**3GPP TSG-RAN2 Meeting # *R2-220wxyz***

**, - , 2022**

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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:***  |  |
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| ***Source to WG:*** | MediaTek Inc. |
| ***Source to TSG:*** |  |
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| ***Work item code:*** |  |  | ***Date:*** |  |
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| ***Category:*** |  |  | ***Release:*** |  |
|  | *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 canbe 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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | 1. NR sidelink communication is used to carry the 5G Proximity based Services (ProSe) as defined in TS 23.304, which cover 5G ProSe Direct Discovery, 5G ProSe Direct communication and 5G ProSe UE-to-Network Relay Communication.
2. Added text to specify resource allocation for L3 U2N relays.
3. As specified in TS 38.351, for Remote UE’s SRB0, it is also handled by SRAP sublayer for at least bearer mapping. It is confusing to say “the SRAP sublayer is not present over PC5 hop”. Actually, it is more accurate to say that SRB0 is transmitted without SRAP header over PC5 hop. It is suggested to change to “the SRAP header is not present over PC5 hop”.
4. There is a typo at SRAP header on the remote UE’s SRAP prcessing (which should be PC5 SRAP). There is a restriction on the update of local Remote ID via *RRCReconfiguration* message from gNB to only Relay UE
5. The Uu threshold configured by the network is used by the U2N remote UE to determine if it can transmit/receive NR sidelink discovery message, not only for transmiting Relay discovery solicitation message
6. Unclear text for the resource allocation of Relay discovery.
7. In clause 16.12.4, the Relay UE can indicate Remote UE to do U2N Relay reselection, when the Uu RRC connection establishment/resume of Relay UE failures, as specified in 38.331, in addition to cell (re)selection, handover, and Uu RLF happens. This case is missing in the current specification.
8. In L2 U2N Relay UE, there are two kinds of RLF, i.e., Uu RLF and PC5 RLF, for a Relay UE. The RLF type should be clearly indicated to avoid misunderstanding.
9. A relay UE in any state does not perform UAC for remote UE. However, the current spec limits it in RRC-CONNECTED.
10. The configuration of within *RRCSetup* message gNB to U2N Remote UE during RRC connection establishment is not clear.
11. Lack of readability on the description for paging monitoring indication
12. The “sidelink measurement quantity information” in sidelink relay measurement report is not clear. It seems like to report an indication of SL-RSRP or SD-RSRP. Actually, it is the measured quantity results in the measurement report. So suggest to change to “sidelink measurement quantity result”.
13. The cause value setting in the case when the L2 U2N relay starts from IDLE/INACTIVE for service continuity is not described
14. The case of RAN sharing is not covered for serving cell ID report
15. In 16.12.6.1, in step 6, since relay UE may serve multiple remote UEs, the RRC reconfiguration to relay UE is just to release the Uu/PC5 Relay RLC channel and bearer mapping configuration related to the remote UE switched to direct link. So it is better to explicitly capture that the configuration is related to the remote UE.
16. According to RAN2#116 agreements, the sharing of unicast link between relay service and non-relay service is not considered and the related descriptions are to be removed from stage 2 spec. It is not necessary to keep PC5 unicast link between remote UE and relay UE when remote UE switched to direct path. So the execution of PC5 connection reconfiguration to release PC5 relay RLC channel related description shall be removed in step 7 in 16.12.6.1. In addition, the agreement that “Remote UE or Relay UE’s AS layer releases PC5-RRC connection and indicates upper layer to release PC5 unicast link” could be captured in step 7.
17. The identity information within *RRCReconfiguration* message (for the case that Remote UE switches from direct to indirect path) is not complete.
18. In 16.12.6.1, in step 8, suggest to remove “The DL/UL lossless delivery during the path switch is done according to PDCP data recovery procedure.” And just capture the agreement “The legacy PDCP re-establishment or data recovery in UL should be performed by the Remote UE during path switch if gNB configures it.”.
19. As agreed in RAN2, when gNB selects an IDLE/INACTIVE Relay UE for Remote UE, the Relay UE is triggered into RRC\_CONNETCED by the *RRCReconfigurationComplete* message from Remote UE (i.e. step5 to trigger relay UE into connected state). Thus the *RRCReconfigurationComplete* message is before the RRC setup and Reconfiguration procedure of Relay UE. This is not correctly captured in clause 16.12.6.2.
20. In 16.12.6.2, in case the selected relay UE is in RRC\_IDLE or RRC\_INACTIVE, it is not correct to say “...step 4 is performed before step 2”. As we can see, step 2 includes two parts, i.e. “Decision of switching to a target relay UE” and “RRC reconfiguration” to relay UE, actually, it is the “RRC reconfiguration” to relay UE performed after relay UE enters RRC\_CONNECTED.
21. L2 terminology is not aligned
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| ***Summary of change:*** | 1. In 3.2, text is expaned to allow NR sidelink communication be used to carry the 5G Proximity based Services (ProSe) as defined in TS 23.304
2. Added text for missing L3 U2N relays behaviour.
3. Editorial changes/corrections and added a note to clarify U2N relay UE cause value setting for when initiating connection establishment from IDLE/INACTIVE state.
4. Editorial changes/corrections and added a note to clarify U2N Remote UE behaviour in the case of RAN sharing
5. In 16.12.2.1, change “the SRAP sublayer is not present over PC5 hop” to “the SRAP header is not present over PC5 hop”. In 16.12.2.1, Uu SRAP is changed to PC5 SRAP the remote UE’s SRAP prcessing. Remove the restriction of local Remote ID, which mean it can be updated for both Relay UE and Remote UE
6. In 16.12.3, reorganize the sentence to make the text clear and show that the resource allocation is actually for the transmission of Relay discovery message. And also change some editorals.
7. Modify in clause 16.12.3 that broadcasted threshold by network is used by the U2N Remote UE to determine if it can transmit Relay discovery solicitation messages to U2N Relay UE(s) and receive the Relay discovery messages to U2N Relay UE(s).
8. Add the case Uu RRC connection establishment/resume of Relay UE failures in clause 16.12.4.
9. In 16.12.5.1, in step-2 of RRC connection establishment from Remote UE to gNB, add that when the gNB responds with an *RRCSetup* message to U2N Remote UE, the PC5 Relay RLC channel configuration and SRAP configuration of the Remote UE SRB1 is included.
10. In clause 16.12.5.2, clarify that the radio link failure happends to Relay UE is “Uu RLF”.
11. In 16.12.5.6, change the text to say the paging monitoring is based on the indication within PC5 RRC signalling and do some other miscellaneous ediroal change
12. In clause 16.12.5.7, modify that the U2N Relay UE does not perform UAC for U2N Remote UE's data, not for RRC\_CONNECTED Relay UE only, by removing “in RRC-CONNECTED”. In 16.12.5.7, add the reference number for the referred TS.
13. In 16.12.6, Clarified that path switch between indirect path and group mobility are not supported in Rel-17 and then add one more subsection.
14. In old 16.12.6.1, change the “sidelink measurement quantity information” in sidelink relay measurement report to “sidelink measurement quantity result”.
15. In old 16.12.6.1, in step 6, capture that the configuration is related to the remote UE. In old 16.12.6.1, remove “PC5 connection reconfiguration to release PC5 relay RLC channel” related descriptions in step 7. And capture “Remote UE or Relay UE’s AS layer releases PC5-RRC connection and indicates upper layer to release PC5 unicast link” in step 7.
16. Remove the sentence “The DL/UL lossless delivery during the path switch is done according to PDCP data recovery procedure.”. Instead, capture “The legacy PDCP re-establishment or data recovery in UL should be performed by the Remote UE during path switch if gNB configures it.”.
17. In old 16.12.6.2, Include the Remote UE's local ID within the *RRCReconfiguration* message for the case that Remote UE switches from direct to indirect path.
18. In old 16.12.6.2, modified the sentence “...step 4 is performed before step 2” to “the RRC Reconfiguration to U2N Relay UE in step 2 is performed after it enters RRC\_CONNECTED state”.
19. Fix the editorials.
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| ***Consequences if not approved:*** | 1. Some descriptions are not aligned with the agreements made.
2. Unclear text remains.
3. Readbility needs to improve for the descriptions
4. Some terminologies are not aligned
5. Some descriptions are incomplete
6. Editorial issues remain
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| ***Clauses affected:*** | 3.2 16.12 |
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|  | **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 ...  |
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| ***Other comments:*** |  |
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| ***This CR's revision history:*** |  |

