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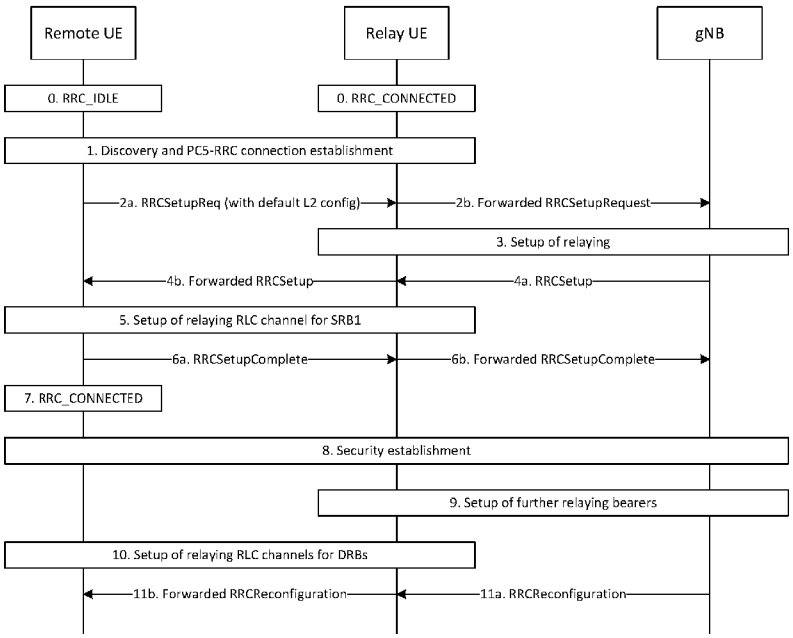

Figure 1

(57) **Abstract:** In an aspect of the disclosure, a method is provided. The method of connection establishment operable in a remote UE. The remote UE operates in an idle state of a protocol (RRC_IDLE). The remote UE performs a discovery procedure. The remote UE selects a relay UE. The remote UE sends a setup request message for a network node [RRCSetupRequest] to the relay UE. The remote UE receives a first configuration message comprising a configuration for a first RLC channel [for SRB1 from the relay UE. In response to the first configuration message, the remote UE sends a first completion message [RRCReconfigurationCompleteSidelink] to the relay UE. The remote UE receives a setup message from the network node [RRCSetup] from the relay UE. The remote UE sends a setup completion message for the network node [RRCSetupComplete] to the relay UE. The remote UE enters a connected state of the protocol [RRC_CONNECTED]. The remote UE establishes security with the network node [SecurityModeCommand/SecurityMod

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eComplete legacy procedure]. The remote UE receives a second configuration message comprising configuration information for one or more RLC channels [RRCReconfigurationSidelink for DRBs] from the relay UE. In response to the second configuration message, the remote UE sends a second completion message [RRCReconfigurationCompleteSidelink] to the relay UE. The remote UE receives a third configuration message from the network node, comprising configuration information for one or more radio bearers [RRCReconfiguration] from the relay UE. In response to the third configuration message, the remote UE sends a third completion message for the network node [RRCReconfigurationComplete] to the relay UE.

CONNECTION ESTABLISHMENT FOR A LAYER 2 UE-TO-NETWORK RELAY

TECHNICAL FIELD

[0001]This disclosure describes a connection establishment procedure suitable for a layer 2 UE-to-network relay architecture using the NR sidelink for communication between a remote UE and a relay UE.

BACKGROUND

[0002]The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

[0003] The concept of a sidelink relay between user equipments (UEs) is introduced in 3GPP Rel-17, in response to a number of perceived needs including network coverage extension, support of wearable devices paired with a user's phone, and internet of things (IoT) relaying scenarios. The relaying concept uses a so-called "relay UE" interposed between the network and a "remote UE", which may be in poor network coverage or out of coverage entirely. The relay UE operates to relay communications between the remote UE and the network, thus allowing the network to effectively extend its coverage to the remote UE.

[0004] The architecture may perform relaying at either layer 2—for instance, with relaying located between a radio link control (RLC) layer and a packet data convergence protocol (PDCP) layer of a protocol stack—or layer 3, with relaying at an internet protocol (IP) layer of a protocol stack. In the case of a layer 3 relaying architecture, the remote UE may not have a radio resource control (RRC) connection with the network, meaning that there is no interaction between a base station of the network (for example, a gNB) and the remote UE. By contrast, in the layer 2 architecture, the RRC protocol layer is terminated between the gNB and the remote UE, and to communicate with the network, the remote UE in a layer 2 design requires an RRC connection. This disclosure describes means of establishing such a connection "through the relay", i.e., using the relay UE for all communication between the remote UE and the network.

