**3GPP TSG-RAN WG2 Meeting #114 Electronic R2-210NNNN**

**Online Meeting, May 19 – 27, 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.300** | **CR** |  | **rev** |  | **Current version:** | **16.5.0** |  |
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| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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| ***Title:*** | Introduction of Rel-17 Sidelink Relay | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | MediaTek Inc. | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_SL\_relay-Core | | | | |  | ***Date:*** | | | 2021-05-30 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | ***B*** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | This CR introduces the support of sidelink relay in NR | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Introduction of general description, protocol architecture, relay discovery, relay selection/reselection, control plane procedures and service continuity aspects for sidelink relay | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Sidelink Relay is not supported in NR | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 3.2, 16.X (New) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*First Modified Subclause*

# 3 Abbreviations and Definitions

## 3.1 Abbreviations

[omitted]

L2 Layer-2

L3 Layer-3

[omitted]

## 3.2 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], in TS 36.300 [2] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1] and TS 36.300 [2].

**BH RLC channel**: an RLC channel between two nodes, which is used to transport backhaul packets**.**

**CAG Cell**:a PLMN cell broadcasting at least one Closed Access Group identity.

**CAG Member Cell**:for a UE, a CAG cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN, and for that PLMN, a CAG identifier belonging to the Allowed CAG list of the UE for that PLMN.

**CAG-only cell**: a CAG cell that is only available for normal service for CAG UEs.

**Cell-Defining SSB**: an SSB with an RMSI associated.

**Child node**: IAB-DU's and IAB-donor-DU's next hop neighbour node; the child node is also an IAB-node.

**Conditional Handover (CHO**): a handover procedure that is executed only when execution condition(s) are met.

**CORESET#0**: the control resource set for at least SIB1 scheduling, can be configured either via MIB or via dedicated RRC signalling.

**DAPS Handover**: a handover procedure that maintains the source gNB connection after reception of RRC message for handover and until releasing the source cell after successful random access to the target gNB.

**Downstream**: Direction toward child node or UE in IAB-topology.

**Early Data Forwarding**: data forwarding that is initiated before the UE executes the handover.

**gNB**: node providing NR user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

**IAB-donor**:gNB that provides network access to UEs via a network of backhaul and access links.

**IAB-donor-CU**: as defined in TS 38.401 [4].

**IAB-donor-DU**:as defined in TS 38.401 [4].

**IAB-DU**: gNB-DU functionality supported by the IAB-node to terminate the NR access interface to UEs and next-hop IAB-nodes, and to terminate the F1 protocol to the gNB-CU functionality, as defined in TS 38.401 [4], on the IAB-donor.

**IAB-MT**: IAB-node function that terminates the Uu interface to the parent node using the procedures and behaviours specified for UEs unless stated otherwise. IAB-MT function used in 38-series of 3GPP Specifications corresponds to IAB-UE function defined in TS 23.501 [3].

**IAB-node**: RAN node that supports NR access links to UEs and NR backhaul links to parent nodes and child nodes. The IAB-node does not support backhauling via LTE.

**Intra-system Handover**:Handover that does not involve a CN change (EPC or 5GC).

**Inter-system Handover**:Handover that involves a CN change (EPC or 5GC).

**Late Data Forwarding**: data forwarding that is initiated after the source NG-RAN node knows that the UE has successfully accessed a target NG-RAN node.

**MSG1**: preamble transmission of the random access procedure for 4-step random access (RA) type.

**MSG3**: first scheduled transmission of the random access procedure.

**MSGA**:preamble and payload transmissions of the random access procedure for 2-step RA type.

**MSGB**:response to MSGA in the 2-step random access procedure. MSGB may consist of response(s) for contention resolution, fallback indication(s), and backoff indication.

**Multi-hop backhauling**: Using a chain of NR backhaul links between an IAB-node and an IAB-donor.

**ng-eNB**: node providing E-UTRA user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

**NG-C**: control plane interface between NG-RAN and 5GC.

**NG-U**: user plane interface between NG-RAN and 5GC.

**NG-RAN node**: either a gNB or an ng-eNB.

**Non-CAG Cell**: a PLMN cell which does not broadcast any Closed Access Group identity.

**NR backhaul link**: NR link used for backhauling between an IAB-node and an IAB-donor, and between IAB-nodes in case of a multi-hop backhauling.

**NR sidelink communication**: AS functionality enabling at least V2X communication as defined in TS 23.287 [40], between two or more nearby UEs, using NR technology but not traversing any network node.

**Numerology**: corresponds to one subcarrier spacing in the frequency domain. By scaling a reference subcarrier spacing by an integer *N*, different numerologies can be defined.

**Parent node**: IAB-MT's next hop neighbour node; the parent node can be IAB-node or IAB-donor-DU

**PLMN Cell**: a cell of the PLMN.

**SNPN Access Mode**: mode of operation whereby a UE only accesses SNPNs.

**SNPN-only cell**: a cell that is only available for normal service for SNPN subscribers.

**SNPN Identity:** the identity of Stand-alone NPN defined by the pair (PLMN ID, NID).

**Transmit/Receive Point:** Part of the gNB transmitting and receiving radio signals to/from UE according to physical layer properties and parameters inherent to that element.

**Upstream**: Direction toward parent node in IAB-topology.

**UE-to-Network Relay UE:** a UE that provides functionality to support connectivity to the network for UE-to-NetworkRemote UE(s).

**UE-to-Network Relay Selection:** Process of identifying a potential UE-to-Network Relay UE, which can be used for connectivity services.

**UE-to-Network Relay Reselection:** process of changing previously selected UE-to-Network Relay UE and identifying potential a new UE-to-Network Relay UE, which can be be used for connectivity services.

