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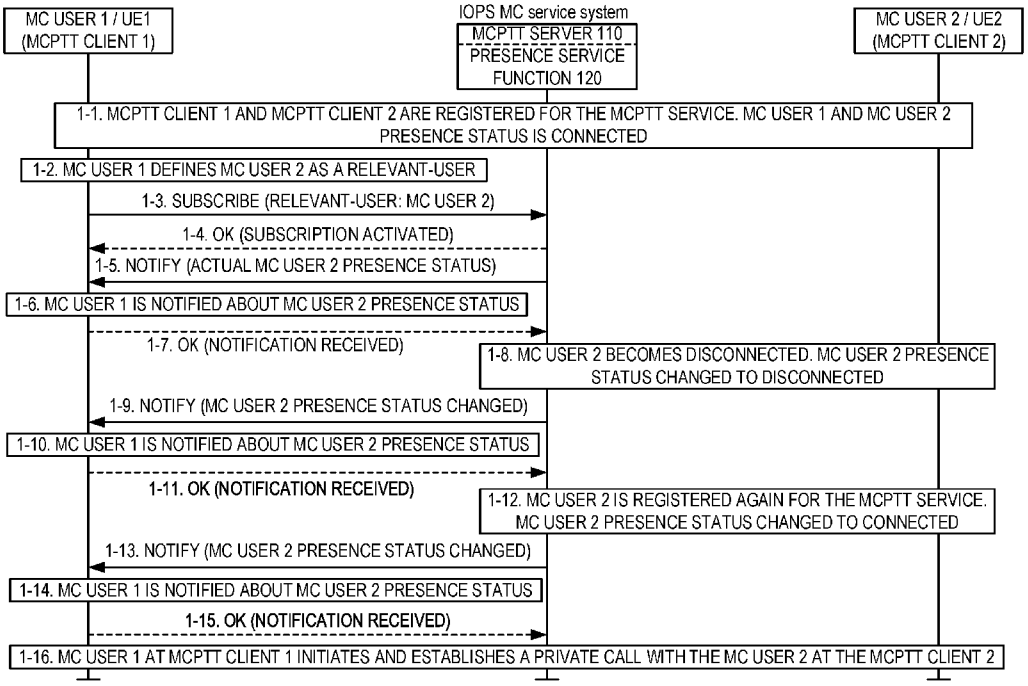

FIG. 1

(57) **Abstract:** A method performed by a first wireless device (212, UE1) for an IOPS system, which first wireless device is associated with a particular MC group communication service group. The method comprises: sending (1-3) towards a MC presence service function (120), a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device (212, UE2) that is associated with the particular MC group communication service group or a different MC group communication service group; and receiving (1-5), a notify message sent by the MC presence server function and comprising an indication of a presence status of the second wireless device.

[Continued on next page]

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PRESENCE SERVICE SUPPORT FOR MISSION CRITICAL SERVICES

BACKGROUND

[0001] Generally, all terms used herein are to be interpreted according to their ordinary meaning in the relevant technical field, unless a different meaning is clearly given and/or is implied from the context in which it is used. All references to a/an/the element, apparatus, component, means, step, etc. are to be interpreted openly as referring to at least one instance of the element, apparatus, component, means, step, etc., unless explicitly stated otherwise. The steps of any methods disclosed herein do not have to be performed in the exact order disclosed, unless a step is explicitly described as following or preceding another step and/or where it is implicit that a step must follow or precede another step. Any feature of any of the embodiments disclosed herein may be applied to any other embodiment, wherever appropriate. Likewise, any advantage of any of the embodiments may apply to any other embodiments, and vice versa. Other objectives, features, and advantages of the enclosed embodiments will be apparent from the following description.

[0002] Mission Critical (MC) communication services are essential for the work performed by public safety users e.g. police and fire brigade. The MC communications service requires preferential handling compared to normal telecommunication services including handling of prioritized MC calls for emergency and imminent threats. Furthermore, the MC communication service requires several resilience features that provide a guaranteed service level even if part of the network or backhaul infrastructure fails.

[0003] The most commonly used communication method for public safety users is Group Communication (GC) which requires that the same information is delivered to multiple users. One type of Group Communication is Push to Talk (PTT) service. A Group Communication system can be designed with a centralized architecture approach, in which a centralized GC control node provides full control of all group data e.g. group membership, policies, user authorities and prioritizations. Such approach requires a network infrastructure that provides high network availability. This type of operation is sometimes known as Trunked Mode Operation (TMO) or on-network operation.

[0004] Third Generation Partnership Project (3GPP) based networks supporting GC services or Mission Critical (MC) services like Mission Critical Push To Talk (MCPTT) are specified in 3GPP TS 23.280 v16.1.0 and 3GPP TS 23.379 v16.1.0. Each MC service supports several types of communications amongst the users (e.g. group call, private call). There are several common functions and entities (e.g. group, configuration, identity) which are used by the MC services. The common functional architecture supporting MC services comprises a central MC service server connected to the network providing full control of the MC service data and MC

service client(s) operating on a user-equipment (UE) providing MC service communications support. The MC service UE primarily obtains access to a MC service via Evolved Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access Network (E-UTRAN), using e.g. the EPS architecture defined in 3GPP TS 23.401 v16.1.0.

[0005] Also, cellular networks have supported presence services to store and distribute presence information about users within the system to interested parties, e.g. other users. For instance, the presence service has been specified as part of the open mobile alliance (OMA) push to talk over cellular (PoC) architecture v2.0 and in 3GPP TS 23.141 v15.0.0. The presence information can be used for the systems to provide information of the availability of a user to communicate with other users on the network. In current 3GPP mission critical specifications, e.g. in 3GPP TS 23.280 v16.1.0, 3GPP TS 23.379 v16.1.0 and 3GPP TS 24.379 v15.4.0, some procedures have been specified to provide information about users within the same MC service group. For instance, a user which is registered and affiliated to a MC service group can subscribe to receive information about which other users are also affiliated within the same MC service group or are present in an ongoing group call.

SUMMMARY

[0006] Embodiments of the present disclosure are described within the context of a 3GPP-based LTE network, i.e. an Evolved Packet System (EPS) including E-UTRAN and EPC. However, the problems and solutions described herein are equally applicable to wireless access networks and UEs implementing other access technologies and standards (e.g. a 5G system including 5G core and 5G radio access). LTE is used as an example technology where the invention is suitable and using LTE in the description therefore is particularly useful for understanding the problem and solutions solving the problem.

[0007] There currently exist certain challenge(s). Among the desired features of 3GPP based networks to support mission critical services are the feature to provide mechanisms for MC users to query whether a particular MC user is present on the network as well as the feature of enabling an MC service administrator to configure and determine the presence information of a particular MC user on the network. However, in the 3GPP mission critical specifications the support and procedures for such features have only included information about group-related MC users, i.e. to provide information about users within the same MC service group. Therefore, a solution still needs to be specified for mission critical services for the case that any authorized MC user can query whether a particular MC user is present on the network, regardless of whether the MC users belong to the same MC service group or in general to any group.

[0008] Certain aspects of the present disclosure and their embodiments may provide solutions to the aforementioned or other challenges. The proposed solution provides methods for wireless devices and mission critical systems to support presence services for mission critical services. The solution is based on a presence service function to be implemented within the MC service system. The presence service function provides mechanisms for authorized MC users to query whether a particular MC user is present on the network. Also, the presence service function provides mechanisms for an MC service administrator to configure and determine the presence information of a particular MC user on the network, regardless of whether the MC user is a member of a MC service group.

[0009] In embodiments, the solution described herein supports presence services for mission critical services in 3GPP based networks. Hence, an authorized mission critical user can query whether a particular mission critical user is present on the network, regardless if the users belong to the same mission critical service group.

[0010] One embodiment is directed to a method performed by a first wireless device associated with a particular MC group communication service group. The method comprises: sending towards a MC presence service function, a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device that is associated with the particular MC group communication service group or a different MC group communication service group; and receiving a notify message sent by the MC presence server function and comprising an indication of a presence status of the second wireless device.

[0011] Another embodiment is directed to a first wireless device for an IOPS system, which first wireless device is associated with a particular Mission Critical, MC, group communication service group and comprises: one or more transmitters and one or more receivers; and processing circuitry associated with the one or more transmitters and the one or more receivers, the processing circuitry configured to cause the first wireless device to: send, towards a MC presence service function, a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device that is associated with the particular MC group communication service group or a different MC group communication service group; and receive, a notify message sent by the MC presence server function and comprising an indication of a presence status of the second wireless device.

