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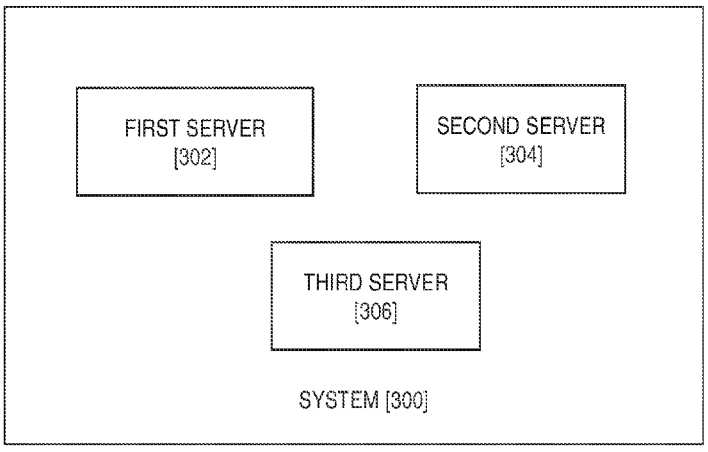
(54) Title: METHOD AND SYSTEM FOR PERFORMING A BARRING PROCEDURE IN A PRE-DEFINED PRESENCE REPORTING AREA (PRA)

FIG. 3



(57) Abstract: The present disclosure relates to a method and a system for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA) The present disclosure encompasses receiving, by a core network server, an area information for application of the barring procedure. The method comprises identifying, by the core network server, set of one or more second servers, based on the area information. The method comprises sending, by user interface at the one or more second servers implementing a session management function (SMF) to one or more first servers implementing a policy control function (PCF). The method comprises receiving from the first server at the second server, an updated policy related to the at least one PRA trigger command sent by user interface to the first server. The method comprises sending, by the second server to a third server implementing a user plane function (UPF).

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METHOD AND SYSTEM FOR PERFORMING A BARRING PROCEDURE IN A PRE-DEFINED PRESENCE REPORTING AREA (PRA)

FIELD OF INVENTION

[0001] Embodiments of the present disclosure relates generally to the field of wireless communication systems. More particularly, embodiments of the present disclosure relate to methods and systems for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA).

BACKGROUND

[0002] The following description of the related art is intended to provide background information 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.

[0003] Wireless communication technology has rapidly evolved over the past few decades, with 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. The third generation (3G) 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 generation, wireless communication technology has become more advanced, sophisticated, and capable of delivering more services to its users.

[0004] In a particular area, barring or unbarring of data transmission from a user equipment may be required, for any reason. In conventional approaches, during barring of data transmission, a user equipment is detached from the network by sending a signal to that effect from a session management function (SMF) implemented on a server to an user plane function (UPF)

implemented on the server. In such an approach, if the user changes location and re-attaches to the network, again the user has to be detached from the network by sending a signal to that effect. In a given area, where barring or unbarring is desired, there can be millions of user equipment. Therefore, detaching or attaching (for unbarring or barring, respectively) such a large number of user equipment imposes undue stress/surge on the network as the network has to send an equivalently large number of signals to that effect, for each user equipment.

[0005] Further, over the period of time various solutions have been developed to reduce load on network during barring or unbarring user equipment from a network. However, there are certain challenges with existing solutions. It is reiterated that detaching or attaching (for unbarring or barring, respectively) a large number of user equipment places undue stress/surge on the network as the network has to send an equivalently large number of signals to that effect for each user equipment. It is emphasized that this approach is laborious, inefficient and resource intensive from a network point of view.

[0006] Thus, there exists an imperative need in the art to bar or unbar user equipment without attaching or detaching the same, which the present disclosure aims to address.

SUMMARY

[0007] 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.

[0008] An aspect of the present disclosure relates to a method for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), the method comprising sending, by a user interface at one or more second servers implementing a session management function (SMF) to one or more first servers implementing a policy control function (PCF), at least one PRA trigger command, wherein the at least one PRA trigger command is related to performing the barring procedure for the one or more user devices, and wherein the at least one PRA trigger command is sent by the user interface at the one or more second servers to the one or more first servers in an event there is a zero relative movement of the one or more user devices with respect the PRA. The method comprises receiving from the first server at the second server, an updated policy related to the at least one PRA trigger command sent by the user interface to the first server. The method comprises sending, by the second server to a third server implementing a

user plane function (UPF), the set of governing rules for implementation at the third server, wherein the set of governing rules facilitates modification of at least one of an uplink data flow and downlink data flow, for performing the barring procedure.

[0009] In an exemplary aspect of the present disclosure, the one or more second servers are identified by a core network server.

[0010] In an exemplary aspect of the present disclosure, the core network server is to identify the one or more second servers based on an area information, received by the core network server, for application of the barring procedure.

[0011] In an exemplary aspect of the present disclosure, the pre-defined presence reporting area comprises a list of tracking areas (TAs), NG-RAN nodes, and cell identifiers in a public land mobile network.

[0012] In an exemplary aspect of the present disclosure, the set of governing rules are generated at the first server based on the at least one PRA trigger command received from the SMF.

[0013] In an exemplary aspect of the present disclosure, prior to the sending, by the user interface at the second server to the first server, the at least one PRA trigger command, the method comprises activating, by the second server, the at least one PRA trigger command for the pre-defined presence reporting area.

[0014] In an exemplary aspect of the present disclosure, the zero relative movement of the one or more user devices with respect the PRA refers to no movement of the one or more user devices from outside the PRA to inside the PRA, and no movement of the one or more user devices from inside the PRA to outside the PRA.

[0015] In an exemplary aspect of the present disclosure, wherein the updated policy comprises a set of governing rules related to the one of a barring and an unbarring of the one or more user devices based on the at least one PRA trigger command received from the SMF implemented by second server.

[0016] Another aspect of the present disclosure relates to a system for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), the system

comprising a first server, the first server implementing a policy control function (PCF). The system comprises a second server connected to at least the first server, the second server implementing a session management function (SMF). The system comprises a third server connected to at least the second server and the first server, the third server implementing a user plane function (UPF). The second server is further configured to send, to the first server via a user interface at the second server, at least one PRA trigger command, wherein the at least one PRA trigger command is related to performing the barring procedure for the one or more user devices, and wherein the at least one PRA trigger command is sent by the user interface at the second server to the first server in an event there is a zero relative movement of the one or more user devices with respect to the PRA. The second server is further implemented to receive, from the first server, an updated policy related to the at least one PRA trigger command sent by the user interface to the first server, wherein the updated policy comprises a set of governing rules related to the one of the barring and the unbarring of the one or more user devices based on the at least one PRA trigger command received from the SMF implemented by second server. The second server is further configured to send, to the third server, the set of governing rules for implementation at the third server, wherein the set of governing rules facilitates modification of at least one of an uplink data flow and downlink data flow, for performing the barring procedure.

