



- (51) **International Patent Classification:**
H04W 76/15 (2018.01) *H04W 60/00* (2009.01)
- (21) **International Application Number:**
PCT/US2020/018355
- (22) **International Filing Date:**
14 February 2020 (14.02.2020)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
62/806,133 15 February 2019 (15.02.2019) US
62/826,237 29 March 2019 (29.03.2019) US
- (71) **Applicant: IDAC HOLDINGS, INC.** [US/US]; 200 Bellevue Parkway, Suite 300, Wilmington, DE 19809 (US).
- (72) **Inventors: WANG, Guanzhou;** 3665 Croissant des Caryers, Brossard, Quebec, J4Z 3S7 (CA). **AHMAD, Saad;** 1150 Rue Saint Denis Apartment 613, Montreal, Quebec, H2X 0B3 (CA).
- (74) **Agent: ROCCIA, Vincent, J. et al.;** Condo Roccia Kop-tiw LLP, 1800 JFK Boulevard, Suite 1700, Philadelphia, PA 19103 (US).
- (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, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,

(54) **Title:** MULTI-ACCESS PDU SESSION

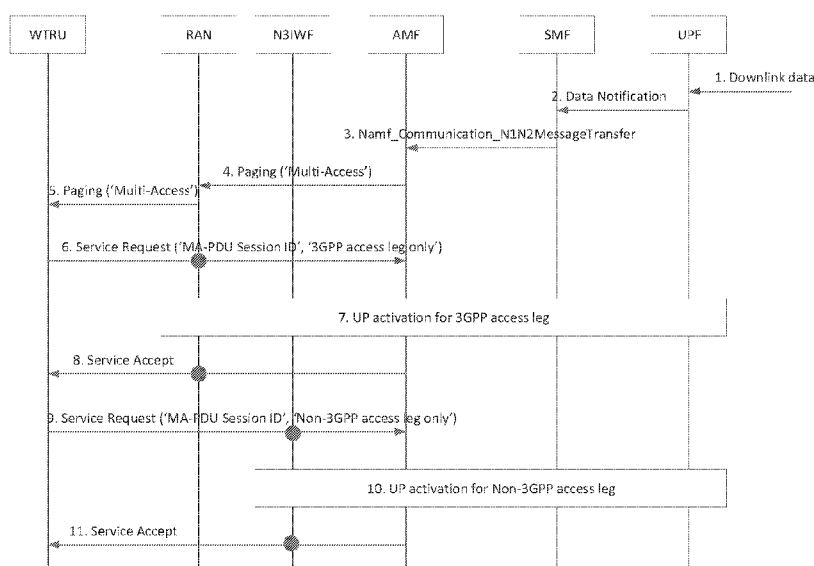


FIG. 5

(57) **Abstract:** A WTRU may receive a paging message from a core network system via a 3GPP access network. The paging message may comprise a "Multi-Access" indication and may be associated with reactivating an existing MA PDU session over the 3GPP access network and a non-3GPP access network. The WTRU may be in a CM-IDLE mode for the 3GPP and non-3GPP access networks. The WTRU may respond by generating a first Service Request and a second Service Request. The first Service Request may comprise an indication associated with the 3GPP access network and may be communicated via the 3GPP access network. The second Service Request may comprise an indication associated with the non-3GPP access network and may be communicated via the non-3GPP access network. In response to the Service Requests, the core network may activate user planes for each of the 3GPP access network and the non-3GPP access network.

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, GH, GM, KE, LR, LS, MW, MZ, NA, RW, 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, 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).

Published:

— *with international search report (Art. 21(3))*

MULTI-ACCESS PDU SESSION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/826,237, filed March 29, 2019, and titled "Multi-Access PDU Session for WTRU in Restricted Service Area," and of U.S. Provisional Application No. 62/806,133, filed February 15, 2019, and titled "Multi-Access PDU Session for WTRU in Restricted Service Area," the contents of both of which are hereby incorporated herein by reference in their entireties.

BACKGROUND

[0002] Wireless communication devices may establish communications with other devices and data networks via various access networks. For example, a wireless communication device may establish communications via a 3GPP radio access network (RAN). A wireless communication device may access a 3GPP network in order to communicate with other wireless devices and to interface with data networks communicatively coupled with the 3GPP RAN.

[0003] The wireless communication device may be adapted to also access non-3GPP radio access networks. For example, a wireless communication device, which may be adapted to access a 3GPP RAN, may also be adapted to access 802.11 networks. A wireless communication device may communicate over the 3GPP RAN and the non-3GPP RAN, e.g., an 802.11 network.

SUMMARY

[0004] Disclosed herein are systems and implementations for establishing multi-access (MA) protocol data unit (PDU) sessions. A computing system which may be, for example, a wireless transmit and receive unit (WTRU), may be programmed to receive a paging message. The paging message may be received over a radio access network such as, for example, a 3GPP access network and may have originated from a server system comprised in a core network. The paging message may comprise an indication associated with a multi-access PDU session. The paging message may comprise an indication of "Multi-Access" and may be associated with reactivating an existing MA PDU session over the 3GPP access network and a non-3GPP access network. The WTRU may be in a Connection Management-Idle (CM-IDLE) mode for the

3GPP access network and may be in Connection Management-Idle (CM-IDLE) mode for the non-3GPP access network when the paging message is received.

[0005] The WTRU may respond to the paging message by generating a first Service Request. The first Service Request may comprise an indication associated with the 3GPP access network. The first Service Request may further comprise an indication that the first Service Request applies to the 3GPP access network only. The first Service Request may also comprise one or more session identifiers associated with MA PDU sessions. The session identifiers may be associated with one or more MA PDU sessions that may be identified for potential reactivation. The WTRU may send the first Service Request via the 3GPP access network to the server system comprised in the core network.

[0006] The WTRU may further respond to the paging message by generating a second Service Request. The second Service Request may comprise an indication associated with a non-3GPP access network. The second Service Request may comprise an indication that the second Service Request applies to the non-3GPP access network only. The second Service Request may also comprise one or more session identifiers associated with MA PDU sessions. The session identifiers may be associated with one or more MA PDU sessions that may be reactivated and may be associated with the 3GPP access network and/or the non-3GPP access network. The WTRU may send the second Service Request via the non-3GPP access network to the server system comprised in the core network.

[0007] The WTRU may be programmed to receive a first Service Accept message in response to transmitting the first Service Request. The first Service Accept message may be received via the 3GPP access network and may indicate the user plane has been activated for communications on the 3GPP access network. The WTRU may send the second Service Request after receiving the first Service Accept message. The WTRU may be programmed to receive a second Service Accept message in response to transmitting the second Service Request. The second Service Accept message may be received via the non-3GPP access network and may indicate the user plane has been activated for communications on the non-3GPP access network. The WTRU may receive data over a MA-PDU session using the 3GPP access network and the non-3GPP access network.

[0008] The WTRU may be programmed to establish and/or reactivate a MA PDU session wherein the WTRU may be in M-IDLE mode for a first access network and may be in CM-Connected mode for a second access network. In examples, the WTRU may be in CM-IDLE mode for a 3GPP access network and in CM-Connected mode for a non-3GPP access network. The WTRU may be in CM-IDLE mode for a non-3GPP access network and may be in CM-Connected mode for a 3GPP access network. The WTRU may receive a message comprising an indication associated with a MA-PDU session. The message may

be received, for example, over the second access network for which the WTRU may be in, for example, CM-Connected mode.

[0009] The WTRU may respond to the message by generating a first Service Request. The Service Request may comprise an indication associated with the first access network which may be in, for example, a CM-Idle mode. The Service Request may comprise an indication that the Service Request applies to the first access network only. The Service Request may comprise one or more session identifiers associated with MA PDU sessions. The WTRU may send the Service Request via the first access network. The WTRU may be programmed to receive a Service Accept message in response to the first Service Request. The WTRU may receive data over a MA-PDU session using the 3GPP access network and the non-3GPP access network.

[0010] A server system may be programmed to establish and/or reactivate MA PDU sessions with a WTRU. The server system may be comprised in a network adapted to provide mobile-broadband functionality such as, for example, an Evolved Packet Core (EPC) or 5G core network. The server system, which may comprise, for example, an Access and Mobility Management Function (AMF) may receive a communication requesting to establish a MA PDU session. The communication may comprise a PDU session identifier corresponding to an existing PDU session that is to be reactivated. The communication may identify a WTRU to which the MA PDU applies.

[0011] The server system, in response to receiving the communication, may generate a message comprising an indication associated with a MA PDU session. The message may comprise, for example, a "Multi-Access" indication. The server system may send the message via a first access network which may be, for example, a 3GPP access network or a non-3GPP access network. If the message is sent over a 3GPP access network, the message may be a paging message, for example. If the message is sent over a non-3GPP access network, the message may be, for example, a non-Access Stratum (NAS) formatted signal.

[0012] The server system may receive a first Service Request which may comprise an indication associated with the first access network. The first Service Request may comprise one or more session identifiers associated with multi-access PDU sessions. The first Service Request may also comprise an indication the Service Request is associated with the first service access network only.

[0013] The server system may receive a second Service Request which may comprise an indication associated with the second access network. The second Service Request may comprise one or more session identifiers associated with multi-access PDU sessions. The second Service Request may also comprise an indication the Service Request is associated with the second service access network only.

[0014] In response to the first Service Request, the server system may activate a user plane for the first access network. The server system may generate a first Service Accept message and may send the message via the first access network.

[0015] In response to the second Service Request, the server system may activate a user plane for the first access network. The server system may generate a first Service Accept message and may send the message via the first access network.

[0016] The server system may send and receive data over a MA-PDU session using the first network, e.g., 3GPP access network, and the second network, e.g., non-3GPP access network.

[0017] This Summary is provided to introduce a selection of concepts in a simplified form that are further described herein in the Detailed Description. This Summary is not intended to limit the scope of the claimed subject matter. Other features are described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] A more detailed understanding may be had from the following description, given by way of example in conjunction with the accompanying drawings wherein:

[0019] FIG. 1A is a system diagram illustrating an example communications system in which one or more disclosed embodiments may be implemented.

[0020] FIG. 1B is a system diagram illustrating an example wireless transmit/receive unit (WTRU) that may be used within the communications system illustrated in FIG. 1A according to an embodiment.

[0021] FIG. 1C is a system diagram illustrating an example radio access network (RAN) and an example core network (CN) that may be used within the communications system illustrated in FIG. 1A according to an embodiment.

[0022] FIG. 1D is a system diagram illustrating a further example RAN and a further example CN that may be used within the communications system illustrated in FIG. 1A according to an embodiment.

[0023] FIG. 2 depicts an example multi-access PDU session.

[0024] FIG. 3 depicts example processing for selecting a URSP rule for PDU session establishment.

[0025] FIG. 4 depicts example processing for determining to reactivate a multi-access PDU session.

[0026] FIG. 5 depicts example processing for network triggered Service Requests to activate a multi-access PDU session.

[0027] FIG. 6 depicts example processing for network triggered Service Requests to activate a multi-access PDU session.

DETAILED DESCRIPTION

[0028] Disclosed herein are systems and implementations for establishing and managing multi-access (MA) PDU sessions through 3GPP RANs and non-3GPP networks. A WTRU may be configured to establish a communication session through one or both of a 3GPP RAN and a non-3GPP network. The WTRU may account for restricted service areas for 3GPP RAN service in configuring a communication session via one or both of a 3GPP RAN and a non-3GPP network. A communications network may communicate with a WTRU to trigger activation of a MA-PDU session over a 3GPP RAN and a non-3GPP network.

[0029] FIG. 1A is a diagram illustrating an example communications system 100 in which one or more disclosed embodiments may be implemented. The communications system 100 may be a multiple access system that provides content, such as voice, data, video, messaging, broadcast, etc., to multiple wireless users. The communications system 100 may enable multiple wireless users to access such content through the sharing of system resources, including wireless bandwidth. For example, the communications systems 100 may employ one or more channel access methods, such as code division multiple access (CDMA), time division multiple access (TDMA), frequency division multiple access (FDMA), orthogonal FDMA (OFDMA), single-carrier FDMA (SC-FDMA), zero-tail unique-word DFT-Spread OFDM (ZT UW DTS-s OFDM), unique word OFDM (UW-OFDM), resource block-filtered OFDM, filter bank multicarrier (FBMC), and the like.

[0030] As shown in FIG. 1A, the communications system 100 may include wireless transmit/receive units (WTRUs) 102a, 102b, 102c, 102d, a RAN 104/113, a CN 106/115, a public switched telephone network (PSTN) 108, the Internet 110, and other networks 112, though it will be appreciated that the disclosed embodiments contemplate any number of WTRUs, base stations, networks, and/or network elements. Each of the WTRUs 102a, 102b, 102c, 102d may be any type of device configured to operate and/or communicate in a wireless environment. By way of example, the WTRUs 102a, 102b, 102c, 102d, any of which may be referred to as a "station" and/or a "STA", may be configured to transmit and/or receive wireless signals and may include a user equipment (UE), a mobile station, a fixed or mobile subscriber unit, a subscription-based unit, a pager, a cellular telephone, a personal digital assistant (PDA), a smartphone, a laptop, a netbook, a personal computer, a wireless sensor, a hotspot or Mi-Fi device, an Internet of Things (IoT) device, a watch or other wearable, a head-mounted display (HMD), a vehicle, a drone, a medical device and applications (e.g., remote surgery), an industrial device and applications (e.g., a robot and/or other wireless devices operating in an industrial and/or an automated processing chain contexts), a

consumer electronics device, a device operating on commercial and/or industrial wireless networks, and the like. Any of the WTRUs 102a, 102b, 102c and 102d may be interchangeably referred to as a UE.