**UE-to-Network Remote UE:** a UE, that communicates with the network via a UE-to-NetworkRelay UE.

**V2X sidelink communication**: AS functionality enabling V2X communication as defined in TS 23.285 [41], between nearby UEs, using E-UTRA technology but not traversing any network node.

**Xn**: network interface between NG-RAN nodes.

*Next Modified Subclause (new)*

## 16.x Sidelink Relay

### 16.x.1 General

*Editor’s Note: the general description for sidelink relay is provided in this section based on TR38.836. Describe both L2 and L3 relay in general. A system architecture may be depicted from RAN perspective. This section can also describe the subtopics that does not need be assigned with a separate sub-section.*

### 16.x.2 Protocol Architecture

*Editor’s Note: L3 architecture is described by text only based on TR38.836. L2 User plane and control plane protocol architecture to be described in this section based on TR38.836 and the conclusion of PC5 adaptation layer. Describe also the high level function of adaptation layer. QoS handling can also be described here in case of any RAN specific impact.*

*Editor’s Note: The following paragraph is to capture the agreement of “RRC state combination of Relay UE in RRC\_IDLE and Remote UE in RRC\_INACTIVE is supported.”. the additional text is sourced from TR38.836*

A Relay UE shall be in RRC\_CONNECTED to perform relaying of unicast data.

For L2 UE-to-Network Relay, the following RRC state combinations are supported:

- Both UE-to-Network Relay and Remote UE shall be in RRC CONNECTED to perform transmission/reception of relayed unicast data.

- The UE-to-Network Relay Relay UE can be in RRC\_IDLE, RRC\_INACTIVE or RRC\_CONNECTED as long as all the PC5-connected UE-to-Network Relay Remote UE(s) are in RRC\_IDLE.

- The UE-to-Network Relay Relay UE can be in RRC\_IDLE, RRC\_INACTIVE or RRC\_CONNECTED as long as all the PC5-connected UE-to-Network Relay Remote UE(s) are in RRC\_INACTIVE*.*

### 16.x.3 Relay Discovery

*Editor’s Note: describe the high level relay discovery mechanism. Most of the text is common for L2 and L3 relay.*

The UE-to-Network Remote UE can perform Relay discovery message (i.e. Solicitation message in Mode B) transmission while in RRC\_IDLE, RRC\_INACTIVE or RRC\_CONNECTED. The gNB may broadcast a threshold, which is used by the UE-to-Network Remote UE to determine if it can transmit Relay discovery solicitation messages to UE-to-Network Relay UE(s).

The UE-to-Network Relay UE is can perform Relay discovery message (i.e. Announcement message in Mode A, or Response message in Mode B) transmission while in RRC\_IDLE, RRC\_INACTIVE or RRC\_CONNECTED. The gNB may broadcast a maximum threshold and a minimum threshold for Uu signal strength, which are used by the UE-to-Network Relay UE to determine if it can transmit Relay discovery messages to UE-to-Network Remote UE(s).

The gNB may provide the Relay discovery configuration using broadcast or dedicated signalling for Relay Operation. In addition, the UE-to-Network Remote UE and UE-to-Network Relay UE may use pre-configuration for relay discovery. The following cases apply:

- For UE-to-Network Remote UE which is out-of-coverage:

- For L2 and L3 UE-to-Network Remote UE which is neither in RRC\_CONNECTED nor RRC\_IDLE/INACTIVE, it can follow pre-configuration;

- For L2 UE-to-Network Remote UE which is connected to network via a UE-to-Network Relay UE (i.e., either in RRC\_CONNECTED or RRC\_IDLE/INACTIVE), it should follow network configuration, i.e., SIB or dedicated signalling, if available. Or if the network configuration is not available, the L2 UE-to-Network Remote UE shall rely on pre-configuration to perform discovery.

- For UE-to-Network Relay UE and UE-to-Network Remote UE which is in-coverage on the serving frequency,

- if there is discovery related SIB broadcasted on the serving frequency, and if the configuration of concerned SL frequency is included within the SIB of the serving frequency:

- For UE in RRC\_IDLE/RRC\_INACTIVE state, if the Tx resource pool configuration is absent, UE shall enter RRC\_CONNECTED state to acquire dedicated configuration on Tx resource pool. Otherwise, if the Tx resource pool configuration is present, it shall use the discovery configuration provided via SIB.

- For UE in RRC\_CONNECTED, it can only use the SL discovery Tx resource configuration provided by dedicated signalling if provided, or not transmit discovery message if not provided.

- if the configuration of concerned SL frequency is absent within the SIB of the serving frequency or if there is no discovery related SIB on the serving frequency,

- if the serving frequency is not shared with concerned frequency, for UE-to-Network Relay UE and UE-to-Network Remote UE in RRC\_IDLE/RRC\_INACTIVE state, and L3 UE-to-Network Relay UE, L3 UE-to-Network Remote UE and L2 UE-to-Network Remote UE in RRC\_CONNECTED,

- If there is Uu coverage at the concerned SL frequency, UE shall 1) rely on the discovery related SIB, if any broadcasted in the concerned SL frequency; or 2) if there is no discovery related SIB on the concerned SL frequency, UE does not perform SL discovery transmission/reception on the concerned frequency.

- If there is no Uu coverage at the concerned frequency, UE shall rely on pre-configuration.

- if the serving frequency is shared with concerned SL frequency, for UE-to-Network Relay UE and UE-to-Network Remote UE in RRC\_IDLE/RRC\_INACTIVE state,

- UE does not perform SL discovery transmission/reception on the concerned frequency if there is no discovery related SIB broadcasted on the serving carrier.