[0017] Yet another aspect of the present disclosure relates to a non-transitory computer-readable storage medium storing instructions for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA). The instructions may include executable code which, when executed by a second server implementing a session management function (SMF), causes the second server to perform certain functions. The instructions when executed causes the second server to send, by a user interface, at least one PRA trigger command to one or more first servers implementing a policy control function (PCF). The at least one PRA trigger command is related to performing the barring procedure for the one or more user devices, and the at least one PRA trigger command is sent, by the user interface, to the one or more first servers in an event there is a zero relative movement of the one or more user devices with respect the PRA. The instructions when executed further causes the second server to receive, from the first server, an updated policy related to the at least one PRA trigger command sent by the user interface to the first server. The instructions when executed furthermore causes the second server to send, to a third server implementing a user plane function (UPF), the set of governing rules for implementation at the third server, wherein the set of governing rules facilitates modification of at least one of an uplink data flow and downlink data flow, for performing the barring procedure.

OBJECTS OF THE DISCLOSURE

[0018] Some of the objects of the present disclosure, which at least one embodiment disclosed herein satisfies are listed herein below.

[0019] It is an object of the present disclosure to provide a system and a method for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA).

[0020] It is another object of the present disclosure to provide a solution that does not impose undue stress/surge on the network as the network has to send an equivalently large number of signals to bar or unbar each user equipment.

DESCRIPTION OF THE DRAWINGS

[0021] 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.

[0022] FIG. 1 illustrates an exemplary block diagram representation of 5th generation core (5GC) network architecture.

[0023] 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.

[0024] FIG. 3 illustrates an exemplary block diagram of a system for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), in accordance with exemplary implementations of the present disclosure.

[0025] FIG. 4 illustrates a method flow diagram for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), in accordance with exemplary implementations of the present disclosure.

[0026] FIG. 5 illustrates a signalling flow diagram for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), in accordance with exemplary implementations of the present disclosure.

[0027] The foregoing shall be more apparent from the following more detailed description of the disclosure.

DETAILED DESCRIPTION

[0028] 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. 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.

[0029] 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 in the function and arrangement of elements without departing from the spirit and scope of the disclosure as set forth.

[0030] 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, processes, and other components may be shown as components in block diagram form in order not to obscure the embodiments in unnecessary detail.

[0031] 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

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 re-arranged. A process is terminated when its operations are completed but could have additional steps not included in a figure.

[0032] 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 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.

[0033] 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 microcontroller, 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.

[0034] 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 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 unit(s) which are required to implement the features of the present disclosure.

[0035] 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.

[0036] 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 a 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.

[0037] 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.

[0038] As used herein the transceiver unit include at least one receiver and at least one transmitter configured respectively for receiving and transmitting data, signals, information or a combination thereof between units/components within the system and/or connected with the system.

[0039] As discussed in the background section, the current known solutions have several shortcomings. The present disclosure aims to overcome the above-mentioned and other existing problems in this field of technology by providing method and system of performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA).

[0040] Barring means disallowing data communication between user equipment and network. Unbarring means resuming data communication between user equipment and network after the same has been barred earlier. Attaching means user equipment is registering itself onto a network. Detaching means de-registering a user equipment from network. Session Management Function

(SMF), User Plane Function (UPF) and Policy Control Function (PCF) are independent network nodes on hardware servers executing a set of instructions.

[0041] As discussed in the background section, the current known solutions for barring or unbarring user equipment have several shortcomings such as detaching or attaching (for unbarring or barring, respectively) a large number of user equipment places undue stress/surge on the network as the network has to send an equivalently large number of signals to that effect for each user equipment. It is re-emphasized that this approach is laborious, inefficient and resource intensive from a network point of view.

[0042] The present disclosure aims to overcome the above-mentioned and other existing problems in this field of technology by a method and a system for barring or unbarring user equipment without attaching or detaching the same.

[0043] Hereinafter, exemplary embodiments of the present disclosure will be described with reference to the accompanying drawings.

[0044] 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 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 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.

[0045] 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 types of networks (e.g., 5G network). It consists of radio base stations and the radio access technologies that enable wireless communication.

[0046] 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 reachability. It also handles mobility management procedures like handovers and paging.

[0047] 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 allocation and QoS enforcement.

[0048] 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.

[0049] 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.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] 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.

[0054] 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.

[0055] Unified Data Management (UDM) [124] is a network function that centralizes the management of subscriber data, including authentication, authorization, and subscription information.

[0056] Application Function (AF) [126] is a network function that represents external applications interfacing with the 5G core network to access network capabilities and services.

[0057] User Plane Function (UPF) [128] is a network function responsible for handling user data traffic, including packet routing, forwarding, and QoS enforcement.

[0058] 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.

[0059] **FIG. 2** illustrates an exemplary block diagram of a computing device [200] (or referred to herein as a computer system [200]) 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 [200] may also implement a method for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), utilising the system. In another implementation, the computing device [200] itself implements the method for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), using one or more units configured within the computing device [200], wherein said one or more units are capable of implementing the features as disclosed in the present disclosure.

[0060] The computing device [200] may include a bus [202] or other communication mechanism for communicating information, and a hardware processor [204] coupled with bus [202] for processing information. The hardware processor [204] may be, for example, a general-purpose microprocessor. The computing device [200] may also include a main memory [206], such as a random-access memory (RAM), or other dynamic storage device, coupled to the bus [202] for storing information and instructions to be executed by the processor [204]. The main memory

[206] also may be used for storing temporary variables or other intermediate information during execution of the instructions to be executed by the processor [204]. Such instructions, when stored in non-transitory storage media accessible to the processor [204], render the computing device [200] into a special-purpose machine that is customized to perform the operations specified in the instructions. The computing device [200] further includes a read only memory (ROM) [208] or other static storage device coupled to the bus [202] for storing static information and instructions for the processor [204].

[0061] A storage device [210], such as a magnetic disk, optical disk, or solid-state drive is provided and coupled to the bus [202] for storing information and instructions. The computing device [200] may be coupled via the bus [202] to a display [212], 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 [214], including alphanumeric and other keys, touch screen input means, etc. may be coupled to the bus [202] for communicating information and command selections to the processor [204]. Another type of user input device may be a cursor controller [216], such as a mouse, a trackball, or cursor direction keys, for communicating direction information and command selections to the processor [204], and for controlling cursor movement on the display [212]. 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.

[0062] The computing device [200] 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 [200] causes or programs the computing device [200] to be a special-purpose machine. According to one implementation, the techniques herein are performed by the computing device [200] in response to the processor [204] executing one or more sequences of one or more instructions contained in the main memory [206]. Such instructions may be read into the main memory [206] from another storage medium, such as the storage device [210]. Execution of the sequences of instructions contained in the main memory [206] causes the processor [204] 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.