[0031] The communications systems 100 may also include a base station 114a and/or a base station 114b. Each of the base stations 114a, 114b may be any type of device configured to wirelessly interface with at least one of the WTRUs 102a, 102b, 102c, 102d to facilitate access to one or more communication networks, such as the CN 106/115, the Internet 110, and/or the other networks 112. By way of example, the base stations 114a, 114b may be a base transceiver station (BTS), a Node-B, an eNode B, a Home Node B, a Home eNode B, a gNB, a NR NodeB, a site controller, an access point (AP), a wireless router, and the like. While the base stations 114a, 114b are each depicted as a single element, it will be appreciated that the base stations 114a, 114b may include any number of interconnected base stations and/or network elements.

[0032] The base station 114a may be part of the RAN 104/113, which may also include other base stations and/or network elements (not shown), such as a base station controller (BSC), a radio network controller (RNC), relay nodes, etc. The base station 114a and/or the base station 114b may be configured to transmit and/or receive wireless signals on one or more carrier frequencies, which may be referred to as a cell (not shown). These frequencies may be in licensed spectrum, unlicensed spectrum, or a combination of licensed and unlicensed spectrum. A cell may provide coverage for a wireless service to a specific geographical area that may be relatively fixed or that may change over time. The cell may further be divided into cell sectors. For example, the cell associated with the base station 114a may be divided into three sectors. Thus, in one embodiment, the base station 114a may include three transceivers, i.e., one for each sector of the cell. In an embodiment, the base station 114a may employ multiple-input multiple output (MIMO) technology and may utilize multiple transceivers for each sector of the cell. For example, beamforming may be used to transmit and/or receive signals in desired spatial directions.

[0033] The base stations 114a, 114b may communicate with one or more of the WTRUs 102a, 102b, 102c, 102d over an air interface 116, which may be any suitable wireless communication link (e.g., radio frequency (RF), microwave, centimeter wave, micrometer wave, infrared (IR), ultraviolet (UV), visible light, etc.). The air interface 116 may be established using any suitable radio access technology (RAT).

[0034] More specifically, as noted above, the communications system 100 may be a multiple access system and may employ one or more channel access schemes, such as CDMA, TDMA, FDMA, OFDMA, SC-FDMA, and the like. For example, the base station 114a in the RAN 104/113 and the WTRUs 102a, 102b, 102c may implement a radio technology such as Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (UTRA), which may establish the air interface 115/116/117 using wideband CDMA (WCDMA). WCDMA may include communication protocols such as High-Speed Packet

Access (HSPA) and/or Evolved HSPA (HSPA+). HSPA may include High-Speed Downlink (DL) Packet Access (HSDPA) and/or High-Speed UL Packet Access (HSUPA).

[0035] In an embodiment, the base station 114a and the WTRUs 102a, 102b, 102c may implement a radio technology such as Evolved UMTS Terrestrial Radio Access (E-UTRA), which may establish the air interface 116 using Long Term Evolution (LTE) and/or LTE-Advanced (LTE-A) and/or LTE-Advanced Pro (LTE-A Pro).

[0036] In an embodiment, the base station 114a and the WTRUs 102a, 102b, 102c may implement a radio technology such as NR Radio Access, which may establish the air interface 116 using New Radio (NR).

[0037] In an embodiment, the base station 114a and the WTRUs 102a, 102b, 102c may implement multiple radio access technologies. For example, the base station 114a and the WTRUs 102a, 102b, 102c may implement LTE radio access and NR radio access together, for instance using dual connectivity (DC) principles. Thus, the air interface utilized by WTRUs 102a, 102b, 102c may be characterized by multiple types of radio access technologies and/or transmissions sent to/from multiple types of base stations (e.g., a eNB and a gNB).

[0038] In other embodiments, the base station 114a and the WTRUs 102a, 102b, 102c may implement radio technologies such as IEEE 802.11 (i.e., Wireless Fidelity (WiFi)), IEEE 802.16 (i.e., Worldwide Interoperability for Microwave Access (WiMAX)), CDMA2000, CDMA2000 1X, CDMA2000 EV-DO, Interim Standard 2000 (IS-2000), Interim Standard 95 (IS-95), Interim Standard 856 (IS-856), Global System for Mobile communications (GSM), Enhanced Data rates for GSM Evolution (EDGE), GSM EDGE (GERAN), and the like.

[0039] The base station 114b in FIG. 1A may be a wireless router, Home Node B, Home eNode B, or access point, for example, and may utilize any suitable RAT for facilitating wireless connectivity in a localized area, such as a place of business, a home, a vehicle, a campus, an industrial facility, an air corridor (e.g., for use by drones), a roadway, and the like. In one embodiment, the base station 114b and the WTRUs 102c, 102d may implement a radio technology such as IEEE 802.11 to establish a wireless local area network (WLAN). In an embodiment, the base station 114b and the WTRUs 102c, 102d may implement a radio technology such as IEEE 802.15 to establish a wireless personal area network (WPAN). In yet another embodiment, the base station 114b and the WTRUs 102c, 102d may utilize a cellular-based RAT (e.g., WCDMA, CDMA2000, GSM, LTE, LTE-A, LTE-A Pro, NR etc.) to establish a picocell or femtocell. As shown in FIG. 1A, the base station 114b may have a direct connection to the Internet 110. Thus, the base station 114b may not be required to access the Internet 110 via the CN 106/115.

[0040] The RAN 104/113 may be in communication with the CN 106/115, which may be any type of network configured to provide voice, data, applications, and/or voice over internet protocol (VoIP) services to one or more of the WTRUs 102a, 102b, 102c, 102d. The data may have varying quality of service (QoS) requirements, such as differing throughput requirements, latency requirements, error tolerance requirements, reliability requirements, data throughput requirements, mobility requirements, and the like. The CN 106/115 may provide call control, billing services, mobile location-based services, pre-paid calling, Internet connectivity, video distribution, etc., and/or perform high-level security functions, such as user authentication. Although not shown in FIG. 1A, it will be appreciated that the RAN 104/113 and/or the CN 106/115 may be in direct or indirect communication with other RANs that employ the same RAT as the RAN 104/113 or a different RAT. For example, in addition to being connected to the RAN 104/113, which may be utilizing a NR radio technology, the CN 106/115 may also be in communication with another RAN (not shown) employing a GSM, UMTS, CDMA 2000, WiMAX, E-UTRA, or WiFi radio technology.

[0041] The CN 106/115 may also serve as a gateway for the WTRUs 102a, 102b, 102c, 102d to access the PSTN 108, the Internet 110, and/or the other networks 112. The PSTN 108 may include circuit-switched telephone networks that provide plain old telephone service (POTS). The Internet 110 may include a global system of interconnected computer networks and devices that use common communication protocols, such as the transmission control protocol (TCP), user datagram protocol (UDP) and/or the internet protocol (IP) in the TCP/IP internet protocol suite. The networks 112 may include wired and/or wireless communications networks owned and/or operated by other service providers. For example, the networks 112 may include another CN connected to one or more RANs, which may employ the same RAT as the RAN 104/113 or a different RAT.

[0042] Some or all of the WTRUs 102a, 102b, 102c, 102d in the communications system 100 may include multi-mode capabilities (e.g., the WTRUs 102a, 102b, 102c, 102d may include multiple transceivers for communicating with different wireless networks over different wireless links). For example, the WTRU 102c shown in FIG. 1A may be configured to communicate with the base station 114a, which may employ a cellular-based radio technology, and with the base station 114b, which may employ an IEEE 802 radio technology.

[0043] FIG. 1B is a system diagram illustrating an example WTRU 102. As shown in FIG. 1B, the WTRU 102 may include a processor 118, a transceiver 120, a transmit/receive element 122, a speaker/microphone 124, a keypad 126, a display/touchpad 128, non-removable memory 130, removable memory 132, a power source 134, a global positioning system (GPS) chipset 136, and/or other peripherals 138, among others. It will be appreciated that the WTRU 102 may include any sub-combination of the foregoing elements while remaining consistent with an embodiment.

[0044] The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASICs), Field Programmable Gate Arrays (FPGAs) circuits, any other type of integrated circuit (IC), a state machine, and the like. The processor 118 may perform signal coding, data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment. The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip.

[0045] The transmit/receive element 122 may be configured to transmit signals to, or receive signals from, a base station (e.g., the base station 114a) over the air interface 116. For example, in one embodiment, the transmit/receive element 122 may be an antenna configured to transmit and/or receive RF signals. In an embodiment, the transmit/receive element 122 may be an emitter/detector configured to transmit and/or receive IR, UV, or visible light signals, for example. In yet another embodiment, the transmit/receive element 122 may be configured to transmit and/or receive both RF and light signals. It will be appreciated that the transmit/receive element 122 may be configured to transmit and/or receive any combination of wireless signals.

[0046] Although the transmit/receive element 122 is depicted in FIG. 1B as a single element, the WTRU 102 may include any number of transmit/receive elements 122. More specifically, the WTRU 102 may employ MIMO technology. Thus, in one embodiment, the WTRU 102 may include two or more transmit/receive elements 122 (e.g., multiple antennas) for transmitting and receiving wireless signals over the air interface 116.

[0047] The transceiver 120 may be configured to modulate the signals that are to be transmitted by the transmit/receive element 122 and to demodulate the signals that are received by the transmit/receive element 122. As noted above, the WTRU 102 may have multi-mode capabilities. Thus, the transceiver 120 may include multiple transceivers for enabling the WTRU 102 to communicate via multiple RATs, such as NR and IEEE 802.11, for example.

[0048] The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128 (e.g., a liquid crystal display (LCD) display unit or organic light-emitting diode (OLED) display unit). The processor 118 may also output user data to the speaker/microphone 124, the keypad 126, and/or the display/touchpad 128. In addition, the processor 118 may access information from, and store data in, any type of suitable memory, such as

the non-removable memory 130 and/or the removable memory 132. The non-removable memory 130 may include random-access memory (RAM), read-only memory (ROM), a hard disk, or any other type of memory storage device. The removable memory 132 may include a subscriber identity module (SIM) card, a memory stick, a secure digital (SD) memory card, and the like. In other embodiments, the processor 118 may access information from, and store data in, memory that is not physically located on the WTRU 102, such as on a server or a home computer (not shown).

[0049] The processor 118 may receive power from the power source 134, and may be configured to distribute and/or control the power to the other components in the WTRU 102. The power source 134 may be any suitable device for powering the WTRU 102. For example, the power source 134 may include one or more dry cell batteries (e.g., nickel-cadmium (NiCd), nickel-zinc (NiZn), nickel metal hydride (NiMH), lithium-ion (Li-ion), etc.), solar cells, fuel cells, and the like.

[0050] The processor 118 may also be coupled to the GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102. In addition to, or in lieu of, the information from the GPS chipset 136, the WTRU 102 may receive location information over the air interface 116 from a base station (e.g., base stations 114a, 114b) and/or determine its location based on the timing of the signals being received from two or more nearby base stations. It will be appreciated that the WTRU 102 may acquire location information by way of any suitable location-determination method while remaining consistent with an embodiment.

[0051] The processor 118 may further be coupled to other peripherals 138, which may include one or more software and/or hardware modules that provide additional features, functionality and/or wired or wireless connectivity. For example, the peripherals 138 may include an accelerometer, an e-compass, a satellite transceiver, a digital camera (for photographs and/or video), a universal serial bus (USB) port, a vibration device, a television transceiver, a hands free headset, a Bluetooth® module, a frequency modulated (FM) radio unit, a digital music player, a media player, a video game player module, an Internet browser, a Virtual Reality and/or Augmented Reality (VR/AR) device, an activity tracker, and the like. The peripherals 138 may include one or more sensors, the sensors may be one or more of a gyroscope, an accelerometer, a hall effect sensor, a magnetometer, an orientation sensor, a proximity sensor, a temperature sensor, a time sensor, a geolocation sensor, an altimeter, a light sensor, a touch sensor, a magnetometer, a barometer, a gesture sensor, a biometric sensor, and/or a humidity sensor.

[0052] The WTRU 102 may include a full duplex radio for which transmission and reception of some or all of the signals (e.g., associated with particular subframes for both the UL (e.g., for transmission) and downlink (e.g., for reception) may be concurrent and/or simultaneous. The full duplex radio may include an interference management unit to reduce and or substantially eliminate self-interference via either hardware

(e.g., a choke) or signal processing via a processor (e.g., a separate processor (not shown) or via processor 118). In an embodiment, the WRTU 102 may include a half-duplex radio for which transmission and reception of some or all of the signals (e.g., associated with particular subframes for either the UL (e.g., for transmission) or the downlink (e.g., for reception)).

[0053] FIG. 1C is a system diagram illustrating the RAN 104 and the CN 106 according to an embodiment. As noted above, the RAN 104 may employ an E-UTRA radio technology to communicate with the WTRUs 102a, 102b, 102c over the air interface 116. The RAN 104 may also be in communication with the CN 106.

[0054] The RAN 104 may include eNode-Bs 160a, 160b, 160c, though it will be appreciated that the RAN 104 may include any number of eNode-Bs while remaining consistent with an embodiment. The eNode-Bs 160a, 160b, 160c may each include one or more transceivers for communicating with the WTRUs 102a, 102b, 102c over the air interface 116. In one embodiment, the eNode-Bs 160a, 160b, 160c may implement MIMO technology. Thus, the eNode-B 160a, for example, may use multiple antennas to transmit wireless signals to, and/or receive wireless signals from, the WTRU 102a.

[0055] Each of the eNode-Bs 160a, 160b, 160c may be associated with a particular cell (not shown) and may be configured to handle radio resource management decisions, handover decisions, scheduling of users in the UL and/or DL, and the like. As shown in FIG. 1C, the eNode-Bs 160a, 160b, 160c may communicate with one another over an X2 interface.