SUMMARY

[0005]The following presents a simplified summary of one or more aspects in order to provide a basic understanding of such aspects. This summary is not an extensive overview of all contemplated aspects, and is intended to neither identify key or critical elements of all aspects nor delineate the scope of any or all aspects. Its sole purpose is to present some concepts of one or more aspects in a simplified form as a prelude to the more detailed description that is presented later.

[0006] In an aspect of the disclosure, a method is provided. The method of connection establishment operable in a remote UE. The remote UE operates in an idle state of a protocol(RRC_IDLE). The remote UE performs a discovery procedure. The remote UE selects a relay UE. The remote UE sends a setup request message for a network node [RRCSetupRequest] to the relay UE. The remote UE receives a first configuration message comprising a configuration for a first RLC channel [for SRB1 from the relay UE. In response to the first configuration message, the remote UE sends a first completion message [RRCReconfigurationCompleteSidelink] to the relay UE. The remote UE receives a setup message from the network node [RRCSetup] from the relay UE. The remote UE sends a setup completion message for the network node [RRCSetupComplete] to the relay UE. The remote UE enters a connected state of the protocol [RRC_CONNECTED]. The remote UE establishes security with the network node [SecurityModeCommand/SecurityModeComplete legacy procedure]. The remote UE receives a second configuration message comprising configuration information for one or more RLC channels [RRCReconfigurationSidelink for DRBs] from the relay UE. In response to the second configuration message, the remote UE sends a second completion message [RRCReconfigurationCompleteSidelink] to the relay UE. The remote UE receives a third configuration message from the network node, comprising configuration information for one or more radio bearers [RRCReconfiguration] from the relay UE. In response to the third configuration message, the remote UE sends a third completion message for the network node [RRCReconfigurationComplete] to the relay UE.

[0007]To the accomplishment of the foregoing and related ends, the one or more aspects comprise the features hereinafter fully described and particularly pointed out in the claims. The following description and the annexed drawings set forth in detail certain illustrative features of the one or more aspects. These features are indicative, however, of but a few of the various ways in which the principles of various aspects may be employed, and this description is intended to include all such aspects and their equivalents.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a diagram illustrating an exemplary high level relaying connection establishment.

[0009] FIG. 2 is a diagram illustrating an example of detailed relaying connection establishment.

DETAILED DESCRIPTION OF PREFERRED IMPLEMENTATIONS

[0010] The detailed description set forth below in connection with the appended drawings is

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

[0011] Several aspects of telecommunication systems will now be presented with reference to various apparatus and methods. These apparatus and methods will be described in the following detailed description and illustrated in the accompanying drawings by various blocks, components, circuits, processes, algorithms, etc. (collectively referred to as "elements"). These elements may be implemented using electronic hardware, computer software, or any combination thereof. Whether such elements are implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system.

[0012] When a remote UE in a layer 2 relaying architecture needs to communicate with the network, it requires an RRC connection to manage the communication. There are well-known methods of establishing an RRC connection through direct communication on the Uu interface between the gNB and a UE. However, when a remote UE is out of coverage (OOC), these methods are clearly not applicable, and even when in coverage of the network, it may be preferable for a remote UE to use a "through-the-relay" mode of connection establishment. This is because the remote UE's coverage may be poor (resulting in a need to retransmit messages over the air interface, with attendant costs in interference and capacity), and also because it may be expedient from a standardisation or implementation point of view to have a single common procedure for connection establishment, applicable in or out of coverage. Accordingly, a method of connection establishment through the relay for a remote UE is needed.

[0013] The diagram in Figure 1 shows a high-level summary of the process that needs to happen for connection establishment through the relay, i.e. assuming the remote UE does not first perform a random access channel (RACH) procedure on Uu to request a transfer to the relay link. (This would be obviously necessary for the OOC UE, and it could be beneficial also for a UE in poor Uu coverage, which is the case most likely to need relaying.) The steps of Figure 1 can be summarised as follows:

[0014] The remote and relay UEs perform discovery according to the Rel-17 discovery procedure, and PC5-RRC connection establishment according to the legacy Rel-16 procedure.

a. This step may include providing a paging identifier, such as an NG-5G-S-TMSI of the remote UE, to the relay UE, to allow the relay UE to configure itself to monitor paging occasions for the remote UE. This facility will not be needed in the rest of this analysis (since

we assume the remote UE establishes an RRC connection of its own accord), but may be necessary in case the remote UE performs discovery, selects the relay UE, and then remains in an RRC_IDLE or RRC_INACTIVE state.

b. If the relay UE remains in an RRC_IDLE or RRC_INACTIVE state after selecting the relay UE, it may subsequently receive a paging message from the network, forwarded by the relay UE. In legacy operation on the Uu interface, receiving a paging message causes the UE to trigger an RRC connection establishment procedure to respond to the page. In the relaying case, the remote UE can similarly respond to the page by triggering an RRC connection establishment through the relay, that is, by pursuing the remaining steps of this procedure.