[0063] The computing device [200] also may include a communication interface [218] coupled to the bus [202]. The communication interface [218] provides a two-way data communication

coupling to a network link [220] that is connected to a local network [222]. For example, the communication interface [218] 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 [218] 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 [218] sends and receives electrical, electromagnetic or optical signals that carry digital data streams representing various types of information.

[0064] The computing device [200] can send messages and receive data, including program code, through the network(s), the network link [220] and the communication interface [218]. In the Internet example, a server [230] might transmit a requested code for an application program through the Internet [228], the ISP [226], the local network [222], the host [224] and the communication interface [218]. The received code may be executed by the processor [204] as it is received, and/or stored in the storage device [210], or other non-volatile storage for later execution.

[0065] Referring to **FIG. 3**, an exemplary block diagram of a system [300] for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), is shown, in accordance with the exemplary implementations of the present disclosure. The system [300] comprises at least one first server [302], at least one second server [304], and at least one third server. 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 [300] 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 be present in a user device/ user equipment [102] to implement the features of the present disclosure. The system [300] may be a part of the user device [102]/ or may be independent of but in communication with the user device [102] (may also referred herein as a UE). In another implementation, the system [300] may reside in a server or a network entity. In yet another implementation, the system [300] may reside partly in the server/ network entity and partly in the user device.

[0066] The system [300] is configured for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), with the help of the interconnection between the components/units of the system [300].

[0067] The system comprises a first server [302], the first server [302] implementing a policy control function (PCF). The present disclosure encompasses the first server [302], the first server [302] is responsible for executing the functionalities of the invention. The first server hosts the Policy Control Function (PCF).

[0068] The system further comprises a second server [304] connected to at least the first server [302], the second server [304] implementing a session management function (SMF). The present disclosure encompasses the second server [304] is responsible for implementing the Session Management Function (SMF), which manages a user sessions within the network, including tasks such as session establishment, modification, and termination, wherein the second server [304], prior to sending to the first server [302] via the user interface, the at least one PRA trigger command, is configured to activate the at least one PRA trigger command for the pre-defined presence reporting area. The second server [304] is configured to activate at least one PRA trigger command. The PRA trigger command is a specific instruction that initiates the monitoring and the reporting of presence within a predefined area, known as the presence reporting area. This area is determined prior to system operation and includes specific geographical zones where network elements and user activity are tracked. Before sending the PRA trigger command to the first server [302] via the user interface, the second server [304] activates and manages presence within the predefined area. The user interface serves as the communication medium between the second server [304] and the first server [302], enabling the transmission of commands and data for the coordinated operation of the servers.

[0069] The system comprises a third server [306] connected to at least the second server [304] and the first server [302], the third server [306] implementing a user plane function (UPF). The present disclosure encompasses the third server [306] implements a User Plane Function (UPF), which is responsible for handling the data traffic within the network. The UPF facilitates the routing and forwarding of user data packets, between users and the network.

[0070] The second server [304] is configured to send, to the first server [302] via a user interface at the second server [304], at least one PRA trigger command, wherein the at least one PRA trigger command is related to performing the barring procedure for the one or more user devices, and wherein the at least one PRA trigger command is sent by the user interface at the second server [304] to the first server [302] in an event there is a zero relative movement of the one or more user devices with respect to the PRA. The present disclosure encompasses the second server [304] is

configured to send, via its user interface, at least one PRA trigger command to the first server [302]. This PRA trigger command relates to executing the barring procedure for one or more user devices. The PRA is an area identifier in a network such as TAC, cell ID, gNodeB ID, NG-RAN ID. The barring procedure involves restricting access to network resources for these devices. The second server [304] sends this PRA trigger command to the first server [302] through its user interface when it detects that there is zero relative movement of the one or more user devices within the PRA. This condition of zero relative movement indicates that the devices are inactive within the predefined presence reporting area, warning the activation of the barring procedure to manage the network resource allocation, wherein the zero relative movement of the one or more user devices with respect to the PRA refers to no movement of the one or more user devices from outside the PRA to inside the PRA, and no movement of the one or more user devices from inside the PRA to outside the PRA. The term "zero relative movement of the one or more user devices with respect to the PRA" refers to the absence of movement of the user devices both into and out of the PRA, wherein the pre-defined presence reporting area comprises a list of tracking areas (TAs), NG-RAN nodes, and cell identifiers in a public land mobile network. The predefined presence reporting area, where the invention monitors and reports the presence and activity of network elements and users. Each TA helps the system track the location of mobile devices as they move, allowing the PCF to manage network policies based on device location. The NG-RAN nodes, such as gNodeBs, facilitate wireless communication between mobile devices and the core network. Cell Identifiers are the unique codes assigned to individual cells within the mobile network that are part of the predefined presence reporting area in a Public Land Mobile Networks (PLMN). The PLMN means the broader telecommunications infrastructure in which the invention operates. The determination of "zero relative movement of the one or more user devices" condition is assessed based on continuous monitoring of the geographical location of user devices relative to the PRA. It is determined that there is zero relative movement when there is no detectable movement of any user device from outside the PRA to inside it, and vice versa. This determination depends on real-time data received from location tracking systems or mobile network signals, which indicate the inactive status of user devices within or outside the defined area. Further, the SMF receives updates and commands regarding the barring or unbarring of user devices based on the status of movement relative to the predefined PRA. The information is transmitted to the SMF through a communication interface wherein the one or more second servers are identified by a core network server and the core network server is to identify the one or more second servers based on an area information, received by the core network server, for application of the barring procedure. Further, prior to the sending, by the user interface at the second server [304] to the first server [302], the at least one PRA trigger command, the method comprises activating, by the second

server [304], the at least one PRA trigger command for the pre-defined presence reporting area. The second server [304] is configured to activate at least one PRA trigger command. The PRA trigger command is a specific instruction that initiates the monitoring and reporting of presence within a predefined area, known as the pre-defined presence reporting area. This area is determined prior to system operation and includes specific geographical zones where the network elements and the user activity are tracked. Before sending the PRA trigger command to the first server [302] via the user interface, the second server [304] activates and manages presence within the predefined area. The user interface serves as the communication medium between the second server [304] and the first server [302], enabling the transmission of commands and data for the coordinated operation of the servers.

