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(54) **Title:** NID FOR MB SESSION ID FOR 5MBS

FIG. 7

(57) **Abstract:** Embodiments of a method performed by a network node of a cellular communications system are disclosed. In one embodiment, a method performed by a network node of a cellular communications system comprises obtaining a network identifier (NID) associated to a standalone non-public network (SNPN) and utilizing the NID together with one or more identifiers (e.g., Multicast/Broadcast Service (MBS) session ID) to uniquely identify an MBS session associated to the SNPN. In this manner, the MBS session can be uniquely identified even in the case of a multiple SNPNs sharing a Multi-Operator Core Network (MOCN).

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NID FOR MB SESSION ID FOR 5MBS

Technical Field

The present disclosure relates to Multicast/Broadcast Service (MBS) in a cellular communications system.

Background

Multicast Broadcast Service (MBS) in Evolved Packet System (EPS) and in Fifth Generation System (5GS)

Third Generation Partnership Project (3GPP) previously developed the Multicast/Broadcast Multimedia Subsystem (MBMS) (see 3GPP TS 23.246 v16.1.0) for Third Generation (3G) and Fourth Generation (4G) networks for video multicast/broadcasting and streaming services and later introduced the evolved MBMS (eMBMS) for the Evolved Packet System (EPS). In Release 13 and Release 14, the MBMS system has been updated to support new services such as Public Safety, Cellular Internet of Things (CIoT), and Vehicle to everything (V2X).

In Release 17, Multicast / Broadcast services (MBSs) are studied in different 3GPP work groups (study still ongoing), and the study results from 3GPP SA2 are documented in 3GPP Technical Report (TR) 23.757 V1.2.0.

Multicast communication and Broadcast communication in 5GS

TR 23.757 defines the following:

Broadcast communication service: A communication service in which the same service and the same specific content data are provided simultaneously to all UEs in a geographical area (i.e., all UEs in the broadcast coverage area are authorized to receive the data).

Multicast communication service: A communication service in which the same service and the same specific content data are provided simultaneously to a dedicated set of UEs (i.e., not all UEs in the multicast coverage are authorized to receive the data).

MBS Session ID for broadcast communication and multicast communication in 5GS

MBS session ID is used to identify an MBS Session in 5GS. In TR 23.757 V.1.2.0, it states:

********** START EXCERPT FROM 3GPP TR 23.757 **********

- *For MBS session management the following conclusions are reached as baseline for normative work:*
  - *The MBS session is identified throughout the 5G system transport on external interface towards AF and between AF and UE, and towards the UE with an MBS Session ID.*
- *MBS Session ID may have the following types:* ***TMGI (****MBS* ***broadcast and multicast Session****), source specific IP multicast address (MBS multicast Session).*
- *For MBS multicast Session, source specific IP multicast address can be assigned by 5GC or external network.*

- *TMGI definition is updated for 5G MBS to be able to identify the MBS session when used for the Multicast Session Context and to identify the MBS service when used for the Multicast service context. (see Figure 8.2.2.2-1).*

Editor's note: How TMGI can identify MBS sessions/services in an SNPN and how to signal this efficiently need coordination with FS_eNPN.

- *The UE shall be able to obtain at least one MBS Session ID via MBS service announcement.*

********** END EXCERPT FROM 3GPP TR 23.757 **********

Figure 1

TMGI (Temporary Mobile Group Identity)

As specified in 3GPP Technical Specification (TS) 23.003, TMGI consists of MBMS Service ID and Public Land Mobile Network (PLMN) identity (ID) (PLMN ID) (=Mobile Country Code (MCC) and Mobile Network Code (MNC)) as shown in **Figure 1**.

TMGI is unique within a public network which is represented by PLMN ID.

SNPN (Standalone Non-Public Network)

Per 3GPP TS 23.501, SNPN is identified by combination of PLMN ID and NID, see excerpt below from v16.6.0:

********** START EXCERPT FROM 3GPP TS 23.501 **********

5.30.2 Stand-alone non-public networks

...

5.30.2.1 Identifiers

The combination of a PLMN ID and Network identifier (NID) identifies an SNPN.

********** END EXCERPT FROM 3GPP TS 23.501 **********

Summary

For Standalone Non-Public Network (SNPN), the same Public Land Mobile Network (PLMN) identity (ID) may be shared by different SNPNs. As a result, with only PLMN ID included in the Multicast/Broadcast Service (MBS) Session ID, the uniqueness of Temporary Mobile Group Identity (TMGI) cannot be ensured. In the case of Multi-Operator Core Network (MOCN) deployment for SNPN where the radio access network (RAN) is shared by multiple SNPNs, the same TMGI may be used for different MBS sessions belonging to different SNPNs, which is problematic.

Embodiments are disclosed herein that introduce a Network Identifier (NID) to work together with MBS session ID, which consists of PLMN ID and Service ID, to uniquely identity an MBS session. This is particularly beneficial in the case of multiple SNPNs sharing a single MOCN.

Embodiments of a method performed by a network node of a cellular communications system are disclosed. In one embodiment, a method performed by a network node of a cellular communications system comprises obtaining

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a network identifier (NID) associated to a standalone non-public network (SNPN) and utilizing the NID together with one or more identifiers (e.g., MBS session ID) to uniquely identify an MBS session associated to the SNPN. In this manner, the MBS session can be uniquely identified even in the case of a multiple SNPNs sharing a MOCN.

In one embodiment, the one or more identifiers comprise a PLMN ID and a Multicast/Broadcast Multimedia Subsystem (MBMS) Service ID. In one embodiment, utilizing the NID together with the one or more identifiers comprises utilizing a MBS session ID that comprises the NID, the PLMN ID, and the MBMS Service ID.

In one embodiment, the one or more identifiers comprise MBS session ID that comprises a PLMN ID and a MBMS Service ID. In one embodiment, utilizing the NID together with the one or more identifiers comprises utilizing the NID together with the MBS session ID, where the NID and the MBS session ID are separate identifiers.

In one embodiment, the PLMN ID is associated to the SNPN. In one embodiment, the MBMS Service ID is associated to the MBS session.

In one embodiment, the network node is a network node that implements a network function (NF) in a core network of the cellular communications system. In one embodiment, utilizing the NID together with the one or more identifiers comprises sending a message to either another NF in the core network or to one or more network nodes in a RAN of the cellular communications system, the message comprising either: (a) the NID and the one or more identifiers (e.g., conventional MBS Session ID including PLMN ID and MBMS Service ID) or (b) a new MBS Session ID that comprises the NID and the one or more identifiers (e.g., PLMN ID and MBMS Service ID). In one embodiment, obtaining the NID comprises receiving the NID from an Application Function (AF) directly or indirectly via one or more other NFs in the core network. In one embodiment, obtaining the NID comprises allocating the NID.

In one embodiment, the NF is a Network Exposure Function (NEF). In one embodiment, obtaining the NID comprises receiving a request from an AF, wherein the request comprises the NID. In another embodiment, the method further comprises receiving a request from an AF, wherein obtaining the NID comprises obtaining the NID, wherein the NID is allocated by the NEF or another NF in the core network. In one embodiment, the request is a request to allocate an MBS Session ID for the MBS session. In one embodiment, utilizing the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending a response to the AF (312), the response comprising the NID and an MBS Session ID allocated for the MBS session. In another embodiment, the request is a request to allocate an MBS Session ID for the MBS session and to activate an MBS bearer for the MBS session.

In one embodiment, the NF is a Multicast/Broadcast Session Management Function (MB-SMF). In one embodiment, obtaining the NID comprises receiving a request from a Network Exposure Function (NEF) or an MBS control Function (MBSF), wherein the request comprises either: (a) the NID and an MBS Session ID of the MBS session or (b) a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session. In one embodiment, the request is an MBS session start request. In one embodiment, utilizing the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending one or more messages to one or more other NFs in the core network in association with staring the MBS session, the one or more messages comprising either: (a) the NID and the MBS Session ID of the MBS session or (b) the new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, the PLMN ID, and the MBMS Service ID that together uniquely identify the MBS session.

In one embodiment, the NF is an Access and Mobility Management Function (AMF). In one embodiment, obtaining the NID comprises receiving an MBS session start request from another NF function in the core network, wherein the MBS session start request comprises either: (a) the NID and an MBS Session ID of the MBS session or (b) a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session. In one embodiment, utilizing the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending a request to setup resources for the MBS session to one or more network nodes in the RAN of the cellular communications system, request comprising either: (a) the NID and the MBS Session ID of the MBS session or (b) the new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, the PLMN ID, and the MBMS Service ID that together uniquely identify the MBS session.

In one embodiment, the NF is a Session Management Function (SMF). In one embodiment, obtaining the NID comprises receiving an MBS session start request from another NF function in the core network, wherein the MBS session start request comprises either: (a) the NID and an MBS Session ID of the MBS session or (b) a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session. In one embodiment, utilizing the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending a request to setup resources for the MBS session towards one or more network nodes in the RAN of the cellular communications system, request comprising either: (a) the NID and the MBS Session ID of the MBS session or (b) the new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, the PLMN ID, and the MBMS Service ID that together uniquely identify the MBS session.

In one embodiment, the network node is a network node in a radio access network (RAN) of the cellular communications system. In one embodiment, obtaining the NID comprises receiving a request from a NF in the core network of the cellular communications system, the request being a request to setup resources for the MBS session, wherein the request comprises either: (a) the NID and an MBS Session ID of the MBS session or (b) a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session. In one embodiment, utilizing the NID together with the one or more identifiers to uniquely identify the MBS session comprises advertising the MBS session using either: (a) the NID and an MBS Session ID of the MBS session or (b) the new MBS Session ID of the MBS session. In one embodiment, utilizing the NID together with the one or more identifiers to uniquely identify the MBS session comprises broadcasting system information comprising either: (a) the NID and an MBS Session ID of the MBS session or (b) the new MBS Session ID of the MBS session. In one embodiment, utilizing the NID together with the one or more identifiers to uniquely identify the MBS session comprises performing point-to-point (PTP) or point-to-multipoint (PTM) establishment and delivery using either: (a) the NID and an MBS Session ID of the MBS session or (b) the new MBS Session ID of the MBS session.

Corresponding embodiment of a network node are also disclosed. In one embodiment, a network node for a cellular communications system is adapted to obtain a NID associated to a SNPN and utilize the NID together with one or more identifiers (e.g., MBS session ID) to uniquely identify an MBS session.

In one embodiment, a network node for a cellular communications system comprises processing circuitry configured to cause the network node to obtain a NID associated to a SNPN and utilize the NID together with one or more identifiers (e.g., MBS session ID) to uniquely identify an MBS session.

Brief Description of the Drawings

The accompanying drawing figures incorporated in and forming a part of this specification illustrate several aspects of the disclosure, and together with the description serve to explain the principles of the disclosure.

Figure 1 illustrates the structure of a Temporary Mobile Group Identity (TMGI) in a Third Generation Partnership Project (3GPP) system;

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

Figures 3 and **4** illustrate example embodiments in which the cellular communication system of Figure 2 is a Fifth Generation (5G) System (5GS);

Figure 5 illustrates an example procedure in which a Network Identifier (NID) is used together with one or more other identifiers to uniquely identify a Multicast/Broadcast Service (MBS) session in accordance with one embodiment of the present disclosure;

Figures 6A and **6B** illustrate an example procedure in which a NID is used together with one or more other identifiers to uniquely identify an MBS session in accordance with another embodiment of the present disclosure;

Figure 7 is a flow chart that illustrates the operation of a network node in accordance with one embodiment of the present disclosure;

Figure 8 is a schematic block diagram of a network node according to some embodiments of the present disclosure;

Figure 9 is a schematic block diagram that illustrates a virtualized embodiment of the network node of Figure 8 according to some embodiments of the present disclosure;

Figure 10 is a schematic block diagram of the network node of Figure 8 according to some other embodiments of the present disclosure;

Figure 11 is a schematic block diagram of a User Equipment device (UE) according to some embodiments of the present disclosure; and

Figure 12 is a schematic block diagram of the UE of Figure 11 according to some other embodiments of the present disclosure.