The resource pool for Relay discovery can be shared with the resource pool for Sidelink communication and the resource pool for Relay discovery can also be an dedicated resource pool. Such configuration is based on network implementation. The Rel-16 resource pool design (including resource allocation design) shall be reused.

The Rel-16 power control mechanism is reused for the transmission of relay discovery messages.

No ciphering and integrity protection in PDCP layer is needed for the Relay discovery messages.

### 16.x.4 Relay Selection/Reselection

*Editor’s Note: describe the high level Relay Selection/Reselection mechanism. Most of the text is common for L2 and L3 relay.*

The UE-to-Network Remote UE performs radio measurements at PC5 interface and uses them for UE-to-Network Relay selection and reselection along with higher layer critera, as specified in TS 23.304. For UE-to-Network Relay UEs without established unicast PC5 connection with UE-to-Network Remote UE, UE-to-Network Remote UE uses SD-RSRP measurements to evaluate whether PC5 link quality of a UE-to-Network Relay UE satisfies relay selection and reselection criterion.

For relay reselection, UE-to-Network Remote UE uses SL-RSRP measurements for relay reselection trigger evaluation when data transmission from UE-to-Network Relay UE to UE-to-Network Remote UE is available, and it is left to UE implementation whether to use SL-RSRP or SD-RSRP for relay reselection trigger evaluation in case of no data transmission from UE-to-Network Relay UE to UE-to-Network Remote UE.

A UE-to-Network Relay UE is considered suitable in terms of radio criteria if the PC5 link quality exceeds configured threshold (pre-configured or provided by gNB). The UE-to-Network Remote UE searches for suitable UE-to-Network Relay UE candidates which meet all AS layer and higher layer criteria. If there are multiple such candidate UE-to-Network Relay UEs, it is up to UE-to-Network Remote UE implementation to choose one UE-to-Network Relay UE among them. For L2 UE-to-Network Relay (re)selection , the PLMN ID and cell ID can be used as an additional AS criteria.

The UE-to-Network Remote UE triggers L3 UE-to-Network Relay selection when:

- Direct Uu signal strength of current serving cell is below a configured signal strength threshold;

- Indicated by upper layer

The UE-to-Network Remote UE triggers UE-to-Network Relay reselection when:

- PC5 signal strength of current UE-to-Network Relay UE is below a (pre)configured signal strength threshold;

- It receives a Disconnect Request message, as specified in TS23.304 or similar indication, from current UE-to-Network Relay UE, when Uu RLF is detected by UE-to-Network Relay UE, or UE-to-Network Relay UE performs handover to another gNB;

- PC5 RLF with current UE-to-Network Relay UE is detected by UE-to-Network Remote UE.

- Indicated by upper layer.

*Editor notes: For* *Relay reselection triggered by Remote UE, in case of L2 relay, there would be some difference between IDLE/INACTIVE and CONNECETD, where the latter one is based on network configuration/command instead of remote UE, FFS on how to capture that following the above paragraph.*

*Editor notes: For* *the above paragraph, there is FFS captured at the agreement at RAN2#113bis-e: FFS other indication/message can also be used for notification*

*Editor Notes: RAN2 need to discuss if it is needed to capture the legacy operation as agreed: When PC5 RLF is detected by relay UE on a PC5 unicast link towards a remote UE, relay UE in RRC\_CONNECTED sends the PC5 RLF indication to gNB (as supported in R16 specification).*

For L2 UE-to-Network Remote UEs in RRC\_IDLE/INACTIVE and L3 UE-to-Network Remote UEs, the legacy cell (re)selection procedure and relay (re)selection procedure run independently. If both a suitable cell and a suitable UE-to-Network Relay UE are available, the UE-to-Network Remote UE’s selection on either cell or UE-to-Network Relay UE is based on UE implementation. Besides, in case of L3 Relay, the UE-to-Network Remote UE’s selection on both cell and UE-to-Network Relay UE is also based on UE implementation.

*Editor Notes: for above paragraph, according to the agreements, For RRC\_CONNECTED L2 remote UE, it is handled by CP procedure and service continuity topic for L2 relay.*

### 16.x.5 Control plane procedures for L2 U2N relay

*Editor’s Note: describe the high level control plane procedures including connection management, system information, paging, access control etc.*

For the delivery of UE-to-Network Remote UE’s RRC message and data, the following configurations apply:

- **UE-to-Network** **Remote UE’s SRB0**: Specified (fixed) configuration is used for the configuration of PC5 RLC channel.

- **UE-to-Network** **Remote UE’s SRB1 (i.e. for message of RRCResume and RRCReestablishment)**: Default configuration which can be reconfigured by network is used for the configuration of PC5 RLC channel.

- **UE-to-Network** **Remote UE’s SRB1 (for message other than RRCResume and RRCReestablishment)**: Network configuration via dedicated signalling is used for the configuration of PC5 RLC channel and Uu RLC channel.

- **UE-to-Network** **Remote UE’s SRB2**: Network configuration via dedicated signalling is used for the configuration of PC5 RLC channel and Uu RLC channel.

- **UE-to-Network** **Remote UE’s Uu DRB**: Network configuration via dedicated signalling is used for the configuration of PC5 RLC channel and Uu RLC channel.

For the PC5 RLC channel configuration, the RLC/LCH configuration is provided to the UE-to-Network Relay UE and UE-to-Network Remote UE. For the Uu RLC channel configuration, the RLC/LCH configuration is provided to the UE-to-Network Relay UE. For the Remote UE’s SRB1/SRB2 and DRB configuration, the Uu PDCP configuration can be provided to the UE-to-Network Remote UE.

