



(43) International Publication Date
13 October 2016 (13.10.2016)

- (51) International Patent Classification:
H04W 8/26 (2009.01) *H04W 76/06* (2009.01)
- (21) International Application Number:
PCT/EP2015/078964
- (22) International Filing Date:
8 December 2015 (08.12.2015)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
1883/CHE/2015 10 April 2015 (10.04.2015) IN
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- (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, 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.

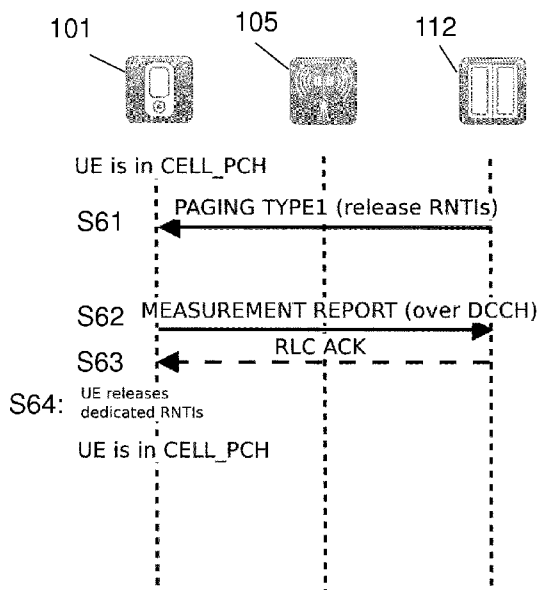
- (84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ,
TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU,
TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,
DK, EE, ES, FI, FR, GB, GR, HR, 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))

(54) Title: METHOD, APPARATUS AND SYSTEM TO RELEASE RESOURCES

Figure 6



(57) Abstract: There is provided a method comprising receiving a paging message at a paging message receiver, said paging message comprising information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and causing the release of the at least one set of resources.

*Title***METHOD, APPARATUS AND SYSTEM TO RELEASE RESOURCES**5 *Field*

The present application relates to a method, apparatus, system and computer program and in particular but not exclusively, to release of dedicated radio network temporary identifiers (RNTI) in cellular communication systems.

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Background

A communication system can be seen as a facility that enables communication sessions between two or more entities such as user terminals, base stations and/or other nodes by providing carriers between the various entities involved in the communications path. A communication system can be provided for example by means of a communication network and one or more compatible communication devices. The communications may comprise, for example, communication of data for carrying communications such as voice, electronic mail (email), text message, multimedia and/or content data and so on. Non-limiting examples of services provided comprise two-way or multi-way calls, data communication or multimedia services and access to a data network system, such as the Internet.

In a wireless communication system at least a part of communications between at least two stations occurs over a wireless link. Examples of wireless systems comprise public land mobile networks (PLMN), satellite based communication systems and different wireless local networks, for example wireless local area networks (WLAN). The wireless systems can typically be divided into cells, and are therefore often referred to as cellular systems.

A user can access the communication system by means of an appropriate communication device or terminal. A communication device of a user is often referred to as user equipment (UE). A communication device is provided with an appropriate signal receiving and transmitting apparatus for enabling communications, for example enabling access to a communication network or communications directly with other users. The communication device may access a carrier provided by a station, for example a base station of a cell, and transmit and/or receive communications on the carrier.

The communication system and associated devices typically operate in accordance with a given standard or specification which sets out what the various entities associated with the system are permitted to do and how that should be achieved. Communication protocols and/or parameters which shall be used for the connection are also typically defined. An example of attempts to solve the problems associated with the increased demands for capacity is an architecture that is known as the long-term evolution (LTE) of the Universal Mobile Telecommunications System (UMTS) radio-access technology.

Summary

In a first aspect there is provided a method comprising receiving a paging message at a paging message receiver, said paging message comprising information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and causing the release of the at least one set of resources.

The at least one set of resources allocated to the paging message receiver may comprise identity information which is used for data transmission from the paging message receiver.

The identity information may comprise at least one radio network temporary identifier.

The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may indicate at least one set of resources used for data transmission.

The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may comprise a flag indicating the at least one set of resources.

The at least one set of resources allocated to the paging message receiver may be dedicated to a data transmission from the paging message receiver.

Causing the release of the at least one set of resources may comprises causing the release of the resource at at least one of the paging message receiver and a paging message sender.

The method may comprise providing an indication of the release of the resource to the paging message sender.

5 The indication may comprises a cause value indicating the release of the at least one set of resources.

In a second aspect there is provided a method comprising causing a paging message to be sent, said paging message comprising information useable by a paging message receiver to determine at least one set of resources allocated to the paging message receiver to be
10 released and causing the release of the at least one set of resources.

The method may comprise causing the paging message to be sent to, or towards, the paging message receiver. Causing the paging message to be sent may comprise transmitting the paging message or causing the paging message to be transmitted.
15

The at least one set of resources allocated to the paging message receiver may comprise identity information which is used for data transmission from the paging message receiver.

20 The identity information may comprise at least one radio network temporary identifier.

The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may indicate at least one set of resources used for data transmission.

25 The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may comprise a flag indicating the at least one set of resources.

30 The at least one set of resources allocated to the paging message receiver may be dedicated to a data transmission from the paging message receiver.

Causing the release of the at least one set of resources may comprise causing the release of the at least one set of resources at at least one of the paging message receiver and a paging message sender.
35

The method may comprise receiving an indication of the release of the at least one set of resources from the paging message receiver.

The indication may comprise a cause value indicating the release of the at least one set or resources.

- 5 In a third aspect there is provided an apparatus comprising means for receiving a paging message at a paging message receiver, said paging message comprising information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and means for causing the release of the at least one set of resources.

10

The at least one set of resources allocated to the paging message receiver may comprise identity information which is used for data transmission from the paging message receiver.

The identity information may comprise at least one radio network temporary identifier.

15

The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may indicate at least one set of resources used for data transmission.

- 20 The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may comprise a flag indicating the at least one set of resources.

The at least one set of resources allocated to the paging message receiver may be
25 dedicated to a data transmission from the paging message receiver.

Mean for causing the release of the at least one set of resources may comprises means for causing the release of the resource at at least one of the paging message receiver and a paging message sender.

30

The apparatus may comprise means for providing an indication of the release of the resource to the paging message sender.

The indication may comprises a cause value indicating the release of the at least one set of
35 resources.

In a fourth aspect there is provided an apparatus comprising means for causing a paging message to be sent, said paging message comprising information useable by a paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and mean for causing the release of the at least one set of resources.

The apparatus may comprise means for causing the paging message to be sent to, or towards, the paging message receiver. Means for causing the paging message to be sent may comprise means for transmitting the paging message or means for causing the paging message to be transmitted.

The at least one set of resources allocated to the paging message receiver may comprise identity information which is used for data transmission from the paging message receiver.

The identity information may comprise at least one radio network temporary identifier.

The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may indicate at least one set of resources used for data transmission.

The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may comprise a flag indicating the at least one set of resources.

The at least one set of resources allocated to the paging message receiver may be dedicated to a data transmission from the paging message receiver.

Means for causing the release of the at least one set of resources may comprise means for causing the release of the at least one set of resources at at least one of the paging message receiver and a paging message sender.

The apparatus may comprise means for receiving an indication of the release of the at least one set of resources from the paging message receiver.

The indication may comprise a cause value indicating the release of the at least one set or resources.

In a fifth aspect there is provided an apparatus comprising at least one processor and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to receive a paging message at a paging message receiver, said paging message
5 comprising information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and cause the release of the at least one set of resources.

The at least one set of resources allocated to the paging message receiver may comprise
10 identity information which is used for data transmission from the paging message receiver.

The identity information may comprise at least one radio network temporary identifier.

The information useable by the paging message receiver to determine at least one set of
15 resources allocated to the paging message receiver to be released may indicate at least one set of resources used for data transmission.

The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may comprise a flag
20 indicating the at least one set of resources.

The at least one set of resources allocated to the paging message receiver may be dedicated to a data transmission from the paging message receiver.

25 The apparatus may be configured to cause the release of the resource at at least one of the paging message receiver and a paging message sender.

The apparatus may be configured to provide an indication of the release of the resource to the paging message sender.
30

The indication may comprises a cause value indicating the release of the at least one set of resources.

In a sixth aspect there is provided an apparatus, comprising at least one processor and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus
35 at least to cause a paging message to be sent, said paging message comprising information

useable by a paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and cause the release of the at least one set of resources.

- 5 The apparatus may be configured to cause the paging message to be sent to, or towards, the paging message receiver. The apparatus may be configured to transmit the paging message or cause the paging message to be transmitted.

10 The at least one set of resources allocated to the paging message receiver may comprise identity information which is used for data transmission from the paging message receiver.

