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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 May 2015 (21.05.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/070420 A1

(51) International Patent Classification:
H04W 36/14 (2009.01)

(21) International Application Number:
PCT/CN2013/087138

(22) International Filing Date:
14 November 2013 (14.11.2013)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **QUALCOMM INCORPORATED** [US/US]; ATTN: International IP Administration, 5775 Morehouse Drive, San Diego, California 92121-1714 (US).

(72) Inventors; and
(71) Applicants *(for US only)*: **ZHU, Xipeng** [CN/CN]; 5775 Morehouse Drive, San Diego, California 92121-1714 (US). **LI, Yan** [CN/CN]; 5775 Morehouse Drive, San Diego, California 92121-1714 (US).

(74) Agent: **NTD PATENT & TRADEMARK AGENCY LIMITED**; 10th Floor, Block A, Investment Plaza, 27 Jinrongdajie, Xicheng District, Beijing 100033 (CN).

(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, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, 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, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, 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, 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).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

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

(54) Title: DUAL RADIO VOICE CALL CONTINUITY

(57) Abstract: Certain aspects of the present disclosure relate to methods and apparatus for network-controlled DRVCC.

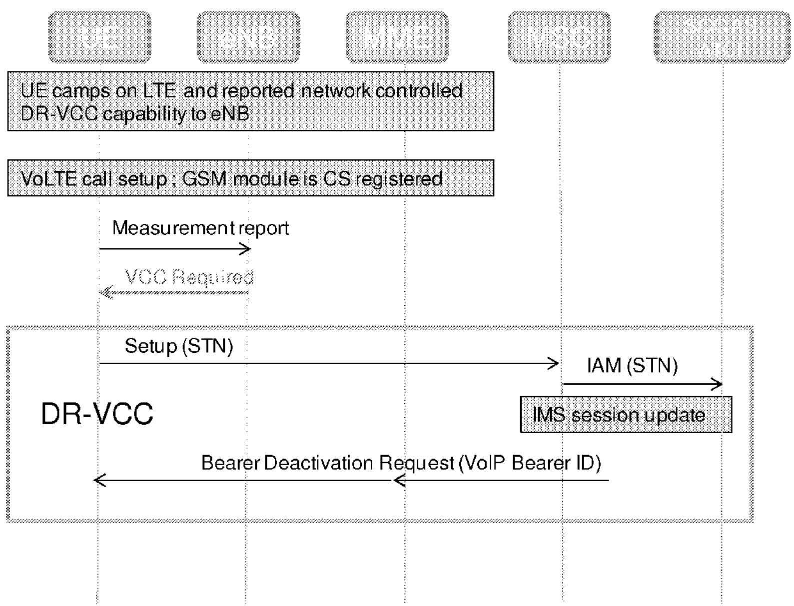

FIG. 6

WO 2015/070420 A1

DUAL RADIO VOICE CALL CONTINUITY

BACKGROUND

Field

[0001] Aspects of the present disclosure relate generally to wireless communication systems, and more particularly, continuity of wireless communications in radio access networks.

Background

[0002] Wireless communication networks are widely deployed to provide various communication services such as telephony, video, data, messaging, broadcasts, and so on. Such networks, which are usually multiple access networks, support communications for multiple users by sharing the available network resources. One example of such a network is the Universal Terrestrial Radio Access Network (UTRAN). The UTRAN is the radio access network (RAN) defined as a part of the Universal Mobile Telecommunications System (UTMS), a third generation (3G) mobile phone technology supported by the 3rd Generation Partnership Project (3GPP). The UMTS, which is the successor to Global System for Mobile Communications (GSM) technologies, currently supports various air interface standards, such as Wideband-Code Division Multiple Access (W-CDMA), Time Division–Code Division Multiple Access (TD-CDMA), and Time Division–Synchronous Code Division Multiple Access (TD-SCDMA). For example, China is pursuing TD-SCDMA as the underlying air interface in the UTRAN architecture with its existing GSM infrastructure as the core network. The UMTS also supports enhanced 3G data communications protocols, such as High Speed Downlink Packet Data (HSDPA), which provides higher data transfer speeds and capacity to associated UMTS networks.

[0003] As the demand for mobile broadband access continues to increase, research and development continue to advance the UMTS technologies not only to meet the growing demand for mobile broadband access, but to advance and enhance the user experience with mobile communications.

SUMMARY

[0004] In an aspect of the disclosure, a method for wireless communications by a user equipment (UE) is provided. The method generally includes requesting handover

of a voice over Internet protocol (VoIP) call from a first radio access technology (RAT) network to a second RAT network, activating a radio of the second RAT, continuing the voice call on the circuit switched (CS) domain of the second RAT network, and communicating data for applications other than the voice call via the first RAT network.

[0005] In an aspect of the disclosure, a method for wireless communications by a base station (BS) is provided. The method generally includes sending a request to handover a voice call to a second RAT network, receiving a failure or reject message in response to the request to handover, and receiving a bearer deactivation request for the voice call.

[0006] In an aspect of the disclosure, a method for wireless communications a mobility management entity (MME) is provided. The method generally includes receiving an indication of network controlled dual radio voice call continuity (DR-VCC) capability from a UE, receiving a request to handover a voice call for the UE from a first radio access technology (RAT) network to a second RAT network, sending a failure or reject message in response to the request to handover, and sending a command to the UE indicating the UE to perform dual radio voice call continuity.

[0007] In an aspect of the disclosure, a method for wireless communications by a base station of a first radio access technology (RAT) network is provided. The method generally includes receiving an indication of network controlled dual radio voice call continuity (DR-VCC) capability from a UE, receiving a request to handover a voice call to a second RAT network from the UE, sending a message to the UE requesting the UE to perform dual radio voice call continuity, and receiving a bearer deactivation request for the voice call.

[0008] In an aspect of the disclosure, a method for wireless communications by a base station of a first radio access technology (RAT) network is provided. The method generally includes receiving an indication of network controlled dual radio voice call continuity (DR-VCC) capability from a UE, receiving a measurement report of a second RAT network from the UE, sending a request to handover a voice call to a second RAT network, wherein the request indicates the UE has DR-VCC capability, and sending a message to the UE indicating the voice call will continue via the second RAT network.

[0009] In an aspect of the disclosure, a method for wireless communications by a mobility management entity (MME) is provided. The method generally includes receiving an indication that a UE has network controlled dual radio voice call continuity

(DR-VCC) capability from a base station, receiving a request to handover a voice call for the UE from a first radio access technology (RAT) network to a second RAT network, and not releasing an S1 connection after the handover.

[0010] In an aspect of the disclosure, a method for wireless communications by a mobility management entity (MME) is provided. The method generally includes receiving an indication that a UE has network controlled dual radio voice call continuity (DR-VCC) capability, receiving a request to handover a voice call for the UE from a first radio access technology (RAT) network to a second RAT network, and not releasing an S1 connection after the handover.

[0011] Numerous other aspects are provided including apparatus, systems and computer program products.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 illustrates an exemplary telecommunications system of multiple wireless radio access technologies (RATs), according to aspects of the present disclosure.

[0013] FIG. 2 conceptually illustrates examples of a user equipment (UE), evolved NodeB (eNB), and mobility management entity (MME) in communication, according to aspects of the present disclosure.

[0014] FIG. 3 is a block diagram conceptually illustrating an example of a Node B in communication with a user equipment (UE) in a telecommunications system, according to aspects of the present disclosure. .

[0015] FIG. 4 illustrates an example of single radio voice call continuity (SRVCC), according to aspects of the present disclosure.

[0016] FIG. 5 illustrates an example of network-controlled dual radio voice call continuity (DR-VCC), according to aspects of the present disclosure.

[0017] FIG. 6 illustrates an example of network-controlled DR-VCC, according to aspects of the present disclosure.

[0018] FIG. 7 illustrates an example of network-controlled DR-VCC, according to aspects of the present disclosure.

[0019] FIG. 8 illustrates an example of network-controlled DR-VCC, according to aspects of the present disclosure.

[0020] FIG. 9 illustrates example operations for SRVCC, according to aspects of the present disclosure.

[0021] FIG. 10 illustrates example operations for DR-VCC, according to aspects of the present disclosure.

[0022] FIG. 11 illustrates example operations for DR-VCC, according to aspects of the present disclosure.

[0023] FIG. 12 illustrates example operations for DR-VCC, according to aspects of the present disclosure.

[0024] FIG. 13 illustrates example operations for DR-VCC, according to aspects of the present disclosure.

[0025] The attached APPENDIX provides details for certain aspects of the present disclosure.

DETAILED DESCRIPTION

[0026] The detailed description set forth below, in connection with the appended drawings, is intended as a description of various configurations and is not intended to represent the only configurations in which the concepts described herein may be practiced. The detailed description includes specific details for the purpose of providing a thorough understanding of the various concepts. However, it will be apparent to those skilled in the art that these concepts may be practiced without these specific details. In some instances, well-known structures and components are shown in block diagram form in order to avoid obscuring such concepts.

[0027] FIG. 1 shows an exemplary deployment in which multiple wireless networks have overlapping coverage. An evolved universal terrestrial radio access network (E-UTRAN) 120 may support LTE and may include a number of evolved Node Bs (eNBs) 122 and other network entities that can support wireless communication for user equipments 110 (UEs). Each eNB 122 may provide communication coverage for a particular geographic area. The term "cell" can refer to a coverage area of an eNB and/or an eNB subsystem serving this coverage area. A serving gateway (S-GW) 124 may communicate with E-UTRAN 120 and may perform various functions such as packet routing and forwarding, mobility anchoring, packet buffering, initiation of network-triggered services, etc. A mobility management entity (MME) 126 may communicate with E-UTRAN 120 and serving gateway 124 and may perform various functions such as mobility management, bearer management, distribution of paging messages, security control, authentication, gateway selection, etc. The network entities in LTE are described in 3GPP TS 36.300, entitled "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description," which is publicly available.

[0028] A radio access network (RAN) 130 may support GSM and may include a number of base stations 132 and other network entities that can support wireless communication for UEs. A mobile switching center (MSC) 134 may communicate with the RAN 130 and may support voice services, provide routing for circuit-switched calls, and perform mobility management for UEs located within the area served by MSC 134. Optionally, an inter-working function (IWF) 140 may facilitate communication between MME 126 and MSC 134 (e.g., for 1xCSFB).

[0029] E-UTRAN 120, serving gateway 124, and MME 126 may be part of an LTE network 102. RAN 130 and MSC 134 may be part of a GSM network 104. For simplicity, FIG. 1 shows only some network entities in the LTE network 102 and the GSM network 104. The LTE and GSM networks may also include other network entities that may support various functions and services.

[0030] In general, any number of wireless networks may be deployed in a given geographic area. Each wireless network may support a particular RAT and may operate on one or more frequencies. A RAT may also be referred to as a radio technology, an air interface, etc. A frequency may also be referred to as a carrier, a frequency channel, etc. Each frequency may support a single RAT in a given geographic area in order to avoid interference between wireless networks of different RATs.

[0031] A UE 110 may be stationary or mobile and may also be referred to as a mobile station, a terminal, an access terminal, a subscriber unit, a station, etc. UE 110 may be a cellular phone, a personal digital assistant (PDA), a wireless modem, a wireless communication device, a handheld device, a laptop computer, a cordless phone, a wireless local loop (WLL) station, etc.

[0032] Upon power up, UE 110 may search for wireless networks from which it can receive communication services. If more than one wireless network is detected, then a wireless network with the highest priority may be selected to serve UE 110 and may be referred to as the serving network. UE 110 may perform registration with the serving network, if necessary. UE 110 may then operate in a connected mode to actively communicate with the serving network. Alternatively, UE 110 may operate in an idle mode and camp on the serving network if active communication is not required by UE 110.

