**3GPP TSG-RAN WG2 Meeting #124 R2-231xxxx**

**Chicago, US, 13-17 November, 2023 (was R2-2312337)**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **38.321** | **CR** | **1703** | **rev** | **1** | **Current version:** | **17.6.0** |  |
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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 NR sidelink relay enhancements |
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| ***Source to WG:*** | Apple (Rapporteur) |
| ***Source to TSG:*** | R2 |
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| ***Work item code:*** | NR\_SL\_relay\_enh-Core |  | ***Date:*** | 2023-11-02 |
|  |  |  |  |  |
| ***Category:*** | ***B*** |  | ***Release:*** | Rel-18 |
|  | *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:*** | Sidelink UE-to-UE relay, UE-to-Network service continuity enhancement and multi-path relay are introduced. For MAC open issues related to Sidelink relay enhancements,**RAN2#122 Agreements**::* For Scenario-1/2, PDCP duplication of DRB is controlled by legacy Duplication Activation/Deactivation MAC CE and Duplication RLC Activation/Deactivation MAC CE delivered via direct path.

**RAN2#123bis Agreements**::* Communication resource pool is used for the DCR/DCA message with integrated-discovery.

.**RAN2#124 Agreements**::* Only 1 leg is allowed in the indirect path for MP duplication (i.e., any e2e traffic cannot be duplicated either in PC5 hop or Uu hop in the indirect path) .
* Only PDCP duplication in MCG is considered for Rel-18 Multi-path.
* MP remote UE reports UL BSR and SL BSR respectively by following legacy procedure, including, e.g., buffer size calculation.  No new interdependency is introduced between UL and SL BSRs.
* Remove the editor note “FFS whether the SL-BSR also reports Uu path traffic buffer“ in clause 6.1.3.33.
* Only introduce a single new LCID (e.g., LCID 55) for SCCH carrying end-to-end SL-SRB0/1/2/3 messages in L2 U2U relay in MAC spec.
* More than one leg (i.e., CA configuration with 2 or 3 legs) on direct Uu path in MP is supported. Capability for this feature to be discussed under the general capability discussion.
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| ***Summary of change:*** | * Section 3.1: added definitions related to Rel-18 relay enhancements. “NR Sidelink discovery” definition is updated to include U2U relay discovery case. “NR Sidelink communication” definition is updated to include the “U2U integrated discovery” case
* Section 3.2: added acronyms related to Rel-18 relay enhancements.
* Section 5.10: Add a NOTE to explain how to identify associated RLC entity in N3C interface is out of 3GPPs scope. A similar NOTE is also added in 6.1.3.32.
* Section 6,1.3.32, added “For Multi-path, i is ascending order of logical channel ID of secondary RLC entities in the order of direct path and indirect path for the DRB if primary RLC entity is in direct path”
* Section 6.1.3.33, for destinatinaiton index definition, added a new SL destination list name introduced for UE-to-UE relay communication.
* Section 6.2.4, LCID 55 is specified for carry end-to-end SL SRB messages.
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| ***Secti*** |  |
| ***Consequences if not approved:*** | Sidelink relay for UE-to-UE, service continuity, and multi-path operation will not be supported in NR. |
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| ***Clauses affected:*** | 3.1, 3.2, 5.10, 6.1.3.1, 6.1.3.11, 6.1.3.32, 6.1.3.33, 6.2.4  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.331 CR 4441 |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

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| *Start of change* |

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] 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].

**Dormant BWP:** The dormant BWP is one of downlink BWPs configured by the network via dedicated RRC signaling. In the dormant BWP, the UE stop monitoring PDCCH on/for the SCell, but continues performing CSI measurements, Automatic Gain Control (AGC) and beam management, if configured.

**DRX group:** A group of Serving Cells that is configured by RRC and that have the same DRX Active Time.

**HARQ information:** HARQ information for DL-SCH, for UL-SCH, or for SL-SCH transmissions consists of New Data Indicator (NDI), Transport Block Size (TBS), Redundancy Version (RV), and HARQ process ID.