The identity information may comprise at least one radio network temporary identifier.

15 The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may indicate at least one set of resources used for data transmission.

20 The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may comprise a flag indicating the at least one set of resources.

The at least one set of resources allocated to the paging message receiver may be dedicated to a data transmission from the paging message receiver.

25 The apparatus may be configured to cause the release of the at least one set of resources at at least one of the paging message receiver and a paging message sender.

30 The apparatus may be configured to receive an indication of the release of the at least one set of resources from the paging message receiver.

The indication may comprise a cause value indicating the release of the at least one set or resources.

35 In a seventh aspect there is provided a computer program embodied on a non-transitory computer-readable storage medium, the computer program comprising program code for controlling a process to execute a process, the process comprising receiving a paging message at a paging message receiver, said paging message comprising information

useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and causing the release of the at least one set of resources.

- 5 The at least one set of resources allocated to the paging message receiver may comprise identity information which is used for data transmission from the paging message receiver.

The identity information may comprise at least one radio network temporary identifier.

- 10 The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may indicate at least one set of resources used for data transmission.

- 15 The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may comprise a flag indicating the at least one set of resources.

The at least one set of resources allocated to the paging message receiver may be dedicated to a data transmission from the paging message receiver.

20

Causing the release of the at least one set of resources may comprises causing the release of the resource at at least one of the paging message receiver and a paging message sender.

- 25 The process may comprise providing an indication of the release of the resource to the paging message sender.

The indication may comprises a cause value indicating the release of the at least one set of resources.

30

In an eighth aspect there is provided a computer program embodied on a non-transitory computer-readable storage medium, the computer program comprising program code for controlling a process to execute a process, the process comprising causing a paging message to be sent, said paging message comprising information useable by a paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and causing the release of the at least one set of resources.

35

The process may comprise causing the paging message to be sent to, or towards, the paging message receiver. Causing the paging message to be sent may comprise transmitting the paging message or causing the paging message to be transmitted.

5

The at least one set of resources allocated to the paging message receiver may comprise identity information which is used for data transmission from the paging message receiver.

The identity information may comprise at least one radio network temporary identifier.

10

The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may indicate at least one set of resources used for data transmission.

15 The information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released may comprise a flag indicating the at least one set of resources.

The at least one set of resources allocated to the paging message receiver may be
20 dedicated to a data transmission from the paging message receiver.

Causing the release of the at least one set of resources may comprise causing the release of the at least one set of resources at at least one of the paging message receiver and a paging message sender.

25

The process may comprise receiving an indication of the release of the at least one set of resources from the paging message receiver.

The indication may comprise a cause value indicating the release of the at least one set or
30 resources.

In a ninth aspect there is provided a computer program product for a computer, comprising software code portions for performing the steps the method of any one of the first and/or second aspects when said product is run on the computer.

35

In the above, many different embodiments have been described. It should be appreciated that further embodiments may be provided by the combination of any two or more of the embodiments described above.

5 *Description of Figures*

Embodiments will now be described, by way of example only, with reference to the accompanying Figures in which:

10 Figure 1 shows a schematic diagram of an example communication system comprising a base station and a plurality of communication devices;

Figure 2 shows a schematic diagram, of an example mobile communication device;

15 Figure 3 shows an example signalling diagram for release of dedicated RNTIs;

Figure 4a shows a flowchart of an example method for release of dedicated RNTIs;

Figure 4b shows a flowchart of an example method for release of dedicated RNTIs;

20

Figure 5 shows a signalling diagram for release of dedicated RNTIs according to an embodiment;

Figure 6 shows a signalling diagram for release of dedicated RNTIs according to an
25 embodiment;

Figure 7 shows a signalling diagram for release of dedicated RNTIs according to an embodiment;

30 Figure 8 shows a signalling diagram for release of dedicated RNTIs according to an embodiment;

Figure 9 shows a signalling diagram for release of dedicated RNTIs according to an embodiment;

35

Figure 10 shows a schematic diagram of an example control apparatus;

Figure 11 shows a schematic diagram of an apparatus;

Figure 12 shows a schematic diagram of an apparatus;

5 *Detailed Description*

Before explaining in detail the examples, certain general principles of a wireless communication system and mobile communication devices are briefly explained with reference to Figures 1 to 2 to assist in understanding the technology underlying the described examples.

In a wireless communication system 100, such as that shown in figure 1, mobile communication devices or user equipment (UE) 101, 102, 103, 104 are provided wireless access via at least one base station or similar wireless transmitting and/or receiving node or point. In figure 1 three neighbouring and overlapping access systems, cells or radio service areas 115, 110 and 120 are shown being provided by base stations 105, 106, and 108.

However, it is noted that instead of three access systems, any number of access systems can be provided in a communication system. An access system can be provided by a cell of a cellular system or another system enabling a communication device to access a communication system. A base station site 105, 106, 108 can provide one or more cells. A base station can also provide a plurality of sectors, for example three radio sectors, each sector providing a cell or a subarea of a cell. All sectors within a cell can be served by the same base station. A radio link within a sector can be identified by a single logical identification belonging to that sector. Thus a base station can provide one or more radio service areas. Each mobile communication device 101, 102, 103, 104, and base station 105, 106, and 108 may have one or more radio channels open at the same time and may send signals to and/or receive signals from more than one source.

Base stations are typically controlled by at least one appropriate controller apparatus, so as to enable operation thereof and management of mobile communication devices in communication with the base stations. The controller apparatus may be located in a radio access network (RAN) (e.g. wireless communication system 100) or in a core network (CN) (not shown) and may be implemented as one central apparatus or its functionality may be distributed over several apparatus. The controller apparatus may be part of the base station and/or provided by a separate entity such as a Radio Network Controller (RNC). Base stations 105, 106, 108 may be controlled by a RNC 112 so as to enable operation thereof

and management of mobile communication devices 101, 102, 103, 104 in communication with the base stations 105, 106, 108. The function of the RNC may be distributed between a plurality of entities. Although not shown in Figure 1 in some embodiments, each base station 105, 106 and 108 can have at least part of the RNC function.

5

The cell borders or edges are schematically shown for illustration purposes only in Figure 1. It shall be understood that the sizes and shapes of the cells or other radio service areas may vary considerably from the similarly sized omni-directional shapes of Figure 1.

10 In particular, Figure 1 depicts two wide area base stations 105, 106, which can be macro-NBs (node B) 105, 106. The macro-NBs 105, 106 transmit and receive data over the entire coverage of the cells 115 and 110 respectively. Figure 1 also shows a smaller base station or access point 108. The coverage of the smaller base station 108 may generally be smaller than the coverage of the wide area base stations 105, 106. The coverage provided by the
15 smaller node 108 overlap with the coverage provided by the macro-NBs 105, 106. In some embodiments, the smaller node can be pico NB or a femto NB. A femto node B may be connected to a Home NodeB Gateway which in turn is connected to RNC.

A possible mobile communication device will now be described in more detail with reference
20 to Figure 2 showing a schematic, partially sectioned view of a communication device 200. Such a communication device is often referred to as user equipment (UE) or terminal. An appropriate mobile communication device may be provided by any device capable of sending and receiving radio signals. Non-limiting examples comprise a mobile station (MS) or mobile device such as a mobile phone or what is known as a 'smart phone', a computer
25 provided with a wireless interface card or other wireless interface facility (e.g., USB dongle), personal data assistant (PDA) or a tablet provided with wireless communication capabilities, or any combinations of these or the like. A mobile communication device may provide, for example, communication of data for carrying communications such as voice, electronic mail (email), text message, multimedia and so on. Users may thus be offered and provided
30 numerous services via their communication devices. Non-limiting examples of these services comprise two-way or multi-way calls, data communication or multimedia services or simply an access to a data communications network system, such as the Internet. Users may also be provided broadcast or multicast data. Non-limiting examples of the content comprise
35 information.

The mobile device 200 may receive signals over an air or radio interface 207 via appropriate apparatus for receiving and may transmit signals via appropriate apparatus for transmitting radio signals. In Figure 2 transceiver apparatus is designated schematically by block 206. The transceiver apparatus 206 may be provided for example by means of a radio part and associated antenna arrangement. The antenna arrangement may be arranged internally or externally to the mobile device.

A mobile device is typically provided with at least one data processing entity 201, at least one memory 202 and other possible components 203 for use in software and hardware aided execution of tasks it is designed to perform, including control of access to and communications with access systems and other communication devices. The data processing, storage and other relevant control apparatus can be provided on an appropriate circuit board and/or in chipsets. This feature is denoted by reference 204. The user may control the operation of the mobile device by means of a suitable user interface such as key pad 205, voice commands, touch sensitive screen or pad, combinations thereof or the like. A display 208, a speaker and a microphone can be also provided. Furthermore, a mobile communication device may comprise appropriate connectors (either wired or wireless) to other devices and/or for connecting external accessories, for example hands-free equipment, thereto.