[0012] Another embodiment is directed to a method performed by a MC presence service function, the method comprising: receiving from a first wireless device that is associated with a particular MC group communication service group, a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device that is associated with the particular MC group

communication service group or a different MC group communication service group; and sending towards the first wireless device, a notify message comprising an indication of a presence status of the second wireless device.

[0013] Another embodiment is directed to a MC presence service function, comprising processing circuitry configured to cause the MC presence service function to: receive from a first wireless device that is associated with a particular MC group communication service group, a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device that is associated with the particular MC group communication service group or a different MC group communication service group; and send towards the first wireless device, a notify message comprising an indication of a presence status of the second wireless device.

[0014]

[0015] Certain embodiments may provide one or more of the following technical advantage(s). The advantages include:

- Any authorized MC user can query whether another particular MC user is present on the network, i.e. it is not limited to group-related users.
- Any authorized MC user can be notified about the availability/presence of other user as soon as the user becomes available within the system.
- The solution is based on the implementation of a presence service function within the MC service system.
- The presence-related requirements for 3GPP networks to support mission critical services, as described in 3GPP TS 22.280 v16.4.0, are fully covered.

BRIEF DESCRIPTION OF DRAWINGS

[0016] The accompanying drawings, which are included to provide a further understanding of the disclosure and are incorporated in a constitute a part of this application, illustrate certain non-limiting embodiments of inventive concepts. In the drawings:

Figure 1 depicts an example of a presence service support for an MCPTT service;

Figure 2 illustrates an example of a cellular communications system 200 in which embodiments of the present disclosure may be implemented;

Figure 3 is a schematic block diagram of an IOPS system implementing a MCPTT server 300 (e.g., a MCPTT server) including a presence service function according some embodiments of the present disclosure;

Figure 4 is a schematic block diagram that illustrates a virtualized embodiment of the MCPTT Server 300 according to some embodiments of the present disclosure;

Figure 5 is a schematic block diagram of the MCPTT Server 300 according to some other embodiments of the present disclosure;

Figure 6 is a schematic block diagram of a UE 600 according to some embodiments of the present disclosure;

Figure 7 is a schematic block diagram of the UE 600 according to some other embodiments of the present disclosure.

DETAILED DESCRIPTION

[0017] Some of the embodiments contemplated herein will now be described more fully with reference to the accompanying drawings. Other embodiments, however, are contained within the scope of the subject matter disclosed herein, the disclosed subject matter should not be construed as limited to only the embodiments set forth herein; rather, these embodiments are provided by way of example to convey the scope of the subject matter to those skilled in the art. Additional information may also be found in the document(s) provided in the Appendix.

[0018] **Radio Node:** As used herein, a "radio node" is either a radio access node or a wireless device.

[0019] **Radio Access Node:** As used herein, a "radio access node" or "radio network node" is any node in a radio access network of a cellular communications network that operates to wirelessly transmit and/or receive signals. Some examples of a radio access node include, but are not limited to, a base station (e.g., a New Radio (NR) base station (gNB) in a Third Generation Partnership Project (3GPP) Fifth Generation (5G) NR network or an enhanced or evolved Node B (eNB) in a 3GPP Long Term Evolution (LTE) network), a high-power or macro base station, a low-power base station (e.g., a micro base station, a pico base station, a home eNB, or the like), and a relay node.

[0020] **Core Network Node:** As used herein, a "core network node" is any type of node in a core network. Some examples of a core network node include, e.g., a Mobility Management Entity (MME), a Packet Data Network Gateway (P-GW), a Service Capability Exposure Function (SCEF), or the like.

[0021] **Wireless Device:** As used herein, a "wireless device" is any type of device that has access to (i.e., is served by) a cellular communications network by wirelessly transmitting and/or receiving signals to a radio access node(s). Some examples of a wireless device include, but are not limited to, a User Equipment device (UE) in a 3GPP network and a Machine Type Communication (MTC) device.

[0022] **Network Node:** As used herein, a "network node" is any node that is either part of the radio access network or the core network of a cellular communications network/system.

[0023] Note that the description given herein focuses on a 3GPP cellular communications system and, as such, 3GPP terminology or terminology similar to 3GPP terminology is oftentimes used. However, the concepts disclosed herein are not limited to a 3GPP system.

[0024] Note that, in the description herein, reference may be made to the term "cell"; however, particularly with respect to 5G NR concepts, beams may be used instead of cells and, as such, it is important to note that the concepts described herein are equally applicable to both cells and beams.

[0025] Also note that while the discussion herein focuses on MC GC (e.g. MCPTT), the embodiments described herein are equally applicable to other types of GC services and other type of MC services (e.g., MC video service or MC data service).

[0026] Throughout the present disclosure it is assumed that the mission critical (MC) users, also referred to herein as UEs or just users, are registered (i.e. authenticated and authorized) in the MC service system, i.e. in the MC service server and related functional entities, or are enabled to register within the MC service system. Also, it is assumed that the MC service user profile configuration data include information to determine if the users are authorized to query presence information about other users, i.e. whether other particular user is present on the system.

[0027] In an embodiment, a presence service function is defined and implemented within the MC service system to provide mechanisms for MC users to query whether a particular MC user is present on the network. Also, the presence service function provides mechanisms for an MC service administrator to configure and determine the presence information of a particular MC user on the network, regardless if the users are members of the same MC service group or even if the users do not belong to an MC service group at all. In other words, based on the presence service function, a full presence service is supported for MC services, i.e. any (authorized) user can query presence information about any other particular user within the MC service system.

[0028] In an embodiment, the presence service function can be implemented as part of the MC service server or can be defined as a new functional entity, e.g. a MC presence server, within the MC service system.

[0029] Throughout the present disclosure, the users querying presence information about other user(s) are referred as subscriber-users. On the other hand, the users being queried their presence are referred as relevant-users, as they are anyhow relevant to the subscriber-users.

[0030] Hence, the presence-related requirements for 3GPP networks to support mission critical services, as described in 3GPP TS 22.280 v16.4.0, can be further covered. Also, based on the presence service support,

when users become out-of-service or go out-of-coverage of the network and are temporarily not available for other users, an (authorized) subscriber-user can be notified about the availability (i.e., presence) of other relevant-users as soon as the relevant-users become available within the system. Likewise, the presence service function can also provide information to interested users, i.e. subscriber-users, about when a relevant-user is not anymore present/available within the system.

[0031] In an embodiment, the users are authorized to query presence information about other relevant-users based on the MC service user profile configuration data. For instance, the MC service user profile configuration data, e.g. the MCPTT user profile configuration data described in 3GPP TS 23.379 v16.1.0, includes parameters to indicate if the presence status is available or not available to other users as well as the list of users that an MC user is authorized to obtain presence of. Besides, other information can be utilized for the authorization of querying presence information. For example, if in the MC service user profile configuration data of a subscriber-user the relevant-user is within the list of users who can be called in private call, then the subscriber-user is authorized to request receiving presence information of that relevant-user(s). Likewise, if the relevant-user belongs to the same MC service group of the subscriber-user, then the subscriber-user is authorized to request receiving presence information of that particular relevant-user. For the latter case, although the 3GPP specifications, e.g. as described in 3GPP TS 24.379 v15.4.0, already support providing affiliation status of other users within the same MC service group, it can be further enhanced so that a subscriber-user can be notified about the presence of a relevant-user, e.g. a user which is not anymore affiliated to the subscriber-user's service group, when the relevant-user is or becomes available in the system and could be reached out for a MC communication service, e.g., via a private call. Other users with special profiles can be authorized to request the presence information of any other user, e.g. for emergency calls.

[0032] In a further embodiment, the presence service support for mission critical services is based on a presence protocol for the publication, subscription and notification of presence information. The session initiation protocol (SIP) is an example that could be used as a presence protocol as defined in IETF RFC6665, IETF RFC3856 and IETF RFC3903. Other request/response protocols can also be utilized for the presence service support, e.g. Hypertext Transfer Protocol (HTTP).

[0033] In an embodiment, the presence information is related, but not limited, to the presence status of a MC user being served by a MC service system. The presence status mainly indicates if a user is available or not within the system to be reached out by other user(s). Therefore, the presence status of a user can be defined by the presence service function based on the current registration status of the user within the MC service system, i.e. if the user is registered within the MC service system then it is assumed to be available/present.