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

**IAB-node:** RAN node that supports NR access links to UEs and NR backhaul links to parent nodes and child nodes.

**Listen Before Talk**: A procedure according to which transmissions are not performed if the channel is identified as being occupied, see TS 37.213 [18].

**Msg3**: Message transmitted on UL-SCH containing a C-RNTI MAC CE or CCCH SDU, submitted from upper layer and associated with the UE Contention Resolution Identity, as part of a Random Access procedure.

**Multi-path:** Mode of operation of a remote UE in RRC\_CONNECTED configured with one direct path on which the UE connects to gNB using NR Uu, and one indirect path on which the UE connects to the same gNB via a relay UE using L2 U2N relay operation or non-3GPP connectivity.

**Multi-path U2N sidelink relay**: AS functionality providing both direct path and indirect path via Layer-2 U2N relay UE to the network according to the NR sidelink communication.

**Multi-path U2N N3C relay**: AS functionality providing both direct path and indirect path via relay UE with non-3GPP connectivity.

**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 [19] and ProSe communication (including ProSe non-Relay, UE-to-Network Relay and UE-to-UE Relay communication (including ProSe UE-to-UE Relay communication with integrated discovery)) as defined in TS 23.304 [26], between two or more nearby UEs, using NR technology but not traversing any network node.

**NR sidelink discovery**: AS functionality enabling ProSe non-Relay discovery, ProSe UE-to-Network Relay discovery and ProSe UE-to-UE Relay discovery for Proximity based Services as defined in TS 23.304 [26], between two or more nearby UEs, using NR technology but not traversing any network node.

**NR sidelink transmission**: Any NR Sidelink-based transmission, including both transmission for NR sidelink discovery and transmission for NR sidelink communication.

**PDCCH occasion**: A time duration (i.e. one or a consecutive number of symbols) during which the MAC entity is configured to monitor the PDCCH.

**PRS Processing Window**: A time window during which UE may perform PRS measurement inside the active DL BWP with the same numerology as the active DL BWP without measurement gap.

**RedCap UE:** A UE with reduced capabilities as specified in clause 4.2.21.1 in TS 38.306 [25].

**Serving Cell:** A PCell, a PSCell, or an SCell in TS 38.331 [5].

**Sidelink transmission information:** Sidelink transmission information included in an SCI for an SL-SCH transmission as specified in clause 8.3 and 8.4 of TS 38.212 [9] consists of Sidelink HARQ information including NDI, RV, Sidelink process ID, HARQ feedback enabled/disabled indicator, Sidelink identification information including cast type indicator, Source Layer-1 ID and Destination Layer-1 ID, and Sidelink other information including CSI request, a priority, a communication range requirement and Zone ID.

**Special Cell:** For Dual Connectivity operation the term Special Cell refers to the PCell of the MCG or the PSCell of the SCG depending on if the MAC entity is associated to the MCG or the SCG, respectively. Otherwise the term Special Cell refers to the PCell. A Special Cell supports PUCCH transmission and contention-based Random Access, and is always activated.

**Timing Advance Group:** A group of Serving Cells that is configured by RRC and that, for the cells with a UL configured, using the same timing reference cell and the same Timing Advance value. A Timing Advance Group containing the SpCell of a MAC entity is referred to as Primary Timing Advance Group (PTAG), whereas the term Secondary Timing Advance Group (STAG) refers to other TAGs.

**UE-gNB RTT:** For non-terrestrial networks, the sum of the UE's Timing Advance value (see TS 38.211 [8] clause 4.3.1) and *kmac*.

**V2X sidelink communication**: AS functionality enabling V2X Communication as defined in TS 23.285 [20], between nearby UEs, using E-UTRA technology but not traversing any network node.