Detailed Description

The embodiments set forth below represent information to enable those skilled in the art to practice the embodiments and illustrate the best mode of practicing the embodiments. Upon reading the following description in light of the accompanying drawing figures, those skilled in the art will understand the concepts of the disclosure and

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will recognize applications of these concepts not particularly addressed herein. It should be understood that these concepts and applications fall within the scope of the disclosure.

Radio Node: As used herein, a "radio node" is either a radio access node or a wireless communication device.

Radio Access Node: As used herein, a "radio access node" or "radio network node" or "radio access network node" is any node in a Radio Access Network (RAN) 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), a relay node, a network node that implements part of the functionality of a base station or a network node that implements a gNB Distributed Unit (gNB-DU)) or a network node that implements part of the functionality of some other type of radio access node.

Core Network Node: As used herein, a "core network node" is any type of node in a core network or any node that implements a core network function. 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), a Home Subscriber Server (HSS), or the like. Some other examples of a core network node include a node implementing an Access and Mobility Function (AMF), a User Plane Function (UPF), a Session Management Function (SMF), an Authentication Server Function (AUSF), a Network Slice Selection Function (NSSF), a Network Exposure Function (NEF), a Network Function (NF) Repository Function (NRF), a Policy Control Function (PCF), a Unified Data Management (UDM), or the like.

Communication Device: As used herein, a "communication device" is any type of device that has access to an access network. Some examples of a communication device include, but are not limited to: mobile phone, smart phone, sensor device, meter, vehicle, household appliance, medical appliance, media player, camera, or any type of consumer electronic, for instance, but not limited to, a television, radio, lighting arrangement, tablet computer, laptop, or Personal Computer (PC). The communication device may be a portable, hand-held, computer-comprised, or vehicle-mounted mobile device, enabled to communicate voice and/or data via a wireless or wireline connection.

Wireless Communication Device: One type of communication device is a wireless communication device, which may be any type of wireless device that has access to (i.e., is served by) a wireless network (e.g., a cellular network). Some examples of a wireless communication device include, but are not limited to: a User Equipment device (UE) in a 3GPP network, a Machine Type Communication (MTC) device, and an Internet of Things (IoT) device. Such wireless communication devices may be, or may be integrated into, a mobile phone, smart phone, sensor device, meter, vehicle, household appliance, medical appliance, media player, camera, or any type of consumer electronic, for instance, but not limited to, a television, radio, lighting arrangement, tablet computer, laptop, or PC. The wireless communication device may be a portable, hand-held, computer-comprised, or vehicle-mounted mobile device, enabled to communicate voice and/or data via a wireless connection.

Network Node: As used herein, a "network node" is any node that is either part of the RAN or the core network of a cellular communications network/system.

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.

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.

For Standalone Non-Public Network (SNPN), the same Public Land Mobile Network (PLMN) identity (ID) may be shared by different SNPNs. As a result, with only PLMN ID included in the Multicast/Broadcast Service (MBS) Session ID, the uniqueness of Temporary Mobile Group Identity (TMGI) cannot be ensured. In the case of Multi-Operator Core Network (MOCN) deployment for SNPN where the radio access network (RAN) is shared by multiple SNPNs, the same TMGI may be used for different MBS sessions belonging to different SNPNs, which is problematic.

Embodiments are disclosed herein that introduce a Network Identifier (NID) to work together with MBS session ID, which consists of PLMN ID and Service ID. In one embodiment, this is done by defining a new MBS session ID that is a combination of the NID and conventional MBS session ID (i.e., NID + PLMN ID + Service ID). In another embodiment, the NID is kept separate from the MBS session ID (PLMN ID + Service ID) and used tougher with the MBS session ID to uniquely identifier an MBS session.

In one embodiment, the NID is defined in the core network (e.g., 5GC). In another embodiment, the NID is passed from an Application Function (AF) to one or more core network functions (e.g., one or more 5GC network functions (NFs)).

In one embodiment, one or more core NFs provide the NID to the RAN (e.g., NG-RAN).

In one embodiment, the core network (e.g., 5GC) and the RAN (e.g., NG-RAN) can utilize NID + MBS Session ID to uniquely identify an MBS Session.

In one embodiment, the core network (e.g., 5GC) utilizes the NID in one or more actions or procedures (e.g., group paging).

In one embodiment, the RAN (e.g., NG-RAN) utilizes the NID in one or more actions or procedures. For example, the RAN (e.g., NG-RAN) may put NID and MBS Session ID together in the system information to identify the session. The RAN (e.g., NG-RAN) may put MBS Session ID in the system information (e.g., SIB13) with an additional reference with the existing NID in system information (e.g., SIB1).

Note that, for SNPN, there exists the possibility to indicate PLMN ID and NID in SIB, and there is a specified way to understand the association of the NID with some specific PLMN ID. It should be new to apply it to MBS Session ID.

Embodiments of the present disclosure provide a NID that, together with a MBS Session ID, uniquely identify an MBS session. This ensures that MBS (e.g., 5G MBS (5MBS)) works properly in the case of multiple SNPNs with shared MOCN.

Figure 2

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 a 5G system (5GS) including a Next Generation RAN (NG-RAN) and a 5G Core (5GC). In this example, the RAN includes base stations 202-1 and 202-2, which in the NG-RAN include NR base stations (gNBs) and optionally next generation eNBs (ng-eNBs) (e.g., LTE RAN nodes connected to the 5GC), 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 RAN 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, which in the 5G System (5GS) is referred to as the 5GC. The base stations 202 (and optionally the low power nodes 206) are connected to the core network 210.

The base stations 202 and the low power nodes 206 provide service to wireless communication devices 212-1 through 212-5 in the corresponding cells 204 and 208. The wireless communication devices 212-1 through 212-5 are generally referred to herein collectively as wireless communication devices 212 and individually as wireless communication device 212. In the following description, the wireless communication devices 212 are oftentimes UEs, but the present disclosure is not limited thereto.

Figure 3

Figure 3 illustrates a wireless communication system represented as a 5G network architecture composed of core Network Functions (NFs), where interaction between any two NFs is represented by a point-to-point reference point/interface. Figure 3 can be viewed as one particular implementation of the system 200 of Figure 2.

Seen from the access side the 5G network architecture shown in Figure 3 comprises a plurality of UEs 212 connected to either a RAN 202 or an Access Network (AN) as well as an AMF 300. Typically, the R(AN) 202 comprises base stations, e.g. such as eNBs or gNBs or similar. Seen from the core network side, the 5GC NFs shown in Figure 3 include a NSSF 302, an AUSF 304, a UDM 306, the AMF 300, a SMF 308, a PCF 310, and an Application Function (AF) 312.

Reference point representations of the 5G network architecture are used to develop detailed call flows in the normative standardization. The N1 reference point is defined to carry signaling between the UE 212 and AMF 300. The reference points for connecting between the AN 202 and AMF 300 and between the AN 202 and UPF 314 are defined as N2 and N3, respectively. There is a reference point, N11, between the AMF 300 and SMF 308, which implies that the SMF 308 is at least partly controlled by the AMF 300. N4 is used by the SMF 308 and UPF 314 so that the UPF 314 can be set using the control signal generated by the SMF 308, and the UPF 314 can report its state to the SMF 308. N9 is the reference point for the connection between different UPFs 314, and N14 is the reference point connecting between different AMFs 300, respectively. N15 and N7 are defined since the PCF 310 applies policy to the AMF 300 and SMF 308, respectively. N12 is required for the AMF 300 to perform authentication of the UE 212. N8 and N10 are defined because the subscription data of the UE 212 is required for the AMF 300 and SMF 308.

The 5GC network aims at separating UP and CP. The UP carries user traffic while the CP carries signaling in the network. In Figure 3, the UPF 314 is in the UP and all other NFs, i.e., the AMF 300, SMF 308, PCF 310, AF 312, NSSF 302, AUSF 304, and UDM 306, are in the CP. Separating the UP and CP guarantees each plane resource to be scaled independently. It also allows UPFs to be deployed separately from CP functions in a distributed fashion. In this architecture, UPFs may be deployed very close to UEs to shorten the Round Trip Time (RTT) between UEs and data network for some applications requiring low latency.

The core 5G network architecture is composed of modularized functions. For example, the AMF 300 and SMF 308 are independent functions in the CP. Separated AMF 300 and SMF 308 allow independent evolution and scaling. Other CP functions like the PCF 310 and AUSF 304 can be separated as shown in Figure 3. Modularized function design enables the 5GC network to support various services flexibly.

Each NF interacts with another NF directly. It is possible to use intermediate functions to route messages from one NF to another NF. In the CP, a set of interactions between two NFs is defined as service so that its reuse is possible. This service enables support for modularity. The UP supports interactions such as forwarding operations between different UPFs.

Figure 4

Figure 4 illustrates a 5G network architecture using service-based interfaces between the NFs in the CP, instead of the point-to-point reference points/interfaces used in the 5G network architecture of Figure 3. However, the NFs described above with reference to Figure 3 correspond to the NFs shown in Figure 4. The service(s) etc. that a NF provides to other authorized NFs can be exposed to the authorized NFs through the service-based interface. In Figure 4 the service based interfaces are indicated by the letter "N" followed by the name of the NF, e.g. Namf for the service based interface of the AMF 300 and Nsmf for the service based interface of the SMF 308, etc. The NEF 400 and the NRF 402 in Figure 4 are not shown in Figure 3 discussed above. However, it should be clarified that all NFs depicted in Figure 3 can interact with the NEF 400 and the NRF 402 of Figure 4 as necessary, though not explicitly indicated in Figure 3.

Some properties of the NFs shown in Figures 3 and 4 may be described in the following manner. The AMF 300 provides UE-based authentication, authorization, mobility management, etc. A UE 212 even using multiple access technologies is basically connected to a single AMF 300 because the AMF 300 is independent of the access technologies. The SMF 308 is responsible for session management and allocates Internet Protocol (IP) addresses to UEs. It also selects and controls the UPF 314 for data transfer. If a UE 212 has multiple sessions, different SMFs 308 may be allocated to each session to manage them individually and possibly provide different functionalities per session. The AF 312 provides information on the packet flow to the PCF 310 responsible for policy control in order to support QoS. Based on the information, the PCF 310 determines policies about mobility and session management to make the AMF 300 and SMF 308 operate properly. The AUSF 304 supports authentication function for UEs or similar and thus stores data for authentication of UEs or similar while the UDM 306 stores subscription data of the UE 212. The Data Network (DN), not part of the 5GC network, provides Internet access or operator services and similar.

An NF may be implemented either as a network element on a dedicated hardware, as a software instance running on a dedicated hardware, or as a virtualized function instantiated on an appropriate platform, e.g., a cloud infrastructure.

Notably, in the preferred embodiments of the present disclosure, the core network 210 is a MOCN, which is shared by multiple SNPNs. In one embodiment, a SNPN is identified by combination of PLMN ID and NID (Network Identifier). It is necessary to introduce NID together with MBS Session ID to ensure the uniqueness of the identifier.

Embodiments of the present disclosure use one of two options:

- Option-1: A new MBS Session ID format (MBS_Session_ID_new) is defined that include NID inside. For example, MBS_Session_ID_new = NID + MBS Session ID (PLMN ID + Service ID).
- Option-2: The MBS Session ID for public network is unchanged, and NID is provided as a separate parameter which works together with MBS Session ID. That is, NID + MBS Session ID identify the MBS Session.

The following sections describe how the NID is utilized in 5MBS.

NID in Broadcast Communication

Figure 5

Figure 5 illustrates one example procedure in which NID is utilized in broadcast communication in accordance with an embodiment of the present disclosure. This procure is based on chapter 6.44 in TR 23.757 and, as such, some details that are not relevant to the present disclosure may be omitted as compared to chapter 6.44 of TR 23.757 for conciseness. This procedure shows an example of how NID is provided as a separate parameter together with MBS session ID to uniquely identify an MBS session.

No matter which network function decides MBS Session ID, the AF 312 provides the NID for the SNPN deployment when requesting an MBS session. It is also possible to let the 5GC configure the NID locally for the SNPN deployment. The solution illustrated in Figure 5 is an example on how NID is provided in the broadcast communication.

