

based on detected call failure in a network, wherein if the subscriber is attached to a 4G network, a deregistration notification is sent to a mobility management entity (MME) with a cause of 'Re-Attach required', and wherein if the subscriber is attached to a 5G network, a deregistration notification is sent to an access and mobility management function (AMF) with a cause of Re-registration required. The processing unit is further configured to receive the corresponding cause over non-access stratum (NAS) from at least one of the AMF, and the MME; re-attach the subscriber to the network based on an attach status of the subscriber after successful detachment.

[00110] According to yet another aspect of the present disclosure, a non-transitory computer-readable storage medium storing instruction, the storage medium comprising executable code which, when executed by one or more units of a system, causes: a detecting unit of the system to detect, via a binding support function (BSF), a call failure in a network; an invoking unit of the system to invoke, via the BSF, an application programming interface (API) call in at least one of a Unified Data Management (UDM) system and home subscriber server (HSS) to deregister at least one subscriber from the network; a determining unit [306] configured to determine, via the at least one of UDM [124], and HSS system, attach status of the subscriber, wherein if the subscriber is attached to a 4G network, send a deregistration notification to a mobility management entity (MME) [502] with a cause of 'Re-Attach required', by the HSS, and wherein if the subscriber is attached to a 5G network, send a deregistration notification to an access and mobility management function (AMF) [506] with a cause of Re-registration required by the UDM [124]; a transmitting unit [308] configured to transmit the corresponding cause over non-access stratum (NAS) by at least one of the AMF [506], and the MME [502]; and an attaching unit [310] configured to re-attach the subscriber to the network based on the attach status of the subscriber after successful detachment.

[00111] As is evident from the above, the present disclosure provides a technically advanced solution for recovery of subscriber services. The present solution provides a method and system for recovery subscriber services recovery upon failure detection at network end that provides automated recovery in the event of a call failure to significantly reduce downtime and improve service availability. The present solution further provides a standardized approach to deregistering and re-registering subscribers across different network types (4G and 5G). It enables real-time detection of the network failure and prompt recovery. This could minimize service disruptions for subscribers.

[00112] Further, in accordance with the present disclosure, it is to be acknowledged that the functionality described for the various components/units can be implemented interchangeably. While specific embodiments may disclose a particular functionality of these units for clarity, it is recognized that various configurations and combinations thereof are within the scope of the disclosure. The functionality of specific units, as disclosed in the disclosure, should not be construed as limiting the scope of the present disclosure. Consequently, alternative arrangements and substitutions of units, provided they achieve the intended functionality described herein, are considered to be encompassed within the scope of the present disclosure.

[00113] While considerable emphasis has been placed herein on the disclosed implementations, it will be appreciated that many implementations can be made and that many changes can be made to the implementations without departing from the principles of the present disclosure. These and other changes in the implementations of the present disclosure will be apparent to those skilled in the art, whereby it is to be understood that the foregoing descriptive matter to be implemented is illustrative and non-limiting.

We Claim:

1. A method for recovery of subscriber services, the method comprising the steps of:
detecting, by a detecting unit [302] via a binding support function (BSF) [508], a call
5 failure in a network;
invoking, by an invoking unit [304] via the BSF [508], an application programming
interface (API) call in at least one of a unified data management (UDM) [124] system, and
home subscriber server (HSS) to deregister at least one subscriber from the network;
determining, by a determining unit [306] via the at least one of UDM [124], and HSS,
10 attach status of the subscriber, wherein
if the subscriber is attached to a 4G network, sending a deregistration notification
to a mobility management entity (MME) [502] with a cause of 'Re-Attach required',
by the HSS, and wherein
if the subscriber is attached to a 5G network, sending a deregistration notification
15 to an access and mobility management function (AMF) [506] with a cause of re-
registration required by the UDM [124];
transmitting, by a transmitting unit [308], the corresponding cause over non-access
stratum (NAS) by at least one of the AMF [506], and the MME [502]; and
re-attaching, by an attaching unit [310], based on the attach status of the subscriber,
20 the subscriber to the network after successful detachment.
2. The method as claimed in claim 1, wherein the call failure occurs due to an error in an
authorization and authentication (AA) ANSWER system from one or more network
functions, detected at a binding support function (BSF) [508] end.
- 25 3. The method as claimed in claim 2, wherein the error is IP-CAN_Session_Not_Available
(5065) error.
4. The method as claimed in claim 2, wherein the one or more network functions comprise at
30 least one of a policy and charging rules function (PCRF) [510], and policy control function
(PCF) [510].
5. The method as claimed in claim 1, the method comprises restoring, via a restoring unit [312],
high-speed internet (HSI) and voice video and multimedia (VVM) services by the network.

