(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
03 October 2024 (03.10.2024)

WIPO | PCT

(10) International Publication Number
WO 2024/199754 A1

(51) International Patent Classification:
H04W 8/18 (2009.01) *H04W 36/32* (2009.01)
G05D 1/00 (2024.01) *H04W 48/04* (2009.01)
G08G 3/00 (2006.01) *H04W 84/06* (2009.01)
H04W 36/16 (2009.01)

(21) International Application Number:
PCT/EP2024/051563

(22) International Filing Date:
23 January 2024 (23.01.2024)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
20240100019 11 January 2024 (11.01.2024) GR

(71) Applicant: **LENOVO (SINGAPORE) PTE. LTD.** [SG/SG]; 151, Lorong Chuan #02-01, New Tech Park, Singapore 556741 (SG).

(72) Inventors: **KARAMPATSIS, Dimitrios**; 9 Lawn Close, Ruislip, Middlesex HA4 6ED (GB). **VELEV, Genadi**; Im Erlich 82, 64291 Darmstadt (DE).

(74) Agent: **MARKS & CLERK LLP**; 15 Fetter Lane, London, Greater London EC4A 1BW (GB).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: NON-TRANSMIT ZONES FOR UNCREWED AERIAL VEHICLES

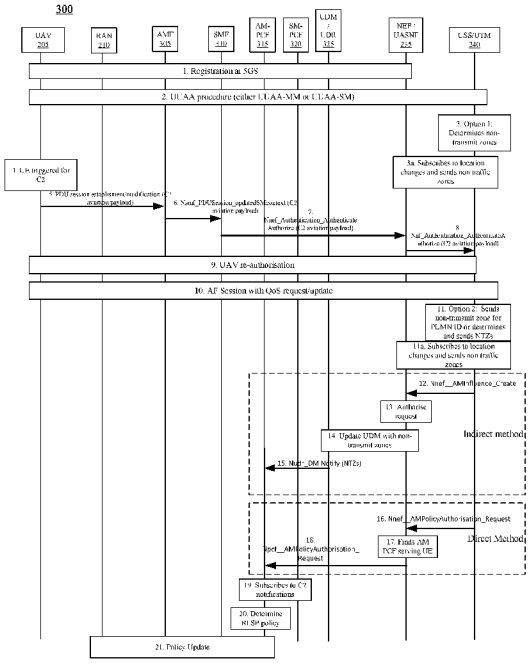

Figure 3

(57) Abstract: Various aspects of the present disclosure relate to a network entity for wireless communication, the network entity comprising instructions executable by at least one processor to cause the network entity to: obtain an indication that indicates an uncrewed aerial vehicle (UAV) accessing a public land mobile network (PLMN); and transmit, to a second network entity, a request to modify a policy to include a set of non-communication zones associated with the PLMN for the UAV.

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Published:

— *with international search report (Art. 21(3))*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*
— *upon request of the applicant, before the expiration of the time limit referred to in Article 21(2)(a)*

NON-TRANSMIT ZONES FOR UNCREWED AERIAL VEHICLES

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to wireless communications relating to operation of uncrewed aerial vehicles (UAVs).

BACKGROUND

[0002] A wireless communications system may include one or multiple network communication devices, such as base stations, which may support wireless communications for one or multiple user communication devices, which may be otherwise known as user equipment (UE), or other suitable terminology. The wireless communications system may support wireless communications with one or multiple user communication devices by utilizing resources of the wireless communication system (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers, or the like). Additionally, the wireless communications system may support wireless communications across various radio access technologies including third generation (3G) radio access technology, fourth generation (4G) radio access technology, fifth generation (5G) radio access technology, among other suitable radio access technologies beyond 5G (e.g., sixth generation (6G)).

SUMMARY

[0003] An article “a” before an element is unrestricted and understood to refer to “at least one” of those elements or “one or more” of those elements. The terms “a,” “at least one,” “one or more,” and “at least one of one or more” may be interchangeable. As used herein, including in the claims, “or” as used in a list of items (e.g., a list of items prefaced by a phrase such as “at least one of” or “one or more of” or “one or both of”) indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase “based on” shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as “based on condition A” may be based on both a condition A and a

condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase “based on” shall be construed in the same manner as the phrase “based at least in part on. Further, as used herein, including in the claims, a “set” may include one or more elements.

[0004] Some implementations of the method and apparatuses described herein may further include a network entity for wireless communication, the network entity comprising instructions executable by at least one processor to cause the network entity to obtain an indication that indicates an uncrewed aerial vehicle (UAV) accessing a public land mobile network (PLMN), and to transmit, to a second network entity, a request to modify a policy to include a set of non-communication zones associated with the PLMN for the UAV. The non-communication zones may for example be non-transmit zones.

[0005] The network entity may comprise one or more of an uncrewed aerial system (UAS) traffic management (UTM), UAS Service Supplier (USS), or an application function, (AF).

[0006] The second entity may comprise one or more of a UAS network function (NF) or a UAS network exposure function (NEF).

[0007] The set of non-communication zones may correspond to one or more geographical areas in which one or more radio frequency bands are prohibited for the UAV.

[0008] The modified policy may prohibit the one or more frequency bands for the UAV in the one or more geographical areas.

[0009] The policy may comprise a mapping of one or more radio access technology (RAT) frequency selection priority (RFSP) indexes to the one or more geographical areas to define the set of non-communication zones.

[0010] The instructions may be further executable by the at least one processor to cause the network entity to determine the set of non-communication zones based on at least in part on one or more of an identifier of the PLMN or a flight path of the UAV.

[0011] The indication may indicate that the UAV is authorized to access the PLMN to perform at least one UAV operation.

[0012] The instructions may be further executable by the at least one processor to cause the network entity to determine that the UE is UAS service supplier (USS) authenticated and authorized based at least in part on the indication.

[0013] The instructions may be further executable by the at least one processor to cause the network entity to determine that the UE is authorized for communication in the PLMN, wherein the communication comprises command and control (C2) communication.

[0014] The indication may indicate that the UAV has entered at least one non-communication zone of the set of non-communication zones.

[0015] In some implementations of the method and apparatuses described herein, a network entity may be provided for wireless communication. The network entity may comprise instructions executable by at least one processor to cause the network entity to receive, from a second network entity, a message comprising a set of modified policies associated with an uncrewed aerial vehicle (UAV), determine a set of radio access technology, RAT, Frequency Selection Priority, RFSP, policies associated with a set of non-communication zones for a public land mobile network (PLMN), and output, to a third network entity, the set of modified policies including the set of RFSP policies for the set of non-communication zones for the PLMN.

[0016] The network entity may comprise a policy control function (PCF). Alternatively or additionally, the second network entity may comprise a unified data management (UDM).

[0017] The network entity may comprise a policy control function (PCF). Alternatively or additionally, the third network entity may comprise an access and mobility function (AMF).

[0018] The instructions may be further executable by the at least one processor to cause the network entity to output the set of modified policies based at least in part on an indication that the UAV established a session for at least one UAV operation.

[0019] The third network entity may comprise a session management function (SMF).

[0020] The instructions may be further executable by the at least one processor to cause the network entity to output the set of modified policies in response to an indication from the third network function that the UAV has entered at least one non-communication zone of the set of non-communication zones or is estimated to enter the at least one non-communication zone of the set of non-communication zones, wherein the third network entity comprises an access and mobility function (AMF) or a location management function (LMF)

[0021] In some implementations of the methods and apparatuses described herein, a method is performed by a first network entity for wireless communication, the method comprising obtaining an indication that indicates an uncrewed aerial vehicle (UAV) accessing a public land mobile network (PLMN), and transmitting, to a second network entity, a request to modify a policy to include a set of non-communication zones associated with the PLMN for the UAV.

[0022] In some implementations of the methods and apparatuses described herein, a method is performed by a network entity for wireless communication, the method comprising receiving, from a second network entity, a message comprising a set of modified policies associated with an uncrewed aerial vehicle (UAV), determining a set of radio access technology, RAT, Frequency Selection Priority, RFSP, policies associated with a set of non-communication zones for a public land mobile network (PLMN), and outputting, to a third network entity, the set of modified policies including the set of RFSP policies for the set of non-communication zones for the PLMN.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Figure 1 illustrates an example of a wireless communications system in accordance with aspects of the present disclosure.

[0024] Figure 2 illustrates a network in accordance with aspects of the present disclosure.

[0025] Figure 3 illustrates a communication flow in accordance with aspects of the present disclosure.

[0026] Figure 4 illustrates a communication flow in accordance with aspects of the present disclosure.

[0027] Figure 5 illustrates an example of a network entity (NE) in accordance with aspects of the present disclosure.

[0028] Figure 6 illustrate a flowchart of a method performed by a NE in accordance with aspects of the present disclosure.