The steps of the procedure of Figure 5 are as follows:

- Step 0a. The AF 312 sends a request to the 5GC to allocate MBS Session ID (e.g., TMGI). A NID is provided in the request or otherwise in association with the request. As illustrated, in this example, the AF 312 sends the request to the NEF 400 or MBS control function (MBSF).
    - In another embodiment, the NID is not provided by the AF 400, and the NID is expected to be configured in 5GC.

- Step 0b. One or more 5GC entities (e.g., one or more NFs) allocate an MBS Session ID considering the NID. The one or more NFs that allocate the MBS session ID considering the NID may be the MB-SMF 308-MB, or the NEF 400, or the MBSF. Note that the reference number 308-MB is used to denote that the SMF is a SMF capable of handling MBS and may or may not be the same as the SMF 308.
- Step 0c. 5GC sends an allocate TMGI response to the AF 312 with NID + MBS Session ID. More specifically, in this example, the NEF 400 sends the response to the AF 312. Note that the NEF 400 may have allocated the TMGI considering the NID or may have received the allocated TMGI from another NF (e.g., the MB-SMF 308-MB or the MBSF).
- Step 0d. The AF 312 performs service announcement towards the UE 212 via the 5GC. Within the service announcement, the NID and MBS Session ID together identify the MBS Session.
- Step 1. The AF 312 sends an Activate MBMS Bearer Request to the 5GC (e.g., to the NEF 400 or MBSF) with the NID and MBS Session ID to identify the MBS Session.
- Step 2. The NEF 400 / MBSF sends a MB Session Start to the MB-SMF 308-MB with the NID and the MBS Session ID to identify the MBS Session.
- Step 3. The MB-SMF 308-MB communicates with the PCF 310 for policy control. The NID and the MBS Session ID together identify the MBS Session for purposes of policy control.
- Step 4. The MB-SMF 308-MB communicates with the MB-UPF 314-MB for user plane establishment. The NID and the MBS Session ID together identify the MBS Session for user plane establishment. Note that the reference number 314-MB is used to denote that the UPF is a UPF capable of handling MBS and may or may not be the same as the UPF 314.
    - Note that MB-UPF 314-MB may need the NID and the MBS Session ID for statistic purpose.
- Step 5. The MB-SMF 308-MB sends a MB Session Start Request to the AMF 300 with the NID and the MBS Session ID to identify the MBS Session.
- Step 6. The AMF 300 sends, to the NG-RAN (e.g., to a base station(s) 202 in the NG-RAN), a MB Session Resource Setup Request with the NID and the MBS Session ID to identify the MBS Session.
- Step 7. The NG-RAN (e.g., the base station(s) 202) activate the MBS Session identified by the NID and the MBS Session ID.
- Steps 8-9b. The requests are acknowledged or responded from the downlink function to the uplink function. The NID and the MBS Session ID together identify the MBS session.
- Step 10. The NG-RAN (e.g., the base station(s) 202) advertise the NID and the MBS Session ID for the MBS Session. The NG-RAN (e.g., the base station(s) 202) may put the NID and the MBS Session ID together in system information (which is broadcast by the base station(s) 202) to identify the session. In one embodiment, the NG-RAN (e.g., base station(s) 202) put the MBS Session ID in the system information (e.g., SIB13) with an additional reference to the existing NID in system information (e.g., SIB1).
- If the NID is encoded as MBS_Session_ID_new, from step 0c to step 9b, MBS_Session_new replaces the two parameters (NID and MBS Session ID). Further, in step 10, NG-RAN either advertises

MBS_Session_ID_new in system information directly, or advertises the MBS Session ID with an additional reference with the existing NID as described above.

- Note: In one embodiment, step 0a and step 1 can be combined into one message. This enables the AF 312 to trigger the MBS Session ID allocation and activate the MBS bearer using a single message/request.

NID in Multicast Communication

Figures 6A-6B

Figures 6A and **6B** illustrate one example procedure in which NID is utilized in multicast communication in accordance with an embodiment of the present disclosure. For multicast communication, Steps 0-4 are similar as the ones for broadcast communication (Figure 5), except the differences below:

- In one embodiment, one or more parameters that indicate whether the service is a broadcast session or a multicast session are explicitly or implicitly included in the request from AF 312 to 5GC in step 0a and/or in the request from the AF 312 to the 5GC in step 1. For example, a serviceType parameter can be introduced in the Allocate MBS Bearer Request of step 1 to make such differentiation (it can be included in Allocate TMGI Request as well). As another example, a broadcast session is indicated by a "broadcast area" parameter, while a multicast session is indicated by "multicast area" parameter.
- In one embodiment, a "broadcast area" is essential for a broadcast session, while "multicast area" is optional for a multicast session. Without "multicast area", the multicast session is intended for the whole PLMN (or NID + PLMN).

After step 4, the procedure continues in one of two alternative approaches, namely, in an AMF-centric approach or a SMF-centric approach, both of which are described below.

In AMF-centric approach:

- Step 5. The MB-SMF 308-MB sends a MB Session Start Request to the AMF 300 with the NID and the MBS Session ID to identify the MBS Session.
- Step 6. The AMF 300 may perform group paging for IDLE UEs who joined the MBS session. In the group paging, the NID and the MBS Session ID are used.
- Step 7. The AMF 300 sends a MB Session Resource Setup Request with the NID and the MBS Session ID to identify the MBS Session.
- Steps 8-9b. The requests are acknowledged or responded from the downlink function to the uplink function. The NID and the MBS Session ID together identify the MBS session.
- Step 10. The NG-RAN (e.g., base station(s) 202) perform point-to-point (PTP) / point-to-multipoint (PTM) delivery to UEs, while using the NID and the MBS Session ID to identify the MBS session.
- Step 11. The AMF 300 may trigger individual delivery in the core network 210 for those UEs who are under non-5MBS NG-RAN. That is, the AMF 300 may trigger the SMF 308, and the SMF 308 may further communicate with the UPF 314 and the MB-SMF 308-MB, and the MB-SMF 308-MB communicates with the

MB-UPF 314-MB to deliver the session data from the MB-UPF 314-MB to the UPF 314 to the PDU session towards UE 212. Here, the NID and the MBS Session ID together identify the MBS session.

In SMF-centric approach:

- Step 12. The MB-SMF 308-MB sends a MB Session Start Request to the SMF 308 with the NID and the MBS Session ID to identify the MBS Session.
- Step 13. For each UE 212, if the UE 212 is under 5MBS support NG-RAN (NG-RAN that supports 5MBS), the MB-SMF 308-MB sends a MB Session Resource Setup Request to the NG-RAN (e.g., to base station(s) 202) via the AMF 300.
- Steps 14-17. The requests are acknowledged or responded from the downlink function to the uplink function. The NID and the MBS Session ID together identify the MBS session.
- Step 18. The NG-RAN (e.g., base station(s) 202) perform PTP/PTM delivery to UEs, while using the NID and the MBS Session ID to identify the MBS session.
- Step 19. For the UEs who are under non-5MBS NG-RAN, the SMF 308 triggers individual delivery in the core network 208. That is, the SMF 308 communicates with the UPF 314 and the MB-SMF 308-MB, and the MB-SMF 308-MB communicates with the MB-UPF 314-MB to deliver the session data from the MB-UPF 314-MB to the UPF 314 to the PDU session towards the UE. Here, the NID and the MBS Session ID together identify the MBS session.

If the NID is encoded into MBS_Session_ID_new, from step 0c to step 19, MBS_Session_new replaces the two parameters (NID and MBS Session ID).

Note: In one embodiment, step 0a and step 1 can be combined into one message. This enables the AF 312 to trigger the MBS Session ID allocation and activate the MBS bearer using a single message/request.

Figure 7

Figure 7 is a flow chart that illustrates the operation of a network node in accordance with one embodiment of the present disclosure. Note that optional steps are represented by dashed lines/boxes. The network node may be a network node that implements a NF (e.g., the AMF 300, the SMF 308, the UPF 314, the PCF 310, the NEF 400, the MBSF, the AF 312, the MB-SMF 308-MB, the MB-UPF 314-MB, or the like) or a network node that implements at least some of the functionality of a RAN node (e.g., base station 202). As illustrated, the network node obtains a NID associated to a SNPN (step 700). While the SNPN is used for the preferred embodiments described herein, the NID is not limited to use for identification of a SNPN. As described above, in some embodiments, the network node obtains the NID by receiving a message including the NID (e.g., a message including the NID + MBS Session ID or a message including a new MBS Session ID that itself includes the NID) from another network node. In some other embodiments, the network node obtains the NID by allocating the NID within the core network 210.

The network node uses the NID together with one or more other IDs (e.g., conventional MBS Session ID, PLMN ID, or MBMS Service ID) to uniquely identify an MBS session (step 702). More specifically, the network node uses either: (a) the NID+MBS Session ID (which includes the PLMN ID + MBMS Service ID) or (b) a new MBS Session

ID that includes the NID (e.g., includes the NID + PLMN ID + MBMS Service ID). For example, the network node uses the NID together with the one or more other IDs to uniquely identify the MBS session by sending message to another network node (e.g., a NF or RAN node), where the message includes either: (a) the NID+MBS Session ID (which includes the PLMN ID + MBMS Service ID) or (b) a new MBS Session ID that includes the NID (e.g., includes the NID + PLMN ID + MBMS Service ID).

In some specific examples, the network node may be a network node that implements the AF 312, the NEF 400, the MBSF, the PCF 310, the MB-UPF 314-MB, the MB-SMF 308-MB, the AMF 300, the SMF 308, or the RAN node 202 of Figure 5 or Figures 6A-6B. Thus, the functions of these various nodes described above with respect to how they obtain the NID (e.g., in a message from another network node or allocating the NID) and use the NID (e.g., including the NID or new MBS Session that includes the NID) in a message or broadcast sent by the network node are equally applicable here to steps 700 and 702.

Figure 8

Figure 8 is a schematic block diagram of a network node 800 according to some embodiments of the present disclosure. Optional features are represented by dashed boxes. The network node 800 may be, for example, a base station 202 or 206 or a network node that implements all or part of the functionality of the base station 202 or gNB described herein or a network node that implements the functionality of a core NF (e.g., the AMF 300, the SMF 308, the UPF 314, the PCF 310, the NEF 400, the MBSF, the AF 312, the MB-SMF 308-MB, the MB-UPF 314-MB, or the like). As illustrated, the network node 800 includes a control system 802 that includes one or more processors 804 (e.g., Central Processing Units (CPUs), Application Specific Integrated Circuits (ASICs), Field Programmable Gate Arrays (FPGAs), and/or the like), memory 806, and a network interface 808. The one or more processors 804 are also referred to herein as processing circuitry. In addition, if the network node 800 is a radio access node (e.g., base station 202), the network node 800 may include one or more radio units 810 that each includes one or more transmitters 812 and one or more receivers 814 coupled to one or more antennas 816. The radio units 810 may be referred to or be part of radio interface circuitry. In some embodiments, the radio unit(s) 810 is external to the control system 802 and connected to the control system 802 via, e.g., a wired connection (e.g., an optical cable). However, in some other embodiments, the radio unit(s) 810 and potentially the antenna(s) 816 are integrated together with the control system 802. The one or more processors 804 operate to provide one or more functions of a network node 800 as described herein (e.g., one or more functions of the base station 202 or gNB described herein or one or more functions of a core NF (e.g., the AMF 300, the SMF 308, the UPF 314, the PCF 310, the NEF 400, the MBSF, the AF 312, the MB-SMF 308-MB, the MB-UPF 314-MB, or the like) as described herein). In some embodiments, the function(s) are implemented in software that is stored, e.g., in the memory 806 and executed by the one or more processors 804.

Figure 9

Figure 9 is a schematic block diagram that illustrates a virtualized embodiment of the network node 800 according to some embodiments of the present disclosure. Again, optional features are represented by dashed boxes. As used herein, a “virtualized” network node is an implementation of the network node 800 in which at least a portion of the functionality of the network node 800 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, the network node 800 includes one or more processing nodes 900 coupled to or included as part of a network(s) 902. Each processing node 900 includes one or more processors 904 (e.g., CPUs, ASICs, FPGAs, and/or the like), memory 906, and a network interface 908. If the network node 800 is a radio access node (e.g., a base station 202), the network node 800 may include the control system 802 and/or the one or more radio units 810, as described above. The control system 802 may be connected to the radio unit(s) 810 via, for example, an optical cable or the like. If present, the control system 802 or the radio unit(s) are connected to the processing node(s) 900 via the network 902.