*Start Change*

## 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**.**

**Boundary IAB-node:** as defined in TS 38.401 [4].

**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.

**Direct Path**: a type of UE-to-Network transmission path, where data is transmitted between a UE and the network without sidelink relaying.

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

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

**Earth-centered, earth-fixed**: A global geodetic reference system for the Earth intended for practical applications of mapping, charting, geopositioning and navigation, as specified in NIMA TR 8350.2 [51].

**Feeder link**: Wireless link between the NTN Gateway and the NTN payload.

**Geosynchronous Orbit**: Earth-centered orbit at approximately 35786 kilometres above Earth's surface and synchronised with Earth's rotation. A geostationary orbit is a non-inclined geosynchronous orbit, i.e. in the Earth’s equator plane.

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

**High Altitude Platform Station**: airborne vehicle embarking the NTN payload placed at an altitude between 8 and 50 km.

**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.

**IAB topology:** The unison of all IAB-nodes and IAB-donor-DUs that are interconnected via BH links and terminate F1 and/or RRC at the same IAB-donor-CU.

**Indirect Path**: a type of UE-to-Network transmission path, where data is forwarded via a U2N Relay UE between a U2N Remote UE and the network.

**Inter-donor partial migration:** Migration of an IAB-MT to a parent node underneath a different IAB-donor-CU while the collocated IAB-DU and descendant IAB-node(s), if any, are terminated at the initial IAB-donor-CU. The procedure renders the said IAB-node as a boundary IAB-node.