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6. The method as claimed in claim 1, wherein the API call comprises at least one of a subscription permanent identifier (SUPI), and international mobile subscriber identity (IMSI) as a query parameter.
- 5 7. The method as claimed in claim 1, wherein if the subscriber is connected to the 4G network, the HSS sends a cancel location request (CLR) to the MME [502].
8. The method as claimed in claim 1, wherein if the subscriber is attached to the 5G network, the UDM [124] sends the deregistration notification to the AMF [506].
- 10 9. The method as claimed in claim 1, wherein determining the attach status of the subscriber comprises checking, by the determining unit [306], if a user equipment (UE) [102] associated with the subscriber is attached to at least one of 4G network, and 5G network.
- 15 10. The method as claimed in claim 1, wherein the call failure occurs due to establishment or maintenance of a pre-established internet protocol connectivity access network (IP-CAN) session.
- 20 11. A system for recovery of subscriber services, said system comprises:
a detecting unit [302] configured to detect, via a binding support function (BSF) [508], a call failure in a network;
an invoking unit [304] configured to invoke, via the BSF [508], an application programming interface (API) call in at least one of a Unified Data Management (UDM) [124] system and home subscriber server (HSS) to deregister at least one subscriber from
25 the network;
a determining unit [306] configured to determine, via the at least one of UDM [124], and HSS, attach status of the subscriber, wherein
if the subscriber is attached to a 4G network, send a deregistration notification to a mobility management entity (MME) [502] with a cause of 'Re-Attach required',
30 by the HSS, and wherein
if the subscriber is attached to a 5G network, send a deregistration notification to an access and mobility management function (AMF) [506] with a cause of Re-registration required by the UDM [124];
a transmitting unit [308] configured to transmit the corresponding cause over non-
35 access stratum (NAS) by at least one of the AMF [506], and the MME [502]; and

an attaching unit [310] configured to re-attach the subscriber to the network based on the attach status of the subscriber after successful detachment.

- 5 12. The system [300] as claimed in claim 11, wherein the call failure occurs due to an error in an authorization and authentication (AA) ANSWER system from one or more network functions, detected at a binding support function (BSF) [508] end.
- 10 13. The system [300] as claimed in claim 12, wherein the error is IP-CAN_Session_Not_Available (5065) error.
14. The system [300] as claimed in claim 12, wherein the one or more network functions comprise at least one of a policy and charging rules function (PCRF) [510] and policy control function (PCF) [510].
- 15 15. The system [300] as claimed in claim 11, comprising a restoring unit [312] is configured to restore, via the network, high-speed internet (HSI) and voice video and multimedia (VVM) services.
- 20 16. The system [300] as claimed in claim 11, wherein the API call comprises at least one of a subscription permanent identifier (SUPI), and international mobile subscriber identity (IMSI) as a query parameter.
- 25 17. The system [300] as claimed in claim 11, wherein if the subscriber is connected to the 4G network, the HSS sends a cancel location request (CLR) to the MME [502].
18. The system [300] as claimed in claim 11, wherein if the subscriber is attached to the 5G network, the UDM [124] sends the deregistration notification to the AMF [506].
- 30 19. The system [300] as claimed in claim 11, wherein for the determination of the attach status of the subscriber the determining unit [306] is configured to check if a user equipment (UE) [102] associated with the subscriber is attached to at least one of 4G network, and 5G network.

20. The system [300] as claimed in claim 11, wherein the call failure occurs due to at least one of establishment, and maintenance of a pre-established internet protocol connectivity access network (IP-CAN) session.
- 5 21. A user equipment (UE) [102] comprises a processing unit, said processing unit is configured to:
- receive a request to deregister a subscriber based on a detected call failure in a network, wherein
- if the subscriber is attached to a 4G network, a deregistration notification is sent
- 10 to a mobility management entity (MME) [502] with a cause of 're-Attach required', and wherein
- if the subscriber is attached to a 5G network, a deregistration notification is sent to an access and mobility management function (AMF) [506] with a cause of Re-registration required;
- 15 receive the corresponding cause over non-access stratum (NAS) from at least one of the AMF [506], and the MME [502]; and
- re-attach the subscriber to the network based on an attach status of the subscriber after successful detachment.
- 20 22. The UE [102] as claimed in claim 21, wherein the request to deregister is generated based on the steps performed in claim 1.
23. A non-transitory computer-readable storage medium storing instruction for recovery of subscriber services, the storage medium comprising executable code which, when executed
- 25 by one or more units of a system, causes:
- a detecting unit [302] of the system to detect, via a binding support function (BSF) [508], a call failure in a network;
- an invoking unit [304] of the system to invoke, via the BSF [508], an application programming interface (API) call in at least one of a Unified Data Management (UDM)
- 30 system and home subscriber server (HSS) to deregister at least one subscriber from the network;
- a determining unit [306] to determine, via the at least one of UDM [124], and HSS, attach status of the subscriber, wherein

if the subscriber is attached to a 4G network, send a deregistration notification to a mobility management entity (MME) [502] with a cause of 'Re-Attach required', by the HSS, and wherein