In this example, functions 910 of the network node 800 described herein (e.g., one or more functions of the base station 202 or gNB described herein or one or more functions of a core NF (e.g., the AMF 300, the SMF 308, the UPF 314, the PCF 310, the NEF 400, the MBSF, the AF 312, the MB-SMF 308-MB, the MB-UPF 314-MB, or the like) as described herein) are implemented at the one or more processing nodes 900 or distributed across the one or more processing nodes 900 and the control system 802 and/or the radio unit(s) 810 in any desired manner. In some particular embodiments, some or all of the functions 910 of the network node 800 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) 900. As will be appreciated by one of ordinary skill in the art, additional signaling or communication between the processing node(s) 900 and the control system 802 is used in order to carry out at least some of the desired functions 910. Notably, in some embodiments, the control system 802 may not be included, in which case the radio unit(s) 810 communicate directly with the processing node(s) 900 via an appropriate network interface(s).

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 network node 800 or a node (e.g., a processing node 900) implementing one or more of the functions 910 of the network node 800 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 10

Figure 10 is a schematic block diagram of the network node 800 according to some other embodiments of the present disclosure. The network node 800 includes one or more modules 1000, each of which is implemented in software. The module(s) 1000 provide the functionality of the network node 800 described herein (e.g., one or more functions of the base station 202 or gNB described herein or one or more functions of a core NF (e.g., the AMF 300, the SMF 308, the UPF 314, the PCF 310, the NEF 400, the MBSF, the AF 312, the MB-SMF 308-MB, the MB-UPF 314-MB, or the like) as described herein). This discussion is equally applicable to the processing node 900 of Figure 9 where the modules 1000 may be implemented at one of the processing nodes 900 or distributed across multiple processing nodes 900 and/or distributed across the processing node(s) 900 and the control system 802.

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Figure 11

Figure 11 is a schematic block diagram of a wireless communication device 212 (or UE or UE 212) according to some embodiments of the present disclosure. As illustrated, the wireless communication device 212 includes one or more processors 1102 (e.g., CPUs, ASICs, FPGAs, and/or the like), memory 1104, and one or more transceivers 1106 each including one or more transmitters 1108 and one or more receivers 1110 coupled to one or more antennas 1112. The transceiver(s) 1106 includes radio-front end circuitry connected to the antenna(s) 1112 that is configured to condition signals communicated between the antenna(s) 1112 and the processor(s) 1102, as will be appreciated by on of ordinary skill in the art. The processors 1102 are also referred to herein as processing circuitry. The transceivers 1106 are also referred to herein as radio circuitry. In some embodiments, the functionality of the wireless communication device 212 described above may be fully or partially implemented in software that is, e.g., stored in the memory 1104 and executed by the processor(s) 1102. Note that the wireless communication device 212 may include additional components not illustrated in Figure 11 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 wireless communication device 212 and/or allowing output of information from the wireless communication device 212), a power supply (e.g., a battery and associated power circuitry), etc.

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 wireless communication device 212 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 12

Figure 12 is a schematic block diagram of the wireless communication device 212 according to some other embodiments of the present disclosure. The wireless communication device 212 includes one or more modules 1200, each of which is implemented in software. The module(s) 1200 provide the functionality of the wireless communication device 212 described herein.

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

1. A method performed by a network node (800) of a cellular communications system (200), the method comprising:
obtaining (700) a network identifier, NID, associated to a standalone non-public network, SNPN;
utilizing (702) the NID together with one or more identifiers (e.g., MBS session ID) to uniquely identify a Multicast/Broadcast Service, MBS, session.

2. The method of embodiment 1 wherein the one or more identifiers comprise a Public Land Mobile Network, PLMN, ID and a Multicast/Broadcast Multimedia Subsystem, MBMS, Service ID.

3. The method of embodiment 2 wherein utilizing (702) the NID together with the one or more identifiers comprises utilizing (702) an MBS session ID that comprises the NID, the PLMN ID, and the MBMS Service ID.

4. The method of embodiment 1 wherein the one or more identifiers comprise MBS session ID that comprises a Public Land Mobile Network, PLMN, ID and a Multicast/Broadcast Multimedia Subsystem, MBMS, Service ID.

5. The method of embodiment 4 wherein utilizing (702) the NID together with the one or more identifiers comprises utilizing (702) the NID together with the MBS session ID, where the NID and the MBS session ID are separate identifiers.

6. The method of any one of embodiment 2 to 5 wherein the PLMN ID is associated to the SNPN.

7. The method of any one of embodiment 2 to 6 wherein the MBMS Service ID is associated to the MBS session.

8. The method of any one of embodiment 1 to 7 wherein the network node (800) is a network node (800) that implements a network function, NF, in a core network (210) of the cellular communications system (200).

9. The method of embodiment 8 wherein utilizing (702) the NID together with the one or more identifiers comprises sending (702-1) a message to either another NF in the core network (210) or to one or more network nodes in a RAN of the cellular communications system (200), the message comprising either: (a) the NID and the one or more identifiers (e.g., conventional MBS Session ID including PLMN ID and MBMS Service ID) or (b) a new MBS Session ID that comprises the NID and the one or more identifiers (e.g., PLMN ID and MBMS Service ID).

10. The method of embodiment 8 or 9 wherein obtaining (700) the NID comprises receiving (Fig. 5, step 0a) the NID from an Application Function, AF, (312), directly or indirectly via one or more other NFs in the core network (210).

11. The method of embodiment 8 or 9 wherein obtaining (700) the NID comprises allocating the NID.

12. The method of any one of embodiment 8 to 11 wherein the NF is a Network Exposure Function, NEF, (400).

13. The method of embodiment 12 wherein obtaining (700) the NID comprises receiving (Fig. 5, step 0a; Fig. 6A, step 0a) a request from an Application Function, AF, (312), wherein the request comprises the NID.

14. The method of embodiment 12 further comprising:
receiving (Fig. 5, step 0a; Fig. 6A, step 0a) a request from an Application Function, AF, (312);

wherein obtaining (700) the NID comprises obtaining (700) the NID, wherein the NID is allocated by the NEF (400) or another NF in the core network (210).

15. The method of embodiment 13 or 14 wherein the request is a request to allocate an MBS Session ID for the MBS session.

16. The method of embodiment 15 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending a response (Fig. 5, step 0c; Figure 6A, step 0c) to the AF (312), the response comprising the NID and an MBS Session ID allocated for the MBS session.

17. The method of embodiment 13 or 14 wherein the request is a request to allocate an MBS Session ID for the MBS session and to activate an MBS bearer for the MBS session.

18. The method of any one of embodiment 8 to 11 wherein the NF is a Multicast/Broadcast Session Management Function, MB-SMF, (308-MB).

19. The method of embodiment 18 wherein obtaining (700) the NID comprises receiving (Fig. 5, step 2; Fig. 6A, step 2) a request from a Network Exposure Function, NEF, (400) or an MBS control Function, MBSF, wherein the request comprises either:

the NID and an MBS Session ID of the MBS session; or

a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session.

20. The method of embodiment 19 wherein the request is an MBS session start request.

21. The method of embodiment 20 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending (Fig. 5, steps 3 and 4; Fig. 6a, steps 3-5) one or more messages to one or more other NFs in the core network (210) in association with staring the MBS session, the one or more messages comprising either:

the NID and the MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, the PLMN ID, and the MBMS Service ID that together uniquely identify the MBS session.

22. The method of any one of embodiment 8 to 11 wherein the NF is an Access and Mobility Management Function, AMF, (300).

23. The method of embodiment 22 wherein obtaining (700) the NID comprises receiving (Fig. 5, step 5; Fig. 6A, step 2) an MBS session start request from another NF function (308-MB) in the core network (210), wherein the MBS session start request comprises either:

the NID and an MBS Session ID of the MBS session; or

a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session.

24. The method of embodiment 23 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending (Fig. 5, step 6; Fig. 6a, step 7) a request to setup resources for the MBS session to one or more network nodes (202) in the RAN of the cellular communications system (200), request comprising either:

the NID and the MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, the PLMN ID, and the MBMS Service ID that together uniquely identify the MBS session.

25. The method of any one of embodiment 8 to 11 wherein the NF is a Session Management Function, SMF, (308).

26. The method of embodiment 25 wherein obtaining (700) the NID comprises receiving (Fig. 6B, step 12) an MBS session start request from another NF function (308-MB) in the core network (210), wherein the MBS session start request comprises either:

the NID and an MBS Session ID of the MBS session; or

a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session.

27. The method of embodiment 26 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending (Fig. 6B, step 13) a request to setup resources for the MBS session towards one or more network nodes (202) in the RAN of the cellular communications system (200), request comprising either:

the NID and the MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, the PLMN ID, and the MBMS Service ID that together uniquely identify the MBS session.

28. The method of any one of embodiment 1 to 7 wherein the network node (800) is a network node (800) in a radio access network, RAN, of the cellular communications system (200).

29. The method of embodiment 28 wherein obtaining (700) the NID comprises receiving (Fig. 5, step 6; Fig. 6A, step 7; Fig. 6B, step 13) a request from a NF in the core network (210) of the cellular communications system (210), the request being a request to setup resources for the MBS session, wherein the request comprises either:

the NID and an MBS Session ID of the MBS session; or

a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session.

30. The method of embodiment 28 or 29 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises advertising (Fig. 5, step 10) the MBS session using either:

the NID and an MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session.

31. The method of embodiment 28 or 29 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises broadcasting (Fig. 5, step 10) system information comprising either:

the NID and an MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session.

32. The method of embodiment 28 or 29 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises performing (Fig. 6A, step 10; Fig. 6B, step 18) PTP or PTM establishment and delivery using either:

the NID and an MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session.

33. A network node (800) for a cellular communications system (200), the network node (800) adapted to:

obtain (700) a network identifier, NID, associated to a standalone non-public network, SNPN;

utilize (702) the NID together with one or more identifiers (e.g., MBS session ID) to uniquely identify a Multicast/Broadcast Service, MBS, session.

34. The network node (800) of embodiment 33 wherein the network node (800) is further adapted to perform the method of any of embodiment s 2 to 32.

35. A network node (800) for a cellular communications system (200), the network node (800) comprising processing circuitry (804; 904) configured to cause the network node (800) to:

obtain (700) a network identifier, NID, associated to a standalone non-public network, SNPN;

utilize (702) the NID together with one or more identifiers (e.g., MBS session ID) to uniquely identify a Multicast/Broadcast Service, MBS, session.

36. The network node (800) of embodiment 33 wherein the processing circuitry (804; 904) is further configured to cause the network node (800) to perform the method of any one of embodiment 2 to 32.

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 Processors (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.

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.).

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).

- 3GPP Third Generation Partnership Project
- 5G Fifth Generation
- 5GC Fifth Generation Core
- 5GS Fifth Generation System
- AF Application Function
- AMF Access and Mobility Function
- AN Access Network
- AUSF Authentication Server Function
- DCI Downlink Control Information
- DN Data Network
- eNB Enhanced or Evolved Node B
- EPS Evolved Packet System
- E-UTRA Evolved Universal Terrestrial Radio Access
- gNB New Radio Base Station
- HSS Home Subscriber Server
- IoT Internet of Things

- IP Internet Protocol
- LTE Long Term Evolution
- MME Mobility Management Entity
- NEF Network Exposure Function
- NF Network Function
- NR New Radio
- NRF Network Function Repository Function
- NSSF Network Slice Selection Function
- PCF Policy Control Function
- P-GW Packet Data Network Gateway
- RAN Radio Access Network
- SCEF Service Capability Exposure Function
- SMF Session Management Function
- UDM Unified Data Management
- UE User Equipment
- UPF User Plane Function

Those skilled in the art will recognize improvements and modifications to the embodiments of the present disclosure. All such improvements and modifications are considered within the scope of the concepts disclosed herein.