[0071] Further, the second server [304] is configured to receive, from the first server [302], an updated policy related to the at least one PRA trigger command sent by the user interface to the first server [302], wherein the updated policy comprises a set of governing rules related to the one of the barring and the unbarring of the one or more user devices based on the at least one PRA trigger command received from the SMF implemented by second server [302]. The present disclosure encompasses receiving an updated policy related to at least one PRA trigger command from the first server [302], via its user interface. This updated policy consists of a defined set of rules governing the actions of the barring or the unbarring the one or more user devices, based on the PRA trigger command received from the SMF implemented by the second server [304]. The policy update ensures that the system implements consistent and predefined actions, such as restricting or allowing access to network resources for the identified user devices, in accordance with the specific conditions triggered by the PRA commands managed by the SMF, wherein the set of governing rules are generated at the first server [302] based on the at least one PRA trigger command received from the SMF. These rules include such as the detection of zero relative movement of user devices within or outside the predefined PRA, as determined by location tracking systems or network signals.

[0072] Furthermore, the second server [304] is configured to send, to the third server [306], the set of governing rules for implementation at the third server [306], wherein the set of governing rules facilitates modification of at least one of an uplink data flow and downlink data flow, for performing the barring procedure. The present disclosure a process where it sends the set of governing rules to the third server [306] for implementation. These governing rules are designed to enable the modification of at least one aspect of both uplink and downlink data flows within the

network. These modifications are meant to facilitate the barring procedure, which restricts access to network resources for identified user devices.

[0073] Referring to **FIG. 4**, an exemplary method flow diagram [400] for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), 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 device to implement the features of the present disclosure. Also, as shown in FIG. 4, the method [400] starts at step [402].

[0074] At step 404, the method comprises, sending, by a user interface at the one or more second servers [304] implementing a session management function (SMF) to one or more first servers [302] implementing a policy control function (PCF), at least one PRA trigger command, wherein the at least one PRA trigger command is related to performing the barring procedure for the one or more user devices, and wherein the at least one PRA trigger command is sent by the user interface at the at the second servers [304] to the first servers [302] in an event there is a zero relative movement of the one or more user devices with respect the PRA. The present disclosure encompasses the second server [304] is configured to send, via its user interface, at least one PRA trigger command to the first server [302]. This PRA trigger command relates to executing the barring procedure for one or more user devices. The PRA is an area identifier in a network such as TAC, cell ID, gNodeB ID, NG-RAN ID. The barring procedure involves restricting access to network resources for these devices. The second server [304] sends this PRA trigger command to the first server [302] through its user interface when it detects that there is zero relative movement of the one or more user devices within the PRA. This condition of zero relative movement indicates that the devices are inactive within the predefined presence reporting area, warning the activation of the barring procedure to manage network resource allocation, wherein the zero relative movement of the one or more user devices with respect the PRA refers to no movement of the one or more user devices from outside the PRA to inside the PRA, and no movement of the one or more user devices from inside the PRA to outside the PRA. The term "zero relative movement of the one or more user devices with respect to the PRA" refers to the absence of movement of the user devices both into and out of the PRA, wherein the pre-defined presence reporting area comprises a list of tracking areas (TAs), NG-RAN nodes, and cell identifiers in a public land mobile network. The predefined presence reporting area, monitors and reports the presence and activity of network elements and users. Each TA helps the system track the location of mobile devices as they move, allowing the PCF to manage network policies based on device location. The

NG-RAN nodes, such as gNodeBs, facilitate wireless communication between mobile devices and the core network. Cell Identifiers are the unique codes assigned to individual cells within the mobile network that are part of the predefined presence reporting area in a Public Land Mobile Networks (PLMN). The PLMN means the broader telecommunications infrastructure in which the invention operates. The determination of "zero relative movement of the one or more user devices" condition is assessed based on continuous monitoring of the geographical location of user devices relative to the PRA. It is determined that there is zero relative movement when there is no detectable movement of any user device from outside the PRA to inside it, and vice versa. This determination depends on real-time data received from location tracking systems or mobile network signals, which indicate the inactive status of user devices within or outside the defined area. Further, the SMF receives updates and commands regarding the barring or unbarring of user devices based on the status of movement relative to the predefined PRA. The information is transmitted to the SMF through a communication interface wherein the one or more second servers are identified by a core network server and the core network server is to identify the one or more second servers based on an area information, received by the core network server, for application of the barring procedure. Further, prior to the sending, by the user interface at the second server [304] to the first server [302], the at least one PRA trigger command, the method comprises activating, by the second server [304], the at least one PRA trigger command for the pre-defined presence reporting area. The second server [304] is configured to activate at least one PRA trigger command. The PRA trigger command is a specific instruction that initiates the monitoring and reporting of presence within a predefined area, known as the pre-defined presence reporting area. This area is determined prior to system operation and includes specific geographical zones where network elements and the user activity are tracked. Before sending the PRA trigger command to the first server [302] via the user interface, the second server [304] activates and manages presence within the predefined area. The user interface serves as the communication medium between the second server [304] and the first server [302], enabling the transmission of commands and data for the coordinated operation of the servers

[0075] At step 406, the method comprises, receiving by the second server [304], from the first server [302] at the second server [304], an updated policy related to the at least one PRA trigger command sent by the user interface to the first server [302], wherein the updated policy comprises a set of governing rules related to the one of a barring and an unbarring of the one or more user devices based on the at least one PRA trigger command received from the SMF implemented by second server [302]. The present disclosure encompasses receiving an updated policy related to at least one PRA trigger command from the first server [302], via its user interface. This updated

policy consists of a defined set of rules governing the actions of the barring or the unbarring one or more user devices, based on the PRA trigger command received from the SMF implemented by the second server [304]. The policy update ensures that the system implements consistent and predefined actions, such as restricting or allowing access to network resources for the identified user devices, in accordance with the specific conditions triggered by the PRA commands managed by the SMF, wherein the set of governing rules are generated at the first server [302] based on the at least one PRA trigger command received from the SMF. These rules include such as the detection of zero relative movement of user devices within or outside the predefined PRA, as determined by location tracking systems or network signals.

[0076] At step 408, the method comprises, sending, by the second server [304] to a third server [306] implementing a user plane function (UPF), the set of governing rules for implementation at the third server [306], wherein the set of governing rules facilitates modification of at least one of an uplink data flow and downlink data flow, for performing the barring procedure. The present disclosure a process where it sends the set of governing rules to the third server [306] for implementation. These governing rules are designed to enable the modification of at least one aspect of both uplink and downlink data flows within the network. These modifications are meant to facilitate the barring procedure, which restricts access to network resources for identified user devices.

[0077] Thereafter, the method terminates at step 410.

[0078] Referring to FIG. 5 illustrates a signalling flow diagram for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), in accordance with exemplary implementations of the present disclosure.

[0079] At step 1: It indicates that a regulatory body has requested some services, e.g., data, call, etc. to be either loaded (enabled) or disabled. The request is sent to the SMF.

[0080] At step 2: A Command Line Interface (CLI) command is executed at the SMF using PLMN (Public Land Mobile Network) and TAC (Tracking Area Code). This command is related to implementing the request from the regulatory body.

