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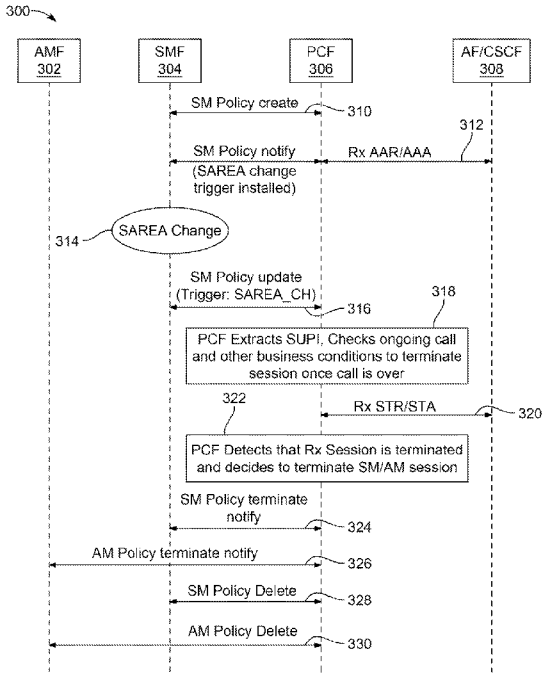


FIG. 3

(57) Abstract: The disclosed system(108) and method(400) provide a policy control function (PCF)(306) that is used to support a regulatory requirement which mandates termination of an ongoing service (e.g., an audio call) when a user moves into a restricted location (i.e., a Tracking Area Location (TAL)), where the audio call barring is enabled. The system(108) aims to enforce restrictions on the audio call based on specific geographical areas. When the user enters the TAL, where the audio call barring is active, the PCF(306) takes an appropriate action to terminate any ongoing audio calls for that user. The system(108) ensures compliance with a regulatory requirement and prevents an unauthorized communication within the TAL.

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SYSTEM AND METHOD FOR MANAGING SERVICES BASED ON LOCATION OF A USER

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TECHNICAL FIELD

[002] The present disclosure relates to wireless cellular communications, and specifically to a tracking mechanism which constantly monitors location of a user and triggers immediate termination of an ongoing call when the user moves in a specific Tracking Area Location (TAL).

DEFINITION

[003] As used in the present disclosure, the following terms are generally intended to have the meaning as set forth below, except to an extent that a context in which they are used to indicate otherwise.

[004] The expression 'Tracking Area Location (TAL)' used hereinafter in the specification refers to a geographic area that has been designated by a network operator where restriction of services (voice, video, message) is required to enforce a law enforcement.

[005] The expression 'call barring' used hereinafter in the specification refers to a telecommunication feature that allows users (e.g., administrators) to block certain types of calls, either an incoming or outgoing call. Call barring can be done for various reasons, including security, privacy, or compliance with regulations.

[006] These definitions are in addition to those expressed in the art.

BACKGROUND

[007] The following description of 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 be used only to enhance the understanding of the reader with respect to the present disclosure, and not as admissions of prior art.

[008] In certain scenarios for maintaining law and order, particularly in sensitive areas (such as healthcare facilities, courtrooms, private business meetings, military bases, government facilities, or other high-security areas), an audio call barring is employed. The objective of the audio call barring is to prevent an unauthorized audio communication and enhance security. Implementing audio call barring in specific Tracking Area Locations (TALs) adds an additional layer of control, allowing organizations to customize call restrictions based on geographical locations. This can be especially useful in large facilities or areas where different security levels are required in various zones. For example, military bases, government facilities, and high-security areas, unauthorized audio calls may potentially compromise confidential information or disrupt operations. Therefore, an ability to abort ongoing calls through a Policy Control Function (PCF) can be a valuable tool in maintaining control and ensuring compliance with security protocols.

[009] The effectiveness of the audio call barring relies on a configuration, integration, and management of a telecommunication infrastructure. Additionally, such measures should be implemented in compliance with relevant laws and regulations to strike a balance between security and individual privacy. However, current mechanisms to enforce restrictions on audio calls based on a movement of a user in a specific geographic area have limited functionality.

[0010] There is, therefore, a need in the art to provide an improved mechanism that supports a regulatory requirement that mandates a termination of an ongoing call when a user moves into a TAL, where the audio call barring is enabled.

OBJECTS OF THE PRESENT DISCLOSURE

[0011] It is an object of the present disclosure to provide a tracking mechanism that constantly monitors location of a user and triggers immediate termination of an ongoing call when a user moves to a specific TAL.

[0012] It is an object of the present disclosure to terminate the ongoing call, which ensures a compliance with a regulatory requirement and prevents an unauthorized communication within restricted areas.

SUMMARY

[0013] The present disclosure discloses a system for terminating at least one service based on location of a user equipment. The system includes a processing engine and a memory coupled to the processing engine and configured to store instructions executable by the processing engine causes the processing engine to receive, by a policy control function (PCF), a first current location and a second current location corresponding to a first user equipment and a second user equipment respectively, from an access and mobility management function (AMF). The processing engine is further configured to map, by the PCF, the first current location and the second current location with each of a plurality of restricted locations stored in a database associated the PCF for determining a presence of at least one of the first current location and the second current location within a restricted location of the plurality of restricted locations. The processing engine is further configured to upon determining the presence of the at least one of the first current location and the second current location with the restricted location, fetch, by the PCF, a set of policies from the database corresponding to the restricted location to generate a triggering signal. The processing engine is further configured to transmit, by the PCF, the triggering signal to a session management function (SMF) for terminating a session corresponding to the at least one service associated with a corresponding user equipment of the at least one of the first user equipment and the second user equipment upon receiving the triggering signal.

[0014] In an embodiment, the at least one service includes at least one of an audio call service, a text service, or a video call service.

[0015] In an embodiment, the set of policies includes access policies, location policies, resource allocation policies, and session setup policies.

[0016] In an embodiment, the set of policies is configured based on at least one of a plurality of regulatory requirements and an operator preference.

[0017] In an embodiment, the PCF is configured to periodically receive the first current location and the second current location from the AMF.

[0018] In an embodiment, the PCF is configured to receive the first current location and the second current location from a location management function (LMF), and a gateway mobile location centre (GMLC).

[0019] In an embodiment, the SMF is configured to send at least one alert message to the corresponding user equipment in response to terminating the session.

[0020] In an embodiment, each of the first user equipment and the second user equipment is configured to employ a Global Positioning System (GPS), a Wi-Fi Positioning System (WPS) or a Cellular Positioning System (CPS) for determining its current location.

[0021] The present disclosure discloses a method for terminating at least one service based on location of a user equipment. The method includes receiving, by a policy control function (PCF), a first current location and a second current location corresponding to a first user equipment and a second user equipment respectively, from a network function (NF). The method includes mapping, by the PCF, the first current location and the second current location with each of a plurality of restricted locations stored in a database associated with the PCF for determining a presence of at least one of the first current location and the second current location within a restricted location of the plurality of restricted locations. The method includes upon determining the presence of the at least one of the first current location and the second current location within the restricted location, fetching, by the PCF, a set of policies from the database corresponding to the restricted location to generate a triggering signal, transmitting, by the PCF, the triggering signal to a session management function (SMF) to terminate a session corresponding to the at least one service associated with a corresponding user

equipment of the at least one of the first user equipment and the second user equipment, upon receiving the triggering signal.

[0022] In an embodiment, the method further includes establishing by the first user equipment, the session corresponding to the at least one service with the second user equipment via the SMF, upon receiving an authorization from the NF, wherein the first user equipment and the second user equipment is configured to send the first current location and the second current location, respectively, to the NF.

[0023] In an embodiment, the method further includes receiving the first current location and the second current location from the NF.

[0024] In an embodiment, the NF includes at least one of an access and mobility management function (AMF), a location management function (LMF), and a gateway mobile location centre (GMLC).

[0025] In an embodiment, the method further includes sending at least one alert message to the corresponding user equipment in response to terminating the session.

[0026] The present disclosure discloses a first user equipment communicatively coupled to a system. The first user equipment is configured to establish a session corresponding to at least one service with a second user equipment via a session management function (SMF), upon receiving an authorization from a network function (NF). The first user equipment is configured to send a first current location associated with the first user equipment to the NF. The first user equipment is configured to receive at least one alert message corresponding to termination of the session associated with the at least one service upon determining a presence of the first current location within a restricted location.