Claims

What is claimed is:

1. A method performed by a network node (800) of a cellular communications system (200), the method comprising:
obtaining (700) a network identifier, NID, associated to a standalone non-public network, SNPN;
utilizing (702) the NID together with one or more identifiers (e.g., MBS session ID) to uniquely identify a Multicast/Broadcast Service, MBS, session.

2. The method of claim 1 wherein the one or more identifiers comprise a Public Land Mobile Network, PLMN, ID and a Multicast/Broadcast Multimedia Subsystem, MBMS, Service ID.

3. The method of claim 2 wherein utilizing (702) the NID together with the one or more identifiers comprises utilizing (702) an MBS session ID that comprises the NID, the PLMN ID, and the MBMS Service ID.

4. The method of claim 1 wherein the one or more identifiers comprise MBS session ID that comprises a Public Land Mobile Network, PLMN, ID and a Multicast/Broadcast Multimedia Subsystem, MBMS, Service ID.

5. The method of claim 4 wherein utilizing (702) the NID together with the one or more identifiers comprises utilizing (702) the NID together with the MBS session ID, where the NID and the MBS session ID are separate identifiers.

6. The method of any one of claim 2 to 5 wherein the PLMN ID is associated to the SNPN.

7. The method of any one of claim 2 to 6 wherein the MBMS Service ID is associated to the MBS session.

8. The method of any one of claim 1 to 7 wherein the network node (800) is a network node (800) that implements a network function, NF, in a core network (210) of the cellular communications system (200).

9. The method of claim 8 wherein utilizing (702) the NID together with the one or more identifiers comprises sending (702-1) a message to either another NF in the core network (210) or to one or more network nodes in a RAN of the cellular communications system (200), the message comprising either: (a) the NID and the one or more identifiers (e.g., conventional MBS Session ID including PLMN ID and MBMS Service ID) or (b) a new MBS Session ID that comprises the NID and the one or more identifiers (e.g., PLMN ID and MBMS Service ID).

10. The method of claim 8 or 9 wherein obtaining (700) the NID comprises receiving (Fig. 5, step 0a) the NID from an Application Function, AF, (312), directly or indirectly via one or more other NFs in the core network (210).

11. The method of claim 8 or 9 wherein obtaining (700) the NID comprises allocating the NID.

12. The method of any one of claim 8 to 11 wherein the NF is a Network Exposure Function, NEF, (400).

13. The method of claim 12 wherein obtaining (700) the NID comprises receiving (Fig. 5, step 0a; Fig. 6A, step 0a) a request from an Application Function, AF, (312), wherein the request comprises the NID.

14. The method of claim 12 further comprising:
receiving (Fig. 5, step 0a; Fig. 6A, step 0a) a request from an Application Function, AF, (312);
wherein obtaining (700) the NID comprises obtaining (700) the NID, wherein the NID is allocated by the NEF (400) or another NF in the core network (210).

15. The method of claim 13 or 14 wherein the request is a request to allocate an MBS Session ID for the MBS session.

16. The method of claim 15 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending a response (Fig. 5, step 0c; Figure 6A, step 0c) to the AF (312), the response comprising the NID and an MBS Session ID allocated for the MBS session.

17. The method of claim 13 or 14 wherein the request is a request to allocate an MBS Session ID for the MBS session and to activate an MBS bearer for the MBS session.

18. The method of any one of claim 8 to 11 wherein the NF is a Multicast/Broadcast Session Management Function, MB-SMF, (308-MB).

19. The method of claim 18 wherein obtaining (700) the NID comprises receiving (Fig. 5, step 2; Fig. 6A, step 2) a request from a Network Exposure Function, NEF, (400) or an MBS control Function, MBSF, wherein the request comprises either:

the NID and an MBS Session ID of the MBS session; or

a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session.

20. The method of claim 19 wherein the request is an MBS session start request.

21. The method of claim 20 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending (Fig. 5, steps 3 and 4; Fig. 6a, steps 3-5) one or more messages to one or more other NFs in the core network (210) in association with staring the MBS session, the one or more messages comprising either:

the NID and the MBS Session ID of the MBS session; or the new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, the PLMN ID, and the MBMS Service ID that together uniquely identify the MBS session.

22. The method of any one of claim 8 to 11 wherein the NF is an Access and Mobility Management Function, AMF, (300).

23. The method of claim 22 wherein obtaining (700) the NID comprises receiving (Fig. 5, step 5; Fig. 6A, step 2) an MBS session start request from another NF function (308-MB) in the core network (210), wherein the MBS session start request comprises either:

the NID and an MBS Session ID of the MBS session; or

a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session.

24. The method of claim 23 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending (Fig. 5, step 6; Fig. 6a, step 7) a request to setup resources for the MBS session to one or more network nodes (202) in the RAN of the cellular communications system (200), request comprising either:

the NID and the MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, the PLMN ID, and the MBMS Service ID that together uniquely identify the MBS session.

25. The method of any one of claim 8 to 11 wherein the NF is a Session Management Function, SMF, (308).

26. The method of claim 25 wherein obtaining (700) the NID comprises receiving (Fig. 6B, step 12) an MBS session start request from another NF function (308-MB) in the core network (210), wherein the MBS session start request comprises either:

the NID and an MBS Session ID of the MBS session; or

a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session.

27. The method of claim 26 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises sending (Fig. 6B, step 13) a request to setup resources for the MBS session towards one or more network nodes (202) in the RAN of the cellular communications system (200), request comprising either:

the NID and the MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, the PLMN ID, and the MBMS Service ID that together uniquely identify the MBS session.

28. The method of any one of claim 1 to 7 wherein the network node (800) is a network node (800) in a radio access network, RAN, of the cellular communications system (200).

29. The method of claim 28 wherein obtaining (700) the NID comprises receiving (Fig. 5, step 6; Fig. 6A, step 7; Fig. 6B, step 13) a request from a NF in the core network (210) of the cellular communications system (210), the request being a request to setup resources for the MBS session, wherein the request comprises either:

the NID and an MBS Session ID of the MBS session; or

a new MBS Session ID of the MBS session, the new MBS Session ID comprising the NID, a PLMN ID, and a MBMS Service ID that together uniquely identify the MBS session.

30. The method of claim 28 or 29 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises advertising (Fig. 5, step 10) the MBS session using either:

the NID and an MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session.

31. The method of claim 28 or 29 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises broadcasting (Fig. 5, step 10) system information comprising either:

the NID and an MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session.

32. The method of claim 28 or 29 wherein utilizing (702) the NID together with the one or more identifiers to uniquely identify the MBS session comprises performing (Fig. 6A, step 10; Fig. 6B, step 18) PTP or PTM establishment and delivery using either:

the NID and an MBS Session ID of the MBS session; or

the new MBS Session ID of the MBS session.

33. A network node (800) for a cellular communications system (200), the network node (800) adapted to:

obtain (700) a network identifier, NID, associated to a standalone non-public network, SNPN;

utilize (702) the NID together with one or more identifiers (e.g., MBS session ID) to uniquely identify a Multicast/Broadcast Service, MBS, session.

34. The network node (800) of claim 33 wherein the network node (800) is further adapted to perform the method of any one of claim 2 to 32.

35. A network node (800) for a cellular communications system (200), the network node (800) comprising processing circuitry (804; 904) configured to cause the network node (800) to:

obtain (700) a network identifier, NID, associated to a standalone non-public network, SNPN;

utilize (702) the NID together with one or more identifiers (e.g., MBS session ID) to uniquely identify a Multicast/Broadcast Service, MBS, session.

36. The network node (800) of claim 33 wherein the processing circuitry (804; 904) is further configured to cause the network node (800) to perform the method of any one of claim 2 to 32.

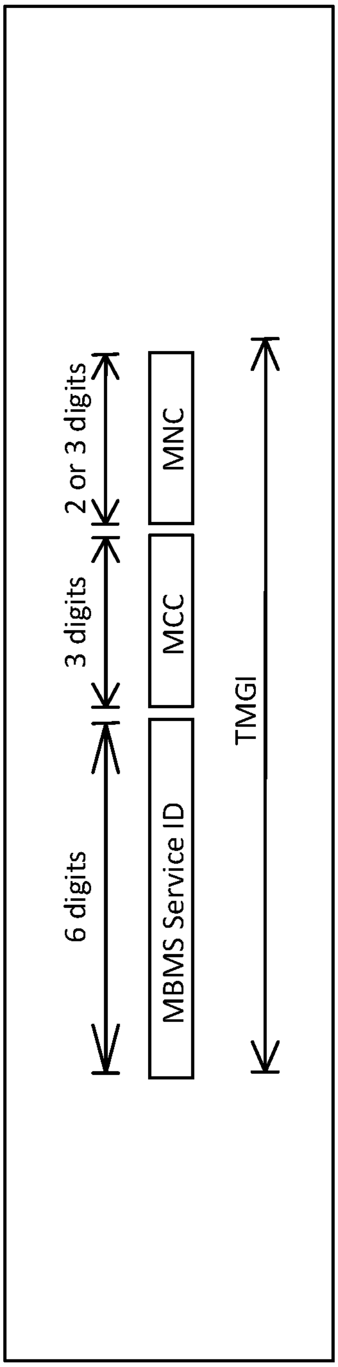

FIG. 1

Structure of TMGI

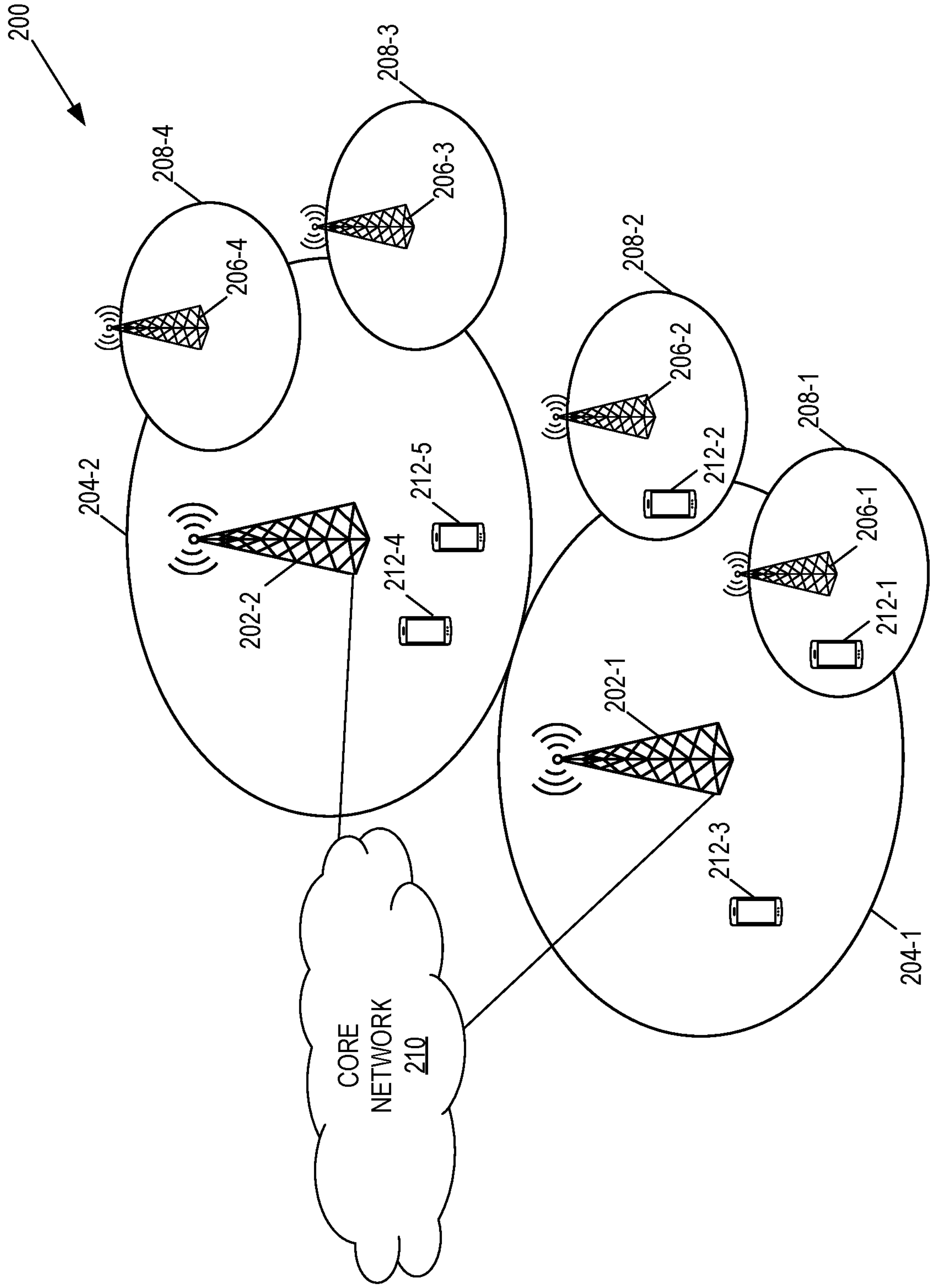
200
208-3
208-4
206-3
206-4
208-2
206-2
204-2
212-5
212-4
202-2
208-1
206-1
212-2
212-1
202-1
212-3
204-1
CORE
NETWORK
210