[0015] The remote UE sends a message requesting setup of the connection (for instance, an RRCSetupRequest message of an RRC protocol) to the gNB via the relay, using a default L2 configuration on PC5 (which may be possible to override with a configuration; this point is identified as FFS in the current status of 3GPP RAN2 work) and using some form of dedicated signalling on Uu (for example, a message of an RRC protocol as discussed below). The transmission towards the network alerts the UE that relaying needs to be set up with the gNB

a. For purposes of this diagram, we assume that the relay UE starts in an RRC_CONNECTED state (the initial conditions in step 0 of the figure). However, if the relay UE starts in an RRC_IDLE or RRC_INACTIVE state instead, it needs to establish its own RRC connection as part of step 2. This can be done by applying well-known procedures for connection establishment on the Uu interface.

[0016] The relay UE and gNB perform a relaying setup procedure (it could be considered for step 2b to be assimilated in this step, as further discussed below).

a. Step 2b could be assimilated as follows. The relay UE could transmit a suitable message, such as a UEAssistanceInformation (UAI) message or a SidelinkUEInformation (SUI) message of an RRC protocol, with a new field to indicate "I have a peer who requests relaying", together with a link-local ID of the remote UE (not the existing initialUE-Identity from the RRCSetupRequest message) and the RRCSetupRequest containerised.

b. The gNB needs to know the initialUE-Identity from the RRCSetupRequest message in case the remote UE is in coverage and already has an NG-5G-S-TMSI. If the remote UE selected a random ID, it is a new UE for the serving system (i.e., it is performing an initial attach procedure or coming from OOC), but the random ID is not actually used for anything.

c. The network response is an RRCReconfiguration to the relay UE, with a configuration for the remote UE's signalling radio bearer 1 (SRB1). In some embodiments, the gNB may dictate the PC5 L2 configuration in its entirety, while in other embodiments, the gNB may give the higher-layer configuration and allow the relay UE to determine how to configure the

RLC channel for SRB1.

[0017] The gNB sends an RRCSetup message to the remote UE via the relay, containing at least the radioBearerConfig field. (The masterCellGroup field seems not useful here as it contains MAC and PHY configurations that should be set by the relay UE. Its applicability is further discussed in point c below.)

a. This step actually could be assimilated in steps 3 and 5. As part of step 3, the gNB can send the RRCSetup message to the relay UE, and the RRCSetup message can be containerised and sent along with the RLC channel configuration in step 5.

b. The RRCSetup delivery to the remote UE uses the default configuration for L2 on PC5.

c. The masterCellGroup is a mandatory field in the RRCSetup message, containing the IE CellGroupConfig. However, the only mandatory field in CellGroupConfig is the cellGroupId, which in this scenario should always be set to 0. The gNB can send a limited form of the RRCSetup containing the radioBearerConfig and only the cellGroupId of the masterCellGroup.

[0018] The relay UE configures an RLC channel for relaying of SRB1 towards the remote UE.

[0019] The remote UE sends an RRCSetupComplete message to the gNB via the relay UE (using SRB1).

[0020] The remote UE enters an RRC_CONNECTED state.

[0021] The remote UE and gNB establish security as usual (security messages forwarded through the relay on SRB1).

[0022] The gNB configures the relay UE with the configuration of additional radio bearers for relaying.

[0023] The relay UE configures the remote UE with the needed PC5 RLC channels for the additional bearers.

[0024] The gNB sends the first RRCReconfiguration to the remote UE through the relay to set up data radio bearers (DRBs). This step may require setting up additional RLC channels between the remote and relay UEs; alternatively, the relay UE may be previously informed of the needed configuration, for example as part of step 3, and set up the RLC channels with the remote UE in advance of this step.

[0025] A more detailed version of the flow at the message level could be as shown in Figure 2. The steps of Figure 2 can be summarised as follows:

1.The remote and relay UEs perform discovery according to the Rel-17 discovery procedure, and PC5-RRC connection establishment according to the legacy Rel-16 procedure.

2.The remote UE sends an RRCSetupRequest message to the relay UE using the default L2

configuration on PC5 (which may be possible to override with a configuration, as discussed under step 2 of Figure 1).

3.The relay UE sends an RRC message (e.g. a UAI or SUI) to the network to convey the information that it has a peer UE that requests relaying, along with the containerised RRCSetupRequest from step 2.