NOTE 1: A timer is running once it is started, until it is stopped or until it expires; otherwise it is not running. A timer can be started if it is not running or restarted if it is running. A Timer is always started or restarted from its initial value. The duration of a timer is not updated until it is stopped or expires (e.g. due to BWP switching). When the MAC entity applies zero value for a timer, the timer shall be started and immediately expire unless explicitly stated otherwise.

NOTE 2: In this version of the specification, the SRS in the procedural description includes Positioning SRS except for the Positioning SRS for transmission in RRC\_INACTIVE as in clause 5.26. Positioning SRS except for the Positioning SRS for transmission in RRC\_INACTIVE is treated the same as SRS by the UE unless explicitly stated otherwise.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

AP Aperiodic

BFR Beam Failure Recovery

BSR Buffer Status Report

BWP Bandwidth Part

CE Control Element

CG Cell Group

CG-SDT Configured Grant-based SDT

CI-RNTI Cancellation Indication RNTI

CSI Channel State Information

CSI-IM CSI Interference Measurement

CSI-RS CSI Reference Signal

CS-RNTI Configured Scheduling RNTI

DAPS Dual Active Protocol Stack

DCP DCI with CRC scrambled by PS-RNTI

DL-PRS DownLink-Positioning Reference Signal

G-CS-RNTI Group Configured Scheduling RNTI

G-RNTI Group RNTI

IAB Integrated Access and Backhaul

INT-RNTI Interruption RNTI

LBT Listen Before Talk

LCG Logical Channel Group

LCP Logical Channel Prioritization

MBS Multicast/Broadcast Services

MCCH MBS Control Channel

MCCH-RNTI MBS Control Channel RNTI

MCG Master Cell Group

MP Multi-path

MPE Maximum Permissible Exposure

MTCH MBS Traffic Channel

N3C Non-3GPP Connection

NCD-SSB Non Cell Defining SSB

NSAG Network Slice AS Group

NUL Normal Uplink

NZP CSI-RS Non-Zero Power CSI-RS

PDB Packet Delay Budget

PEI-RNTI Paging Early Indication RNTI

PHR Power Headroom Report

PS-RNTI Power Saving RNTI

PTAG Primary Timing Advance Group

PTM Point to Multipoint

PTP Point to Point

QCL Quasi-colocation

PPW PRS Processing Window

PRS Positioning Reference Signal

RA-SDT Random Access-based SDT

RS Reference Signal

SCG Secondary Cell Group

SDT Small Data Transmission

SFI-RNTI Slot Format Indication RNTI

SI System Information

SL-RNTI Sidelink RNTI

SLCS-RNTI Sidelink Configured Scheduling RNTI

SpCell Special Cell

SP Semi-Persistent

SP-CSI-RNTI Semi-Persistent CSI RNTI

SPS Semi-Persistent Scheduling

SR Scheduling Request

SS Synchronization Signals

SSB Synchronization Signal Block

STAG Secondary Timing Advance Group

SUL Supplementary Uplink

TAG Timing Advance Group

TCI Transmission Configuration Indicator

TPC-SRS-RNTI Transmit Power Control-Sounding Reference Signal-RNTI

TRIV Time Resource Indicator Value

TRP Transmit/Receive Point

TRS CSI-RS for tracking

U2N UE-to-Network

U2U UE-to-UE

UCI Uplink Control Information

V2X Vehicle-to-Everything

ZP CSI-RS Zero Power CSI-RS

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## 5.10 Activation/Deactivation of PDCP duplication

If one or more DRBs are configured with PDCP duplication, the network may activate and deactivate the PDCP duplication for all or a subset of associated RLC entities for the configured DRB(s).

The PDCP duplication for the configured DRB(s) is activated and deactivated by:

- receiving the Duplication Activation/Deactivation MAC CE described in clause 6.1.3.11;

- receiving the Duplication RLC Activation/Deactivation MAC CE described in clause 6.1.3.32;

- indication by RRC.

The PDCP duplication for all or a subset of associated RLC entities for the configured DRB(s) is activated and deactivated by:

- receiving the Duplication RLC Activation/Deactivation MAC CE described in clause 6.1.3.32;

- indication by RRC.