[0033] FIG. 2 shows a block diagram of a design of UE 110, eNB 122, and MME 126 in FIG. 1. At UE 110, an encoder 212 may receive traffic data and signaling messages to be sent on the uplink. Encoder 212 may process (e.g., format, encode, and interleave) the traffic data and signaling messages. A modulator (Mod) 214 may further process (e.g., symbol map and modulate) the encoded traffic data and signaling messages and provide output samples. A transmitter (TMTR) 222 may condition (e.g., convert to analog, filter, amplify, and frequency upconvert) the output samples and generate an uplink signal, which may be transmitted via an antenna 224 to eNB 122.

[0034] On the downlink, antenna 224 may receive downlink signals transmitted by eNB 122 and/or other eNBs/base stations. A receiver (RCVR) 226 may condition (e.g., filter, amplify, frequency downconvert, and digitize) the received signal from antenna 224 and provide input samples. A demodulator (Demod) 216 may process (e.g., demodulate) the input samples and provide symbol estimates. A decoder 218 may process (e.g., deinterleave and decode) the symbol estimates and provide decoded data and signaling messages sent to UE 110. Encoder 212, modulator 214, demodulator 216, and decoder 218 may be implemented by a modem processor 210. These units may perform processing in accordance with the RAT (e.g., LTE, 1xRTT, etc.) used by the wireless network with which UE 110 is in communication.

[0035] A controller/processor 230 may direct the operation at UE 110. Controller/processor 230 may also perform or direct other processes for the techniques described herein. Controller/processor 230 may also perform or direct the processing by UE. Memory 232 may store program codes and data for UE 110. Memory 232 may also store a priority list and configuration information.

[0036] At eNB 122, a transmitter/receiver 238 may support radio communication with UE 110 and other UEs. A controller/processor 240 may perform various functions for communication with the UEs. On the uplink, the uplink signal from UE 110 may be received via an antenna 236, conditioned by receiver 238, and further processed by controller/processor 240 to recover the traffic data and signaling messages sent by UE 110. On the downlink, traffic data and signaling messages may be processed by controller/processor 240 and conditioned by transmitter 238 to generate a downlink signal, which may be transmitted via antenna 236 to UE 110 and other UEs.

Controller/processor 240 may also perform or direct other processes for the techniques described herein. Controller/processor 240 may also perform or direct the processing by eNB 122. Memory 242 may store program codes and data for the base station. A communication (Comm) unit 244 may support communication with MME 126 and/or other network entities.

[0037] At MME 126, a controller/processor 250 may perform various functions to support communication services for UEs. Controller/processor 250 may also perform or direct the processing by MME 126 in FIGS. 3 and 4. Memory 252 may store program codes and data for MME 126. A communication unit 254 may support communication with other network entities.

[0038] FIG. 2 shows simplified designs of UE 110, eNB 122, and MME 126. In general, each entity may include any number of transmitters, receivers, processors, controllers, memories, communication units, etc. Other network entities may also be implemented in similar manner.

[0039] FIG. 3 is a block diagram of a Node B 310 in communication with a UE 350 in a RAN 300, wherein the RAN 300 may be the RAN 102 in FIG. 1, the Node B 310 may be the Node B 108 in FIG. 1, and the UE 350 may be the UE 110 in FIG. 1. In the downlink communication, a transmit processor 320 may receive data from a data source 312 and control signals from a controller/processor 340. The transmit processor 320 provides various signal processing functions for the data and control signals, as well as reference signals (e.g., pilot signals). For example, the transmit processor 320 may provide cyclic redundancy check (CRC) codes for error detection, coding and interleaving to facilitate forward error correction (FEC), mapping to signal constellations based on various modulation schemes (e.g., binary phase-shift keying (BPSK), quadrature phase-shift keying (QPSK), M-phase-shift keying (M-PSK), M-quadrature amplitude modulation (M-QAM), and the like), spreading with orthogonal variable spreading factors (OVSF), and multiplying with scrambling codes to produce a series of symbols. Channel estimates from a channel processor 344 may be used by a controller/processor 340 to determine the coding, modulation, spreading, and/or scrambling schemes for the transmit processor 320. These channel estimates may be derived from a reference signal transmitted by the UE 350 or from feedback contained in the midamble 214 (FIG. 2) from the UE 350. The symbols generated by the transmit processor 320 are provided to a transmit frame processor 330 to create a frame structure.

The transmit frame processor 330 creates this frame structure by multiplexing the symbols with a midamble 214 (FIG. 2) from the controller/processor 340, resulting in a series of frames. The frames are then provided to a transmitter 332, which provides various signal conditioning functions including amplifying, filtering, and modulating the frames onto a carrier for downlink transmission over the wireless medium through smart antennas 334. The smart antennas 334 may be implemented with beam steering bidirectional adaptive antenna arrays or other similar beam technologies.

[0040] At the UE 350, a receiver 354 receives the downlink transmission through an antenna 352 and processes the transmission to recover the information modulated onto the carrier. The information recovered by the receiver 354 is provided to a receive frame processor 360, which parses each frame, and provides the midamble 214 (FIG. 2) to a channel processor 394 and the data, control, and reference signals to a receive processor 370. The receive processor 370 then performs the inverse of the processing performed by the transmit processor 320 in the Node B 310. More specifically, the receive processor 370 descrambles and despreads the symbols, and then determines the most likely signal constellation points transmitted by the Node B 310 based on the modulation scheme. These soft decisions may be based on channel estimates computed by the channel processor 394. The soft decisions are then decoded and deinterleaved to recover the data, control, and reference signals. The CRC codes are then checked to determine whether the frames were successfully decoded. The data carried by the successfully decoded frames will then be provided to a data sink 372, which represents applications running in the UE 350 and/or various user interfaces (e.g., display). Control signals carried by successfully decoded frames will be provided to a controller/processor 390. When frames are unsuccessfully decoded by the receiver processor 370, the controller/processor 390 may also use an acknowledgement (ACK) and/or negative acknowledgement (NACK) protocol to support retransmission requests for those frames.

[0041] In the uplink, data from a data source 378 and control signals from the controller/processor 390 are provided to a transmit processor 380. The data source 378 may represent applications running in the UE 350 and various user interfaces (e.g., keyboard). Similar to the functionality described in connection with the downlink transmission by the Node B 310, the transmit processor 380 provides various signal processing functions including CRC codes, coding and interleaving to facilitate FEC, mapping to signal constellations, spreading with OVSFs, and scrambling to produce a series of symbols. Channel estimates, derived by the channel processor 394 from a reference signal transmitted by the Node B 310 or from feedback contained in the midamble transmitted by the Node B 310, may be used to select the appropriate coding, modulation, spreading, and/or scrambling schemes. The symbols produced by the transmit processor 380 will be provided to a transmit frame processor 382 to create a frame structure. The transmit frame processor 382 creates this frame structure by multiplexing the symbols with a midamble 214 (FIG. 2) from the controller/processor 390, resulting in a series of frames. The frames are then provided to a transmitter 356, which provides various signal conditioning functions including amplification, filtering, and modulating the frames onto a carrier for uplink transmission over the wireless medium through the antenna 352.

[0042] The uplink transmission is processed at the Node B 310 in a manner similar to that described in connection with the receiver function at the UE 350. A receiver 335 receives the uplink transmission through the antenna 334 and processes the transmission to recover the information modulated onto the carrier. The information recovered by the receiver 335 is provided to a receive frame processor 336, which parses each frame, and provides the midamble 214 (FIG. 2) to the channel processor 344 and the data, control, and reference signals to a receive processor 338. The receive processor 338 performs the inverse of the processing performed by the transmit processor 380 in the UE 350. The data and control signals carried by the successfully decoded frames may then be provided to a data sink 339 and the controller/processor, respectively. If some of the frames were unsuccessfully decoded by the receive processor, the controller/processor 340 may also use an acknowledgement (ACK) and/or negative acknowledgement (NACK) protocol to support retransmission requests for those frames.

[0043] The controller/processors 340 and 390 may be used to direct the operation at the Node B 310 and the UE 350, respectively. For example, the controller/processors 340 and 390 may provide various functions including timing, peripheral interfaces, voltage regulation, power management, and other control functions. The computer readable media of memories 342 and 392 may store data and software for the Node B 310 and the UE 350, respectively. A scheduler/processor 346 at the Node B 310 may be used to allocate resources to the UEs and schedule downlink and/or uplink transmissions for the UEs.

[0044] According to one aspect of the present disclosure, controller/processor 390 of UE 350 may take measurements in a second RAN while on a voice call in a first RAN.

VOICE CALL CONTINUITY ON SIMULTANEOUS GSM AND LTE

[0045] Dual radio UEs, including simultaneous GSM and LTE (SGLTE) and simultaneous voice and LTE (SVLTE) UEs, are popular in the networks of some operators which do not support UMTS.

[0046] Voice over LTE (VoLTE) is a target of LTE voice solution evolution. Migration of voice over dual radio UEs to VoLTE may also be desirable. Single radio voice call continuity (SRVCC) is a key component of VoLTE. SRVCC allows a UE to handover from a first radio access technology (RAT) network to a second RAT network while continuing the voice call uninterrupted.

[0047] SRVCC can be enhanced by dual radio UEs in that dual radio UEs may allow:

Concurrent circuit switched (CS) voice service and LTE packet switched (PS) data services

Fast measurement of non-LTE signals by a dual radio UE

Robust mobility, due to an ability to make a CS connection for the voice call before breaking the LTE voice connection (make before break)

[0048] Due to factors such as network loading and/or loss of coverage, an LTE voice call may need to be transferred to a circuit switch (CS) domain. Current Single Radio Voice Call Continuity (VCC) may require an interworking function between a mobile switching center (MSC) and mobility management entity (MME).

[0049] A dual radio UE may perform SRVCC similarly to how a single radio UE may perform SRVCC.

[0050] FIG. 4 illustrates an example of a dual radio UE performing SRVCC, according to aspects of the present disclosure. A UE may camp on an LTE network. The UE may setup a VoLTE call; the second (GSM) radio module will be off or idle when the VoLTE call is ongoing. The UE may measure signal strength of its serving eNB and at least one GSM BS. The UE's serving eNB may send a handover (HO) required message to a Mobility Management Entity (MME). The MME may send a PS to CS HO request to a mobile switching center (MSC). After receiving an appropriate response from the MSC, the MME may send a HO command to the UE's serving eNB. The UE's serving eNB may then send an E-UTRAN mobility notification to the UE. The MME and MSC may update information regarding the IP multimedia subsystem (IMS) session for the UE. The UE may activate its GERAN module and contact a GSM BS to begin a CS call. When the CS call is established, the MSC may send a HO complete message to the MME. At this point, the MME may release the S1 bearer. The UE may initiate a tracking area update (TAU) procedure to resume LTE services. If dual transfer mode (DTM) is not supported by either the target GSM cell or UE, the PS domain would be suspended by the MME during the SRVCC procedure. The TAU resumes the PS domain. If DTM is supported by both the target GSM cell and the UE, the PS domain may be transferred to GSM in parallel with the SRVCC procedure. In this case, the UE may initiate a TAU procedure to transfer the PS domain back to LTE. If DTM is supported by target GSM cell and UE, and PS domain is not transferred to GSM during the SRVCC procedure, then the UE may not initiate a TAU procedure. Instead, the UE may perform a Service Request procedure to enter RRC CONNECTED state to continue the PS services.

[0051] According to aspects of the present disclosure, the SRVCC may be rejected by the UE's serving base station controller (BSC) if the UE's GSM module is active while the VoLTE call is ongoing.

[0052] Similar to Single Radio Voice Call Continuity (SRVCC), according to aspects of the present disclosure, the network may control a call transfer in Dual Radio Voice Call Continuity (DR-VCC). Network-controlled DRVCC may be designed to have minimal impact on the UE and network.

[0053] A dual radio UE may have an ongoing IP Multimedia Subsystem (IMS) voice session in an evolved Universal Terrestrial Radio Access Network (E-UTRAN). An eNB may request for signal measurements from both E-UTRAN and CS networks from the UE. After analysis, the eNB may order the UE to transfer the IMS voice session to a CS voice session. The UE may make this transfer decision if it loses E-UTRAN coverage and has not been ordered by the network to transfer the session.