[0056] The CN 106 shown in FIG. 1C may include a mobility management entity (MME) 162, a serving gateway (SGW) 164, and a packet data network (PDN) gateway (or PGW) 166. While each of the foregoing elements are depicted as part of the CN 106, it will be appreciated that any of these elements may be owned and/or operated by an entity other than the CN operator.

[0057] The MME 162 may be connected to each of the eNode-Bs 162a, 162b, 162c in the RAN 104 via an S1 interface and may serve as a control node. For example, the MME 162 may be responsible for authenticating users of the WTRUs 102a, 102b, 102c, bearer activation/deactivation, selecting a particular serving gateway during an initial attach of the WTRUs 102a, 102b, 102c, and the like. The MME 162 may provide a control plane function for switching between the RAN 104 and other RANs (not shown) that employ other radio technologies, such as GSM and/or WCDMA.

[0058] The SGW 164 may be connected to each of the eNode Bs 160a, 160b, 160c in the RAN 104 via the S1 interface. The SGW 164 may generally route and forward user data packets to/from the WTRUs 102a, 102b, 102c. The SGW 164 may perform other functions, such as anchoring user planes during inter-eNode B handovers, triggering paging when DL data is available for the WTRUs 102a, 102b, 102c, managing and storing contexts of the WTRUs 102a, 102b, 102c, and the like.

[0059] The SGW 164 may be connected to the PGW 166, which may provide the WTRUs 102a, 102b, 102c with access to packet-switched networks, such as the Internet 110, to facilitate communications between the WTRUs 102a, 102b, 102c and IP-enabled devices.

[0060] The CN 106 may facilitate communications with other networks. For example, the CN 106 may provide the WTRUs 102a, 102b, 102c with access to circuit-switched networks, such as the PSTN 108, to facilitate communications between the WTRUs 102a, 102b, 102c and traditional land-line communications devices. For example, the CN 106 may include, or may communicate with, an IP gateway (e.g., an IP multimedia subsystem (IMS) server) that serves as an interface between the CN 106 and the PSTN 108. In addition, the CN 106 may provide the WTRUs 102a, 102b, 102c with access to the other networks 112, which may include other wired and/or wireless networks that are owned and/or operated by other service providers.

[0061] Although the WTRU is described in FIGS. 1A-1D as a wireless terminal, it is contemplated that in certain representative embodiments that such a terminal may use (e.g., temporarily or permanently) wired communication interfaces with the communication network.

[0062] In representative embodiments, the other network 112 may be a WLAN.

[0063] A WLAN in Infrastructure Basic Service Set (BSS) mode may have an Access Point (AP) for the BSS and one or more stations (STAs) associated with the AP. The AP may have an access or an interface to a Distribution System (DS) or another type of wired/wireless network that carries traffic in to and/or out of the BSS. Traffic to STAs that originates from outside the BSS may arrive through the AP and may be delivered to the STAs. Traffic originating from STAs to destinations outside the BSS may be sent to the AP to be delivered to respective destinations. Traffic between STAs within the BSS may be sent through the AP, for example, where the source STA may send traffic to the AP and the AP may deliver the traffic to the destination STA. The traffic between STAs within a BSS may be considered and/or referred to as peer-to-peer traffic. The peer-to-peer traffic may be sent between (e.g., directly between) the source and destination STAs with a direct link setup (DLS). In certain representative embodiments, the DLS may use an 802.11e DLS or an 802.11z tunneled DLS (TDLS). A WLAN using an Independent BSS (IBSS) mode may not have an AP, and the STAs (e.g., all of the STAs) within or using the IBSS may communicate directly with each other. The IBSS mode of communication may sometimes be referred to herein as an "ad-hoc" mode of communication.

[0064] When using the 802.11ac infrastructure mode of operation or a similar mode of operations, the AP may transmit a beacon on a fixed channel, such as a primary channel. The primary channel may be a fixed width (e.g., 20 MHz wide bandwidth) or a dynamically set width via signaling. The primary channel may be the operating channel of the BSS and may be used by the STAs to establish a connection with the

AP. In certain representative embodiments, Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) may be implemented, for example in 802.11 systems. For CSMA/CA, the STAs (e.g., every STA), including the AP, may sense the primary channel. If the primary channel is sensed/detected and/or determined to be busy by a particular STA, the particular STA may back off. One STA (e.g., only one station) may transmit at any given time in a given BSS.

[0065] High Throughput (HT) STAs may use a 40 MHz wide channel for communication, for example, via a combination of the primary 20 MHz channel with an adjacent or nonadjacent 20 MHz channel to form a 40 MHz wide channel.

[0066] Very High Throughput (VHT) STAs may support 20MHz, 40 MHz, 80 MHz, and/or 160 MHz wide channels. The 40 MHz, and/or 80 MHz, channels may be formed by combining contiguous 20 MHz channels. A 160 MHz channel may be formed by combining 8 contiguous 20 MHz channels, or by combining two non-contiguous 80 MHz channels, which may be referred to as an 80+80 configuration. For the 80+80 configuration, the data, after channel encoding, may be passed through a segment parser that may divide the data into two streams. Inverse Fast Fourier Transform (IFFT) processing, and time domain processing, may be done on each stream separately. The streams may be mapped on to the two 80 MHz channels, and the data may be transmitted by a transmitting STA. At the receiver of the receiving STA, the above described operation for the 80+80 configuration may be reversed, and the combined data may be sent to the Medium Access Control (MAC).

[0067] Sub 1 GHz modes of operation are supported by 802.11af and 802.11ah. The channel operating bandwidths, and carriers, are reduced in 802.11af and 802.11ah relative to those used in 802.11n, and 802.11ac. 802.11af supports 5 MHz, 10 MHz and 20 MHz bandwidths in the TV White Space (TVWS) spectrum, and 802.11ah supports 1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz bandwidths using non-TVWS spectrum. According to a representative embodiment, 802.11ah may support Meter Type Control/Machine-Type Communications, such as MTC devices in a macro coverage area. MTC devices may have certain capabilities, for example, limited capabilities including support for (e.g., only support for) certain and/or limited bandwidths. The MTC devices may include a battery with a battery life above a threshold (e.g., to maintain a very long battery life).

[0068] WLAN systems, which may support multiple channels, and channel bandwidths, such as 802.11n, 802.11ac, 802.11af, and 802.11ah, include a channel which may be designated as the primary channel. The primary channel may have a bandwidth equal to the largest common operating bandwidth supported by all STAs in the BSS. The bandwidth of the primary channel may be set and/or limited by a STA, from among all STAs in operating in a BSS, which supports the smallest bandwidth operating mode. In the example of 802.11ah, the primary channel may be 1 MHz wide for STAs (e.g., MTC type devices)

that support (e.g., only support) a 1 MHz mode, even if the AP, and other STAs in the BSS support 2 MHz, 4 MHz, 8 MHz, 16 MHz, and/or other channel bandwidth operating modes. Carrier sensing and/or Network Allocation Vector (NAV) settings may depend on the status of the primary channel. If the primary channel is busy, for example, due to a STA (which supports only a 1 MHz operating mode), transmitting to the AP, the entire available frequency bands may be considered busy even though a majority of the frequency bands remains idle and may be available.

[0069] In the United States, the available frequency bands, which may be used by 802.11ah, are from 902 MHz to 928 MHz. In Korea, the available frequency bands are from 917.5 MHz to 923.5 MHz. In Japan, the available frequency bands are from 916.5 MHz to 927.5 MHz. The total bandwidth available for 802.11ah is 6 MHz to 26 MHz depending on the country code.

[0070] FIG. 1D is a system diagram illustrating the RAN 113 and the CN 115 according to an embodiment. As noted above, the RAN 113 may employ an NR radio technology to communicate with the WTRUs 102a, 102b, 102c over the air interface 116. The RAN 113 may also be in communication with the CN 115.

[0071] The RAN 113 may include gNBs 180a, 180b, 180c, though it will be appreciated that the RAN 113 may include any number of gNBs while remaining consistent with an embodiment. The gNBs 180a, 180b, 180c may each include one or more transceivers for communicating with the WTRUs 102a, 102b, 102c over the air interface 116. In one embodiment, the gNBs 180a, 180b, 180c may implement MIMO technology. For example, gNBs 180a, 180b may utilize beamforming to transmit signals to and/or receive signals from the gNBs 180a, 180b, 180c. Thus, the gNB 180a, for example, may use multiple antennas to transmit wireless signals to, and/or receive wireless signals from, the WTRU 102a. In an embodiment, the gNBs 180a, 180b, 180c may implement carrier aggregation technology. For example, the gNB 180a may transmit multiple component carriers to the WTRU 102a (not shown). A subset of these component carriers may be on unlicensed spectrum while the remaining component carriers may be on licensed spectrum. In an embodiment, the gNBs 180a, 180b, 180c may implement Coordinated Multi-Point (CoMP) technology. For example, WTRU 102a may receive coordinated transmissions from gNB 180a and gNB 180b (and/or gNB 180c).

[0072] The WTRUs 102a, 102b, 102c may communicate with gNBs 180a, 180b, 180c using transmissions associated with a scalable numerology. For example, the OFDM symbol spacing and/or OFDM subcarrier spacing may vary for different transmissions, different cells, and/or different portions of the wireless transmission spectrum. The WTRUs 102a, 102b, 102c may communicate with gNBs 180a, 180b, 180c using subframe or transmission time intervals (TTIs) of various or scalable lengths (e.g., containing varying number of OFDM symbols and/or lasting varying lengths of absolute time).

[0073] The gNBs 180a, 180b, 180c may be configured to communicate with the WTRUs 102a, 102b, 102c in a standalone configuration and/or a non-standalone configuration. In the standalone configuration, WTRUs 102a, 102b, 102c may communicate with gNBs 180a, 180b, 180c without also accessing other RANs (e.g., such as eNode-Bs 160a, 160b, 160c). In the standalone configuration, WTRUs 102a, 102b, 102c may utilize one or more of gNBs 180a, 180b, 180c as a mobility anchor point. In the standalone configuration, WTRUs 102a, 102b, 102c may communicate with gNBs 180a, 180b, 180c using signals in an unlicensed band. In a non-standalone configuration WTRUs 102a, 102b, 102c may communicate with/connect to gNBs 180a, 180b, 180c while also communicating with/connecting to another RAN such as eNode-Bs 160a, 160b, 160c. For example, WTRUs 102a, 102b, 102c may implement DC principles to communicate with one or more gNBs 180a, 180b, 180c and one or more eNode-Bs 160a, 160b, 160c substantially simultaneously. In the non-standalone configuration, eNode-Bs 160a, 160b, 160c may serve as a mobility anchor for WTRUs 102a, 102b, 102c and gNBs 180a, 180b, 180c may provide additional coverage and/or throughput for servicing WTRUs 102a, 102b, 102c.

[0074] Each of the gNBs 180a, 180b, 180c may be associated with a particular cell (not shown) and may be configured to handle radio resource management decisions, handover decisions, scheduling of users in the UL and/or DL, support of network slicing, dual connectivity, interworking between NR and E-UTRA, routing of user plane data towards User Plane Function (UPF) 184a, 184b, routing of control plane information towards Access and Mobility Management Function (AMF) 182a, 182b and the like. As shown in FIG. 1D, the gNBs 180a, 180b, 180c may communicate with one another over an Xn interface.

[0075] The CN 115 shown in FIG. 1D may include at least one AMF 182a, 182b, at least one UPF 184a, 184b, at least one Session Management Function (SMF) 183a, 183b, and possibly a Data Network (DN) 185a, 185b. While each of the foregoing elements are depicted as part of the CN 115, it will be appreciated that any of these elements may be owned and/or operated by an entity other than the CN operator.

[0076] The AMF 182a, 182b may be connected to one or more of the gNBs 180a, 180b, 180c in the RAN 113 via an N2 interface and may serve as a control node. For example, the AMF 182a, 182b may be responsible for authenticating users of the WTRUs 102a, 102b, 102c, support for network slicing (e.g., handling of different PDU sessions with different requirements), selecting a particular SMF 183a, 183b, management of the registration area, termination of NAS signaling, mobility management, and the like. Network slicing may be used by the AMF 182a, 182b in order to customize CN support for WTRUs 102a, 102b, 102c based on the types of services being utilized WTRUs 102a, 102b, 102c. For example, different network slices may be established for different use cases such as services relying on ultra-reliable low latency (URLLC) access, services relying on enhanced massive mobile broadband (eMBB) access,

services for machine type communication (MTC) access, and/or the like. The AMF 162 may provide a control plane function for switching between the RAN 113 and other RANs (not shown) that employ other radio technologies, such as LTE, LTE-A, LTE-A Pro, and/or non-3GPP access technologies such as WiFi.

[0077] The SMF 183a, 183b may be connected to an AMF 182a, 182b in the CN 115 via an N11 interface. The SMF 183a, 183b may also be connected to a UPF 184a, 184b in the CN 115 via an N4 interface. The SMF 183a, 183b may select and control the UPF 184a, 184b and configure the routing of traffic through the UPF 184a, 184b. The SMF 183a, 183b may perform other functions, such as managing and allocating UE IP address, managing PDU sessions, controlling policy enforcement and QoS, providing downlink data notifications, and the like. A PDU session type may be IP-based, non-IP based, Ethernet-based, and the like.

[0078] The UPF 184a, 184b may be connected to one or more of the gNBs 180a, 180b, 180c in the RAN 113 via an N3 interface, which may provide the WTRUs 102a, 102b, 102c with access to packet-switched networks, such as the Internet 110, to facilitate communications between the WTRUs 102a, 102b, 102c and IP-enabled devices. The UPF 184a, 184b may perform other functions, such as routing and forwarding packets, enforcing user plane policies, supporting multi-homed PDU sessions, handling user plane QoS, buffering downlink packets, providing mobility anchoring, and the like.