The communication devices 101, 102, 103, 104 may access the communication system based on various access techniques, such as code division multiple access (CDMA), or wideband CDMA (WCDMA). Other non-limiting examples comprise time division multiple access (TDMA), frequency division multiple access (FDMA) and various schemes thereof such as the interleaved frequency division multiple access (IFDMA), single carrier frequency division multiple access (SC-FDMA) and orthogonal frequency division multiple access (OFDMA), space division multiple access (SDMA) and so on.

An example of wireless communication systems are architectures standardized by the 3rd Generation Partnership Project (3GPP). The various development stages of the 3GPP specifications are referred to as releases. Other examples of radio access system comprise those provided by base stations of systems that are based on technologies such as wireless local area network (WLAN) and/or WiMax (Worldwide Interoperability for Microwave Access). A base station can provide coverage for an entire cell or similar radio service area.

UMTS technology has been a dominant wireless broadband technology, and may remain so for a number of years. UMTS may provide a good trade off between efficiency and cost.

UMTS is considered as a potential candidate to support massive number of UEs covering both smart phones and machine type communication (MTC)-like devices.

One property of UMTS is that a UE can be in different states, such as CELL_DCH,
5 CELL_FACH, URA/CELL_PCH. For relative small data volumes, devices are anticipated to be kept in CELL_FACH during ongoing data exchange and in CELL/URA_PCH during periods of inactivity. For the latter case of inactivity, an inactive UE may keep assigned dedicated radio network temporary identifier (RNTI) values. In the case of a large number of devices, there may be a shortage of dedicated RNTIs that the network may need for active
10 devices.

For example, if a UE has relatively low volumes of data then it may be kept in the CELL_FACH state. If both the network and a UE supports so-called enhanced DL/UL for CELL_FACH, then each UE is assigned dedicated RNTI identifiers needed for exchanging
15 data in downlink (DL) and uplink (UL) directions. If a UE is moved to a more power efficient state, such as CELL_PCH, then a UE keeps those RNTI values so that it can move quickly back to CELL_FACH.

As the UMTS system serves increasing numbers of UEs (e.g. smartphones and MTC like
20 devices), then the number of devices requiring dedicated RNTIs increases. The majority of those devices may be in the URA/CELL_PCH state with assigned RNTI values, which may prevent those RNTI values from being assigned to other UEs in the cell or cells which are controlled by the RNC (depending on whether the RNTI is cell specific or RNC-wide).

The network may put all UEs into URA/CELL_PCH state without assigned RNTIs. That will ensure that there will be always spare RNTI values for CELL_FACH UEs; however, state transition back to CELL_FACH may be slower because the UE and RNC exchange messages to assign free RNTI values to the UE. Alternatively, or in addition, a network may move a UE to URA/CELL_PCH with assigned RNTIs, and then on demand ask a UE to
30 "release" the assigned RNTIs through the re-configuration procedure as depicted in Figure 3.

Figure 3 shows a signalling diagram for a release of dedicated RNTIs. Dedicated RNTIs are used for data transmission between UE and network. In a procedure such as that shown in figure 3, to release dedicated RNTI values, a RNC 112 and a UE 101, associated with Node
35 B 105, exchange a number of messages (including the radio link control (RLC) level ACKs (acknowledgements)). The RNC 112 performs a paging procedure towards the UE 101,

which is followed by the PHYSICAL CHANNEL RECONFIGURATION / COMPLETE messages.

The UMTS specification has a feature that allows release of the radio resource control

- 5 (RRC) connection through the paging message, including dedicated RNTIs, if any. However it may be desirable to provide a mechanism to release dedicated RNTIs only.

Figure 4a shows a flowchart of a method of releasing stored dedicated RNTIs in the URA/CELL_PCH state. The method comprises, in a first step S1, receiving a paging
10 message at a paging message receiver, said paging message comprising information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and in a second step, S2, causing the release of the at least one set of resources.

- 15 Figure 4b shows a flowchart of a method of releasing stored dedicated RNTIs in the URA/CELL_PCH state. The method comprises, in step T1, causing a paging message to be sent, said paging message comprising information useable by a paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and, in a second step T2 causing the release of the at least one set of resources.
20 The paging message may be caused to be sent, e.g., transmitted, or caused to be transmitted, to, or towards, the paging message receiver.

The paging message receiver may be a UE, or a component 203 or a transceiver 206 of a mobile device 200. The paging message may be received from a paging message sender.

- 25 The paging message sender may comprise a control apparatus, e.g. a RNC.

The at least one set of resources allocated to the paging message receiver may comprise identify information which is used for data transmission from the paging message receiver.

- The at least one set of resources allocated to the paging message receiver may be an
30 identity which is dedicated to data transmission from the paging message receiver. The identity information may comprise at least one dedicated RNTI value, e.g. C-RNTI, E-RNTI, H-RNTI values.

- Information useable by the paging message receiver to determine at least one set of
35 resources allocated to the paging message receiver to be released may indicate at least one set of resources used for data transmission. The information may indicate a set of resources of a predetermined type. The information may be an indication in the paging message e.g.,

a flag in the paging message, e.g. an “identifier release indication”, “resource release indication”, “RNTI release indication”, an “RNTI release flag”. The flag may indicate at least one set of resources.

- 5 Causing release of the resource may comprise causing the release of the resource at at least one of the paging message receiver and paging message sender.

10 The introduction of a paging message comprising information to cause the release of a resource allocated to the paging message receiver, e.g. a paging flag, and causing the release of the resource may allow a network to be able to signal to a UE that it should release dedicated RNTI. For example, the UE may release C-/H-/E-RNTIs (which may be cell specific) but keep U-RNTI.

15 The method may comprise providing an indication of the release of the at least one set of resources to a paging message sender. Providing an indication may comprise transmitting the indication, or causing the indication to be transmitted towards the paging message sender. The indication may be provided prior to, or after, the release of the resource. The indication may be provided to a RNC or towards a control apparatus e.g., via intermediate nodes 105.

20

The indication of the release of the resource may be included in an RRC message. The RRC message may be a measurement report, sent over, for example, dedicated control channel (DCCH) and/or common control channel (CCCH). The RRC message may be a cell update message.

25

The method may comprise receiving an acknowledgement of the indication.
Acknowledgement type may depend on the message type in which the indication is sent.

30 The indication of the release of the at least one set of resources may be provided to an RNC via a base station of the network, for example, a node B of a UMTS network. The indication may be provided in an UL MAC CONTROL PDU (protocol data unit) to a node B.

35 Figure 5 shows an example signalling diagram which may be used in performing a method such as that of figure 4. In step S 51, a UE 101 receives a paging message from a RNC 112, which may include information to cause the release of a resource allocated to the UE 101. The information may indicate several UE identities since the request may be intended for a first UE, a second UE or further UEs. If a UE 101 receiving the paging request in step S51

detects its own UE identity in the paging request, the UE 101 determines how to proceed on the paging request. A UE 101 sends in step S52 a measurement report in response to a paging request received from a RNC 112. In an embodiment, the paging request comprises information to cause the release of resources for data transmission, e.g. RNTIs. The measurement report may comprise an indication of the release of the resources. On receipt of the measurement report at the RNC, the RNC may release dedicated UE identifiers C-/E-/H-RNTI in RNC of first UE in step S53.

In an embodiment such as that shown in figures 6 and 7, an RNC 112 sends a paging message to a UE 101 at step S61. The paging message may include "RNTI release flag", after which a UE sends in step S62 an RRC message as an indication of a successfully received paging request. Since the "RNTI release flag" has been included in the paging request, the RRC message is implicitly a confirmation of having received the RNTI release flag or an identifier release indication. Once the network receives the message it knows that a UE has cleared its dedicated RNTI values, which now could be returned to the pool of available resources.

In the embodiment shown in figure 6, the UE 101 transmits a measurement report message in step S62. The UE 101 receives an acknowledgement message RLC ACK in step S63 for the measurement report message. A UE 101 in step S64 may move back to the CELL_PCH state upon reception of the RCL ACK for the MEASUREMENT REPORT message, whereupon also the dedicated RNTIs are released.

In the embodiment shown in figure 7, a UE 101 releases dedicated RNTI in step S71 prior to submission of the MEASUREMENT REPORT message in step S62, whereupon the latter message would be sent over the CCCH which does not require any acknowledgement message RLC ACK.