[0027] The foregoing general description of the illustrative embodiments and the following detailed description thereof are merely exemplary aspects of the teachings of this disclosure and are not restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

[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. Some drawings may indicate the components using block diagrams and may not represent the internal circuitry of each component. It will be appreciated by those skilled in the art that disclosure of such drawings includes the disclosure of electrical components, electronic components or circuitry commonly used to implement such components.

[0029] FIG. 1 illustrates an exemplary network architecture for implementing a system, in accordance with an embodiment of the present disclosure.

[0030] FIG. 2 illustrates an exemplary block diagram of the system configured for terminating at least one service based on location of a user equipment, in accordance with an embodiment of the present disclosure.

[0031] FIG. 3 illustrates an exemplary process flow for aborting an on-going audio call service when a user moves into a restricted area where an audio call barring is enabled, in accordance with an embodiment of the disclosure.

[0032] FIG. 4 illustrates an exemplary flow diagram of a method for terminating at least one service based on location of a user equipment, in accordance with an embodiment of the present disclosure.

[0033] FIG. 5 illustrates an example computer system in which or with which the embodiments of the present disclosure may be implemented.

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

LIST OF REFERENCE NUMERALS

100 – Network architecture

102-1, 102-2…102-N – Plurality of Users

104-1, 104-2…104-N – Plurality of User Equipments

106 – Network

108 – System

202 – Processor

204 – Memory

206 – A Plurality of Interfaces

208 – Processing Engine

210 – Database

212 – Data Ingestion Engine

214 – Policy Engine

300 – Flowchart

302 – Access and mobility management function (AMF)

304 - Session management function (SMF)

306 - Policy control function (PCF)

308 - Application function (AF)/ Call Session Control Function (CSCF)

400 – Flow diagram

402 – Session establishing step

404 – Location receiving step

406 – Location mapping step

408 – Trigging signal generating step

410 – Session terminating step

216 – Other Engine(s)

510 – External Storage Device

520 – Bus

530 – Main Memory

540 – Read Only Memory

550 – Mass Storage Device

560 – Communication Port

570 – Processor

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. It will be apparent, however, that embodiments of the present disclosure may be practiced without these specific details. Several features described hereafter can 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. Some of the problems discussed above might not be fully addressed by any of the features described herein. Example embodiments of the present disclosure are described below, as illustrated in various drawings in which like reference numerals refer to the same parts throughout the different drawings.

[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 in the function and arrangement of elements without departing from the spirit and scope of 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, networks, processes, and other components may be shown as components in block diagram form in order not to obscure the embodiments in unnecessary detail. In other instances, well-known circuits, processes, algorithms, structures, and techniques may be shown without unnecessary detail in order to avoid obscuring the embodiments.

[0038] Also, it is noted that individual embodiments may be described as a process that 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 can 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. A process may correspond to a method, a function, a procedure, a subroutine, a subprogram, etc. When a process corresponds to a function, its termination can correspond to a return of the function to the calling function or the main function.

[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 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 like the term "comprising" as an open transition word without precluding any additional or other elements.

[0040] Reference throughout this specification to "one embodiment" or "an embodiment" or "an instance" or "one instance" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present disclosure. Thus, the appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

[0041] The terminology used herein is to describe particular embodiments only and is not intended to be limiting the disclosure. As used herein, the singular forms "a", "an", and "the" are intended to include the plural forms as well, unless the context indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or

components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. As used herein, the term "and/or" includes any combinations of one or more of the associated listed items. It should be noted that the terms "mobile device", "user equipment", "user device", "communication device", "device" and similar terms are used interchangeably for the purpose of describing the invention. These terms are not intended to limit the scope of the invention or imply any specific functionality or limitations on the described embodiments. The use of these terms is solely for convenience and clarity of description. The invention is not limited to any particular type of device or equipment, and it should be understood that other equivalent terms or variations thereof may be used interchangeably without departing from the scope of the invention as defined herein.

[0042] As used herein, an "electronic device", or "portable electronic device", or "user device" or "communication device" or "user equipment" or "device" refers to any electrical, electronic, electromechanical, and computing device. The user device is capable of receiving and/or transmitting one or parameters, performing function/s, communicating with other user devices, and transmitting data to the other user devices. The user equipment may have a processor, a display, a memory, a battery, and an input-means such as a hard keypad and/or a soft keypad. The user equipment may be capable of operating on any radio access technology including but not limited to IP-enabled communication, Zig Bee, Bluetooth, Bluetooth Low Energy, Near Field Communication, Z-Wave, Wi-Fi, Wi-Fi direct, etc. For instance, the user equipment may include, but not limited to, a mobile phone, smartphone, virtual reality (VR) devices, augmented reality (AR) devices, laptop, a general-purpose computer, desktop, personal digital assistant, tablet computer, mainframe computer, or any other device as may be obvious to a person skilled in the art for implementation of the features of the present disclosure.

[0043] Further, the user device may also comprise a "processor" or "processing unit" includes processing unit, wherein processor refers to any logic circuitry for processing instructions. The 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 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 is a hardware processor.

[0044] As portable electronic devices and wireless technologies continue to improve and grow in popularity, the advancing wireless technologies for data transfer are also expected to evolve and replace the older generations of technologies. In the field of wireless data communications, the dynamic advancement of various generations of cellular technology are also seen. The development, in this respect, has been incremental in the order of second generation (2G), third generation (3G), fourth generation (4G), and now fifth generation (5G), and more such generations are expected to continue in the forthcoming time. In today's world, where communication and data transmission play an important role, network performance is crucial. Mobile network operators strive to provide their customers with optimal performance, seamless connectivity, and high-quality services.

[0045] In certain situations, audio call barring can be a crucial measure for maintaining law and order, ensuring privacy and security, and preventing unauthorized communication. For instance, in healthcare facilities, courtrooms, or private business meetings, it may be necessary to prevent any audio communication that could compromise confidentiality or disturb the proceedings. Similarly, in sensitive areas such as military bases, government facilities, or other high-security zones, unauthorized audio calls may pose a serious risk to national security or public safety. Any such measure must be implemented with caution and consideration for the potential impacts on emergency services and other privileged network users. Shutting down the network for a whole area, for example, could also disable certain critical services such as police, fire, or emergency personnel, who rely on the network to place and receive emergency calls. Therefore, it is essential to have a

robust system that allows for the selective and controlled implementation of audio call barring, based on specific criteria such as location, time, or user profile.

[0046] The present disclosure discloses a system and a method for terminating at least one service based on location of a user equipment. The present disclosure discloses an enhance policy control function (PCF), which provides a capability to abort at least one service (e.g., an ongoing audio call service) and prevent unauthorized audio communication in a restricted location (i.e., a tracking area location (TAL)). By enabling an audio call barring in the restricted location, the PCF can enhance security and prevent any potential breaches or threats. The present system not only ensures privacy and confidentiality but also guarantees safety and security of individuals and organizations in high-risk areas.

[0047] The disclosed system provides the PCF that is used to support a regulatory requirement which mandates termination of the at least one service when a user moves into the TAL where audio call barring is enabled based on location of a user equipment. A plurality of regulatory requirements aims to enforce restrictions on the at least one service based on specific geographical areas. When the user enters the TAL where the audio call barring is active, the PCF takes an appropriate action to terminate any ongoing audio calls for that user. This ensures compliance with a regulatory requirement and prevents unauthorized communication within restricted locations.

[0048] A sophisticated tracking mechanism is provided within the PCF, which constantly monitors the user's location and associated set of policies. When the user moves into a specific TAL where the audio call barring is enforced by the plurality of regulatory requirements, then the PCF may trigger an immediate termination of the ongoing audio call.

[0049] The various embodiments throughout the disclosure will be explained in more detail with reference to FIG. 1- FIG. 5.

[0050] FIG. 1 illustrates an exemplary network architecture 100 for implementing a system 108, in accordance with an embodiment of the present disclosure. The system 100 is configured to terminate at least one service based on

location of a user equipment. In an example, the at least one service includes at least one of an audio call service, a text service, or a video call service.