[0029] Figure 7 illustrates a flowchart of a method performed by a NE in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

[0030] Some wireless communication systems may support operation of unmanned aerial systems that include an unmanned/uncrewed aerial vehicle (UAV) controller and a UAV, which may perform UAV operations, such as C2 operations. However, these wireless communication systems may be unable to comply with non-communication zones (also referred to as “non-transmit zones”), which may be enforced by a third-party entity. For example, non-communication zones may prohibit transmissions (e.g., on one or more frequency bands) within one or more geographical areas, for example, to mitigate or reduce interference to other UE, such as radars.

[0031] Various aspects of the present disclosure relate to enabling a UE, such as a UAV in a wireless communication system (e.g., a PLMN) to manage operation (e.g., refrain from performing transmission(s)) when the UAV is within at least one non-communication zone associated with at least one geographical area of the wireless communication system. The UAV may be configured with (e.g., indicated) the at least one non-communication zone associated with at least one geographical area of the wireless communication system as described herein.

[0032] Aspects of the present disclosure are described in the context of a wireless communications system.

[0033] Figure 1 illustrates an example of a wireless communications system 100 in accordance with aspects of the present disclosure. The wireless communications system 100 may include one or more NE 102, one or more UE 104, and a core network (CN) 106. The wireless communications system 100 may support various radio access technologies. In some implementations, the wireless communications system 100 may be a 4G network, such as an LTE network or an LTE-Advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a NR network, such as a 5G network, a 5G-Advanced (5G-A) network, or a 5G ultrawideband (5G-UWB) network. In other implementations, the wireless communications system 100 may be a combination of a 4G network and a 5G network, or other suitable radio access technology including Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100 may support radio access technologies beyond 5G, for example, 6G. Additionally, the wireless communications system 100 may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0034] The one or more NE 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the NE 102 described herein may be or include or may be referred to as a network node, a base station, a network entity, a network function, a network element, a radio access network (RAN), a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. An NE 102 and a UE 104 may communicate via a communication link, which may be a wireless or wired connection. For example, an NE 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0035] An NE 102 may provide a geographic coverage area for which the NE 102 may support services for one or more UEs 104 within the geographic coverage area. One or more of these UEs may for example be UAVs as discussed elsewhere herein. For example, an NE 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, an NE 102 may be moveable, for

example, a satellite associated with a non-terrestrial network (NTN). In some implementations, different geographic coverage areas 112 associated with the same or different radio access technologies may overlap, but the different geographic coverage areas may be associated with different NE 102.

[0036] The one or more UE 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a remote unit, a mobile device, a wireless device, a remote device, a subscriber device, a transmitter device, a receiver device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an Internet-of-Things (IoT) device, an Internet-of-Everything (IoE) device, or machine-type communication (MTC) device, among other examples.

[0037] A UE 104 may be able to support wireless communication directly with other UEs 104 over a communication link. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 114 may be referred to as a sidelink. For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0038] An NE 102 may support communications with the CN 106, or with another NE 102, or both. For example, an NE 102 may interface with other NE 102 or the CN 106 through one or more backhaul links (e.g., S1, N2, N2, or network interface). In some implementations, the NE 102 may communicate with each other directly. In some other implementations, the NE 102 may communicate with each other or indirectly (e.g., via the CN 106. In some implementations, one or more NE 102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other access network transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

[0039] The CN 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The CN 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a Packet Data Network (PDN) gateway (P-GW), or a user plane function (UPF)). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g., data bearers, signal bearers, etc.) for the one or more UEs 104 served by the one or more NE 102 associated with the CN 106.

[0040] The CN 106 may communicate with a packet data network over one or more backhaul links (e.g., via an S1, N2, N2, or another network interface). The packet data network may include an application server. In some implementations, one or more UEs 104 may communicate with the application server. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or the like) with the CN 106 via an NE 102. The CN 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the application server using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the CN 106 (e.g., one or more network functions of the CN 106).

[0041] In the wireless communications system 100, the NEs 102 and the UEs 104 may use resources of the wireless communications system 100 (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the NEs 102 and the UEs 104 may support different resource structures. For example, the NEs 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the NEs 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the NEs 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures). The NEs 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0042] One or more numerologies may be supported in the wireless communications system 100, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g., μ=0) may be associated with a first subcarrier spacing (e.g., 15 kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g., μ=0) associated with the first subcarrier spacing (e.g., 15 kHz) may utilize one slot per subframe. A second numerology (e.g., μ=1) may be associated with a second subcarrier spacing (e.g., 30 kHz) and a normal cyclic prefix. A third numerology (e.g., μ=2) may be associated with a third subcarrier spacing (e.g., 60 kHz) and a normal cyclic prefix or an extended cyclic prefix. A fourth numerology (e.g., μ=3) may be associated with a fourth subcarrier spacing (e.g., 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g., μ=4) may be associated with a fifth subcarrier spacing (e.g., 240 kHz) and a normal cyclic prefix.

[0043] A time interval of a resource (e.g., a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (ms) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 ms duration. In some implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0044] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., μ=0, μ=1, μ=2, μ=3, μ=4) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may include a number (e.g., quantity) of symbols (e.g., OFDM symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 60 kHz subcarrier spacing), a slot may include 12

symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g., μ=0) associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots.

[0045] In the wireless communications system 100, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100 may support one or multiple operating frequency bands, such as frequency range designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR4a or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the NEs 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the NEs 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the NEs 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0046] FR1 may be associated with one or multiple numerologies (e.g., at least three numerologies). For example, FR1 may be associated with a first numerology (e.g., μ=0), which includes 15 kHz subcarrier spacing; a second numerology (e.g., μ=1), which includes 30 kHz subcarrier spacing; and a third numerology (e.g., μ=2), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g., at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g., μ=2), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g., μ=3), which includes 120 kHz subcarrier spacing.

[0047] In the wireless communication system 100, a UE 104 may be, for example, a UAV configured to manage operation (e.g., refrain from performing transmission(s)) when the UE 104 is within at least one non-communication zone associated with at least one geographical area of the wireless communication system 100. The UE 104 may be configured with (e.g., indicated) the at least one non-communication zone associated with

at least one geographical area of the wireless communication system 100 as described herein with reference to Figures 2 through 4.

[0048] Figure 2 illustrates a network for supporting UAS in accordance with aspects of the present disclosure. The network may implement or be implemented by aspects of the wireless communication system 100 as described herein with reference to Figure 1. For example, the network may include a UAV 205, which may be an example of a UE 104 as described herein with reference to Figure 1. The network may include an NE 210 associated with a first radio access technology (e.g., 5G NR) and a NE 215 associated with a second radio access technology (e.g., 4G LTE), which may be an example of a NE 102 as described herein with reference to Figure 1. It should be noted that the network may support radio access technologies beyond 4G LTE and 5G NR.

[0049] The UAV 205 may communicate (e.g., one or more of transmit or receive signaling, including control information or data) with one or more of the NE 210 or the NE 215 via one or more communication links (e.g., Uu interface). The NE 210 may communicate (e.g., one or more of transmit or receive signaling) with a CN 220 associated with the first radio access technology via a backhaul interface (e.g., in accordance with an S1, N2, N3, or other interface protocol) and may be an example of a CN 106 as described herein with reference to Figure 1. For example, the CN 220 may be a 5G core network (5GC). The NE 225 may communicate (e.g., one or more of transmit or receive signaling) with a CN 220 associated with the second radio access technology via a backhaul interface (e.g., in accordance with an S1, N2, N3, or other interface protocol) and may be an example of a CN 106 as described herein with reference to Figure 1. For example, the CN 225 may be an evolved packet core network (EPC).

[0050] One or more of the CN 220 or the CN 225 may communicate (e.g., one or more of transmit or receive signaling) with a data network 230. Additionally, or alternatively, the CN 220 may communicate (e.g., one or more of transmit or receive signaling) with a UAS network function (NF) or a UAS network exposure function (NEF) (herein referred to as UAS NF/NEF 235). The UAS NF/NEF 235 may communicate (e.g., one or more of transmit or receive signaling) with a UAS service supplier (USS) 240, which may be part of the data network 230. Additionally, the network may include a third party authorized entity

(TPAE) 245, which may communicate (e.g., one or more of transmit or receive signaling) with the data network 230.

[0051] The UAS NF/NEF 235 (e.g., one or more of the UAS NF or the UAS NEF) may be configured to indicate (e.g., expose) to one or more of a UAS traffic management UTM or the USS 240 location information of the UAV 205. The location information may be based at least in part on location services (LCS) or information obtained from an AMF, for example, associated with one or more of the CN 220 or the CN 225. The UAS NF/NEF 235 (e.g., one or more of the UAS NF or the UAS NEF) may interfaces with one or more of a UTM or the USS 240 for performing an authentication and authorization of the UAV 205, for example, authorizing the UAV 205 to perform one or more UAV operations via the network (e.g. a 3GPP network).