Regardless of whether MEASUREMENT REPORT is sent over CCCH or DCCH in step S62, there exists a race condition when a network sends a paging request including a "RNTI release flag" but a UE 101 has already initiated UL transmission before the paging message arrives. For the RNC 112 to know unambiguously a reason of a received MEASUREMENT REPORT message, a new cause value may be added e.g. "identifier release confirmation" or "resource release confirmation".

In an embodiment such as that shown in figure 8, when a UE 101 receives the paging message in step S61, including in this example a RNTI release flag, a UE 101 immediately

clears stored RNTIs in step S82 and sends a CELL UPDATE message in step S83 following a legacy procedure. In response to CELL UPDATE, the network sends CELL UPDATE CONFIRM in step S84 explicitly moving a UE back to CELL_PCH as presented in Figure 8. It should be noted that this option is identical to MEASUREMENT REPORT over DCCH as shown in figure 6 in a number of exchanged messages.

In an embodiment such as that shown in figure 9, a UE 101, upon reception of a paging message including, in this example, a RNTI release flag, sends a special UL MAC CONTROL PDU to a node of the network, e.g. Node B 105. The Node B 105 sends a L1 ACK to a UE 101 and forwards the "RNTI release" indication to the RNC 112. This embodiment may impact the lub interface and require some cross-layer interaction inside a UE.

Table 1 shows the structure of an example single "Paging record" information element (IE). It may be extended with a "choice to release RNTIs" as presented in the final two rows of table 1.

Table 1: “Paging record” IE and its extension for the RNTI release

Information Element/Group name	Need	Multi	Type and reference	Semantics description	Version
CHOICE <i>Used paging identity</i>	MP				
>CN identity					
>>Paging cause	MP		Paging cause 10.3.3.22		
>>CN domain identity	MP		CN domain identity 10.3.1.1		
>>CHOICE <i>UE Identity</i>	MP			Three spare values are needed.	
>>>IMSI (International mobile subscriber identity) (GSM-MAP)			IMSI (GSM-MAP) 10.3.1.5		
>>>TMSI (temporary mobile subscriber identity) (GSM-MAP)			TMSI (GSM-MAP) 10.3.1.17		
>>>P(packet)-TMSI (GSM-MAP)			P-TMSI (GSM-MAP) 10.3.1.13		
>>>IMSI (DS-41)			Octet string (SIZE (5..7))	TIA/EIA/IS-2000-4	
>>>TMSI (DS-41)			Octet string (SIZE (2..17))	TIA/EIA/IS-2000-4	

Information Element/Group name	Need	Multi	Type and reference	Semantics description	Version
>UTRAN single UE identity					
>>U-RNTI	MP		U-RNTI 10.3.3.47		
>>CN originated page to connected mode UE	OP				
>>>Paging cause	MP		Paging cause 10.3.3.22		
>>>CN domain identity	MP		CN domain identity 10.3.1.1		
>>>Paging record type identifier	MP		Paging record type identifier 10.3.1.10		

Information Element/Group name	Need	Multi	Type and reference	Semantics description	Version
>>RRC connection release information	MP		RRC connection release information 10.3.3.35o		REL-5
>UTRAN group identity		1 to <maxU RNTIgroup>			REL-5
>>RRC connection release information	MP		RRC connection release information 10.3.3.35o		REL-5
>>Group release information	MP		Group release information 10.3.3.14o		REL-5
>UTRAN single UE identity to release RNTIs					REL-13
>>U-RNTI	MP		U-RNTI 10.3.3.47		REL-13

The proposed extension on a PAGING TYPE 1 message may be implemented using ASN.1 (abstract syntax notation one) code. A PAGING TYPE 1 message has a non-critical

5 extension container, where a new paging record may be placed. The new paging record may be visible only to new UEs, while legacy UEs will ignore it.

It should be understood that each block of the flowchart of Figures 4 and any combination thereof may be implemented by various means or their combinations, such as hardware,

10 software, firmware, one or more processors and/or circuitry.

A method as described with reference to figures 4 to 9 may be implemented on a mobile device as described with respect to figure 2 or control apparatus as shown in figure 10.

Figure 10 shows an example of a control apparatus for a communication system, for

5 example to be coupled to and/or for controlling a station of an access system, such as a RAN node, e.g. a base station or (e) Node B, or a node of a core network such as an MME, or a server or host. The method may be implanted in a single control apparatus or across more than one control apparatus. The control apparatus may be integrated with or external to a node or module of a core network or RAN. In some embodiments, base stations

10 comprise a separate control apparatus unit or module. In other embodiments, the control apparatus can be a network element such as a radio network controller or a spectrum controller. In some embodiments, each base station may have such a control apparatus as well as a control apparatus being provided in a radio network controller. The control apparatus 300 can be arranged to provide control on communications in the service area of the system. The control apparatus 300 comprises at least one memory 301, at least one data processing unit 302, 303 and an input/output interface 304. Via the interface the control apparatus can be coupled to a receiver and a transmitter, e.g. of the base station. The receiver and/or the transmitter may be implemented as a radio front end or a remote radio head. For example the control apparatus 300 can be configured to execute an appropriate

15 software code to provide the control functions. Control functions may comprise causing a paging message to be sent, said paging message comprising information useable by a paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and causing the release of the at least one set of resources.

25 Alternatively, or in addition, control functions may comprise causing a paging message to be transmitted or transmitting a paging message, said paging message comprising information useable by a paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and causing the release of the at least one

30 set of resources.

Figure 11 shows an example of an apparatus 1100 comprising means 1110 for receiving a paging message at a paging message receiver, said paging message comprising information useable by the paging message receiver to determine at least one set of

35 resources allocated to the paging message receiver to be released and means 1120 for causing the release of the at least one set of resources.

The apparatus 1100 shown in Figure 11 may be an example paging message receiver. Means 1110 for receiving a paging message may be a receiver 1110 and means 1120 for causing the release of the at least one set of resources may be referred to as a resource releaser 1120.

5

Apparatus 1100 may be included in a chipset. A chipset including apparatus 1100 may be included in a user equipment.

Figure 12 shows an example of an apparatus 1200 comprising means 1210 for causing a paging message to be sent, said paging message comprising information useable by a paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and means 1220 for causing the release of the at least one set of resources.

The apparatus 1200 may be an example paging message sender. Means 1210 for causing a paging message to be sent may be a sender, or transmitter. Means 1220 for causing the release of the at least one set of resources may be referred to as a resource releaser 1220.

Apparatus 1200 may be included in a chipset or modem apparatus. A chipset or modem apparatus which includes apparatus 1200 may be included in a base station and/or RNC.

It should be understood that the apparatuses may comprise or be coupled to other units or modules etc., such as radio parts or radio heads, used in or for transmission and/or reception. Although the apparatuses have been described as one entity, different modules and memory may be implemented in one or more physical or logical entities.

It is noted that whilst embodiments have been described in relation to UMTS, similar principles can be applied in relation to other cellular networks. Therefore, although certain embodiments were described above by way of example with reference to certain example architectures for wireless networks, technologies and standards, embodiments may be applied to any other suitable forms of communication systems than those illustrated and described herein.

It is also noted herein that while the above describes example embodiments, there are several variations and modifications which may be made to the disclosed solution without departing from the scope of the present invention.

In general, the various embodiments may be implemented in hardware or special purpose circuits, software, logic or any combination thereof. Some aspects of the invention may be implemented in hardware, while other aspects may be implemented in firmware or software which may be executed by a controller, microprocessor or other computing device, although
5 the invention is not limited thereto. While various aspects of the invention may be illustrated and described as block diagrams, flow charts, or using some other pictorial representation, it is well understood that these blocks, apparatus, systems, techniques or methods described herein may be implemented in, as non-limiting examples, hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing
10 devices, or some combination thereof.

The embodiments of this invention may be implemented by computer software executable by a data processor of the mobile device, such as in the processor entity, or by hardware, or by a combination of software and hardware. Computer software or program, also called
15 program product, including software routines, applets and/or macros, may be stored in any apparatus-readable data storage medium and they comprise program instructions to perform particular tasks. A computer program product may comprise one or more computer-executable components which, when the program is run, are configured to carry out embodiments. The one or more computer-executable components may be at least one
20 software code or portions of it.

Further in this regard it should be noted that any blocks of the logic flow as in the Figures may represent program steps, or interconnected logic circuits, blocks and functions, or a combination of program steps and logic circuits, blocks and functions. The software may be
25 stored on such physical media as memory chips, or memory blocks implemented within the processor, magnetic media such as hard disk or floppy disks, and optical media such as for example DVD and the data variants thereof, CD. The physical media is a non-transitory media.