FIG. 2

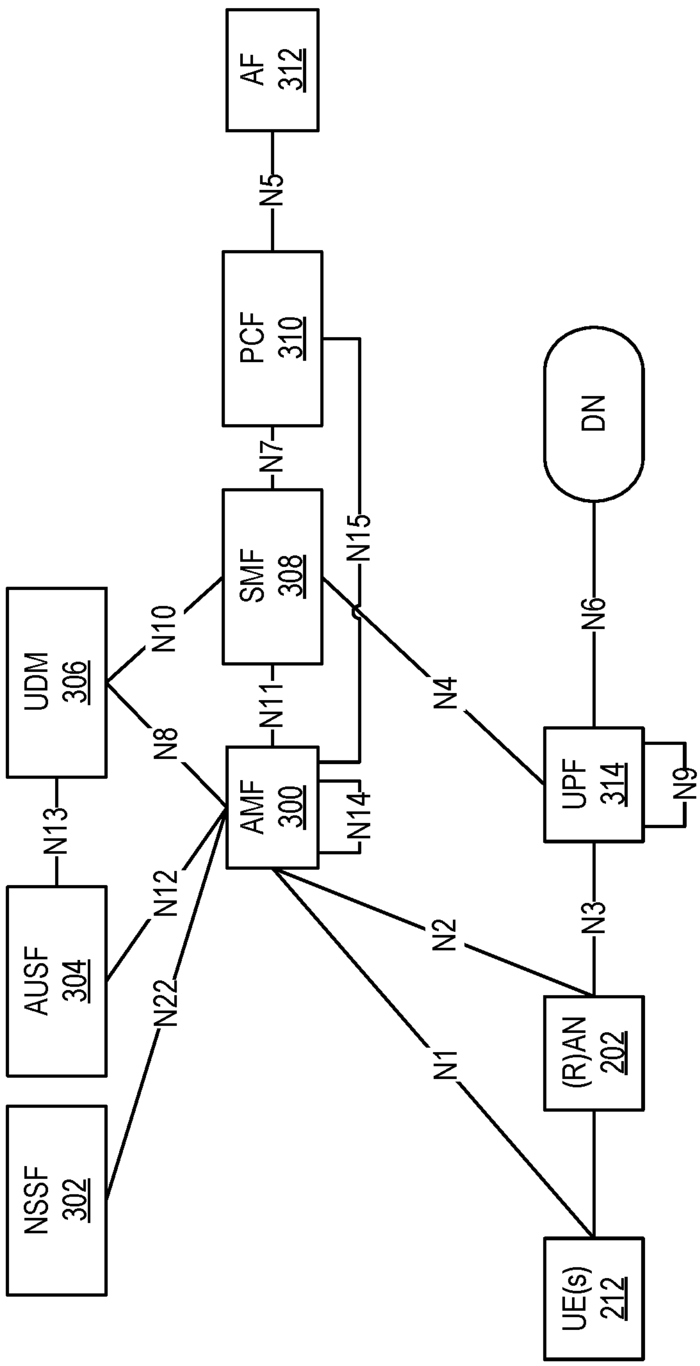
AF
312
N5
PCF
310
N7
N15
SMF
308
DN
UDM
306
N10
N11
N4
N6
N8
N13
AMF
300
N14
UPF
314
N9
AUSF
304
N12
N2
N3
N22
N1
(R)AN
202
NSSF
302
UE(s)
212

FIG. 3

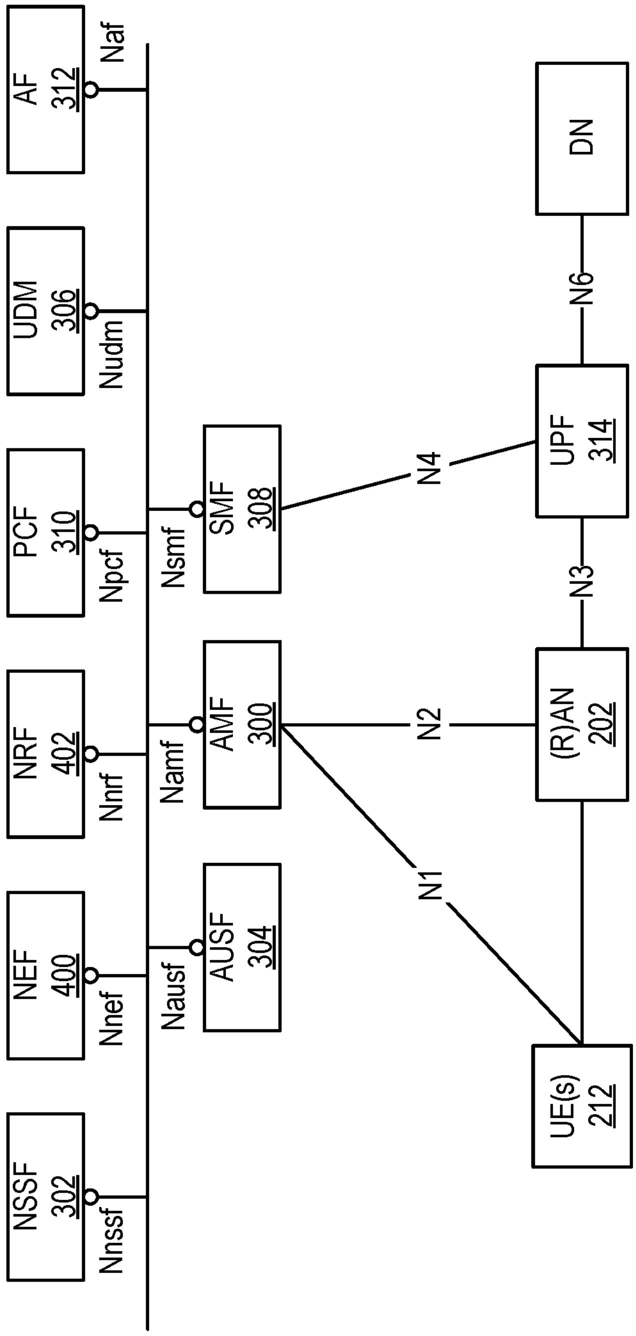
NSSF
302
NEF
400
NRF
402
PCF
310
UDM
306
AF
312
Nnssf
Nnef
Nnrf
Npcf
Nudm
Naf
AUSF
304
AMF
300
SMF
308
Nausf
Namf
Nsmf
N1
N2
N4
UE(s)
212
(R)AN
202
UPF
314
DN
N3
N6

FIG. 4

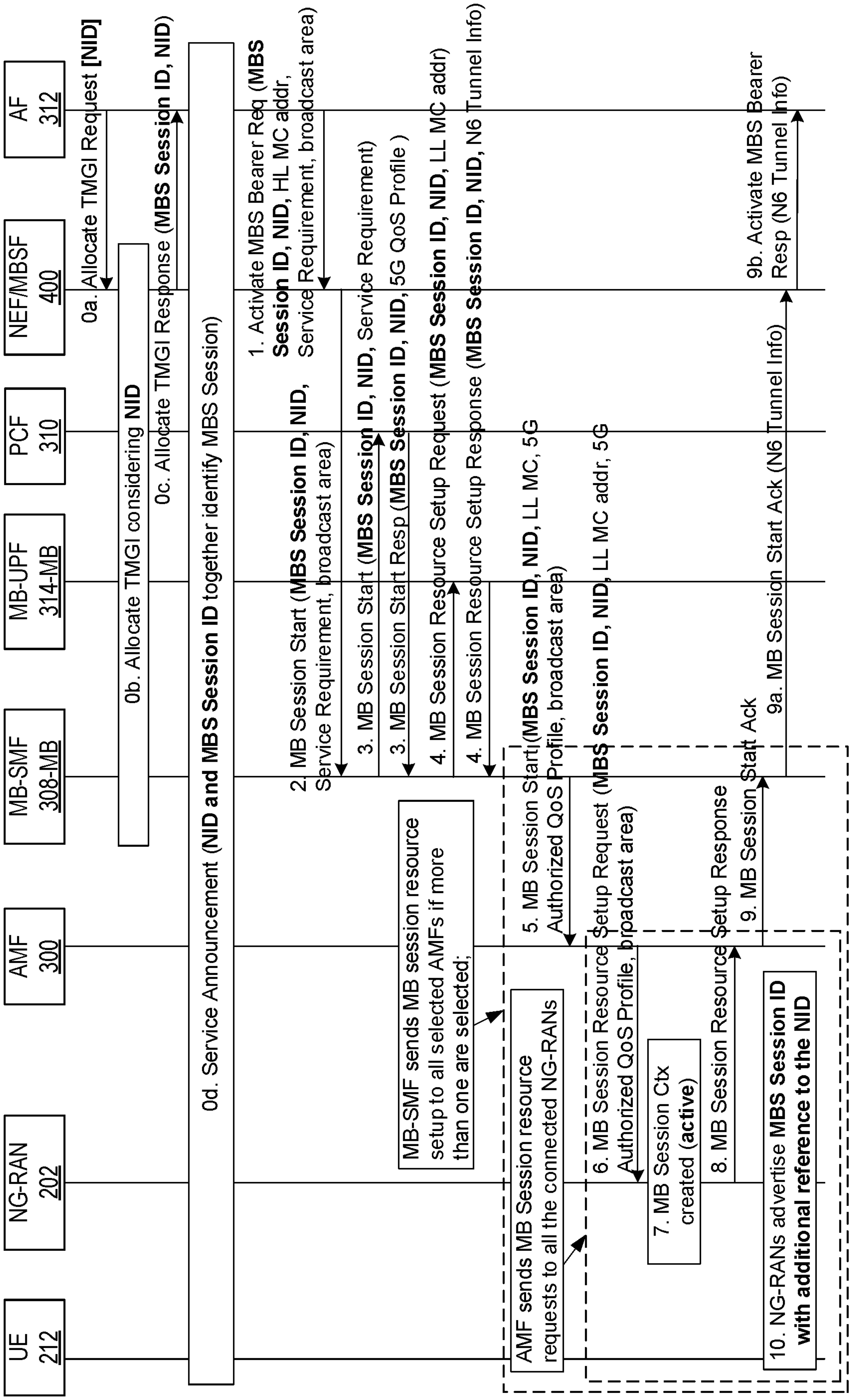
UE 212
NG-RAN 202
AMF 300
MB-SMF 308-MB
MB-UPF 314-MB
PCF 310
NEF/MBSF 400
AF 312
0a. Allocate TMGI Request [NID]
0b. Allocate TMGI considering NID
0c. Allocate TMGI Response (MBS Session ID, NID)
0d. Service Announcement (NID and MBS Session ID together identify MBS Session)
1. Activate MBS Bearer Req (MBS Session ID, NID, HL MC addr, Service Requirement, broadcast area)
2. MB Session Start (MBS Session ID, NID, Service Requirement, broadcast area)
3. MB Session Start (MBS Session ID, NID, Service Requirement)
3. MB Session Start Resp (MBS Session ID, NID, 5G QoS Profile)
4. MB Session Resource Setup Request (MBS Session ID, NID, LL MC addr)
4. MB Session Resource Setup Response (MBS Session ID, NID, N6 Tunnel Info)
MB-SMF sends MB session resource setup to all selected AMFs if more than one are selected;
5. MB Session Start (MBS Session ID, NID, LL MC, 5G Authorized QoS Profile, broadcast area)
AMF sends MB Session resource requests to all the connected NG-RANs
6. MB Session Resource Setup Request (MBS Session ID, NID, LL MC addr, 5G Authorized QoS Profile, broadcast area)
7. MB Session Ctx created (active)
8. MB Session Resource Setup Response
9. MB Session Start Ack
9a. MB Session Start Ack (N6 Tunnel Info)
9b. Activate MBS Bearer Resp (N6 Tunnel Info)
10. NG-RANs advertise MBS Session ID with additional reference to the NID