5 if the subscriber is attached to a 5G network, send a deregistration notification to an access and mobility management function (AMF) [506] with a cause of Re-registration required by the UDM [124];

a transmitting unit [308] to transmit the corresponding cause over non-access stratum (NAS) by at least one of the AMF [506], and the MME [502]; and

10 an attaching unit [310] to re-attach the subscriber to the network based on the attach status of the subscriber after successful detachment.

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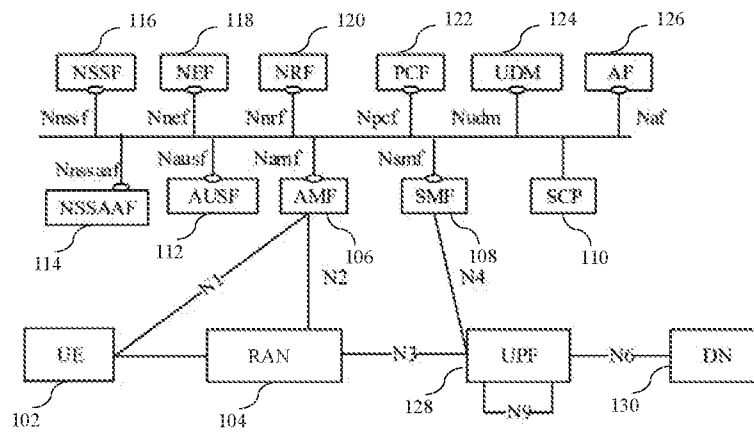