[0079] The CN 115 may facilitate communications with other networks. For example, the CN 115 may include, or may communicate with, an IP gateway (e.g., an IP multimedia subsystem (IMS) server) that serves as an interface between the CN 115 and the PSTN 108. In addition, the CN 115 may provide the WTRUs 102a, 102b, 102c with access to the other networks 112, which may include other wired and/or wireless networks that are owned and/or operated by other service providers. In one embodiment, the WTRUs 102a, 102b, 102c may be connected to a local Data Network (DN) 185a, 185b through the UPF 184a, 184b via the N3 interface to the UPF 184a, 184b and an N6 interface between the UPF 184a, 184b and the DN 185a, 185b.

[0080] In view of Figures 1A-1D, and the corresponding description of Figures 1A-1D, one or more, or all, of the functions described herein with regard to one or more of: WTRU 102a-d, Base Station 114a-b, eNode-B 160a-c, MME 162, SGW 164, PGW 166, gNB 180a-c, AMF 182a-b, UPF 184a-b, SMF 183a-b, DN 185a-b, and/or any other device(s) described herein, may be performed by one or more emulation devices (not shown). The emulation devices may be one or more devices configured to emulate one or more, or all, of the functions described herein. For example, the emulation devices may be used to test other devices and/or to simulate network and/or WTRU functions.

[0081] The emulation devices may be designed to implement one or more tests of other devices in a lab environment and/or in an operator network environment. For example, the one or more emulation devices

may perform the one or more, or all, functions while being fully or partially implemented and/or deployed as part of a wired and/or wireless communication network in order to test other devices within the communication network. The one or more emulation devices may perform the one or more, or all, functions while being temporarily implemented/deployed as part of a wired and/or wireless communication network. The emulation device may be directly coupled to another device for purposes of testing and/or may performing testing using over-the-air wireless communications.

[0082] The one or more emulation devices may perform the one or more, including all, functions while not being implemented/deployed as part of a wired and/or wireless communication network. For example, the emulation devices may be utilized in a testing scenario in a testing laboratory and/or a non-deployed (e.g., testing) wired and/or wireless communication network in order to implement testing of one or more components. The one or more emulation devices may be test equipment. Direct RF coupling and/or wireless communications via RF circuitry (e.g., which may include one or more antennas) may be used by the emulation devices to transmit and/or receive data.

[0083] Disclosed herein are systems and implementations for establishing and managing multi-access (MA) PDU sessions (MA-PDU) through 3GPP RANs and non-3GPP networks. A WTRU may be configured to establish a communication session through one or both of a 3GPP RAN and a non-3GPP network. The WTRU may account for restricted service areas for 3GPP RAN service in configuring a communication session via one or both of a 3GPP RAN and a non-3GPP network. A communications network may communicate with a WTRU to trigger activation of a MA-PDU session through one or both of a 3GPP RAN and a non-3GPP network.

[0084] A protocol data unit (PDU) session may be a logical connection between a WTRU and a data network. A MA-PDU session may be a PDU session that provides PDU connectivity via more than one access network. For example, a MA-PDU session may be a PDU session that provides PDU connectivity simultaneously via a 3GPP access network and a non-3GPP access network, and/or provides PDU connectivity one-at-a-time via one of a 3GPP access network or non-3GPP access network. MA-PDU sessions may be employed to support 3GPP processing such as, for example, "Access Traffic Steering, Switching and Splitting" (ATSSS) processing, which may support data traffic steering, switching, and/or splitting between a 3GPP access network and a non-3GPP access network.

[0085] A MA-PDU session may be established using an example PDU Session Establishment implementation. For example, a WTRU may provide a "MA-PDU Request" indication and the WTRU's ATSSS capability info in a PDU Session Establishment Request message. A network, which may be, for example, a 3GPP or 5G core network, may select the session management function (SMF) and user plane functions (UPF) that support MA-PDU session processing and may activate the User Plane (UP) for a

3GPP RAN, which may be referred to as, for example, a 3GPP access network or a 3GPP access leg, and a non-3GPP network, which may be referred to as, for example, a non-3GPP access network or a non-3GPP access leg.

[0086] FIG. 2 depicts an example MA-PDU session. As shown, multiple data flows (e.g., flow 1, flow 2, and flow 3) may be established between a WTRU and user plane functionality (UPF) with access provided to a data network. One or more flows (e.g., flow 1 and flow 2) may be established through a 3GPP RAN network. One or more flows (e.g., flow 3) may be established through a non-3GPP network. A network, which may be, for example, a 5G core network, may coordinate the establishment of access through the 3GPP and non-3GPP networks. The 5G network may generate ATSSS rules which may be used to control how data traffic may be distributed between a 3GPP access network and a non-3GPP access network. The 3GPP network may install the rules on the WTRU and on related network functions such as, for example, user plane functions (UPFs).

[0087] In 5G systems, various Mobility Restrictions may be defined. For example, a Forbidden Area and/or non-Allowed Area restriction may be defined.

[0088] In connection with a Forbidden Area restriction, a WTRU may not be permitted to initiate communication with the radio access network for a public land mobile network (PLMN).

[0089] For a non-Allowed Area restriction, a WTRU and the RAN may not be permitted to initiate a Service Request or SM signaling to obtain user services. A non-Allowed Area restriction may apply to a WTRU in various states including, for example, CM-IDLE and/or CM-CONNECTED states. A WTRU located in a non-Allowed Area may (e.g., shall) respond to core network paging and/or non-Access Stratum (NAS) Notification messages from the non-3GPP access network with a Service Request.

[0090] As used herein, the term "Restricted Service Area" may be used to refer to either a Forbidden Area or non-Allowed Area or both.

[0091] For a WTRU that supports MA-PDU sessions and that camps onto or is connected with a cell that is in the WTRU's Restricted Service Area (e.g. Forbidden Area or non-Allowed Area), numerous processing scenarios may arise.

[0092] For example, a WTRU may have pending uplink (UL) data that may be associated with a MA-PDU session as specified, for example, by a URSP rule, and may have not established a MA-PDU session. The WTRU may not be allowed to initiate PDU session establishment if the associated PDU Session is a 3GPP-access-only PDU Session. But if the PDU Session is a Multi-Access PDU session with a non-3GPP network or access leg, the non-3GPP access leg may not be impacted by the 3GPP-access area restriction. The WTRU may be configured to initiate MA-PDU session establishment if certain conditions are satisfied. The WTRU may be configured with service logic to determine whether the WTRU may initiate

a MA-PDU session establishment, and to determine the manner that MA-PDU session establishment may be performed in view of the WTRU possibly being restricted with respect to 3GPP network access.

[0093] In an example, the WTRU may have pending UL data that may be associated with a MA-PDU session as specified, for example, by a URSP rule, and may have previously established a MA-PDU session. The WTRU may be configured to determine whether the WTRU may activate the MA-PDU session for UP data transmission, and to determine the manner the MA-PDU session activation may be performed while taking into consideration the WTRU may be restricted with respect to 3GPP access network.

[0094] A MA-PDU session may be triggered by a network such as, for example, a 5G core network. For example, if there is down link (DL) data for a normal single-access PDU session, and the WTRU is in Idle state for the access network (e.g., 3GPP RAN and/or non-3GPP network) with which the PDU session is associated, the 5G network may use paging (e.g., on the 3GPP RAN or access leg only) or DL Notification (e.g., on either the 3GPP access leg or non-3GPP access leg) to trigger a Service Request and bring the WTRU to Connected status on the particular access. The network may be configured to trigger the activation of a MA-PDU session in instances where both 3GPP access and non-3GPP access legs may be involved. The network may be configured to provide processing in instances that the WTRU is in a Restricted Service Area for 3GPP access.

[0095] A WTRU that may be in a restricted service area (RSA) with respect to a 3GPP RAN and has uplink (UL) data for a MA-PDU session, may apply lower priority URSP (UE Route Selection Policy) rule(s) or Route Selection Descriptor(s) to associate the data with non-3GPP access network PDU sessions. A WTRU that may be in an RSA and has UL data for a MA-PDU session, may determine whether to activate a MA-PDU session based on the preferred access as specified in Access Traffic Steering Switching Splitting (ATSSS) rules. A WTRU that may be in an RSA and which determines to reactivate a MA-PDU session, may use indications in the Service Request (SR) message to activate the non-3GPP access leg (e.g., the non-3GPP access leg only).

[0096] MA-PDU sessions may be established or activated when a WTRU is in Restricted Service Area. If the WTRU has UL pending data that may be associated with a MA-PDU Session (as specified by, for example, the URSP rules), and the WTRU is in the Restricted Service Area for 3GPP access, the WTRU may be configured to determine whether the WTRU may initiate the MA-PDU Session establishment (if the target MA-PDU Session has not been established), or whether the WTRU may request the activation of an existing MA-PDU Session.

[0097] The WTRU may determine whether there are other URSP rules that satisfy the following conditions: the Traffic Descriptor of the URSP rule matches the pending data and the corresponding Route

Selection Descriptor matches at least one existing non-3GPP-access PDU Session; or the Traffic Descriptor of the URSP rule matches the pending data and the corresponding Route Selection Descriptor has non-3GPP Access as the preferred Access Type. If a URSP rule(s) that satisfy these conditions is found, even if its Rule Precedence or Route Selection Descriptor Precedence is of lower priority than the URSP rule or the Route Selection Descriptor that associates the data to a MA-PDU Session, the WTRU may use this URSP rule to establish a new non-3GPP-access PDU Session or to reactivate the existing non-3GPP-access PDU Session for the data, rather than establishing or reactivating the MA-PDU Session.

[0098] FIG. 3 depicts example PDU session establishment based on URSP rules. In example A illustrated on the left side of FIG. 3, a URSP rule, which has a corresponding Traffic Descriptor, may be selected. The URSP may have a higher priority Route Selection Descriptor (RSD) 1 which points to a Multi-Access PDU Session, and a lower priority RSD 2 which points to a non-3GPP access PDU Session. If the WTRU is in Restricted Service Area for 3GPP access, the lower priority RSD 2 may be applied and the WTRU may establish a non-3GPP-access-only PDU Session for the data. Route selection descriptor 2 may be selected even though it has lower priority due to the location of the WTRU within a Restricted Service Area.

[0099] In example B illustrated on the right side of FIG. 3, the WTRU may have two URSP rules, each of which may have a corresponding or matching Traffic Descriptor. The RSD in the URSP Rule 1, which may have a higher priority, points to a Multi-Access PDU Session, while the RSD in the URSP Rule 2, which may have a lower priority, points to a non-3GPP access PDU Session. If the WTRU is in Restricted Service Area for 3GPP access, the lower priority URSP Rule 2 may be applied and the WTRU may establish a non-3GPP-access-only PDU Session for the data. URSP rule 2 may be selected even though it has lower priority due to the location of the WTRU within a Restricted Service Area.

[0100] A MA-PDU Session may already exist and may have ATSSS rules associated with the MA-PDU session. The WTRU may be configured to check the configured ATSSS rules that may be used to control data steering for the MA-PDU Session before reactivating the MA-PDU Session. If the ATSSS rules indicate that the preferred access or active access for the UL data is non-3GPP access, the WTRU may initiate the reactivation of the MA-PDU session. The WTRU may indicate to the network, e.g., 5G network, to re-activate the user plane (UP) for the non-3GPP access leg (e.g., for the non-3GPP access leg only). If the ATSSS rules indicate that the preferred access or active access for the UL data is 3GPP access, the WTRU may determine to not initiate the reactivation of the MA-PDU session.

[0101] FIG. 4 depicts an example process for a WTRU to determine whether to reactivate a MA-PDU session. As shown, a WTRU in RSA may receive UL data from a higher layer. The WTRU may select a URSP rule that points to a MA-PDU session. The WTRU may determine the preferred access (e.g., 3GPP

access or non-3GPP access) based on, for example, one or more ATSS rules. If the WTRU determines the preferred access is 3GPP access, the WTRU may perform processing to re-activate a MA-PDU session with non-3GPP access in the user plane (UP). If the WTRU determines the preferred access is non-3GPP access, the WTRU may not reactivate the MA-PDU session, in which case data may be buffered or discarded.

[0102] The WTRU may initiate the establishment or reactivation of the MA-PDU session, regardless of the ATSSS rules output. The WTRU may indicate to the network to activate the user plane (UP) for the non-3GPP access leg only. If the WTRU is in the Service Restricted Area, the WTRU may determine not to follow the ATSSS rules for the MA-PDU session and may steer the data traffic associated with the MA-PDU session towards the non-3GPP access leg only.

[0103] If the WTRU has determined to initiate the establishment of a new MA-PDU Session, the WTRU may initiate the MA-PDU session establishment over the non-3GPP access leg. For example, the WTRU may send a PDU Session Establishment Request over the non-3GPP access leg to the network. If the WTRU is in CM_IDLE state, it may initiate Service Request implementation over the non-3GPP access leg to enter CM_Connected state first. In the PDU Session Establishment Request, the WTRU may include an indication, "non-3GPP access leg only", to inform the network, e.g., 5G network, that only the UP for the non-3GPP access leg may presently be needed. Or the WTRU may indicate in the request that the WTRU is in Restricted Service Area for 3GPP access, which may cause the network to set up the UP for the non-3GPP access leg (e.g., for the non-3GPP access leg only). Upon receiving a "non-3GPP access leg only" or "3GPP access in RSA" indication, the network may skip the UP activation processing for the 3GPP access leg. The network may also configure the ATSSS rules to steer traffic to the non-3GPP access leg.