[0051] As shown in FIG. 1, the network architecture 100 includes a plurality of user equipments 104-1, 104-2…104-N, and a network 106. In an example, the system 108 includes an access and mobility management function (AMF), a session management function (SMF), a policy control function (PCF) and an application function (AF). The AMF is responsible for controlling an entry of the plurality of user equipments 104-1, 104-2…104-N into the network 106 (e.g., fifth generation (5G) network). The AMF is configured to perform authentication and authorization procedures to ensure secure and authorized access. The AMF manages a movement of a user equipment within the network (106). The AMF facilitates seamless handovers and efficiently handles mobility events, ensuring a continuous and reliable user experience as the plurality of user equipments 104-1, 104-2…104-N move through different network areas. The SMF is configured to establish and manage communication sessions for the plurality of user equipments 104-1, 104-2…104-N. The SMF is configured to coordinate an initiation, a maintenance, and a termination of the sessions efficiently. Additionally, the SMF oversees packet data unit (PDU) sessions in packet-switched networks, contributing to a reliable transfer of data. The AF is configured to identify a type of application traffic and apply appropriate policies accordingly. This involves detecting and controlling various application-specific behaviors within the network 106. The AF interfaces with application service providers, contributing to an optimization and enhancement of application-specific experiences for users.

[0052] The PCF is configured to implement a set of policies that govern various aspects of network behavior. In an example, the set of policies include policies related to Quality of Service (QoS), security, and access control, such as access policies, location policies, resource allocation policies, and session setup policies. The PCF dynamically adapts policies based on changing network conditions and user requirements, ensuring optimal performance and resource utilization. Furthermore, the PCF plays a role in policy charging, monitoring, and controlling charging aspects associated with a usage of network resources.

[0053] The plurality of plurality of user equipments 104-1, 104-2…104-N are associated with a plurality of users 102-1, 102-2…102-N in an environment. A person of ordinary skill in the art will understand that the plurality of users 102-1, 102-2…102-N may be individually referred to as the user 102 and collectively referred to as the users 102. Similarly, a person of ordinary skill in the art will understand that the plurality of user equipments 104-1, 104-2…104-N may be individually referred to as the user equipment 104 and collectively referred to as the user equipment 104. A person of ordinary skill in the art will appreciate that the terms "computing devices (s)" and "user equipment" may be used interchangeably throughout the disclosure. In an embodiment, each of the user equipment 104 may have a unique identifier attribute associated therewith. In an embodiment, the unique identifier attribute may be indicative of a Mobile Station International Subscriber Directory Number (MSISDN), an International Mobile Equipment Identity (IMEI) number, an International Mobile Subscriber Identity (IMSI), a Subscriber Permanent Identifier (SUPI), and the like.

[0054] In an embodiment, the user equipment 104 may include, but is not limited to, a handheld wireless communication device (e.g., a mobile phone, a smart phone, a phablet device, and so on), a wearable computer device(e.g., a head-mounted display computer device, a head-mounted camera device, a wristwatch computer device, and so on), a Global Positioning System (GPS) device, a laptop computer, a tablet computer, or another type of portable computer, a media playing device, a portable gaming system, and/or any other type of computer device with wireless communication capabilities, and the like. In an embodiment, the user equipment 104 may include, but is not limited to, any electrical, electronic, electro-mechanical, or an equipment, or a combination of one or more of the above devices such as virtual reality (VR) devices, augmented reality (AR) devices, a laptop, a general-purpose computer, a desktop, a personal digital assistant, a tablet computer, a mainframe computer, or any other computing device. The user equipment 104 may include one or more in-built or externally coupled accessories including, but not limited to, a visual aid device such as a camera, an audio aid, a microphone, a keyboard, and input devices for receiving input from the user 102 or an entity such

as a touch pad, a touch enabled screen, an electronic pen, and the like. A person of ordinary skill in the art will appreciate that the user equipment 104 may not be restricted to above mentioned devices and various other devices may be used.

[0055] Referring to FIG. 1, the user equipment 104 is configured to communicate with the system 108 via the network 106. In an embodiment, the network 106 may include at least one of a 5G network, a 6G network, or the like. The network 106 may enable the user equipment 104 to communicate with other devices (or user equipments) in the network 106 and/or with the system 108. The network 106 may include a wireless card or some other transceiver connection to facilitate this communication. In another embodiment, the network 106 may be implemented as, or include any of a variety of different communication technologies such as a wide area network (WAN), a local area network (LAN), a wireless network, a mobile network, a Virtual Private Network (VPN), an Internet, a Public Switched Telephone Network (PSTN), or the like. In an embodiment, the network 106 includes one or more base stations for facilitating communication between the plurality of user equipments 104. The network 106 may be formed by a set of base stations communicatively coupled to enable telecommunication exchanges between the plurality of user equipments 104.

[0056] In an operative aspect, a first user equipment is configured to establish a session with a second user equipment via the SMF upon receiving an authorization from the AMF. The first user equipment is configured to send a first current location (i.e., a current location of the first user equipment) to the AMF and the second user equipment is configured to send a second current location (i.e., a current location of the second user equipment) to the AMF. In an embodiment, each user equipment is configured to employ the GPS, a Wi-Fi Positioning System (WPS) or a Cellular Positioning System (CPS) for determining the first current location and the second current location.

[0057] The PCF is configured to receive the first current location and the second current location corresponding to the first user equipment and the second user equipment respectively from the AMF. In an example, the PCF is configured to receive the first current location and the second current location from the AMF

periodically. In another example, the PCF is configured to receive the first current location and the second current location from the LMF and the GMLC. The LMF is configured to manage location information of the plurality of user equipments 104 (e.g., the first user equipment or the second user equipment) within the network 106 by tracking a current location of users, updating their location information as they move between different cells or geographic areas, and ensuring that the sessions can be successfully delivered to the correct location. The GMLC acts as a centralized entity that interfaces with various location-based service applications and emergency service providers. The GMLC retrieves location information from the network 106, typically through the LMF, and provides accurate location information to applications or services (e.g., the AMF) requesting it.

[0058] Further, the PCF is configured to map the first current location and the second current location with a restricted location (e.g., the TAL) of a plurality of restricted locations. The mapping is done for determining a presence of at least one of the first current location and the second current location within the restricted location. In an example, the plurality of restricted locations are stored in a database associated with the PCF. In an embodiment, the restricted locations include a government building, a military base, an aircraft, a church, a cinema, a graveyard, a hospital, a theatre, an opera, a court room, a school, a restaurant, and the like.

[0059] Upon determining the presence of the at least one of the first current location and the second current location with the restricted location, the PCF is configured to fetch a set of policies from the database corresponding to the restricted locations to generate a triggering request. In an example, the set of policies includes access policies, location policies, resource allocation policies, and session setup policies. The set of policies is configured based on regulatory requirements or an operator preference.

[0060] The SMF is cooperatively coupled with the PCF and is configured to receive the triggering signal from the PCF. The SMF is further configured to terminate the session corresponding to the at least one service associated with a corresponding user equipment of the at least one of the first user equipment and the second user equipment, upon receiving the triggering signal. In an embodiment, the

SMF is configured to send at least one alert message to the corresponding user equipment. In an example, the at least one alert message is a text message saying that "you are in restricted area".

[0061] FIG. 2 illustrates an example block diagram 200 of the system 108 for terminating at least one service based on location of a user equipment, in accordance with an embodiment of the present disclosure. FIG. 2 is explained in conjunction with FIG. 1. In particular, the system 108 is implemented for aborting the at least one service (e.g., an ongoing audio call) when the user moves into the TAL where the audio call barring is enabled, in accordance with an embodiment of the disclosure.

[0062] Referring to FIG. 2, the system 108 includes one or more processor(s) 202. The one or more processor(s) 202 may be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, logic circuitries, and/or any devices that process data based on operational instructions. Among other capabilities, the one or more processor(s) 202 may be configured to fetch and execute computer-readable instructions stored in a memory 204 of the system 108. The memory 204 is configured to store one or more computer-readable instructions or routines in a non-transitory computer readable storage medium, which may be fetched and executed to create or share data packets over a network service. In an aspect, the memory 204 is configured to store received requests (e.g., triggering signals). In another aspect, the memory 204 is configured to store the plurality of restricted locations. The memory (204) may comprise any non-transitory storage device including, for example, volatile memory such as random-access memory (RAM), or non-volatile memory such as erasable programmable read only memory (EPROM), flash memory, and the like.