**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.

**Mapped Cell ID**: In NTN, it corresponds to a fixed geographical area.

**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.

**Non-Geosynchronous orbit**: Earth-centered orbit with an orbital period that does not match Earth's rotation on its axis. This includes Low and Medium Earth Orbit (LEO and MEO).

**Non-terrestrial network**: An NG-RAN consisting of gNBs, which provide non-terrestrial NR access to UEs by means of an NTN payload embarked on an airborne or space-borne NTN vehicle and an NTN Gateway.

**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] and the 5G Proximity based Services (ProSe) as defined in TS 23.304 [48], between two or more nearby UEs, using NR technology but not traversing any network node.

**NTN Gateway**: an earth station located at the surface of the earth, providing connectivity to the NTN payload using the feeder link. An NTN Gateway is a TNL node.

**NTN payload:** a network node, embarked on board a satellite or high altitude platform station, providing connectivity functions, between the service link and the feeder link. In the current version of this specification, the NTN payload is a TNL 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

**PC5 Relay RLC channel**: an RLC channel between L2 U2N Remote UE and L2 U2N Relay UE, which is used to transport packets over PC5 for L2 UE-to-Network Relay**.**

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

**RedCap UE:** A UE with reduced capabilities as specified in sub-clause 4.2.21.1. in TS 38.306 [11].

**Relay discovery**: AS functionality enabling 5G ProSe UE-to-Network Relay Discovery as defined in TS 23.304 [48], using NR technology but not traversing any network node.

**Satellite:** a space-borne vehicle orbiting the Earth embarking the NTN payload.

**Service link:** Wireless link between the NTN payload and UE.

**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.

**U2N Relay UE:** a UE that provides functionality to support connectivity to the network for U2N Remote UE(s).

**U2N Remote UE:** a UE that communicates with the network via a U2N Relay UE.

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

**Uu Relay RLC channel**: an RLC channel between L2 U2N Relay UE and gNB, which is used to transport packets over Uu for L2 UE-to-Network Relay**.**

**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 Change*

## 16.12 Sidelink Relay

### 16.12.1 General

Sidelink relay is introduced to support 5G ProSe UE-to-Network Relay (U2N Relay) function (specified in TS 23.304 [48]) to provide connectivity to the network for U2N Remote UE(s). Both L2 and L3 U2N Relay architectures are supported. The L3 U2N Relay architecture is transparent to the serving RAN of the U2N Relay UE, except for controlling sidelink resources. The detailed architecture and procedures for L3 U2N Relay can be found in TS 23.304 [48].

A U2N Relay UE shall be in RRC\_CONNECTED to perform relaying of unicast data.

For L2 U2N Relay operation, the following RRC state combinations are supported:

- Both L2 U2N Relay UE and L2 U2N Remote UE shall be in RRC\_CONNECTED to perform transmission/reception of relayed unicast data; and

- The L2 U2N Relay UE can be in RRC\_IDLE, RRC\_INACTIVE or RRC\_CONNECTED as long as all the L2 U2N Remote UE(s) that are connected to the L2 U2N Relay UE are either in RRC\_INACTIVE or in RRC\_IDLE.

A single unicast link is established between one L2 U2N Relay UE and one L2 U2N Remote UE. The traffic of L2 U2N Remote UE via a given L2 U2N Relay UE and the traffic of the L2 U2N Relay UE shall be separated in different Uu Relay RLC channels.

For L2 U2N Relay, the U2N Remote UE can only be configured to use resource allocation mode 2 (as specified in 5.7.2 and 16.9.3.1) for data to be relayed.

### 16.12.2 Protocol Architecture

#### 16.12.2.1 L2 UE-to-Network Relay

The protocol stacks for the user plane and control plane of L2 U2N Relay architecture are illustrated in Figure 16.12.2.1-1 and Figure 16.12.2.1-2. The SRAP sublayer is placed above the RLC sublayer for both CP and UP at both PC5 interface and Uu interface. The Uu SDAP, PDCP and RRC are terminated between L2 U2N Remote UE and gNB, while SRAP, RLC, MAC and PHY are terminated in each hop (i.e. the link between L2 U2N Remote UE and L2 U2N Relay UE and the link between L2 U2N Relay UE and the gNB).

For L2 U2N Relay, the SRAP sublayer over PC5 hop is only for the purpose of bearer mapping. The SRAP sublayer is not present over PC5 hop for relaying the L2 U2N Remote UE's message on BCCH and PCCH. For L2 U2N Remote UE's message on SRB0, the SRAP header is not present over PC5 hop, but the SRAP header is present over Uu hop for both DL and UL.