[0052] The UAV 205, including a UAV controller (UAV-C) of the UAV 205, may be part of a UAS. The UAS may establish a user plane connectivity between the UAV 205 and a UTM/USS. Identification and tracking information may be exchanged (e.g., transmitted, received) over the user plane connectivity. The UAS may also establish a user plane connectivity between the UAV-C of the UAV 205 and the UAV 205 for C2. To support one or more UAV operations, the network may have a requirement for the UAS to be registered (or register) to a USS provider. The registration to the USS provider and/or establishment that the requirement has been met may, for example, be established with a non-3GPP procedure. In some implementations, the requirement may correspond to the UAS having a valid flight authorization provided by the USS provider. The requirement for the UAS to have the valid flight authorization may, for example, be established with a non-3GPP procedure.

[0053] In the example of Figure 2, the network may perform various operations, processes, tasks, or procedures in order to authorize the UAV 205 to access a network, for example, in conformance with 3GPP TS 23.256. For example, the network may perform a USS UAV authorization/authentication (UUAA) procedure to verify that a UAS has a valid registration to a USS provider. The network may perform a C2 authorization procedure to authorize the UAV 205 to establish user plane connectivity via a 3GPP system for UAV operation.

[0054] In some cases, an application function (AF) may trigger a change to one or more access and mobility (AM) management policies. Such an AF may be able to impact a change to the one or more AM policies associated with a service coverage and one or more throughput requirements. However, the AF may lack the capability or functionality to indicate one or more frequency bands, associated with prohibiting communications on the one or more frequency bands, in the one or more AM policies. In the examples of Figure 2, it may be desirable to enforce restrictions to one or more UAV operations of the UAV 205, for example, such as one or more non-communication zones (also referred to as non-transmit zones (NTZs)). An NTZ may be a geographical area, in which the UAV 205 may be prohibited (e.g., not allowed) to transmit on one or more frequency bands, for example, in order to reduce interference on similar or adjacent frequency bands. Aspects of the present disclosure allow the network to be configured with one or more NTZs, for example, by a USS/UTM operator. Aspects of the present disclosure allow a USS/UTM 240 to indicate one or more geographical areas (e.g., coverage areas of the network) corresponding to one or more NTZs with the requirements (e.g., one or more frequency bands on which the UAV 205 is not permitted to transmit).

[0055] Figure 3 shows a process flow 300 in accordance with aspects of the present disclosure. The process flow 300 may implement aspects of the wireless communications system 100 as described with reference to Figure 1. The process flow 300 may involve one or more of a UAV 205, a RAN 210, an AMF 305, a session management function (SMF) 310, an access and mobility policy control function (AM-PCF) 315, a session management policy control function (SM-PCF) 320, a unified data management/user data repository (UDM/UDR) 325, a NEF/UASNF 235, and a USS/UTM 240. In the following description of the process flow 300, the operations between one or more of the UAV 205, the RAN 210, the AMF 305, the SMF 310, the AM-PCF 315, the SM-PCF 320, the UDM/UDR 325, the NEF/UASNF 235, or the USS/UTM 240 may be transmitted or received in a different order than the example order shown, or the operations performed by one or more of the UAV 205, the RAN 210, the AMF 305, the SMF 310, the AM-PCF 315, the SM-PCF 320, the UDM/UDR 325, the NEF/UASNF 235, or the USS/UTM 240 may be performed in different order or at different times. Some operations may also be omitted from the process flow 300, and other operations may be added to the process flow 300.

[0056] In the example of Figure 3, the UTM/USS 240 may trigger a change of one or more AM policies. The USS/UTM 240 may trigger a change of one or more AM policies based at least in part on the UTM/USS 240 determining that the UAV 205 is UUAA authorized. Additionally, or alternatively, the USS/UTM 240 may trigger the change of the one or more AM policies based at least in part on the UTM/USS 240 determining that the UAV 205 requested C2 communication. Additionally, or alternatively, the USS/UTM 240 may trigger the change of the one or more AM policies based at least in part on the UTM/USS 240 determining that the UAV 205 is located within with an NTZ.

[0057] At 1, the UAV 205 may perform a registration procedure, for example, with a network, which may involve one or more of the RAN 210, the AMF 305, the SMF 310, the AM-PCF 315, the SM-PCF 320, the UDM/UDR 325, or the NEF/UASNF 235. In some implementations, the UAV 205 may transmit an indication that indicates a CAA-Level UAV identifier associated with the UAV 205 during the registration procedure. A CAA (Civil Aviation Administration)-Level UAV identifier may be an identifier that uniquely identifies a UAV within the scope of a USS.

[0058] At 2, one or more of the AMF 305 (UUAA-MM) or the SMF 310 (UUAA-SM) may perform a UUAA procedure, which may involve one or more of the UAV 205, the RAN 210, the AM-PCF 315, the SM-PCF 320, the UDM/UDR 325, the NEF/UASNF 235, or the USS/UTM 240.

[0059] At 3, optionally, the UTM/USS 240 may determine one or more NTZ zones. In some implementations, the UTM/USS 240 may determine one or more NTZ zones in response to the UTM/USS 240 determining that the UAV 205 is UUAA authorized. For example, the UTM/USS 240 may determine that the UAV 205 is UUAA authorized based at least in part on a PLMN identifier.

[0060] At 3a, optionally, the UTM/USS 240 may subscribe to location changes associated with the UAV 205, for example by transmitting a subscription message to the NEF/UASNF 235. Put another way, the UTM/USS 240 may subscribe to be indicated of a change to a location of the UAV 205. In some implementations, in response to the UTM/USS 240 determining that the UAV 205 has entered (or is predicted to enter, for

example, based at least in part on a flight path of the UAV 205) an NTZ, the UTM/USS 240 may trigger an AM policy influence process to update an AM policy.

[0061] At 4, the UAV 205 may determine a trigger to establish a communication session for C2. Put another way, the UAV 205 may be triggered to establish the communication session for C2, for example in respond to a command to establish C2.

[0062] At 5 through 10, the UAV 205 performs an authorization for C2, including flight path information, via a PDU session establishment procedure (or a PDU session modification procedure). The UTM/USS 240 configures pairing policies for the UAV/UAV-C.

[0063] Specifically, at 5, the UAV 205 transmits a PDU session establishment/modification message, with a C2 aviation payload, to the AMF 305. At 6, the AMF 305 transmits a Nsmf_PDUSession_updatedSMcontext message with the C2 aviation payload to the SMF 310. At 7, the SMF 310 transmits a Nnef_Authentication_AuthenticateAuthorize message with the C2 aviation payload to the NEF/UASNF 235. At 8, the NEF/UASNF 235 transmits a Naf_Authentication_AuthenticateAuthorize message with the C2 aviation payload to the UTM/USS 240. At 9, the UAV re-authorises to the network. At 10, an AF session is established with quality of service (QoS) request/update.

[0064] At 11, optionally, once C2 is authorised the UTM/USS 240 determines one or more NTZ zones for the UAV 205. The determination may be based on a PLMN ID of the operator where the UAV 205 is registered. In an alternative example, the UTM/USS may determine the NTZ zones based on an authorised flight path of the UAV 205. The UTM/USS 240 sends the NTZ zone info by invoking 12 or 16 (as discussed below).

[0065] At 11a, optionally, the UTM/USS 240 may request information regarding location changes for the UAV 205. When the UTM/USS 240 determines that the UAV 205 has entered (or is about to enter) an NTZ zone the UTM/USS 240 may trigger AM policy influence (as in 12 or 16 discussed below).

[0066] 12-18 will now be discussed. In examples, either 12-15, or 16-18 are performed. 12-15 relate to an indirect method and 16-18 relate to a direct method.

[0067] At 12, the UTM/USS 240 may invoke an Nnef_AMInfluence_Create service operation that includes a USS Identify/AF identifier, GPSI, CAA-Level UAV ID and NTZ

zone info. The NTZ zone info may include one or more permitted and/or restricted frequency bands for one or more geographical areas.

[0068] In an alternative example, the UTM/USS 240 may invoke step 12 for a group of UAVs (including the UAV 205) that are UUAA or C2 authorized. In this example the UTM/USS 240 additionally includes a group identifier in the request in 12.

[0069] At 13, the UAS NF/NEF 235 may authorise the request.

[0070] At 14, the UAS NF/NEF 235 may update the UDM 325 with non-transmit zones for the UAV 205 or group of UAVs.

[0071] At 15, the UDM 325 may notify the AM-PCF 315 that it has subscribed to notification of AM policy changes.

[0072] At 16, the UTM/USS 240 may invoke an Nnef_AMPolicyAuthorisation_Request service operation that includes a USS Identify/AF identifier, GPSI, CAA-Level UAV ID and NTZ zone info. The NTZ zone info may include one or more permitted and/or restricted frequency bands for one or more geographical areas.

[0073] At 17, the UAS NF/NEF 235 may find the particular AM-PCF 315 which is serving the UAV 205.

[0074] At 18, the UAS NF/NEF 235 may forward the request to the AM-PCF 315.

