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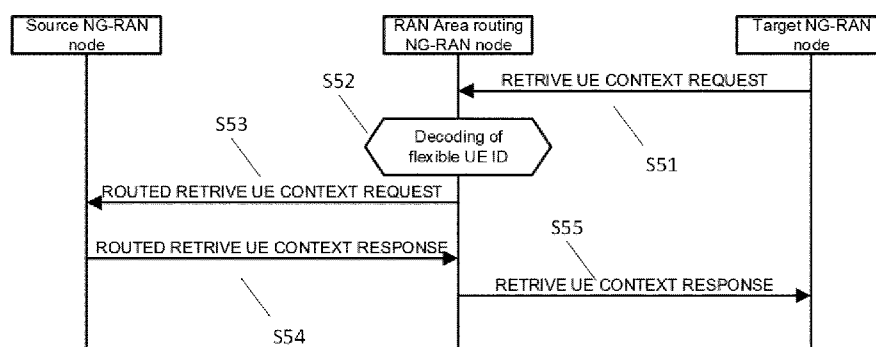
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(54) Title: INACTIVE USER EQUIPMENT CONTEXT ROUTING



(57) Abstract: The present invention provides apparatuses, methods, computer programs, computer program products and computer-readable media regarding inactive user equipment context routing. A method comprises receiving, at the routing base station, a user context request message for user equipment, UE, information from the target base station located in the second notification area, the user context request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID, decoding, at the routing base station, the received information element and retrieving routing information regarding the source base station from the UE ID included in the information element, sending the user context request message to the source base station using the retrieved routing information, receiving a user context response message including UE information from the source base station, and forwarding the received response message to the target base station.

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DESCRIPTION

INACTIVE USER EQUIPMENT CONTEXT ROUTING

Technical Field

Various example embodiments relate to apparatuses, methods, systems, computer programs, computer program products and computer-readable media regarding inactive user equipment context routing.

Abbreviations and Definitions:

5GC	5G Core Network
AMF	Access and Mobility Management Function
CM	Connection Management
gNB	Next generation NodeB
gNB-CU	gNB Central Unit
gNB-DU	gNb Distributed Unit
I-RNTI	Inactive RNTI: Identifier of the suspended UE context of a UE in RRC_INACTIVE
NGAP	NG Application Program
NG-RAN	Next Generation RAN: consists of a set of gNBs connected to the 5GC through the NG interface. One gNB-DU can include one or more radio cells
RAN	Radio Access Network
RNA	RAN Notification Area: the notification area can cover a single or multiple cells; UE does not send any "location update" indication when it stays within the boundaries of the area; when leaving the area, the UE updates its location to the network.
RNTI	Radio Network Temporary Identifier
RRC	Radio Resource Control
TAU	Tracking Area Update

UE	User Equipment
UPF	User Plane Function

Background

RRC_INACTIVE is a new state for 5G where a UE remains in CM-CONNECTED and can move within an area configured by NG-RAN (the RNA, RAN notification area) without notifying NG-RAN. In RRC_INACTIVE, the last serving gNB node keeps the UE context and the UE-associated NG connection with the serving AMF and UPF.

If the UE accesses a gNB other than the last serving gNB, the receiving gNB triggers the XnAP Retrieve UE Context procedure to get the UE context from the last serving gNB (cf. Fig. 2) and may also trigger a Data Forwarding procedure including tunnel information for potential recovery of data from the last serving gNB. Upon successful UE context retrieval, the receiving gNB shall perform the slice-aware admission control in case of receiving slice information and becomes the serving gNB and it further triggers the NGAP Path Switch Request procedure. After the path switch procedure, the serving gNB triggers release of the UE context at the last serving gNB by means of the XnAP UE Context Release procedure (cf. 3GPP TS 38.300 V15.2.0).

With this functionality, RRC connection between the UE and target NG-RAN node can be restored fast again, whenever needed.

The retrieved UE context includes also security context that is known only by the source NG-RAN node and the UE. Without this information, the target node cannot continue communication with the UE with the same connection. If the target node fails to clarify this, it needs to establish new RRC connection with the UE meaning also that the RRC inactive state is not working as planned.

The Information Element (IE) I-RNTI is used to address a UE Context within an NG-RAN node (cf. 3GPP TS 38.423 V15.0.0).

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE <i>UE Context ID</i>	M			
> <i>RRC Resume</i>				
>>I-RNTI	M		9.2.3.46	How the new NG-RAN node is able to resolve the old NG-RAN ID from the I-RNTI is a matter of proper configuration in the old and new NG-RAN node.
> <i>RRC Reestablishment</i>				
>>C-RNTI	M		BIT STRING (SIZE (16))	C-RNTI contained in the <i>RRC Re-establishment Request</i> message (TS 38.331 [10])
>> Failure Cell PCI	M		NG-RAN Cell PCI 9.2.2.10	

The coding of the UE identifier is matter of source and target node agreement. This basically causes that UE context fetch between different network vendors is very challenging or inefficient, for example, as the request may be broadcasted to many gNBs and this would easily lead to failures. Further, it is necessary to know how the field is encoded.

A gNB may consist of a gNB-CU and one or more gNB-DU(s) (cf. 3GPP TS 38.401 V15.0.0). The number of gNB-DU may vary even from 1 to thousands. So some gNBs may be covering just a small single site area whereas some gNBs can cover huge geographical area with huge number of users. If a big gNB would be close to small gNB sites there would be needed a huge amount of Xn interfaces for all surrounding small gNBs and also to their neighboring sites to allow UE to move in the RRC inactive state without continuous updates to the network.

When network receives this I-RNTI, it needs to be able to clarify the NG-RAN node that is holding the UE context. 3GPP has specified two options for the length of the I-RNTI, i.e. 24 bits or 40 bits. Length of gNB-ID is specified to be size of 22...32 bits (cf. 3GPP TS 38.423 V15.0.0). Both option are actually too short to really indicate the source NG-RAN ID and at the same time also the unique UE ID.

Fig. 3 illustrates a simplified network configuration with four RAN Areas. When UE RRC state is changed to RRC inactive state it can receive a list of RAN Areas where it can move like in the RRC idle state. The UE sends an indication to network only if it moves out of the RAN Notification area. The procedure here is similar as in the core network TAU. To avoid continued indication from the UE to the network, the

RAN area config list may contain e.g. RAN Area1, RAN Area2 and RAN Area3. So if the UE is set to RRC inactive in cell 1 in RAN Area2 and it moves towards cell 3 in RAN Area4, it does not need to indicate anything to the network e.g. in the area of RAN Area3. It would initiate RAN Areaupdate procedure in the cell3 in RAN Area4.

The Xn interface is the interface meant originally to transfer UE context in handovers between gNBs. A handover typically happens to neighboring gNB. This is a bit different compared to need of RRC inactive where idea is that UE can move to neighboring cells (or gNBs) without indicating it to network. So the area compared to handover maybe huge and this would basically explode the number of needed Xn connections between gNBs as in addition of neighboring gNBs the Xn connection would be needed to all gNBs in the RNA.

According to certain aspects of the present invention, there is defined how the source gNB can be coded to the I-RNTI and how the amount of needed Xn connections can be limited. The certain aspects of the present invention shall also allow optimal and easy network planning and efficient RRC inactivity state usage.

Summary

It is an object of various example embodiments to provide apparatuses, methods, systems, computer programs, computer program products and computer-readable media regarding inactive user equipment context routing.

According to an aspect of various example embodiments there is provided a method for use in a routing base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

receiving, at the routing base station, a user context request message for user equipment, UE, information from the target base station located in the second notification area, the user context request message including an information

element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

decoding, at the routing base station, the received information element and retrieving routing information regarding the source base station from the UE ID included in the information element,

sending the user context request message to the source base station using the retrieved routing information,

receiving a user context response message including UE information from the source base station, and

forwarding the received response message to the target base station.

According to another aspect of various example embodiments there is provided a method for use in a target base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to the target base station, comprising:

receiving, at the target base station, a resume request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

sending a user context request message to a routing base station in the first notification area based on the first notification area ID,

receiving, at the target base station, a user context response message including UE information about the user equipment from the routing base station, the UE information originating from the source base station.

According to another aspect of various example embodiments there is provided a method for use in a source base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

receiving, at the source base station, downlink data,

composing a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

sending the paging message to a routing base station in the second notification area based on the second notification area ID.

According to another aspect of various example embodiments there is provided a method for use in a routing base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to a target base station located in the second notification area, comprising:

- receiving a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

- sending, by the routing base station in the second notification, the paging message to all target base stations in the second notification area based on a second notification area ID.

According to another aspect of various example embodiments there is provided an apparatus for use in a routing base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

- at least one processor, and

- at least one memory for storing instructions to be executed by the processor, wherein

- the at least one memory and the instructions are configured to, with the at least one processor, cause the apparatus at least to perform:

- receiving, at the routing base station, a user context request message for user equipment, UE, information from the target base station located in the second notification area, the user context request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

- decoding, at the routing base station, the received information element and retrieving routing information regarding the source base station from the UE ID included in the information element,

sending the user context request message to the source base station using the retrieved routing information,
receiving a user context response message including UE information from the source base station, and
forwarding the received response message to the target base station.

According to another aspect of various example embodiments there is provided an apparatus for use in a target base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to the target base station, comprising

at least one processor, and

at least one memory for storing instructions to be executed by the processor, wherein

the at least one memory and the instructions are configured to, with the at least one processor, cause the apparatus at least to perform:

receiving, at the target base station, a resume request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

sending a user context request message to a routing base station in the first notification area based on the first notification area ID,

receiving, at the target base station, a user context response message including UE information about the user equipment from the routing base station, the UE information originating from the source base station.