The memory may be of any type suitable to the local technical environment and may be implemented using any suitable data storage technology, such as semiconductor based memory devices, magnetic memory devices and systems, optical memory devices and systems, fixed memory and removable memory. The data processors may be of any type
30 suitable to the local technical environment, and may comprise one or more of general purpose computers, special purpose computers, microprocessors, digital signal processors (DSPs), application specific integrated circuits (ASIC), FPGA, gate level circuits and
35 processors based on multi core processor architecture, as non limiting examples.

Embodiments of the inventions may be practiced in various components such as integrated circuit modules. The design of integrated circuits is by and large a highly automated process. Complex and powerful software tools are available for converting a logic level
5 design into a semiconductor circuit design ready to be etched and formed on a semiconductor substrate.

The foregoing description has provided by way of non-limiting examples a full and informative description of the exemplary embodiment of this invention. However, various
10 modifications and adaptations may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings and the appended claims. However, all such and similar modifications of the teachings of this invention will still fall within the scope of this invention as defined in the appended
15 claims. Indeed there is a further embodiment comprising a combination of one or more embodiments with any of the other embodiments previously discussed.

Claims

1. A method comprising:
receiving a paging message at a paging message receiver, said paging message
5 comprising information useable by the paging message receiver to determine at least one
set of resources allocated to the paging message receiver to be released; and
causing the release of the at least one set of resources.
2. A method according to claim 1, wherein the at least one set of resources allocated to
10 the paging message receiver comprises identity information which is used for data
transmission from the paging message receiver.
3. A method according to claim 2, wherein the identity information comprises at least
one radio network temporary identifier.
15
4. A method according to any preceding claim, wherein the information useable by the
paging message receiver to determine at least one set of resources allocated to the paging
message receiver to be released indicates at least one set of resources used for data
transmission.
20
5. A method according to claim 4, wherein the information useable by the paging
message receiver to determine at least one set of resources allocated to the paging
message receiver to be released comprises a flag indicating the at least one set of
resources.
25
6. A method according to any preceding claim, wherein the at least one set of resources
allocated to the paging message receiver is dedicated to a data transmission from the
paging message receiver.
- 30 7. A method according to any preceding claim wherein causing the release of the at
least one set of resources comprises causing the release of the resource at at least one of
the paging message receiver and a paging message sender.
8. A method according to any claim 7, comprising providing an indication of the release
35 of the resource to the paging message sender.

9. A method according to claim 8, wherein said indication comprises a cause value indicating the release of the at least one set of resources.

10. A method comprising:

- 5 causing a paging message to be sent, said paging message comprising information useable by a paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released; and
causing the release of the at least one set of resources.

10 11. A method according to claim 10, wherein the at least one set of resources allocated to the paging message receiver comprises identity information which is used for data transmission from the paging message receiver.

12. A method according to claim 11, wherein the identity information comprises at least
15 one radio network temporary identifier.

13. A method according to any one of claims 10 to 12, wherein the information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released indicates at least one set of resources used for data
20 transmission.

14. A method according to claim 13, wherein the information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released comprises a flag indicating the at least one set of
25 resources.

15. A method according to any one of claims 10 to 14, wherein the at least one set of resources allocated to the paging message receiver is dedicated to a data transmission from the paging message receiver.
30

16. A method according to any one of claims 10 to 15 wherein causing the release of the at least one set of resources comprises causing the release of the at least one set of resources at at least one of the paging message receiver and a paging message sender.

35 17. A method according to any claim 16, comprising receiving an indication of the release of the at least one set of resources from the paging message receiver.

18. A method according to claim 17, wherein said indication comprises a cause value indicating the release of the at least one set or resources.

19. A computer program product for a computer, comprising software code portions for performing the steps of any of claims 1 to 18 when said product is run on the computer.

20. An apparatus comprising means for performing a method according to any one of claims 1 to 18.

21. An apparatus comprising:

at least one processor and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to:

receive a paging message at a paging message receiver, said paging message comprising information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released; and cause the release of the at least one set of resources.

22. An apparatus comprising:

at least one processor and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to:

cause a paging message to be sent, said paging message comprising information useable by a paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released; and cause the release of the at least one set of resources.

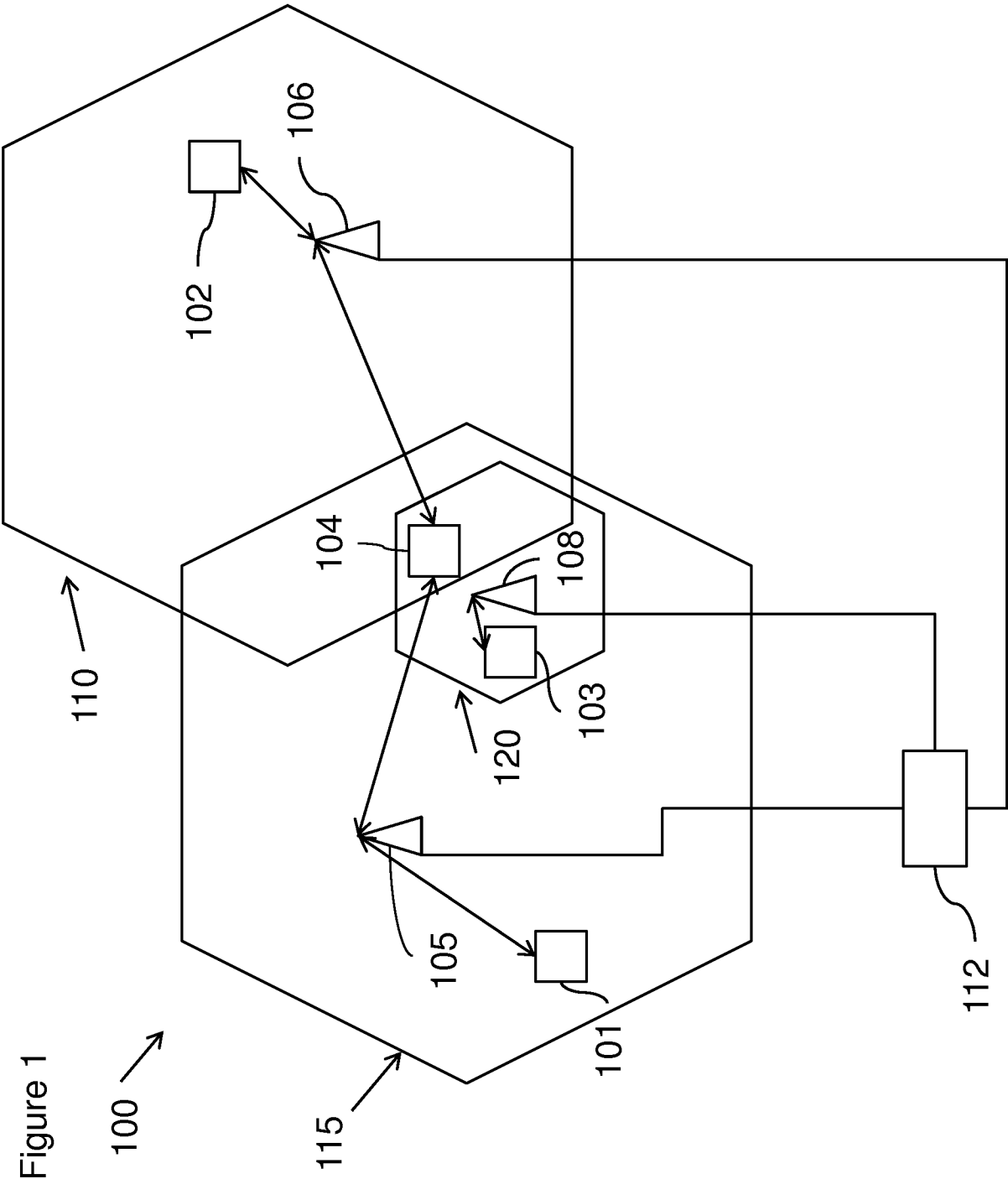
23. A chipset comprising apparatus as claimed in claims 20 to 22.

24. An electronic device comprising apparatus as claimed in claims 20 to 23.

25. A system comprising:

a paging message sender; and

a paging message receiver configured to receive a paging message from the paging message sender, said paging message comprising information useable by the paging message receiver to determine at least one set of resources allocated to the paging message receiver to be released and cause the release of the at least one set of resources.