[0054] FIG. 5 illustrates an example of network controlled DR-VCC, according to aspects of the present disclosure. A UE may camp on an LTE network, and may report network controlled DR-VCC capability to a MME. The UE may setup a VoLTE call and register the UE's GSM module with a GSM network. The UE may perform measurements and may report them to a serving eNB. The eNB may make a handover decision based at least in part on the received measurement reports. The eNB may transmit a handover required message to an MME, for example when it determines the UE should handover to CS. The MME may transmit a handover preparation failure message to the eNB in response to the handover required message. The MME may also transmit a VCC required message to the UE, including a session transfer number (STN) in the VCC required message. The UE may send a CS call setup message including the STN to a MSC. The MSC may send an initial address message (IAM) including the STN to a service centralization and continuity application server (SCC AS) access transfer control function (ATCF). The MSC and SCC AS may update the IMS session for the UE. The SCC AS may also send a bearer deactivation request for the VoIP bearer to the MME. The MME may deactivate the VoIP bearer and send a bearer deactivation request for the VoIP bearer to the UE.

[0055] According to certain aspects, an MME may check the UE's device identity (e.g., the International Mobile Equipment Identity Software Version or IMEISV) to determine if the UE has network controlled DR-VCC capability. If an MME may determine a UE has network controlled DR-VCC capability by checking the UE's device identity, then changing NAS protocol to allow UEs to report network controlled DR-VCC capability would not be necessary.

[0056] According to certain aspects, when an eNB determines SRVCC is needed, the eNB may send a Handover Required message to an MME. According to these aspects, instead of proceeding with SRVCC, the MME may inform the UE to perform DR-VCC by a new network access stratum (NAS) message and reject the SRVCC HO request by sending a Handover preparation failure message to the eNB. According to certain aspects, the MME may inform the UE to perform DR-VCC by a new NSA message or by reusing a Generic NAS Transportation message to carry the VCC Required (STN) information to the UE.

[0057] According to certain aspects, a UE may hand over the call to CS domain by DR-VCC.

[0058] Some differences exist between network-controlled DR-VCC and SRVCC. For example, in SRVCC, a UE may be controlled to take measurements in the CS domain during measurement gaps. In network-controlled DR-VCC, there may not be a need for measurement gaps, for example, due to the dual radio. In SRVCC, the network may decide if the UE should handover to CS.

[0059] In SRVCC, the UE transmits the measurement report message to the eNB, which makes the determination that SRVCC should be performed. In network-controlled DR-VCC, the UE transmits the CS origination message to the MSC via a GSM or CDMA2000 BS.

[0060] FIG. 6 illustrates an example of network controlled DR-VCC, according to aspects of the present disclosure. A UE may camp on an LTE network, and may report network controlled DR-VCC capability to the UE's serving eNB. The UE may setup a VoLTE call and register the UE's GSM module with a GSM network. The UE may perform measurements and may report them to a serving eNB. The eNB may make a handover decision based at least in part on the received measurement reports. The eNB may transmit a VCC required message to the UE, instead of sending a handover command (as it would when SRVCC is being performed) or an RRC Connection Release message. The UE may be pre-configured with a STN by, for example, an Open Mobile Alliance Device Management (OMA-DM) server. The UE may send a CS call setup message including the STN to a MSC. The MSC may send an initial address message (IAM) including the STN to a service centralization and continuity application server (SCC AS) access transfer control function (ATCF). The MSC and SCC AS may update the IMS session for the UE. The SCC AS may also send a bearer deactivation request for the VoIP bearer to the MME. The MME may deactivate the VoIP bearer and send a bearer deactivation request for the VoIP bearer to the UE. The LTE PS connection for the UE may not be impacted by the network controlled DR-VCC procedure.

[0061] According to certain aspects, when an eNB determines SRVCC is needed, the eNB informs a UE to perform VCC by a new radio resource configuration (RRC) message.

[0062] According to certain aspects, an eNB may not need to configure a measurement gap for a UE to measure GSM signals, because the UE supports dual radio operations and can measure GSM signals with the second radio without tuning the first radio away from LTE signals. According to certain aspects, measurement of GSM signals can be very fast because GSM module may continuously monitor the GSM signal.

[0063] FIG. 7 illustrates an example of network controlled DR-VCC, according to aspects of the present disclosure. A UE may camp on an LTE network, and may report network controlled DR-VCC capability to the UE's serving eNB. The UE may setup a VoLTE call while the UE's GSM module is off or idle. The UE may perform measurements and may report them to the UE's serving eNB. The eNB may make a handover decision based at least in part on the received measurement reports. The eNB may transmit a handover required message to an MME including an indication that the UE has network controlled DR-VCC capability, for example when it determines the UE should handover to CS. The MME may send a PS to CS HO request to a mobile switching center (MSC). After receiving an appropriate response from the MSC, the MME may send a HO command to the UE's serving eNB. The UE's serving eNB may then send an E-UTRAN mobility notification to the UE, indicating that the UE should handover only the voice call from PS to CS. The MME and MSC may update information regarding the IP multimedia subsystem (IMS) session for the UE. The UE may activate its GERAN module and contact a GSM BS to begin a CS call without disconnecting from the LTE network. When the CS call is established, the MSC may send a HO complete message to the MME. However, the S1 bearer may not be released by the MME and the RRC connection may not be released by the eNB and UE.

[0064] According to certain aspects, the SRVCC may be rejected by the UE's serving base station controller (BSC) if the UE's GSM module is active while the VoLTE call is ongoing.

[0065] According to certain aspects, an eNB may indicate DR-SRVCC to an MME in a S1 handover required message so that the MME may not release the S1 connection after the handover.

[0066] According to certain aspects, an eNB may include a new parameter in an E-UTRAN Mobility Command to indicate to a UE not to release LTE.

[0067] FIG. 8 illustrates an example of network controlled DR-VCC, according to aspects of the present disclosure. A UE may camp on an LTE network, and may report the UE has network controlled DR-VCC capability to an MME. The UE may setup a VoLTE call while the UE's GSM module is off or idle. The UE may perform measurements and may report them to the UE's serving eNB. The eNB may make a handover decision based at least in part on the received measurement reports. The eNB may transmit a handover required message to an MME, for example when it determines the UE should handover to CS. The MME may send a PS to CS HO request to a mobile switching center (MSC). After receiving an appropriate response from the MSC, the MME may send a HO command to the UE's serving eNB. The UE's serving eNB may then send an E-UTRAN mobility notification to the UE. The MME and MSC may update information regarding the IP multimedia subsystem (IMS) session for the UE. The UE may activate its GERAN module and contact a GSM BS to begin a CS call without disconnecting from the LTE network. When the CS call is established, the MSC may send a HO complete message to the MME. However, the S1 bearer may not be released by the MME and the RRC connection may not be released by the eNB and UE.

[0068] According to certain aspects, a UE may report its DR-SRVCC capability to an MME so that MME may not release the S1 connection after the handover.

[0069] According to certain aspects, the SRVCC may be rejected by the UE's serving base station controller (BSC) if the UE's GSM module is active while the VoLTE call is ongoing.

[0070] FIG. 9 illustrates example operations 900 performed by a user equipment (UE) for SRVCC, according to aspects of the present disclosure. The operations may begin at 902 by the UE requesting handover of a voice over Internet protocol (VoIP) call from a first radio access technology (RAT) network to a second RAT network. The request may be sent, for example, to the UE's serving eNodeB. The operations may continue at 904 by the UE activating a radio of the second RAT. At 906, the UE may continue the voice call on the circuit switched (CS) domain of the second RAT network. The operations may continue at 908 by the UE communicating data for applications other than the voice call via the first RAT network.

[0071] FIG. 10 illustrates example operations 1000 performed by a base station (BS) of a first radio access technology (RAT) for DR-VCC, according to aspects of the present disclosure. The operations may begin at 1002 by the BS sending a request to handover a voice call to a second RAT network. The BS may send the request to a mobility management entity (MME), for example. The operations may continue at 1004 by the BS receiving a failure message in response to the request to handover. The failure message may comprise a handover preparation failure message and may be received from an MME, for example. At 1006, the BS may receive a bearer deactivation request for the voice call.

[0072] FIG. 11 illustrates example operations 1100 performed by a mobility management entity (MME) for DR-VCC, according to aspects of the present disclosure. The operations may begin at 1102 by the MME receiving an indication of network controlled dual radio voice call continuity (DR-VCC) capability from a UE. The operations may continue at 1104 by the MME receiving a request to handover a voice call for the UE from a first radio access technology (RAT) network to a second RAT network. The handover request may be received from the UE's serving eNodeB, for example. At 1106, the MME may send a failure message in response to the request to handover. The failure message may comprise a handover preparation failure message, for example. The operations may continue at 1108 by the MME sending a command to the UE to perform voice call continuity.

[0073] FIG. 12 illustrates example operations 1200 performed by a base station (BS) of a first radio access technology (RAT) network for DR-VCC, according to aspects of the present disclosure. The operations may begin at 1202 by the BS receiving an indication of network controlled dual radio voice call continuity (DR-VCC) capability from a UE. The operations may continue at 1204 by the BS receiving a request to handover a voice call to a second RAT network from the UE. At 1206, the BS may send a message to the UE requesting the UE to perform voice call continuity. The operations may continue at 1208 by the BS receiving a bearer deactivation request for the voice call.

[0074] FIG. 13 illustrates example operations 1300 for DR-VCC performed by a mobility management entity (MME), according to aspects of the present disclosure. The operations may begin at 1302 by the MME receiving an indication that a UE has network controlled dual radio voice call continuity (DR-VCC) capability. The indication may be received from the UE or from the UE's serving eNodeB, for example. The operations may continue at 1304 by the MME receiving a request to handover a voice call for the UE from a first radio access technology (RAT) network to a second RAT network. The handover request may be received from the UE's serving eNodeB, for example. The operations may continue at 1306 by the MME not releasing an S1 connection after the handover. The S1 connection may be for data services to the UE, for example.

[0075] The attached APPENDIX provides details for certain aspects of the present disclosure.

[0076] As those skilled in the art will readily appreciate, various aspects described throughout this disclosure may be extended to other telecommunication systems, network architectures and communication standards. By way of example, various aspects may be extended to other UMTS systems such as W-CDMA, High Speed Downlink Packet Access (HSDPA), High Speed Uplink Packet Access (HSUPA), High Speed Packet Access Plus (HSPA+) and TD-CDMA. Various aspects may also be extended to systems employing Long Term Evolution (LTE) (in FDD, TDD, or both modes), LTE-Advanced (LTE-A) (in FDD, TDD, or both modes), CDMA2000, Evolution-Data Optimized (EV-DO), Ultra Mobile Broadband (UMB), IEEE 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, Ultra-Wideband (UWB), Bluetooth, and/or other suitable systems. The actual telecommunication standard, network architecture, and/or communication standard employed will depend on the specific application and the overall design constraints imposed on the system.

[0077] Several processors have been described in connection with various apparatuses and methods. These processors may be implemented using electronic hardware, computer software, or any combination thereof. Whether such processors are implemented as hardware or software will depend upon the particular application and overall design constraints imposed on the system. By way of example, a processor, any portion of a processor, or any combination of processors presented in this disclosure may be implemented with a microprocessor, microcontroller, digital signal processor (DSP), a field-programmable gate array (FPGA), a programmable logic device (PLD), a state machine, gated logic, discrete hardware circuits, and other suitable processing components configured to perform the various functions described throughout this disclosure. The functionality of a processor, any portion of a processor, or any combination of processors presented in this disclosure may be implemented with software being executed by a microprocessor, microcontroller, DSP, or other suitable platform.