4.The gNB sends an RRCReconfiguration message to the relay UE containing the sidelink configuration for the relaying SRB1, along with a containerised RRCSetup message for the remote UE. In some embodiments, the RRCReconfiguration message from the gNB may dictate the entire sidelink configuration, while in other embodiments, the RRCReconfiguration message from the gNB may configure only certain parameters, leaving others for the relay UE to determine autonomously. The RRCSetup message may contain only a restricted set of fields, such as the radioBearerConfig and the cellGroupId of the masterCellGroup, as discussed under step 4 of Figure 1.

5.The relay UE sends a message (for instance, an RRCReconfigurationSidelink message of a PC5-RRC protocol) to the remote UE to set up the sidelink RLC channel for relaying SRB1, along with the containerised RRCSetup from step 4.

6.The remote UE processes the RRCReconfigurationSidelink message and sends a completion message (for example, an RRCReconfigurationCompleteSidelink message) to the relay UE (responsive to step 5).

7.The relay UE sends a completion message (for example, an RRCReconfigurationComplete message) to the gNB (responsive to step 4). This step may take place before or after step 6; that is, in some embodiments, the relay UE may indicate completion of its own reconfiguration procedure before it receives confirmation that the remote UE has completed its reconfiguration procedure.

8.The remote UE processes the RRCSetup message and sends a completion message (for example, an RRCSetupComplete message) on SRB1 to the gNB via the relay.

9.The remote UE enters an RRC_CONNECTED state.

10.The gNB sends a SecurityModeCommand to the remote UE via the relay on SRB1 to establish security (legacy procedure).

11.The remote UE sends a SecurityModeComplete to the gNB via the relay on SRB1.

12.The gNB sends an RRCReconfiguration message to the relay UE containing the sidelink configuration for the relaying DRBs, including bearer mapping information. In some embodiments, the RRCReconfiguration message from the gNB may dictate the entire sidelink configuration, while in other embodiments, the RRCReconfiguration message from the gNB may configure only certain parameters, leaving others for the relay UE to determine

autonomously.

13.The relay UE sends an RRCReconfigurationSidelink message to the remote UE to set up the sidelink RLC channels for relaying DRBs.

14.The remote UE sends an RRCReconfigurationCompleteSidelink message to the relay UE (responsive to step 13).

15.The relay UE sends an RRCReconfigurationComplete message to the gNB (responsive to step 12). In some embodiments, this step may take place before step 14.

16.The gNB sends an RRCReconfiguration message to the remote UE via the relay, to set up the relaying DRBs.

17.The remote UE sends an RRCReconfigurationComplete message to the gNB via the relay (responsive to step 16)

[0026] The spec impact to enable these procedures can be summarised as follows:

1.Define the L2 default configuration for PC5 to be used in step 2

2.Add to the UAI or SUI an extension for indicating the existence of a peer that needs relaying, along with a container for the RRCSetupRequest message in step 3

3.Add to the RRCReconfiguration a container for the RRCSetup in step 4

4.Add to the RRCReconfigurationSidelink a container for the RRCSetup in step 5

5.Add to the RRCSetup a constraint indicating that only the radioBearerConfig is included when it is used for relaying

6.Add to the RRCReconfiguration the necessary information to capture the bearer mapping between Uu DRBs of the remote UE and Uu RLC channels of the relay UE in step 12

7.Possibly add to SL-ConfigDedicatedNR a new field for the RLC/MAC/PHY configuration of relaying bearers (maybe this can be handled by the existing sl-PHY-MAC-RLC-Config, with some extension to associate the RLC channels being set up with end-to-end bearers)

[0027] The bearer mapping aspects of step 12 require some further discussion. In the downlink direction, it should be possible to map one or more radio bearers (SRBs/DRBs) of the remote UE to a specific RLC channel of the relay UE on the Uu interface (corresponding to a specific radio bearer of the relay UE), meaning that data of these remote UE bearers can share the same RLC configuration on Uu and be mapped to the appropriate RLC channels on the PC5 interface. Similarly, from the uplink perspective, it should be possible to map one or more PC5 RLC channels of the remote UE to one or more corresponding Uu RLC channels of the relay UE (corresponding to radio bearers of the relay UE). The Uu adaptation layer (between the relay UE and the gNB) can be used to describe this bearer mapping relation, according to a configuration delivered by the RRCReconfiguration message in step 12 of Figure 2. Alternatively, the bearer mapping configuration may be delivered by a separate message from the gNB to the relay UE

(not shown in the figures).