[0034] For the case that users are within a poor coverage service area or have insufficient network resources, the users can become temporarily not reachable by the MC service system. Therefore, in an embodiment, the presence status of a user can be directly updated by, e.g., the MC service server when it detects that the presence status of a user has changed, e.g., when a user has been registered or disconnected. Thus, for the case that the network is experiencing congestion, there is no need to increase the signaling overhead by several users publishing their presence information. Only if required, the MC service server, e.g. based on the network resource utilization status, can request particular relevant-users registered in the MC service system to periodically publish their presence information while connected to the system. In another embodiment, e.g. for networks with low congestion, users which are registered in the MC service system can be pre-configured to periodically publish their presence information until they are registered within the MC service system.

[0035] In a further embodiment, the subscriber-users subscribe to receive the presence information of users which are relevant to them, i.e. presence information of relevant-users. As described above, the subscriber-users may be interested to subscribe to receive the presence information of users which are within the list of users who can be called in private call or for users which belong to the same MC service group of the subscriber-user. Also, a user with a special profile can be authorized to subscribe to receive the presence information of any other user. The different aspects related to the subscription requests, e.g. subscription duration, can be based, but not limited, on the framework defined in SIP for subscription requests, as described in IETF RFC6665.

[0036] In a further embodiment, the subscriber-users receive the presence information of the relevant-users via notification messages. These notifications can be sent by the presence service function based on different triggers, e.g. any presence status change of the relevant-users, i.e. users related to the active subscriptions of the subscriber-users, or as periodic notification messages defined by the presence service function. Other different aspects related to the notification messages can be based, but not limited, on the framework defined in SIP for notification requests, as described in IETF RFC6665.

Figure 1

[0037] **Figure 1** depicts an example of the presence service support for an MCPTT service. For that, the described presence service entity is described in the following steps 1-1 to 1-16. In this example, it is assumed that the presence service function entity 120 (e.g. a MC presence service function entity) is implemented in an IOPS MC system, e.g. in connection with the MCPTT server 110 (e.g. an IOPS MCPTT server) and that the MC user 1 (UE1) at the MCPTT client 1 defines the MC user 2 (UE2) at the MCPTT client 2 as a relevant-user.

Also, the MC user 2 is assumed to be within the list of users who can be called via an MCPTT private call by the MC user 1.

1-1. The MC users at the MCPTT clients are registered in the MCPTT server for MCPTT service. In other words, the UE at which MCPTT client 1 is implemented (referred to as UE1) communicates with the MCPTT server to register MC user 1 for MCPTT service. Likewise, the UE at which the MCPTT client 2 is implemented (referred to as UE2) communicates with the MCPTT server to register MC user 2 for MCPTT service. Based on the registration, the presence service function at the MCPTT server defines the presence status for both MC users as connected.

1-2. MC user 1 wants to subscribe to receive notification about the MC user 2 presence status. MC user 1 (i.e. UE1) defines the MC user 2 (i.e. UE2) as a relevant-user. For example, MCPTT client 1 receives input from MC user 1 that indicates that MC user 2 is relevant-user for MC user 1.

1-3. MC user 1 at the MCPTT client 1 sends a SUBSCRIBE request to the presence service function at the MCPTT server to receive presence status notifications about the MC user 2. For example, MCPTT client 1 controls UE 1 such that UE 1 sends a SUBSCRIBE request from MCPTT client 1 to the MCPTT server to receive presence status notifications about MC user 2. Preferably the SUBSCRIBE request comprises information that identifies MC user 2, e.g. identifies MC user 2 as a relevant user.

1-4. The MCPTT server may confirm the subscription request.

1-5. The MCPTT server, based on the presence service function, sends a NOTIFY message to the MC user 1 informing that the actual presence status of the MC user 2 is connected. In other words, the presence service function (e.g., dynamically) obtains the actual presence status of MC user 2 and preferably stores the actual presence status of MC user 2 (e.g., at the MCPTT server). The presence service function operations to update the actual presence status of MC user 2 over time. At this particular point in time, the actual presence status of MC user 2 is “connected”. The MCPTT server sends the NOTIFY message to UE 1, and in particular to the MCPTT client 1 implemented at UE 1, that includes an indication that the presence status of MC user 2 is “connected”.

1-6. The MCPTT client 1 notifies the MC user 1 about the presence information of the MC user 2. Thereby, the MC user 1 knows that MC user 2 is available, i.e. MC user 1 can reach out to MC user 2, e.g. via an MCPTT private call.

1-7. The MCPTT client 1 may confirm to the MCPTT server the reception of the notification sent to the MC user 1.

1-8. The MC user 2 becomes disconnected from the MCPTT server, e.g. due to an out-of-coverage situation for the UE 2 on which the MCPTT client 2 is operating, or because the MC user 2 simply de-registered

from the MCPTT server. Hence, the presence service function at the MCPTT server changes the presence status of the MC user 2 to disconnected.

1-9. The MCPTT server, based on the presence service function, sends a NOTIFY message to the MC user 1 informing that the presence status of the MC user 2 has changed to disconnected. More specifically, the MCPTT server sends a NOTIFY message to MCPTT client 1 at UE 1 including information that indicates that the presence status of MC user 2 has changed to "disconnected."

1-10. The MCPTT client 1 notifies the MC user 1 about the presence information change of the MC user 2, i.e. that the presence status of the MC user 2 has changed to disconnected. Thereby, the MC user 1 knows that MC user 2 is not available. Thus, the MC user 1 avoids reaching out to MC user 2. Based on the MC user 1 subscription, the MC user 1 will get notified once the MC user 2 is again available in the system.

1-11. The MCPTT client 1 may confirm to the MCPTT server the reception of the notification sent to the MC user 1.

1-12. The MC user 2 at the MCPTT client 2 is again registered for the MCPTT service. The presence service function at the MCPTT server changes the presence status of the MC user 2 to connected.

1-13. The MCPTT server, based on the presence service function, sends a NOTIFY message to the MC user 1 informing that the MC user 2 has become available again in the system, i.e. that the presence status of the MC user 2 has changed to connected. More specifically, the MCPTT server sends a NOTIFY message to MCPTT client 1 at UE 1 including information that indicates that the presence status of MC user 2 has changed to "connected."

1-14. The MCPTT client 1 notifies the MC user 1 about the presence information change of the MC user 2. Thereby, the MC user 1 knows that MC user 2 is again available for an MCPTT communication.

1-15. The MCPTT client 1 may confirm to the MCPTT server the reception of the notification sent to the MC user 1.

1-16. As the MC user 1 is aware that it can reach out to the MC user 2, the MC user 1 initiates and establishes an MCPTT private call with the MC user 2. In other words, MCPTT client 1 at UE 1 receives input from MC user 1 that triggers MCPTT client 1 to initiate and establish a MCPTT private call between MC user 1 (at UE 1) and MC user 2 (at UE 2).

Figure 2

[0038] **Figure 2** illustrates one example of a cellular communications system 200 in which embodiments of the present disclosure may be implemented. In the embodiments described herein, the cellular

communications system 200 is, e.g., 4G system (e.g., an Evolved Packet System (EPS) including a Long Term Evolution (LTE) radio access network (RAN) and an Evolved Packet Core (EPC)) or 5G system (e.g., the 5GS including the New Radio (NR) RAN and 5G core (5GC)). In this example, the RAN of the cellular communications system 200 includes base stations 202-1 and 202-2, which in LTE are referred to as eNBs and in 5G NR are referred to as gNBs, controlling corresponding macro cells 204-1 and 204-2. The base stations 202-1 and 202-2 are generally referred to herein collectively as base stations 202 and individually as base station 202. Likewise, the macro cells 204-1 and 204-2 are generally referred to herein collectively as macro cells 204 and individually as macro cell 204. The cellular communications network 200 may also include a number of low power nodes 206-1 through 206-4 controlling corresponding small cells 208-1 through 208-4. The low power nodes 206-1 through 206-4 can be small base stations (such as pico or femto base stations) or Remote Radio Heads (RRHs), or the like. Notably, while not illustrated, one or more of the small cells 208-1 through 208-4 may alternatively be provided by the base stations 202. The low power nodes 206-1 through 206-4 are generally referred to herein collectively as low power nodes 206 and individually as low power node 206. Likewise, the small cells 208-1 through 208-4 are generally referred to herein collectively as small cells 208 and individually as small cell 208. The cellular communications system 200 also includes a core network 210, where the base stations 202 (and optionally the low power nodes 206) are connected to the core network 210.

[0039] The base stations 202 and the low power nodes 206 provide service to wireless devices 212-1 through 212-5 in the corresponding cells 204 and 208. The wireless devices 212-1 through 212-5 are generally referred to herein collectively as wireless devices 212 and individually as wireless device 212. The wireless devices 212 are also sometimes referred to herein as UEs.