[0078] Software shall be construed broadly to mean instructions, instruction sets, code, code segments, program code, programs, subprograms, software modules, applications, software applications, software packages, routines, subroutines, objects, executables, threads of execution, procedures, functions, etc., whether referred to as software, firmware, middleware, microcode, hardware description language, or otherwise. The software may reside on a computer-readable medium. A computer-readable medium may include, by way of example, memory such as a magnetic storage device (e.g., hard disk, floppy disk, magnetic strip), an optical disk (e.g., compact disc (CD), digital versatile disc (DVD)), a smart card, a flash memory device (e.g., card, stick, key drive), random access memory (RAM), read only memory (ROM), programmable ROM (PROM), erasable PROM (EPROM), electrically erasable PROM (EEPROM), a register, or a removable disk. Although memory is shown separate from the processors in the various aspects presented throughout this disclosure, the memory may be internal to the processors (e.g., cache or register).

[0079] Computer-readable media may be embodied in a computer-program product. By way of example, a computer-program product may include a computer-readable medium in packaging materials. Those skilled in the art will recognize how best to implement the described functionality presented throughout this disclosure depending on the particular application and the overall design constraints imposed on the overall system.

[0080] It is to be understood that the specific order or hierarchy of steps in the methods disclosed is an illustration of exemplary processes. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the methods may be rearranged. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented unless specifically recited therein.

[0081] The previous description is provided to enable any person skilled in the art to practice the various aspects described herein. Various modifications to these aspects will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects. Thus, the claims are not intended to be limited to the aspects shown herein, but is to be accorded the full scope consistent with the language of the claims, wherein reference to an element in the singular is not intended to mean "one and only one" unless specifically so stated, but rather "one or more." Unless specifically stated otherwise, the term "some" refers to one or more. A phrase referring to "at least one of" a list of items refers to any combination of those items, including single members. As an example, "at least one of: a, b, or c" is intended to cover: a; b; c; a and b; a and c; b and c; and a, b and c. All structural and functional equivalents to the elements of the various aspects described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed under the provisions of 35 U.S.C. §112, sixth paragraph, unless the element is expressly recited using the phrase "means for" or, in the case of a method claim, the element is recited using the phrase "step for."

CLAIMS

WHAT IS CLAIMED IS:

1. A method for wireless communications by a user equipment (UE), comprising:

requesting handover of a voice over Internet protocol (VoIP) call from a first radio access technology (RAT) network to a second RAT network;

activating a radio of the second RAT;

continuing the voice call on the circuit switched (CS) domain of the second RAT network; and

communicating data for applications other than the voice call via the first RAT network.

2. The method of claim 1, further comprising:

resuming or continuing packet switched (PS) services via the first RAT network.

3. The method of claim 1, further comprising:

handing over the VoIP call from the first RAT to the CS domain of the second RAT without disconnecting the first RAT.

4. The method of claim 1, wherein the UE comprises two or more radios, and activating a radio of the second RAT comprises activating an inactive radio.

5. The method of claim1, further comprising:

after performing single radio voice call continuity (SRVCC), initiating a Tracking Area Update (TAU) on the first RAT to resume PS service if dual transmission mode (DTM) is not supported by the UE or the second RAT, or transferring the PS domain back to the first RAT if DTM is supported by both the UE and the second RAT.

6. The method of claim 1, further comprising:

sending an indication of network controlled dual radio voice call continuity (DR-VCC) capability.

7. The method of claim 6, further comprising:

receiving a command from the first RAT network (MME or eNB) to perform DR-VCC;

requesting a new CS connection via the second RAT network to perform the DR-VCC; and

receiving a bearer deactivation request for the voice call on the first RAT network.

8. The method of claim 7, wherein the indication of network controlled DR-VCC capability is delivered to a mobility management entity (MME), and the command to perform DR-VCC originates in the MME.

9. The method of claim 7, wherein the indication of network controlled DR-VCC capability is delivered to a base station (BS), and the command to perform DR-VCC originates in the BS.

10. The method of claim 6, further comprising:

receiving an indication to handover to the second RAT network, wherein the indication further indicates that the UE should maintain a connection to the first RAT network.

11. A method for wireless communications by a base station of a first radio access technology (RAT), comprising:

sending a request to handover a voice call to a second RAT network;

receiving a failure message in response to the request to handover; and

receiving a bearer deactivation request for the voice call.

12. A method for wireless communications by a mobility management entity (MME), comprising:

receiving an indication of network controlled dual radio voice call continuity (DR-VCC) capability from a UE;

receiving a request to handover a voice call for the UE from a first radio access technology (RAT) network to a second RAT network;

sending a failure message in response to the request to handover; and

sending a command to the UE to perform voice call continuity.

13. A method for wireless communications by a base station of a first radio access technology (RAT) network, comprising:

receiving an indication of network controlled dual radio voice call continuity (DR-VCC) capability from a UE;

receiving a request to handover a voice call to a second RAT network from the UE;

sending a message to the UE requesting the UE to perform voice call continuity; and

receiving a bearer deactivation request for the voice call.

14. The method of claim 13, further comprising:

indicating the UE has network controlled DR-VCC capability to a mobility management entity (MME).

15. The method of claim 14, wherein the message to the UE indicates the UE should maintain the connection to the network of the first RAT.

16. A method for wireless communications by a mobility management entity (MME), comprising:

receiving an indication that a UE has network controlled dual radio voice call continuity (DR-VCC) capability;

receiving a request to handover a voice call for the UE from a first radio access technology (RAT) network to a second RAT network; and

not releasing an S1 connection after the handover.

17. The method of claim 16, wherein the indication that the UE has network controlled DR-VCC is received from a base station (BS).

18. The method of claim 16, wherein the indication that the UE has network controlled DR-VCC is received from the UE.

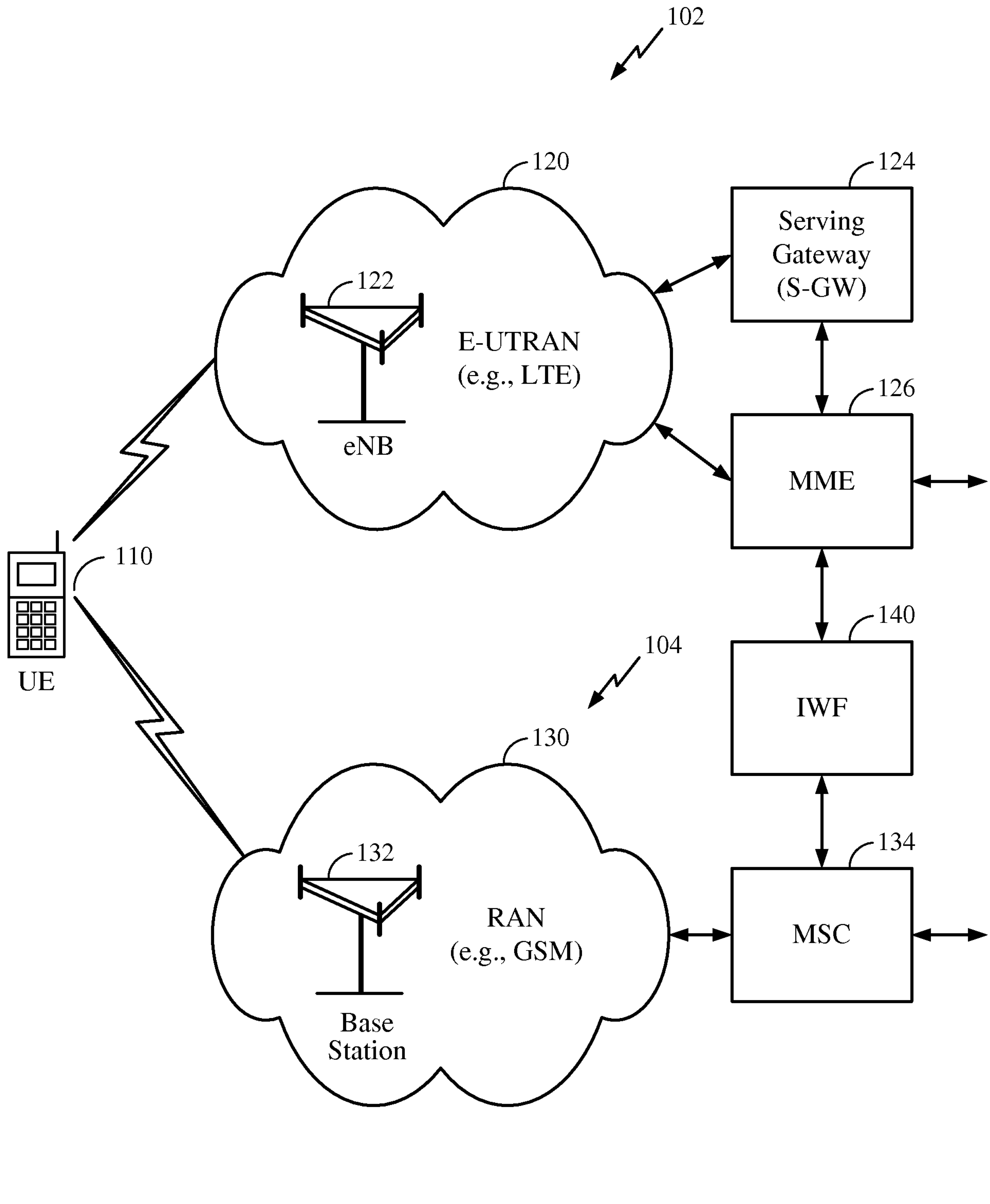
102
120
122
E-UTRAN
(e.g., LTE)
eNB
124
Serving
Gateway
(S-GW)
126
MME
110
UE
140
IWF
104
130
132
RAN
(e.g., GSM)
Base
Station
134
MSC

FIG. 1

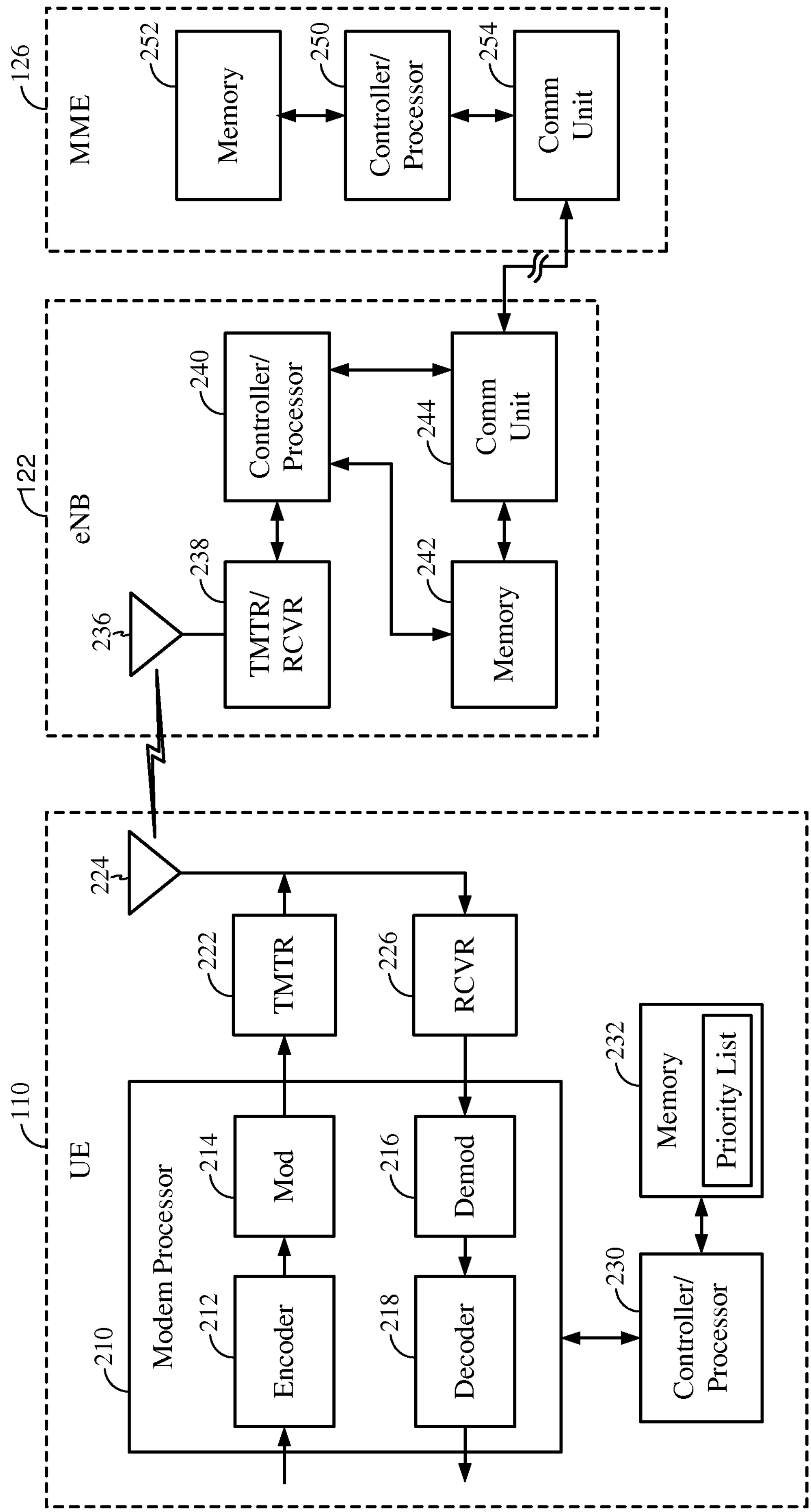
126
MME
252
Memory
250
Controller/
Processor
254
Comm
Unit
122
eNB
236
238
TMTR/
RCVR
240
Controller/
Processor
242
Memory
244
Comm
Unit
110
UE
224
222
TMTR
226
RCVR
210
Modem Processor
212
Encoder
214
Mod
216
Demod
218
Decoder
232
Memory
Priority List
230
Controller/
Processor