FIG. 5

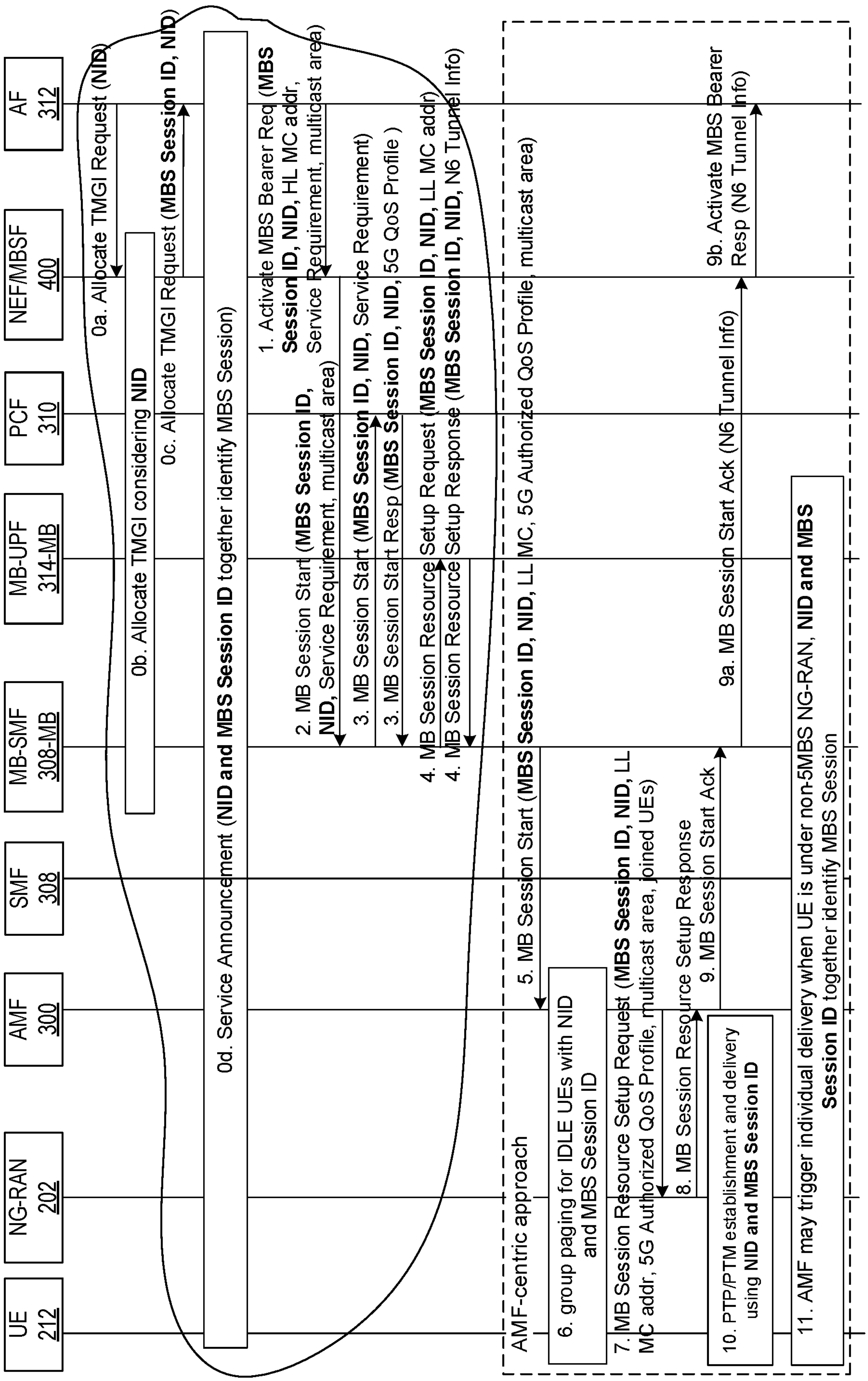
UE 212
NG-RAN 202
AMF 300
SMF 308
MB-SMF 308-MB
MB-UPF 314-MB
PCF 310
NEF/MBSF 400
AF 312
0a. Allocate TMGI Request (NID)
0b. Allocate TMGI considering NID
0c. Allocate TMGI Request (MBS Session ID, NID)
0d. Service Announcement (NID and MBS Session ID together identify MBS Session)
1. Activate MBS Bearer Req (MBS Session ID, NID, HL MC addr, Service Requirement, multicast area)
2. MB Session Start (MBS Session ID, NID, Service Requirement, multicast area)
3. MB Session Start (MBS Session ID, NID, Service Requirement)
3. MB Session Start Resp (MBS Session ID, NID, 5G QoS Profile)
4. MB Session Resource Setup Request (MBS Session ID, NID, LL MC addr)
4. MB Session Resource Setup Response (MBS Session ID, NID, N6 Tunnel Info)
AMF-centric approach
5. MB Session Start (MBS Session ID, NID, LL MC, 5G Authorized QoS Profile, multicast area)
6. group paging for IDLE UEs with NID and MBS Session ID
7. MB Session Resource Setup Request (MBS Session ID, NID, LL MC addr, 5G Authorized QoS Profile, multicast area, joined UEs)
8. MB Session Resource Setup Response
9. MB Session Start Ack
9a. MB Session Start Ack (N6 Tunnel Info)
9b. Activate MBS Bearer Resp (N6 Tunnel Info)
10. PTP/PTM establishment and delivery using NID and MBS Session ID
11. AMF may trigger individual delivery when UE is under non-5MBS NG-RAN, NID and MBS Session ID together identify MBS Session

FIG. 6A

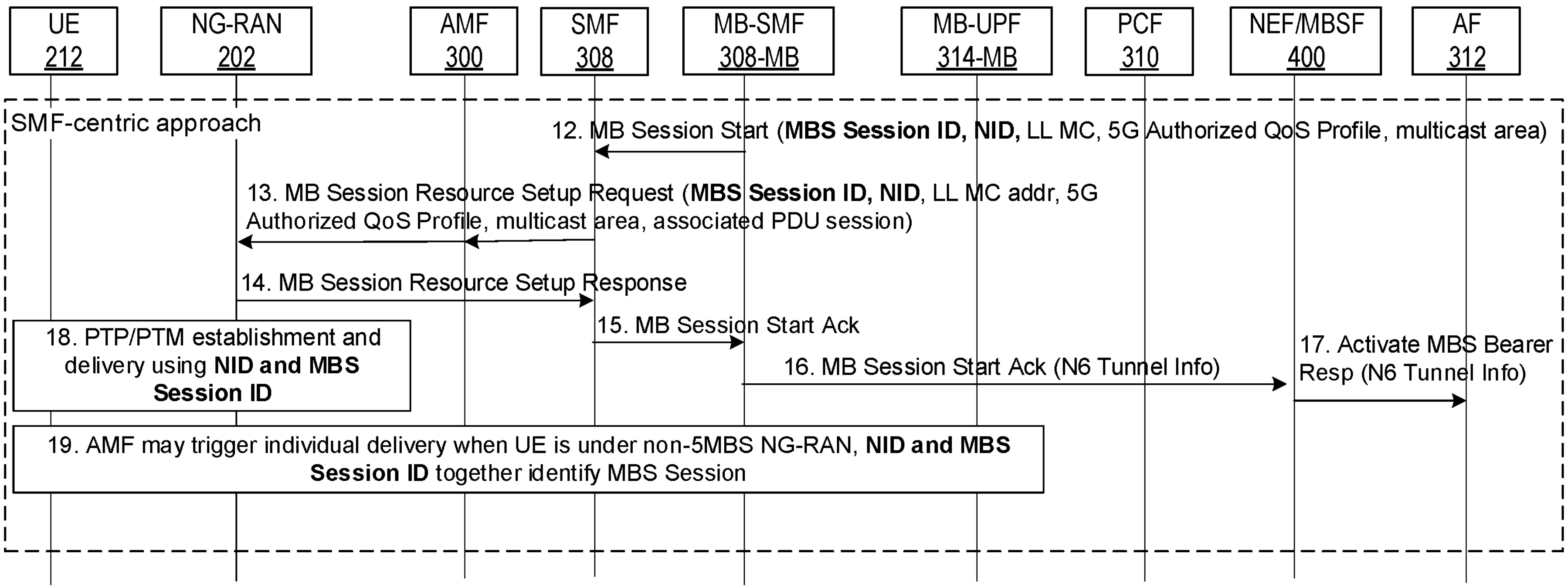
UE 212
NG-RAN 202
AMF 300
SMF 308
MB-SMF 308-MB
MB-UPF 314-MB
PCF 310
NEF/MBSF 400
AF 312
SMF-centric approach
12. MB Session Start (MBS Session ID, NID, LL MC, 5G Authorized QoS Profile, multicast area)
13. MB Session Resource Setup Request (MBS Session ID, NID, LL MC addr, 5G Authorized QoS Profile, multicast area, associated PDU session)
14. MB Session Resource Setup Response
15. MB Session Start Ack
16. MB Session Start Ack (N6 Tunnel Info)
17. Activate MBS Bearer Resp (N6 Tunnel Info)
18. PTP/PTM establishment and delivery using NID and MBS Session ID
19. AMF may trigger individual delivery when UE is under non-5MBS NG-RAN, NID and MBS Session ID together identify MBS Session

FIG. 6B

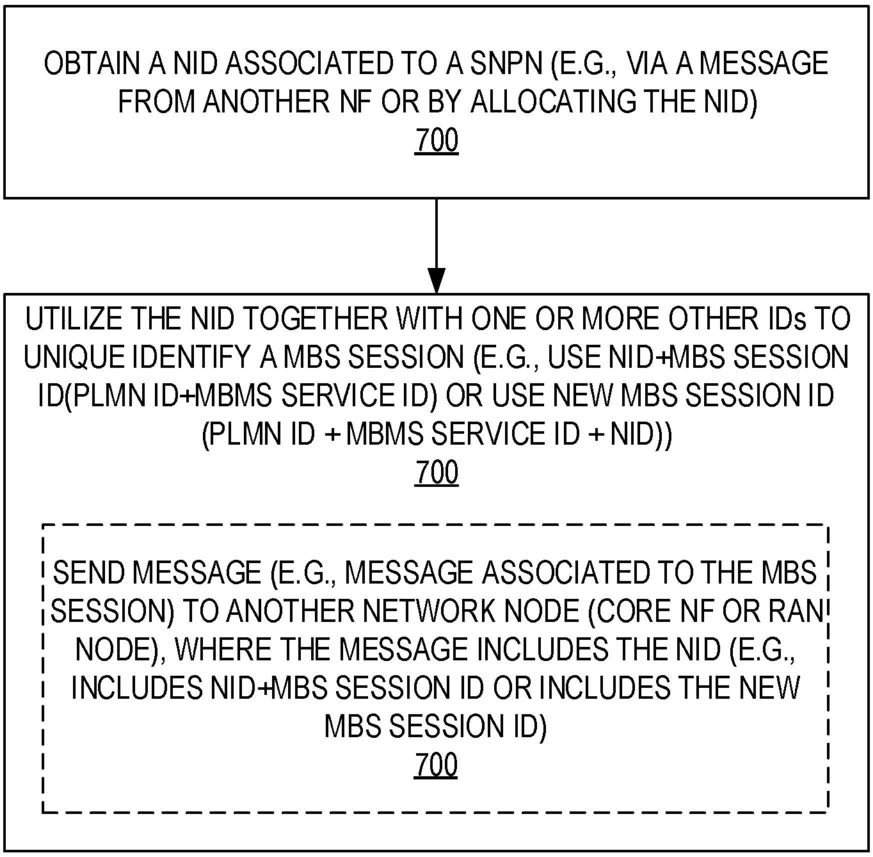
OBTAIN A NID ASSOCIATED TO A SNPN (E.G., VIA A MESSAGE FROM ANOTHER NF OR BY ALLOCATING THE NID)
700
UTILIZE THE NID TOGETHER WITH ONE OR MORE OTHER IDs TO UNIQUE IDENTIFY A MBS SESSION (E.G., USE NID+MBS SESSION ID(PLMN ID+MBMS SERVICE ID) OR USE NEW MBS SESSION ID (PLMN ID + MBMS SERVICE ID + NID))
700
SEND MESSAGE (E.G., MESSAGE ASSOCIATED TO THE MBS SESSION) TO ANOTHER NETWORK NODE (CORE NF OR RAN NODE), WHERE THE MESSAGE INCLUDES THE NID (E.G., INCLUDES NID+MBS SESSION ID OR INCLUDES THE NEW MBS SESSION ID)
700