The UE-to-Network Remote UE in RRC\_CONNECTED suspends Uu RLM when UE-to-Network Remote UE is connected to gNB via UE-to-Network Relay UE. The Uu RLF indication from UE-to-Network Relay UE may trigger connection re-establishment for UE-to-Network Remote UE. Upon detecting PC5 RLF, the UE-to-Network Remote UE may trigger connection re-establishment.

**RRC re-establishment and RRC resume**

The UE-to-Network Remote UE may perform RRC re-establishment procedure as follows:

- If only suitable cell(s) are available, the UE-to-Network Remote UE initiates RRC re-establishment procedure towards a suitable cell;

- If only suitable relay(s) are available, the UE-to-Network Remote UE initiates RRC re-establishment procedure towards a suitable relay UE’s serving cell;

- If both a suitable cell and a suitable relay are available, the remote UE can select either one to initiate RRC re-establishment procedure based on implementation.

In case the UE-to-Network Remote UE initiates RRC resume to a new gNB, the legacy Retrieve UE Context procedure is performed, i.e., the new gNB retrieves the Remote UE context for UE-to-Network Remote UE.

**System information**

For UE-to-Network Remote UE in RRC\_CONNECTED, the DedicatedSIBRequest message is re-used for the UE-to-Network Remote UE to request the SI via UE-to-Network Relay UE. For UE-to-Network Remote UE in RRC\_IDLE or RRC\_INACTIVE, it informs UE-to-Network Relay UE on requested SIB type(s) via PC5-RRC message. Then, UE-to-Network Relay UE triggers legacy on-demand SI acquisition procedure according to its own RRC state (if needed) and sends the acquired SIB to UE-to-Network Remote UE. PC5-RRC message can be used to carry the system information forwarding via PC5.

The UE-to-Network Remote UE can receive the system information via PC5 after PC5 connection establishment with UE-to-Network Relay UE.

**Paging**

When both UE-to-Network Relay UE and UE-to-Network Remote UE are in RRC IDLE/RRC INACTVE, the UE-to-Network Relay UE monitors paging occasions of its PC5-RRC connected Remote UE(s). When a UE-to-Network Relay UE needs to monitor paging for a UE-to-Network Remote UE, the UE-to-Network Relay UE should monitor all POs for the UE-to-Network Remote UE.

Unicast can be used for the paging forwarding via PC5.

When both UE-to-Network Relay UE and UE-to-Network Remote UE are in RRC CONNECTED, the UE-to-Network Relay UE may monitor SI change indication and/or PWS notifications in any PO as legacy procedure.

**Access control**

The UE-to-Network Remote UE performs unified access control based on legacy procedure.

**TAU/RNAU**

The UE-to-Network Remote UE performs TAU/RNAU procedure while in RRC\_INACTIVE or RRC\_IDLE. For UE-to-Network Remote UE in coverage, it performs TAU/RNAU based on its own serving cell information (i.e., as legacy) if it is not PC5-connected with a UE-to-Network Relay UE.

### 16.x.6 Service Continuity for L2 U2N relay

Editor's Note: The current descriptions of the procedures are the baselines agreed in the study phase.

16.x.6.1 Switching from indirect to direct path

For service continuity of L2 UE-to-Network relay, the following procedure is used, in case of UE-to-Network Remote UE switching to direct Uu cell.



Figure 16.x.6.1 -1: Procedure for UE-to-Network Remote UE switching to direct Uu cell

Step 1: Legacy Measurement configuration and Measurement Report signalling procedures can be used with extension to evaluate relay link measurement and Uu link measurement. Detailed measurement results from UE-to-Network Remote UE are reported when configured reporting criteria is met as legacy measurement report. The SL relay measurement report can include at least UE-to-Network Relay UE ID, serving cell ID, and SL-RSRP information.

Step 2: Decision of switching to a direct cell is made by gNB

Step 3: RRC Reconfiguration message is sent to the UE-to-Network Remote UE. The UE-to-Network Remote UE stops UP and CP transmission via relay link after reception of RRC Reconfiguration message from gNB.

Step 4: The UE-to-Network Remote UE performs Random Access to the gNB

Step 5: The UE-to-Network Remote UE feedbacks the RRCReconfigurationComplete to gNB via target path, using the target configuration provided in the RRC Reconfiguration message.

Step 6: RRC Reconfiguration is sent to the UE-to-Network Relay UE

Step 7: The PC5 link is released between the UE-to-Network Remote UE and the UE-to-Network Relay UE, if needed.

Step 8: The data path is switched from indirect to direct path between the UE-to-Network Remote UE and the gNB. The timing of step 8 is independent of step 6 and step 7.

During the procedure for UE-to-Network Remote UE switching to direct Uu cell, the RLC and lower layers behaviours of a Remote UE can be similar with those of legacy UE in intra-gNB handover.

16.x.6.2 Switching from direct to indirect path

For service continuity of L2 UE-to-Network Relay, the following procedure is used, in case of UE-to-Network Remote UE switching to indirect Relay UE:



Figure 16.x.6.2-1: Procedure for UE-to-Network Remote UE switching to indirect Relay UE

Step 1: UE-to-Network Remote UE reports one or multiple candidate UE-to-Network Relay UE(s), after UE-to-Network Remote UE measures/discoveries the candidate UE-to-Network Relay UE(s).

- UE-to-Network Remote UE may filter the appropriate UE-to-Network Relay UE(s) meeting higher layer criteria when reporting. The detailed measurement results from UE-to-Network Remote UE are reported when configured reporting criteria is met as legacy measurement report.

- The reporting can include at least UE-to-Network Relay UE ID, UE-to-Network Relay UE’ serving cell ID, and the RSRP information over sidelink.

Step 2: Decision of switching to a target UE-to-Network Relay UE is made by gNB, and target (re)configuration is sent to UE-to-Network Relay UE optionally (like HO preparation).