According to another aspect of various example embodiments there is provided an apparatus for use in a source base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

at least one processor, and

at least one memory for storing instructions to be executed by the processor, wherein

the at least one memory and the instructions are configured to, with the at least one processor, cause the apparatus at least to perform:

receiving, at the source base station, downlink data,
composing a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,
sending the paging message to a routing base station in the second notification area based on the second notification area ID.

According to another aspect of various example embodiments there is provided an apparatus for use in a routing base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to a target base station located in the second notification area, comprising:

at least one processor, and
at least one memory for storing instructions to be executed by the processor, wherein

the at least one memory and the instructions are configured to, with the at least one processor, cause the apparatus at least to perform:

receiving a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

sending, by the routing base station in the second notification, the paging message to all target base stations in the second notification area based on a second notification area ID.

According to another aspect of various example embodiments there is provided an apparatus for use in a routing base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

means for receiving, at the routing base station, a user context request message for user equipment, UE, information from the target base station located in the second notification area, the user context request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

means for decoding, at the routing base station, the received information element and retrieving routing information regarding the source base station from the UE ID included in the information element,

means for sending the user context request message to the source base station using the retrieved routing information,

means for receiving a user context response message including UE information from the source base station, and

means for forwarding the received response message to the target base station.

According to another aspect of various example embodiments there is provided an apparatus for use in a target base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to the target base station, comprising:

means for receiving, at the target base station, a resume request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

means for sending a user context request message to a routing base station in the first notification area based on the first notification area ID,

means for receiving, at the target base station, a user context response message including UE information about the user equipment from the routing base station, the UE information originating from the source base station.

According to another aspect of various example embodiments there is provided an apparatus for use in a source base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

means for receiving, at the source base station, downlink data,

means for composing a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

means for sending the paging message to a routing base station in the second notification area based on the second notification area ID.

According to another aspect of various example embodiments there is provided an apparatus for use in a routing base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to a target base station located in the second notification area, comprising:

means for receiving a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

means for sending, by the routing base station in the second notification, the paging message to all target base stations in the second notification area based on a second notification area ID.

According to another aspect of the present invention there is provided a computer program product comprising code means adapted to produce steps of any of the methods as described above when loaded into the memory of a computer.

According to a still further aspect of the invention there is provided a computer program product as defined above, wherein the computer program product comprises a computer-readable medium on which the software code portions are stored.

According to a still further aspect of the invention there is provided a computer program product as defined above, wherein the program is directly loadable into an internal memory of the processing device.

According to an aspect of various example embodiments there is provided a computer readable medium storing a computer program as set out above.

Further aspects and features of the present invention are set out in the dependent claims.

Brief Description of the Drawings

These and other objects, features, details and advantages will become more fully apparent from the following detailed description of various aspects/embodiments which is to be taken in conjunction with the appended drawings, in which:

Fig. 1 is a diagram illustrating an RAN overall architecture to which certain aspects of the present invention are applicable.

Fig. 2 is a signaling diagram illustrating retrieval of UE context.

Fig. 3 is an example of a network configuration to which certain aspects of the present invention are applicable.

Fig. 4 is an example of I-RNTI encoding according to certain aspects of the present invention.

Fig. 5 is a signaling diagram illustrating a scenario for retrieving UE context with the flexible UE ID in the I-RNTI according to certain aspects of the present invention.

Fig. 6 is an example of a network configuration according to certain aspects of the present invention.

Fig. 7 is a flowchart illustrating an example of a method according to certain aspects of the present invention.

Fig. 8 is a flowchart illustrating another example of a method according to certain aspects of the present invention.

Fig. 9 is a block diagram illustrating an example of an apparatus according to certain aspects of the present invention.

Fig. 10 is a block diagram illustrating another example of an apparatus according to certain aspects of the present invention.

Fig. 11 is a block diagram illustrating another example of an apparatus according to certain aspects of the present invention.

Fig. 12 is a signaling diagram illustrating an overall scenario for retrieving UE context with the flexible UE ID in the I-RNTI according to certain aspects of the present invention.

Fig. 13 is a signaling diagram illustrating a scenario relating to path switching according to certain aspects of the present invention.

Fig. 14 is a block diagram illustrating an example of a network configuration relating to RAN paging according to certain aspects of the present invention.

Fig. 15 is a signaling diagram illustrating a scenario relating to RAN paging according to certain aspects of the present invention.

Fig. 16 is a flowchart illustrating another example of a method according to certain aspects of the present invention.

Fig. 17 is a flowchart illustrating another example of a method according to certain aspects of the present invention.

Fig. 18 is a block diagram illustrating another example of an apparatus according to certain aspects of the present invention.

Fig. 19 is a block diagram illustrating another example of an apparatus according to certain aspects of the present invention.

Detailed Description

The present disclosure is described herein with reference to particular non-limiting examples and to what are presently considered to be conceivable embodiments. A person skilled in the art will appreciate that the present disclosure is by no means limited to these examples and embodiments, and may be more broadly applied.

In the following, some example versions of the disclosure and embodiments are described with reference to the drawings. For illustrating the various embodiments, the examples and embodiments will be described in connection with a cellular communication network based on a 3GPP based communication system, for example, a 5G/NR system or the like. As such, the description of example embodiments given herein specifically refers to terminology which is directly related thereto. Such terminology is only used in the context of the presented non-limiting examples and embodiments, and does naturally not limit the present disclosure in any way. Rather, any other system configuration or deployment may equally be utilized as long as complying with what is described herein and/or example embodiments described herein are applicable to it. Further, it is to be noted that the various embodiments are not limited to an application using such types of communication systems or communication networks, but is also applicable in other types of communication systems or communication networks.

Certain aspects of the present invention are described in the following with respect to 5G RAN. Fig. 1 illustrates a 5G RAN overall architecture. As shown in Fig. 1, the NG-RAN consists of a set of gNBs connected to the 5g core network through the NG interface. Each gNB consists of a gNB-CU part and one or more gNB-DU parts and one gNB-DU can include one or more radio cells.

According to certain aspects of the present invention, it is defined how the source gNB ID/address can be coded to the I-RNTI and how the amount of needed Xn connections can be limited.

In the following, a short overview of certain aspects of the present invention is shown.

1. The RRC inactive state UE context identifier (I-RNTI) includes RAN Area ID part, gNB ID part and flexible UE ID part
2. The Operator configures RAN Area routing address table to every gNB. The table includes e.g. maximum 255 entries

3. Each gNB knows RAN Area and the flexible UE ID coding rules. Coding rules shall not be needed to be known by any other RAN Area. Hence, RRC inactive feature is possible to be implement per network vendor per RAN Area or even per gNB. Inside RAN Area, the gNBs knows the gNB based on the index value. Algorithm to map gNB index to actual gNB is done e.g. by an OAM mapping table
4. RAN Area address is the address of one gNB in the RAN Area.
5. The gNB is aware of the routing rules and can route the UE context request to correct gNB and back in the RAN Area

According to certain aspects of the present invention, as set out below, it is defined how the source gNB address can be coded into the I-RNTI and how the amount of needed Xn connections can be limited by still allowing huge amount of UE identifiers.

Fig. 4 shows an example according to certain aspects of the present invention how the I-RNTI can be coded to include all the needed routing info for the RRC inactive state UE. The I-RNTI shall consist of RAN Area ID part (that is already defined to 8 bits in 3GPP), gNB ID part and flexible UE ID part. RAN Area ID is the parameter that specify the one more gNBs as shown in Fig. 3. In case the RAN Area includes only one gNB, addressing is simple as the target cell can just read from its configuration the address of the gNB handling the RAN Area.

Fig. 5 is a signaling diagram illustrating a scenario for retrieving UE context with the flexible UE ID in the I-RNTI according to certain aspects of the present invention.

In case the RAN Area consists of many gNBs, the target gNB reads from its configuration the address for the RAN Area. The address can be the address of any gNB in the RAN Area. The target gNB triggers an UE context request to this address as shown in Fig. 5 (S51). When the gNB in the RAN Area receives the *retrieveUEcontextRequest* message, it knows that in this RAN Area, where the gNB belongs to, the flexible UE ID part actually includes also internal gNB ID index or address mapping info for the gNB in the RAN Area. The routing gNB then decodes

the address part of the gNB ID included in the flexible UE ID part (S52) together with the preconfigured address table in the target gNB and sends the UE context request to the source gNB in a *routedRetrieveUEcontextRequest* message (S53). Then, the routing gNB receives the UE context from the source gNB, i.e. *routedRetrieveUEcontextResponse* message (S54) and forwards a new message to the correct target gNB, i.e. *retrieveUEcontextResponse* message (S55). It is fully up to the RAN Area configuration how many bits are used for the UE identifier and how many bits are used for the gNB index.

Fig. 6 shows an example where the UE moves (arrow 61) from cell 3 in RAN Area 4 where the UE was set to RRC inactive state to cell 1 in RAN Area 2. As the cell 3 in RAN Area 4 is far away from the cell 1, there is not really a need to have Xn connection for handovers between these cells. It is enough that cell 1 in RAN Area 2 knows one address in the RAN Area 4. It is cell 4 in this case. The cell 1 sends the UE context request to RAN Area 4/cell 4 (arrow 62). The cell 4 in the RAN Area 4 routes the message to the final destination (source gNB holding the UE context info), which is cell 3 in this case (arrow 63). The cell 3 performs then the actions defined for the source cell in 3GPP TS 38.300 and TS 38.423 and responds the UE context info back to target cell (cell 1) via routing cell (cell 4). This way cell 1/RAN Area 2 does not need to have an Xn connection for the RAN Area 4/cell 3. Further, the routing table size can be kept small as in addition to normal handover Xn only a limited amount of Xn connection points is needed to be defined from neighboring RAN Areas for RRC inactive state mobility. This kind of routing solution also makes that already defined number of bits for I-RNTI is enough.

According to certain aspects of the present invention, the RAN Area ID part in the I-RNTI can be any other identifier that identifies the routing NG-RAN node. RAN Area ID here is just used as an example and one possible implementation alternative is RRC inactive area related identifier, as already specified.