[0040] In some embodiments, MC clients (e.g., MCPTT clients such as that illustrated in Figure 1 and described above) are implemented at (e.g., executing on) at least some of the wireless devices 212. Further, the MC system (e.g., MC server such as the MCPTT server described above, e.g., with respect to Figure 1, e.g. an IOPS MCPTT server) may be implemented in or an association with the cellular communications system 200 in any suitable manner. For example, in one embodiment, the MC system (e.g., the MC server) is implemented as a system or server that is connected to the core network 210 of the cellular communications system 200. As another example, the MC system (e.g., the MC server) is implemented as a system or server that is implemented at, connected to, or otherwise associated with a core network node or one or more of the base stations (e.g., one or more of the base stations 202). As a particular example, the MC system may be implemented at, connected to, or otherwise associated with a base station (e.g., a base station 202) to provide

MC GC in an IOPS-based architecture (e.g. an IOPS MC system) when the base station has lost connectivity to the core network 210.

Figure 3

[0041] **Figure 3** is a schematic block diagram of a IOPS MC system implementing a MC server 300 (e.g., a MCPTT server, e.g. an IOPS MCPTT server) including the presence service function entity according to some embodiments of the present disclosure. In other words, the presence service function is implemented together with the MCPTT server. The system 300 may be, for example, a system that is connected to the core network 210 of the cellular communications system 200 or a system that is connected to a base station 202 (e.g., for an IOPS-based architecture). As another example, the system 300 may be implemented at a network node (e.g., a core network node or base station 202) of the cellular communications system or distributed across two or more network nodes of the cellular communications system 200.

[0042] As illustrated, the system 300 includes one or more processors 304 (e.g., Central Processing Units (CPUs), Application Specific Integrated Circuits (ASICs), Field Programmable Gate Arrays (FPGAs), and/or the like), memory 306, and a network interface 308. The one or more processors 304 are also referred to herein as processing circuitry. The one or more processors 304 operate to provide one or more functions of the MC server (e.g., the MCPTT server) including the presence service function, as described herein. In some embodiments, the function(s) are implemented in software that is stored, e.g., in the memory 306 and executed by the one or more processors 304.

Figure 4

[0043] **Figure 4** is a schematic block diagram that illustrates a virtualized embodiment of the IOPS MC system 300 according to some embodiments of the present disclosure. As used herein, a "virtualized" system is an implementation of the IOPS MC system 300 in which at least a portion of the functionality of the MC server including the presence service function entity is implemented as a virtual component(s) (e.g., via a virtual machine(s) executing on a physical processing node(s) in a network(s)). As illustrated, in this example, the system 300 includes one or more processing nodes 400 coupled to or included as part of a network(s) 402 via the network interface 308. Each processing node 400 includes one or more processors 404 (e.g., CPUs, ASICs, FPGAs, and/or the like), memory 406, and a network interface 408.

[0044] In this example, functions 410 of the MC server including the presence service function described herein are implemented at the one or more processing nodes 400 in any desired manner. In some particular embodiments, some or all of the functions 410 of the MC server including the presence service function

described herein are implemented as virtual components executed by one or more virtual machines implemented in a virtual environment(s) hosted by the processing node(s) 400.

[0045] In some embodiments, a computer program including instructions which, when executed by at least one processor, causes the at least one processor to carry out the functionality of the system 300 (e.g., functions of the MC server including the presence service function entity) or a node (e.g., a processing node 400) implementing one or more of the functions 410 of the MC server including the presence service function in a virtual environment according to any of the embodiments described herein is provided. In some embodiments, a carrier comprising the aforementioned computer program product is provided. The carrier is one of an electronic signal, an optical signal, a radio signal, or a computer readable storage medium (e.g., a non-transitory computer readable medium such as memory).

Figure 5

[0046] **Figure 5** is a schematic block diagram of the IOPS MC system 300 according to some other embodiments of the present disclosure. The IOPS MC system 300 includes one or more modules 500, each of which is implemented in software. The module(s) 500 provide the functionality of the MC server including the presence service function entity described herein. This discussion is equally applicable to the processing node 400 of Figure 4 where the modules 500 may be implemented at one of the processing nodes 400 or distributed across multiple processing nodes 400.

Figure 6

[0047] **Figure 6** is a schematic block diagram of a UE 600 according to some embodiments of the present disclosure. As illustrated, the UE 600 includes one or more processors 602 (e.g., CPUs, ASICs, FPGAs, and/or the like), memory 604, and one or more transceivers 606 each including one or more transmitters 608 and one or more receivers 610 coupled to one or more antennas 612. The transceiver(s) 606 includes radio-front end circuitry connected to the antenna(s) 612 that is configured to condition signals communicated between the antenna(s) 612 and the processor(s) 602, as will be appreciated by on of ordinary skill in the art. The processors 602 are also referred to herein as processing circuitry. The transceivers 606 are also referred to herein as radio circuitry. In some embodiments, the functionality of the UE 600 described above (e.g., the functionality of the MC client, e.g., the MCPTT client described above) may be fully or partially implemented in software that is, e.g., stored in the memory 604 and executed by the processor(s) 602. Note that the UE 600 may include additional components not illustrated in Figure 6 such as, e.g., one or more user interface components (e.g., an input/output interface including a display, buttons, a touch screen, a microphone, a speaker(s), and/or the like and/or any other components for allowing input of information into the UE 600 and/or

allowing output of information from the UE 600), a power supply (e.g., a battery and associated power circuitry), etc.

[0048] In some embodiments, a computer program including instructions which, when executed by at least one processor, causes the at least one processor to carry out the functionality of the UE 600 (e.g., the functionality of the MC client, e.g., the MCPTT client described above) according to any of the embodiments described herein is provided. In some embodiments, a carrier comprising the aforementioned computer program product is provided. The carrier is one of an electronic signal, an optical signal, a radio signal, or a computer readable storage medium (e.g., a non-transitory computer readable medium such as memory).

Figure 7

[0049] **Figure 7** is a schematic block diagram of the UE 600 according to some other embodiments of the present disclosure. The UE 600 includes one or more modules 700, each of which is implemented in software. The module(s) 700 provide the functionality of the UE 600 described herein (e.g., the functionality of the MC client, e.g., the MCPTT client described above).

[0050] Any appropriate steps, methods, features, functions, or benefits disclosed herein may be performed through one or more functional units or modules of one or more virtual apparatuses. Each virtual apparatus may comprise a number of these functional units. These functional units may be implemented via processing circuitry, which may include one or more microprocessor or microcontrollers, as well as other digital hardware, which may include Digital Signal Processor (DSPs), special-purpose digital logic, and the like. The processing circuitry may be configured to execute program code stored in memory, which may include one or several types of memory such as Read Only Memory (ROM), Random Access Memory (RAM), cache memory, flash memory devices, optical storage devices, etc. Program code stored in memory includes program instructions for executing one or more telecommunications and/or data communications protocols as well as instructions for carrying out one or more of the techniques described herein. In some implementations, the processing circuitry may be used to cause the respective functional unit to perform corresponding functions according one or more embodiments of the present disclosure.

[0051] While processes in the figures may show a particular order of operations performed by certain embodiments of the present disclosure, it should be understood that such order is exemplary (e.g., alternative embodiments may perform the operations in a different order, combine certain operations, overlap certain operations, etc.).

Some embodiments described above may be summarized in the following manner:

1. A method performed by a communication service client implemented at a wireless device in a cellular communications system, the communication service client being associated with a first user in a particular communication service group, the method comprising:

receiving (Fig. 1, step 1-5), from a communication service server via a radio access node of the cellular communications system, a message comprising an indication of a presence status of a second user, the second user being in the particular communication service group or in a different communication service group.

2. The method of embodiment 1 wherein the communication service is a mission-critical communication service.

3. The method of embodiment 1 wherein the communication service is a mission-critical group communication service.

4. The method of embodiment 1 wherein the communication service is a mission-critical service (e.g., mission critical push-to-talk service, mission-critical video service, or mission-critical data service).

5. The method of any one of embodiments 1 to 4 further comprising notifying (Fig. 1, step 1-6) the first user of the presence status of the second user.

6. The method of any one of embodiments 1 to 5 further comprising receiving (Fig. 1, step1-9) a message comprising an indication of a new presence status of the second user.

7. The method of embodiment 6 further comprising notifying (Fig. 1, step 1-10) the first user of the presence status of the second user.

8. The method of any one of embodiments 1 to 7 wherein user profile configuration data associated with the second user comprises information that indicates that the presence status of the second user is permitted to be made available to other users and/or information that indicates one or more other users to which the presence status of the second user is permitted to be made available.