Step 3: RRC Reconfiguration message is sent to the UE-to-Network Remote UE. The contents in the RRC Reconfiguration message can include at least Relay UE ID, PC5 RLC configuration for relaying and associated E2E RB. The UE-to-Network Remote UE stops UP and CP transmission over Uu after reception of RRC Reconfiguration message from gNB.

Step 4: The UE-to-Network Remote UE establishes PC5 connection with target UE-to-Network Relay UE, if the connection has not been setup yet.

Step 5: The UE-to-Network Remote UE feedback the RRCReconfigurationComplete to gNB via target path, using the target configuration provided in RRCReconfiguration.

Step 6: The data path is switched from direct to indirect path between the UE-to-Network Remote UE and the gNB.

# Annex - Collection of RAN2 agreements on NR SL Relay WI

Cyan highlight – agreement captured in stage-2 specifications

Green highlight – stage-3 level agreement, not captured in stage-2 specifications

No highlight – agreement with no direct impact on specifications

## RAN2#113bis-e agreements

***Relay discovery***

* As in LTE, the RRC\_IDLE/RRC\_INACTIVE relay UE is able to perform discovery message transmission, in case:

- Uu RSRP is above a configured minimum threshold by a hysteresis and below a configured maximum threshold by a hysteresis, or

- only minimum threshold is provided and Uu RSRP is above the minimum threshold by a hysteresis, or

- only maximum threshold is provided and Uu RSRP is below the maximum threshold by a hysteresis

* As in LTE, the RRC\_IDLE/RRC\_INACTIVE remote UE is able to perform discovery message transmission, if and only if Uu RSRP of serving cell is below a configured minimum threshold by a hysteresis.
* Define threshHighRelay and threshLowRelay for relay UE and threshHighRemote for remote UE. The value range for the three thresholds can be half of RSRP-Range specified in TS 38.331.
* One new SL-SRB4 is used for all discovery messages. Its parameters will be fixed and defined as SCCH configuration in 38.331. (FFS on the LCH priority in Proposal 8b)
* No ciphering and integrity protection in PDCP layer is needed for the discovery messages.
* [609] Shared resource pool shall be the baseline for discovery message transmission/reception.
* [609] For determining whether remote UE and/or relay UE in RRC CONNECTED can trigger discovery message transmission, i.e., the remote UE and relay UE in the RRC\_CONNECTED can use the threshold based methods as in IDLE/INACTIVE, to determine whether it is allowed to perform discovery message transmission.
* [609] Relay UE and remote UE (IC) in RRC CONNECTED can use the discovery configuration provided via dedicated signalling if available.
* [609] Relay UE and remote UE (IC) in RRC IDLE or RRC INACTIVE shall use the discovery configuration provided via SIB if available.
* [609] WA: L3 relay UE uses pre-configuration for discovery, only if the discovery SIB configuration is not provided by gNB, in case its serving carrier is not shared with carrier for sidelink operation. Otherwise, L3 relay UE uses the configuration for discovery provided by gNB.
* [609] L2 relay UE will always use the discovery configuration provided by gNB (either via SIB or dedicated signalling).
* [609] FFS: Remote UE (regardless of L2 relaying or L3 relaying) performs discovery based on pre-configuration, only if the discovery configuration is not provided by gNB (regardless not provided, or not able to provide, or not able to obtain in OOC, etc.). Otherwise, Remote UE uses the configuration for discovery provided by gNB..

***Relay re/selection***

* For relay (re)selection, RAN2 clarify that only the common parts of L2 and L3 relay is required to be completed by RAN#92. L2 specific design may be discussed in L2 relay agenda items in contribution driven manner.
* RAN2 confirm below NR relay (re)selection procedures which are same as LTE Prose relay:

1) PC5 Measurement: For relay(s) without unicast PC5 sconnection, remote UE uses RSRP measurements of sidelink discovery messages (i.e. SD-RSRP) to evaluate whether PC5 link quality of a Relay UE satisfies relay selection and reselection criterion

2) Trigger of relay selection: Triggered at remote UE when: a) direct Uu link quality is below a configured threshold for an in-coverage remote UE (in IDLE/INACTIVE and CONNECTED for L3 U2N relay; L2 case to be further discussed); or b) triggered by upper layer

3) Trigger of relay reselection: Triggered at remote UE when: a) PC5 measurement towards current relay UE is below a (pre)configured threshold; or b) Reception of an upper layer release message or similar indication from current relay UE; or c) Triggered by upper layer

4) How to choose relay UE in relay (re)selection: Remote UE searches for suitable relay UE candidates which meet all AS-layer & higher layer criteria. If multiple such candidate relay UEs available, it is up to Remote UE implementation to choose one Relay UE.