[0104] If the WTRU determines to reactivate an existing MA-PDU Session, the WTRU may initiate the MA-PDU session activation over the non-3GPP access leg, or the WTRU may initiate the MA-PDU session activation over the 3GPP access leg.

[0105] In connection with the WTRU initiating the MA-PDU session activation over the non-3GPP access leg, the WTRU may include in a Service Request message sent over the non-3GPP access leg, an indication, "non-3GPP access leg only," to inform the network, e.g., 5G network, that only the UP for the non-3GPP access leg may presently be needed. Or the WTRU may indicate in the Service Request that the WTRU is in Restricted Service Area for 3GPP access, which may cause the network to reactivate only the UP for the non-3GPP access leg. Upon receiving this "non-3GPP access leg only" or "3GPP access in RSA" indication, the network may skip the UP activation processing for the 3GPP access leg. The network may also configure the ATSSS rules to steer all the traffic to the non-3GPP access leg.

[0106] In connection with the WTRU initiating the MA-PDU session activation over the 3GPP access leg (unless the WTRU is in the Forbidden Area), the WTRU may include in a Service Request message a MA-PDU Session ID to identify the PDU Session to be activated. If located in the Forbidden Area of Restricted Access Area, the WTRU may also include the "non-3GPP access leg only" or "3GPP access in RSA" indication to inform the network to reactivate only the UP for the non-3GPP access leg.

[0107] A network, such as, for example, a 5G core network or EPC, may send a communication that triggers a WTRU to generate and send Service Requests for establishing MA-PDU sessions. The network communication may include a "Multi-Access" indication in a paging message or NAS Notification. In response to the communication, the WTRU may initiate parallel Service Request implementations over both 3GPP access and non-3GPP access legs and may use indications to activate user plane (UP) functionality for each access leg respectively.

[0108] If a network, e.g., a 5G core network or EPC, has DL data that may be associated with a MA-PDU session which has not been activated, different processing may be employed for triggering the WTRU to initiate the Service Request processing to activate the MA-PDU session depending on the WTRU connection management (CM) modes or states on the 3GPP access network and the non-3GPP access network. The processing may be different, for example, depending upon: whether the WTRU is in CM-IDLE mode for both 3GPP access and non-3GPP access networks; and/or whether the WTRU is in CM-IDLE mode for 3GPP access network and CM_Connected mode for the non-3GPP access network.

[0109] If a WTRU may be in CM_IDLE state for both 3GPP access network and non-3GPP access network, the network, e.g., 5G core network, may page the WTRU over the 3GPP access leg and may include in the paging message a "Multi-Access" indication. Upon observing this "Multi-Access" indication in the paging message, the WTRU may initiate a Service Request implementation over the 3GPP access leg. The WTRU may (e.g., may optionally) include the MA-PDU Session ID(s) as the "PDU Session to be activated" in one or more Service Request messages and may (e.g., may optionally) include an additional indication, "3GPP access leg only," in the Service Request message over 3GPP access. Each Service Request implementation may (e.g., may only) activate the UP for the 3GPP access leg (e.g., for only the 3GPP access leg). The WTRU may also initiate a Service Request implementation over the non-3GPP access leg. For example, the WTRU may initiate a Service Request implementation over the non-3GPP access leg and may include an additional indication in the Service Request. For example, the additional indication may correspond to a "non-3GPP access leg only" flag and/or IE in the Service Request message over the non-3GPP access leg.

[0110] FIG. 5 depicts example processing for network-triggered Service Requests for a MA-PDU session where the WTRU may be in CM-IDLE for a 3GPP access network and a non-3GPP access

network. As shown in FIG. 5, at 1, a User Plane Function (UPF), which may be comprised in a 5G core network, may receive downlink (DL) data. At 2, the UPF may notify the Session Management Function (SMF), which may also be comprised in a 5G core network, of the data arrival.

[0111] The SMF may determine a PDU Session ID associated with a MA-PDU session that may be used to communicate the received downlink data to the WTRU. At 3, the SMF may invoke the Access Management Function (AMF) service `Namf_Communication_N1N2MessageTransfer` and may include the PDU Session ID in the request.

[0112] The AMF, which may also be comprised in the 5G core network, may maintain information regarding which PDU sessions are MA-PDU sessions. Upon receiving a PDU session ID from the SMF, the AMF may search its stored session context information to identify whether the particular Session ID received from the SMF corresponds to a MA-PDU session. At 4, the AMF may generate and communicate one or more messages (e.g., paging messages) to the radio access network (RAN) which may be a 3GPP RAN. The associated access in the one or more messages, e.g., paging messages, may be set to "Multi-Access."

[0113] At 5, the RAN may receive the one or more messages, e.g., paging messages, from the AMF and may communicate messages, e.g., paging messages, to the WTRU. The "Multi-Access" indication may be included in the one or more messages, e.g., paging messages, that are sent to the WTRU.

[0114] At 6, in response to the received one or more messages, e.g., paging messages, the WTRU may generate and send a Service Request over the 3GPP access network leg and may include its MA-PDU Session ID(s) and a "3GPP access network leg only" indication in the Service Request message. The WTRU may also include in the Service Request other 3GPP-access-only PDU Session IDs together with MA-PDU Session ID(s) as the "PDU Sessions to be activated." The WTRU may send the Service Request to the AMF via the 3GPP access network.

[0115] At 7, the AMF may coordinate the activation of the user plane (UP) for the 3GPP access network leg of the MA-PDU session as a part of the Service Request implementation over the 3GPP access network leg.

[0116] At 8, the AMF may generate and send a Service Accept message over the 3GPP access network leg to the WTRU.

[0117] At 9, and in response to the first paging message and the Service Accept message, the WTRU may initiate a second Service Request over the non-3GPP access network leg and may include its MA-PDU Session ID(s) and an additional indication (e.g., "non-3GPP access leg only" indication) in the Service Request message. The WTRU may also include other non-3GPP-access-only PDU Session IDs together

with MA-PDU Session ID(s) as the "PDU Sessions to be activated." The WTRU may send the Service Request to the AMF via the non-3GPP access network.

[0118] At 10, the AMF may coordinate activating the user plane (UP) for the non-3GPP access network leg of the MA-PDU session as part of the Service Request implementation over non-3GPP access network leg.

[0119] At 11, the AMF may generate and send a Service Accept message over the non-3GPP access network leg to the WTRU.

[0120] If a WTRU may be in CM_IDLE mode or state for a 3GPP access network and CM_Connected mode for a non-3GPP access network, the network, e.g., 5G core network, may use a paging message over the 3GPP access network leg or a NAS Notification message over the non-3GPP access network leg to trigger the WTRU to request a MA-PDU session. A "Multi-Access" indication may be included in the paging or Notification message.

[0121] Upon receiving the paging or notification message, the WTRU may initiate a Service Request over the 3GPP access network leg and may include, e.g., optionally include, the MA-PDU Session ID in the Service Request message. Because the WTRU may be in CM_Connected state over non-3GPP access network leg, the network may activate, e.g., directly activate, the user plane (UP) for the non-3GPP access network leg of the MA-PDU session without waiting for the Service Request from the 3GPP access network leg. When the network receives the Service Request from the 3GPP access network leg, the network may (e.g., may only) activate the UP for the 3GPP access network leg of the MA-PDU session. The WTRU may include (e.g., explicitly include) a "3GPP access leg only" indication in the Service Request message.

[0122] FIG. 6 depicts processing for network-triggered Service Request for a MA-PDU session where the WTRU may be in CM-IDLE mode for a 3GPP access network and in CM_Connected mode for a non-3GPP access network. As shown in FIG. 6, at 1, the UPF may receive downlink (DL) data. The data may be for deliver to the WTRU.

[0123] At 2, the UPF may notify the SMF of the data arrival. The SMF may determine the PDU Session ID which is associated with a MA-PDU Session that may be used to deliver the data.

[0124] At 3, the SMF may invoke the AMF service Namf_Communication_N1N2MessageTransfer and may include the determined PDU Session ID in the request. The request is received at the AMF.

[0125] At 4, in response to the request from the AMF, the AMF may generate and send one or more NAS Notification messages over the non-3GPP access network leg to the WTRU. The associated access in the Notification message may be set to "Multi-Access."

[0126] At 5, the AMF may coordinate activating the user plane (UP) for the non-3GPP access network leg of the MA-PDU session.

[0127] At 6, the WTRU may initiate, e.g., generate and send, a Service Request over the 3GPP access network leg and may include its MA-PDU Session ID(s) in the SR message. The WTRU may also include a "3GPP access leg only" indication.

[0128] At 7, the AMF may coordinate activating the user plane (UP) for the 3GPP access network leg of the MA-PDU session as part of the Service Request implementation over the 3GPP access network leg.

[0129] At 8, the AMF may communicate, e.g., generate and send, a Service Accept message over the 3GPP access network leg to the WTRU.

[0130] Similar processing may apply if the WTRU is in CM_Connected mode for 3GPP access network and in CM_IDLE mode for non-3GPP access network. The network may reactivate, e.g., directly reactivate, the UP connection for the 3GPP access network leg. The WTRU, upon receiving the triggering message (e.g., paging or NAS Notification over the 3GPP access network leg), may use a Service Request implementation to reactivate the UP connection for the non-3GPP access network leg.

[0131] Accordingly, techniques have been described for establishing and managing multi-access (MA) PDU sessions (MA-PDU) through 3GPP RANs and non-3GPP networks. A WTRU may be configured to establish a communication session through one or both of a 3GPP RAN and a non-3GPP network. The WTRU may account for restricted service areas for 3GPP RAN service in configuring a communication session via one or both of a 3GPP RAN and a non-3GPP network.

[0132] A communications network may communicate with a WTRU to trigger activation of communications through one or both of a 3GPP RAN and a non-3GPP network. A WTRU may be programmed to receive a paging message from a 5G core network system via a radio access network, such as, for example, a 3GPP access network. The paging message may comprise an indication of "Multi-Access" and may be associated with reactivating an existing MA PDU session over the 3GPP access network and a non-3GPP access network. The WTRU may be in a CM-IDLE mode for both the 3GPP access network and the non-3GPP access network. The WTRU may respond by generating a first Service Request and a second Service Request. The first Service Request may comprise an indication associated with the 3GPP access network and may be communicated via the 3GPP access network. The second Service Request may comprise an indication associated with the non-3GPP access network and may be communicated via the non-3GPP access network. In response to the Service Requests, the 5G core network may activate user planes for each of the 3GPP access network connection and the non-3GPP access network connection.

[0133] It will be appreciated that while illustrative embodiments have been disclosed, the scope of potential embodiments is not limited to those explicitly set out. For example, while the system has been described with reference to a 3GPP, 5G, and/or NR network layer, the envisioned embodiments extend beyond implementations using a particular network layer technology. Likewise, the potential implementations extend to all types of service layer architectures, systems, and embodiments. The techniques described herein may be applied independently and/or used in combination with other resource configuration techniques.

[0134] It is understood that the entities performing the processes described herein may be logical entities that may be implemented in the form of software (i.e., computer-executable instructions) stored in a memory of, and executing on a processor of, a mobile device, network node or computer system. That is, the processes may be implemented in the form of software (i.e., computer-executable instructions) stored in a memory of a mobile device and/or network node, such as the node or computer system, which computer executable instructions, when executed by a processor of the node, perform the processes discussed. It is also understood that any transmitting and receiving processes illustrated in FIGs may be performed by communication circuitry of the node under control of the processor of the node and the computer-executable instructions (e.g., software) that it executes.

[0135] The various techniques described herein may be implemented in connection with hardware or software or, where appropriate, with a combination of both. Thus, the implementations and apparatus of the subject matter described herein, or certain aspects or portions thereof, may take the form of program code (i.e., instructions) embodied in tangible media, such as floppy diskettes, CD-ROMs, hard drives, or any other machine-readable storage medium wherein, when the program code is loaded into and executed by a machine, such as a computer, the machine becomes an apparatus for practicing the subject matter described herein. In the case where program code is stored on media, it may be the case that the program code in question is stored on one or more media that collectively perform the actions in question, which is to say that the one or more media taken together contain code to perform the actions, but that – in the case where there is more than one single medium – there is no requirement that any particular part of the code be stored on any particular medium. In the case of program code execution on programmable devices, the computing device generally includes a processor, a storage medium readable by the processor (including volatile and non-volatile memory and/or storage elements), at least one input device, and at least one output device. One or more programs that may implement or utilize the processes described in connection with the subject matter described herein, e.g., through the use of an API, reusable controls, or the like. Such programs are preferably implemented in a high level procedural or object oriented programming language to communicate with a computer system. However, the program(s) can be implemented in

assembly or machine language, if desired. In any case, the language may be a compiled or interpreted language, and combined with hardware implementations.

[0136] Although example embodiments may refer to utilizing aspects of the subject matter described herein in the context of one or more stand-alone computing systems, the subject matter described herein is not so limited, but rather may be implemented in connection with any computing environment, such as a network or distributed computing environment. Still further, aspects of the subject matter described herein may be implemented in or across a plurality of processing chips or devices, and storage may similarly be affected across a plurality of devices. Such devices might include personal computers, network servers, handheld devices, supercomputers, or computers integrated into other systems such as automobiles and airplanes.

[0137] In describing preferred embodiments of the subject matter of the present disclosure, as illustrated in the Figures, specific terminology is employed for the sake of clarity. The claimed subject matter, however, is not intended to be limited to the specific terminology so selected, and it is to be understood that each specific element includes all technical equivalents that operate in a similar manner to accomplish a similar purpose.