Figure 16.12.2.1-1: User plane protocol stack for L2 UE-to-Network Relay



Figure 16.12.2.1-2: Control plane protocol stack for L2 UE-to-Network Relay

For L2 U2N Relay, for uplink:

- The Uu SRAP sublayer performs UL bearer mapping between ingress PC5 Relay RLC channels for relaying and egress Uu Relay RLC channels over the L2 U2N Relay UE Uu interface. For uplink relaying traffic, the different end-to-end Uu Radio Bearers(SRBs or DRBs) of the same L2 U2N Remote UE and/or different L2 U2N Remote UEs can be multiplexed over the same egress Uu Relay RLC channel;

- The Uu SRAP sublayer supports L2 U2N Remote UE identification for the UL traffic. The identity information of L2 U2N Remote UE end-to-end Uu Radio Bearer and a local Remote UE ID are included in the Uu SRAP header at UL in order for gNB to correlate the received packets for the specific PDCP entity associated with the right end-to-end Uu Radio Bearer of the L2 U2N Remote UE;

- The PC5 SRAP sublayer at the L2 U2N Remote UE supports UL bearer mapping between L2 U2N Remote UE end-to-end Uu Radio Bearers and egress PC5 Relay RLC channels.

For L2 U2N Relay, for downlink:

- The Uu SRAP sublayer performs DL bearer mapping at gNB to map end-to-end Uu Radio Bearer (SRB, DRB) of L2 U2N Remote UE into Uu Relay RLC channel over L2 U2N Relay UE Uu interface. The Uu SRAP sublayer performs DL bearer mapping and data multiplexing between multiple end-to-end Radio Bearers (SRBs or DRBs) of a L2 U2N Remote UE and/or different L2 U2N Remote UEs and one Uu Relay RLC channel over the L2 U2N Relay UE Uu interface;

 - The Uu SRAP sublayer supports L2 U2N Remote UE identification for DL traffic. The identity information of L2 U2N Remote UE end-to-end Uu Radio Bearer and a local Remote UE ID are included into the Uu SRAP header by the gNB at DL for the L2 U2N Relay UE to map the received packets from L2 U2N Remote UE end-to-end Uu Radio Bearer to its associated PC5 Relay RLC channel;

- The PC5 SRAP sublayer at the L2 U2N Relay UE performs DL bearer mapping between ingress Uu Relay RLC channels and egress PC5 Relay RLC channels;

- The PC5 SRAP sublayer at the L2 U2N Remote UE correlates the received packets for the specific PDCP entity associated with the right end-to-end Radio Bearer of the L2 U2N Remote UE based on the identity information included in the PC5 SRAP header.

A local Remote UE ID is included in both PC5 SRAP header and Uu SRAP header. L2 U2N Relay UE is configured by the gNB with the local Remote UE ID to be used in SRAP header. Remote UE obtains the local Remote UE ID from the gNB via Uu RRC messages including *RRCSetup*, *RRCReconfiguration*, *RRCResume* and *RRCReestablishment*.

The end-to-end DRB(s) or end-to-end SRB(s) of L2 U2N Remote UE can be multiplexed to the PC5 Relay RLC channels and Uu Relay RLC channels in both PC5 hop and Uu hop, but an end-to-end DRB and an end-to-end SRB cannot be mapped into the same PC5 Relay RLC channel or Uu Relay RLC channel.

It is the gNB responsibility to avoid collision on the usage of local Remote UE ID. The gNB can update the local Remote UE ID by sending the updated local Remote UE ID via *RRCReconfiguration* message. The serving gNB can perform local Remote UE ID update independent of the PC5 unicast link L2 ID update procedure.

### 16.12.3 Relay Discovery

Model A and Model B discovery models as defined in TS 23.304 [48] are supported for U2N Relay discovery. The protocol stack used for discovery is illustrated in Figure 16.12.3-1.



Figure 16.12.3.1: Protocol Stack of Discovery Message for UE-to-Network Relay

The U2N Remote UE can perform Relay discovery message (i.e. as specified in TS 23.304 [48]) transmission and may monitor the sidelink for Relay discovery message while in RRC\_IDLE, RRC\_INACTIVE or RRC\_CONNECTED. The network may broadcast a Uu RSRP threshold, which is used by the U2N Remote UE to determine if it can transmit Relay discovery messages to U2N Relay UE(s).

The U2N Relay UE can perform Relay discovery message (i.e. as specified in TS 23.304 [48]) transmission and may monitor the sidelink for Relay discovery message while in RRC\_IDLE, RRC\_INACTIVE or RRC\_CONNECTED. The network may broadcast a maximum Uu RSRP threshold, a minimum Uu RSRP threshold, or both, which are used by the U2N Relay UE to determine if it can transmit Relay discovery messages to U2N Remote UE(s).

The network may provide the Relay discovery configuration using broadcast or dedicated signalling for Relay discovery. In addition, the U2N Remote UE and U2N Relay UE may use pre-configuration for Relay discovery.

The resource pool(s) used for NR sidelink communication can be used for Relay discovery or the network may configure resource pool(s) dedicated for Relay discovery. Resource pool(s) dedicated for Relay discovery can be configured simultaneously with resource pool(s) for NR sidelink communication in system information, dedicated signalling and/or pre-configuration. Whether dedicated resource pool(s) for Relay discovery are configured is based on network implementation. If resource pool(s) dedicated for Relay discovery are configured, only those resource pool(s) dedicated for Relay discovery shall be used for Relay discovery. If only resource pool(s) for NR sidelink communication are configured, all the configured resource pool(s) can be used for Relay discovery and sidelink communication.