[0063] In an embodiment, the system 108 may include an interface(s) 206. The interface(s) 206 may comprise a variety of interfaces, for example, interfaces for data input and output devices (I/O), storage devices, and the like. The interface(s) 206 may facilitate communication through the system 108. The interface(s) 206 may also provide a communication pathway for one or more components of the system 108. Examples of such components include, but are not

limited to, processing engine(s) 208 and a database 210. Further, the processing engine(s) 208 may include a data ingestion engine 212, a policy engine 214, and other engine(s) 216. In an embodiment, the other engine(s) may include, but not limited to, an input/output engine, an access management engine, a session management engine, and a notification engine.

[0064] The data ingestion engine (212) tracks the plurality of restricted location (TALs). To track the plurality of restricted locations, the network (e.g., the network 106) is divided into tracking areas to manage mobility and handover between different network cells. Each tracking area represents a geographic region covered by a set of base stations or cell towers. Further, the data ingestion engine (212) tracks the plurality of regulatory requirements that specify that when the user moves into the restricted location of the plurality of restricted location where the audio call barring is enabled, any ongoing audio call on a user equipment (e.g., the first user equipment) is aborted. The plurality of regulatory requirements ensure compliance with regulations related to audio call restrictions in specific locations.

[0065] The policy engine (214) relies on the PCF that is responsible for performing policy and charging control functions in the network. The policy engine (214) enforces policies and rules related to various services, including calls control. The input/output engine is configured for receiving input (such as the first current location and the second current location) and generating output (e.g., the triggering signal and the at least one alert message). The access management engine relies on the AMF and is configured for authorizing to establish the session. A session management engine relies on the SMF and is configured for managing the session. The notification engine configured to notify the triggering signal to the SMF and the at least one alert message to the user. Further, the database 210 is configured to store information associated with the plurality of restricted locations.

[0066] In an embodiment, the processing engine(s) 208 may be implemented as a combination of hardware and programming (for example, programmable instructions) to implement one or more functionalities of the processing engine(s) 208. In examples described herein, such combinations of hardware and programming may be implemented in several different ways. For

example, the programming for the processing engine(s) 208 may be processor-executable instructions stored on a non-transitory machine-readable storage medium and the hardware for the processing engine(s) 208 may comprise a processing resource (for example, one or more processors), to execute such instructions. In the present examples, the machine-readable storage medium may store instructions that, when executed by the processing resource, implement the processing engine(s) 208. In such examples, the system 108 may comprise the machine-readable storage medium storing the instructions and the processing resource to execute the instructions, or the machine-readable storage medium may be separate but accessible to the system and the processing resource. In other examples, the processing engine(s) 208 may be implemented by electronic circuitry.

[0067] FIG. 3 illustrates an exemplary flowchart 300 for aborting an on-going audio call service when the user moves into the restricted location (i.e., the TAL) where the audio call barring is enabled, in accordance with an embodiment of the disclosure. FIG. 3 is explained in conjunction with FIGS. 1 and 2.

[0068] Initially, the network is divided into various the plurality of restricted locations to manage mobility and handover between different network cells. Each restricted location of the plurality of restricted locations may represent the geographic region covered by the set of base stations or cell towers. Further, the plurality of regulatory requirements may specify that if the user moves into the restricted locations of the plurality of restricted locations where the audio call barring is enabled, any ongoing call on the user equipment must be aborted. The plurality of regulatory requirements ensure compliance with regulations related to audio call restrictions in specific locations.

[0069] A PCF 306 is a network component that may be responsible for policy and charging control in the network. It enforces policies and rules related to various services, including call control. The PCF 306 is configured to contain an audio call barring policy that defines which restricted locations of the plurality of restricted locations have call barring enabled. This policy may be configured based on the plurality of regulatory requirements or the operator preference. For a call

session establishment, when the user initiates a call, the network is configured to set up a call session between a user's device (e.g., the first user equipment) and a destination device (e.g., the second user equipment). This may involve establishing signalling and media connections between the user device, the network, and the destination device. As users (e.g., the user of the user device and a user of the destination device) moves within the network, their device periodically (for example: in every 30 seconds) sends current locations information (i.e., the first current location corresponding to the user device and the second current location corresponding to the destination device) to inform the network about its current location. The PCF 306 is configured to continuously monitor updates from the user's device. It may check whether the user has moved into the restricted location where the audio call barring is enabled, based on the audio call barring policy. If the PCF 306 determines that the user has entered the restricted location with the audio call barring, the PCF 306 may send a message to appropriate network component (i.e., a SMF 304) to abort the ongoing call. This involves sending signalling messages, i.e., the at least one message (e.g., you are in call restricted zone) to the user device and/or the destination device to terminate the ongoing call.

[0070] At step 310, the SMF 304 is configured to create a session management (SM) policy and indicate the PCF 306 about creation of the SM policy. At step 312, the PCF 306 is configured to communicate with an Application Function (AF) (e.g. a Call Session Control Function (CSCF)) 308 over a receive (Rx) interface. The PCF 306 can transmit a AAA (Authentication, Authorization, and Accounting) or an authentication authorization request (AAR) message to the AF/CSCF 308. Further, the PCF 306 is configured to send the SM policy notify message to the SMF 304 based on any SAREA (service area, i.e., the restricted location) changes as mentioned via step 314. Upon receiving SAREA changes, the SMF 304 is configured to update the SM policy and send the updated SM policy including the SAREA changes (indicated as a Trigger : SAREA_CH) to the PCF 306 as mentioned via step 316.

[0071] At step 318, the PCF 306 is configured to extract Subscription Permanent Identifier (SUPI) associated with the user equipment and check ongoing

call sessions and other business conditions to terminate session once the ongoing call is over. At step 320, the PCF 306 is configured to receive Simultaneous transmit-receive (STR) and Session-Termination-Answer (STA) messages from the AF/CSCF 308. The PCF 306 detects that a Rx session is terminated and decides to terminate session management (SM)/ access management (AM) session at step 322. Based on termination of the Rx session, the PCF 306 and the SMF 304 are configured to exchange SM policy terminate notification messages at step 324. Further, at step 326, the PCF 306 and the AMF 302 are configured to exchange AM policy terminate notification messages. Further, the PCF 306 and the SMF 304 are configured to exchange SM policy delete messages at step 328 and the PCF 306 and the AMF 302 are configured to exchange AM policy delete messages at step 330.

[0072] As will be appreciated, in one embodiment, the PCF 306, the AMF 302, the SMF 304, and the AF/CSCF 308 that are configured to communicate with each other may be implemented within the processing engine 208 of the system 108. Further, in another embodiment, the PCF 306 may be implemented within the processing engine 208 of the system 108, whereas the AMF 302, the SMF 304, and the AF/CSCF 308 may be implemented within one or more systems including a memory and a processing engine. In this embodiment, the AMF 302, the SMF 304, and the AF/CSCF 308 may be configured to communicate with the PCF 306 over a network (e.g., the network 106).

[0073] FIG. 4 illustrates an example flow diagram 400 for terminating at least one service based on location of the user equipment, in accordance with an embodiment of the present disclosure. FIG. 4 is explained in conjunction with FIGS. 1, 2 and 3.

[0074] At step 402, the first user equipment establishes a session corresponding to the at least one service with a second user equipment via the SMF (same as the SMF 304) upon receiving an authorization from the NF. Each of the first user equipment and the second user equipment is configured to employ the GPS, the WPS or the CPS for determining the first current location and the second current location. The first user equipment and the second user equipment are

configured to send the first current location and the second current location, respectively, to the NF. In an embodiment, the at least one service includes at least one of an audio call service, a text service, and a video call service. Upon receiving the first current location and the second current location the NF is configured to send the first current location and the second current location to the PCF (same as the PCF 306). In an embodiment, the NF includes at least one of the AMF (same as the AMF 302), the LMF, and the GMLC. As will be appreciated, in some embodiments, the authorization and the sending may be performed via at least one of the AMF, the LMF, and the GMLC. In particular, in an embodiment, the authorization and the sending may be performed by the AMF.

[0075] Further, at step 404, the PCF is configured to receive the first current location associated with the first user equipment and the second current location associated with the second user equipment from the NF. It should be noted that the PCF is configured to receive the first current location and the second current location from the NF periodically (e.g., after every 30 seconds). As will be appreciated, in some embodiments, the first current location and the second current location may be received via at least one of the AMF, the LMF, and the GMLC. In particular, in an embodiment, the first current location and the second current location may be received from the LMF and the GMLC.