[0081] At step 3: The SMF sends an update to the PCF (nPCF), including the necessary (PRA) information or Out trigger, reflecting the request from the regulatory body.

[0082] At step 4: The PCF processes the received update and applies the necessary policies to handle the requested changes, ensuring they are in line with the regulatory requirements.

[0083] At step 5: The SMF then updates the UPF with the new rules that need to be applied to user traffic. This ensures that the user data flow adheres to the new or unbanned services as requested.

[0084] At step 6: The UPF confirms the successful application of the new rules back to the SMF. As a result, the changes (banning/unbanning of services) are now applied to the user traffic.

[0085] The present disclosure further discloses a non-transitory computer-readable storage medium storing instructions for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA). The instructions may include executable code which, when executed by a second server [304] implementing a session management function (SMF), causes the second server [304] to perform certain functions. The instructions when executed causes the second server [304] to send, by a user interface, at least one PRA trigger command to one or more first servers [302] implementing a policy control function (PCF). The at least one PRA trigger command is related to performing the barring procedure for the one or more user devices, and the at least one PRA trigger command is sent, by the user interface, to the one or more first servers [302] in an event there is a zero relative movement of the one or more user devices with respect the PRA. The instructions when executed further causes the second server [304] to receive, from the first server [302], an updated policy related to the at least one PRA trigger command sent by the user interface to the first server [302]. The instructions when executed furthermore causes the second server [304] to send, to a third server [306] implementing a user plane function (UPF), the set of governing rules for implementation at the third server [306], wherein the set of governing rules facilitates modification of at least one of an uplink data flow and downlink data flow, for performing the barring procedure.

[0086] As is evident from the above, the present disclosure provides a technically advanced solution for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA). The present solution removes undue stress/surge on network due attaching or detaching of millions of users while barring or unbarring in a given presence reporting area. This is particularly helpful when user stays with the given presence reporting area where barring or unbarring is performed. Further, the method and system for barring or unbarring user equipment without attaching or detaching the same can be implemented in real time.

[0087] 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.

[0088] 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.

We Claim:

1. A method for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), the method comprising:

- sending, by a user interface at one or more second servers [304] implementing a session management function (SMF) to one or more first servers [302] implementing a policy control function (PCF), at least one PRA trigger command,

  wherein the at least one PRA trigger command is related to performing the barring procedure for the one or more user devices, and

  wherein the at least one PRA trigger command is sent by the user interface at the one or more second servers [304] to the one or more first servers [302] in an event there is a zero relative movement of the one or more user devices with respect the PRA;
- receiving, from the first server [302] at the second server [304], an updated policy related to the at least one PRA trigger command sent by the user interface to the first server [302]; and
- sending, by the second server [304] to a third server [306] implementing a user plane function (UPF), a set of governing rules for implementation at the third server [306], wherein the set of governing rules facilitates modification of at least one of an uplink data flow and downlink data flow, for performing the barring procedure.

2. The method as claimed in claim 1, wherein the one or more second servers are identified by a core network server.

3. The method as claimed in claim 2, wherein the core network server is to identify the one or more second servers based on an area information, received by the core network server, for application of the barring procedure.

4. The method as claimed in claim 1, wherein the pre-defined presence reporting area comprises a list of tracking areas (TAs), NG-RAN nodes, and cell identifiers in a public land mobile network.

5. The method as claimed in claim 1, wherein the set of governing rules are generated at the first server [302] based on the at least one PRA trigger command received from the SMF.

6. The method as claimed in claim 1, wherein prior to the sending, by the user interface at the second server [304] to the first server [302], the at least one PRA trigger command, the method comprises:

- activating, by the second server [304], the at least one PRA trigger command for the pre-defined presence reporting area.

7. The method as claimed in claim 1, wherein the zero relative movement of the one or more user devices with respect the PRA refers to no movement of the one or more user devices from outside the PRA to inside the PRA, and no movement of the one or more user devices from inside the PRA to outside the PRA.

8. The method as claimed in claim 1, wherein the updated policy comprises a set of governing rules related to the one of a barring and an unbarring of the one or more user devices based on the at least one PRA trigger command received from the SMF implemented by second server [302].

9. A system for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA), the system comprising:

- a first server [302], the first server [302] implementing a policy control function (PCF);
- a second server [304] connected to at least the first server [302], the second server implementing a session management function (SMF); and
- a third server [306] connected to at least the second server [304] and the first server [302], the third server [306] implementing a user plane function (UPF);
- the second server [304] configured to:
    - o send, to the first server [302] via a user interface at the second server [304], at least one PRA trigger command,

      wherein the at least one PRA trigger command is related to performing the barring procedure for the one or more user devices, and

      wherein the at least one PRA trigger command is sent by the user interface at the second server [304] to the first server [302] in an event there is a zero relative movement of the one or more user devices with respect to the PRA;
    - o receive, from the first server [302], an updated policy related to the at least one PRA trigger command sent by the user interface to the first server [302]; and
    - o send, to the third server [306], a set of governing rules for implementation at the third server [306], wherein the set of governing rules facilitates modification

of at least one of an uplink data flow and downlink data flow, for performing the barring procedure.

10. The system as claimed in claim 9, wherein the one or more second servers are identified by a core network server.

11. The system as claimed in claim 10, wherein the core network server is to identify the one or more second servers based on an area information, received by the core network server, for application of the barring procedure.

12. The system as claimed in claim 9, wherein the pre-defined presence reporting area comprises a list of tracking areas (TAs), NG-RAN nodes, and cell identifiers in a public land mobile networks.

13. The system as claimed in claim 9, wherein the set of governing rules are generated at the first server [302] based on the at least one PRA trigger command received from the SMF.

14. The system as claimed in claim 9, wherein the second server [304], prior to sending to the first server [302] via the user interface, the at least one PRA trigger command, is configured to:

- activate the at least one PRA trigger command for the pre-defined presence reporting area.

15. The system as claimed in claim 9, wherein the zero relative movement of the one or more user devices with respect to the PRA refers to no movement of the one or more user devices from outside the PRA to inside the PRA, and no movement of the one or more user devices from inside the PRA to outside the PRA .

16. The system as claimed in claim 9, wherein the updated policy comprises a set of governing rules related to the one of a barring and an unbarring of the one or more user devices based on the at least one PRA trigger command received from the SMF implemented by second server [302].

17. A non-transitory computer-readable storage medium storing instructions for performing a barring procedure for one or more user devices in a pre-defined presence reporting area (PRA),

the instructions include executable code which, when executed by a second server [304] implementing a session management function (SMF), causes the second server [304] to:

- send, by a user interface, at least one PRA trigger command to one or more first servers [302] implementing a policy control function (PCF),
    - wherein the at least one PRA trigger command is related to performing the barring procedure for the one or more user devices, and
    - wherein the at least one PRA trigger command is sent, by the user interface, to the one or more first servers [302] in an event there is a zero relative movement of the one or more user devices with respect the PRA;
- receive, from the first server [302], an updated policy related to the at least one PRA trigger command sent by the user interface to the first server [302]; and
- send, to a third server [306] implementing a user plane function (UPF), the set of governing rules for implementation at the third server [306], wherein the set of governing rules facilitates modification of at least one of an uplink data flow and downlink data flow, for performing the barring procedure.