According to certain aspects of the present invention, the final destination shall also be able to route the message directly to the correct target NG-RAN node. This means that the response message does not have to use only the same route where it got the request from. If possible, it can directly respond back to the original

source without the routing gNB. In some cases, the final target may know the original source so in that case it can respond for it directly.

According to certain aspects of the present invention, the gNB index can be extended outside of the RAN Area e.g. for the case where gNB have multiple Xn interfaces for the gNBs in the RAN Area.

Fig. 12 is a signaling diagram illustrating an overall scenario for retrieving UE context with the flexible UE ID in the I-RNTI according to certain aspects of the present invention.

In S121, the network sets the UE to RRC inactive. For example, the source gNB sends a RRC Release message including the coded I-RNTI to the UE and then the UE goes to RRC inactive.

In S122, the UE sends a ResumeRequest message (e.g. due to RAN Area update, due to UL data or response to paging including the coded I-RNTI) to the target gNB, and in S123, the target gNB checks the RAN Area ID part and delivers the UE context request to the routing gNB.

In S124, the routing gNB checks the flexible UE ID part. The routing gNB is aware of the coding rules in the RAN Area and clarifies the final destination address with flexible UE ID bits and with the preconfigured address mapping data.

Then in S125, the source gNB fetches the UE context data, verifies the user with integrity check and responds to the request. That is, the response is sent to the routing gNB and then forwarded to the target gNB in S126. Then, the UE receives the Resume message in S127 and responds with a ResumeComplete message in S128.

According to certain aspects of the present invention, the same routing invention is used for path switching and ran paging.

Fig. 13 is a signaling diagram illustrating a scenario relating to path switching according to certain aspects of the present invention.

In S131, the network sets the UE to RRC inactive. For example, the source gNB sends a RRC Release message including the coded I-RNTI to the UE and then the UE goes to RRC inactive.

In S132, the UE sends a ResumeRequest message (e.g. due to RAN Area update, due to UL data or response to paging) including the coded I-RNTI to the target gNB, and in S133, the target gNB checks the RAN Area ID part and delivers the UE context request to the routing gNB.

In S134, the routing gNB checks the flexible UE ID part. The routing gNB is aware of the coding rules in the RAN Area and clarifies the final destination address with flexible UE ID bits and with the preconfigured address mapping data.

In S135, the source gNB fetches the UE context data, verifies the user with integrity check and responds to the request.

Then, in S136, the target gNB receives UE context data and starts data forwarding procedure by sending data Forwarding Address indication to routing gNB with the I-RNTI. The gNB-routing identifies from the I-RNTI that this is a routing request, it establishes a tunnel for the data and clarifies the final destination address in a similar way as described in S134.

Then, steps S137 and S138 are similar to steps S127 and S128 in Fig. 12.

Fig. 14 is a block diagram illustrating an example of a network configuration relating to RAN paging according to certain aspects of the present invention.

In Fig. 14, there is a RAN area 1 141 including a RAN area 1 routing gNB 142 and a source gNB 143, and a RAN area 2 144 including a RAN area 2 routing gNB 145, a target gNB 146 and another target gNB 147 as well as a user equipment 148.

As derivable from Fig. 14, the source gNB 143 sends a paging message to the RAN area 2 routing gNB 145, which forwards the paging message to all gNB in the RAN area 2 144, i.e. the target gNB 146 and the other target gNB 147. The target gNB forwards the paging message to the User equipment 148 and receives a resume request message from the user equipment 148. Then, the target gNB 146 sends a context request message to the RAN area 1 routing gNB 142, in a similar manner as described above.

Fig. 15 is a signaling diagram illustrating a scenario relating to RAN paging according to certain aspects of the present invention.

In S151, the network sets the UE to RRC inactive. For example, the source gNB sends a RRC Release message including the coded I-RNTI to the UE and then the UE goes to RRC inactive.

Then, the source gNB receives DL data and starts the paging procedure (S152). That is, the source gNB sends the paging request including the I-RNTI to all RAN Area routing gNBs in S153.

Further, in S154, the routing gNBs delivers the paging message including the I-RNTI to all gNBs in the RAN Area and the target gNB sends the paging message including the I-RNTI to the UE in S155. Then, in S156, the UE sends a ResumeRequest message to the target gNB in a similar manner as in s132, described above. Then, also the further processing in step S157 to 162 is similar to the processing in step S133 to S138, as described with respect to Fig. 13.

In this regard, it is noted that the source gNB knows all RAN areas it needs to use for paging, but it does not know where the UE is. So the paging message includes the ID of the first RAN area, but the message is sent to the second RAN area having the second area ID (and possible to many other areas as well). Once the UE responds, the gNB is able to route the response message back to gNB routing. In the response, the routing gNB is different from the routing gNB using during paging, as derivable from Fig. 15.

As drivable from Fig. 15, all of the three procedures, i.e. paging, resume request leading to context request and path switching are independent functions that may happen in the network independently or sequentially.

In the following, a more general description of example versions of the present invention is made with respect to Figs. 7 to 11 and 16 to 19.

Fig. 7 is a flowchart illustrating an example of a method according to some example versions of the present invention.

According to example versions of the present invention, the method may be implemented in or may be part of a node in a network, like a gNB, and in particular, a routing gNB, or the like. The method for use in, e.g., a routing base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprises receiving (S71), at the routing base station, a user context request message for user equipment, UE, information from the target base station located in the second notification area, the user context request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID, decoding (S72), at the routing base station, the received information element and retrieving routing information regarding the source base station from the UE ID included in the information element, sending (S73) the user context request message to the source base station using the retrieved routing information, receiving (S74) a user context response message including UE information from the source base station, and forwarding (S75) the received response message to the target base station.

Fig. 8 is a flowchart illustrating an example of a method according to some example versions of the present invention.

According to example versions of the present invention, the method may be implemented in or may be part of a node in a network, like a gNB, and in particular, a target gNB, or the like. The method for use in, e.g., a target base station located

in a second notification area in a movement of a user equipment from a source base station located in a first notification area to the target base station, comprises receiving (S81), at the target base station, a resume request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID, sending (S82) a user context request message to a routing base station in the first notification area based on the first notification area ID, and receiving (S83), at the target base station, a user context response message including UE information about the user equipment from the routing base station, the UE information originating from the source base station.

Fig. 16 is a flowchart illustrating an example of a method according to some example versions of the present invention.

According to example versions of the present invention, the method may be implemented in or may be part of a node in a network, like a gNB, and in particular, a source gNB used in a paging process, or the like. The method for use in, e.g., a source base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprises receiving (S171), at the source base station, downlink data, composing (S172) a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID, and sending (S173) the paging message to a routing base station in the second notification area based on the second notification area ID.

Fig. 17 is a flowchart illustrating an example of a method according to some example versions of the present invention.

According to example versions of the present invention, the method may be implemented in or may be part of a node in a network, like a gNB, and in particular, a routing gNB used in a paging process, or the like. The method for use in, e.g., a routing base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to a target

base station located in the second notification area, comprises receiving (S181) a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID, and sending (S182), by the routing base station in the second notification, the paging message to all target base stations in the second notification area based on a second notification area ID.

According to example versions of the above-described method(s) of the present invention, the UE ID includes an UE ID part and base station routing ID part of the source base station.

According to example versions of the above-described method(s) of the present invention, each base station stores beforehand a notification area address table and coding rules for coding the UE ID and the notification area ID and information for mapping the base station routing ID to a global base station ID.

According to example versions of the above-described method(s) of the present invention, the notification area ID indicates an address of one arbitrary base station within this notification area.

According to example versions of the above-described method(s) of the present invention, the notification area ID is a radio area network, RAN, notification area identifier, a radio resource control, RRC, inactive area related identifier or any other identifier that identifies a routing node for routing the UE context request.

Fig. 9 is a block diagram illustrating an example of an apparatus according to some example versions of the present invention.

In Fig. 9, a block circuit diagram illustrating a configuration of an apparatus 90 is shown, which is configured to implement the above described various aspects of the invention. It is to be noted that the apparatus 90 shown in Fig. 9 may comprise several further elements or functions besides those described herein below, which are omitted herein for the sake of simplicity as they are not essential for understanding the invention. Furthermore, the apparatus may be also another

device having a similar function, such as a chipset, a chip, a module etc., which can also be part of an apparatus or attached as a separate element to the apparatus, or the like.

The apparatus 90 may comprise a processing function or processor 91, such as a CPU or the like, which executes instructions given by programs or the like. The processor 91 may comprise one or more processing portions dedicated to specific processing as described below, or the processing may be run in a single processor. Portions for executing such specific processing may be also provided as discrete elements or within one or further processors or processing portions, such as in one physical processor like a CPU or in several physical entities, for example. Reference sign 92 denotes transceiver or input/output (I/O) units (interfaces) connected to the processor 91. The I/O units 92 may be used for communicating with one or more other network elements, entities, terminals or the like. The I/O units 92 may be a combined unit comprising communication equipment towards several network elements, or may comprise a distributed structure with a plurality of different interfaces for different network elements. The apparatus 90 further comprises at least one memory 93 usable, for example, for storing data and programs to be executed by the processor 91 and/or as a working storage of the processor 91.

The processor 91 is configured to execute processing related to the above-described aspects, in particular as set out with respect to Figs 7, 8, 16 and 17.

In particular, the apparatus 90 may be implemented in or may be part of a routing base station, e.g. gNB, or the like, and may be configured to perform processing as described in connection with Fig. 7.

Further, the apparatus 90 may be implemented in or may be part of a target base station, e.g. gNB, or the like, and may be configured to perform processing as described in connection with Fig. 8.

In particular, the apparatus 90 may be implemented in or may be part of a source base station, e.g. gNB, or the like, and may be configured to perform processing as described in connection with Fig. 16.