[0075] At 19, the AM-PCF 315 may subscribe to the SM-PCF 320 (e.g. by way of a subscription request message) to be notified when a PDU session for UAV operations (e.g. C2 operations for the UAV 205) is established.

[0076] At 20, the AM-PCF 315 may determine a radio access technology (RAT) Frequency Selection Priority (RFSP) policy for the UAV 205 indicating to the UAV 205 to use frequency bands other than restricted bands in NTZ zones. The AM-PCF 315 may determine such RFSP policies based on the SM-PCF 320 indicating that a UAV 205 has established a PDU session for UAV operations and the AM-PCF 315 has NTZ zone info from the UDM. Alternatively or additionally, the AM-PCF 315 may determine such RFSP policies based on the AM-PCF 315 receiving updated NTZ zone info from the UDM 325 and based on the UAV 205 having entered or being about to enter an NTZ zone.

[0077] At 21, the AM-PCF 315 may update the AM policy towards the RAN 210 for example as described in 23.502 clause 4.16.2.

[0078] Figure 4 shows a process flow 400 in accordance to aspects of the present disclosure. The process flow 400 may implement aspects of the wireless communications system 100 as described with reference to Figure 1. The process flow 400 may involve one or more of a UAV 205, RAN 210, NEF/UASNF 235 and USS/UTM 240, AMF 305, SMF 310, AM-PCF 315, SM-PCF 320, UDM/UDR 325, as discussed above.

[0079] In the following description of the process flow 400, the operations between one or more of the UAV 205, the RAN 210, the AMF 305, the SMF 310, the AM-PCF 315, the SM-PCF 320, the UDM/UDR 325, the NEF/UASNF 235, or the USS/UTM 240 may be transmitted or received in a different order than the example order shown, or the operations performed by one or more of the UAV 205, the RAN 210, the AMF 305, the SMF 310, the AM-PCF 315, the SM-PCF 320, the UDM/UDR 325, the NEF/UASNF 235, or the USS/UTM 240 may be performed in different order or at different times. Some operations may also be omitted from the process flow 400, and other operations may be added to the process flow 400.

[0080] In the example of Figure 4, the UTM/USS 240 may provide flight directions. In this scenario it may be assumed that the 3GPP core network is aware of the one or more NTZ zones. In this example, the UAS-NF may determines any NTZ zones in the flight path of the UAV.

[0081] At 1, the UAV 205 may perform a registration procedure, for example, with a network, which may involve one or more of the RAN 210, the AMF 305, the SMF 310, the AM-PCF 315, the SM-PCF 320, the UDM/UDR 325, or the NEF/UASNF 235. In some implementations, the UAV 205 may transmit an indication that indicates a CAA-Level UAV identifier associated with the UAV 205 during the registration procedure.

[0082] At 2, one or more of the AMF 305 (UUAA-MM) or the SMF 310 (UUAA-SM) may perform a UUAA procedure, which may involve one or more of the UAV 205, the RAN 210, the AM-PCF 315, the SM-PCF 320, the UDM/UDR 325, the NEF/UASNF 235, or the USS/UTM 240.

[0083] At 3, the UAV 205 is triggered to establish a communication session for C2. Put another way, the UAV 205 may be triggered to establish the communication session for C2, for example in respond to a command to establish C2.

[0084] At 4 through 8, the UAV 205 performs an authorisation for C2 (which may include flight path information) via a PDU session establishment procedure (or a PDU session modification procedure). The UTM/USS 240 configures pairing policies for the UAV/UAV-C.

[0085] Specifically, at 4, the UAV 205 transmits a PDU session establishment/modification message, with a C2 aviation payload, to the AMF 305. At 5, the AMF 305 transmits a Nsmf_PDUSession_updatedSMcontext message with the C2 aviation payload to the SMF 310. At 6, the SMF 310 transmits a Nnef_Authentication_AuthenticateAuthorize message with the C2 aviation payload to the NEF/UASNF 235. At 7, the NEF/UASNF 235 transmits a Naf_Authentication_AuthenticateAuthorize message with the C2 aviation payload to the UTM/USS 240. At 8, the UAV re-authorises to the network.

[0086] At 9, the UTM/USS 240 may have information indicating aspects of the flight path of the UAV 205 and may include them in an AF session QoS request to be transmitted to the NEF/UASNF 235.

[0087] At 10, the UTM/USS 240 invokes an Nnef_AFsessionwithQoS create service operation with the NEF/UASNF 235, which may include the flight path info information.

[0088] At 11, the AF session with QoS procedure continues for example as per Figure 4.16.6.6-1 of 23.502.

[0089] At 12, the UAS NF/NEF 235 may determine based on the flight path that the UAV 205 is in an NTZ zone or the flight path is via one or more NTZ zones. The UAS NF/NEF 235 may be aware of the NTZ zones based on configuration from an operations, administration and maintenance (OAM) function. Alternatively or additionally, the UAS NF/NEF 235 may receive a description of the NTZ zones from the UDM 325, in response to a request thereto.

[0090] The UAS NF/NEF 235 may then invoke either 13 to 14 or 15 to 16 as discussed below. 13-14 relate to an indirect method, and 15-16 relate to a direct method.

[0091] At 13, the UAS NF/NEF 235 may update the UDM 325 with a description of NTZs for the UAV 205, or a group of UEs including the UAV 205.

[0092] At 14, the UDM 325 may notify the AM-PCF 315 that it has subscribed to notification of AM policy changes.

[0093] At 15, the UAS NF/NEF 235 may find the identity of the specific AM-PCF 315 serving the UAV 205.

[0094] At 16, a the UAS NF/NEF 235 may transmit a Npcf__AMPolicyAuthorisation_Request request to the AM-PCF 315; the request may include at least one of a USS and/or AF identifier, GPSI, CAA-Level UAA ID and NTZ zone information. The NTZ zone information may include one or more permitted and/or restricted frequency bands for one or more geographical areas.

[0095] At 17, the AM-PCF 315 may subscribe to the SM-PCF 320 to be notified when a PDU session for UAV operations (e.g. C2 operations) is established.

[0096] At 18, the AM-PCF 315 may determine one or more RFSP policies for the UAV 205 indicating to the UAV 205 to use frequency bands other than restricted bands in NTZ zones. The AM-PCF 315 may determine RFSP policies based at least in part on the SM-PCF 320 indicating that the UAV 205 has established a PDU session for UAV operations and the AM-PCF 315 has NTZ zone info from the UDM 325. Alternatively or additionally, the AM-PCF 315 may determine RFSP policies based at least in part on the AM-PCF 315 having received updated NTZ zone info from the UDM 325 and the UAV 205 having entered or being about to enter an NTZ zone.

[0097] At 19, the AM-PCF 315 may update the AM policy towards the RAN 210 for example as described in 23.502 clause 4.16.2.

[0098] In summary, the present disclosure provides for methods and apparatuses for configuring frequency- and geographically- specific non-transmit zones for a UAV operating as a UE in a mobile communications network.

[0099] Figure 5 illustrates an example of a network equipment (also termed “network entity) (NE) 500 in accordance with aspects of the present disclosure. The NE 500 may include a processor 502, a memory 504, a controller 506, and a transceiver 508. The processor 502, the memory 504, the controller 506, or the transceiver 508, or various

combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. These components may be coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

[0100] The processor 502, the memory 504, the controller 506, or the transceiver 508, or various combinations or components thereof may be implemented in hardware (e.g., circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), or other programmable logic device, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure.

[0101] The processor 502 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, or any combination thereof). In some implementations, the processor 502 may be configured to operate the memory 504. In some other implementations, the memory 504 may be integrated into the processor 502. The processor 502 may be configured to execute computer-readable instructions stored in the memory 504 to cause the NE 500 to perform various functions of the present disclosure.

[0102] The memory 504 may include volatile or non-volatile memory. The memory 504 may store computer-readable, computer-executable code including instructions when executed by the processor 502 cause the NE 500 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such the memory 504 or another type of memory. Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer.

[0103] In some implementations, the processor 502 and the memory 504 coupled with the processor 502 may be configured to cause the NE 500 to perform one or more of the functions described herein (e.g., executing, by the processor 502, instructions stored in the memory 504). For example, the processor 502 may support wireless communication at the NE 500 in accordance with examples as disclosed herein. The NE 500 may be configured

to support a means for performing the functions described in the present disclosure, in particular with reference to Figures 3 and 4. For example, the network equipment 500 may implement one or more network functions, such as a UTM/USS/AF 240, UAS NF/NEF 235, PCF 315, UDM 325 and/or AMF 305.

[0104] The controller 506 may manage input and output signals for the NE 500. The controller 506 may also manage peripherals not integrated into the NE 500. In some implementations, the controller 506 may utilize an operating system such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 506 may be implemented as part of the processor 502.