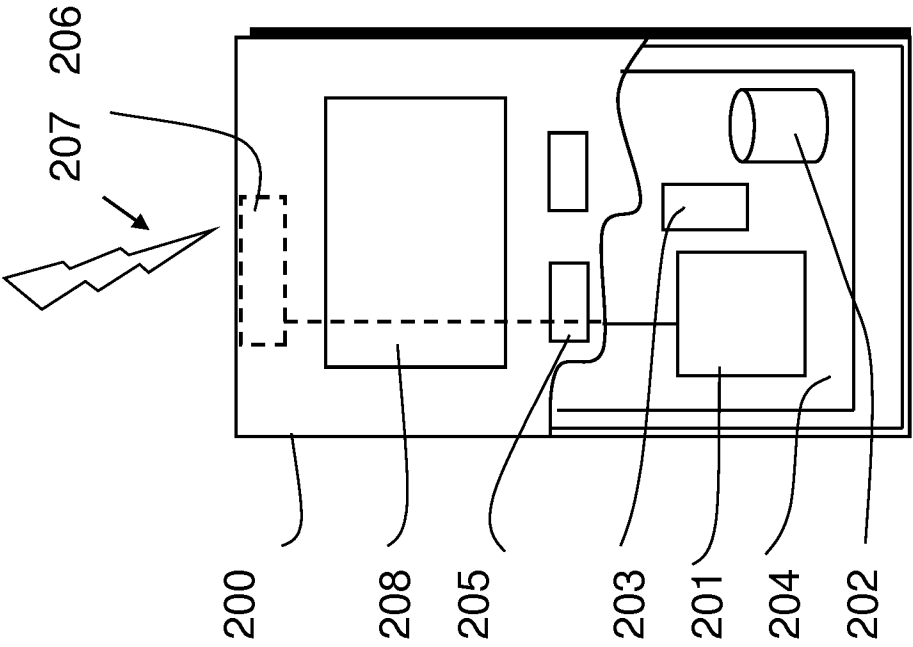


Figure 2

Figure 3

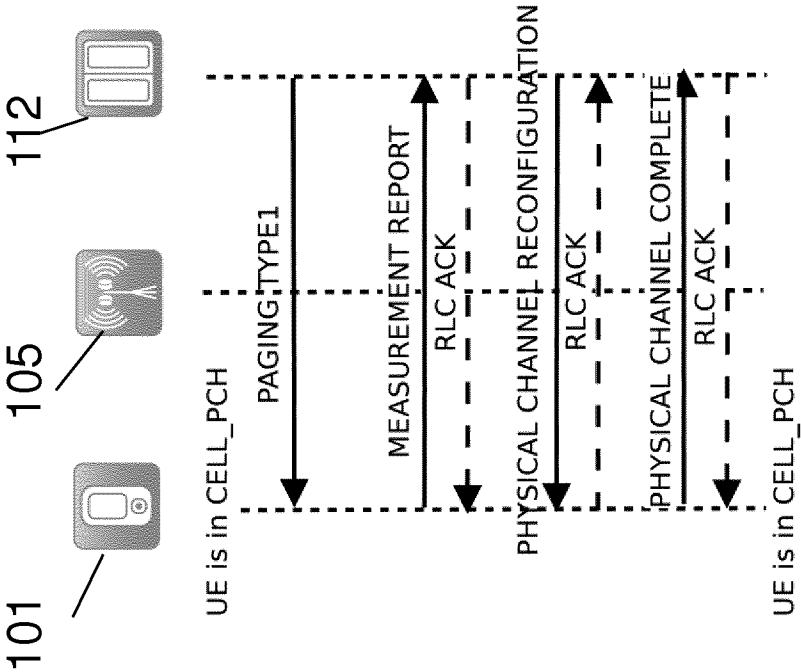


Figure 4a

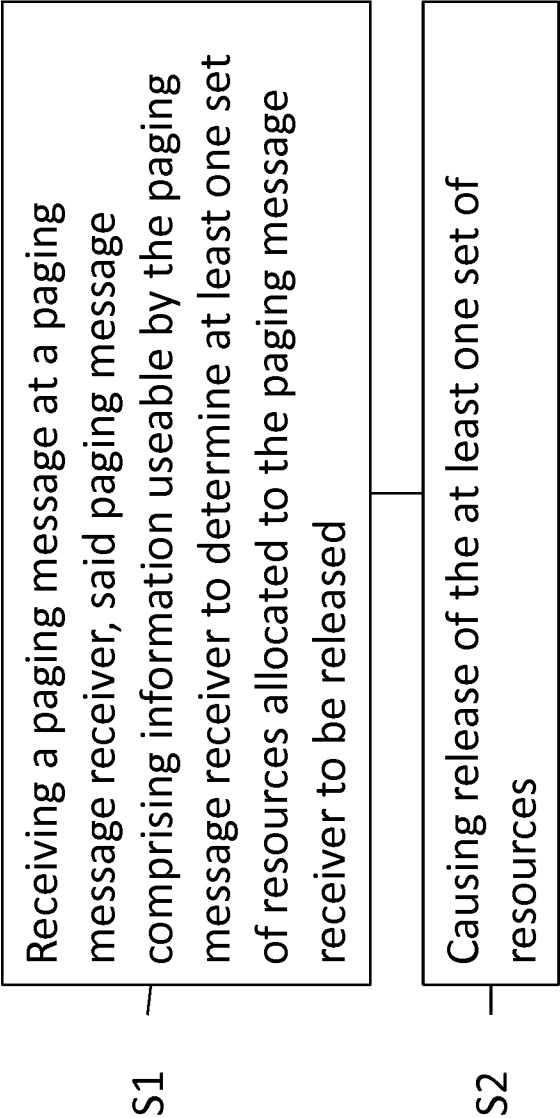


Figure 4b

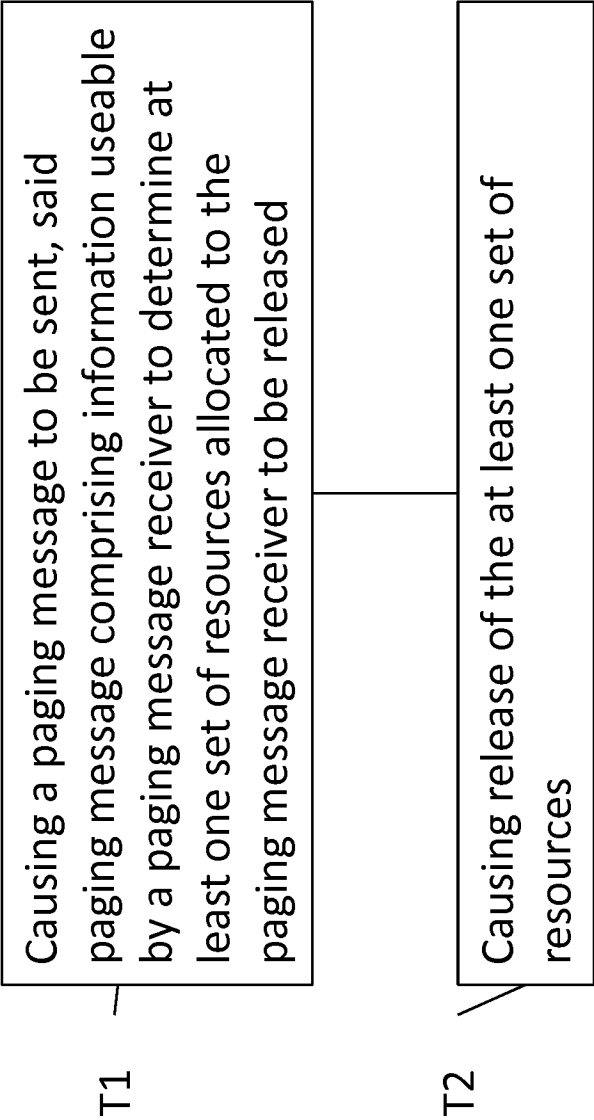


Figure 5

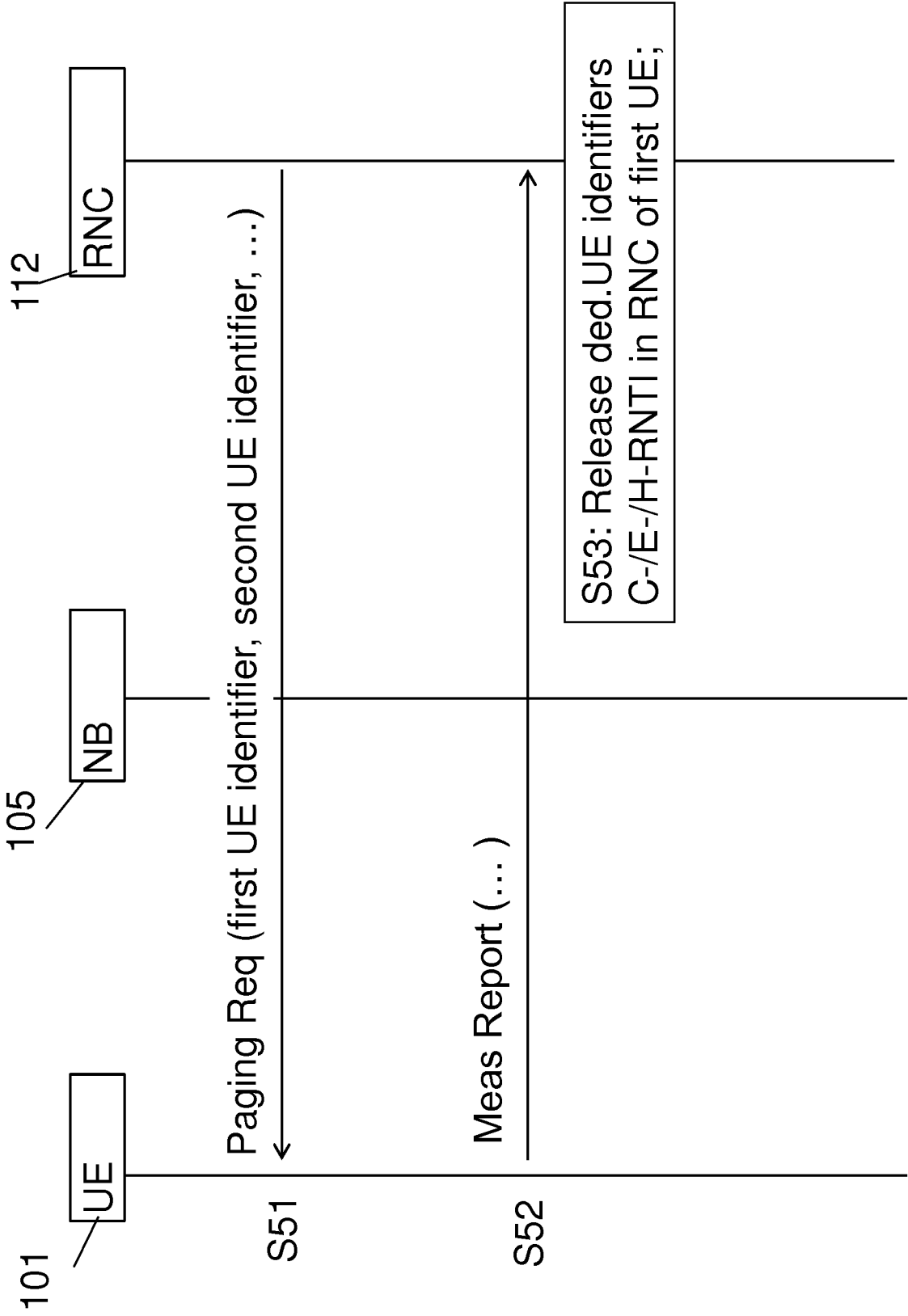


Figure 6

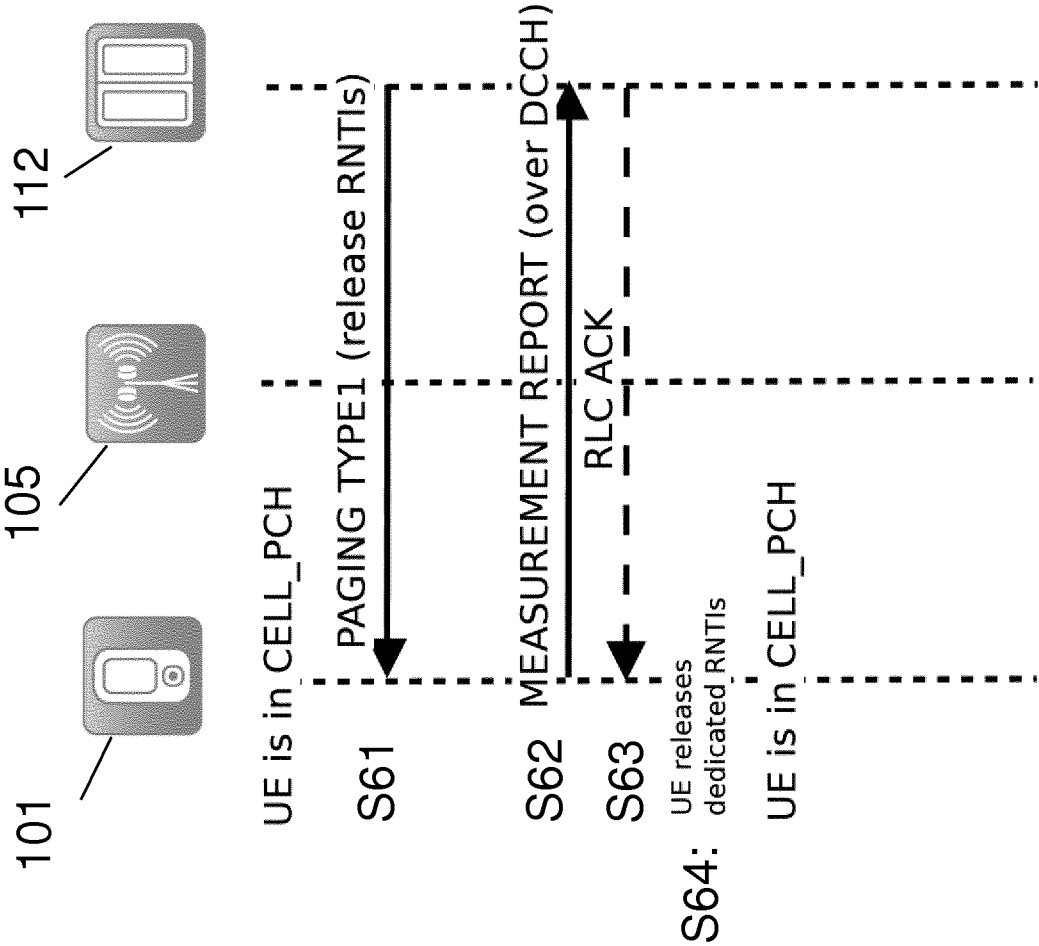


Figure 7

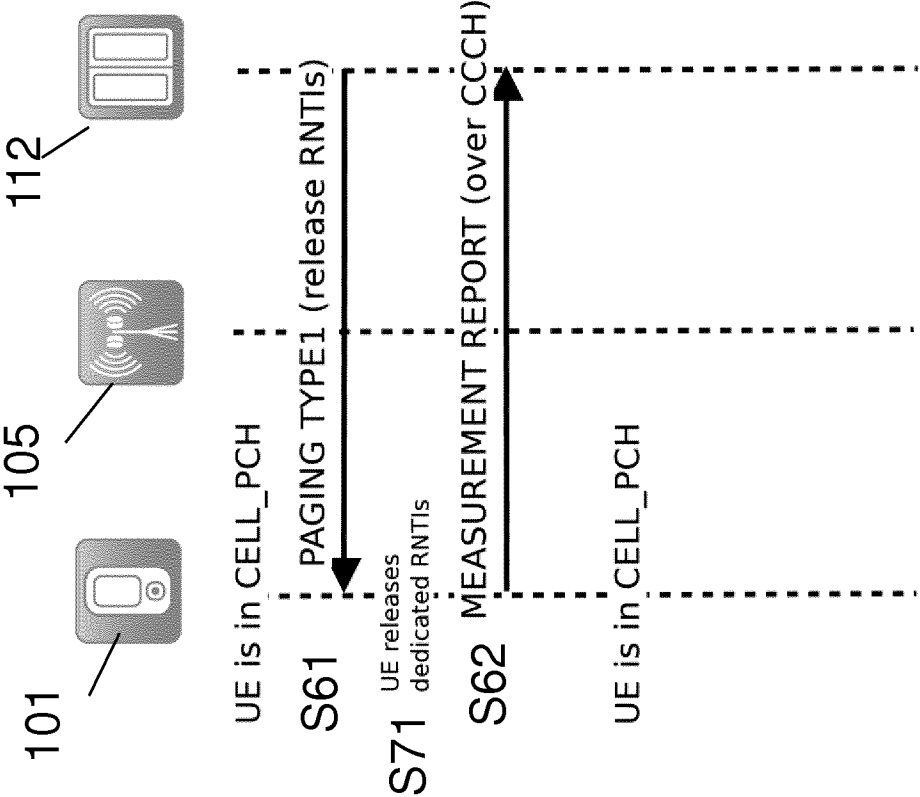


Figure 8

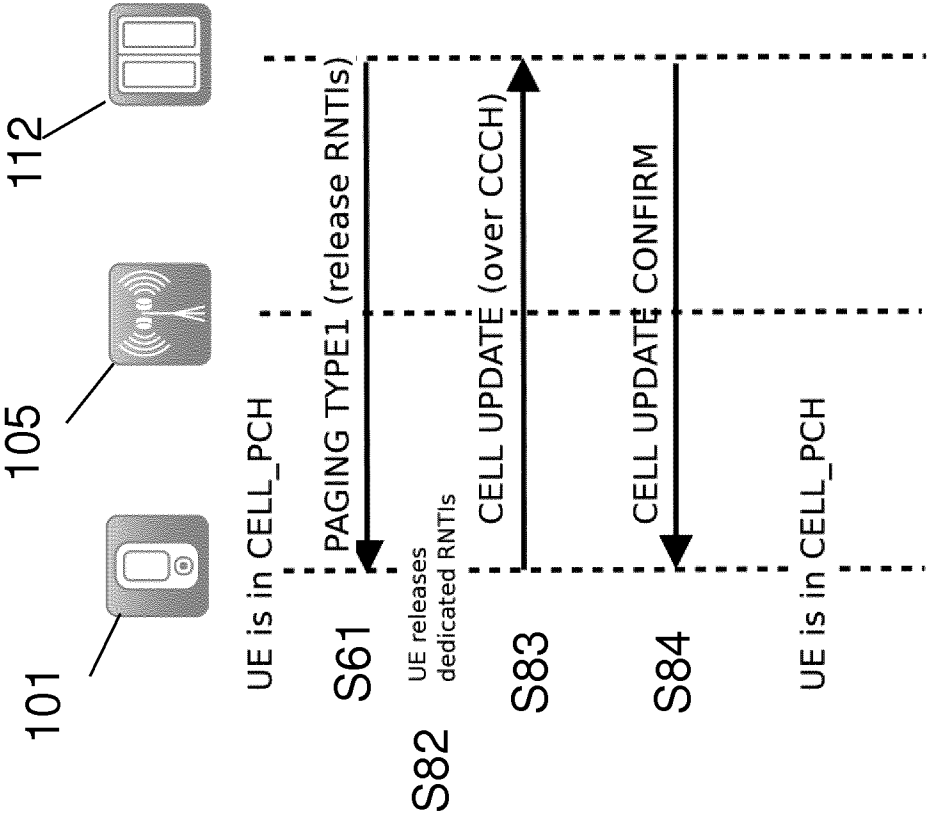


Figure 9

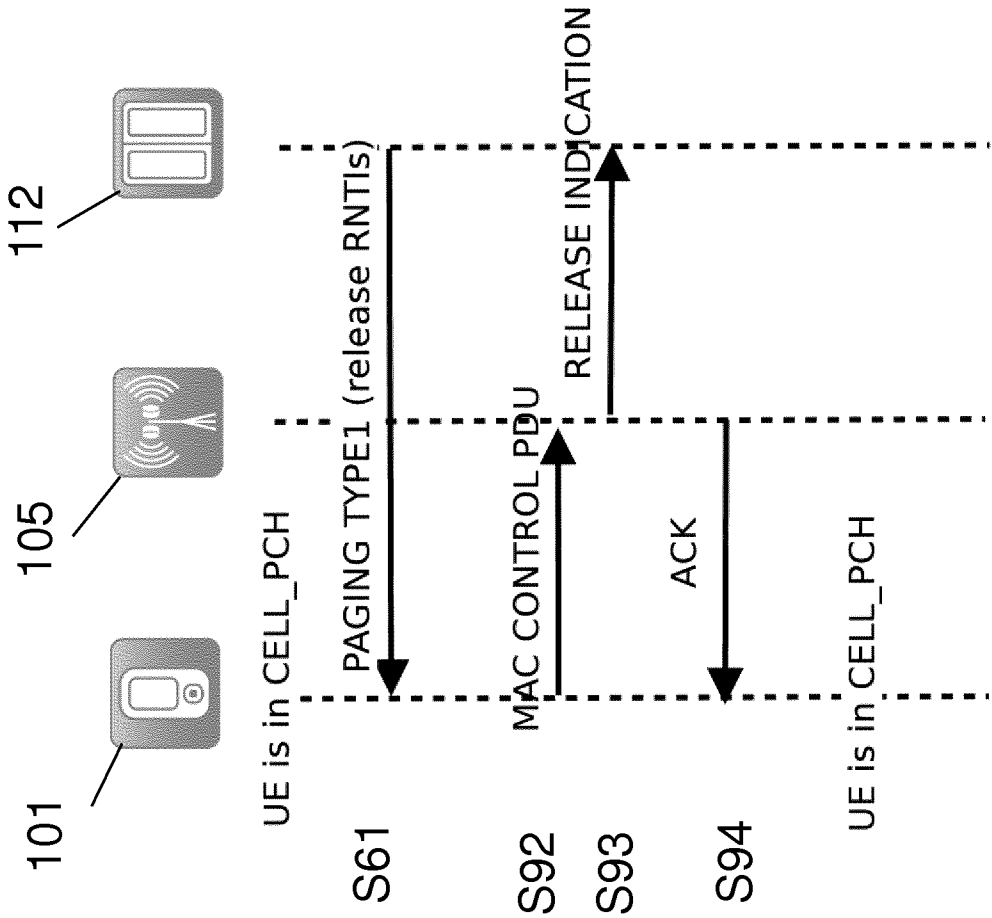


Figure 10

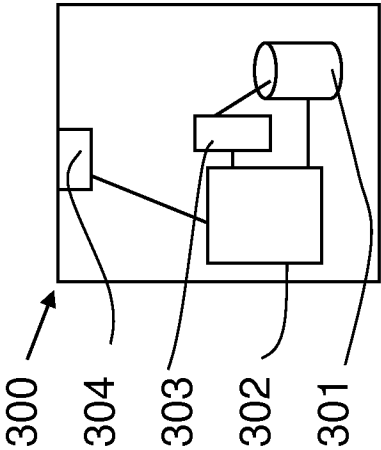