FIG. 2

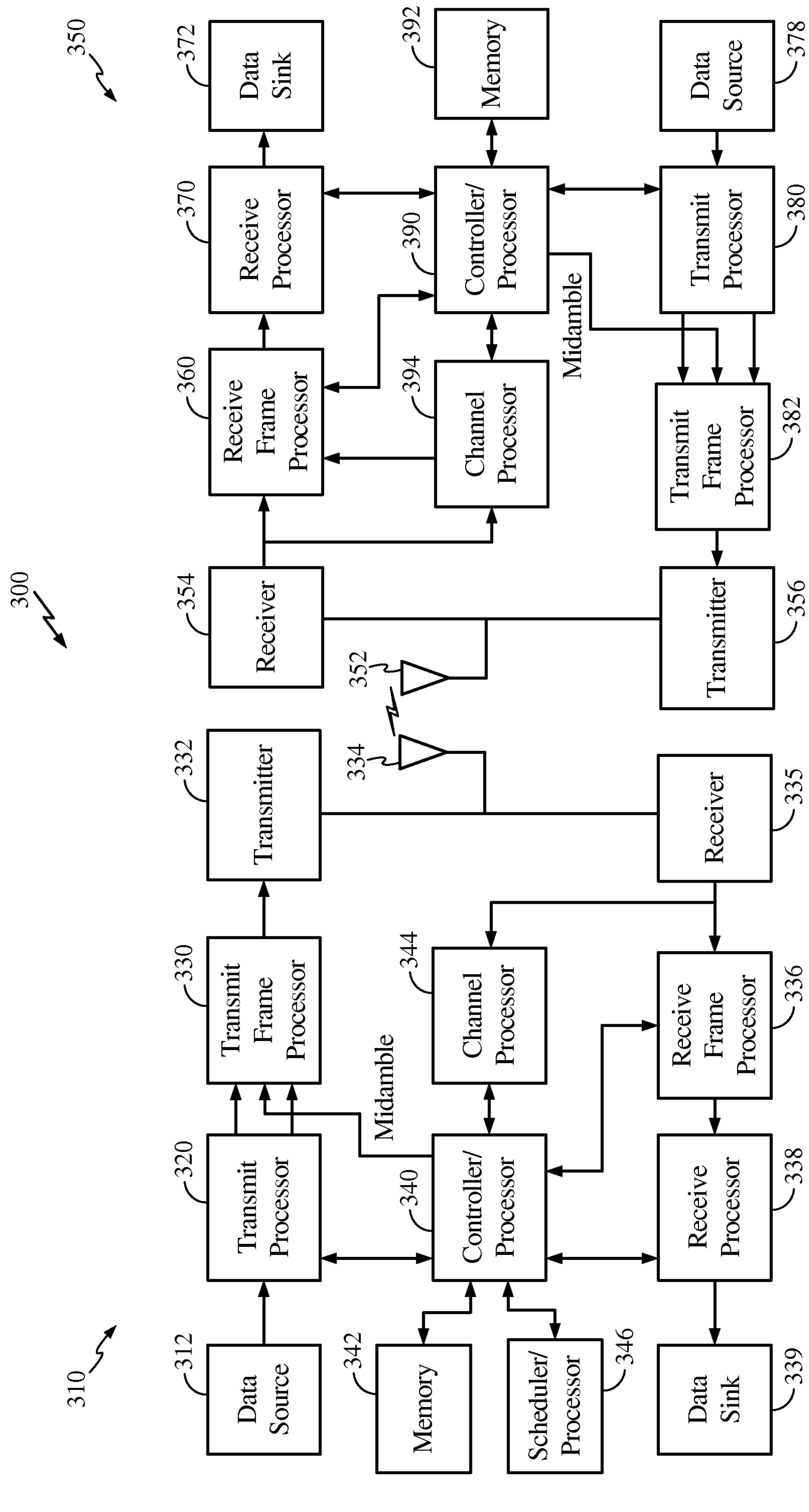
300
350
310
Data Sink
372
Receive Processor
370
Receive Frame Processor
360
Receiver
354
Memory
392
Controller/ Processor
390
Channel Processor
394
Midamble
Data Source
378
Transmit Processor
380
Transmit Frame Processor
382
Transmitter
356
352
334
Transmitter
332
Receiver
335
Transmit Frame Processor
330
Channel Processor
344
Receive Frame Processor
336
Midamble
Transmit Processor
320
Controller/ Processor
340
Receive Processor
338
Data Source
312
Memory
342
Scheduler/ Processor
346
Data Sink
339

FIG. 3

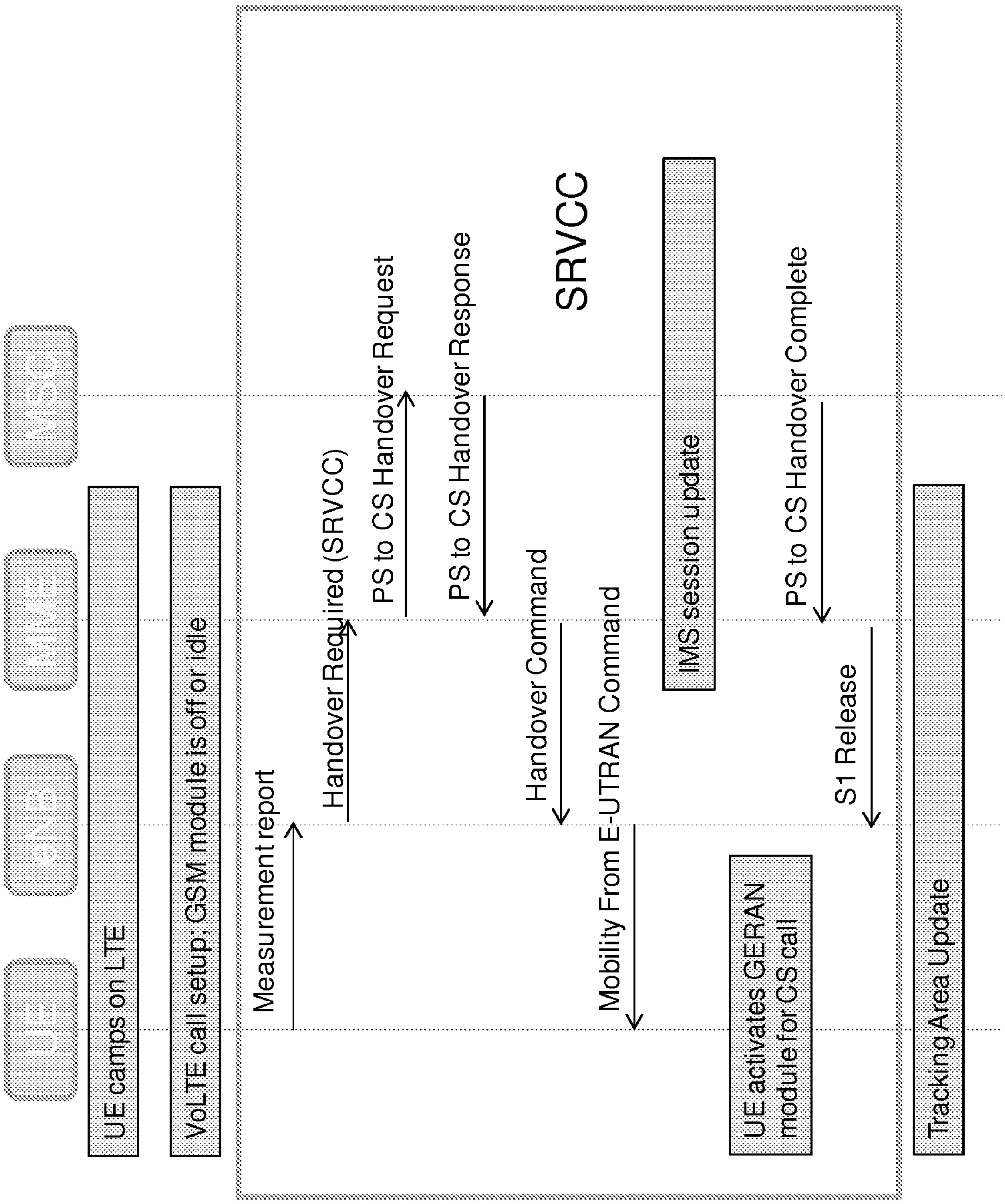
UE
eNB
MME
MSC
UE camps on LTE
VoLTE call setup: GSM module is off or idle
SRVCC
Measurement report
Handover Required (SRVCC)
PS to CS Handover Request
PS to CS Handover Response
Handover Command
Mobility From E-UTRAN Command
IMS session update
PS to CS Handover Complete
S1 Release
UE activates GERAN module for CS call
Tracking Area Update