Further, the apparatus 90 may be implemented in or may be part of a routing base station, e.g. gNB, or the like, and may be configured to perform processing as described in connection with Fig. 17.

Further, the present invention may be implemented by an apparatus comprising means for performing the above-described processing.

Fig. 10 shows an apparatus 100 according to an example embodiment of the invention. The apparatus 100 may be a control unit which may be implemented in routing base station (e.g. gNB) or an element thereof.

The apparatus 100 according to Fig. 10 may perform the method of Fig. 7 but is not limited to this method. The method of Fig. 7 may be performed by the apparatus of Fig. 10 but is not limited to being performed by this apparatus.

The apparatus 100 comprises means for receiving (110), at the routing base station, a user context request message for user equipment, UE, information from the target base station located in the second notification area, the user context request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID, means for decoding (120), at the routing base station, the received information element and retrieving routing information regarding the source base station from the UE ID included in the information element, means for sending (130) the user context request message to the source base station using the retrieved routing information, means for receiving (140) a user context response message including UE information from the source base station, and means for forwarding (150) the received response message to the target base station.

Fig. 11 shows an apparatus 200 according to an example embodiment of the invention. The apparatus 200 may be a control unit which may be implemented in target base station (e.g. gNB) or an element thereof.

The apparatus 200 according to Fig. 11 may perform the method of Fig. 8 but is not limited to this method. The method of Fig. 8 may be performed by the apparatus of Fig. 11 but is not limited to being performed by this apparatus.

The apparatus 200 comprises means for receiving (210), at the target base station, a resume request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID, means for sending (220) a user context request message to a routing base station in the first notification area based on the first notification area ID, and means for receiving (230), at the target base station, a user context response message including UE information about the user equipment from the routing base station, the UE information originating from the source base station.

Fig. 18 shows an apparatus 300 according to an example embodiment of the invention. The apparatus 300 may be a control unit which may be implemented in source base station (e.g. gNB) or an element thereof.

The apparatus 300 according to Fig. 18 may perform the method of Fig. 16 but is not limited to this method. The method of Fig. 16 may be performed by the apparatus of Fig. 18 but is not limited to being performed by this apparatus.

The apparatus 300 comprises means for receiving (310), at the source base station, downlink data, means for composing (320) a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID, and means for sending (330) the paging message to a routing base station in the second notification area based on the second notification area ID.

Fig. 19 shows an apparatus 400 according to an example embodiment of the invention. The apparatus 400 may be a control unit which may be implemented in routing base station (e.g. gNB) or an element thereof.

The apparatus 400 according to Fig. 19 may perform the method of Fig. 17 but is not limited to this method. The method of Fig. 17 may be performed by the apparatus of Fig. 19 but is not limited to being performed by this apparatus.

The apparatus 400 comprises means receiving (410) a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID, and means for sending (420), by the routing base station in the second notification, the paging message to all target base stations in the second notification area based on a second notification area ID.

For further details regarding the functions of the apparatus(es), reference is made to the description of the method(s) according to some example versions of the present invention as described in connection with Figs. 7, 8, 16 and 17.

In the foregoing exemplary description of the apparatus, only the units/means that are relevant for understanding the principles of the invention have been described using functional blocks. The apparatus may comprise further units/means that are necessary for its respective operation, respectively. However, a description of these units/means is omitted in this specification. The arrangement of the functional blocks of the apparatus is not to be construed to limit the invention, and the functions may be performed by one block or further split into sub-blocks.

When in the foregoing description it is stated that the apparatus (or some other means) is configured to perform some function, this is to be construed to be equivalent to a description stating that a (i.e. at least one) processor or corresponding circuitry, potentially in cooperation with computer program code stored in the memory of the respective apparatus, is configured to cause the apparatus to perform at least the thus mentioned function. Also, such function is to be construed to be equivalently implementable by specifically configured circuitry or means for performing the respective function (i.e. the expression "unit configured to" is to be construed to be equivalent to an expression such as "means for").

For the purpose of the present invention as described herein above, it should be noted that

- method steps likely to be implemented as software code portions and being run using a processor at an apparatus (as examples of devices, apparatuses and/or modules thereof, or as examples of entities including apparatuses and/or modules therefore), are software code independent and can be specified using any known or future developed programming language as long as the functionality defined by the method steps is preserved;
- generally, any method step is suitable to be implemented as software or by hardware without changing the idea of the aspects/embodiments and its modification in terms of the functionality implemented;
 - method steps and/or devices, units or means likely to be implemented as hardware components at the above-defined apparatuses, or any module(s) thereof, (e.g., devices carrying out the functions of the apparatuses according to the aspects/embodiments as described above) are hardware independent and can be implemented using any known or future developed hardware technology or any hybrids of these, such as MOS (Metal Oxide Semiconductor), CMOS (Complementary MOS), BiMOS (Bipolar MOS), BiCMOS (Bipolar CMOS), ECL (Emitter Coupled Logic), TTL (Transistor-Transistor Logic), etc., using for example ASIC (Application Specific IC (Integrated Circuit)) components, FPGA (Field-programmable Gate Arrays) components, CPLD (Complex Programmable Logic Device) components, APU (Accelerated Processor Unit), GPU (Graphics Processor Unit) or DSP (Digital Signal Processor) components;
 - devices, units or means (e.g. the above-defined apparatuses, or any one of their respective units/means) can be implemented as individual devices, units or means, but this does not exclude that they are implemented in a distributed fashion throughout the system, as long as the functionality of the device, unit or means is preserved;
- an apparatus may be represented by a semiconductor chip, a chipset, or a (hardware) module comprising such chip or chipset; this, however, does not exclude the possibility that a functionality of an apparatus or module, instead of being hardware implemented, be implemented as software in a (software) module such as a computer program or a computer program product comprising executable software code portions for execution/being run on a processor;

- a device may be regarded as an apparatus or as an assembly of more than one apparatus, whether functionally in cooperation with each other or functionally independently of each other but in a same device housing, for example.

In general, it is to be noted that respective functional blocks or elements according to above-described aspects can be implemented by any known means, either in hardware and/or software, respectively, if it is only adapted to perform the described functions of the respective parts. The mentioned method steps can be realized in individual functional blocks or by individual devices, or one or more of the method steps can be realized in a single functional block or by a single device.

Generally, any method step is suitable to be implemented as software or by hardware without changing the idea of the present invention. Devices and means can be implemented as individual devices, but this does not exclude that they are implemented in a distributed fashion throughout the system, as long as the functionality of the device is preserved. Such and similar principles are to be considered as known to a skilled person.

Software in the sense of the present description comprises software code as such comprising code means or portions or a computer program or a computer program product for performing the respective functions, as well as software (or a computer program or a computer program product) embodied on a tangible medium such as a computer-readable (storage) medium having stored thereon a respective data structure or code means/portions or embodied in a signal or in a chip, potentially during processing thereof.

It is to be noted that the aspects/embodiments and general and specific examples described above are provided for illustrative purposes only and are in no way intended that the present invention is restricted thereto. Rather, it is the intention that all variations and modifications which fall within the scope of the appended claims are covered.

CLAIMS

1. A method for use in a routing base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

receiving, at the routing base station, a user context request message for user equipment, UE, information from the target base station located in the second notification area, the user context request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

decoding, at the routing base station, the received information element and retrieving routing information regarding the source base station from the UE ID included in the information element,

sending the user context request message to the source base station using the retrieved routing information,

receiving a user context response message including UE information from the source base station, and

forwarding the received response message to the target base station.

2. A method for use in a target base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to the target base station, comprising:

receiving, at the target base station, a resume request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

sending a user context request message to a routing base station in the first notification area based on the first notification area ID,

receiving, at the target base station, a user context response message including UE information about the user equipment from the routing base station, the UE information originating from the source base station.

3. A method for use in a source base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

- receiving, at the source base station, downlink data,
- composing a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,
- sending the paging message to a routing base station in the second notification area based on the second notification area ID.

4. A method for use in a routing base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to a target base station located in the second notification area, comprising:

- receiving a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,
- sending, by the routing base station in the second notification, the paging message to all target base stations in the second notification area based on a second notification area ID.

5. The method according to any one of claim 1 to 4, wherein

- the UE ID includes an UE ID part and base station routing ID part of the source base station.

6. The method according to any one of claims 1 to 5, wherein

- each base station stores beforehand a notification area address table and coding rules for coding the UE ID and the notification area ID and information for mapping the base station routing ID to a global base station ID.

7. The method according to any one of claims 1 to 6, wherein

- the notification area ID indicates an address of one arbitrary base station within this notification area.

8. The method according to any one of claims 1 to 7, wherein

the notification area ID is a radio area network, RAN, notification area identifier, a radio resource control, RRC, inactive area related identifier or any other identifier that identifies a routing node for routing the UE context request.

9. An apparatus for use in a routing base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

at least one processor, and

at least one memory for storing instructions to be executed by the processor, wherein

the at least one memory and the instructions are configured to, with the at least one processor, cause the apparatus at least to perform:

receiving, at the routing base station, a user context request message for user equipment, UE, information from the target base station located in the second notification area, the user context request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

decoding, at the routing base station, the received information element and retrieving routing information regarding the source base station from the UE ID included in the information element,

sending the user context request message to the source base station using the retrieved routing information,

receiving a user context response message including UE information from the source base station, and

forwarding the received response message to the target base station.

10. An apparatus for use in a target base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to the target base station, comprising

at least one processor, and

at least one memory for storing instructions to be executed by the processor, wherein

the at least one memory and the instructions are configured to, with the at least one processor, cause the apparatus at least to perform:

receiving, at the target base station, a resume request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

sending a user context request message to a routing base station in the first notification area based on the first notification area ID,

receiving, at the target base station, a user context response message including UE information about the user equipment from the routing base station, the UE information originating from the source base station.