[0076] Upon receiving the first current location and the second current location, at step 406, the first current location and the second current location is mapped with each of the plurality of restricted locations. In particular the PCF maps the first current location and the second current location with each of the plurality of restricted locations. The plurality of restricted locations is stored in the database (same as the database 210) associated the PCF. This is done to determine the presence of at least one of the first current location and the second current location within the restricted location.

[0077] Further, upon determining the presence of the at least one of the first current location and the second current location with the restricted location, at step 408, the PCF fetch the set of policies corresponding to the restricted location from the database. Based on the set of policies, the PCF is configured to generate the

triggering signal. The set of policies includes access policies, location policies, resource allocation policies, and session setup policies. Further, the set of policies is configured based on at least one of a plurality of regulatory requirements and an operator preference.

[0078] Further, at step 410, the PCF transmits the triggering signal to the SMF for terminating the session corresponding to the at least one service associated with a corresponding user equipment of the at least one of the first user equipment and the second user equipment upon receiving the triggering signal. The corresponding user equipment is a user equipment that is present within the restricted location. The SMF is configured to receive the triggering signal from the PCF. On receiving the triggering signal, the SMF is configured to terminate the session corresponding to the at least one service. In an embodiment, the SMF is further configured to send at least one alert message to the corresponding user equipment.

[0079] FIG. 5 illustrates an exemplary computer system 500 in which or with which embodiments of the present disclosure may be implemented. As shown in FIG. 5, the computer system 500 may include an external storage device 510, a bus 520, a main memory 530, a read-only memory 540, a mass storage device 550, communication port(s) 560, and a processor 570. A person skilled in the art will appreciate that the computer system may include more than one processor and communication ports. The processor 570 may include various modules associated with embodiments of the present disclosure. The communication port(s) 560 may be any of an RS-232 port for use with a modem-based dialup connection, a 10/100 Ethernet port, a Gigabit or 10 Gigabit port using copper or fiber, a serial port, a parallel port, or other existing or future ports. The communication port(s) 560 may be chosen depending on a network, such a Local Area Network (LAN), Wide Area Network (WAN), or any network to which the computer system 500 connects.

[0080] The main memory 530 may be random access memory (RAM), or any other dynamic storage device commonly known in the art. The read-only memory 540 may be any static storage device(s) e.g., but not limited to, a Programmable Read Only Memory (PROM) chips for storing static information

e.g., start-up or Basic Input/Output System (BIOS) instructions for the processor 570. The mass storage device 550 may be any current or future mass storage solution, which can be used to store information and/or instructions. Exemplary mass storage device 550 includes, but is not limited to, Parallel Advanced Technology Attachment (PATA) or Serial Advanced Technology Attachment (SATA) hard disk drives or solid-state drives (internal or external, e.g., having Universal Serial Bus (USB) and/or Firewire interfaces), one or more optical discs, Redundant Array of Independent Disks (RAID) storage, e.g. an array of disks.

[0081] The bus 520 communicatively couples the processor 570 with the other memory, storage, and communication blocks. The bus 520 may be, e.g. a Peripheral Component Interconnect (PCI)/PCI Extended (PCI-X) bus, Small Computer System Interface (SCSI), Universal Serial Bus (USB), or the like, for connecting expansion cards, drives, and other subsystems as well as other buses, such a front side bus (FSB), which connects the processor 570 to the computer system 500.

[0082] Optionally, operator and administrative interfaces, e.g. a display, keyboard, joystick, and a cursor control device, may also be coupled to the bus 520 to support direct operator interaction with the computer system. Other operator and administrative interfaces can be provided through network connections connected through the communication port(s) 560. Components described above are meant only to exemplify various possibilities. In no way should the aforementioned exemplary computer system limit the scope of the present disclosure.

[0083] While the foregoing describes various embodiments of the invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof. The scope of the invention is determined by the claims that follow. The invention is not limited to the described embodiments, versions or examples, which are included to enable a person having ordinary skill in the art to make and use the invention when combined with information and knowledge available to the person having ordinary skill in the art.

[0084] The present disclosure is configured to provide an enhanced PCF which is configured to terminate at least one service (e.g., an ongoing audio call)

when a user moves into a restricted location (e.g., a specific Tracking Area Location (TAL)) where the audio call barring is enabled. The TAL is a geographic area that has been designated by the network operator. Using the present system, the operator is able to enforce restrictions on audio calls/services based on specific geographical areas, thereby preventing unauthorized communication within the restricted areas. The present disclosure is applicable to a wide range of applications that require area-based service applicability to the users. When a user enters the TAL where audio call barring is active, the PCF takes appropriate action to terminate any ongoing audio calls for that user, thereby ensuring full compliance with the regulatory requirement and preventing any unauthorized communication within the restricted areas.

[0085] The method and system of the present disclosure may be implemented in a number of ways. For example, the methods and systems of the present disclosure may be implemented by software, hardware, firmware, or any combination of software, hardware, and firmware. The above-described order for the steps of the method is for illustration only, and the steps of the method of the present disclosure are not limited to the order specifically described above unless specifically stated otherwise. Further, in some embodiments, the present disclosure may also be embodied as programs recorded in a recording medium, the programs including machine-readable instructions for implementing the methods according to the present disclosure. Thus, the present disclosure also covers a recording medium storing a program for executing the method according to the present disclosure.

[0086] While considerable emphasis has been placed herein on the preferred embodiments, it will be appreciated that many embodiments can be made and that many changes can be made in the preferred embodiments without departing from the principles of the disclosure. These and other changes in the preferred embodiments of the disclosure will be apparent to those skilled in the art from the disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be implemented merely as illustrative of the disclosure and not as a limitation.

[0087] The present disclosure provides technical advancement related to management of services based on a location of a user. This advancement addresses the limitations of existing solutions by implementing a tracking mechanism which constantly monitors the location of the user and triggers an immediate termination of an ongoing service when the user moves in a specific TAL (i.e., a restricted location). The disclosure involves terminating a session associated with the ongoing service (e.g., an ongoing call) associated with a user equipment (UE), upon determining a presence of a current location of the user associated with the UE, within the restricted location. In this way, the disclosure facilitates prevention of an unauthorized communication within the restricted location and ensures compliance with a regulatory requirement associated with the restricted location.

ADVANTAGES OF THE PRESENT DISCLOSURE

[0088] The present disclosure provides a tracking mechanism which constantly monitors location of a user and triggers an immediate termination of at least one service (e.g., an ongoing audio call service, a video call service, or a text service) a when the user moves in a restricted location (e.g., a specific Tracking Area Location (TAL)).

[0089] The present disclosure facilitates a termination of the at least one service, which ensures compliance with a regulatory requirement and prevents unauthorized communication within the restricted locations.

We Claim:

1. A system (108) for terminating at least one service based on location of a user equipment, the system (108) comprising:

a processor (202); and

a memory (204) coupled to the processor (202) and configured to store instructions executable by the processor (202) causes the processor (202) to:

receive (404), by a policy control function (PCF) (306), a first current location and a second current location corresponding to a first user equipment and a second user equipment respectively, from an access and mobility management function (AMF) (302);

map (406), by the PCF (306), the first current location and the second current location with each of a plurality of restricted locations stored in a database associated the PCF for determining a presence of at least one of the first current location and the second current location within a restricted location of the plurality of restricted locations;

upon determining the presence of the at least one of the first current location and the second current location with the restricted location, fetch (408), by the PCF (306), a set of policies from the database corresponding to the restricted location to generate a triggering signal; and

transmit (410), by the PCF (306), the triggering signal to a session management function (SMF) (304) for terminating a session corresponding to the at least one service associated with a corresponding user equipment of the at least one of the first user equipment and the second user equipment upon receiving the triggering signal.

2. The system (108) as claimed in claim 1, further comprising a plurality of user equipments, and wherein the first user equipment is configured to establish the session with the second user equipment via the SMF (304), upon receiving an authorization from the AMF (302), and wherein the first user equipment and the second user equipment is configured to send the first

current location and the second current location, respectively, to the AMF (302).

3. The system (108) as claimed in claim 1, wherein the at least one service comprises at least one of an audio service, a text service, and a video service.