[0105] In some implementations, the NE 500 may include at least one transceiver 508. In some other implementations, the NE 500 may have more than one transceiver 508. The transceiver 508 may represent a wireless transceiver. The transceiver 508 may include one or more receiver chains 510, one or more transmitter chains 512, or a combination thereof.

[0106] A receiver chain 510 may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receiver chain 510 may include one or more antennas for receive the signal over the air or wireless medium. The receiver chain 510 may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receiver chain 510 may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receiver chain 510 may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0107] A transmitter chain 512 may be configured to generate and transmit signals (e.g., control information, data, packets). The transmitter chain 512 may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmitter chain 512 may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable

for transmission over the wireless medium. The transmitter chain 512 may also include one or more antennas for transmitting the amplified signal into the air or wireless medium.

[0108] Figure 6 illustrates a flowchart of a method in accordance with aspects of the present disclosure. The operations of the method may be implemented by a NE as described herein, for example a NE comprising a first network function such as a UTM/USS/AF 240. In some implementations, the NE may execute a set of instructions to control the function elements of the NE to perform the described functions.

[0109] At 602, the method may include obtaining an indication that indicates an uncrewed aerial vehicle (UAV) accessing a public land mobile network (PLMN).

[0110] At 604, the method may include transmitting, to a second network entity, a request to modify a policy to include a set of non-communication zones associated with the PLMN for the UAV.

[0111] Figure 7 illustrates a flowchart of a method in accordance with aspects of the present disclosure. The operations of the method may be implemented by a NE as described herein. For example, the method may be implemented by a NE comprising a PCF 315. In some implementations, the NE may execute a set of instructions to control the function elements of the NE to perform the described functions.

[0112] At 702, the method may include receiving, from a second network entity, a message comprising a set of modified policies associated with an uncrewed aerial vehicle (UAV).

[0113] At 704, the method may include determining a set of radio access technology, RAT, Frequency Selection Priority, RFSP, policies associated with a set of non-communication zones for a public land mobile network (PLMN).

[0114] At 706, the method may include outputting, to a third network entity, the set of modified policies including the set of RFSP policies for the set of non-communication zones for the PLMN.

[0115] It should be noted that the methods described herein describe possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0116] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

CLAIMS

What is claimed is:

1. A network entity for wireless communication, the network entity comprising instructions executable by at least one processor to cause the network entity to:

obtain an indication that indicates an uncrewed aerial vehicle (UAV) accessing a public land mobile network (PLMN); and

transmit, to a second network entity, a request to modify a policy to include a set of non-communication zones associated with the PLMN for the UAV.

2. The network entity of claim 1, wherein the network entity comprises one or more of an uncrewed aerial system (UAS) traffic management (UTM), UAS Service Supplier (USS), or an application function, (AF).

3. The network entity of claims 1 or 2, wherein the second entity comprises one or more of a UAS network function (NF) or a UAS network exposure function (NEF).

4. The network entity of any preceding claim, wherein the set of non-communication zones correspond to one or more geographical areas in which one or more radio frequency bands are prohibited for the UAV.

5. The network entity of claim 4, wherein the modified policy prohibits the one or more frequency bands for the UAV in the one or more geographical areas.

6. The network entity of claim 4 or claim 5, wherein the policy comprises a mapping of one or more radio access technology (RAT) frequency selection priority (RFSP) indexes to the one or more geographical areas to define the set of non-communication zones.

7. The network entity of any preceding claim, wherein the instructions are further executable by the at least one processor to cause the network entity to:

determine the set of non-communication zones based on at least in part on one or more of an identifier of the PLMN or a flight path of the UAV.

8. The network entity of any preceding claim, wherein the indication indicates that the UAV is authorized to access the PLMN to perform at least one UAV operation.

9. The network entity of claim 8, wherein the instructions are further executable by the at least one processor to cause the network entity to:

determine that the UE is UAS service supplier (USS) authenticated and authorized based at least in part on the indication.

10. The network entity of any preceding claim, wherein the instructions are further executable by the at least one processor to cause the network entity to:

determine that the UE is authorized for communication in the PLMN, wherein the communication comprises command and control (C2) communication.

11. The network entity of any preceding claim, wherein the indication indicates that the UAV has entered at least one non-communication zone of the set of non-communication zones.

12. A network entity for wireless communication, the network entity comprising instructions executable by at least one processor to cause the network entity to:

receive, from a second network entity, a message comprising a set of modified policies associated with an uncrewed aerial vehicle (UAV);

determine a set of radio access technology, RAT, Frequency Selection Priority, RFSP, policies associated with a set of non-communication zones for a public land mobile network (PLMN); and

output, to a third network entity, the set of modified policies including the set of RFSP policies for the set of non-communication zones for the PLMN.

13. The network entity of claim 12, wherein the network entity comprises a policy control function (PCF), and wherein the second network entity comprises a unified data management (UDM).

14. The network entity of claims 12 or 13, wherein the network entity comprises a policy control function (PCF), and wherein the third network entity comprises an access and mobility function (AMF).

15. The network entity of any of claims 12 to 14, wherein the instructions are further executable by the at least one processor to cause the network entity to:

output the set of modified policies based at least in part on an indication that the UAV established a session for at least one UAV operation.

16. The network entity of claim 15, wherein the third network entity comprises a session management function (SMF).

17. The network entity of any of claims 12 to 16, wherein the instructions are further executable by the at least one processor to cause the network entity to:

output the set of modified policies in response to an indication from the third network function that the UAV has entered at least one non-communication zone of the set of non-communication zones or is estimated to enter the at least one non-communication zone of the set of non-communication zones,

wherein the third network entity comprises an access and mobility function (AMF) or a location management function (LMF)

18. A method performed by a first network entity for wireless communication, the method comprising:

obtaining an indication that indicates an uncrewed aerial vehicle (UAV) accessing a public land mobile network (PLMN); and

transmitting, to a second network entity, a request to modify a policy to include a set of non-communication zones associated with the PLMN for the UAV.

19. A method performed by a network entity for wireless communication, the method comprising:

receiving, from a second network entity, a message comprising a set of modified policies associated with an uncrewed aerial vehicle (UAV);

determining a set of radio access technology, RAT, Frequency Selection Priority, RFSP, policies associated with a set of non-communication zones for a public land mobile network (PLMN); and

outputting, to a third network entity, the set of modified policies including the set of RFSP policies for the set of non-communication zones for the PLMN.