[0028] On the PC5 interface, a protocol such as a PC5-RRC protocol may provide a flexible way to map radio bearers of the remote UE to PC5 RLC channels for relaying. There are two alternatives for this mapping:

[0029] Alt. 1: The mapping can be N:1, i.e., multiple radio bearers of the remote UE can be mapped to a single PC5 RLC channel. The mapping can be indicated by the adaptation layer between the relay UE and the gNB; for instance, in the downlink direction, an identifier of the radio bearer of the remote UE can be interpreted by the relay UE (according to the configuration received, for example, in step 12 of Figure 2) as an indicator of which PC5 RLC channel should carry the data. In the uplink direction, it may then be necessary to have an adaptation layer between the remote UE and the relay UE, so that a packet on a particular PC5 RLC channel can be accompanied by an indication of which remote UE radio bearer the packet should be associated with.

[0030] Alt. 2: The mapping can be 1:1, so that each remote UE radio bearer is mapped to a fixed PC5 RLC channel, which it does not share with any other remote UE radio bearer. In this case there may be no need for an adaptation layer between the remote UE and the relay UE, since the choice of PC5 RLC channel for transmission implicitly indicates the corresponding radio bearer of the remote UE:

[0031] In either case, the mapping can be configured by the relay UE to the remote UE using a control message, such as an RRCReconfigurationSidelink message of a PC5-RRC protocol. This configuration may correspond to step 10 of Figure 1 and/or step 13 of Figure 2. Alternatively, the mapping may be configured by a separate message between the relay and remote UEs, for example, after the illustrated step 17 of Figure 2. For this latter alternative, an indication from the gNB to the relay UE would be needed after step 17 has completed, to notify the relay UE that the end-to-end radio bearers of the remote UE are established and the relay UE may configure the bearer mapping. The mapping may also be configured by the gNB itself, for example, as part of the reconfiguration message in step 16 of Figure 2.

CLAIMS

1. A method of connection establishment operable in a remote UE, comprising:

operating in an idle state of a protocol [RRC_IDLE];

performing a discovery procedure;

selecting a relay UE;

sending, to the relay UE, a setup request message for a network node [RRCSetupRequest];

receiving, from the relay UE, a first configuration message comprising a configuration for a first RLC channel [for SRB1];

sending, to the relay UE in response to the first configuration message, a first completion message [RRCReconfigurationCompleteSidelink];

receiving, from the relay UE, a setup message from the network node [RRCSetup];

sending, to the relay UE, a setup completion message for the network node [RRCSetupComplete];

entering a connected state of the protocol [RRC_CONNECTED];

establishing security with the network node [SecurityModeCommand/ SecurityModeComplete legacy procedure];

receiving, from the relay UE, a second configuration message comprising configuration information for one or more RLC channels [RRCReconfigurationSidelink for DRBs];

sending, to the relay UE in response to the second configuration message, a second completion message [RRCReconfigurationCompleteSidelink];

receiving, from the relay UE, a third configuration message from the network node, comprising configuration information for one or more radio bearers [RRCReconfiguration]; and

sending, to the relay UE in response to the third configuration message, a third completion message for the network node [RRCReconfigurationComplete].

2. The method of claim 1, wherein the setup request message for the network node is transmitted using a predefined configuration of one or more layer 2 protocols [PHY/MAC/RLC].

3. The method of claim 1 wherein the establishing security comprises:

receiving, from the relay UE, a security command message from the network node [SecurityModeCommand];

applying a security configuration defined by the security command message; and

sending, to the relay UE, a security complete message for the network node [SecurityModeComplete].

4. The method of claim 1, wherein the performing a discovery procedure comprises sending, to the relay UE, a paging identifier of the remote UE.

5. A method of connection establishment operable in a relay UE, comprising:

operating in a connected state of a protocol [RRC_CONNECTED];

performing a discovery procedure with a remote UE;

receiving, from the remote UE, a first message for a network node [RRCSetupRequest];

sending, to the network node, an information message comprising an indication that the remote UE requests relaying and the first message for the network node [UEAssistanceInformation or SidelinkUEInformation];

receiving, from the network node, a first configuration message comprising a sidelink configuration for a signalling radio bearer [RRCReconfiguration message with sidelink configuration for the remote UE's SRB1];

sending, to the remote UE, a second configuration message comprising a configuration of an RLC channel for the signalling radio bearer [RRCReconfigurationSidelink];

receiving, from the remote UE, a first completion message responsive to the second configuration message [RRCReconfigurationCompleteSidelink];

sending, to the network node, a second completion message responsive to the first configuration message [RRCReconfigurationComplete];

receiving, from the remote UE, a message for the network node using the configuration of the RLC channel for the signalling radio bearer [RRCSetupComplete];

sending, to the network node, the message for the network node [RRCSetupComplete];

receiving, from the network node, a third configuration message comprising a sidelink configuration for one or more radio bearers [RRCReconfiguration message with sidelink configuration for the remote UE's DRBs];

sending, to the remote UE, a fourth configuration message comprising a configuration of one or more RLC channels for the one or more radio bearers [RRCReconfigurationSidelink with sidelink configuration for the remote UE's DRBs];

receiving, from the remote UE, a third completion message responsive to the fourth configuration message [RRCReconfigurationCompleteSidelink]; and

sending, to the network node, a fourth completion message responsive to the third configuration message [RRCReconfigurationComplete].