The PDCP duplication for all associated RLC entities for the configured DRB(s) is activated by:

- receiving an uplink grant addressed to CS-RNTI with NDI=1 for a logical channel associated with the DRB configured with *survivalTimeStateSupport*, described in clause 5.4.1.

The MAC entity shall for each DRB configured with PDCP duplication:

1> if a Duplication Activation/Deactivation MAC CE is received activating the PDCP duplication of the DRB:

2> indicate the activation of PDCP duplication of the DRB to upper layers.

1> if a Duplication Activation/Deactivation MAC CE is received deactivating the PDCP duplication of the DRB:

2> indicate the deactivation of PDCP duplication of the DRB to upper layers.

1> if a Duplication RLC Activation/Deactivation MAC CE is received activating PDCP duplication for associated RLC entities of a DRB configured with PDCP duplication:

2> indicate the activation of PDCP duplication for the indicated secondary RLC entity(ies) of the DRB to upper layers.

1> if a Duplication RLC Activation/Deactivation MAC CE is received deactivating PDCP duplication for associated RLC entities of a DRB configured with PDCP duplication:

2> indicate the deactivation of PDCP duplication for the indicated secondary RLC entity(ies) of the DRB to upper layers.

1> if activation of a PDCP duplication for all configured RLC entities is triggered for the DRB as specified in clause 5.4.1:

2> indicate the activation of PDCP duplication for all configured RLC entities of the DRB to upper layers.

NOTE: How to identify associated RLC entity" or equivalent entity in N3C interface for a DRB configured in Multi-path U2N N3C relay is out of scope of 3GPP.

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#### 6.1.3.32 Duplication RLC Activation/Deactivation MAC CE

The Duplication RLC Activation/Deactivation MAC CE is identified by a MAC subheader with eLCID as specified in Table 6.2.1-1b. It has a fixed size and consists of a single octet defined as follows (Figure 6.1.3.32-1).

- DRB ID: This field indicates the identity of DRB for which the MAC CE applies. The length of the field is 5 bits;

- RLCi: This field indicates the activation/deactivation status of PDCP duplication for the RLC entity i where i is ascending order of logical channel ID of secondary RLC entities in the order of MCG and SCG, for the DRB. The RLCi field is set to 1 to indicate that the PDCP duplication for the RLC entity i shall be activated. The RLCi field is set to 0 to indicate that the PDCP duplication for the RLC entity i shall be deactivated. For Multi-path, i is ascending order of logical channel ID of secondary RLC entities in the order of direct path and indirect path for the DRB if primary RLC entity is in direct path.



Figure 6.1.3.32-1: Duplication RLC Activation/Deactivation MAC CE

NOTE: How to identify "RLC entity" or equivalent entity in N3C interface for Multi-path U2N N3C relay is out of scope of 3GPP.

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#### 6.1.3.33 Sidelink Buffer Status Report MAC CEs

Sidelink Buffer Status Report (SL-BSR) MAC CEs consist of either:

- SL-BSR format (variable size); or

- Truncated SL-BSR format (variable size).

SL-BSR and Truncated SL-BSR MAC control elements consist of one Destination Index field, one LCG ID field and one corresponding Buffer Size field per reported target group.

The SL-BSR formats are identified by MAC subheaders with LCIDs as specified in in Table 6.2.1-2.