* Same as LTE, Uu link threshold (like threshHigh-r13), PC5 link threshold(like q-RxLevMin-r13), L3 filter coefficient for SD-RSRP/SL-RSRP (like filterCoefficient-r13) and hysteresis (like hystMax-r13 and minHyst-r13) can be provided via SIB/RRC by gNB or pre-configuration. Handling of Uu link threshold being absent can reuse LTE approach (i.e. when absence, remote UE considers condition to be met).
* In SD-RSRP measurement for relay (re)selection trigger and candidate relay evaluation, L3 filtering is applied across measurements on the DMRS of PSSCH transmission which carries discovery message from the concerned relay.
* RAN2 confirm that remote UE triggers relay reselection if PC5 RLF with current relay UE is detected by remote UE. FFS if there is any impact to other RLF handling activities.
* Uu quality between relay UE and gNB is not included in discovery message as additional AS criteria for relay (re)selection
* Include the information required for agreed additional AS criteria in discovery message.
* [610] For L3 relay, the use of PLMN ID and cell ID in relay (re)selection is up to SA2
* [610] For L2 relay, PLMN ID supported as additional AS criteria for relay (re)selection. Whether cell ID is used can be further discussed by RAN2.
* [610] Besides serving cell ID, PLMN ID, L2/L3 relay support (if agreed in discovery session) and relay load, other additional AS criteria are not considered in this release.
* [611] For L2/L3 relay common parts of relay (re)selection, RAN2 confirm that there is no support of service continuity from AS layer perspective
* [611] gNB controlled relay (re)selection” or “gNB controlled path switch” belong to L2 relay service continuity agenda item, and they are not treated in relay (re)selection discussion by RAN#92
* [611] QoS controlled relay (re)selection is not treated in relay (re)selection discussion by RAN#92
* [611] When PC5 RLF is detected by relay UE on a PC5 unicast link towards a remote UE, relay UE in RRC\_CONNECTED sends the PC5 RLF indication to gNB (as supported in R16 specification).
* [611] When Uu RLF is detected by relay UE, relay UE may send a PC5-S message (similar to LTE) to its connected remote UE(s) and this message may trigger relay reselection. FFS other indication/message can also be used for notification.
* [611] When relay performs HO to another gNB, relay UE may send a PC5-S message (similar to LTE) to its connected remote UE(s) and this message may trigger relay reselection. FFS other indication/message can also be used for notification
* [611] If both a suitable cell and a suitable relay are available, the remote UE can select either one (or both, for L3 relay only) based on its implementation in this release (i.e. TS 38.304 will not specify any additional procedure for selecting between the cell and the relay). FFS whether any enhancements to the cell (re)selection procedure for L2 relay.

***L2 relay control procedure***

* [603] The remote UE should perform TAU/RNAU procedure while in RRC\_INACTIVE and RRC\_IDLE. No LS to be sent from this meeting to SA2/ CT1/RAN3 on the remote UE’s TAU/RNAU procedure.
* [603] For the delivery of remote UE’s SRB0 RRC message, specified (fixed) configuration is used for the configuration of PC5 RLC channel. FFS for the Uu RLC channel.
* [603] For the delivery of remote UE’s SRB1 RRC message other than RRCResume and RRCReestablishment message, network configuration via dedicated signalling is used for the configuration of PC5 RLC channel and Uu RLC channel.
* [603] For the delivery of remote UE’s SRB1 RRC message such as RRCResume and RRCReestablishment message, default configuration is used for the configuration of PC5 RLC channel which can be reconfigured by network. FFS for Uu RLC channel.
* [603] For the delivery of remote UE’s SRB2 RRC message, network configuration via dedicated signalling is used for the configuration of PC5 RLC channel and Uu RLC channel.
* [603] For the delivery of remote UE’s Uu DRB packet, network configuration via dedicated signalling is used for the configuration of PC5 RLC channel and Uu RLC channel.
* [603] For the PC5 RLC channel configuration, only the RLC/LCH configuration is provided to the relay UE and remote UE.
* [603] For the Uu RLC channel configuration, only the RLC/LCH configuration is provided to the relay UE.
* [603] For the remote UE’s SRB1/SRB2 configuration, only the Uu PDCP configuration is provided to the remote UE.
* [603] For the remote UE’s DRB configuration, only the Uu PDCP/SDAP configuration is provided to the remote UE.
* [603] For RRC\_Connected remote UE, RAN2 confirm that DedicatedSIBRequest procedure is re-used for the Remote UE to request the SI via relay UE.
* [603] For RRC\_Idle/INACTIVE remote UE, remote UE informs relay UE on requested SIB type(s) via PC5 RRC message. Then, relay UE triggers legacy on-demand SI acquisition procedure according to its own RRC state (if needed) and sends the acquired SIB to remote UE.
* [603] PC5-RRC message can be used to carry the system information forwarding via PC5.
* [603] Suppose a relay UE needs to monitor paging for a remote UE, the relay UE should monitor all POs for the remote UE as a baseline.
* [603] Unicast can be used for the paging forwarding via PC5.
* [603] WA: Remote UE can reuse legacy access control and no need to enhance the access control procedure of Remote UE. FFS whether the relay UE performs UAC for itself.

***L2 relay Protocol architecture***

* [604] For both DL and UL transmission of Uu radio bearers other than SRB0, identity information of a remote UE and its Uu radio bearer are included in the header of adaptation layer over Uu. FFS for SRB0. FFS if the presence of adaptation layer header can be configurable. (24/24)
* [604] The radio bearer ID in the adaptation layer header is the Uu radio bearer ID of the remote UE. (23/24)
* [604] The UE ID in the adaptation layer header is a local, temporary remote UE ID. FFS whether the local, temporary remote UE ID is assigned by the relay UE, or the serving gNB of the relay UE. (23/24)
* [604] Mapping is done at Relay UE between PC5 RLC bearer IDs, identity information of remote UE and Uu radio bearer, and Uu RLC bearer IDs.

## RAN2#114-e agreements

***Relay discovery***

* Proposal 3b (modified): RAN2 confirm the SI conclusion that for L2 remote UE which is out-of-coverage, and is neither in RRC\_CONNECTED nor RRC\_IDLE/INACTIVE, it can rely on pre-configuration.
* Proposal 4 (modified): RAN2 confirm the SI conclusion that for L3 remote UE which is out-of-coverage, and is neither in RRC\_CONNECTED nor RRC\_IDLE/INACTIVE, it should follow pre-configuration.
* Proposal 3a (modified): RAN2 agree that for L2 remote UE which is out-of-coverage, but connected to network via a relay UE (i.e., either in RRC CONNECTED or RRC IDLE/INACTIVE), it should follow network configuration, i.e., SIB or dedicated signalling, if available.
* Proposal 1b: RAN2 agree that for relay/remote UE in RRC IDLE/INACTIVE state, in-coverage on the serving frequency, and the serving frequency is not shared with concerned frequency, if the configuration of concerned SL frequency is absent within the SIB of the serving frequency or if there is no discovery related SIB on the serving frequency

- If there is Uu coverage at the concerned SL frequency, UE shall 1) rely on the discovery related SIB, if any broadcasted in the concerned SL frequency; Or 2) if there is no discovery related SIB on the concerned SL frequency, UE does not perform SL discovery transmission/reception on the concerned frequency.