6. The method of claim 5, further comprising:

receiving, from the network node, a message for the remote UE on the signalling radio bearer; and

transmitting, to the remote UE, the message for the remote UE on the RLC channel for the signalling radio bearer [RRCReconfiguration on SRB1].

7. The method of claim 5, further comprising:

receiving, from the remote UE, a message for the network node on the RLC channel for the signalling radio bearer; and

transmitting, to the network node, the message for the network node on the signalling radio bearer [RRCReconfigurationComplete on SRB1].

8. The method of claim 5, further comprising:

receiving, from the network node, a transmission for the remote UE on one of the one or more radio bearers; and

transmitting, to the remote UE, the transmission for the remote UE on one of the RLC channels for the one or more radio bearers [downlink data transmission on a DRB of the remote UE].

9. The method of claim 8, wherein the one of the RLC channels is determined by a mapping from the one of the one or more radio bearers.

10. The method of claim 9, wherein the mapping is an N:1 mapping [multiple Uu DRBs to one PC5 RLC channel].

11. The method of claim 10, wherein the transmitting to the remote UE comprises indicating an identifier of the one of the one or more radio bearers.

12. The method of claim 9, wherein the mapping is a 1:1 mapping [one Uu DRB to one PC5 RLC channel].

13. The method of claim 5, further comprising:

receiving, from the remote UE, a transmission for the network node on one of the one or more RLC channels for the one or more radio bearers; and

transmitting, to the network node, the transmission for the network node on one of the one or more radio bearers [uplink data transmission on a DRB of the remote UE].

14. The method of claim 13, wherein the one of the one or more radio bearers is determined by a mapping from the one of the one or more RLC channels.

15. The method of claim 14, wherein the mapping is an N:1 mapping [multiple Uu DRBs to one PC5 RLC channel].

16. The method of claim 15, wherein the receiving from the remote UE comprises receiving an identifier of the one of the one or more radio bearers.

17. The method of claim 14, wherein the mapping is a 1:1 mapping [one Uu DRB to one PC5 RLC channel].

18. The method of claim 5, wherein the performing a discovery procedure comprises receiving, from the remote UE, a paging identifier of the remote UE.