The fields in the SL-BSR MAC CE are defined as follows:

- Destination Index: The Destination Index field identifies the destination. The length of this field is 5 bits. The value is set to one index corresponding to SL destination identity associated to same destination reported in *sl-TxResourceReqList*, *sl-TxResourceReqListDisc* and *sl-TxResourceReqListCommRelay*, if present. The value is indexed sequentially from 0 in the same ascending order of SL destination identity in *sl-TxResourceReqList*, *sl-TxResourceReqListDisc*, *sl-TxResourceReqListCommRelay* and *sl-TxResourceReqListCommU2URelay* as specified in TS 38.331 [5]. When multiple lists are reported, the value is indexed sequentially across all the lists in the same order as presented in *SidelinkUEInformaitonNR* message;

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) whose SL buffer status is being reported. The length of the field is 3 bits;

- Buffer Size: The Buffer Size field identifies the total amount of data available according to the data volume calculation procedure in TSs 38.322 [3] and 38.323 [4] across all logical channels of a logical channel group of a destination after the MAC PDU has been built (i.e. after the logical channel prioritization procedure, which may result the value of the Buffer Size field to zero). The amount of data is indicated in number of bytes. The size of the RLC headers and MAC subheaders are not considered in the buffer size computation. The length of this field is 8 bits. The values for the Buffer Size field are shown in Table 6.1.3.1-2, respectively. For the Truncated SL-BSR format the number of Buffer Size fields included is maximised, while not exceeding the number of padding bits.

Buffer Sizes of LCGs are included in decreasing order of the highest priority of the sidelink logical channel having data available for transmission in each of the LCGs irrespective of the value of the Destination Index field.

NOTE: Void.



Figure 6.1.3.33-1: SL-BSR and Truncated SL-BSR MAC control element

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### 6.2.4 MAC subheader for SL-SCH

The MAC subheader consists of the following fields:

- V: The MAC PDU format version number field indicates which version of the SL-SCH subheader is used. In this version of the specification, the V field is set to 0. The size of the V field is 4 bits;

- SRC: The SRC field carries the 16 most significant bits of the Source Layer-2 ID set to the identifier provided by upper layers as defined in TS 23.287 [19] or TS 23.304 [26]. The length of the field is 16 bits;

- DST: The DST field carries the 8 most significant bits of the Destination Layer-2 ID set to the identifier provided by upper layers as defined in TS 23.287 [19] or TS 23.304 [26]. The length of the field is 8 bits;

- LCID: The Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU or the type of the corresponding MAC CE within the scope of one Source Layer-2 ID and Destination Layer-2 ID pair or padding as described in Tables 6.2.4-1 for SL-SCH. There is one LCID field per MAC subheader except for SL-SCH subheader. The size of the LCID field is 6 bits;

- L: The Length field indicates the length of the corresponding MAC SDU or variable-sized MAC CE in bytes. There is one L field per MAC subheader except for SL-SCH subheader and subheaders corresponding to the fixed-sized MAC CE or padding. The size of the L field is indicated by the F field;

- F: The Format field indicates the size of the Length field. There is one F field per MAC subheader except for SL-SCH subheader and subheaders corresponding to the fixed-sized MAC CE or padding. The size of the F field is 1 bit. The value 0 indicates 8 bits of the Length field. The value 1 indicates 16 bits of the Length field;

- R: Reserved bit, set to 0.

The MAC subheader is octet aligned.

Table 6.2.4-1 Values of LCID for SL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 0 | SCCH carrying PC5-S messages that are not protected |
| 1 | SCCH carrying PC5-S messages "Direct Security Mode Command" and "Direct Security Mode Complete" |
| 2 | SCCH carrying other PC5-S messages that are protected |
| 3 | SCCH carrying PC5-RRC messages |
| 4–19 | Identity of the logical channel |
| 20–54 | Reserved |
| 55 | SCCH carrying end-to-end SL-SRB0/1/2/3 messages delivered via SL-U2U-RLC as specified in TS 38.331 [5] |
| 56 | SCCH carrying RRC messages delivered via SL-RLC0 as specified in TS 38.331 [5] |
| 57 | SCCH carrying RRC message delivered via SL-RLC1 as specified in TS 38.331 [5] |
| 58 | SCCH for Sidelink Discovery Messages |
| 59 | Sidelink Inter-UE Coordination Request |
| 60 | Sidelink Inter-UE Coordination Information |
| 61 | Sidelink DRX Command |
| 62 | Sidelink CSI Reporting |
| 63 | Padding |

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| *End of change* |