Figure 11

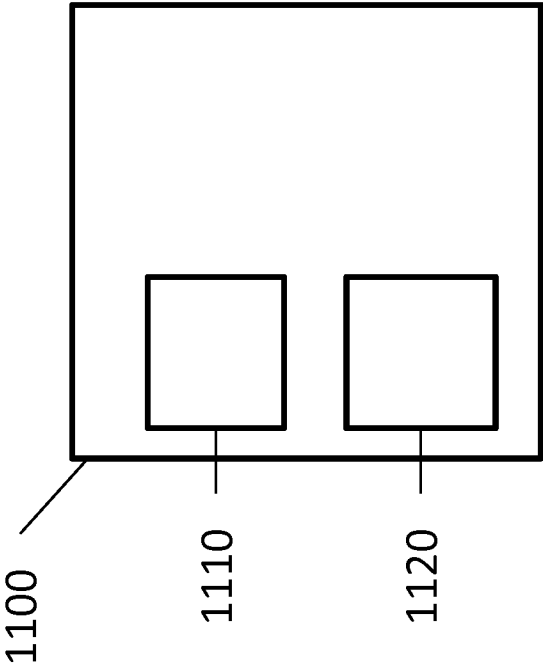
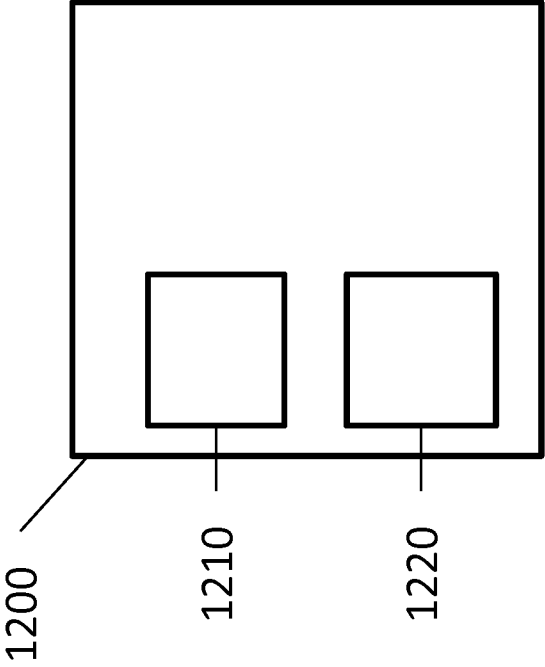


Figure 12



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/078964

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W8/26 H04W76/06
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	WO 2014/053170 A1 (NOKIA SIEMENS NETWORKS OY [FI]) 10 April 2014 (2014-04-10) page 2, paragraph 5 - page 33, paragraph 19 figure 4 claims 1-10	1-25
X	WO 02/45456 A1 (ERICSSON TELEFON AB L M [SE]) 6 June 2002 (2002-06-06) page 7, line 16 - line 23 page 12, line 3 - line 16 page 13, line 9 figures 5, 6	1-25



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

19 February 2016

Date of mailing of the international search report

26/02/2016

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Authorized officer

Siebel, Christian

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/078964

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2014053170	A1	10-04-2014	NONE

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