For U2N Remote UE (including both in-coverage and out of coverage cases) that has been connected to the network via a U2N Relay UE, only resource allocation mode 2 is used for discovery message transmission.

For in-coverage U2N Relay UE, and for both in-coverage and out of coverage U2N Remote UEs, NR sidelink resource allocation principles are applied for Relay discovery message transmission.

The sidelink power control for the transmission of Relay discovery messages is same as for NR sidelink communication.

No ciphering or integrity protection in PDCP layer is applied for the Relay discovery messages.

The U2N Remote UE and U2N Relay UE can determine from SIB12 whether the gNB supports Relay discovery, or Non-Relay discovery, or both.

### 16.12.4 Relay Selection/Reselection

The U2N Remote UE performs radio measurements at PC5 interface and uses them for U2N Relay selection and reselection along with higher layer criteria, as specified in TS 23.304 [48]. When there is no unicast PC5 connection between the U2N Relay UE and the U2N Remote UE, the U2N Remote UE uses SD-RSRP measurements to evaluate whether PC5 link quality towards a U2N Relay UE satisfies relay selection criterion.

For relay reselection, U2N Remote UE uses SL-RSRP measurements towards the serving U2N Relay UE for relay reselection trigger evaluation when there is data transmission from U2N Relay UE to U2N Remote UE, 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 U2N Relay UE to U2N Remote UE.

A U2N Relay UE is considered suitable by a U2N Remote UE in terms of radio criteria if the PC5 link quality measured by U2N Remote UE towards the U2N Relay UE exceeds configured threshold (pre-configured or provided by gNB). The U2N Remote UE searches for suitable U2N Relay UE candidates that meet all AS layer and higher layer criteria (see TS 23.304 [48]). If there are multiple such suitable U2N Relay UEs, it is up to U2N Remote UE implementation to choose one U2N Relay UE among them. For L2 U2N Relay (re)selection, the PLMN ID and cell ID can be used as additional AS criteria.

The U2N Remote UE triggers U2N Relay selection in following cases:

- Direct Uu signal strength of current serving cell of the U2N Remote UE is below a configured signal strength threshold;

- Indicated by upper layer of the U2N Remote UE.

The U2N Remote UE may trigger U2N Relay reselection in following cases:

- PC5 signal strength of current U2N Relay UE is below a (pre)configured signal strength threshold;

- Cell reselection, handover, Uu RLF, or Uu RRC connection establishment/resume failure has been indicated by U2N Relay UE via PC5-RRC signalling;

- When U2N Remote UE receives a PC5-S link release message from U2N Relay UE;

- When U2N Remote UE detects PC5 RLF;

- Indicated by upper layer.

For L2 U2N Remote UEs in RRC\_IDLE/INACTIVE and L3 U2N Remote UEs, the cell (re)selection procedure and relay (re)selection procedure run independently. If both suitable cells and suitable U2N Relay UEs are available, it is up to UE implementation to select either a cell or a U2N Relay UE. A L3 U2N Remote UE may select a cell and a U2N Relay UE simultaneously and this is up to implementation of L3 U2N Remote UE.

For both L2 and L3 U2N Relay UEs in RRC\_IDLE/INACTIVE, the PC5-RRC message(s) are used to inform their connected Remote UE(s) when U2N Relay UEs select a new cell. The PC5-RRC message(s) are also used to inform their connected L2 or L3 U2N Remote UE(s) when L2/L3 U2N Relay UE performs handover or detects Uu RLF or its Uu RRC connection establishment/resume failures. Upon reception of the PC5 RRC message for notification, it is up to U2N Remote UE implementation whether to release or keep the unicast PC5 link. If U2N Remote UE decides to release the unicast PC5 link, it triggers the L2 release procedure and may perform cell or relay reselection.

### 16.12.5 Control plane procedures for L2 U2N Relay

#### 16.12.5.1 RRC Connection Management

The L2 U2N Remote UE needs to establish its own PDU sessions/DRBs with the network before user plane data transmission.

The NR V2X PC5 unicast link establishment procedures can be used to setup a secure unicast link between L2 U2N Remote UE and L2 U2N Relay UE before L2 U2N Remote UE establishes a Uu RRC connection with the network via L2 U2N Relay UE.

The establishment of Uu SRB1/SRB2 and DRB of the L2 U2N Remote UE is subject to Uu configuration procedures for L2 UE-to-Network Relay.

The following high level connection establishment procedure in Figure 16.12.5.1-1 applies to L2 U2N Relay:



Figure 16.12.5.1-1: Procedure for L2 U2N Remote UE connection establishment

1. The L2 U2N Remote and L2 U2N Relay UE perform discovery procedure, and establish PC5-RRC connection using NR V2X procedure.