- If there is no Uu coverage at the concerned frequency, UE shall rely on pre-configuration.

* Proposal 1c: RAN2 agree that for relay/remote UE in RRC IDLE/INACTIVE state, in-coverage on the serving frequency，if the serving frequency is shared with concerned SL frequency

- If there is no discovery related SIB broadcasted on the serving carrier, UE does not perform SL discovery transmission/reception on the concerned frequency.

* Proposal 6: RAN2 agrees to reuse Rel-16 power control mechanism for transmission of discovery messages.
* Proposal 8: The same PDCP data PDU format as SL-SRB0 is used for sidelink discovery message (SL-SRB4), and the SDU type field is not used for SL-SRB4.
* Proposal 9: RAN2 agrees to postpone the discussion related to resource allocation to after RAN#92-e.
* Proposal 10: RAN2 to postpone the issue on network capability differentiation to stage 3 ASN.1 discussion.
* Proposal 11: RAN2 rely on SA2 on the L2 ID design for discovery message. No LS is needed.
* Proposal 13: De-prioritize additional condition for discovery transmission/reception in Rel-17.
* [617]Proposal 1 [easy]: RAN2 agrees that for relay/remote UE in RRC IDLE/INACTIVE state, and in-coverage on the serving frequency, if there is discovery related SIB broadcasted on the serving frequency, and if the configuration of concerned SL frequency is included within the SIB of the serving frequency but the Tx resource pool configuration is absent, UE shall enter RRC CONNECTED state to acquire dedicated configuration on Tx resource pool.
* [617]Proposal 2 [easy]: RAN2 agree that RRC\_CONNECTED relay/remote UE which are in-coverage on the serving frequency, if there is discovery related SIB broadcasted on the serving frequency, and if the configuration of concerned SL frequency is included within the SIB of the serving frequency, it can only use the SL discovery Tx resource configuration provided by dedicated signalling if provided, or not transmit discovery if not provided.
* [617]Proposal 3a [easy]: RAN2 agree that RRC\_CONNECTED L3 relay/remote UE or layer 2 remote UE which are in-coverage on the serving frequency, and the serving frequency is not shared with concerned frequency, if the configuration of concerned SL frequency is absent within the SIB of the serving frequency or if there is no discovery related SIB on the serving frequency,

- If there is Uu coverage at the concerned SL frequency, UE shall 1) rely on the discovery related SIB, if any broadcasted in the concerned SL frequency; Or 2) if there is no discovery related SIB on the concerned SL frequency, UE does not perform SL discovery transmission/reception on the concerned frequency.

- If there is no Uu coverage at the concerned frequency, UE shall rely on pre-configuration.

* [617]Proposal 4a [easy]: RAN2 agree that for L2 remote UE which is out-of-coverage, but connected to network via a relay UE and in RRC IDLE/INACTIVE state, if the network configuration is not available, i.e., SIB, remote UE shall rely on pre-configuration to perform discovery.
* [617]Proposal 5 [easy]: RAN2 agrees to down-prioritize discovery specific resource allocation optimization in this release.
* [617]Proposal 9 [easy]: RAN2 agrees to down-prioritize the support of discovery gaps in this release.
* [617]Proposal 4b [discussion]: RAN2 agree that for L2 remote UE which is out-of-coverage, but connected to network via a relay UE and in RRC CONNECTED state, if the network configuration is not available, i.e., SIB or dedicated signalling, remote UE shall rely on pre-configuration to perform discovery.
* [617]Proposal 6 [discussion]: RAN2 agrees dedicated discovery resource pool is supported besides shared resource pool configuration, whether it is configured is based on network implementation. And PHY layer parameters and design shall reuse the Rel-16 legacy resource pool design (including resource allocation design).
* [617]RAN2 agree that the UE selection between dedicated and shared pool can be discussed as a stage 3 issue after RAN#92-e.
* [617]Proposal 8 [discussion]: RAN2 agrees to fix the priority value as 1 of sidelink discovery message in the specification.

***Relay (re)selection***

* Relay load is not considered as a (re)selection criterion in Rel-17.
* Use only SL-RSRP if available; discuss the no data case by email.
* Proposal 3: For L2 U2N relay, RRC\_IDLE/RRC\_INACTIVE remote UE triggers relay selection when direct Uu link quality is below a configured threshold, and relay selection for RRC\_CONNECTED remote UE by gNB is handled in CP procedure and service continuity topic for L2 relay.
* Proposal 4: For L2 U2N relay, cell ID can be used as additional AS criteria for relay (re)selection. RRC states under which the cell ID may be applied by L2 remote UE and how to use it by L2 remote UE are left to be addressed for L2 specific discussions. And the usage of cell ID by gNB for RRC CONNECTED L2 remote UE is handled by CP procedure and service continuity topic for L2 relay.
* Proposal 6: It is up to SA2 to decide how to include L2/L3 relay support in discovery message.
* Proposal 7: For RRC\_IDLE/INACTIVE L2 remote UE, the legacy cell (re)selection procedure and relay (re)selection procedure could go independently and up to UE implementation to select either cell or relay. For RRC\_CONNECTED L2 remote UE, it is handled by CP procedure and service continuity topic for L2 relay.
* [618]Leave to UE implementation whether to use SL-RSRP or SD-RSRP for relay reselection trigger evaluation in case of no data transmission from relay to remote.
* [618]Proposal 4[18/22][Easy]: Whether L2/L3 relay support can be used as additional criteria for relay (re-)selection can be left to SA2.
* [618]RAN2 do not specify a solution to the power imbalance issue for relay (re)selection in Rel-17.
* [618]RAN2 understand that the L2/L3 common parts of the relay discovery and (re)selection objectives are complete at stage 2 level from RAN2 perspective.