[0138] Although features and elements are described herein in particular combinations, one of ordinary skill in the art will appreciate that each feature or element may be used alone or in any combination with the other features and elements. In addition, the implementations described herein may be implemented in a computer program, software, or firmware incorporated in a computer-readable medium for execution by a computer or processor. Examples of computer-readable media include electronic signals (transmitted over wired or wireless connections) and computer-readable storage media. Examples of computer-readable storage media include, but are not limited to, a read only memory (ROM), a random access memory (RAM), a register, cache memory, semiconductor memory devices, magnetic media such as internal hard disks and removable disks, magneto-optical media, and optical media such as CD-ROM disks, and digital versatile disks (DVDs). A processor in association with software may be used to implement a radio frequency transceiver for use in a WTRU, UE, terminal, base station, RNC, or any host computer.

[0139] The following is a list of acronyms that may appear herein:

AN:	Access Network
ATSSS:	Access Traffic Steering Switching Splitting
CM:	Connection Management
DN:	Data Network
DL:	Downlink

MA-PDU :	Multi-Access PDU Session
N3IWF:	Non-3GPP Interworking Function
PDU:	Protocol Data Unit
RSA:	Restricted Service Area
RSD:	Route Selection Descriptor
SMF:	Session Management Function
SR:	Service Request
UL:	Uplink
UP:	User Plane
UPF:	User Plane Function
URSP:	UE Route Selection Policy

CLAIMS

What is claimed is:

1. A wireless transmit and receive unit (WTRU) comprising:
a processor configured at least to:
receive a paging message, the paging message comprising an indication associated with a multi-access protocol data unit (PDU) session;
generate a first service request, the first service request comprising an indication associated with a 3GPP access network;
send the first service request via the 3GPP access network;
generate a second service request, the second service request comprising an indication associated with a non-3GPP access network; and
send the second service request via the non-3GPP access network.
2. The WTRU of claim 1,
wherein the paging message is associated with reactivating an existing multi-access PDU session implemented over the 3GPP access network and the non-3GPP access network.
3. The WTRU of claim 1,
wherein the WTRU is in Connection Management-Idle (CM-IDLE) mode for the 3GPP access network when receiving the paging message, and
wherein the WTRU is in Connection Management-Idle (CM-IDLE) mode for the non-3GPP access network when receiving the paging message.
4. The WTRU of claim 1,
wherein the first service request further comprises one or more session identifiers associated with multi-access PDU sessions, and
wherein the second service request further comprises one or more session identifiers associated with multi-access PDU sessions.
5. The WTRU of claim 4,

wherein the session identifiers associated with multi-access PDU sessions comprised in the second service request comprise session identifiers associated with the 3GPP access network.

6. The WTRU of claim 1, wherein the paging message indicates a multi-access PDU session re-activation request, and the processor is further configured to:

in response to receiving the paging message, identify one or more session identifiers associated with one or more multi-access PDU sessions for re-activation, and

include the identified one or more session identifiers associated with the one or more multi-access PDU sessions in the first service request and the second service request.

7. The WTRU of claim 1,

wherein the first service request further comprises an indication of 3GPP access network only, and

wherein the second service request further comprises an indication of non-3GPP access network only.

8. The WTRU of claim 1, wherein the processor is further configured to:

receive a first service accept message in response to transmitting the first service request, wherein the second service request is sent in response to receiving the first service accept message; and

receive a second service accept message in response to transmitting the second service request.

9. The WTRU of claim 8,

wherein the first service accept message is received via the 3GPP access network, and

wherein the second service accept message is received via the non-3GPP access network.

10. The WTRU of claim 1,

wherein receiving a paging message comprises receiving a paging message via a radio access network (RAN).

11. A wireless transmit and receive unit (WTRU) comprising:

a processor configured at least to:

receive a message, the message comprising an indication associated with a multi-access protocol data unit (PDU) session;

generate a first service request, the first service request comprising an indication associated with a first access network; and

transmit the first service request via the first access network;
wherein, the WTRU is in Connection Management-Idle (CM-IDLE) mode for the first access network and in Connection Management-Connected (CM-Connected) mode for a second access network.

12. The WTRU of claim 11,
wherein the message is received via the second access network.
13. The WTRU of claim 11,
wherein the first service request further comprises one or more session identifiers associated with multi-access PDU sessions.
14. The WTRU of claim 11,
wherein the first service request further comprises an indication of first access network only.
15. The WTRU of claim 11,
wherein the processor is further configured to:
receive a first service accept message in response to transmitting the first service request.
16. The WTRU of claim 11,
wherein the first access network is a 3GPP access network, and
wherein the second access network is a non-3GPP access network.
17. The WTRU of claim 11,
wherein the first access network is a non-3GPP access network, and
wherein the second access network is a 3GPP access network.
18. The WTRU of claim 11,
wherein the message is associated with reactivating an existing multi-access PDU session implemented over the first access network and the second access network.
19. A method comprising:
a server system receiving a communication to establish a multi-access protocol data unit (PDU) session, the communication comprising a PDU session identifier;

the server system generating a message, the message comprising an indication associated with a multi-access PDU session;

the server system transmitting the message to a first access network;

the server system receiving, from the first access network, a first service request, the first service request comprising an indication associated with a first access network; and

the server system receiving, from a second access network, a second service request, the second service request comprising an indication associated with the second access network.

20. The method of claim 19, further comprising:

the server system, in response to the first service request, activating user plane for the first access network;

the server system generating a first service accept message; and

the server system transmitting the first service accept message via the first access network.

21. The method of claim 19, further comprising:

the server system, in response to the second service request, activating user plane for the second access network;

the server system generating a second service accept message; and

the server system transmitting the second service accept message via the second access network.

22. The method of claim 19,

wherein the first service request further comprises one or more session identifiers associated with multi-access PDU sessions, and

wherein the second service request further comprises one or more session identifiers associated with multi-access PDU sessions.

23. The method of claim 19,

wherein the first service request further comprises an indication of 3GPP access network only, and

wherein the second service request further comprises an indication of non-3GPP access network only.

24. The method of claim 19,

wherein the first access network is a 3GPP access network, and

wherein the second access network is a non-3GPP access network.

25. The method of claim 19,
wherein the first access network is a non-3GPP access network, and
wherein the second access network is a 3GPP access network.
26. The method of claim 19,
wherein the multi-access PDU session is an existing session, and
wherein receiving a communication to establish the multi-access PDU session comprises receiving
a communication to reactivate the multi-access PDU session.

100

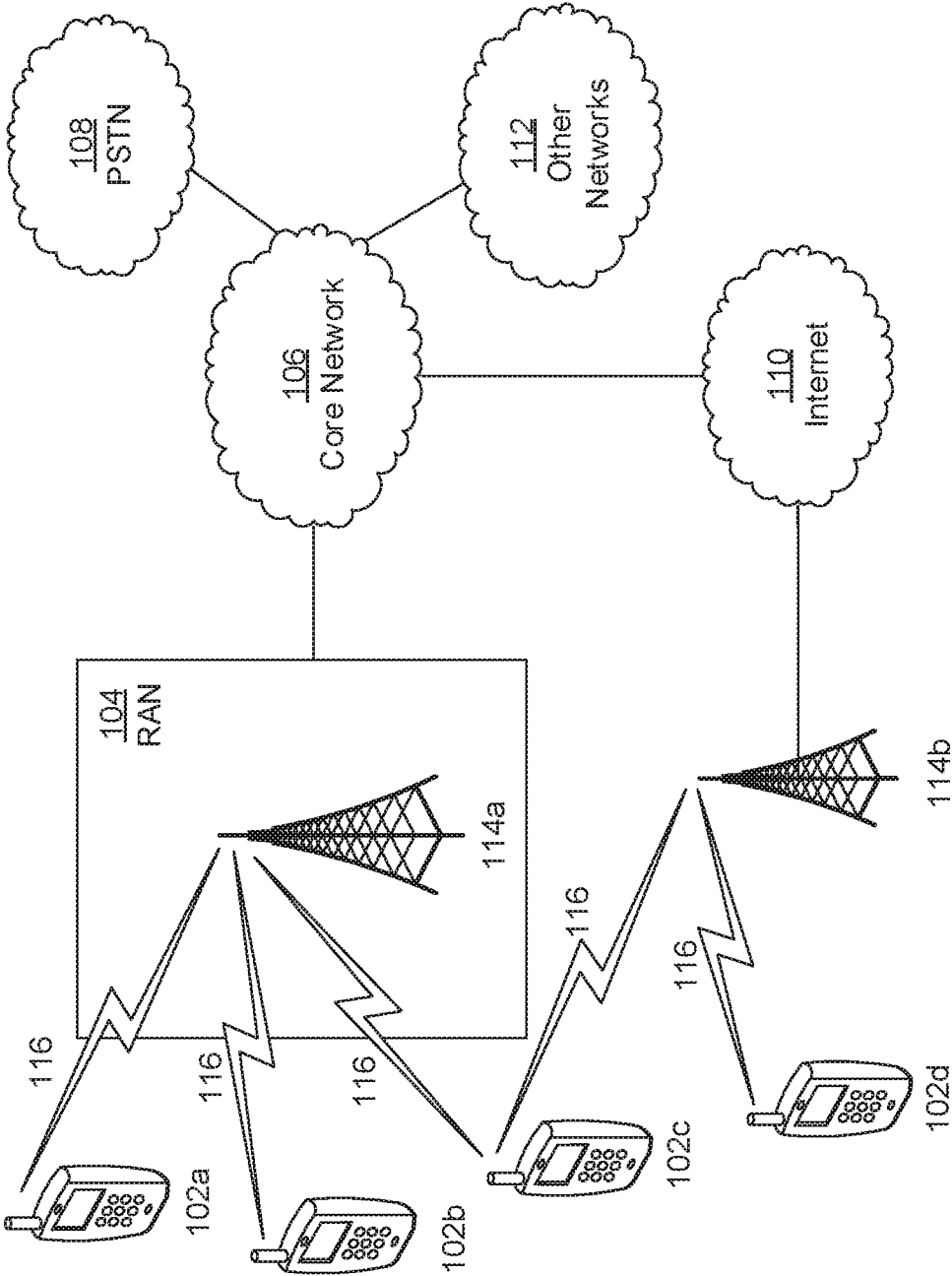
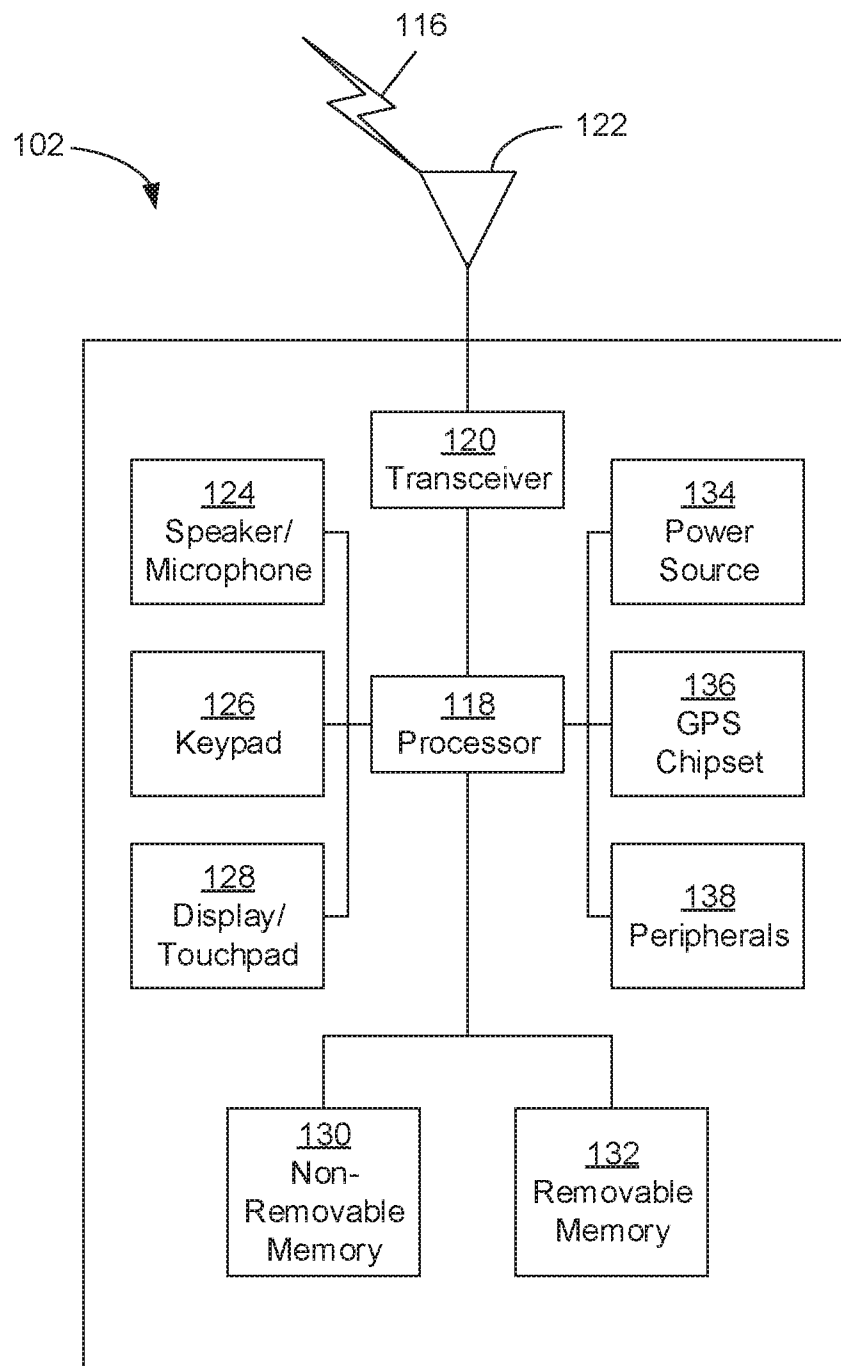