11. An apparatus for use in a source base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

at least one processor, and

at least one memory for storing instructions to be executed by the processor, wherein

the at least one memory and the instructions are configured to, with the at least one processor, cause the apparatus at least to perform:

receiving, at the source base station, downlink data,

composing a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

sending the paging message to a routing base station in the second notification area based on the second notification area ID.

12. An apparatus for use in a routing base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to a target base station located in the second notification area, comprising:

at least one processor, and

at least one memory for storing instructions to be executed by the processor, wherein

the at least one memory and the instructions are configured to, with the at least one processor, cause the apparatus at least to perform:

receiving a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

sending, by the routing base station in the second notification, the paging message to all target base stations in the second notification area based on a second notification area ID.

13. The apparatus according to any one of claim 9 to 12, wherein

the UE ID includes an UE ID part and base station routing ID part of the source base station.

14. The apparatus according to any one of claims 9 to 13, wherein

each base station stores beforehand a notification area address table and coding rules for coding the UE ID and the notification area ID and information for mapping the base station routing ID to a global base station ID.

15. The apparatus according to any one of claims 9 to 14, wherein

the notification area ID indicates an address of one arbitrary base station within this notification area.

16. The apparatus according to any one of claims 9 to 15, wherein

the notification area ID is a radio area network, RAN, notification area identifier, a radio resource control, RRC, inactive area related identifier or any other identifier that identifies a routing node for routing the UE context request.

17. An apparatus for use in a routing base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

means for receiving, at the routing base station, a user context request message for user equipment, UE, information from the target base station located in the second notification area, the user context request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

means for decoding, at the routing base station, the received information element and retrieving routing information regarding the source base station from the UE ID included in the information element,

means for sending the user context request message to the source base station using the retrieved routing information,

means for receiving a user context response message including UE information from the source base station, and

means for forwarding the received response message to the target base station.

18. An apparatus for use in a target base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to the target base station, comprising:

means for receiving, at the target base station, a resume request message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

means for sending a user context request message to a routing base station in the first notification area based on the first notification area ID,

means for receiving, at the target base station, a user context response message including UE information about the user equipment from the routing base station, the UE information originating from the source base station.

19. An apparatus for use in a source base station located in a first notification area in a movement of a user equipment from a source base station located in the first notification area to a target base station located in a second notification area, comprising:

means for receiving, at the source base station, downlink data,

means for composing a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

means for sending the paging message to a routing base station in the second notification area based on the second notification area ID.

20. An apparatus for use in a routing base station located in a second notification area in a movement of a user equipment from a source base station located in a first notification area to a target base station located in the second notification area, comprising:

means for receiving a paging message including an information element, IE, including an identifier of the user equipment, UE ID, and an identifier of the first notification area, first notification area ID,

means for sending, by the routing base station in the second notification, the paging message to all target base stations in the second notification area based on a second notification area ID.

21. A computer program product comprising a set of instructions which, when executed on an apparatus, is configured to cause the apparatus to carry out the method according to any of claims 1 to 8.

22. The computer program product according to claim 21, embodied as a computer-readable medium or directly loadable into a computer.