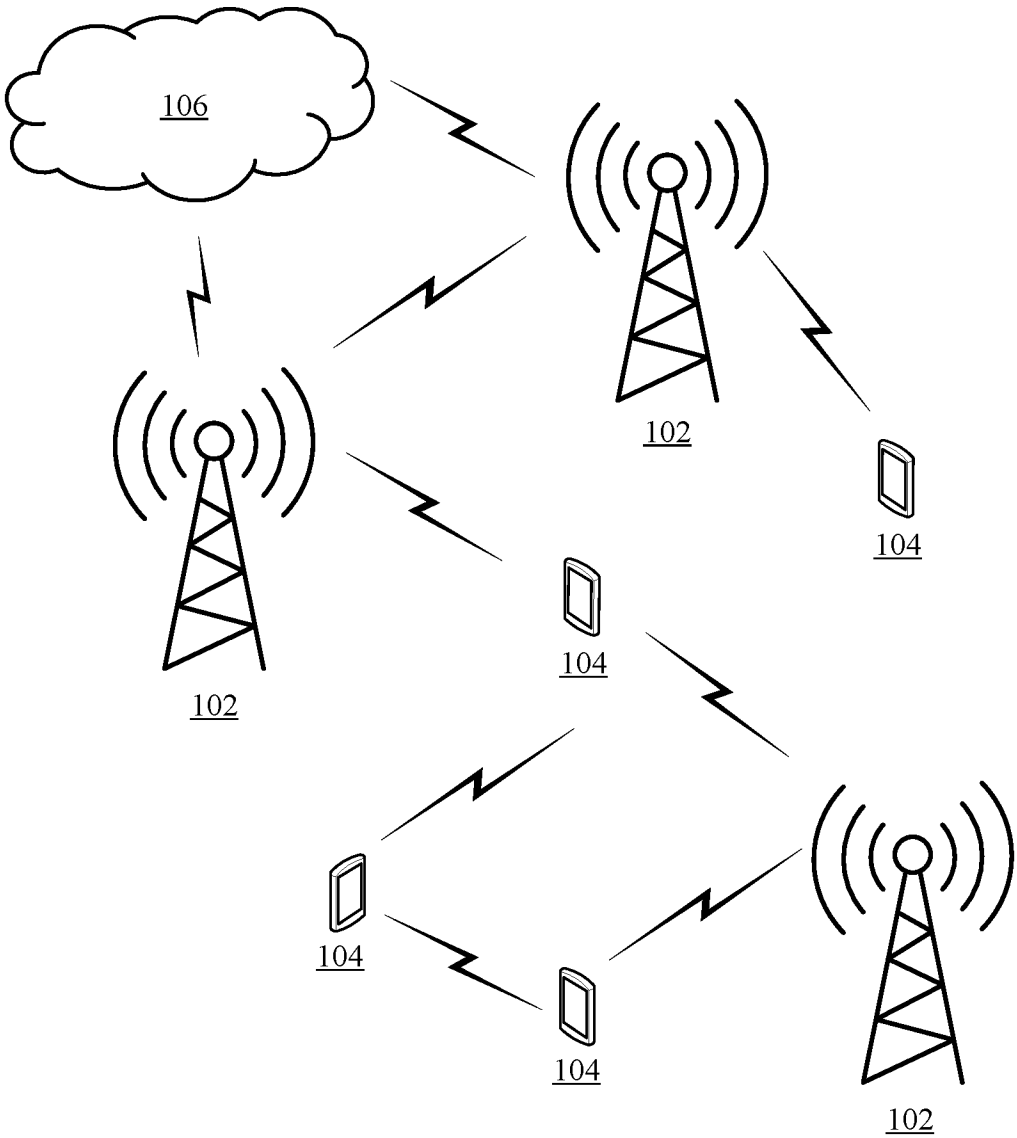
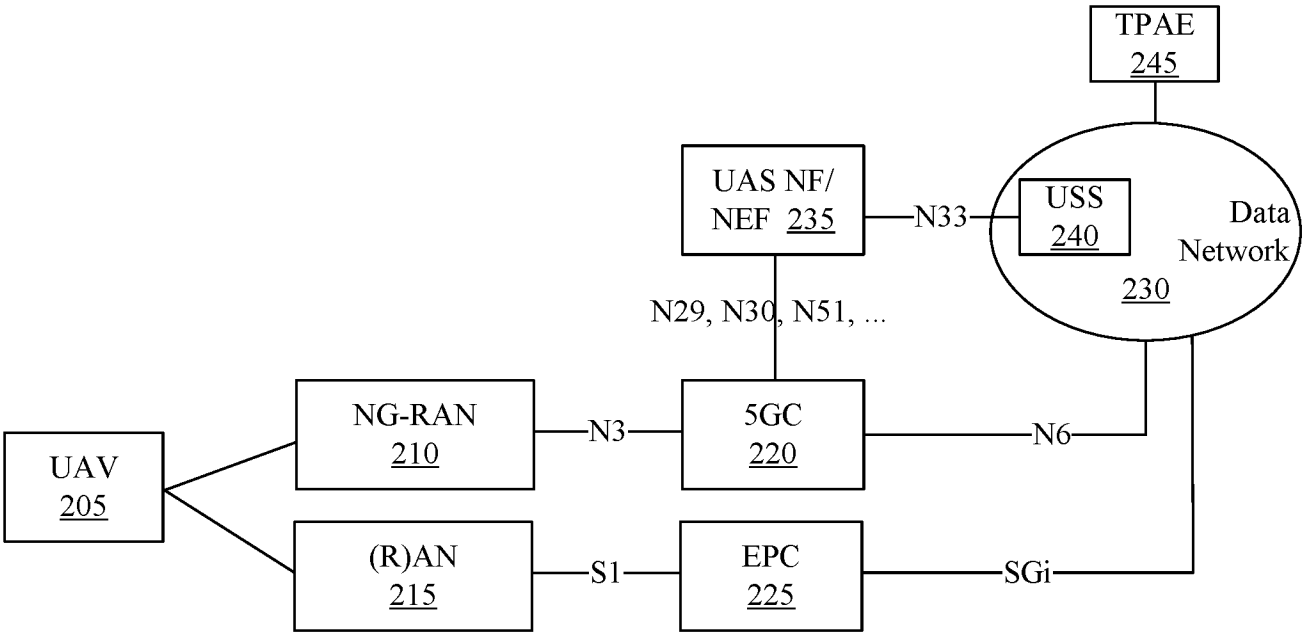


Figure 1


TPAE
245
UAS NF/
NEF 235
N33
USS
240
Data
Network
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N29, N30, N51, ...
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N6
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(R)AN
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S1
EPC
225
SGi

Figure 2

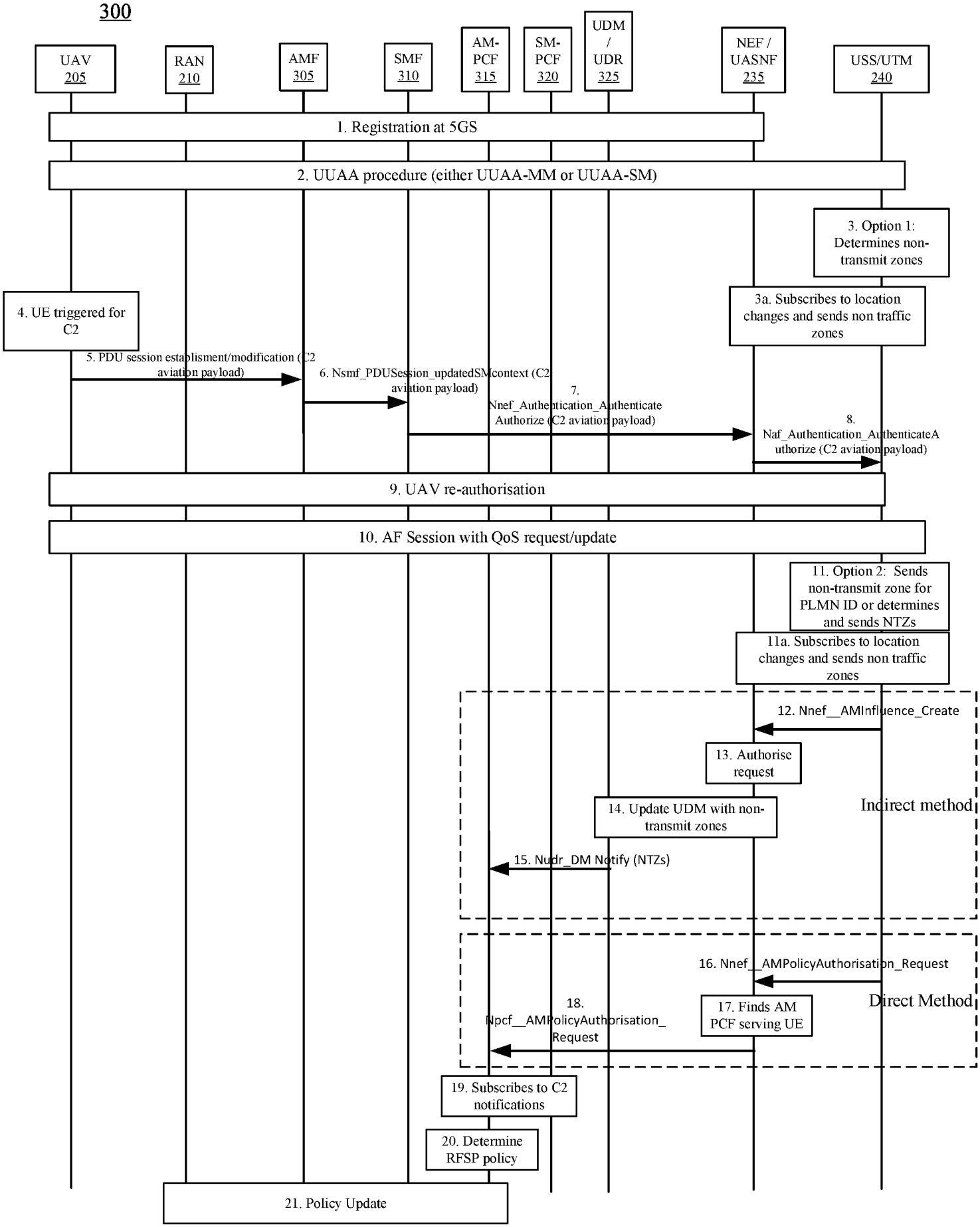
300
UAV 205
RAN 210
AMF 305
SMF 310
AM-PCF 315
SM-PCF 320
UDM / UDR 325
NEF / UASNF 235
USS/UTM 240
1. Registration at 5GS
2. UUAA procedure (either UUAA-MM or UUAA-SM)
3. Option 1: Determines non-transmit zones
3a. Subscribes to location changes and sends non traffic zones
4. UE triggered for C2
5. PDU session establisment/modification (C2 aviation payload)
6. Nsmf_PDUSession_updatedSMcontext (C2 aviation payload)
7. Nnef_Authentication_Authenticate Authorize (C2 aviation payload)
8. Naf_Authentication_AuthenticateAuthorize (C2 aviation payload)
9. UAV re-authorisation
10. AF Session with QoS request/update
11. Option 2: Sends non-transmit zone for PLMN ID or determines and sends NTZs
11a. Subscribes to location changes and sends non traffic zones
12. Nnef__AMInfluence_Create
13. Authorise request
14. Update UDM with non-transmit zones
Indirect method
15. Nudr_DM Notify (NTZs)
16. Nnef__AMPolicyAuthorisation_Request
17. Finds AM PCF serving UE
Direct Method
18. Npcf__AMPolicyAuthorisation_Request
19. Subscribes to C2 notifications
20. Determine RFSP policy
21. Policy Update