FIG. 1A

2/9

**FIG. 1B**

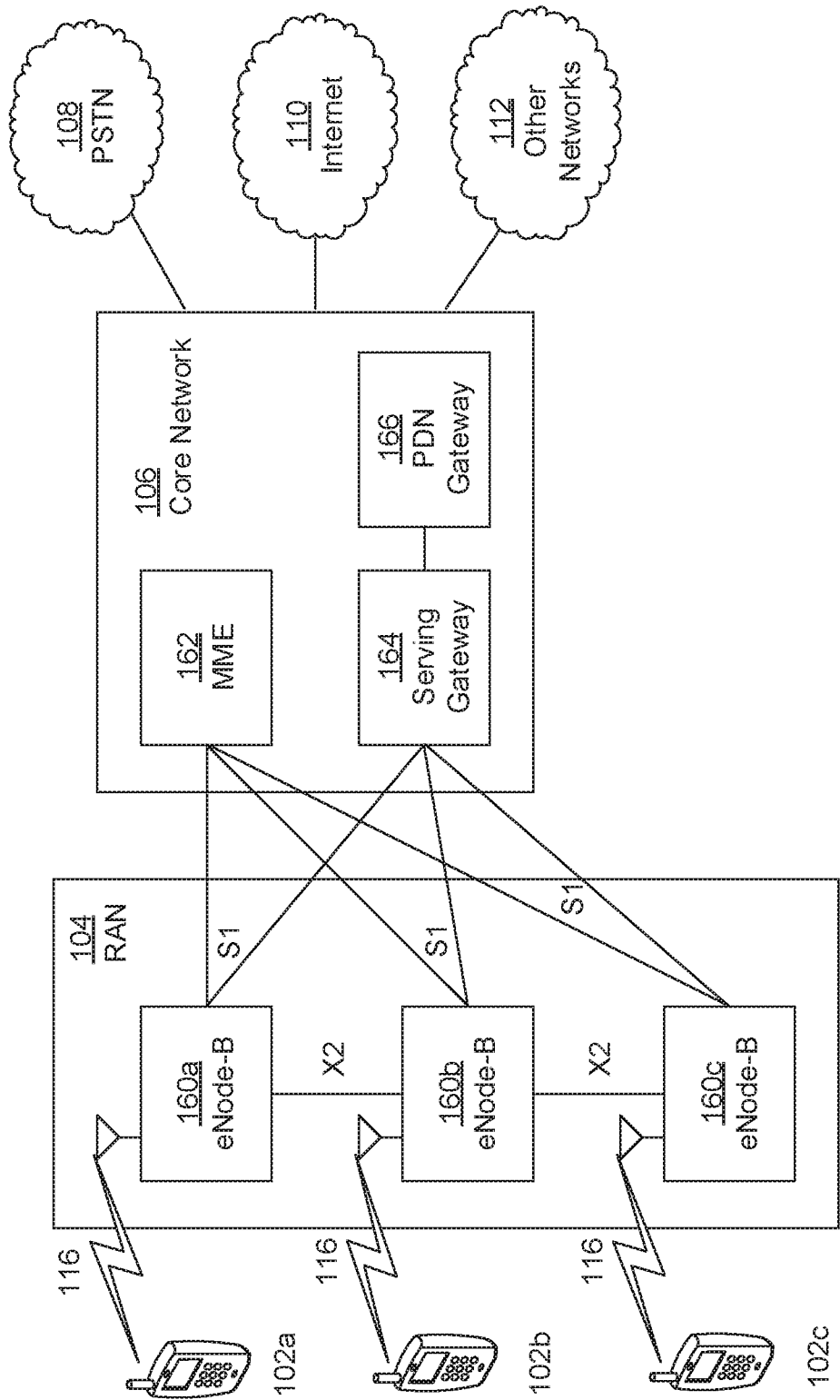


FIG. 1C

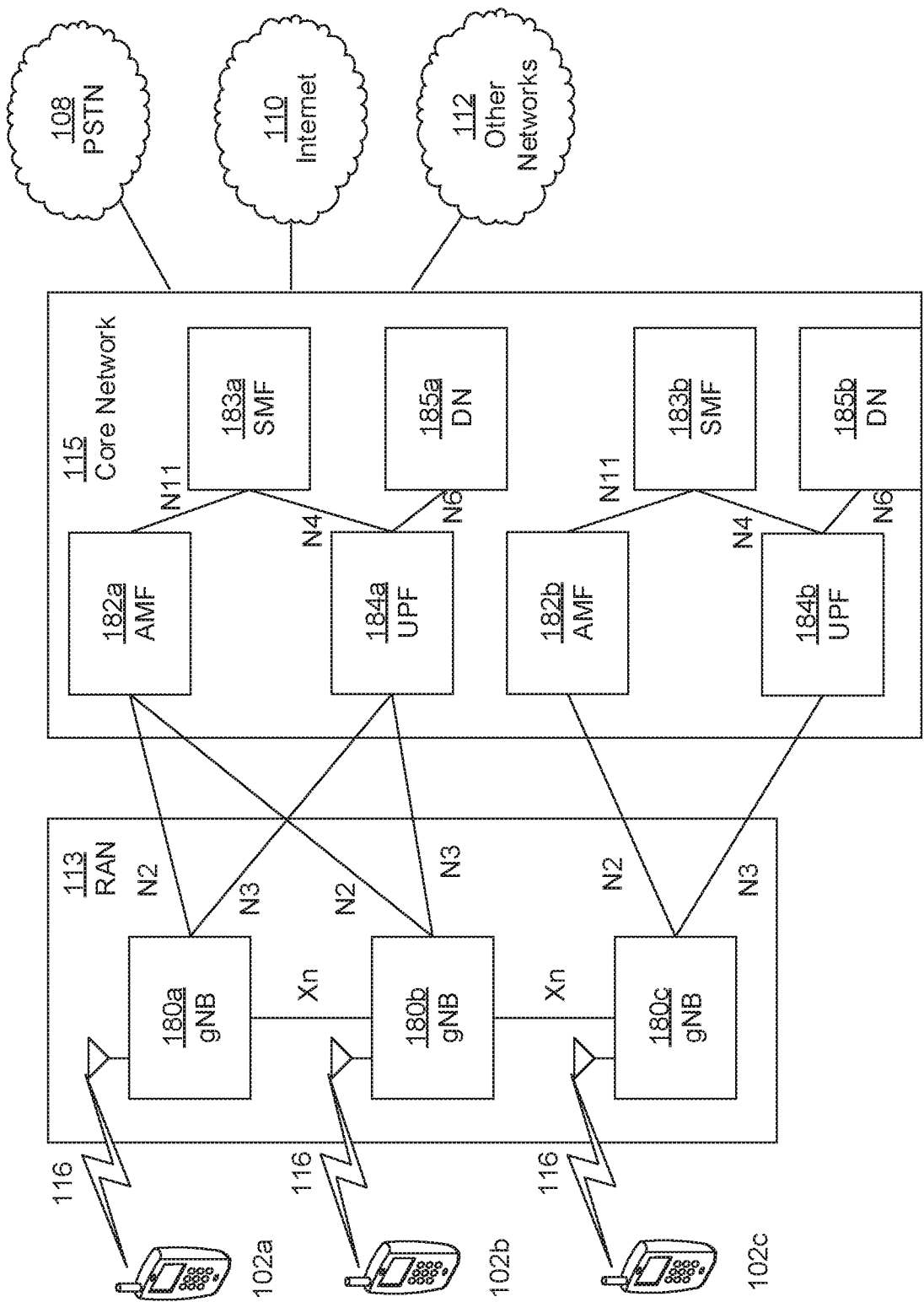


FIG. 1D

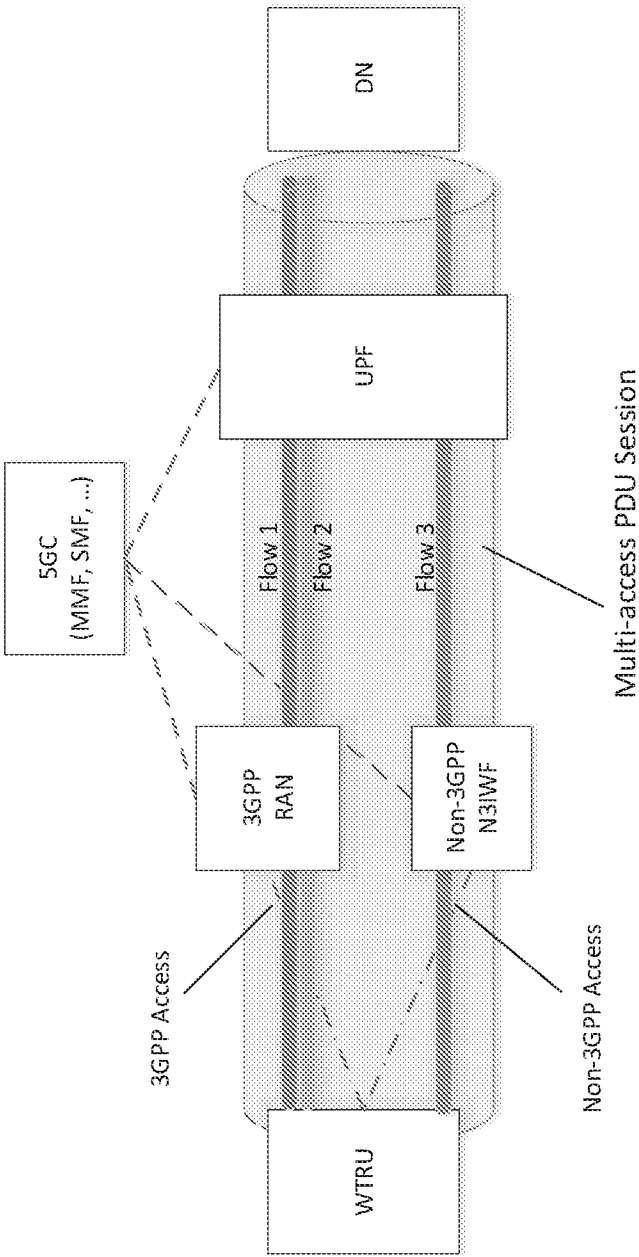
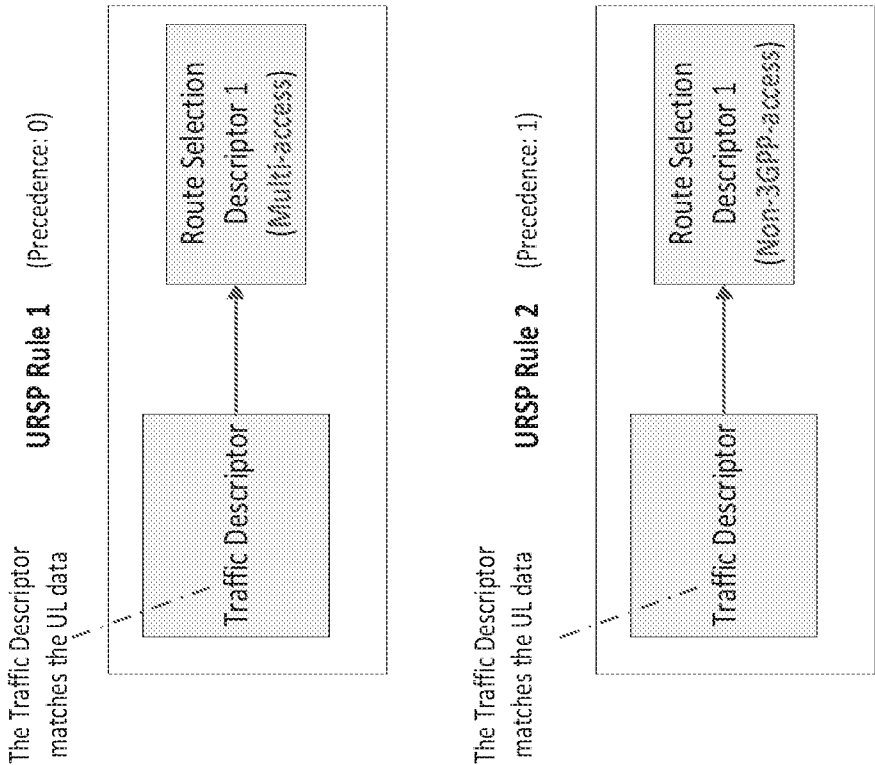
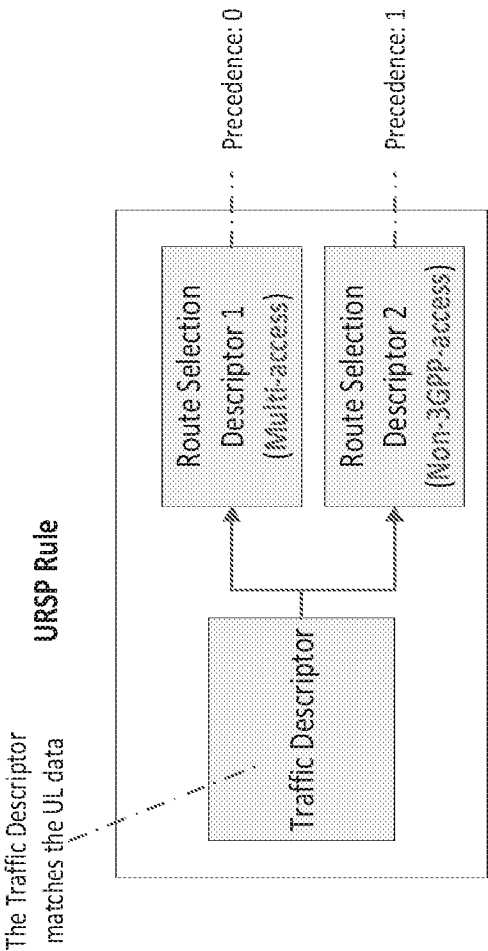