***Control plane procedures***

* [604]Proposal 5： [18/18][Easy]The Uu RLF indication from Relay UE may trigger the Remote UE connection re-establishment
* [604]Proposal 6： [18/18][Easy] The Remote UE may trigger the Remote UE connection re-establishment upon detecting PC5 RLF.
* [604]Proposal 8： [18/18][Easy]Confirm that for the OOC case, Remote UE with the RRC state of IDLE or INACTIVE should perform TAU/RNAU procedure
* [604]Proposal 9： [18/18][Easy]For IC Remote UE case, Remote UE performs TAU/RNAU based on its own serving cell information (i.e., as legacy) if it is NOT PC5-connected with Relay UE.
* [604]Proposal 13： [18/18][Easy] the Remote UE can receive the system information via PC5 after PC5 connection establishment with Relay UE.
* [604]Proposal 1： [14/18[Easy] RRC state combination of Relay UE in RRC\_IDLE and Remote UE in RRC\_INACTIVE is supported.
* [604]Proposal 7 (modified)： [16/17][Easy] The Remote UE may perform RRC re-establishment procedure as follows:

‒ If only suitable cell(s) are available, the Remote UE initiates RRC re-establishment procedure towards a suitable cell;

‒ If only suitable relay(s) are available, the Remote UE initiates RRC re-establishment procedure towards a suitable relay UE’s serving cell;

‒ If both a suitable cell and a suitable relay are available, the remote UE can select either one to initiate RRC re-establishment procedure based on implementation.

* [604]Proposal 11： [15/18][Easy]In case of Remote UE RRC resume to a new gNB, legacy Retrieve UE Context procedure is performed, i.e., the new gNB retrieves the Remote UE context for Remote UE.
* [604]Proposal 17： [17/18][Easy]When Relay UE in RRC IDLE/RRC INACTVE and Remote UE in RRC IDLE/RRC INACTIVE, the Relay UE monitors paging occasions of its PC5-RRC connected Remote UE(s)
* [604]Proposal 19： [17/18][Easy]When Relay UE in RRC CONNECTED and Remote UE in RRC CONNECTED, the Relay UE may monitor for SI change indication and/or PWS notifications in any PO as legacy.
* [604]Proposal 22： [15/18][Easy] A new PC5-RRC message is needed to relay the paging information from Relay UE to Remote UE for unicast.
* [604]Proposal 2： [16/18[Cross WG] RAN2 to send a LS to SA2/CT1 to ask their view on whether a new or existing establishment/resume cause value is used for Relay UE when Relay UE enters RRC\_CONNECTED only for relaying purpose.
* [604]Proposal 23： [17/18][Cross WG] Confirm the WA that Remote UE performs UAC based on legacy procedure and send a LS to SA2/CT1 to inform about RAN2 decision.

***Service Continuity***

* [605]Proposal 1 (easy) (19/19): The procedure of Figure 4.5.4.1-1 in TR38.836 and the procedure of Figure 4.5.4.2-1 in TR38.836 are the baseline for Remote UE’s intra gNB mobility in RRC\_CONNECTED.
* [605]Proposal 2 (easy) (19/19): INM RRC and/or X2/Xn messages for inter-gNB handover are not used for the path switch procedures in intra gNB case.
* [605]Proposal 3 (easy) (19/19): DAPS-like path switch procedure for Remote UE is not considered in this release.
* [605]Proposal 6 (easy) (19/19): Legacy RRC Reconfiguration and Measurement Report signalling procedures can be used for path switch procedure with extension to evaluate relay link measurement and Uu link measurement.
* [605]Proposal 10 (easy) (19/19): In case of path switch from indirect to direct, detailed measurement results from Remote UE are reported when configured reporting criteria is met as legacy measurement report.
* [605]Proposal 11 (easy) (19/19): SL relay measurement report can include at least Relay UE ID, serving cell ID, RSRP information.
* [605]Proposal 13 (easy) (19/19): Remote UE in RRC\_CONNECTED suspend Uu RLM when Remote UE is connected to gNB via Relay UE.
* [605]Proposal 14 (easy) (19/19): For indirect to direct path switch, Remote UE stops UP and CP transmission via relay link after reception of RRC Reconfiguration message from gNB (i.e., step 3).
* [605]Proposal 23 (easy) (19/19): For indirect to direct path switch, the timing of step 8 is independent of step 6 and step 7.

[Note: P23 refers to the step numbers from Figure 4.5.4-1 of TR 38.836]

* [605]Proposal 24 (easy) (19/19): For indirect to direct path switch, RLC and lower layers behaviours of a Remote UE can be similar with those of legacy UE in intra-gNB handover.
* [605]Proposal 29 (easy) (19/19): For direct to indirect path switch, Remote UE stops UP and CP transmission over Uu after reception of RRC Reconfiguration message from gNB (i.e., step 3).
* [605]Proposal 31 (easy) (19/19): For direct to indirect path switch, the contents in RRC Reconfiguration message for Remote UE can include at least Relay UE ID, PC5 RLC configuration for relaying and associated E2E RB.

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