Fig. 1

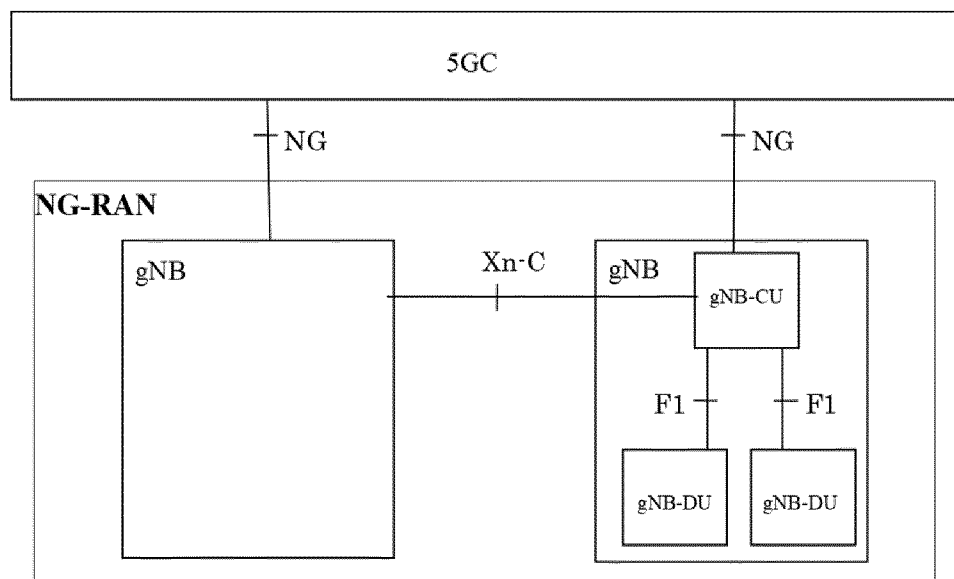


Fig. 2

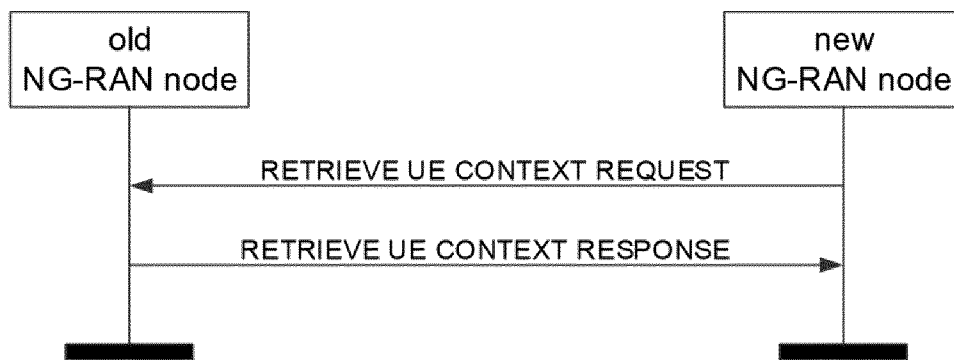


Fig. 3

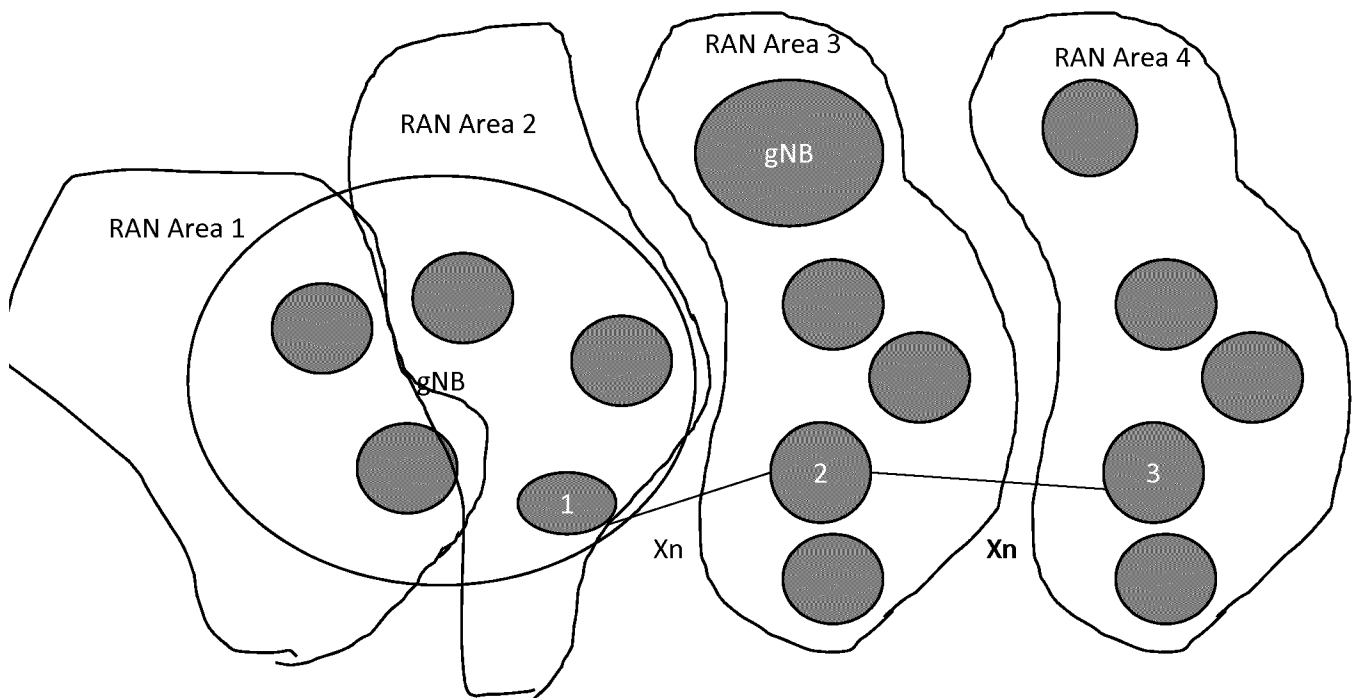


Fig. 4

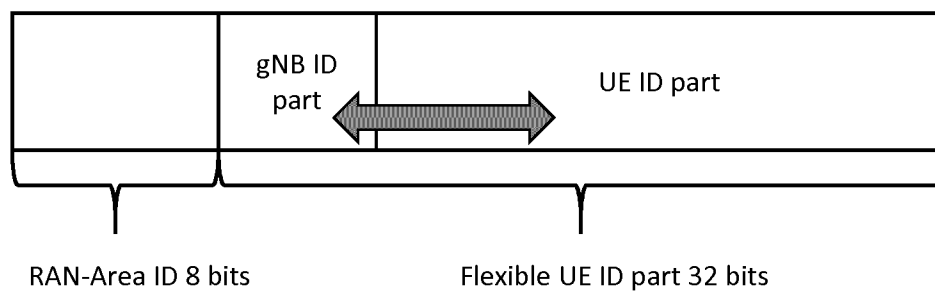


Fig. 5

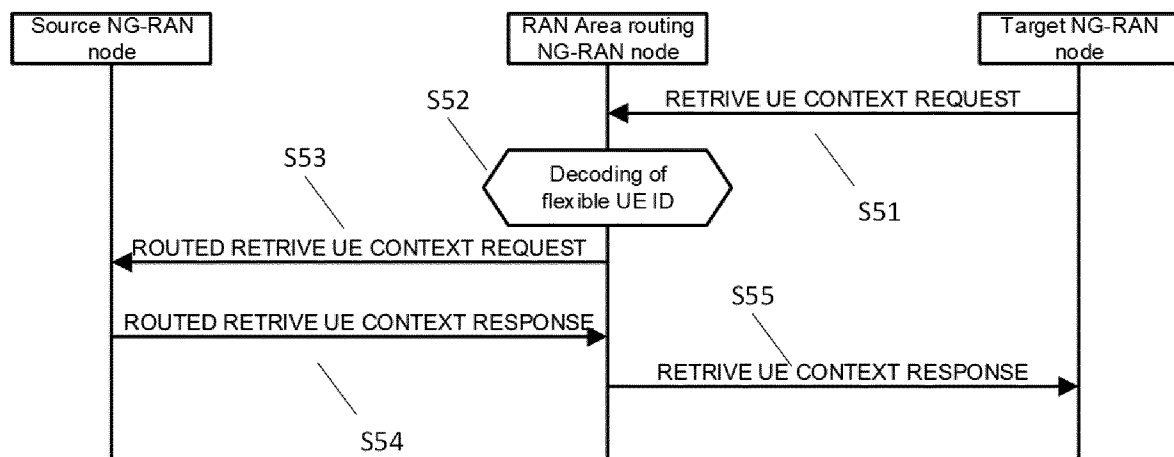


Fig. 7

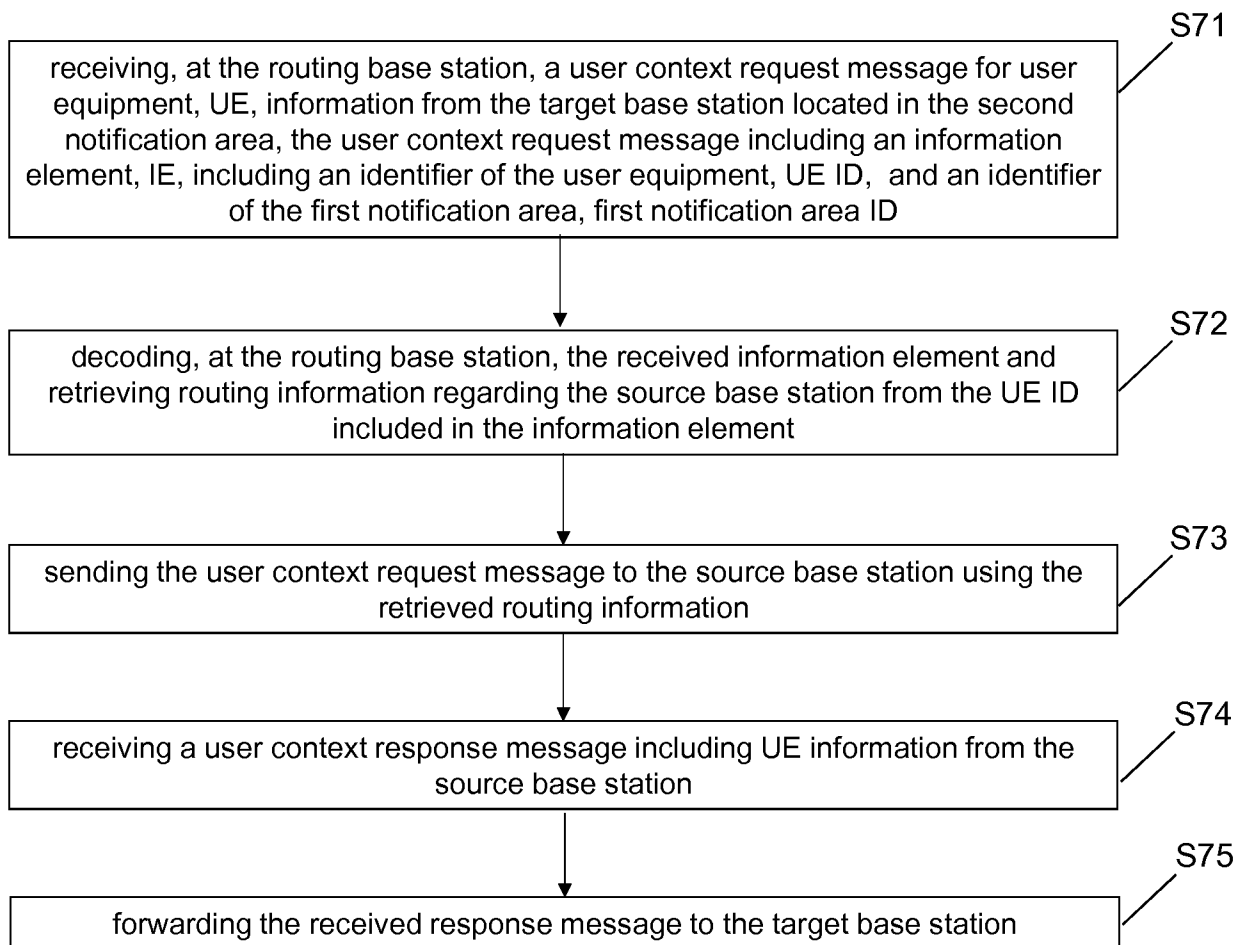


Fig. 8

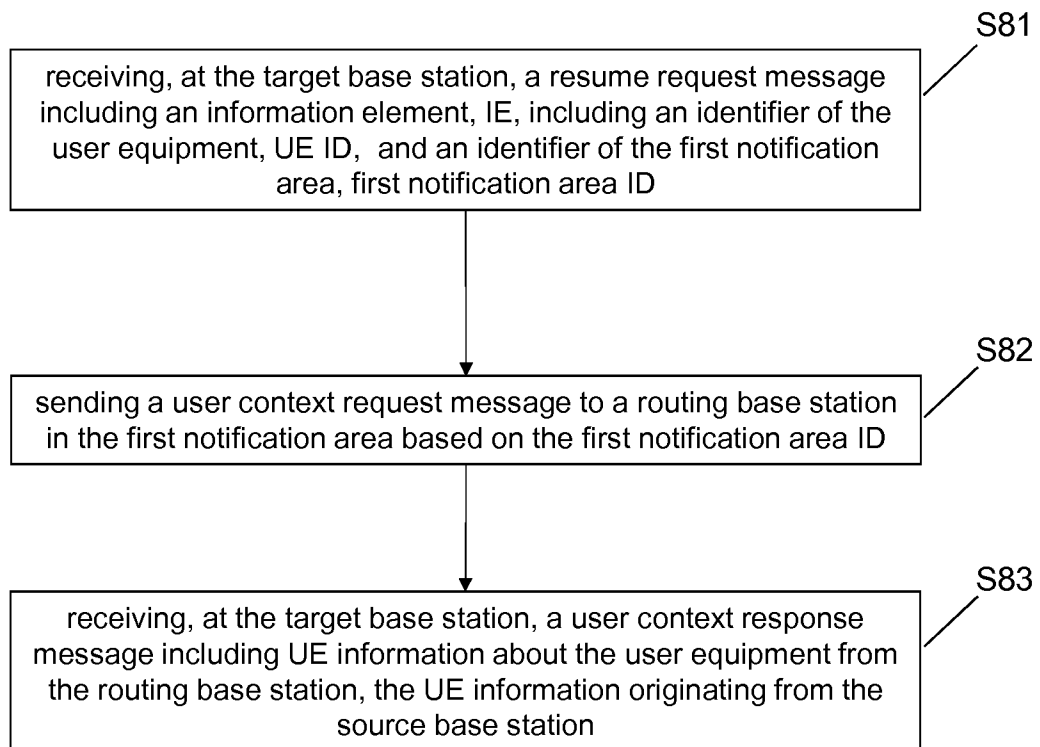


Fig. 9

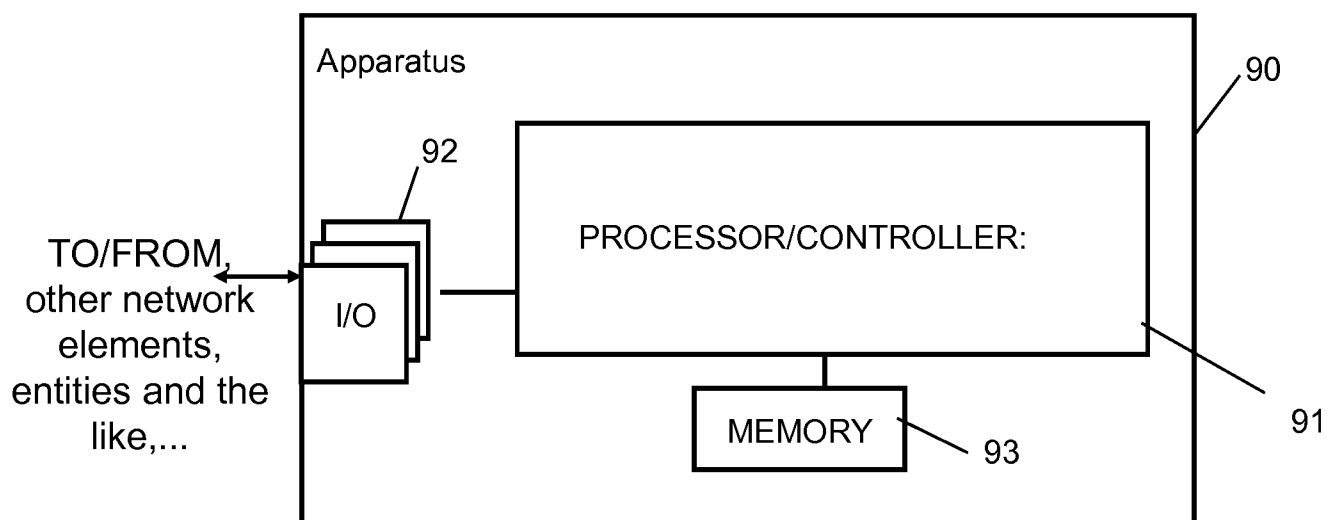


Fig. 10

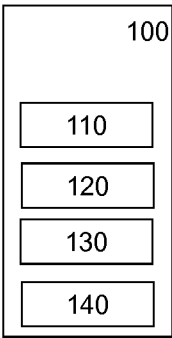


Fig. 11

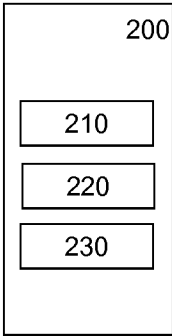


Fig. 12

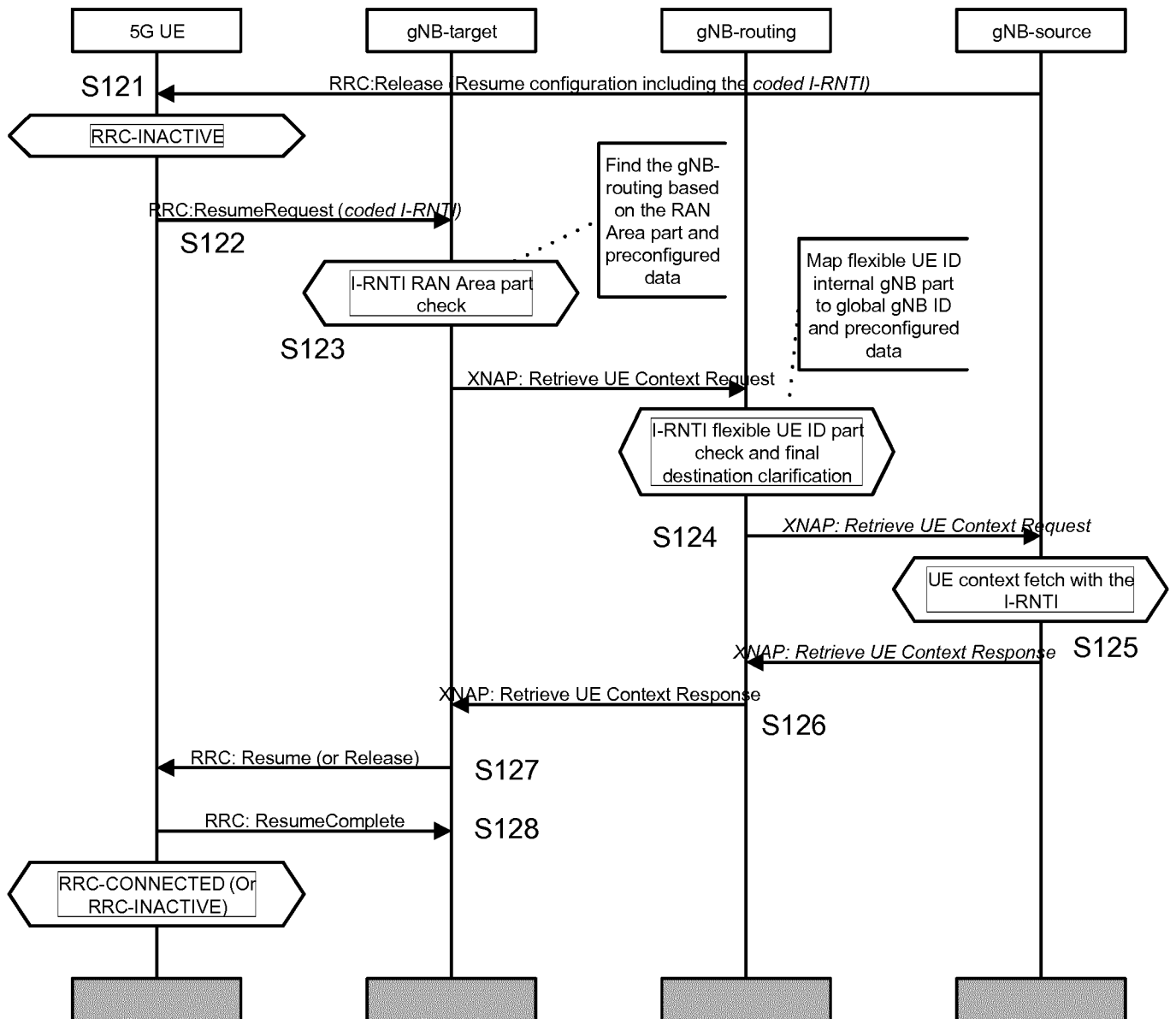


Fig. 13

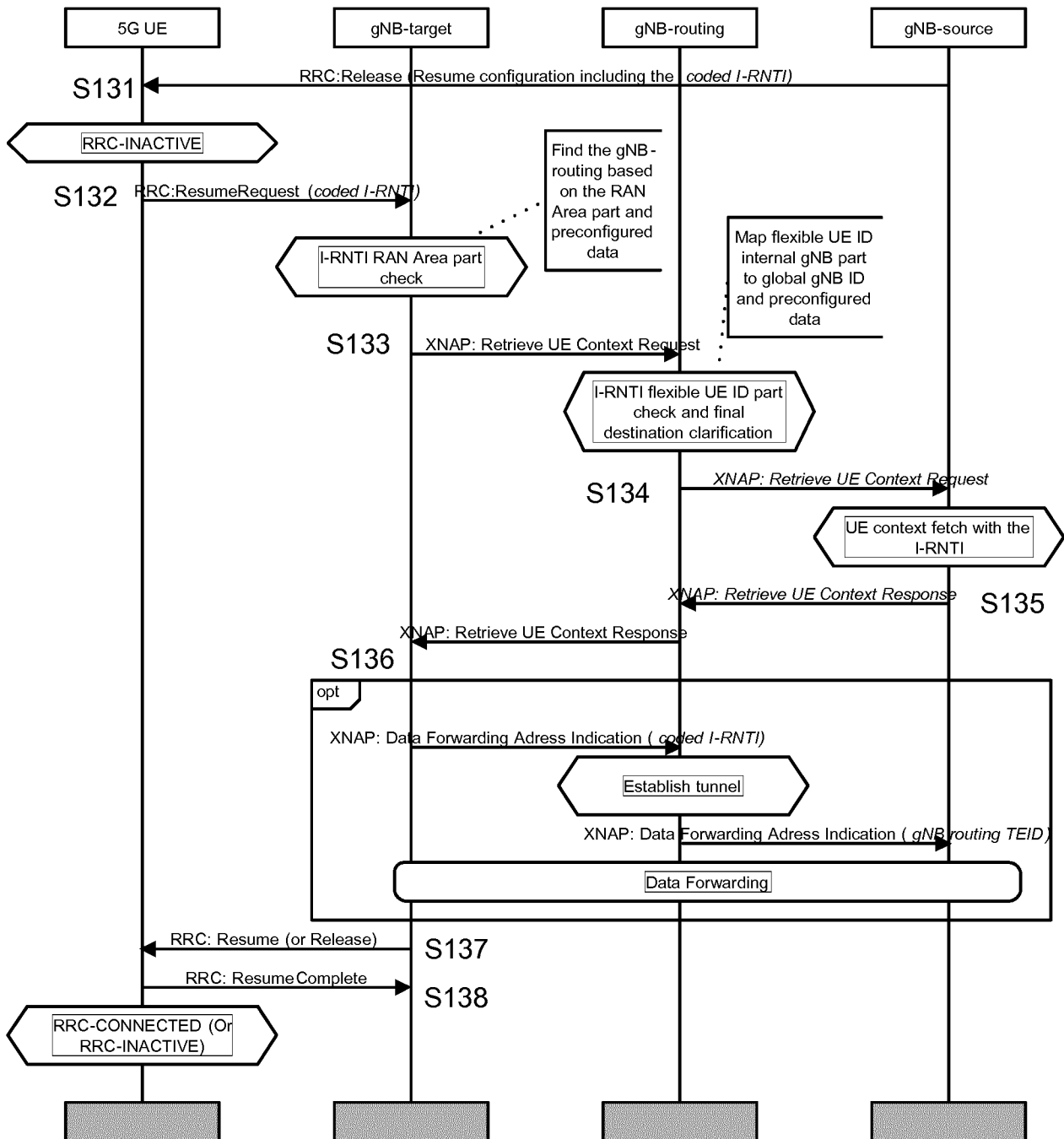


Fig. 14

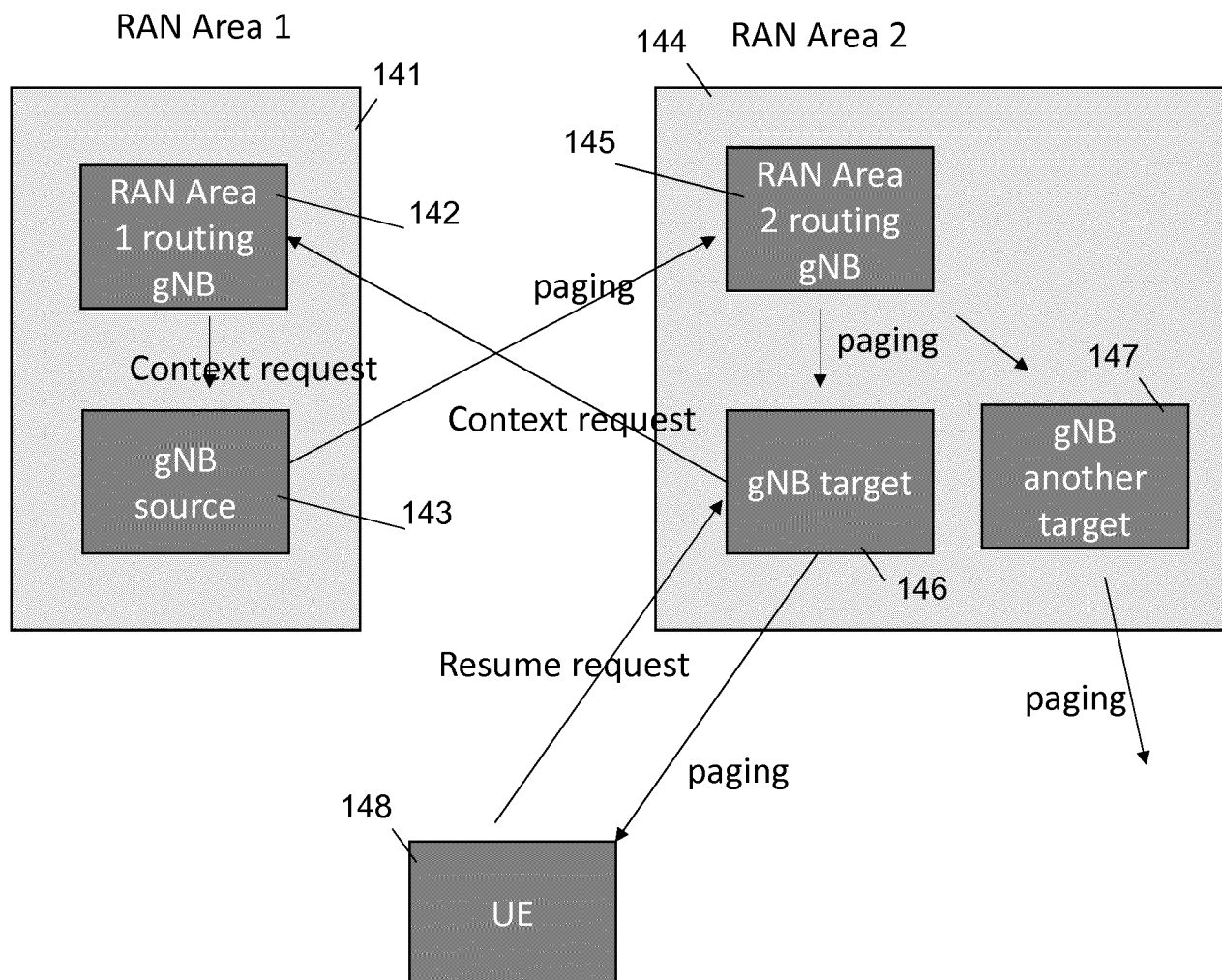


Fig. 16

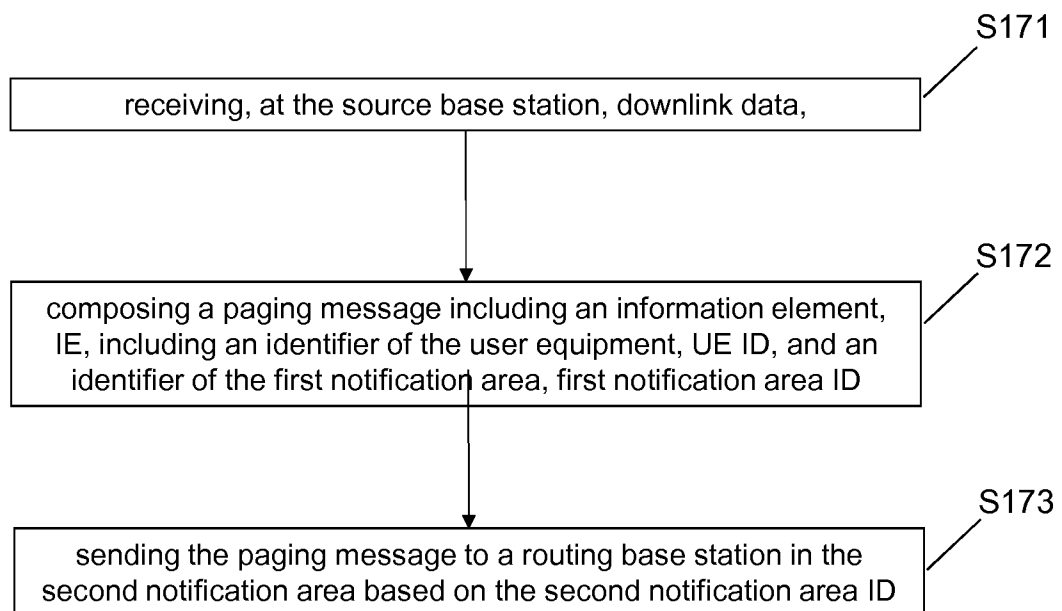


Fig. 17

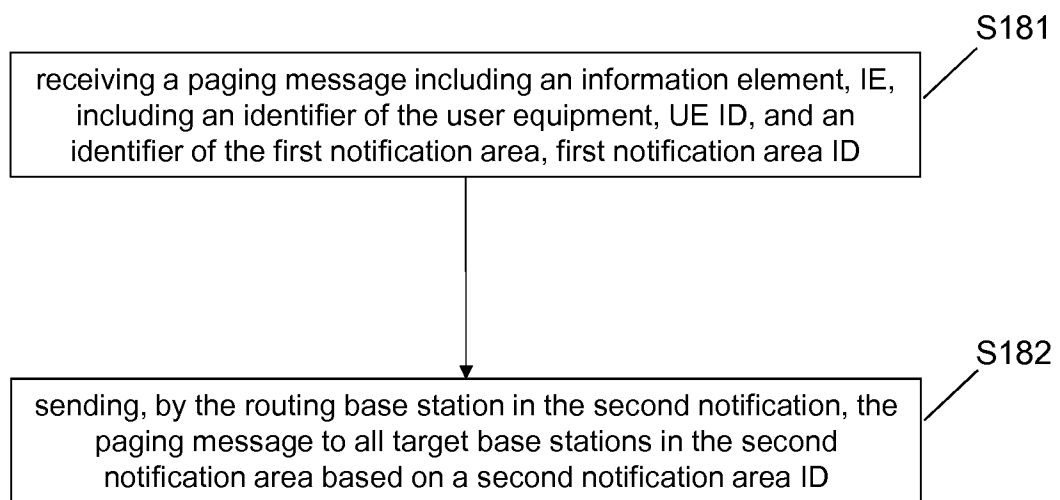


Fig. 18

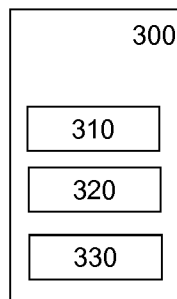
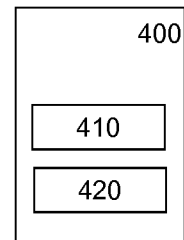


Fig. 19



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/077758

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W76/27
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	NOKIA ET AL: "UE Context Retrieval when UE moves out of RNA", 3GPP DRAFT; R3-182616_RELAYXN38300, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE vol. RAN WG3, no. Busan, Korea; 20180521 - 20180525 20 May 2018 (2018-05-20), XP051445120, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings%5F3GPP P%5FSYNC/RAN3/Docs/ [retrieved on 2018-05-20] pages 3,6	1,2, 5-10, 13-18, 21,22
A	----- -/--	3,4,11, 12,19,20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

28 November 2018

Date of mailing of the international search report

05/12/2018

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Authorized officer

Allot, Corentin

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/077758

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	NOKIA ET AL: "Use case for NG Context Fetch and NG Paging Relay?", 3GPP DRAFT; R3-180501 USECASES, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG3, no. Sophia Antipolis, France; 20180122 - 20180126 12 January 2018 (2018-01-12), XP051387482, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg%5Fran/WG3%5FIu/TSGR3%5FAHGs/R3%2DAH%2D1801/Docs/[retrieved on 2018-01-12]	3,4,11, 12,19,20
A	page 4	1,2, 5-10, 13-18, 21,22
A	----- US 2018/270895 A1 (PARK KYUNGMIN [US] ET AL) 20 September 2018 (2018-09-20) paragraphs [0320] - [0374]; figures 16-17 -----	1-22
A	HUAWEI: "I-RNTI encoding and length reduction", 3GPP DRAFT; R3-182915, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG3, no. Busan, Korea; 20180521 - 20180525 20 May 2018 (2018-05-20), XP051445413, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings%5F3GP P%5FSYNC/RAN3/Docs/[retrieved on 2018-05-20] pages 1-3 ----- -/--	1-22

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/077758

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	MTI: "UE-initiated RAN-based Notification Area Update Procedure", 3GPP DRAFT; R2- 1707864 RAN-BASED NOTIFICATION AREA UPDATE PROCEDURE, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; F , vol. RAN WG2, no. Berlin, Germany; 20170821 - 20170825 20 August 2017 (2017-08-20), XP051317561, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2017-08-20] page 3 -----	1-22
A	EP 3 379 870 A1 (PANASONIC IP CORP AMERICA [US]) 26 September 2018 (2018-09-26) paragraphs [0077] - [0095] -----	1-22

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/077758

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2018270895 A1	20-09-2018	US 2018270895 A1	20-09-2018
		WO 2018170516 A2	20-09-2018

EP 3379870 A1	26-09-2018	EP 3379870 A1	26-09-2018
		WO 2018172013 A1	27-09-2018