2. The L2 U2N Remote UE sends the first RRC message (i.e., *RRCSetupRequest*) for its connection establishment with gNB via the L2 U2N Relay UE, using a specified PC5 Relay RLC channel configuration. If the L2 U2N Relay UE is not in RRC\_CONNECTED, it needs to do its own connection establishment upon reception of a message on the specified PC5 Relay RLC channel. During L2 U2N Relay UE's RRC connection establishment procedure, gNB may configure SRB0 relaying Uu Relay RLC channel to the U2N Relay UE. The gNB responds with an *RRCSetup* message, including the PC5 Relay RLC channel configuration and SRAP configuration of the L2 U2N Remote UE SRB1, to L2 U2N Remote UE. The *RRCSetup* message is sent to the L2 U2N Remote UE using SRB0 relaying channel over Uu and a specified PC5 Relay RLC channel over PC5.

NOTE x: During the L2 U2N Relay UE’s RRC connection establishment procedure, it is left to the L2 U2N Relay UE’s implementation on how to set the establishment cause value in the *RRCSetup* message.

3. The gNB and L2 U2N Relay UE perform relaying channel setup procedure over Uu. According to the configuration from gNB, the L2 U2N Relay/Remote UE establishes a PC5 Relay RLC channel for relaying of SRB1 towards the L2 U2N Remote/Relay UE over PC5.

4. The *RRCSetupComplete* message is sent by the L2 U2N Remote UE to the gNB via the L2 U2N Relay UE using SRB1 relaying channel over PC5 and SRB1 relaying channel configured to the L2 U2N Relay UE over Uu. Then the L2 U2N Remote UE is RRC connected over Uu.

5. The L2 U2N Remote UE and gNB establish security following Uu procedure and the security messages are forwarded through the L2 U2N Relay UE.

6. The gNB sends an *RRCReconfiguration* message to the L2 U2N Remote UE via the L2 U2N Relay UE, to setup the SRB2/DRBs for relaying purpose. The L2 U2N Remote UE sends an *RRCReconfigurationComplete* message to the gNB via the L2 U2N Relay UE as a response. In addition, the gNB may configure additional Uu Relay RLC channels between the gNB and L2 U2N Relay UE, and PC5 Relay RLC channels between L2 U2N Relay UE and L2 U2N Remote UE for the relay traffic.

#### 16.12.5.2 Radio Link Failure

The L2 U2N Remote UE in RRC\_CONNECTED suspends Uu RLM (as described in clause 9.2.7) when L2 U2N Remote UE is connected to gNB via L2 U2N Relay UE.

The L2 U2N Relay UE declares Uu Radio Link Failure (RLF) following the same criteria as described in clause 9.2.7.

After Uu RLF is declared, the L2 U2N Relay UE takes the following action on top of the actions described in clause 9.2.7:

- a PC5-RRC message can be used for sending an indication to its connected L2 U2N Remote UE(s), which may trigger RRC connection re-establishment for L2 U2N Remote UE.

Upon detecting PC5 RLF, the L2 U2N Remote UE may trigger connection re-establishment.

#### 16.12.5.3 RRC Connection Re-establishment

The L2 U2N Remote UE may perform the following actions during the RRC connection re-establishment procedure:

- If only suitable cell(s) are available, the L2 U2N Remote UE initiates RRC re-establishment procedure towards a suitable cell;

- If only suitable L2 U2N Relay UE(s) are available, the L2 U2N 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 L2 U2N Remote UE can select either one to initiate RRC re-establishment procedure based on implementation.

#### 16.12.5.4 RRC Connection Resume

The RRC connection resume mechanism described in clause 9.2.2 is applied to L2 U2N Remote UE.

#### 16.12.5.5 System Information

The in-coverage L2 U2N Remote UE is allowed to acquire any necessary SIB(s) over Uu interface irrespective of its PC5 connection to L2 U2N Relay UE. The L2 U2N Remote UE can also receive the system information from the L2 U2N Relay UE after PC5 connection establishment with L2 U2N Relay UE.

The L2 U2N Remote UE in RRC\_CONNECTED can use the on-demand SIB framework as specified in TS 38.331 [12] to request the SIB(s) via L2 U2N Relay UE. The L2 U2N Remote UE in RRC\_IDLE or RRC\_INACTIVE can inform L2 U2N Relay UE of its requested SIB type(s) via PC5-RRC message. Then, L2 U2N Relay UE triggers on-demand SI/SIB acquisition procedure as specified in TS38.331 [12] according to its own RRC state (if needed) and sends the acquired SI(s)/SIB(s) to L2 U2N Remote UE via PC5-RRC message.

Any SIB that the RRC\_IDLE or RRC\_INACTIVE L2 U2N Remote UE has a requirement to use (e.g., for relay purpose) can be requested by the L2 U2N Remote UE (from the L2 U2N Relay UE or the network). For SIBs that have been requested by the L2 U2N Remote UE from the L2 U2N Relay UE, the L2 U2N Relay UE forwards them again in case of any update for requested SIB(s). In case of RRC\_CONNECTED L2 U2N Remote UE(s), it is the responsibility of the network to send updated SIB(s) to L2 U2N Remote UE(s) when they are updated. The L2 U2N Remote UE de-configures SI request with L2 U2N Relay UE when entering into RRC\_CONNECTED state.