FIG. 1

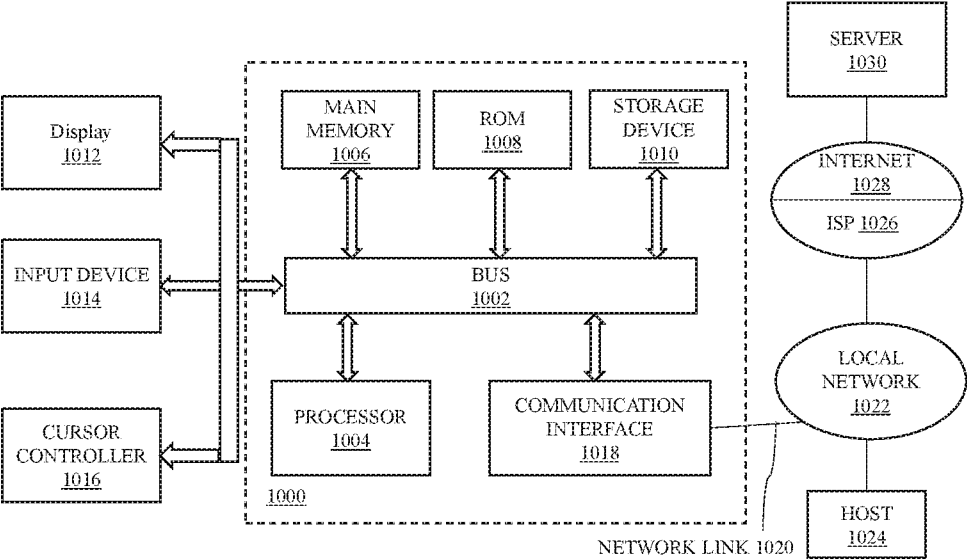


FIG. 2

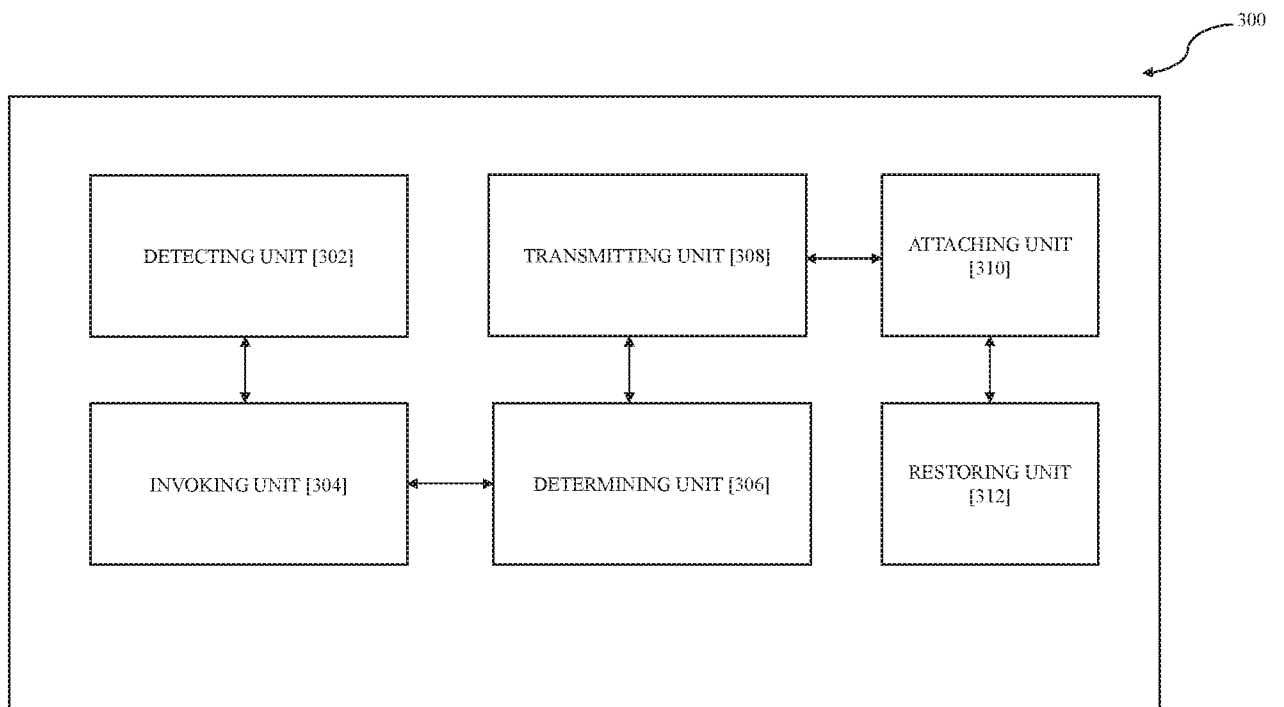


FIG. 3

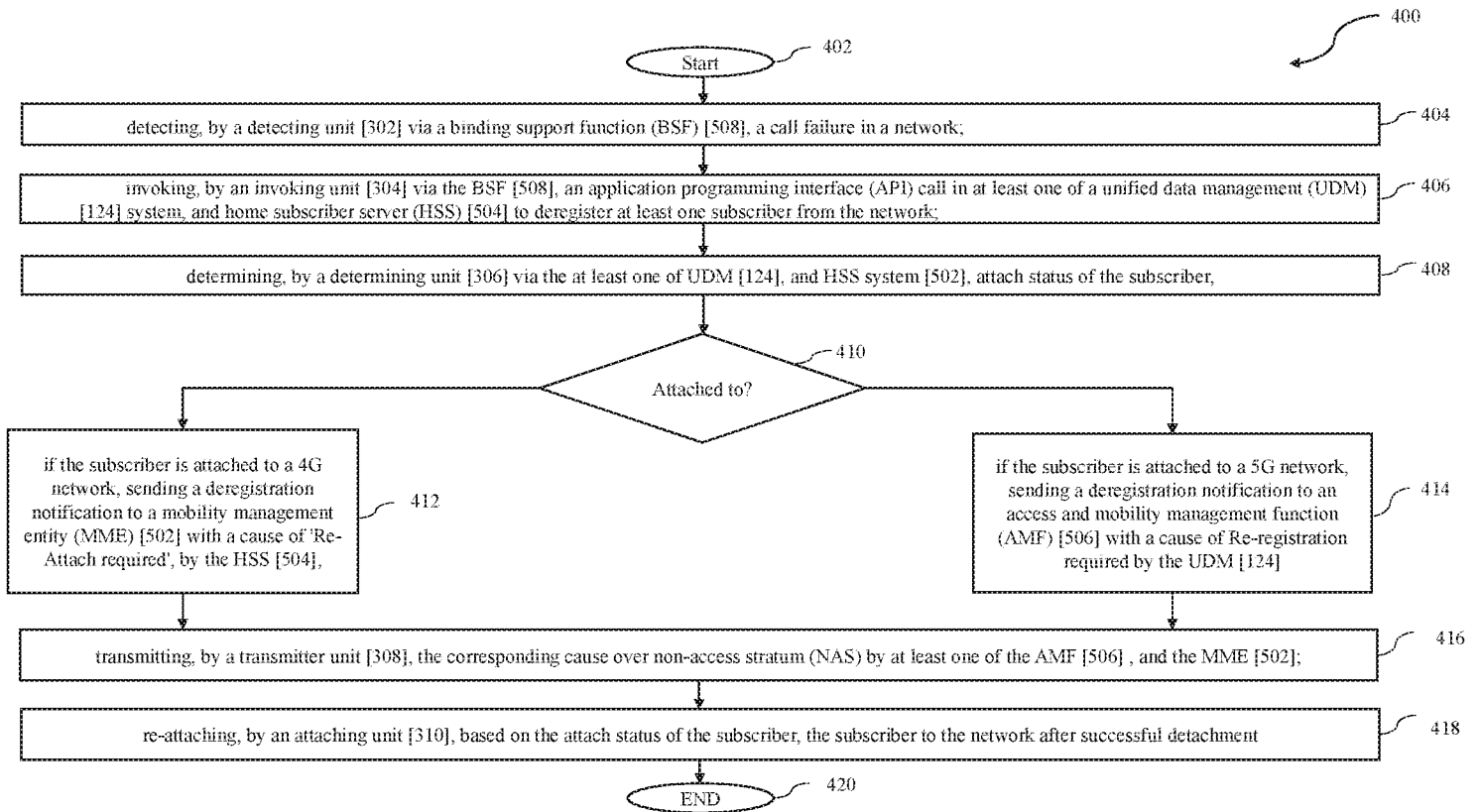


FIG. 4

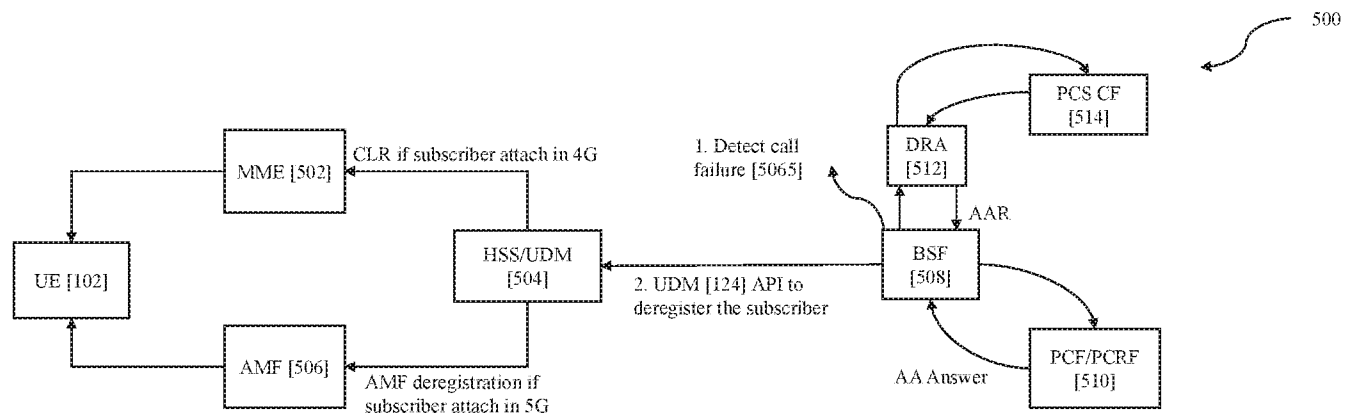


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2024/050797

A. CLASSIFICATION OF SUBJECT MATTER

H04W24/04, H04W60/06, H04W76/19, H04W8/20 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)

PatSeer, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR101513451B1 (SK TELECOM CO LTD) 20 April, 2015 (20-04-2015) English translation copy from Google Patents Abstract and Claim 1	1-23
Y	WO2021223202A1 (QUALCOMM INCORPORATED) 11 November, 2021 (11-11-2021) Abstract and Claims 1-11	1-23
Y	CN104936309B (NEC CORP) 30 November, 2018 (30-11-2018) English translation copy from Google Patents Abstract and Claim 1	1-23



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search

17-10-2024

Date of mailing of the international search report

17-10-2024

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IN2024/050797

Citation	Pub.Date	Family	Pub.Date
CN 104936309 B	30-11-2018	ES 2444815 T3	26-02-2014
		JP 4985880 B2	25-07-2012
		BR 112012019257 B1	25-01-2022
		US 8923194 B2	30-12-2014
		WO 2011136248 A1	03-11-2011
		EP 2472988 B1	25-06-2014
		KR 101332971 B1	25-11-2013