FIG. 7

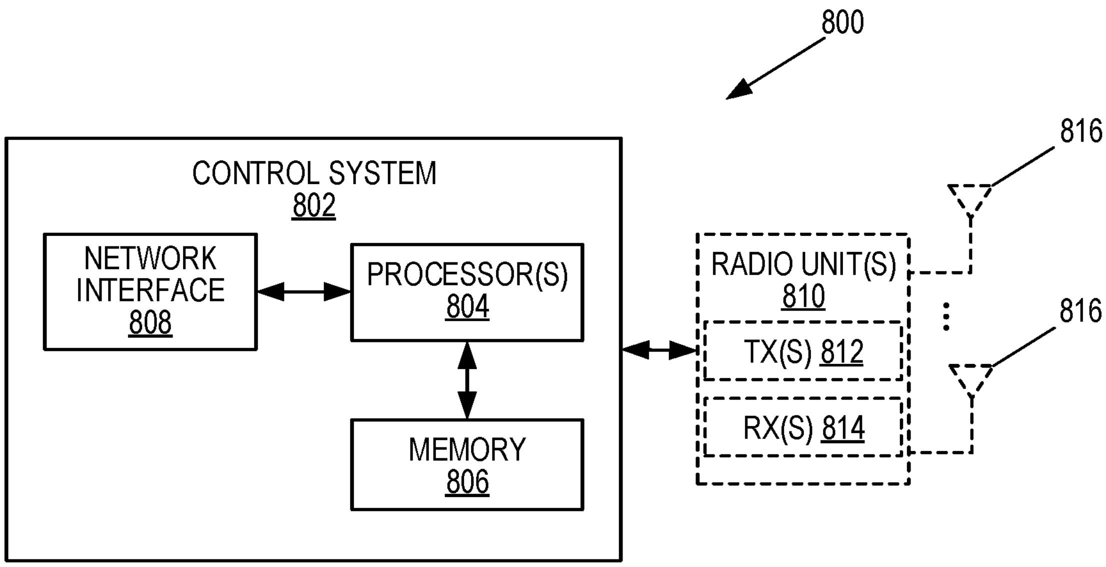
800
816
CONTROL SYSTEM
802
NETWORK
INTERFACE
808
PROCESSOR(S)
804
MEMORY
806
RADIO UNIT(S)
810
TX(S) 812
RX(S) 814
816

FIG. 8

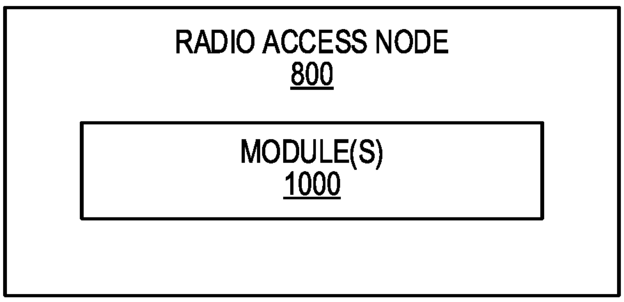
RADIO ACCESS NODE
800
MODULE(S)
1000

FIG. 10

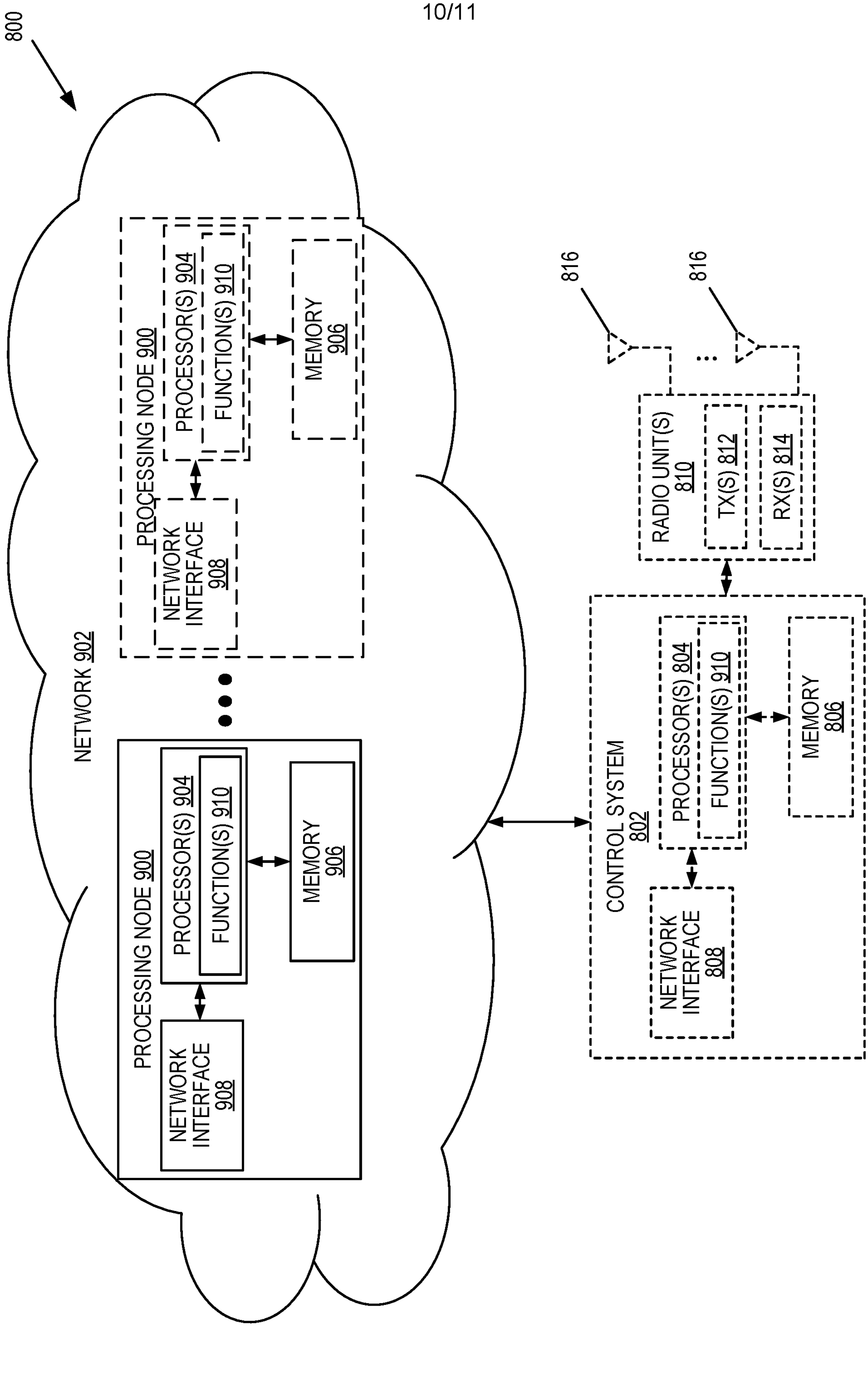
800
NETWORK 902
PROCESSING NODE 900
NETWORK INTERFACE 908
PROCESSOR(S) 904
FUNCTION(S) 910
MEMORY 906
PROCESSING NODE 900
NETWORK INTERFACE 908
PROCESSOR(S) 904
FUNCTION(S) 910
MEMORY 906
CONTROL SYSTEM 802
NETWORK INTERFACE 808
PROCESSOR(S) 804
FUNCTION(S) 910
MEMORY 806
RADIO UNIT(S) 810
TX(S) 812
RX(S) 814
816
816

FIG. 9

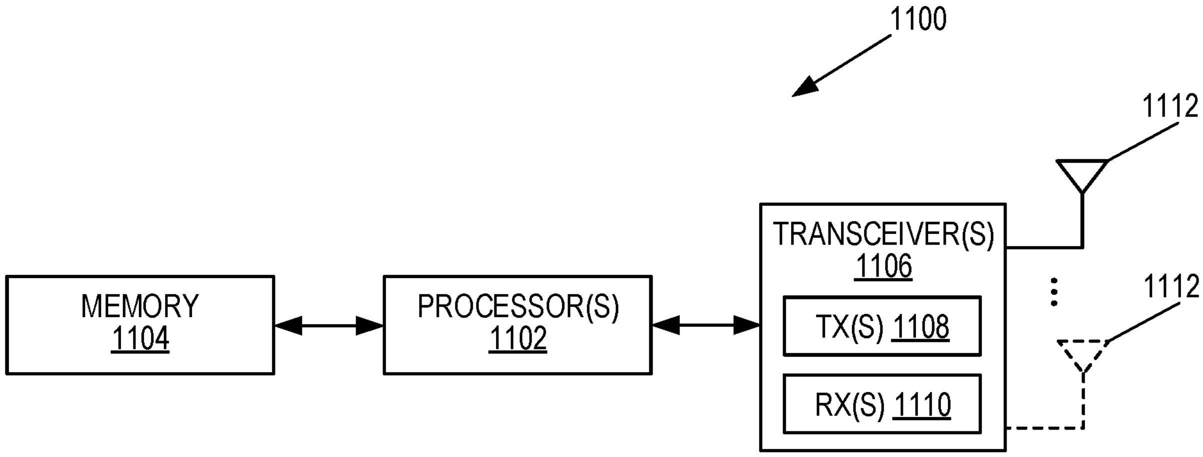
1100
1112
TRANSCEIVER(S)
1106
TX(S) 1108
RX(S) 1110
1112
MEMORY
1104
PROCESSOR(S)
1102

FIG. 11

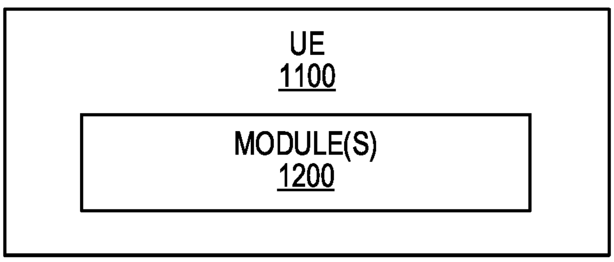
UE
1100
MODULE(S)
1200

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2022/050651

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W4/06 H04W48/00 H04W76/00
ADD.

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

EPO-Internal, COMPENDEX, INSPEC, IBM-TDB, 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	ERICSSON: "Discussion on SA2 LS on 5MBS progress and issues to address", 3GPP DRAFT; R3-210632, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG3, no. Online; 20210125 - 20210204 15 January 2021 (2021-01-15), XP051969029, Retrieved from the Internet: URL:https://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210632.zip R3-210632.doc [retrieved on 2021-01-15] the whole document ----- -/--	1-36

[X] 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
"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
29 March 2022	07/04/2022

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	Mavridis, Theodoros

1

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	HUAWEI ET AL: "KI #2, New Sol: MBS solution for eNPN", 3GPP DRAFT; S2-2005538, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. SA WG2, no. e-meeting; 20200819 - 20200902 13 August 2020 (2020-08-13), XP051920365, Retrieved from the Internet: URL:https://ftp.3gpp.org/tsg_sa/WG2_Arch/TSGS2_140e_Electronic/Docs/S2-2005538.zip S2-2005538-KI #2, New Sol MBS solution for eNPN.doc [retrieved on 2020-08-13] the whole document -----	1-36

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