**3GPP TSG-RAN WG2 Meeting #109-e *update0\_ R2-200***

**Online, 24 Feburary – 06 March 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **38.321** | **CR** | **0701** | **rev** | **-** | **Current version:** | **15.8.0** |  |
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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 5G V2X with NR Sidelink |
|  |  |
| ***Source to WG:*** | LG Electronics Inc. |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | 5G\_V2X\_NRSL |  | ***Date:*** | 2020-03-03 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-16 |
|  | *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-12 (Release 12)Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | 5G V2X with NR sidelink is introduced in REL-16. |
|  |  |
| ***Summary of change:*** | RAN2#107bis:* New abbreviations and definitions are captured in 3.
* Sidelink specific functions are captured in 4.4.
* Sidelink specific channels are captured in 4.5.2, 4.5.3, 4.5.4.1, and 4.5.4.x.
* Prioritization bewteen NR UL and NR/LTE SL is captured in 5.4.2.2
* LTE controlling NR sidelink communication is captured in 5.x.1.1 and 7.1
* Scheduling request for sidelink is captured in 5.4.4, 5.x.1.4 and 5.x.1.5.
* Impact on MAC reset and erroneous data handling are captured in 5.12 and 5.13 respectively.
* SL BWP is captured in 5.15.y following 5.15.x.
* New section 5.x is added for introduction of SL-SCH data transfer.
* New section 5.y is added for introduction of SL-BCH data transfer.
* MAC PDU for SL-SCH, SL-BCH and Sidelink BSR are captured in 6.1.3.x, 6.1.4, 6.1.x, 6.2.1, and 6.2.x.
* New RNTIs ar added in 7.1.

RAN2#108:* Capturing RAN2 agreements made in RAN2#108
* Capturing RAN1 agreements made in RAN1#99

RAN2#109-e* Capturing RAN2 agreements made in RAN2#109-e

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|  |  |
| ***Consequences if not approved:*** | 5G V2X with NR Sidelink will not be introduced in Rel-16. |
|  |  |
| ***Clauses affected:*** | 2, 3.1, 3.2, 4.2.2, 4.4, 4.5.2, 4.5.3, 4.5.4.1, 4.5.4.x, 5.4.2.2, 5.4.3.1.3, 5.4.4, 5.8.x, 5.12, 5.13, 5.15.x, 5.15.y, 5.x, 5.y, 6.1.3.x, 6.1.3.y, 6.1.3.z, 6.1.4, 6.1.x, 6.2.1, 6.2.x, 7.1 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 36.321 CR1467  |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

START OF THE CHANGE

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.300: "NR; Overall description; Stage 2".

[3] 3GPP TS 38.322: "NR; Radio Link Control (RLC) protocol specification".

[4] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) protocol specification".

[5] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[6] 3GPP TS 38.213: "NR; Physical Layer Procedures for control".

[7] 3GPP TS 38.214: "NR; Physical Layer Procedures for data".

[8] 3GPP TS 38.211: "NR; Physical channels and modulation".

[9] 3GPP TS 38.212: "NR; Multiplexing and channel coding".

[10] Void.

[11] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[12] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".

[13] 3GPP TS 26.114: "Technical Specification Group Services and System Aspects; IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction".

[14] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[15] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[16] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[17] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures".

[xa] 3GPP TS 23.287: "Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services ".

[xb] 3GPP TS 23.285: "Architecture enhancements for V2X services".

[xy] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[xz] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC); Protocol specification".

# 3 Definitions, symbols and abbreviations

## 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].

**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.

**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.

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

**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.

**Sidelink transmission information:** Sidelink transmission information included in a SCI for a SL-SCH transmission consists of Sidelink HARQ information including NDI, RV, Sidelink process ID, Source Layer-1 ID and Destination Layer-1 ID, and Sidelink QoS information including a priority, a communication range and location information.

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

**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.

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

NOTE: 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 they are stopped or expires (e.g. due to BWP switching).

## 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].

BSR Buffer Status Report

BWP Bandwidth Part

CE Control Element

CSI Channel State Information

CSI-IM CSI Intereference Measurement

CSI-RS CSI Reference Signal

CS-RNTI Configured Scheduling RNTI

INT-RNTI Interruption RNTI

LCG Logical Channel Group

LCP Logical Channel Prioritization

MCG Master Cell Group

NUL Normal Uplink

NZP CSI-RS Non-Zero Power CSI-RS

PDB Packet Delay Budget

PHR Power Headroom Report

PTAG Primary Timing Advance Group

QCL Quasi-colocation

RS Reference Signal

SCG Secondary Cell Group

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 Symbols-RNTI

UCI Uplink Control Information

V2X Vehicle-to-Everything

ZP CSI-RS Zero Power CSI-RS

NEXT CHANGE

### 4.2.2 MAC Entities

The MAC entity of the UE handles the following transport channels:

- Broadcast Channel (BCH);

- Downlink Shared Channel(s) (DL-SCH);

- Paging Channel (PCH);

- Uplink Shared Channel(s) (UL-SCH);

- Random Access Channel(s) (RACH).

When the UE is configured with SCG, two MAC entities are configured to the UE: one for the MCG and one for the SCG.