9. The method of any one of embodiments 1 to 8 further comprising, prior to receiving the message comprising the indication of the presence status of a second user, sending (Fig. 1, step 1-3), to the communication service server via a radio access node of the cellular communications system, a message that subscribes the first user to presence notifications for the second user.

10. The method of any one of embodiments 1 to 8 further comprising, prior to receiving the message comprising the indication of the presence status of a second user, sending, to the communication service server via a radio access node of the cellular communications system, a request for the presence status of the second user.

11. A wireless device for a cellular communications system, the wireless device adapted to perform the method of any one of embodiments 1 to 10.

12. A wireless device for a cellular communications system, the wireless device comprising:

one or more transmitters;

one or more receivers; and

processing circuitry associated with the one or more transmitters and the one or more receivers, the processing circuitry configured to cause the wireless device to perform the method of any one of embodiments 1 to 10.

13. A method performed by a communication service server implemented in association with a cellular communications system, the method comprising:

sending (Fig. 1, step 1-9), to a wireless device associated with a first user via a radio access node of the cellular communications system, a message comprising an indication of the presence status of a second user, the second user being in a same communication service group as the first user or in a different communication service group than that of the first user.

14. The method of embodiment 13 wherein the communication service is a mission-critical communication service.

15. The method of embodiment 13 wherein the communication service is a mission-critical group communication service.

16. The method of embodiment 13 wherein the communication service is a mission-critical service (e.g., mission critical push-to-talk service, mission-critical video service, or mission-critical data service).

17. The method of any one of embodiments 13 to 16 further comprising obtaining (Fig. 1, step 1-8) the presence status of the second user.

18. The method of any one of embodiments 13 to 17 further comprising sending (Fig. 1, step 1-13), to the wireless device associated with the first user via a radio access node of the cellular communications system, a message comprising an indication of a new presence status of the second user.

19. The method of embodiment 18 further comprising obtaining (Fig. 1, step 1-12) the new presence status of the second user.

20. The method of any one of embodiments 13 to 19 wherein user profile configuration data associated with the second user comprises information that indicates that the presence status of the second user is permitted to be made available to other users and/or information that indicates one or more other users to which the presence status of the second user is permitted to be made available.

21. The method of embodiment 20 further comprising, prior to sending (Fig. 1, step 1-9) the message comprising the indication of the presence status of the second user to the wireless device, determining that the first user is permitted to receive presence status notifications for the second user.

22. The method of embodiment 21 wherein sending (Fig. 1, step 1-9) the message comprising the indication of the presence status of the second user to the wireless device comprises sending (Fig. 1, step 1-9) the message comprising the indication of the presence status of the second user to the wireless device if the first user is permitted to receive presence status notifications for the second user.

23. The method of any one of embodiments 13 to 22 further comprising, prior to sending the message comprising the indication of the presence status of the second user, receiving (Fig. 1, step 1-3), from the wireless device associated with the first user via a radio access node of the cellular communications system, a message that subscribes the first user to presence notifications for the second user.

24. The method of any one of embodiments 13 to 22 further comprising, prior to sending the message comprising the indication of the presence status of the second user, receiving (Fig. 1, step 1-3), from the wireless device associated with the first user via a radio access node of the cellular communications system, a request for the presence status of the second user.

25. A system for implementing a communication service server in association with a cellular communications system, the system adapted to perform the method of any one of embodiments 13 to 24.

26. A system implementing a communication service server in association with a cellular communications system, the system comprising:

a network interface; and

processing circuitry associated with the network interface, the processing circuitry configured to cause the system to perform the method of any one of embodiments 13 to 24.

Some further embodiments described above may be summarized in the following manner:

1. A method performed by a first wireless device (212, UE1) for an IOPS system (e.g. an IOPS MC system), which first wireless device is associated with a particular Mission Critical, MC, group communication service group, the method comprising:

sending (Fig, 1 step 1-3), towards a MC presence service function (120), a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device (212, UE2) that is associated with the particular MC group communication service group or a different MC group communication service group; and as a result of sending the subscribe request message,

receiving (Fig. 1, step 1-5), a notify message sent by the MC presence server function and comprising an indication of a presence status of the second wireless device (212, UE2).

2. The method of embodiment 1 further comprising receiving (Fig. 1, step 1-9) a second notify message comprising an indication of a new presence status of the second MCPTT client.

3. The method of any one of embodiment 1-2 wherein the subscribe request message comprises information that identifies the second wireless device.

4. The method of any one of embodiment 1-3 wherein the MC presence service function is implemented in an Isolated E-UTRAN Operation for Public Safety, IOPS, system.

5. A wireless device for a cellular communications system, the wireless device adapted to perform the method of any one of embodiments 1 to 4.

6. A first wireless device (212, UE1) for an IOPS system (e.g. an IOPS MC system), which first wireless device is associated with a particular Mission Critical, MC, group communication service group and comprises:

one or more transmitters;

one or more receivers; and

processing circuitry associated with the one or more transmitters and the one or more receivers, the processing circuitry configured to cause the first wireless device to:

send (Fig, 1 step 1-3), towards a MC presence service function (120), a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device

(212, UE2) that is associated with the particular MC group communication service group or a different MC group communication service group; and as a result of sending the subscribe request message,

receive (Fig. 1, step 1-5), a notify message sent by the MC presence server function and comprising an indication of a presence status of the second wireless device (212, UE2).

7. A method performed by a Mission Critical, MC, presence service function (20), the method comprising:

receiving (Fig, 1 step 1 3), from a first wireless device (212, UE1) that is associated with a particular Mission Critical, MC, group communication service group, a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device (212, UE2) that is associated with the particular MC group communication service group or a different MC group communication service group; and in response to receiving the subscribe request message,

sending (Fig. 1, step 1-5) towards the first wireless device, a notify message comprising an indication of a presence status of the second wireless device (212, UE2).

8. The method of embodiment 7 further comprising obtaining (Fig. 1, step 1-8, step 1-12) a presence status of the second wireless device.

9. The method of any one of embodiment 7-8 further comprising sending (Fig. 1, step 1-9, step 1-13), to the wireless device a message comprising an indication of a new presence status of the second user.

10. The method of any one of embodiment 7-9 wherein user profile configuration data associated with the second wireless device comprises information that indicates that the presence status of the second wireless device is permitted to be made available to other wireless devices and/or information that indicates one or more other wireless devices to which the presence status of the second wireless device is permitted to be made available.

11. The method of embodiment 10 further comprising, prior to sending (Fig. 1, step 1-9) the message comprising the indication of the presence status of the second wireless device, determining that the first wireless device is permitted to receive presence status notifications for the second wireless device.

12. The method of embodiment 11 wherein sending (Fig. 1, step 1-9) the message comprising the indication of the presence status of the second wireless device comprises sending (Fig. 1, step 1-9) the

message comprising the indication of the presence status of the second wireless device if the first wireless device is permitted to receive presence status notifications for the second wireless device.

13. The method of any one of embodiment 7-12 wherein the MC presence service function is implemented in an Isolated E-UTRAN Operation for Public Safety, IOPS, system (e.g. an IOPS MC system).

14. A Mission Critical, MC, presence service function (20), comprising processing circuitry configured to cause the MC presence service function to:

receive (Fig, 1 step 1 3), from a first wireless device (212, UE1) that is associated with a particular Mission Critical, MC, group communication service group, a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device (212, UE2) that is associated with the particular MC group communication service group or a different MC group communication service group; and in response to receiving the subscribe request message,

send (Fig. 1, step 1-5) towards the first wireless device, a notify message comprising an indication of a presence status of the second wireless device (212, UE2).

Abbreviations

At least some of the following abbreviations may be used in this disclosure. If there is an inconsistency between abbreviations, preference should be given to how it is used above. If listed multiple times below, the first listing should be preferred over any subsequent listing(s).

- 4G Fourth Generation
- 5G Fifth Generation
- AF Application Function
- AMF Access and Mobility Management Function
- AN Access Network
- DN Data Network
- E-UTRA Evolved Universal Terrestrial Radio Access
- E-UTRAN Evolved Universal Terrestrial Radio Access Network
- gNB New Radio Base Station
- IOPS Isolated E-UTRAN Operation for Public Safety
- IP Internet Protocol
- MBMS Multimedia Broadcast Multicast Services
- MBSFN Multimedia Broadcast Multicast Service Single Frequency Network
- MIB Master Information Block
- NEF Network Exposure Function
- NF Network Function
- NR New Radio
- NRF Network Repository Function
- NSSF Network Slice Selection Function
- PCF Policy Control Function
- PLMN Public Land Mobile Network
- PRB Physical Resource Block
- RAN Radio Access Network
- SI System Information
- SIB System Information Block
- SMF Session Management Function
- UDM Unified Data Management
- WD Wireless Device

CLAIMS

1. A method performed by a first wireless device (212, UE1) for an Isolated E-UTRAN Operation for Public Safety, IOPS, system, which first wireless device is associated with a particular Mission Critical, MC, group communication service group, the method comprising:

sending (1-3), towards a MC presence service function (120), a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device (212, UE2) that is associated with the particular MC group communication service group or a different MC group communication service group; and

receiving (1-5), a notify message sent by the MC presence server function and comprising an indication of a presence status of the second wireless device (212, UE2).