Figure 3

400

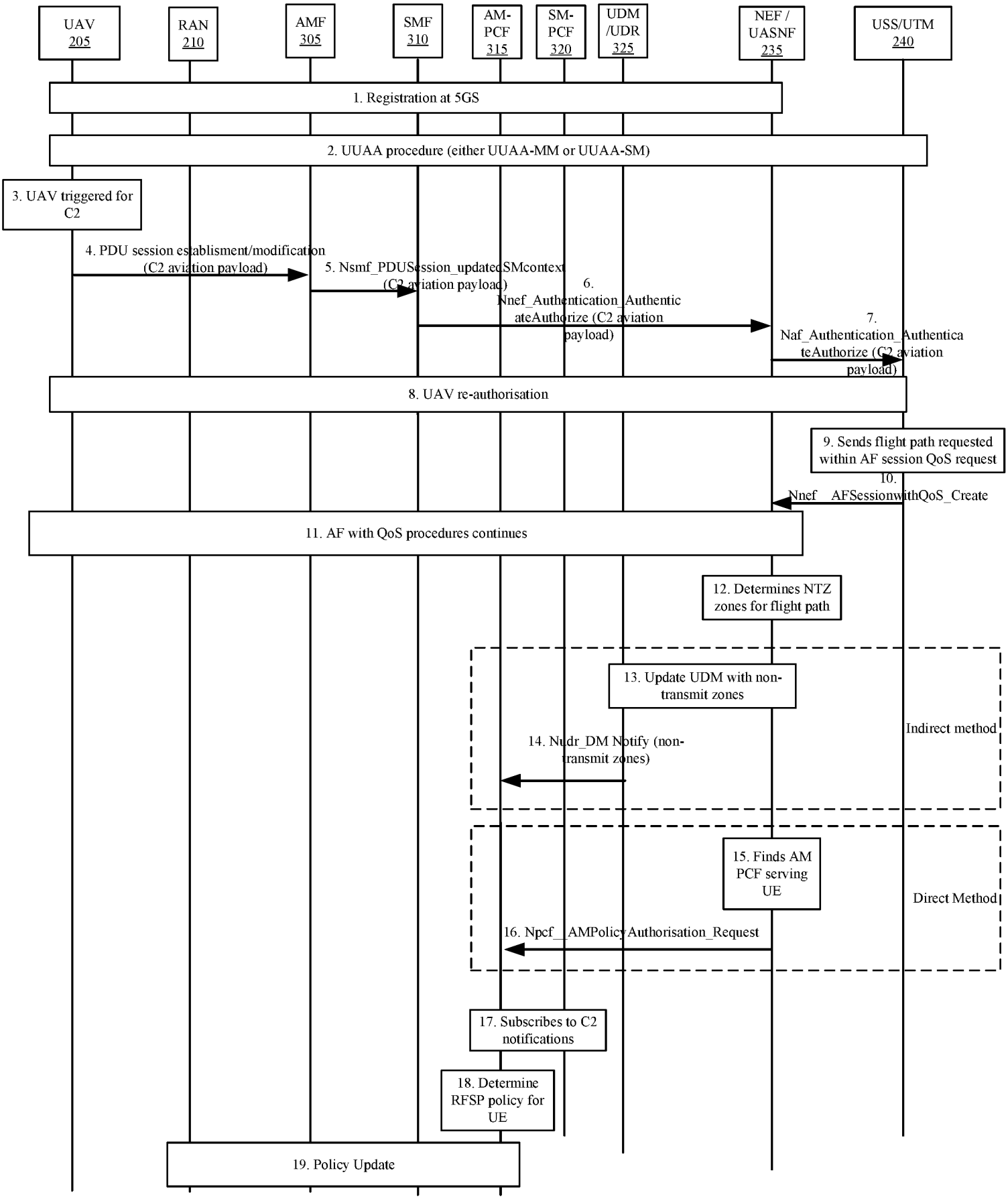
UAV 205
RAN 210
AMF 305
SMF 310
AM-PCF 315
SM-PCF 320
UDM /UDR 325
NEF / UASNF 235
USS/UTM 240
1. Registration at 5GS
2. UUAA procedure (either UUAA-MM or UUAA-SM)
3. UAV triggered for C2
4. PDU session establisment/modification (C2 aviation payload)
5. Nsmf_PDUSession_updateSMcontext (C2 aviation payload)
6. Nnef_Authentication_AuthenticateAuthorize (C2 aviation payload)
7. Naf_Authentication_AuthenticateAuthorize (C2 aviation payload)
8. UAV re-authorisation
9. Sends flight path requested within AF session QoS request
10. Nnef__AFSessionwithQoS_Create
11. AF with QoS procedures continues
12. Determines NTZ zones for flight path
13. Update UDM with non-transmit zones
14. Nudr_DM Notify (non-transmit zones)
Indirect method
15. Finds AM PCF serving UE
16. Npcf__AMPolicyAuthorisation_Request
Direct Method
17. Subscribes to C2 notifications
18. Determine RFSP policy for UE
19. Policy Update

Figure 4

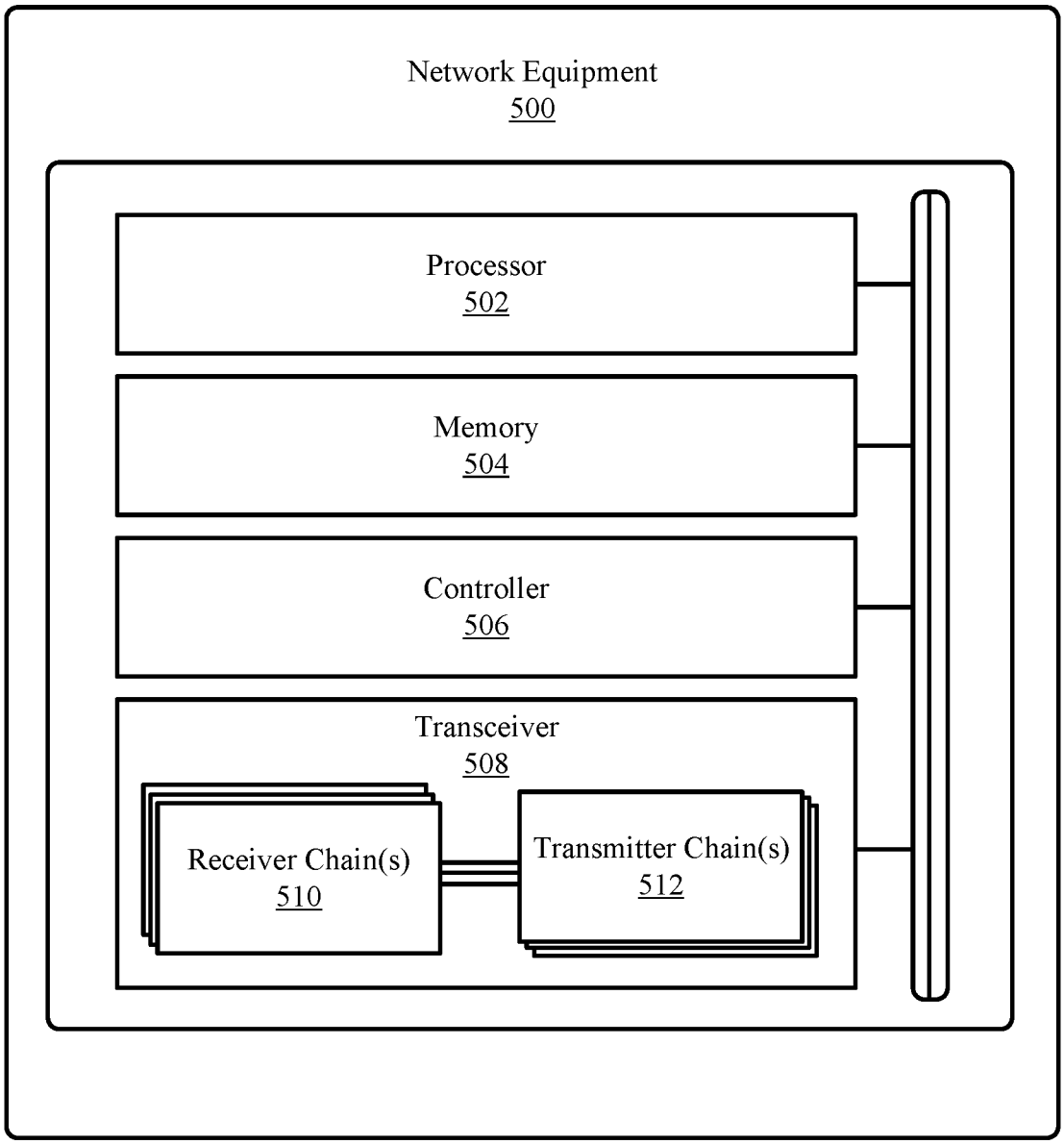
Network Equipment
500
Processor
502
Memory
504
Controller
506
Transceiver
508
Receiver Chain(s)
510
Transmitter Chain(s)
512