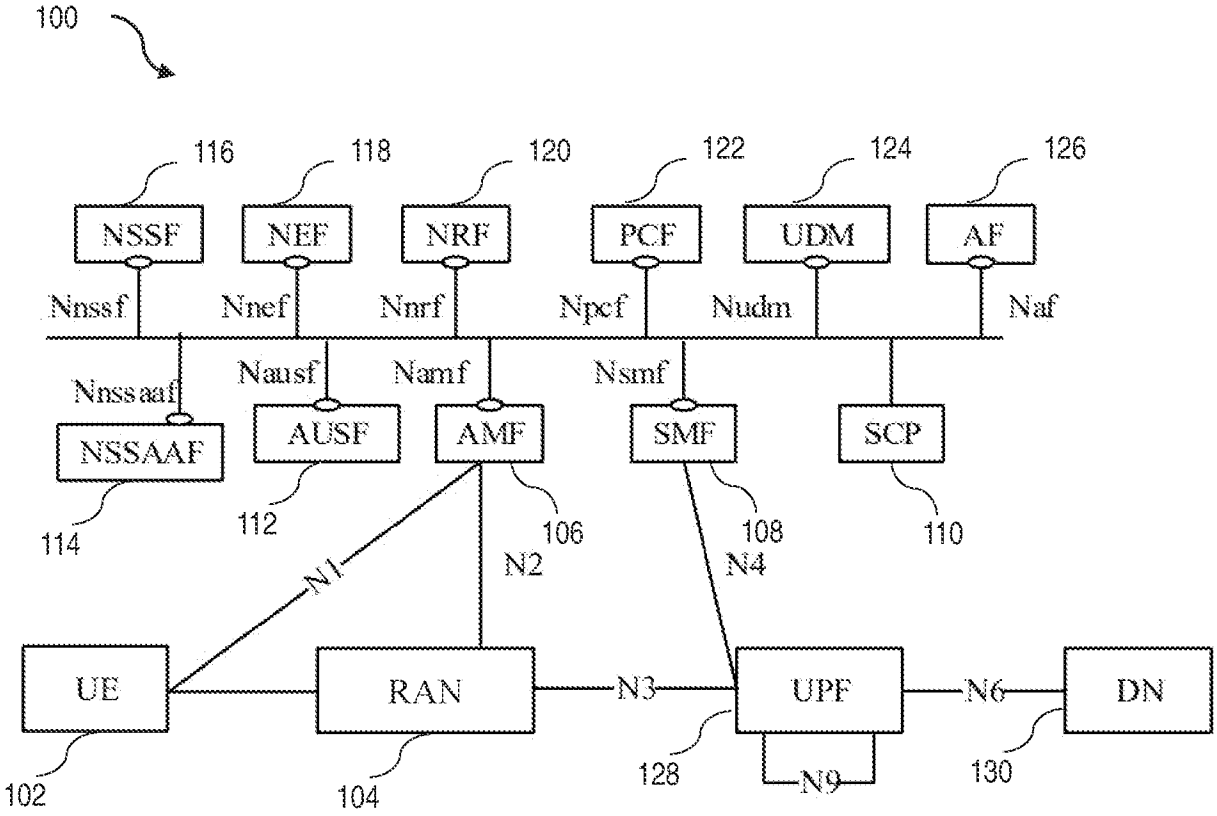
100
116
118
120
122
124
126
NSSF
NEF
NRF
PCF
UDM
AF
Nnssf
Nnef
Nnrf
Npcf
Nudm
Naf
Nnssaaf
Nausf
Namf
Nsmf
NSSAAF
AUSF
AMF
SMF
SCP
114
112
106
108
110
N1
N2
N4
UE
RAN
N3
UPF
N6
DN
102
104
128
N9
130

FIG. 1

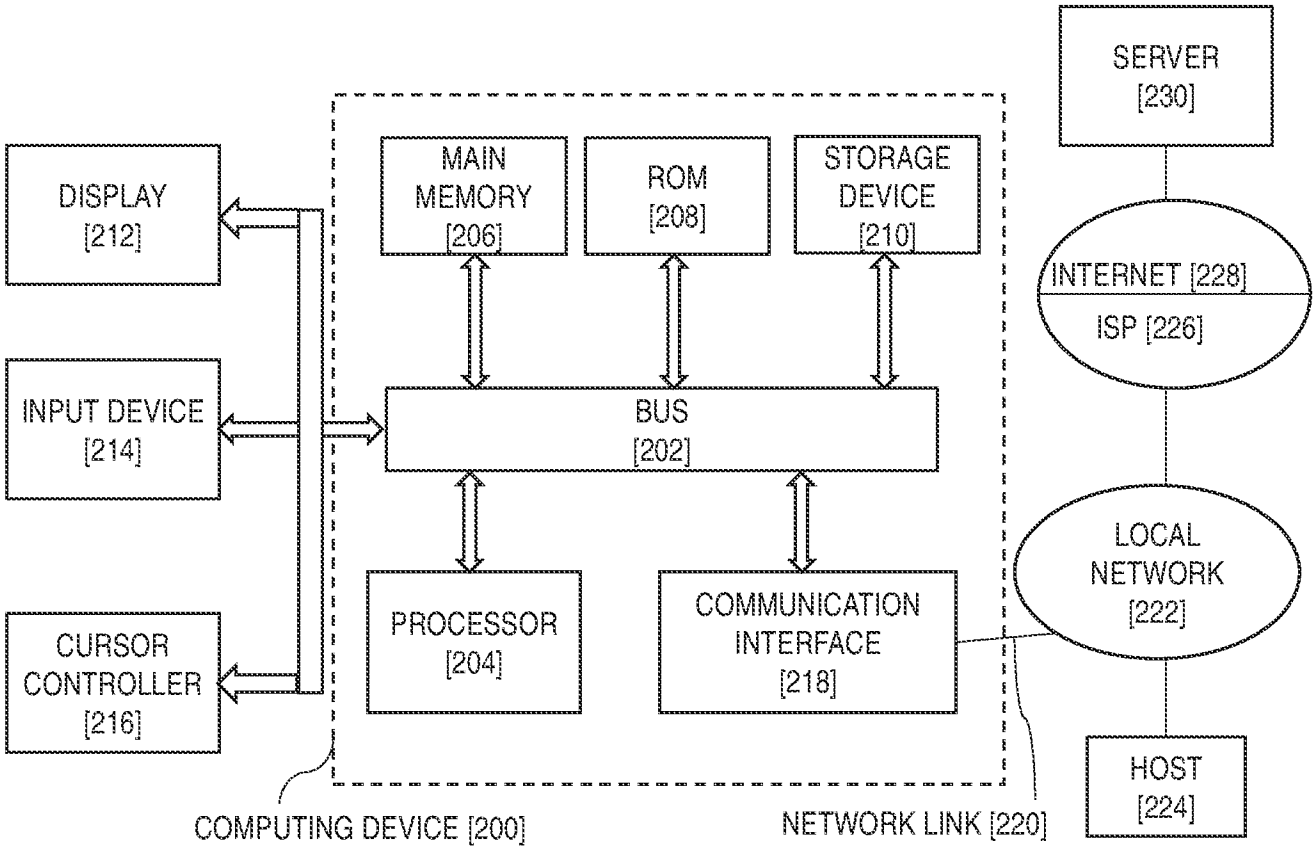
SERVER
[230]
DISPLAY
[212]
MAIN
MEMORY
[206]
ROM
[208]
STORAGE
DEVICE
[210]
INTERNET [228]
ISP [226]
INPUT DEVICE
[214]
BUS
[202]
LOCAL
NETWORK
[222]
CURSOR
CONTROLLER
[216]
PROCESSOR
[204]
COMMUNICATION
INTERFACE
[218]
HOST
[224]
COMPUTING DEVICE [200]
NETWORK LINK [220]