4. The system (108) as claimed in claim 1, wherein the set of policies comprises access policies, location policies, resource allocation policies, and session setup policies.

5. The system (108) as claimed in claim 1, wherein the set of policies is configured based on at least one of a plurality of regulatory requirements and an operator preference.

6. The system (108) as claimed in claim 1, wherein the PCF (306) is configured to periodically receive the first current location and the second current location from the AMF (302).

7. The system (108) as claimed in claim 1, wherein the PCF (306) is configured to receive the first current location and the second current location from a location management function (LMF), and a gateway mobile location centre (GMLC).

8. The system (108) as claimed in claim 1, wherein the SMF (304) is configured to send at least one alert message to the corresponding user equipment in response to receiving the trigging signal.

9. The system (108) as claimed in claim 1, wherein each of the first user equipment and the second user equipment is configured to employ a Global Positioning System (GPS), a Wi-Fi Positioning System (WPS) or a Cellular Positioning System (CPS) for determining the first current location and the second current location.

10. A method (400) for terminating at least one service based on location of a user equipment, the method comprising:

receiving (404), by a policy control function (PCF) (306), a first current location and a second current location corresponding to a first user equipment and a second user equipment respectively, from a network function (NF);

mapping (406), by the PCF (306), the first current location and the second current location with each of a plurality of restricted locations stored in a database associated with the PCF (306) for determining a presence of at least one of the first current location and the second current location within a restricted location of the plurality of restricted locations;

upon determining the presence of the at least one of the first current location and the second current location within the restricted location, fetching (408), by the PCF (306), a set of policies from the database corresponding to the restricted location to generate a triggering signal; and

transmitting (410), by the PCF (306), the triggering signal to a session management function (SMF) (304) to terminate a session corresponding to the at least one service associated with a corresponding user equipment of the at least one of the first user equipment and the second user equipment, upon receiving the triggering signal.

11. The method as claimed in claim 10, further comprising establishing (402), by the first user equipment, the session corresponding to the at least one service with the second user equipment via the SMF (304), upon receiving an authorization from the NF, wherein the first user equipment and the second user equipment is configured to send the first current location and the second current location, respectively, to the NF.

12. The method (400) as claimed in claim 10, further comprising receiving the first current location and the second current location from the NF.

13. The method (400) as claimed in claim 12, wherein the NF comprises at least one of an access and mobility management function (AMF) (302), a location

management function (LMF), and a Gateway Mobile Location Centre (GMLC).

14. The method (400) as claimed in claim 10, further comprising sending at least one alert message to the corresponding user equipment in response to receiving the trigging signal.

15. A first user equipment communicatively coupled to a system (108), the first user equipment is configured to:

establish a session corresponding to at least one service with a second user equipment via a session management function (SMF) (304), upon receiving an authorization from a network function (NF);

send a first current location associated with the first user equipment to the NF; and

receive at least one alert message corresponding to termination of the session associated with the at least one service upon determining a presence of the first current location within a restricted location.

16. A computer program product comprising a non-transitory computer-readable medium comprising instructions that, when executed by one or more processors, cause the one or more processors to:

receive (404), by a policy control function (PCF) (306), a first current location and a second current location corresponding to a first user equipment and a second user equipment respectively, from an access and mobility management function (AMF) (302);

map (406), by the PCF (306), the first current location and the second current location with each of a plurality of restricted locations stored in a database associated with the PCF (306) for determining a presence of at least one of the first current location and the second current location within a restricted location of the plurality of restricted locations;

upon determining the presence of the at least one of the first current location and the second current location with the restricted location, fetch (408), by the PCF (306), a set of policies from the database corresponding to the restricted location to generate a triggering signal; and

transmit (410), by the PCF (306), the triggering signal to a session management function (SMF) (304) for terminating a session corresponding to at least one service associated with a corresponding user equipment of the at least one of the first user equipment and the second user equipment upon receiving the triggering signal.

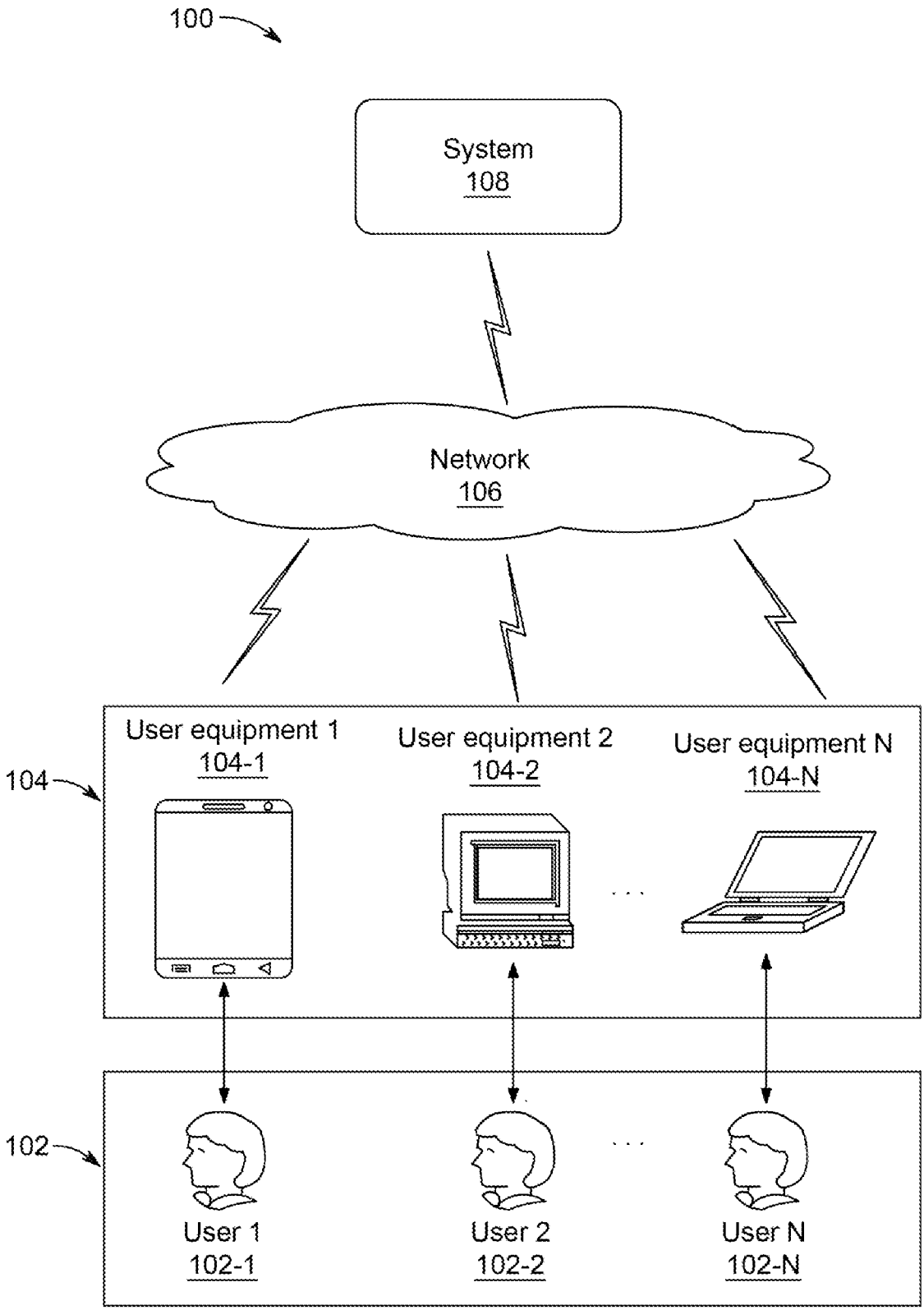

100
System
108
Network
106
User equipment 1
104-1
User equipment 2
104-2
User equipment N
104-N
104
102
User 1
102-1
User 2
102-2
User N
102-N