2. The method of claim 1 further comprising receiving (1-9) a second notify message comprising an indication of a new presence status of the second MCPTT client.

3. The method of any one of claim 1-2 wherein the subscribe request message comprises information that identifies the second wireless device.

4. The method of any one of claim 1-3 wherein the MC presence service function is implemented in the IOPS system.

5. A wireless device for a cellular communications system, the wireless device adapted to perform the method of any one of claim 1-4.

6. A first wireless device (212, UE1) for an Isolated E-UTRAN Operation for Public Safety, IOPS, system, which first wireless device is associated with a particular Mission Critical, MC, group communication service group and comprises:

one or more transmitters;

one or more receivers; and

processing circuitry associated with the one or more transmitters and the one or more receivers, the processing circuitry configured to cause the first wireless device to:

send (1-3), towards a MC presence service function (120), a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device (212, UE2) that is associated with the particular MC group communication service group or a different MC group communication service group; and

receive (1-5), a notify message sent by the MC presence server function and comprising an indication of a presence status of the second wireless device (212, UE2).

7. A method performed by a Mission Critical, MC, presence service function (20), the method comprising:

receiving (1-3), from a first wireless device (212, UE1) that is associated with a particular Mission Critical, MC, group communication service group, a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device (212, UE2) that is associated with the particular MC group communication service group or a different MC group communication service group; and

sending (1-5) towards the first wireless device, a notify message comprising an indication of a presence status of the second wireless device (212, UE2).

8. The method of claim 7 further comprising obtaining (1-8, 1-12) a presence status of the second wireless device.

9. The method of any one of claim 7-8 further comprising sending (1-9, 1-13), to the wireless device a message comprising an indication of a new presence status of the second user.

10. The method of any one of claim 7-9 wherein user profile configuration data associated with the second wireless device comprises information that indicates that the presence status of the second wireless device is permitted to be made available to other wireless devices and/or information that indicates one or more other wireless devices to which the presence status of the second wireless device is permitted to be made available.

11. The method of claim 10 further comprising, prior to sending (1-9) the message comprising the indication of the presence status of the second wireless device, determining that the first wireless device is permitted to receive presence status notifications for the second wireless device.

12. The method of claim 11 wherein sending (1-9) the message comprising the indication of the presence status of the second wireless device comprises sending (1-9) the message comprising the indication of the presence status of the second wireless device if the first wireless device is permitted to receive presence status notifications for the second wireless device.

13. The method of any one of claim 7-12 wherein the MC presence service function is implemented in an Isolated E-UTRAN Operation for Public Safety, IOPS, system.

14. A Mission Critical, MC, presence service function (20) comprising processing circuitry configured to cause the MC presence service function to:

receive (1-3), from a first wireless device (212, UE1) that is associated with a particular Mission Critical, MC, group communication service group, a subscribe request message that subscribes the first wireless device to receive presence status notifications for a second wireless device (212, UE2) that is associated with the particular MC group communication service group or a different MC group communication service group; and

send (1-5) towards the first wireless device, a notify message comprising an indication of a presence status of the second wireless device (212, UE2).

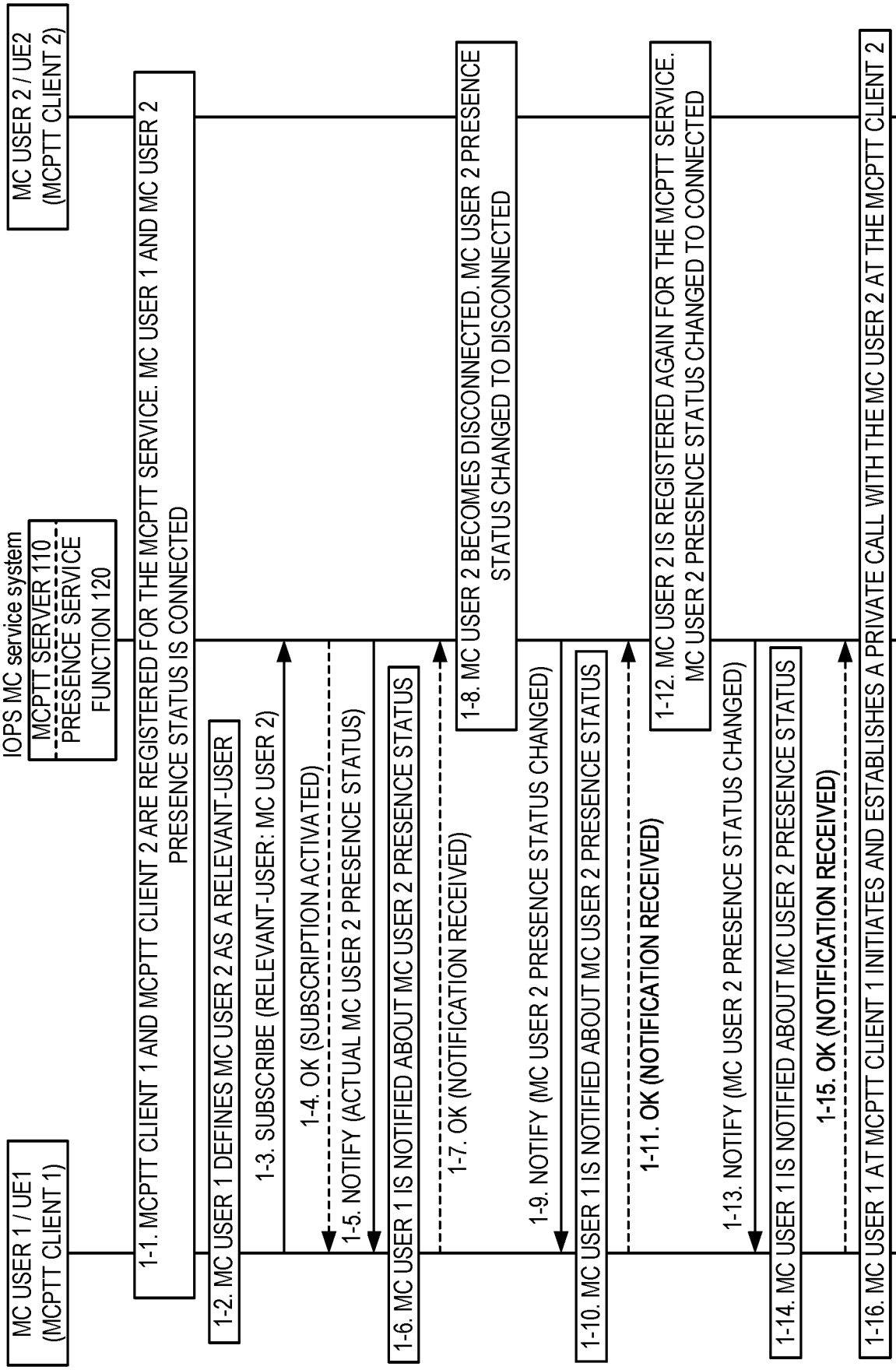

MC USER 1 / UE1 (MCPTT CLIENT 1)
IOPS MC service system
MCPTT SERVER 110
PRESENCE SERVICE FUNCTION 120
MC USER 2 / UE2 (MCPTT CLIENT 2)
1-1. MCPTT CLIENT 1 AND MCPTT CLIENT 2 ARE REGISTERED FOR THE MCPTT SERVICE. MC USER 1 AND MC USER 2 PRESENCE STATUS IS CONNECTED
1-2. MC USER 1 DEFINES MC USER 2 AS A RELEVANT-USER
1-3. SUBSCRIBE (RELEVANT-USER: MC USER 2)
1-4. OK (SUBSCRIPTION ACTIVATED)
1-5. NOTIFY (ACTUAL MC USER 2 PRESENCE STATUS)
1-6. MC USER 1 IS NOTIFIED ABOUT MC USER 2 PRESENCE STATUS
1-7. OK (NOTIFICATION RECEIVED)
1-8. MC USER 2 BECOMES DISCONNECTED. MC USER 2 PRESENCE STATUS CHANGED TO DISCONNECTED
1-9. NOTIFY (MC USER 2 PRESENCE STATUS CHANGED)
1-10. MC USER 1 IS NOTIFIED ABOUT MC USER 2 PRESENCE STATUS
1-11. OK (NOTIFICATION RECEIVED)
1-12. MC USER 2 IS REGISTERED AGAIN FOR THE MCPTT SERVICE. MC USER 2 PRESENCE STATUS CHANGED TO CONNECTED
1-13. NOTIFY (MC USER 2 PRESENCE STATUS CHANGED)
1-14. MC USER 1 IS NOTIFIED ABOUT MC USER 2 PRESENCE STATUS
1-15. OK (NOTIFICATION RECEIVED)
1-16. MC USER 1 AT MCPTT CLIENT 1 INITIATES AND ESTABLISHES A PRIVATE CALL WITH THE MC USER 2 AT THE MCPTT CLIENT 2