For SIB1 forwarding, for L2 U2N Remote UE, both request-based delivery (i.e., SIB1 request by the U2N Remote UE) and unsolicited forwarding are supported by L2 U2N Relay UE, of which the usage is left to L2 U2N Relay UE implementation. If SIB1 changes, for L2 U2N Remote UE in RRC\_IDLE or RRC\_INACTIVE, the L2 U2N Relay UE always forwards SIB1.

For the L2 U2N Remote UE in RRC\_IDLE or RRC\_INACTIVE, the short message over Uu interface is not forwarded by the L2 U2N Relay UE to the L2 U2N Remote UE. The L2 U2N Relay UE can forward PWS SIBs to its connected L2 U2N Remote UE(s).

RAN sharing is supported for L2 U2N Relay UE. In particular, the L2 U2N Relay UE may forward, via discovery message, cell access related information before the establishment of a PC5-RRC connection.

#### 16.12.5.6 Paging

When both L2 U2N Relay UE and L2 U2N Remote UE are in RRC IDLE or RRC INACTIVE, the L2 U2N Relay UE monitors paging occasions of its connected L2 U2N Remote UE(s). When a L2 U2N Relay UE needs to monitor paging for a L2 U2N Remote UE, the L2 U2N Relay UE should monitor all POs of the L2 U2N Remote UE.

When L2 U2N Relay UE is in RRC\_CONNECTED and L2 U2N Remote UE(s) is in RRC\_IDLE or RRC\_INACTIVE, there are two options for paging delivery:

- The L2 U2N Relay UE monitors POs of its connected L2 U2N Remote UE(s) if the active DL BWP of L2 U2N Relay UE is configured with CORESET and paging search space;

- The delivery of the L2 U2N Remote UE's paging can be performed through dedicated RRC message from the gNB to the L2 U2N Relay UE. The dedicated RRC message for delivering L2 U2N Remote UE paging to the RRC\_CONNECTED L2 U2N Relay UE may contain one or more Remote UE IDs (5G-S-TMSI or I-RNTI).

It is up to network implementation to decide which of the above two options to use. The L2 U2N Relay UE in RRC\_CONNECTED, if configured with paging search space, can determine whether to monitor POs for a L2 U2N Remote UE based on the indication within the PC5-RRC signalling received from the L2 U2N Remote UE.

The L2 U2N Remote UE in RRC\_IDLE provides 5G-S-TMSI and UE specific DRX cycle (configured by upper layer) to the L2 U2N Relay UE to request it to perform PO monitoring. The L2 U2N Remote UE in RRC\_INACTIVE provides the minimum value of two UE specific DRX cycles (configured respectively by upper layer and RAN), 5G-S-TMSI and I-RNTI to the L2 U2N Relay UE for PO monitoring. The L2 U2N Relay UE in RRC CONNECTED can notify L2 U2N Remote UE information (i.e. 5G-S-TMSI/I-RNTI) to the gNB via *SidelinkUEInformationNR* message for paging delivery purpose. The L2 U2N Relay UE receives paging messages to check the 5G-S-TSMI/I-RNTI and sends relevant paging record to the L2 U2N Remote UE accordingly.

The L2 U2N Relay UE can use unicast signalling to send paging to the L2 U2N Remote UE via PC5.

#### 16.12.5.7 Access Control

The L2 U2N Remote UE performs unified access control as defined in TS 38.331[12]. The L2 U2N Relay UE does not perform UAC for L2 U2N Remote UE's data.

#### 16.12.5.8 Mobility Registration Update and RAN Area Update

The L2 U2N Remote UE performs Mobility Registration Update/RNAU based on the L2 U2N Relay UE's serving cell when it is connected with the L2 U2N Relay UE. A L2 U2N Remote UE in RRC\_IDLE or RRC\_INACTIVE initiates Mobility Registration Update/RNAU procedure if the serving cell changes (due to cell change by the L2 U2N Relay UE) and the new serving cell is outside of the L2 U2N Remote UE's configured RNA/TA.

### 16.12.6 Service Continuity for L2 U2N relay

#### 16.12.6.1 General

The service continuity procedure is applicable only for the mobility cases of path switch from indirect to direct path, and from direct to indirect path only when the L2 U2N Remote UE and L2 U2N Relay UE belong to the same gNB.

The mobility for path switch from an indirect path to another indirect path as well as group mobility are not supported in this version of the specification.

#### 16.12.6.2 Switching from indirect to direct path

For service continuity of L2 U2N Relay, the following procedure is used, in case of L2 U2N Remote UE switching to direct path:



Figure 16.12.6.1-1: Procedure for L2 U2N Remote UE switching to direct Uu cell

1. The Uu measurement configuration and measurement report signalling procedures are performed to evaluate both relay link measurement and Uu link measurement. The measurement results from L2 U2N Remote UE are reported when configured measurement reporting criteria are met. The sidelink relay measurement report shall include at least L2 U2N Relay UE's source L2 ID, serving cell ID (i.e., NCGI/NCI), and sidelink measurement quantity result. The sidelink measurement quantity can be SL-RSRP of the serving L2 U2N Relay UE, and if SL-RSRP is not available, SD-RSRP is used.