FIG. 2



URSP rule 2 is selected though it has lower priority than URSP rule 1

B



Route Selection Descriptor 2 is selected though it has lower priority than Route Selection Descriptor 1

A

FIG. 3

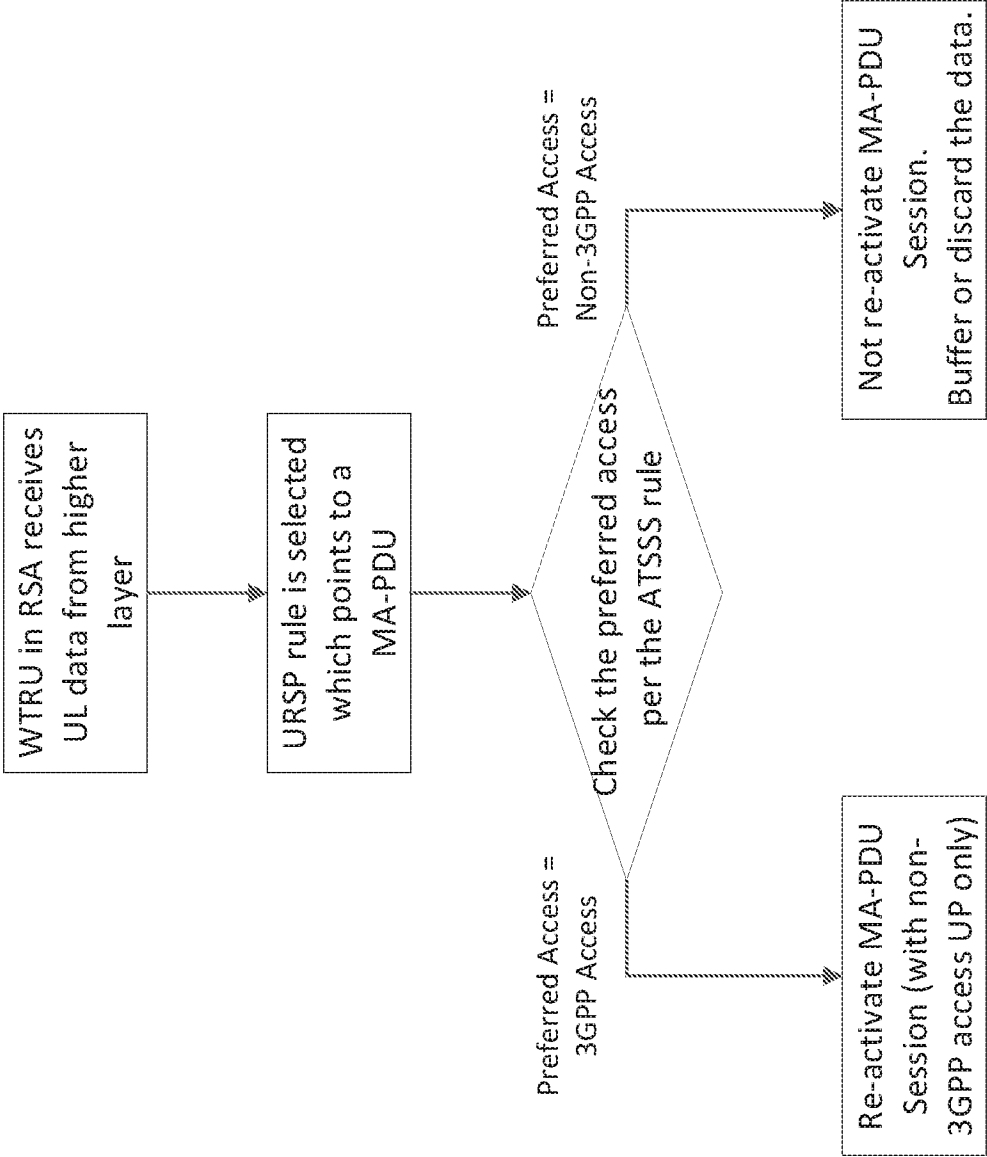


FIG. 4

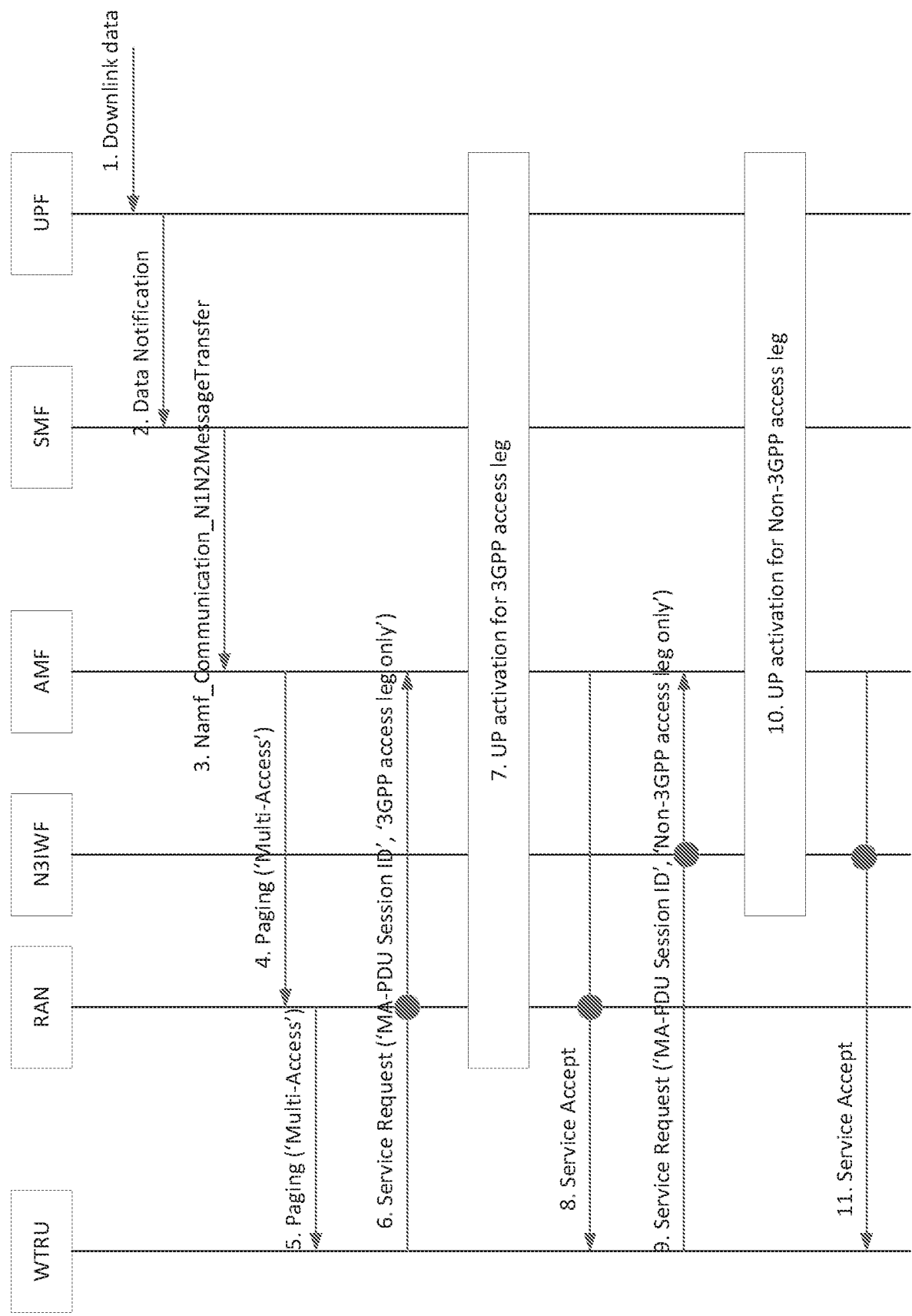


FIG. 5

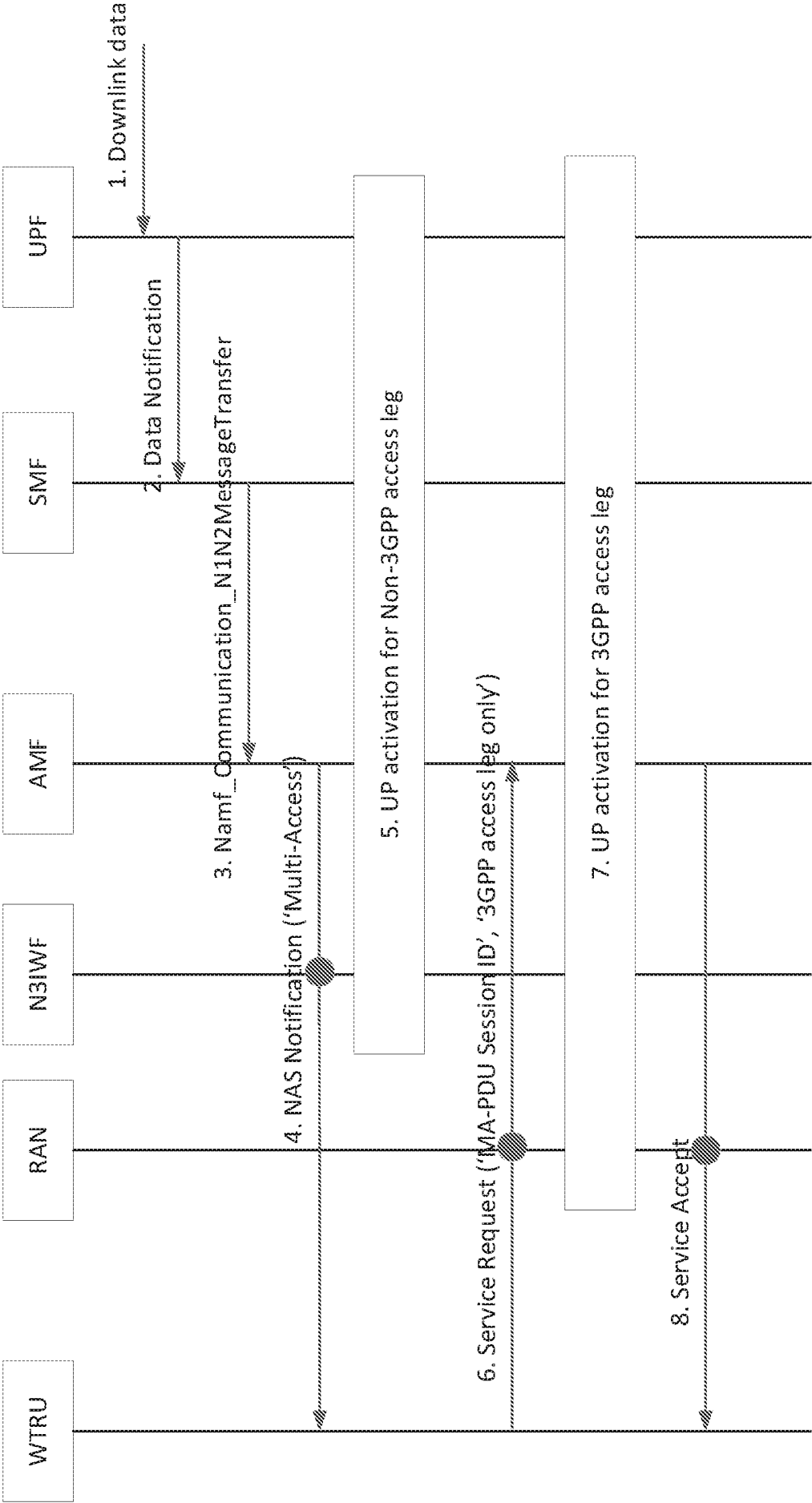


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2020/018355

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W76/15 H04W60/00
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, 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	"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; System Architecture for the 5G System; Stage 2 (Release 16)", 3GPP DRAFT; INTERIM DRAFT (REMOVE 862R3 EMAIL) 23501-N EWREL-16+CRS, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRA , vol. SA WG2 4 February 2019 (2019-02-04), XP051688561, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg%5Fsa/WG2%5FArch/Latest%5FSA2%5FSpecs/DRAFT%5FINTERIM/Archive/INTERIM%5FDRAFT%5F%28remove%5F862R3%5Femail%29%5F23501%2DnewRel%2D16%2BCRs%2Ezip -/-	1-26



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

18 May 2020

Date of mailing of the international search report

28/05/2020

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Siebel, Christian

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2020/018355

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	[retrieved on 2019-02-04] page 93 page 17, lines 14-15 page 78, line 27 - line 28 page 79, line 29 - line 30 page 203, lines 1,2, 19-22 Section 5.6.8 Section 5.6.2 Section 5.3.3.4 ----- "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Procedures for the 5G System; Stage 2 (Release 16)", 3GPP DRAFT; INTERIM DRAFT 23502-NEWREL-16+CRS, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. SA WG2 4 February 2019 (2019-02-04), XP051697369, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg%5Fsa/WG2%5FArch/Latest%5FSA2%5FSpecs/DRAFT%5FINTERIM/Archive/INTERIM%5FDRAFT%5F23502%2DnewRel%2D16%2BCRs%2E%2Ezip [retrieved on 2019-02-04] Section 4.2.3.3 Section 4.22.2 -----	1-26
X	WO 2019/032972 A1 (IDAC HOLDINGS INC [US]) 14 February 2019 (2019-02-14) figure 8 -----	1-26

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2020/018355

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2019032972 A1	14-02-2019	CN 111034336 A	17-04-2020
		EP 3666032 A1	17-06-2020
		WO 2019032972 A1	14-02-2019