FIG. 1

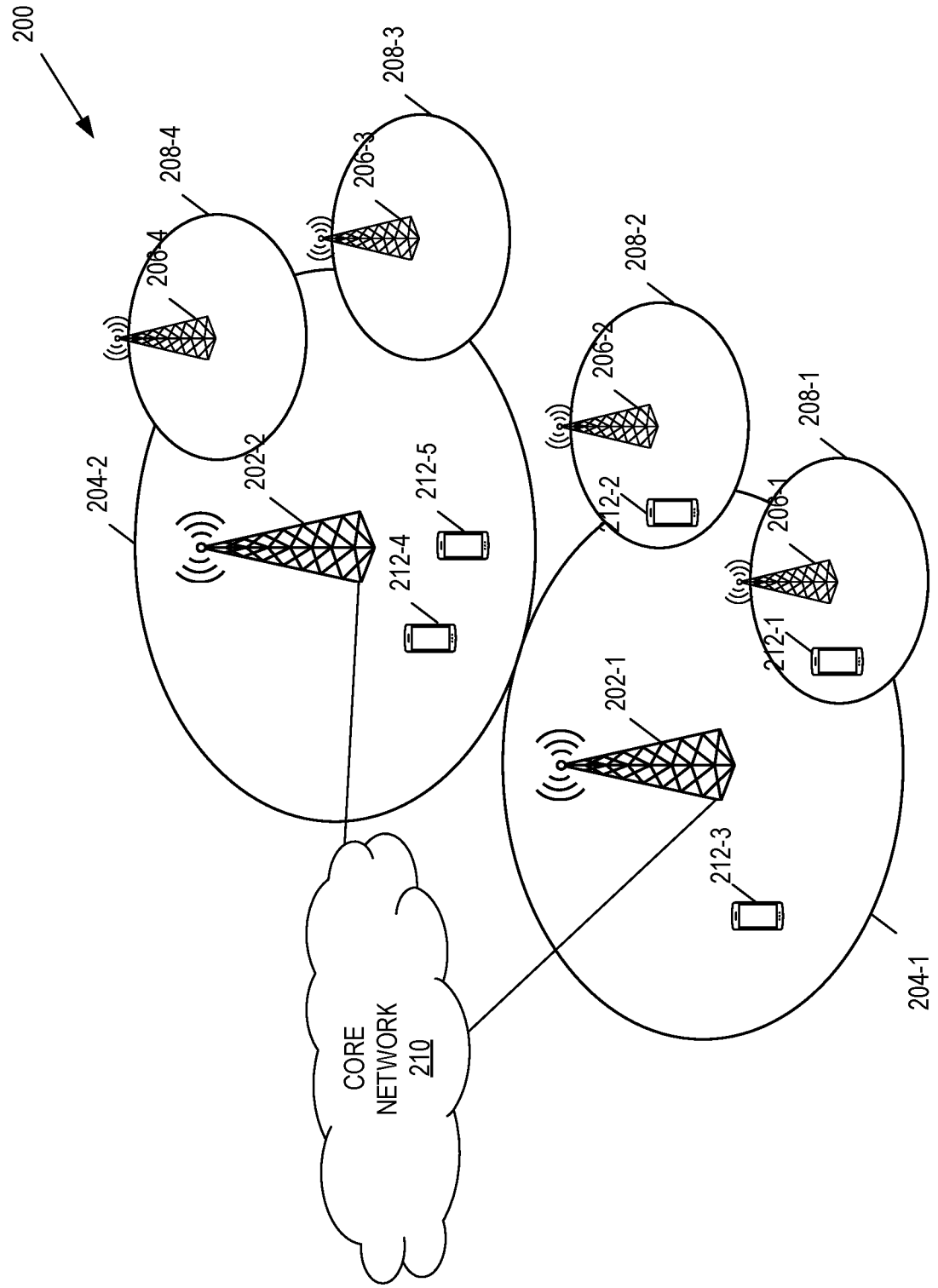

200
208-3
208-4
206-3
206-4
208-2
206-2
208-1
204-2
202-2
212-5
212-2
206-1
212-4
212-1
202-1
212-3
CORE NETWORK 210
204-1

FIG. 2

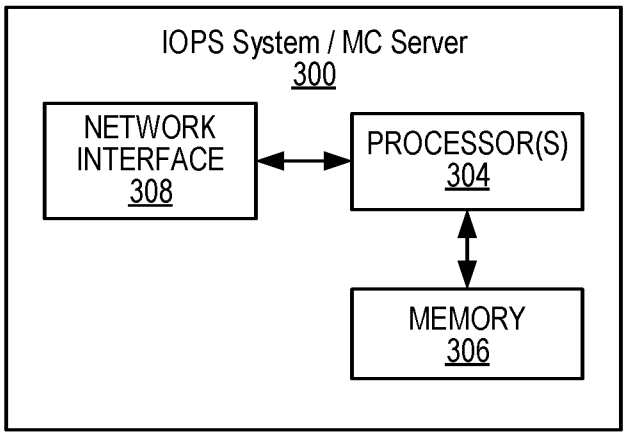

IOPS System / MC Server
300
NETWORK
INTERFACE
308
PROCESSOR(S)
304
MEMORY
306

FIG. 3

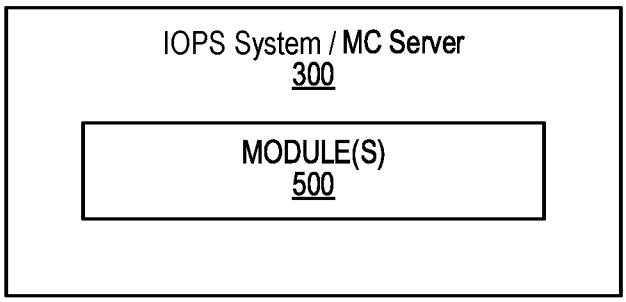
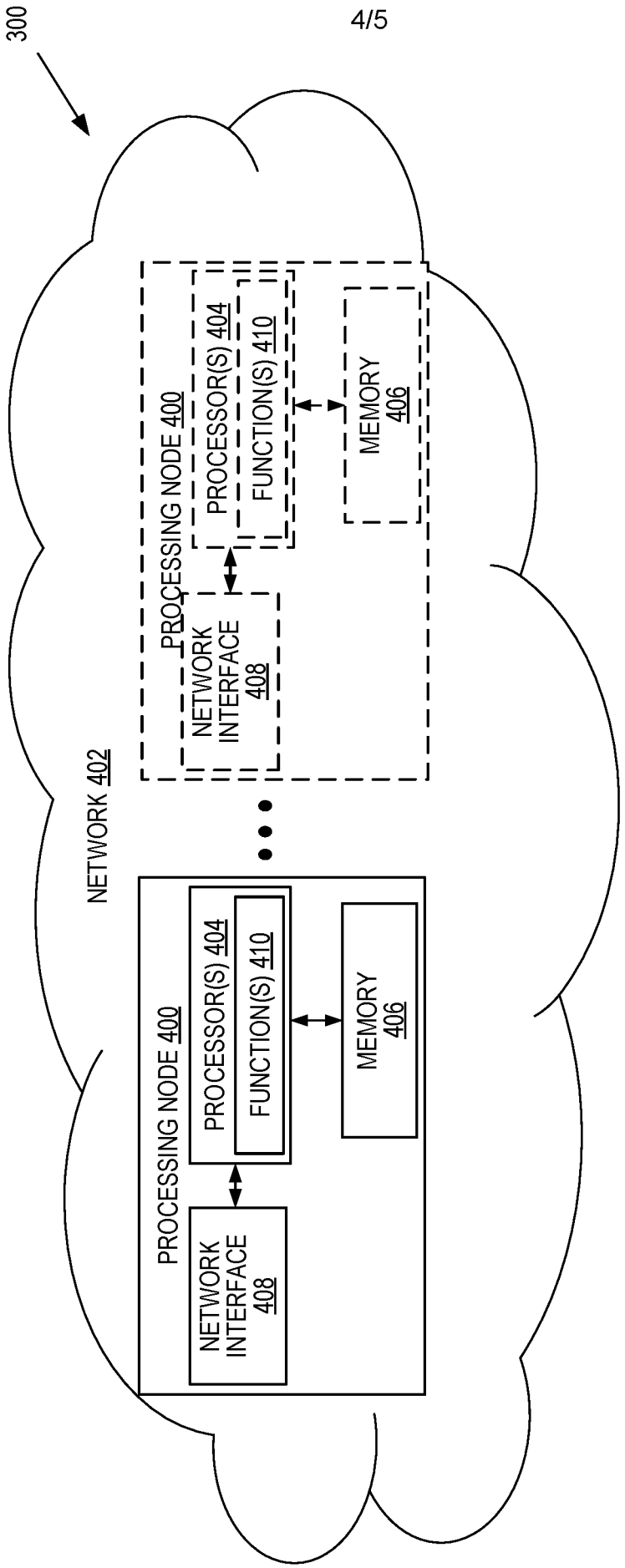