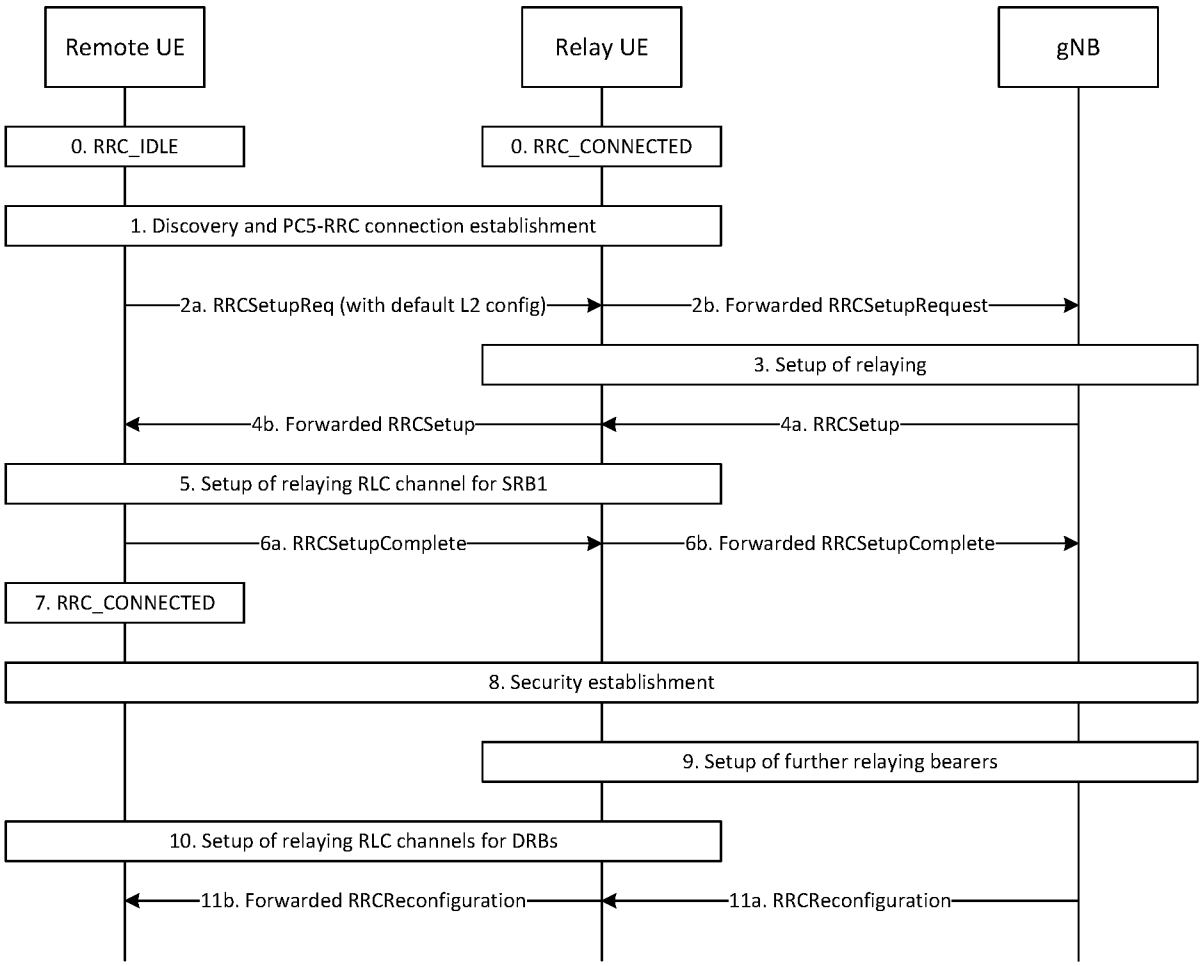
Remote UE
Relay UE
gNB
0. RRC_IDLE
0. RRC_CONNECTED
1. Discovery and PC5-RRC connection establishment
2a. RRCSetupReq (with default L2 config)
2b. Forwarded RRCSetupRequest
3. Setup of relaying
4b. Forwarded RRCSetup
4a. RRCSetup
5. Setup of relaying RLC channel for SRB1
6a. RRCSetupComplete
6b. Forwarded RRCSetupComplete
7. RRC_CONNECTED
8. Security establishment
9. Setup of further relaying bearers
10. Setup of relaying RLC channels for DRBs
11b. Forwarded RRCReconfiguration
11a. RRCReconfiguration