FIG. 2

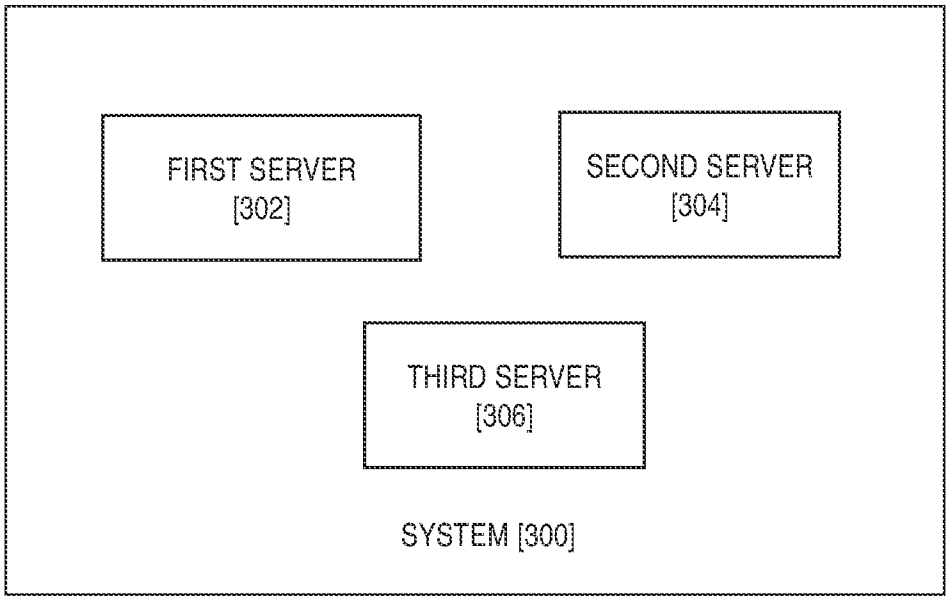
FIRST SERVER
[302]
SECOND SERVER
[304]
THIRD SERVER
[306]
SYSTEM [300]

FIG. 3

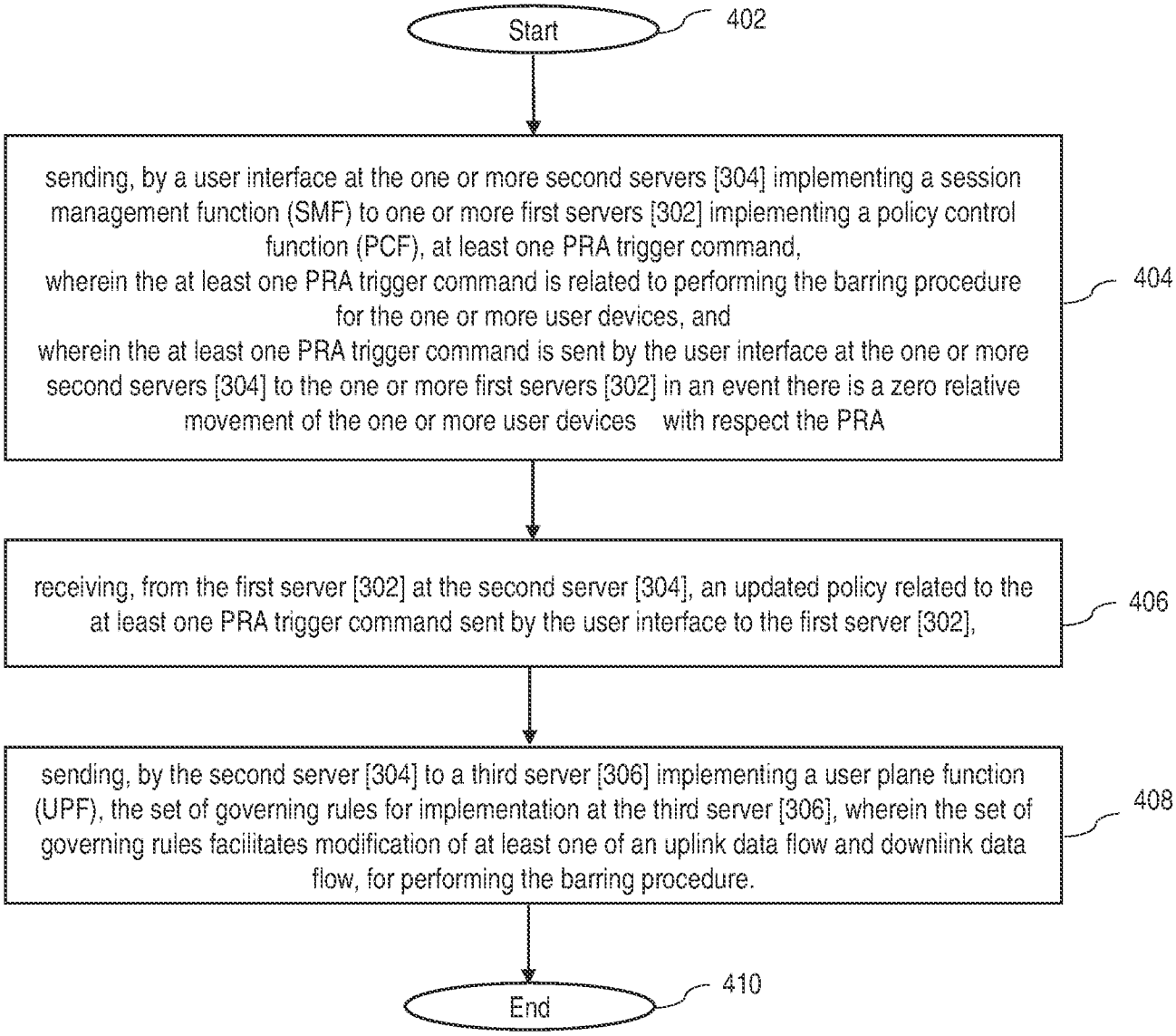
Start
402
sending, by a user interface at the one or more second servers [304] implementing a session management function (SMF) to one or more first servers [302] implementing a policy control function (PCF), at least one PRA trigger command,
wherein the at least one PRA trigger command is related to performing the barring procedure for the one or more user devices, and
wherein the at least one PRA trigger command is sent by the user interface at the one or more second servers [304] to the one or more first servers [302] in an event there is a zero relative movement of the one or more user devices with respect the PRA
404
receiving, from the first server [302] at the second server [304], an updated policy related to the at least one PRA trigger command sent by the user interface to the first server [302],
406
sending, by the second server [304] to a third server [306] implementing a user plane function (UPF), the set of governing rules for implementation at the third server [306], wherein the set of governing rules facilitates modification of at least one of an uplink data flow and downlink data flow, for performing the barring procedure.
408
End
410