FIG. 4

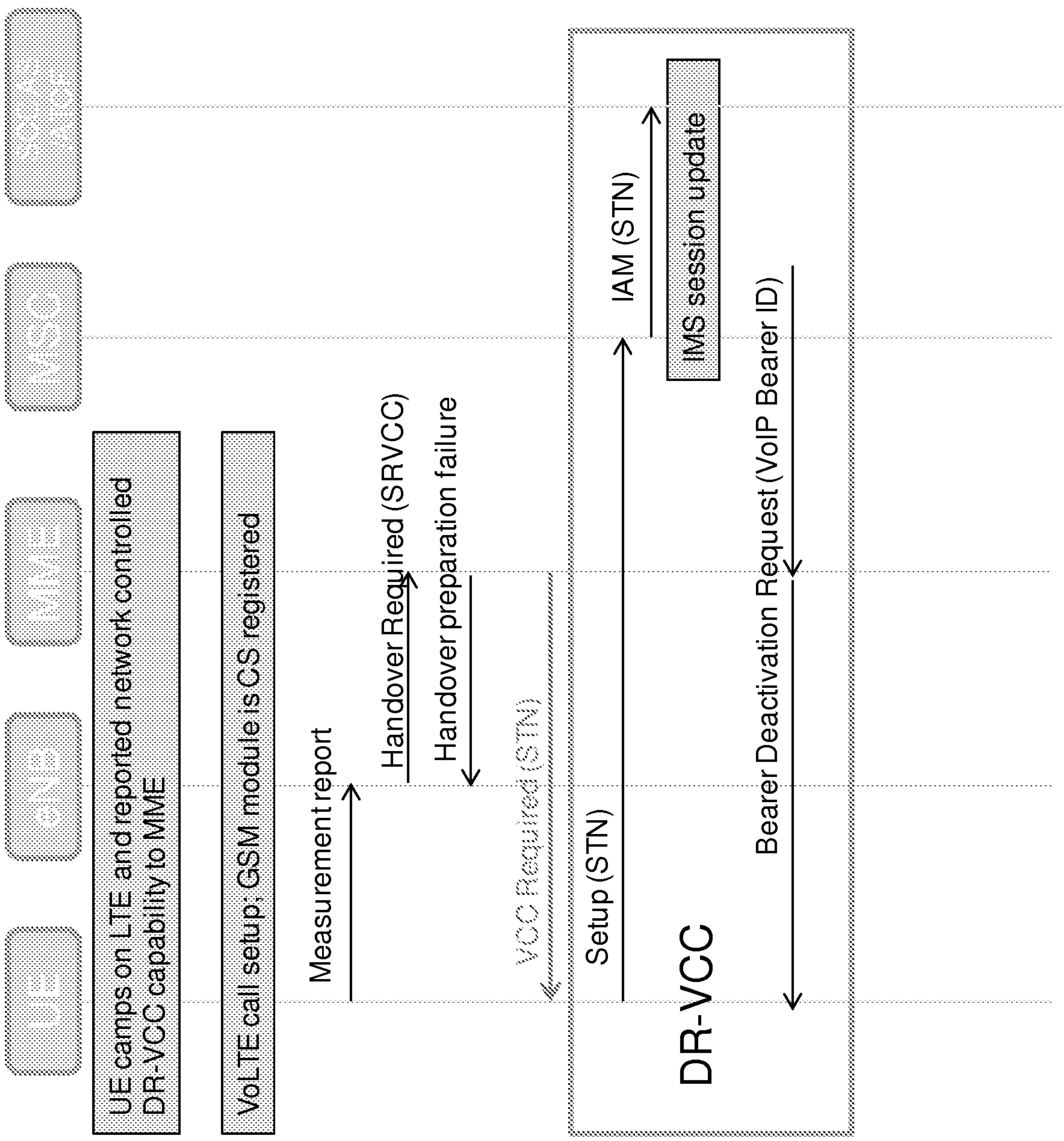
UE
eNB
MME
MSC
SCC AS
UE camps on LTE and reported network controlled DR-VCC capability to MME
VoLTE call setup; GSM module is CS registered
Measurement report
Handover Required (SRVCC)
Handover preparation failure
VCC Required (STN)
DR-VCC
Setup (STN)
IAM (STN)
IMS session update
Bearer Deactivation Request (VoIP Bearer ID)

FIG. 5

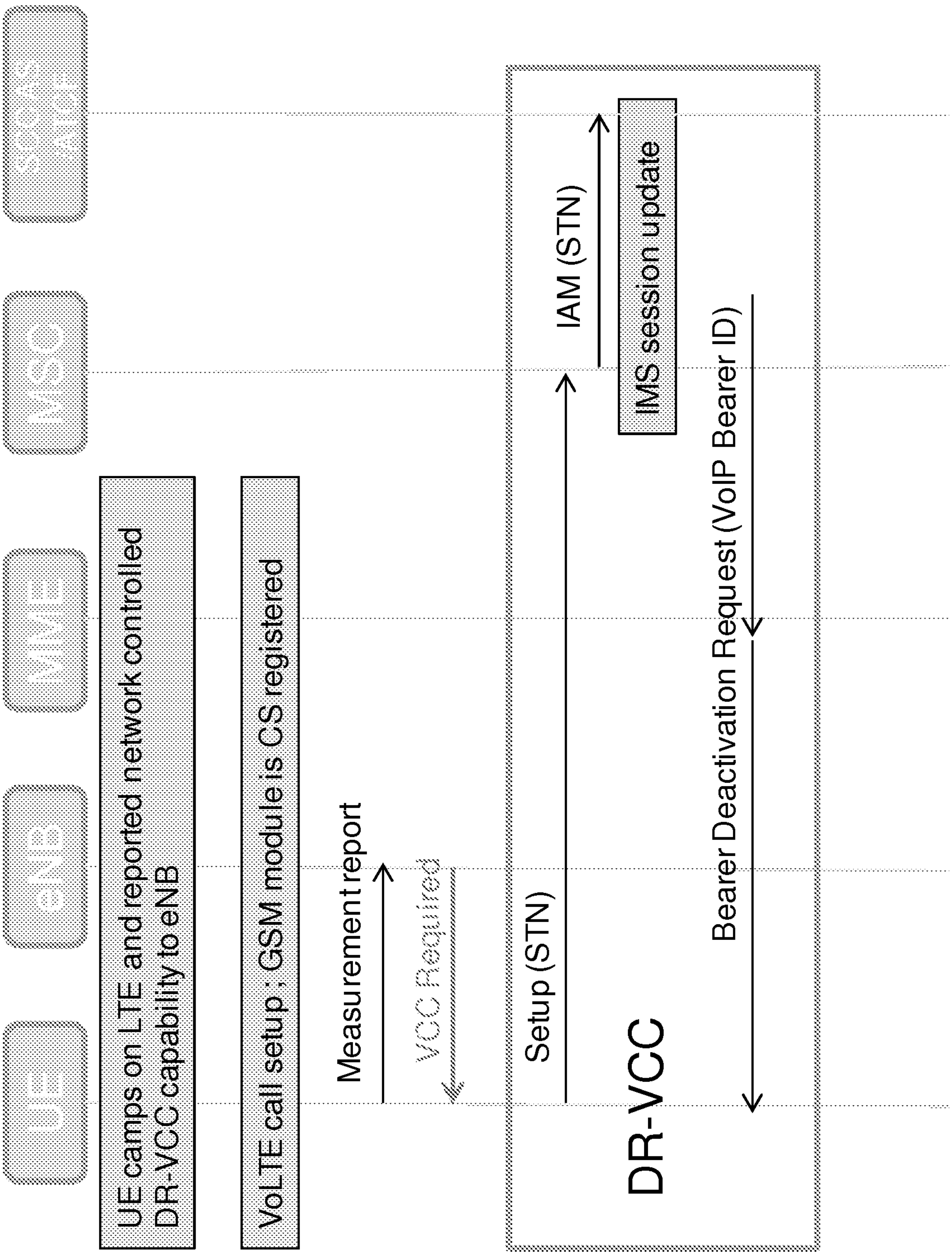
UE
eNB
MME
MSC
SCC AS
ATCF
UE camps on LTE and reported network controlled DR-VCC capability to eNB
VoLTE call setup ; GSM module is CS registered
Measurement report
VCC Required
Setup (STN)
IAM (STN)
IMS session update
Bearer Deactivation Request (VoIP Bearer ID)
DR-VCC

FIG. 6

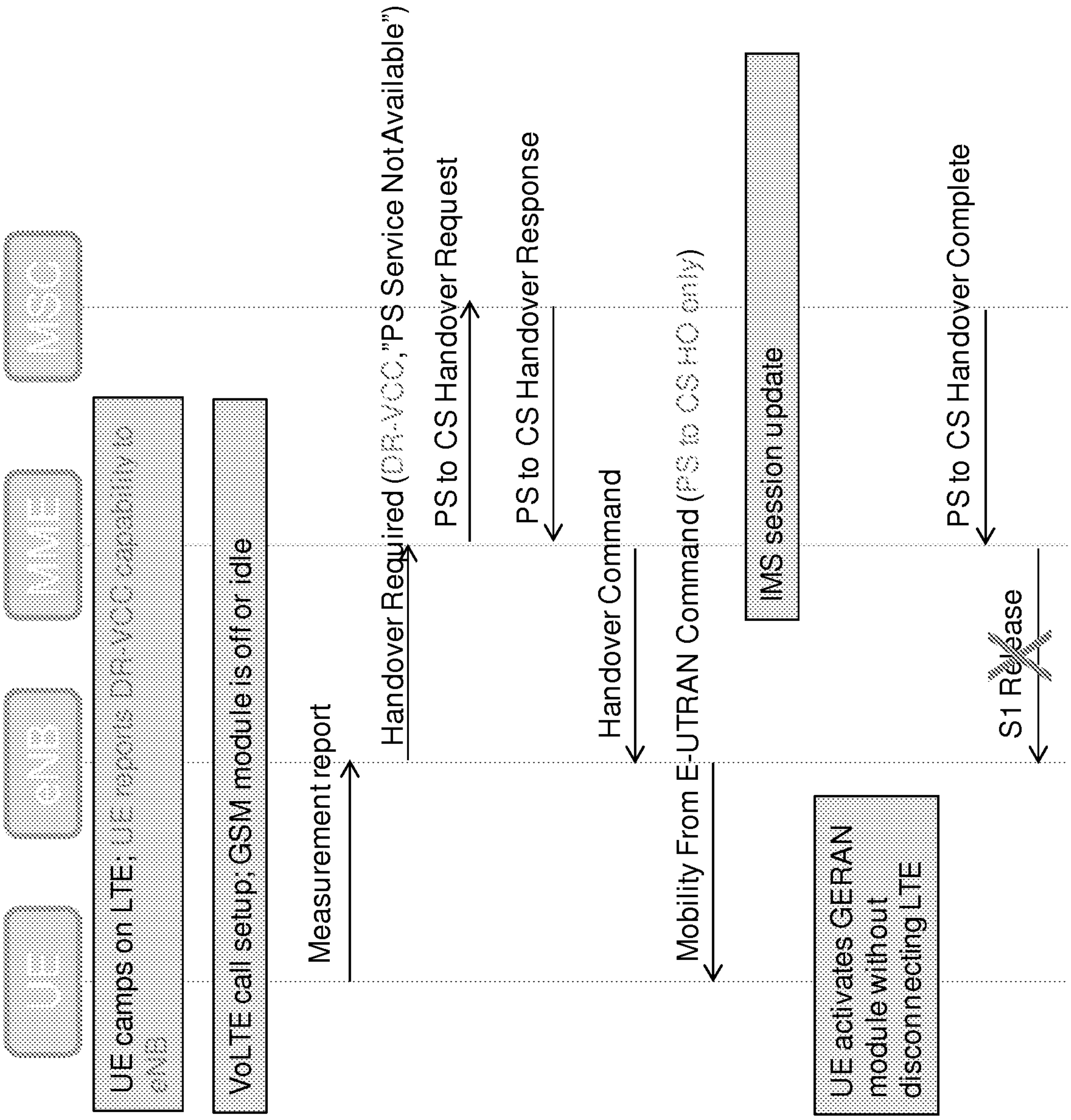
UE
eNB
MME
MSC
UE camps on LTE; UE reports DR-VCC capability to eNB
VoLTE call setup; GSM module is off or idle
Measurement report
Handover Required (DR-VCC, "PS Service Not Available")
PS to CS Handover Request
PS to CS Handover Response
Handover Command
Mobility From E-UTRAN Command (PS to CS HO only)
IMS session update
UE activates GERAN module without disconnecting LTE
PS to CS Handover Complete
S1 Release