FIG. 1

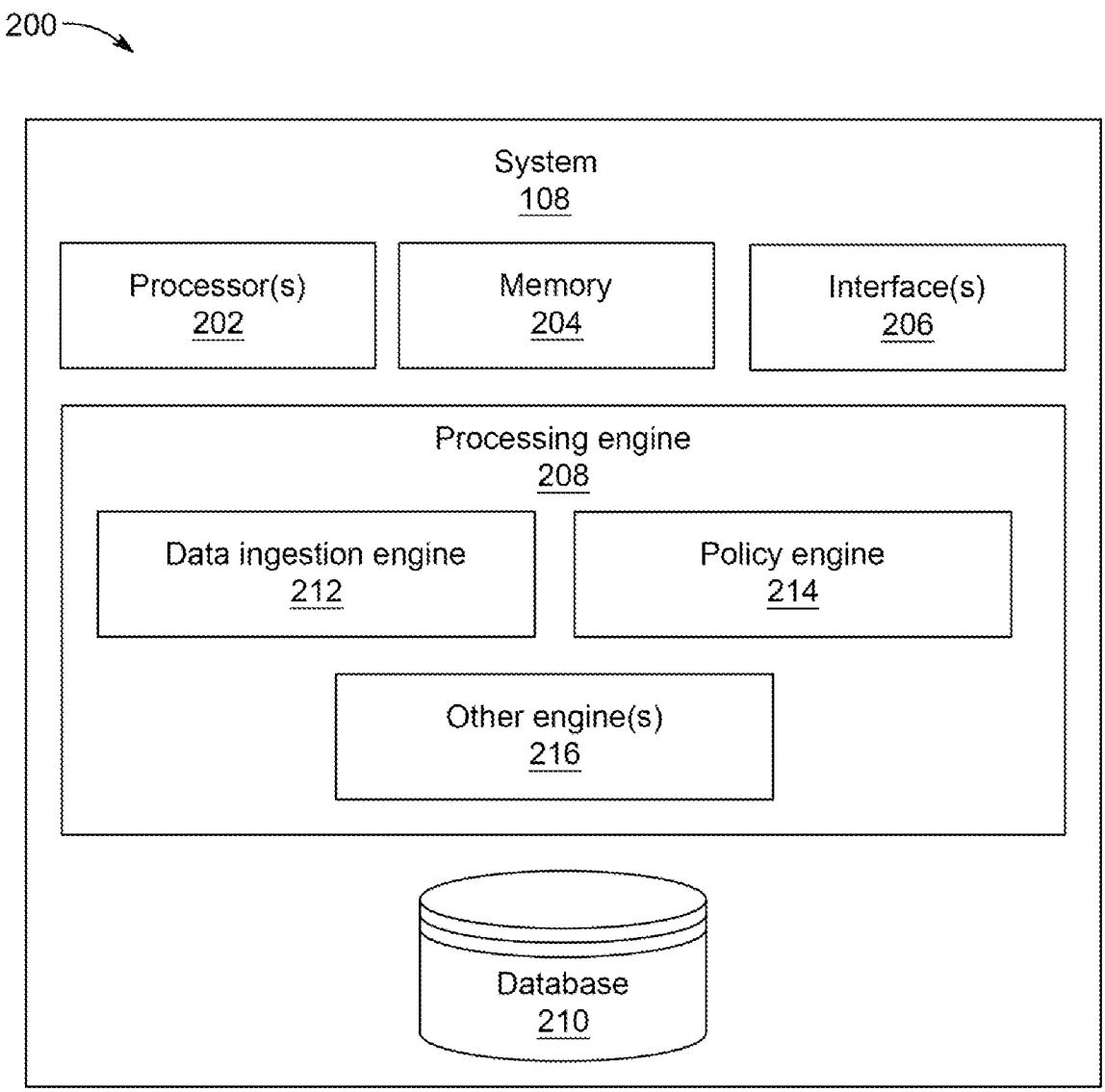

200
System
108
Processor(s)
202
Memory
204
Interface(s)
206
Processing engine
208
Data ingestion engine
212
Policy engine
214
Other engine(s)
216
Database
210

FIG. 2

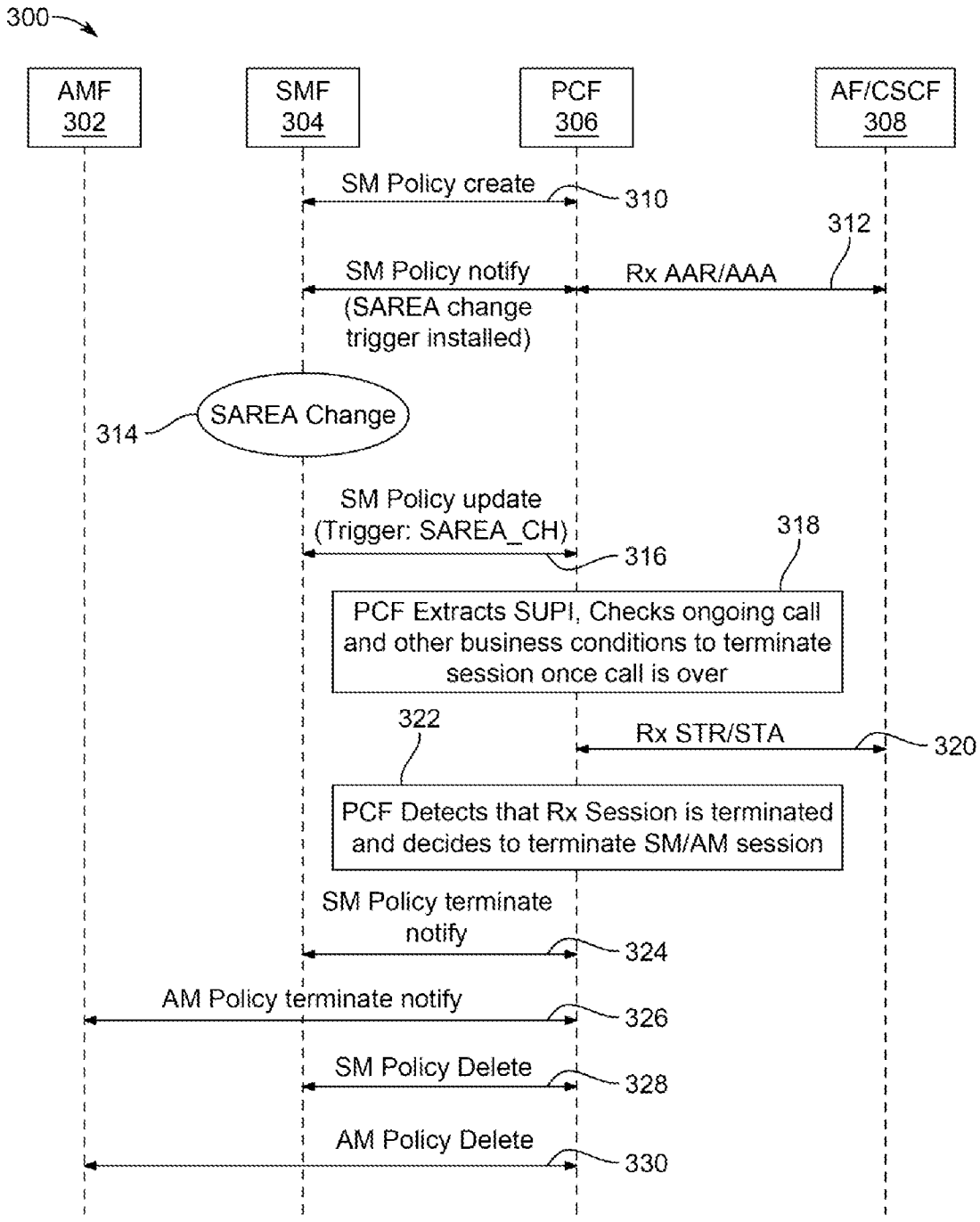

300
AMF
302
SMF
304
PCF
306
AF/CSCF
308
SM Policy create
310
312
SM Policy notify
(SAREA change
trigger installed)
Rx AAR/AAA
314
SAREA Change
SM Policy update
(Trigger: SAREA_CH)
316
318
PCF Extracts SUPI, Checks ongoing call
and other business conditions to terminate
session once call is over
322
Rx STR/STA
320
PCF Detects that Rx Session is terminated
and decides to terminate SM/AM session
SM Policy terminate
notify
324
AM Policy terminate notify
326
SM Policy Delete
328
AM Policy Delete
330