Figure 5

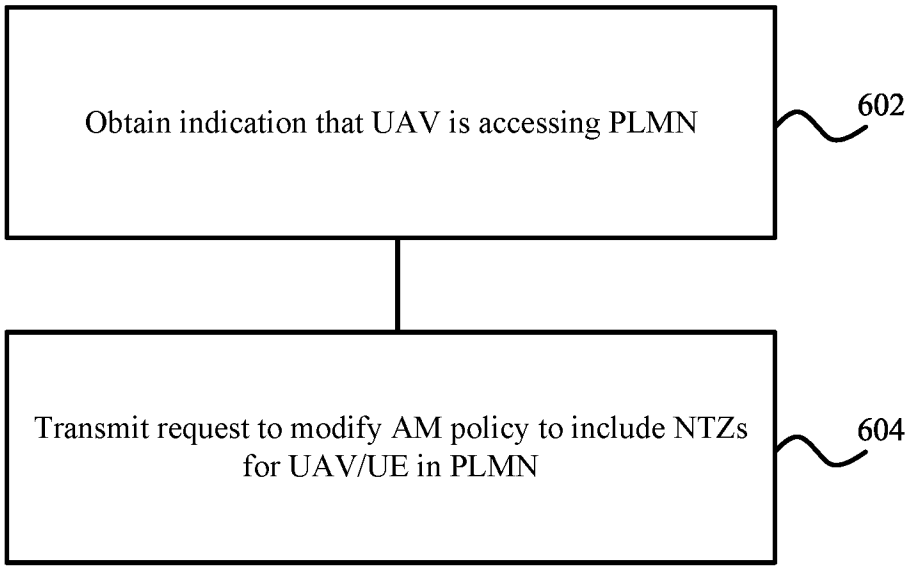
Obtain indication that UAV is accessing PLMN
602
Transmit request to modify AM policy to include NTZs for UAV/UE in PLMN
604

Figure 6

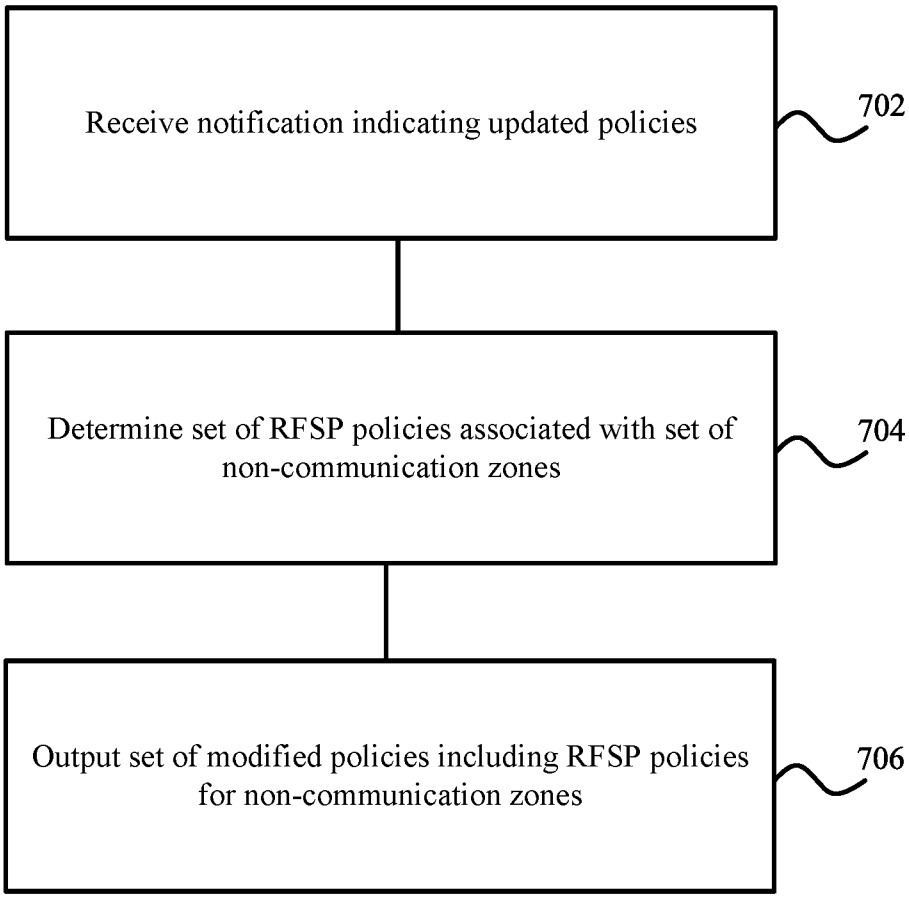
Receive notification indicating updated policies
702
Determine set of RFSP policies associated with set of non-communication zones
704
Output set of modified policies including RFSP policies for non-communication zones
706

Figure 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2024/051563

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/051563

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04W8/18 G05D1/00 G08G3/00
ADD. H04W36/16 H04W36/32 H04W48/04 H04W84/06

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 H04B G08G G05D

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 A	US 2022/312205 A1 (PARK JUNGSHIN [KR] ET AL) 29 September 2022 (2022-09-29) paragraphs [0115] - [0168] -----	1-3, 7-10,18 4-6, 11-17,19
A	US 2021/101679 A1 (HAN YOONSEON [KR] ET AL) 8 April 2021 (2021-04-08) paragraphs [0076] - [0094], [0144] - [0171], [0188] - [0223], [0250] - [0275] -----	1-19

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[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

"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
6 August 2024	19/08/2024

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	Davidovic, Sasa

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

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/051563

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; System architecture for the 5G System (5GS); Stage 2 (Release 18)", 3GPP STANDARD; 3GPP TS 23.501, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. SA WG2, no. V18.4.0 19 December 2023 (2023-12-19), pages 1-706, XP052552988, Retrieved from the Internet: URL:https://ftp.3gpp.org/Specs/archive/23_series/23.501/23501-i40.zip 23501-i40.docx [retrieved on 2023-12-19] chapter 5.3.4.3.1 -----	1-19
A	"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Procedures for the 5G System (5GS); Stage 2 (Release 18)", 3GPP STANDARD; 3GPP TS 23.502, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. SA WG2, no. V18.4.0 19 December 2023 (2023-12-19), pages 1-909, XP052552991, Retrieved from the Internet: URL:https://ftp.3gpp.org/Specs/archive/23_series/23.502/23502-i40.zip 23502-i40.docx [retrieved on 2023-12-19] chapter 4.16.1 -----	1-19

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/051563

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; Policy and charging control framework for the 5G System (5GS); Stage 2 (Release 18)", 3GPP STANDARD; 3GPP TS 23.503, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. SA WG2, no. V18.4.0 19 December 2023 (2023-12-19), pages 1-179, XP052552992, Retrieved from the Internet: URL:https://ftp.3gpp.org/Specs/archive/23_series/23.503/23503-i40.zip 23503-i40.docx [retrieved on 2023-12-19] chapter 6.1.2.1 -----	1-19
A	"3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Study on CT WG3 Aspects of 5G System Phase 1; (Release 16)", 3GPP STANDARD; TECHNICAL REPORT; 3GPP TR 29.890, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. CT WG3, no. V16.0.0 10 July 2020 (2020-07-10), pages 1-158, XP051924753, Retrieved from the Internet: URL:ftp://ftp.3gpp.org/Specs/archive/29_series/29.890/29890-g00.zip 29890-g00.doc [retrieved on 2020-07-10] chapter 5.3.1 -----	1-19

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2024/051563

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2022312205 A1	29-09-2022	CN 117063498 A	14-11-2023
		EP 4302497 A1	10-01-2024
		KR 20220133042 A	04-10-2022
		US 2022312205 A1	29-09-2022
		WO 2022203360 A1	29-09-2022
US 2021101679 A1	08-04-2021	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-19

A network entity for wireless communication and a corresponding method.

1.1. claims: 1-11, 18

- A network entity for wireless communication, the network entity comprising instructions executable by at least one processor to cause the network entity to obtain an indication that indicates an UAV accessing a PLMN; and transmit, to a second network entity, a request to modify a policy to include a set of non-communication zones associated with the PLMN for the UAV.
- A corresponding method.

1.2. claims: 12-17, 19

- A network entity for wireless communication, the network entity comprising instructions executable by at least one processor to cause the network entity to receive, from a second network entity, a message comprising a set of modified policies associated with an UAV; determine a set of RFSP policies associated with a set of non-communication zones for a PLMN; and output, to a third network entity, the set of modified policies including the set of RFSP policies for the set of non-communication zones for the PLMN.
- A corresponding method.