Figure 1

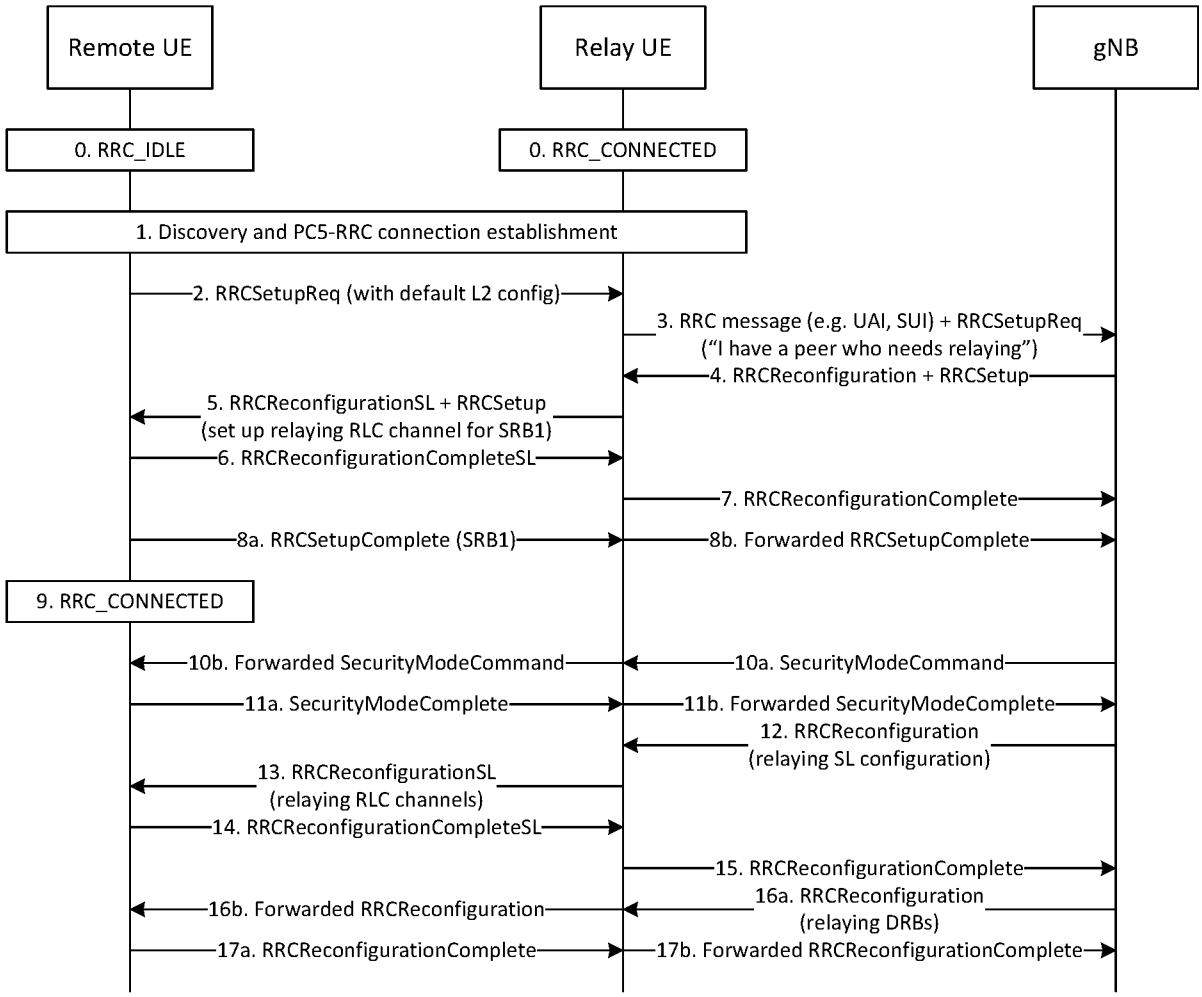
Remote UE
Relay UE
gNB
0. RRC_IDLE
0. RRC_CONNECTED
1. Discovery and PC5-RRC connection establishment
2. RRCSetupReq (with default L2 config)
3. RRC message (e.g. UAI, SUI) + RRCSetupReq
("I have a peer who needs relaying")
4. RRCReconfiguration + RRCSetup
5. RRCReconfigurationSL + RRCSetup
(set up relaying RLC channel for SRB1)
6. RRCReconfigurationCompleteSL
7. RRCReconfigurationComplete
8a. RRCSetupComplete (SRB1)
8b. Forwarded RRCSetupComplete
9. RRC_CONNECTED
10b. Forwarded SecurityModeCommand
10a. SecurityModeCommand
11a. SecurityModeComplete
11b. Forwarded SecurityModeComplete
12. RRCReconfiguration
(relaying SL configuration)
13. RRCReconfigurationSL
(relaying RLC channels)
14. RRCReconfigurationCompleteSL
15. RRCReconfigurationComplete
16b. Forwarded RRCReconfiguration
16a. RRCReconfiguration
(relaying DRBs)
17a. RRCReconfigurationComplete
17b. Forwarded RRCReconfigurationComplete

Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/115020

A. CLASSIFICATION OF SUBJECT MATTER

H04W 40/22(2009.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W, H04Q 7/-, H04L, H04B

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)

CNABS, CNTXT, CNKI, VEN, WOTXT, USTXT, EPTXT, 3GPP: remote, relay, UE, RRC, setup, RRCsetup, configuration, reconfiguration, connection, establishment, SRB, DRB, RLC, PC5, sidelink

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Huawei et al. "Study aspects of UE-to-Network relay and solutions for L2 relay." *3GPP TSG-RAN WG2 Meeting #111-e Online, R2-2008047.*, 07 August 2020 (2020-08-07), section 2.2	1-18
A	CN 110463270 A (HUAWEI TECHNOLOGIES CO LTD) 15 November 2019 (2019-11-15) the whole document	1-18
A	WO 2017026970 A1 (INTEL CORP) 16 February 2017 (2017-02-16) the whole document	1-18

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 May 2021	**02 June 2021**
Name and mailing address of the ISA/CN **National Intellectual Property Administration, PRC** **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing** **100088** **China**	Authorized officer **LU,Jing**
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Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/115020

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	110463270	A	15 November 2019	EP	3586544	A4	04 March 2020
				US	2018279202	A1	27 September 2018
				US	10499307	B2	03 December 2019
				WO	2018177163	A1	04 October 2018
				EP	3586544	A1	01 January 2020
WO	2017026970	A1	16 February 2017	US	10484926	B2	19 November 2019
				DE	112015006791	T5	26 April 2018
				US	2018206176	A1	19 July 2018
				TW	201729554	A	16 August 2017