FIG. 7

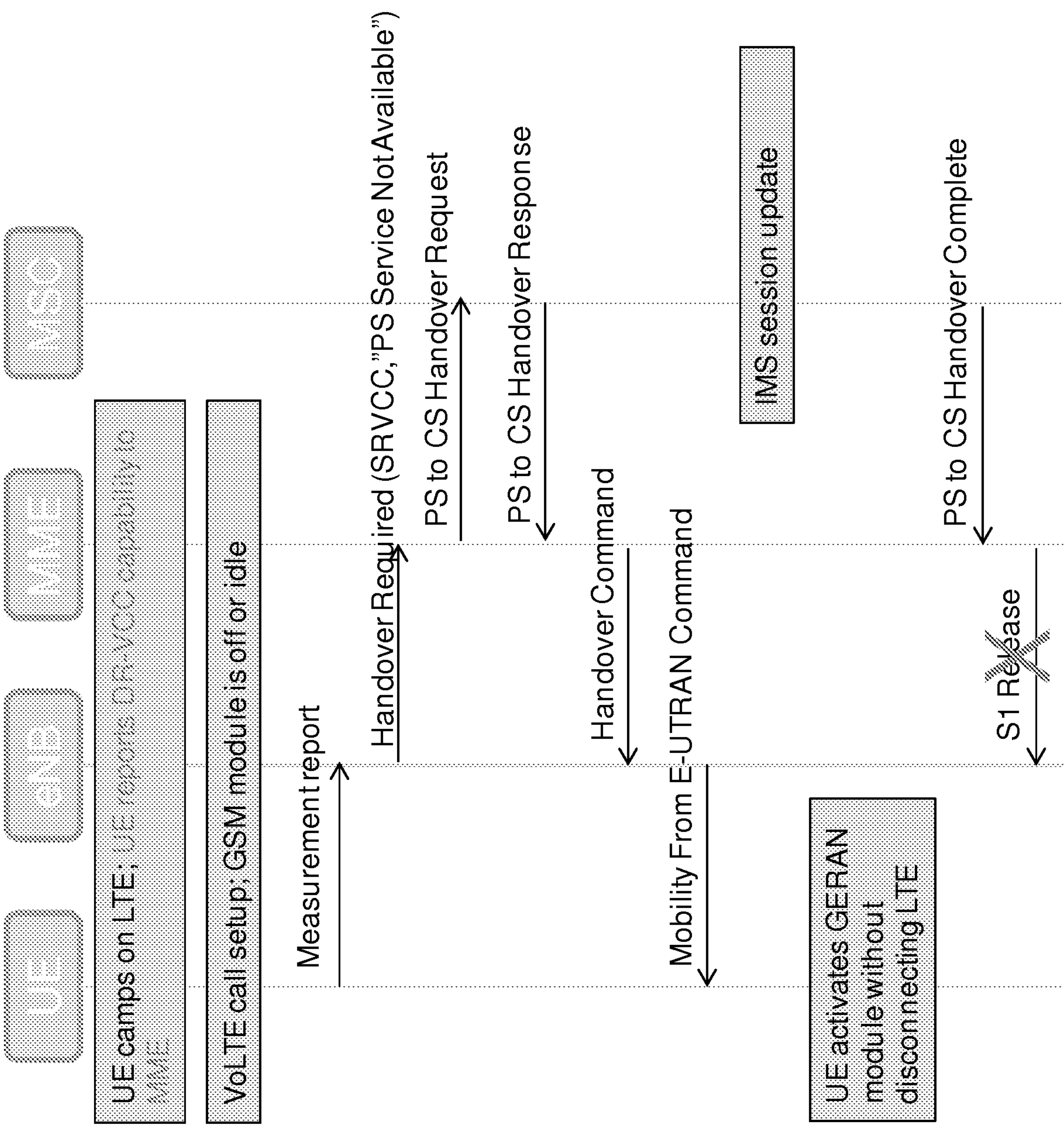
UE
eNB
MME
MSC
UE camps on LTE; UE reports DR-VCC capability to MME
VoLTE call setup; GSM module is off or idle
Measurement report
Handover Required (SRVCC,"PS Service Not Available")
PS to CS Handover Request
PS to CS Handover Response
Handover Command
Mobility From E-UTRAN Command
IMS session update
UE activates GERAN module without disconnecting LTE
PS to CS Handover Complete
S1 Release

FIG. 8

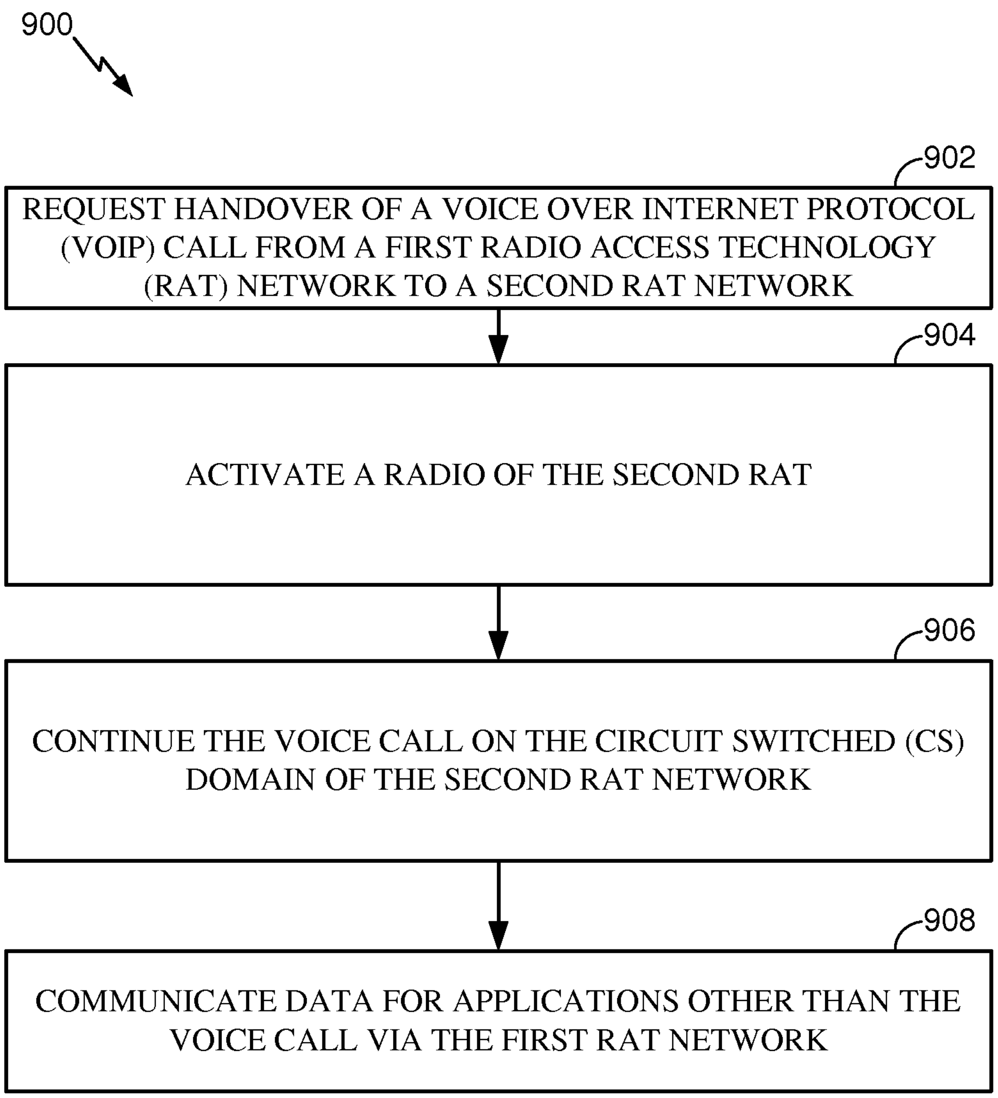
900
902
REQUEST HANDOVER OF A VOICE OVER INTERNET PROTOCOL (VOIP) CALL FROM A FIRST RADIO ACCESS TECHNOLOGY (RAT) NETWORK TO A SECOND RAT NETWORK
904
ACTIVATE A RADIO OF THE SECOND RAT
906
CONTINUE THE VOICE CALL ON THE CIRCUIT SWITCHED (CS) DOMAIN OF THE SECOND RAT NETWORK
908
COMMUNICATE DATA FOR APPLICATIONS OTHER THAN THE VOICE CALL VIA THE FIRST RAT NETWORK

FIG. 9

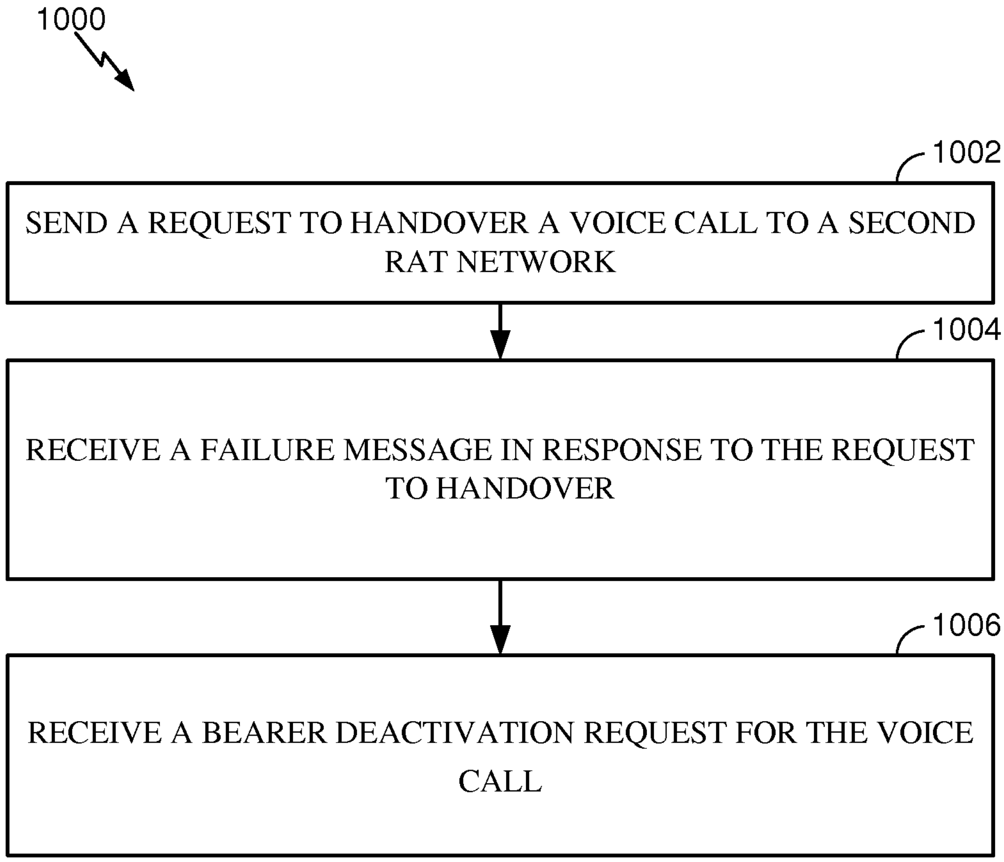
1000
1002
SEND A REQUEST TO HANDOVER A VOICE CALL TO A SECOND RAT NETWORK
1004
RECEIVE A FAILURE MESSAGE IN RESPONSE TO THE REQUEST TO HANDOVER
1006
RECEIVE A BEARER DEACTIVATION REQUEST FOR THE VOICE CALL