FIG. 3

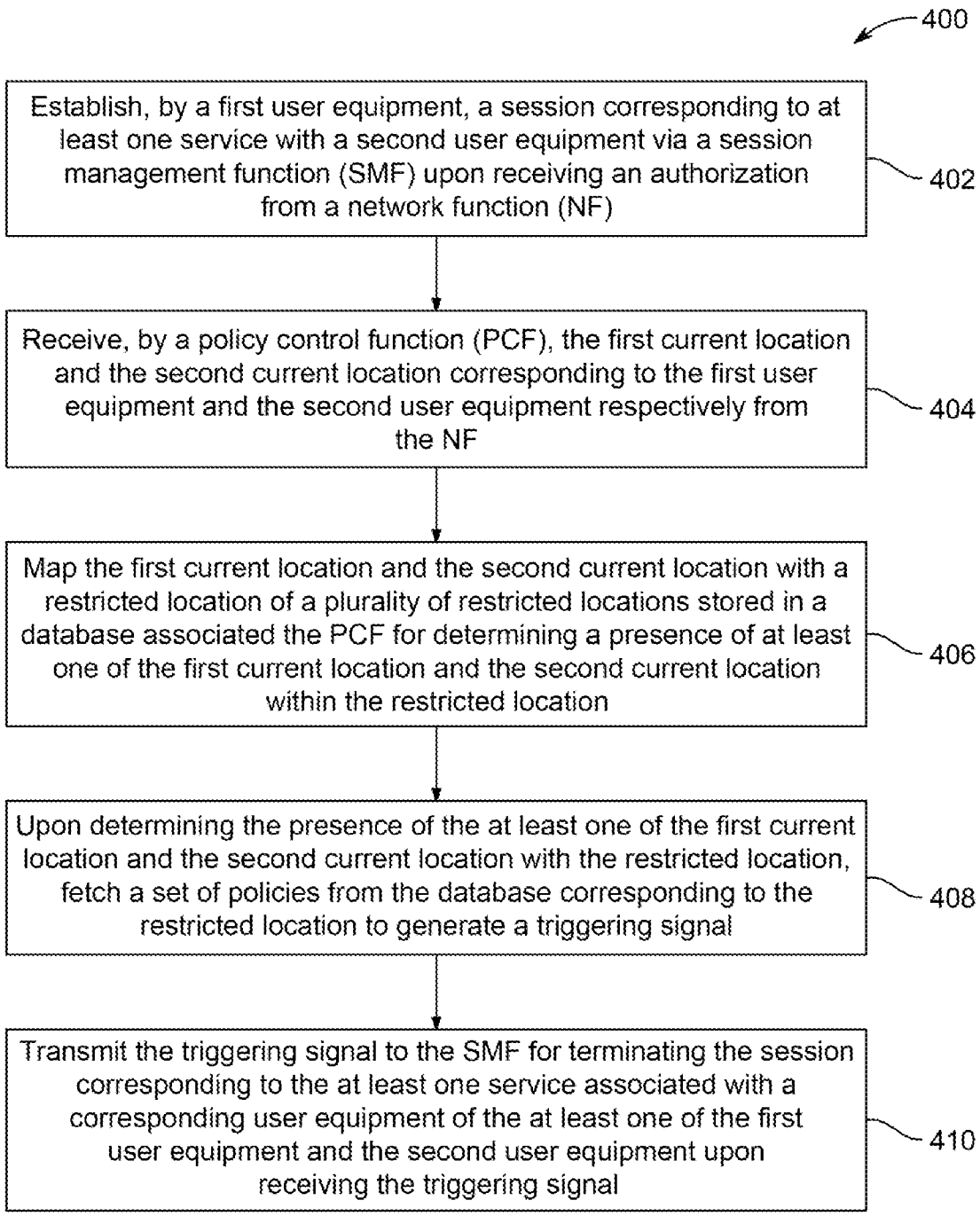

400
Establish, by a first user equipment, a session corresponding to at least one service with a second user equipment via a session management function (SMF) upon receiving an authorization from a network function (NF)
402
Receive, by a policy control function (PCF), the first current location and the second current location corresponding to the first user equipment and the second user equipment respectively from the NF
404
Map the first current location and the second current location with a restricted location of a plurality of restricted locations stored in a database associated the PCF for determining a presence of at least one of the first current location and the second current location within the restricted location
406
Upon determining the presence of the at least one of the first current location and the second current location with the restricted location, fetch a set of policies from the database corresponding to the restricted location to generate a triggering signal
408
Transmit the triggering signal to the SMF for terminating the session corresponding to the at least one service associated with a corresponding user equipment of the at least one of the first user equipment and the second user equipment upon receiving the triggering signal
410

FIG. 4

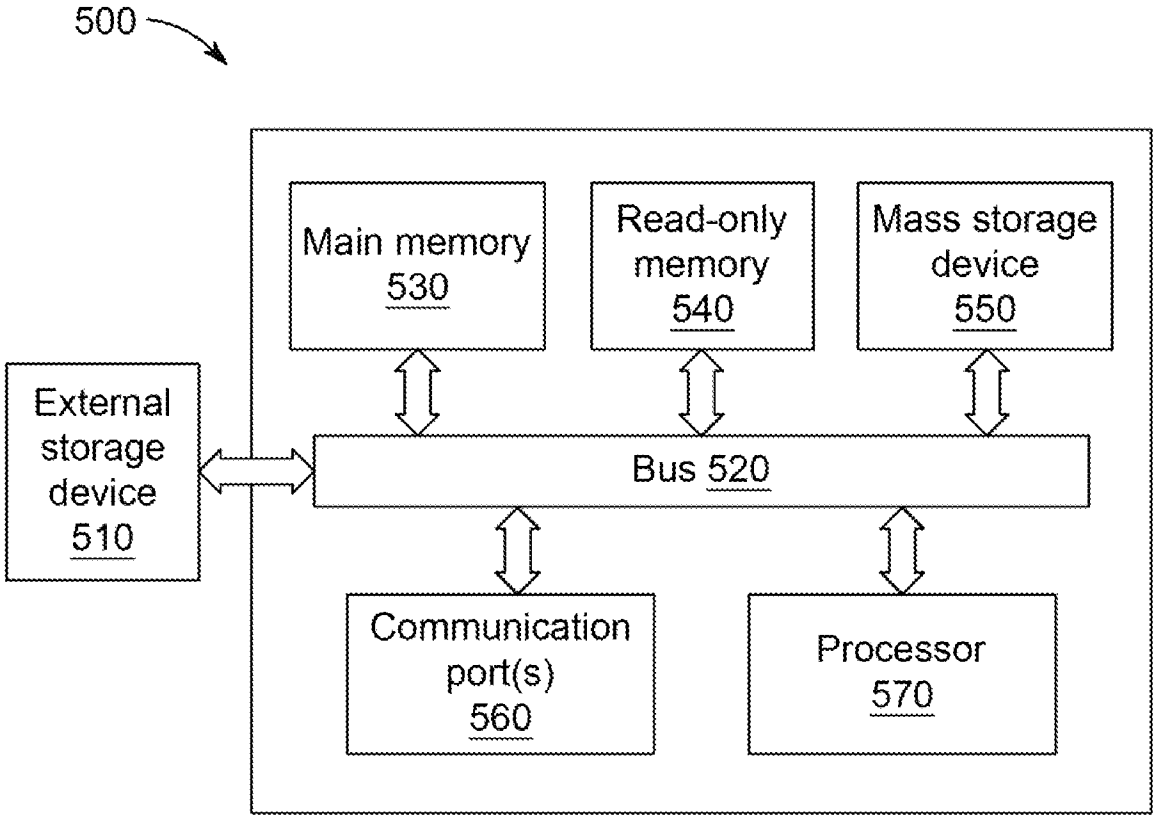

500
Main memory
530
Read-only
memory
540
Mass storage
device
550
External
storage
device
510
Bus 520
Communication
port(s)
560
Processor
570

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2024/051268

A. CLASSIFICATION OF SUBJECT MATTER
H04W48/18,H04W80/10,H04W60/04,H04W4/029 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	US20050181808A1, (LUCENT TECHNOLOGIES INC.), 18 August 2005 (18-08-2005) Paras [0006][0010][0036][0050]	1-16
Y	GB2608258A, (SUMSUNG ELECTRONICS CO. LTD.), 28 December 2022 (28-12-2022) Page[7]	1-16

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

Date of the actual completion of the international search	Date of mailing of the international search report
13-11-2024	13-11-2024
Name and mailing address of the ISA/ Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Authorized officer Ajay Kumar Paswan Telephone No. +91-1125300200