IOPS System / MC Server
300
MODULE(S)
500

FIG. 5


300
NETWORK 402
PROCESSING NODE 400
NETWORK INTERFACE 408
PROCESSOR(S) 404
FUNCTION(S) 410
MEMORY 406
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NETWORK INTERFACE 408
PROCESSOR(S) 404
FUNCTION(S) 410
MEMORY 406

FIG. 4

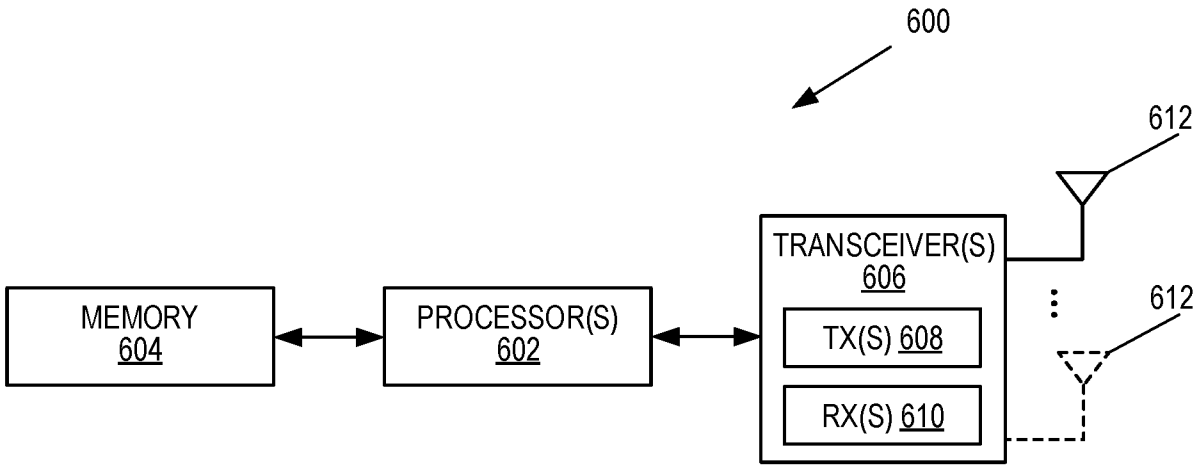
600
612
TRANSCEIVER(S)
606
612
MEMORY
604
PROCESSOR(S)
602
TX(S) 608
RX(S) 610

FIG. 6

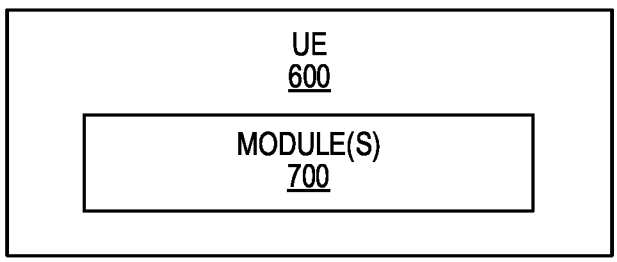
UE
600
MODULE(S)
700

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/059185

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W76/50 H04W76/45
ADD. H04W4/90 H04L29/06 H04W4/08

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

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	ERICSSON: "Presence service support for MC services", 3GPP DRAFT; S6-190581 DISCUSSION ON PRESENCE SERVICE SUPPORT FOR MC SERVICES, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS C , vol. SA WG6, no. Newport Beach, CA, USA; 20190408 - 20190412 1 April 2019 (2019-04-01), XP051722437, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg%5Fsa/WG6%5FMissionCritical/TSGS6%5F030%5FNewport%5FBeach/docs/S6%2D190581%2Ezip [retrieved on 2019-04-01] the whole document ----- -/--	1-14

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search	Date of mailing of the international search report
15 July 2020	24/07/2020

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Englund, Terese

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Mission Critical Services Common Requirements (MCCoRe); Stage 1 (Release 16)", 3GPP STANDARD; TECHNICAL SPECIFICATION; 3GPP TS 22.280, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. SA WG1, no. V16.5.0, 29 March 2019 (2019-03-29), pages 1-97, XP051723198, [retrieved on 2019-03-29] sections 1, 5.9, 6.2.1, 6.4.2, 6.6.4.2, 6.7.2-6.7.4, 6.14 and 10	1-14
X	ERICSSON: "Pseudo-CR on IOPS discovery procedure for Solution 4", 3GPP DRAFT; S6-190507 WAS S6-190445 WAS S6-190339 PCR IOPS DISCOVERY PROCEDURE, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS , vol. SA WG6, no. Montréal, Canada; 20190225 - 20190301 4 March 2019 (2019-03-04), XP051698323, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg%5Fsa/WG6%5FMissionCritical/TSGS6%5F029%5FMontreal/docs/S6%2D190507%2Ezip [retrieved on 2019-03-04] sections 1-3 and 6.4.1	1-14
X	"13rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Study on MC services access aspects (Release 16)", 3GPP STANDARD; 3GPP TR 23.778, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. V1.2.0, 6 March 2019 (2019-03-06), pages 1-25, XP051722726, [retrieved on 2019-03-06] sections 6.4-6.4.1	1-14
X	US 9 510 166 B1 (ALLEN ANDREW MICHAEL [US] ET AL) 29 November 2016 (2016-11-29) section Background column 3, lines 21-39 column 14, line 56 - column 16, line 3; claim 7	1-14

-/--

1

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Common functional architecture to support mission critical services; Stage 2 (Release 16)", 3GPP STANDARD; TECHNICAL SPECIFICATION; 3GPP TS 23.280, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. SA WG6, no. V16.2.0, 26 March 2019 (2019-03-26), pages 1-210, XP051722884, [retrieved on 2019-03-26] cited in the application the whole document -----	1-14
A	"3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Mission Critical Push To Talk (MCPTT) call control; Protocol specification (Release 16)", 3GPP STANDARD; TECHNICAL SPECIFICATION; 3GPP TS 24.379, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. CT WG1, no. V16.0.0, 27 March 2019 (2019-03-27), pages 1-578, XP051722923, [retrieved on 2019-03-27] cited in the application sections 6.3.1.4, 6.3.3.1.11, 9.2.1.1-9.2.2.2.11, 9.2.2.3.4-9.2.2.3.5, 11 and 11.1.3.1.1 -----	1-14
A	US 2018/359612 A1 (BUCKLEY ADRIAN [US] ET AL) 13 December 2018 (2018-12-13) paragraphs [0112], [0121] - [0124], [0127] - [0130], [0132] -----	1-14

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2020/059185

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 9510166 B1	29-11-2016	BR 112017028484 A2	28-08-2018
		CN 107950010 A	20-04-2018
		EP 3314848 A1	02-05-2018
		HK 1252011 A1	10-05-2019
		KR 20180022918 A	06-03-2018
		US 9510166 B1	29-11-2016
		US 2017070868 A1	09-03-2017
		WO 2017004060 A1	05-01-2017
US 2018359612 A1	13-12-2018	CA 3061649 A1	13-12-2018
		CN 110709815 A	17-01-2020
		EP 3635539 A1	15-04-2020
		US 2018359612 A1	13-12-2018
		US 2020045508 A1	06-02-2020
		WO 2018226333 A1	13-12-2018