FIG. 10

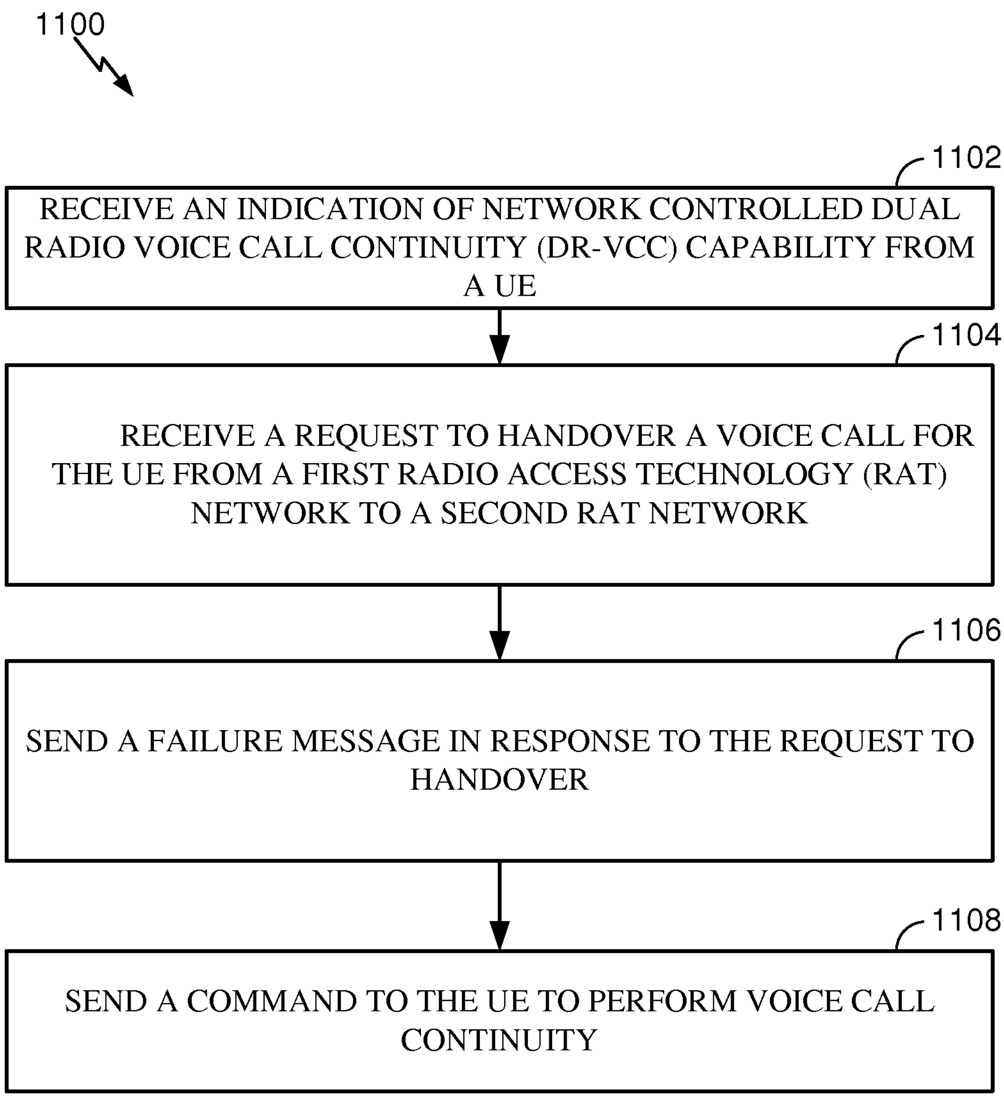
1100
1102
RECEIVE AN INDICATION OF NETWORK CONTROLLED DUAL RADIO VOICE CALL CONTINUITY (DR-VCC) CAPABILITY FROM A UE
1104
RECEIVE A REQUEST TO HANDOVER A VOICE CALL FOR THE UE FROM A FIRST RADIO ACCESS TECHNOLOGY (RAT) NETWORK TO A SECOND RAT NETWORK
1106
SEND A FAILURE MESSAGE IN RESPONSE TO THE REQUEST TO HANDOVER
1108
SEND A COMMAND TO THE UE TO PERFORM VOICE CALL CONTINUITY

FIG. 11

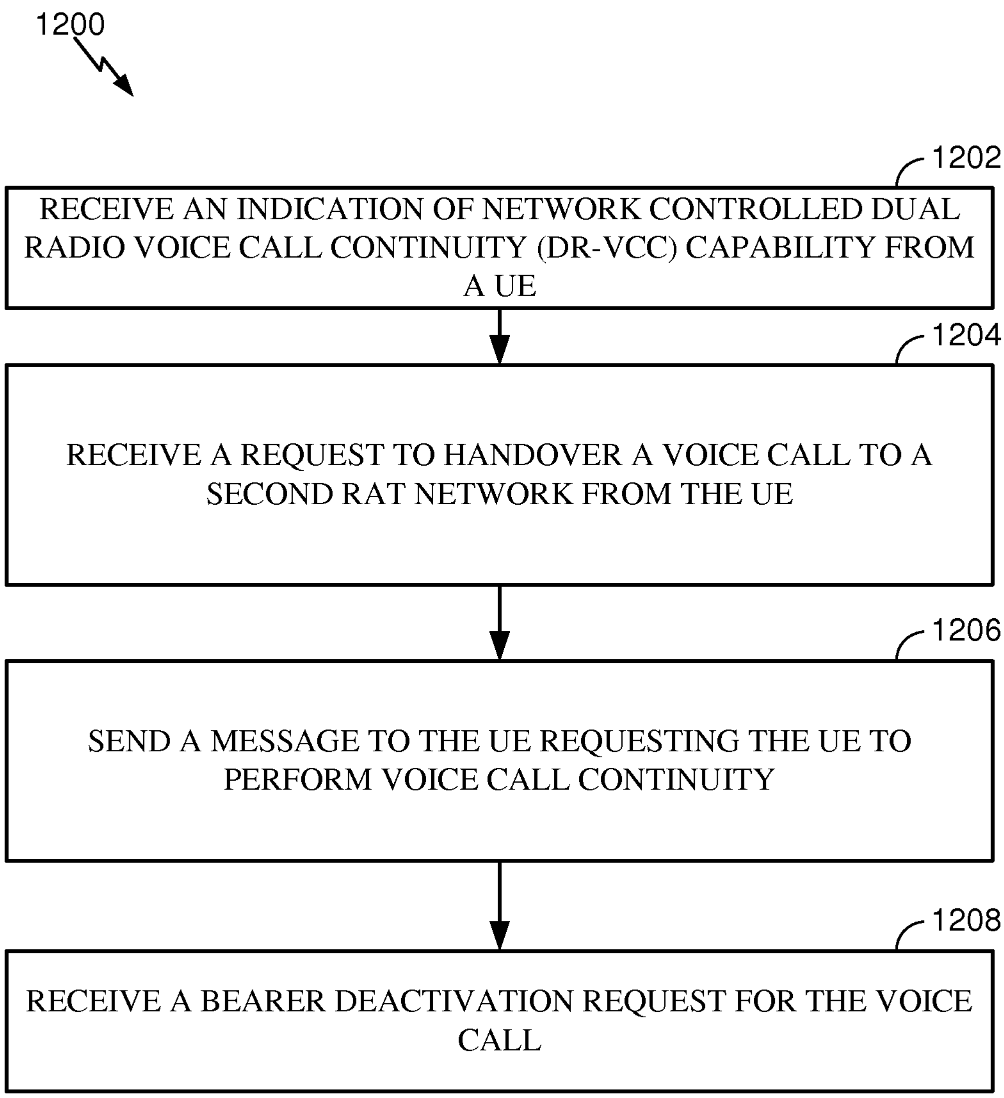
1200
1202
RECEIVE AN INDICATION OF NETWORK CONTROLLED DUAL RADIO VOICE CALL CONTINUITY (DR-VCC) CAPABILITY FROM A UE
1204
RECEIVE A REQUEST TO HANDOVER A VOICE CALL TO A SECOND RAT NETWORK FROM THE UE
1206
SEND A MESSAGE TO THE UE REQUESTING THE UE TO PERFORM VOICE CALL CONTINUITY
1208
RECEIVE A BEARER DEACTIVATION REQUEST FOR THE VOICE CALL

FIG. 12

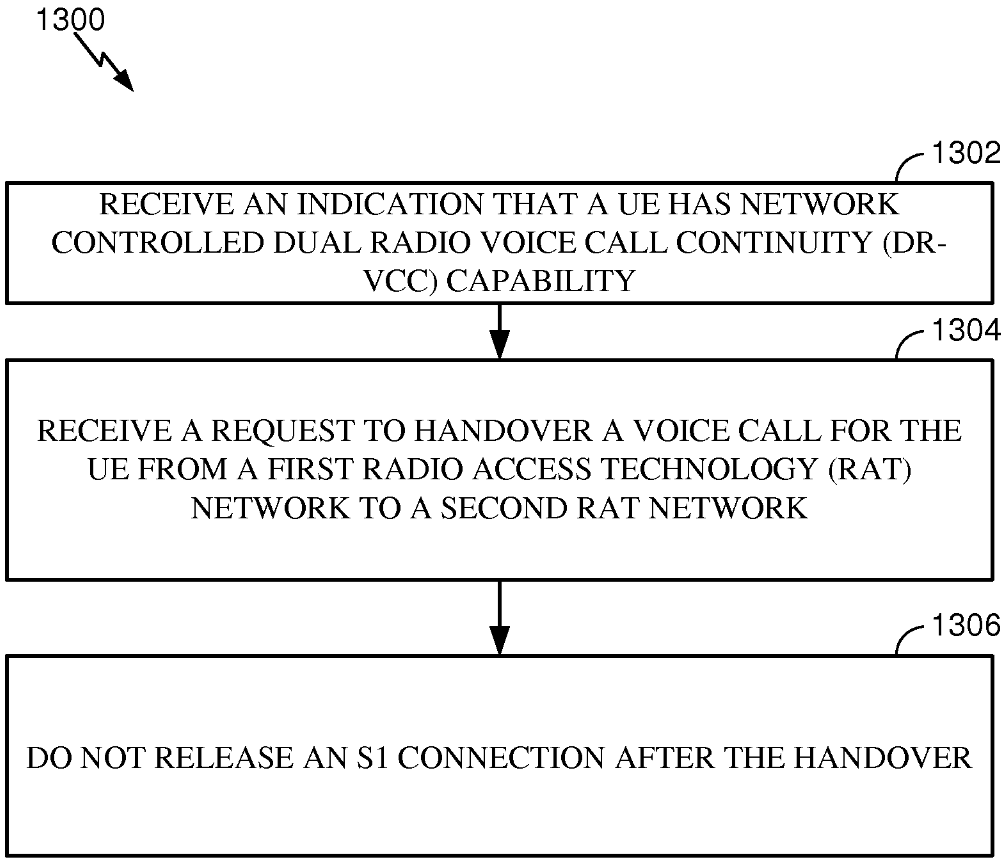
1300
1302
RECEIVE AN INDICATION THAT A UE HAS NETWORK CONTROLLED DUAL RADIO VOICE CALL CONTINUITY (DR-VCC) CAPABILITY
1304
RECEIVE A REQUEST TO HANDOVER A VOICE CALL FOR THE UE FROM A FIRST RADIO ACCESS TECHNOLOGY (RAT) NETWORK TO A SECOND RAT NETWORK
1306
DO NOT RELEASE AN S1 CONNECTION AFTER THE HANDOVER

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/087138

A. CLASSIFICATION OF SUBJECT MATTER

H04W 36/14(2009.01)i

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; H04Q; H04L

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

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

CNPAT, CNKI, EPODOC, WPI, IEEE: handover, circuit switch, VoIP, voice, DRVCC, SRVCC, request, MME

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 103348736 A (NTT DOCOMO INC.) 09 October 2013 (2013-10-09) Description, paragraphs [0011], [0022] and [0033]	1-10
X	CN 101938796 A (DATANG MOBILE COMMUNICATION EQUIPMENT CO., LTD.) 05 January 2011 (2011-01-05) Description, paragraphs [0145]-[0153]	11
A	CN 102215478 A (ZTE CORPORATION) 12 October 2011 (2011-10-12) the whole document	1-18

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 July 2014	**13 August 2014**

Name and mailing address of the ISA/	Authorized officer
STATE INTELLECTUAL PROPERTY OFFICE OF THE P.R.CHINA(ISA/CN) **6,Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088 China**	**ZHENG,Hao**
Facsimile No. **(86-10)62019451**	Telephone No. **(86-10)62413276**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/087138

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 103348736 A	09 October 2013	KR 20130102124 A	16 September 2013
		US 2013321558 A1	05 December 2013
		EP 2675218 A1	18 December 2013
		JP 2012165201 A	30 August 2012
		AU 2012215743 A1	05 September 2013
		CA 2826668 A1	16 August 2012
		WO 2012108423 A1	16 August 2012
CN 101938796 A	05 January 2011	None	
CN 102215478 A	12 October 2011	WO 2012159483 A1	29 November 2012