FIG. 4

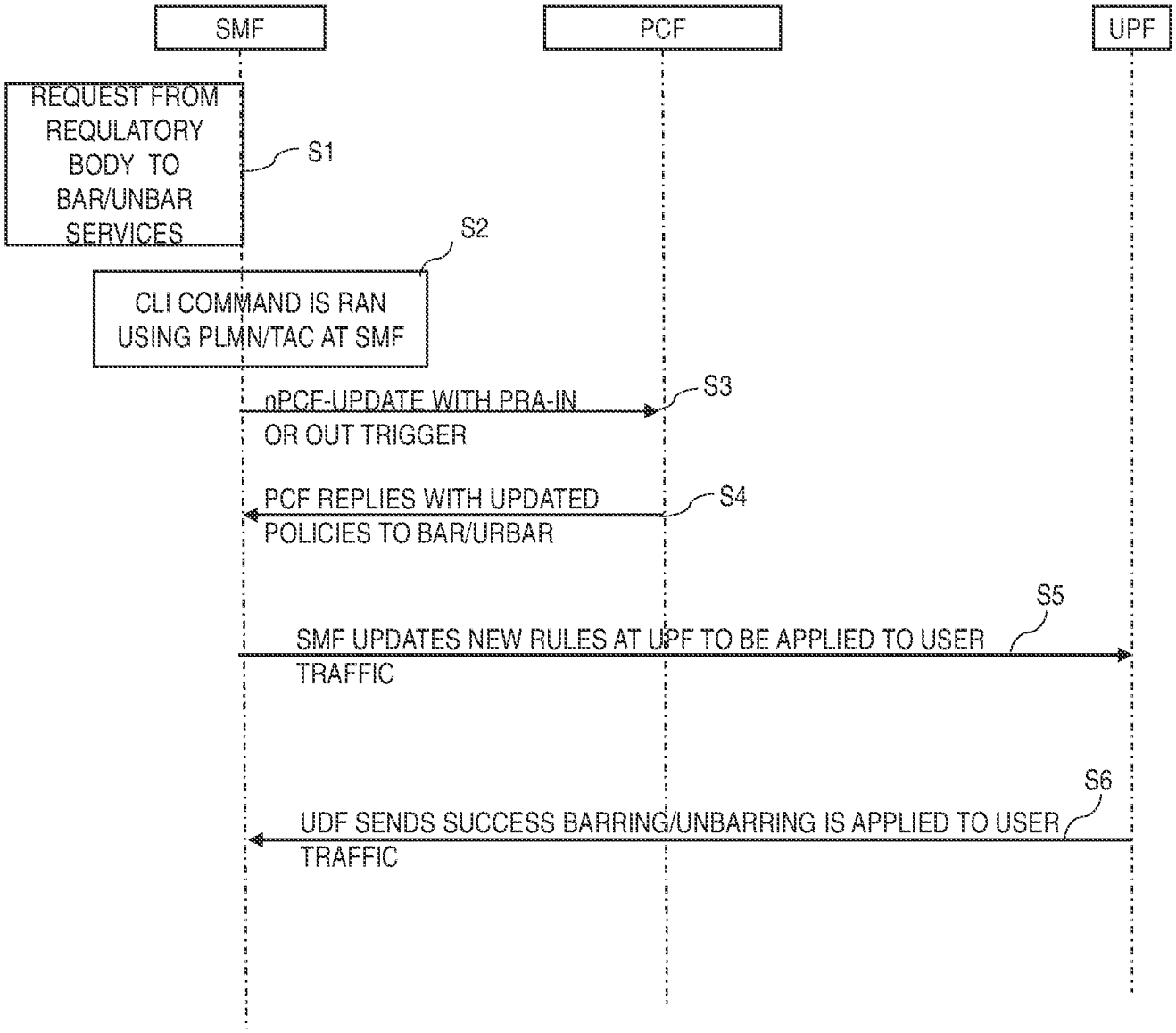
SMF
PCF
UPF
REQUEST FROM REQULATORY BODY TO BAR/UNBAR SERVICES
S1
S2
CLI COMMAND IS RAN USING PLMN/TAC AT SMF
nPCF-UPDATE WITH PRA-IN OR OUT TRIGGER
S3
PCF REPLIES WITH UPDATED POLICIES TO BAR/URBAR
S4
S5
SMF UPDATES NEW RULES AT UPF TO BE APPLIED TO USER TRAFFIC
S6
UDF SENDS SUCCESS BARRING/UNBARRING IS APPLIED TO USER TRAFFIC

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2024/050998

A. CLASSIFICATION OF SUBJECT MATTER
H04W4/24,H04M15/00,H04L12/14,H04W76/12 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, H04L, H04M

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	WO2021144041A1 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)) 22 July 2021 (22-07-2021) Abstract, Description, Claims 1-19	1-17
Y	US20210250724A1 (TELEFONAKTIEBOLAGET LM ERICSSON AB) 12 August 2021 (12-08-2021) Abstract, Para [0009]-[0015],[0065]-[0075], Claims 1-26	1-17

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
29-10-2024	29-10-2024

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

International application No.
PCT/IN2024/050998

Citation	Pub.Date	Family	Pub.Date
WO 2021144041 A1	22-07-2021	US 20230362024 A1	09-11-2023
US 20210250724 A1	12-08-2021	EP 3804366 A1	14-04-2021