NOTE y: In the case of RAN sharing, the serving cell ID included in the measurement report is NCGI, otherwise, NCI is included.

2. The gNB decides to switch the L2 U2N Remote UE onto direct Uu path.

3. The gNB sends *RRCReconfiguration* message to the L2 U2N Remote UE. The L2 U2N Remote UE stops UP and CP transmission via L2 U2N Relay UE after reception of *RRCReconfiguration* message with the path switch configuration from the gNB.

4. The L2 U2N Remote UE synchronizes with the gNB and performs Random Access.

5. The UE (i.e., L2 U2N Remote UE in previous steps) sends the *RRCReconfigurationComplete* message to the gNB via direct path, using the configuration provided in the RRCReconfiguration message. From this step, the UE (i.e., L2 U2N Remote UE in previous steps) uses the RRC connection via the direct path to the gNB.

6. The gNB sends *RRCReconfiguration* message to the L2 U2N Relay UE to reconfigure the connection between the L2 U2N Relay UE and the gNB. The *RRCReconfiguration* message to the L2 U2N Relay UE can be sent any time after step 3 based on gNB implementation (e.g., to release Uu and PC5 Relay RLC channel configuration for relaying, and bearer mapping configuration related to the L2 U2N Remote UE).

7. Either L2 U2N Relay UE or L2 U2N Remote UE’s AS layer can release PC5-RRC connection and indicates upper layer to release PC5 unicast link after receiving *RRCReconfiguration* message from the gNB. The timing to execute link release is up to UE implementation.

8. The data path is switched from indirect path to direct path between the UE (i.e., previous L2 U2N Remote UE) and the gNB. The PDCP re-establishment or PDCP data recovery in UL is performed by the UE during path switch if gNB configures it.

NOTE: Step 8 can be executed any time after step 4. Step 8 is independent of step 6 and step 7.

#### 16.12.6.3 Switching from direct to indirect path

The gNB can select a L2 U2N Relay UE in any RRC state i.e., RRC\_IDLE, RRC\_INACTIVE, or RRC\_CONNECTED, as a target L2 U2N Relay UE for direct to indirect path switch.

For service continuity of L2 U2N Remote UE, the following procedure is used, in case of the L2 U2N Remote UE switching to indirect path via a L2 U2N Relay UE in RRC\_CONNECTED:



Figure 16.12.6.2-1: Procedure for L2 U2N Remote UE switching to indirect path

1. The L2 U2N Remote UE reports one or multiple candidate L2 U2N Relay UE(s) and Uu measurements, after it measures/discovers the candidate L2 U2N Relay UE(s):

- The L2 U2N Remote UE filters the appropriate L2 U2N Relay UE(s) according to Relay selection criteria before reporting. The L2 U2N Remote UE shall report only the L2 U2N Relay UE candidate(s) that fulfil the higher layer criteria;

- The reporting includes at least L2 U2N Relay UE ID, L2 U2N Relay UE' s serving cell ID, and sidelink measurement quantity information. The sidelink measurement quantity can be SL-RSRP of the candidate L2 U2N Relay UE, and if SL-RSRP is not available, SD-RSRP is used.

2. The gNB decides to switch the L2 U2N Remote UE to a target L2 U2N Relay UE. Then the gNB sends an *RRCReconfiguration* message to the target L2 U2N Relay UE, which includes at least L2 U2N Remote UE's local ID and L2 ID, Uu and PC5 Relay RLC channel configuration for relaying, and bearer mapping configuration.

3. The gNB sends the *RRCReconfiguration* message to the L2 U2N Remote UE. The *RRCReconfiguration* message includes at least L2 U2N Relay UE ID, Remote UE's local ID, PC5 Relay RLC channel configuration for relay traffic and the associated end-to-end radio bearer(s). The L2 U2N Remote UE stops UP and CP transmission over Uu after reception of *RRCReconfiguration* message from the gNB.

4. The L2 U2N Remote UE establishes PC5 RRC connection with target L2 U2N Relay UE, if the connection has not been established.

5. The L2 U2N Remote UE completes the path switch procedure by sending the *RRCReconfigurationComplete* message to the gNB via the L2 U2N Relay UE.

6. The data path is switched from direct path to indirect path between the L2 U2N Remote UE and the gNB.

In case the selected L2 U2N Relay UE for direct to indirect path switch is in RRC\_IDLE or RRC\_INACTIVE, after receiving the path switch command, the L2 U2N Remote UE establishes a PC5 link with the L2 U2N Relay UE and sends the *RRCReconfigurationComplete* message via the L2 U2N Relay UE, which triggers the L2 U2N Relay UE to enter RRC\_CONNECTED state. The procedure for L2 U2N Remote UE switching to indirect path in Figure 16.12.6.2-1 can be also applied for the case that the selected L2 U2N Relay UE for direct to indirect path switch is in RRC\_IDLE or RRC\_INACTIVE with the exception that the *RRCReconfiguration* message is sent from the gNB to the L2 U2N Relay UE after the L2 U2N Relay UE enters RRC\_CONNECTED state.

*End of Change*