The functions of the different MAC entities in the UE operate independently unless otherwise specified. The timers and parameters used in each MAC entity are configured independently unless otherwise specified. The Serving Cells, C-RNTI, radio bearers, logical channels, upper and lower layer entities, LCGs, and HARQ entities considered by each MAC entity refer to those mapped to that MAC entity unless otherwise specified.

If the MAC entity is configured with one or more SCells, there are multiple DL-SCH and there may be multiple UL-SCH as well as multiple RACH per MAC entity; one DL-SCH, one UL-SCH, and one RACH on the SpCell, one DL-SCH, zero or one UL-SCH and zero or one RACH for each SCell.

If the MAC entity is not configured with any SCell, there is one DL-SCH, one UL-SCH, and one RACH per MAC entity.

Figure 4.2.2-1 illustrates one possible structure of the MAC entity when SCG is not configured.



Figure 4.2.2-1: MAC structure overview

Figure 4.2.2-2 illustrates one possible structure for the MAC entities when MCG and SCG are configured.



Figure 4.2.2-2: MAC structure overview with two MAC entities

In addition, the MAC entity of the UE handles the following transport channel for sidelink:

- Sidelink Shared Channel (SL-SCH);

- Sidelink Broadcast Channel (SL-BCH).

Figure 4.2.2-x illustrates one possible structure for the MAC entity when sidelink is configured.



Figure 4.2.1-x: MAC structure overview for sidelink

## 4.4 Functions

The MAC sublayer supports the following functions:

- mapping between logical channels and transport channels;

- multiplexing of MAC SDUs from one or different logical channels onto transport blocks (TB) to be delivered to the physical layer on transport channels;

- demultiplexing of MAC SDUs to one or different logical channels from transport blocks (TB) delivered from the physical layer on transport channels;

- scheduling information reporting;

- error correction through HARQ;

- logical channel prioritisation;

- radio resource selection.

The relevance of MAC functions for uplink and downlink is indicated in Table 4.4-1.

Table 4.4-1: The link direction association of MAC functions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| MAC function | Downlink | Uplink | Sidelink TX | Sidelink RX |
| Mapping between logical channels and transport channels | X | X | X | X |
| Multiplexing |  | X | X |  |
| Demultiplexing | X |  |  | X |
| Scheduling information reporting |  | X | X |  |
| Error correction through HARQ | X | X | X | X |
| Logical Channel prioritisation |  | X | X |  |
| Radio resource selection |  |  | X |  |

NEXT CHANGE

### 4.5.2 Transport Channels

The MAC sublayer uses the transport channels listed in Table 4.5.2-1 below.

Table 4.5.2-1: Transport channels used by MAC

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Transport channel name | Acronym | Downlink | Uplink | Sidelink |
| Broadcast Channel | BCH | X |  |  |
| Downlink Shared Channel | DL-SCH | X |  |  |
| Paging Channel | PCH | X |  |  |
| Uplink Shared Channel | UL-SCH |  | X |  |
| Random Access Channel | RACH |  | X |  |
| Sidelink Broadcast Channel | SL-BCH |  |  | X |
| Sidelink Shared Channel | SL-SCH |  |  | X |

### 4.5.3 Logical Channels

The MAC sublayer provides data transfer services on logical channels. To accommodate different kinds of data transfer services, multiple types of logical channels are defined i.e. each supporting transfer of a particular type of information.

Each logical channel type is defined by what type of information is transferred.

The MAC sublayer provides the control and traffic channels listed in Table 4.5.3-1 below.

Table 4.5.3-1: Logical channels provided by MAC.

|  |  |  |  |
| --- | --- | --- | --- |
| Logical channel name | Acronym | Control channel | Traffic channel |
| Broadcast Control Channel | BCCH | X |  |
| Paging Control Channel | PCCH | X |  |
| Common Control Channel | CCCH | X |  |
| Dedicated Control Channel | DCCH | X |  |
| Dedicated Traffic Channel | DTCH |  | X |
| Sidelink Broadcast Control Channel | SBCCH | X |  |
| Sidelink Control Channel | SCCH | X |  |
| Sidelink Traffic Channel | STCH |  | X |

### 4.5.4 Mapping of Transport Channels to Logical Channels

#### 4.5.4.1 General

The MAC entity is responsible for mapping logical channels onto transport channels. This mapping depends on the multiplexing that is configured by RRC.

NEXT CHANGE

#### 4.5.4.x Sidelink mapping

The sidelink logical channels can be mapped as described in Table 4.5.4.x-1.

Table 4.5.4.x-1: Sidelink channel mapping.

|  |  |  |
| --- | --- | --- |
| Transport channelLogical channel | SL-BCH | SL-SCH |
| SBCCH | X |  |
| SCCH |  | X |
| STCH |  | X |

NEXT CHANGE

#### 5.4.2.2 HARQ process

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on either PDCCH, Random Access Response, or RRC. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH, or on the same resource and with the same MCS as was used for last made transmission attempt within a bundle.

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

1> if the MAC PDU was obtained from the Msg3 buffer; or

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer:

2> if there are neither transmission of NR sidelink communication nor transmission of V2X sidelink communication at the time of the transmission; or

2> if there are both a sidelink grant for transmission of NR sidelink communication and a configured grant for transmission of V2X sidelink communication on SL-SCH as described in clause 5.14.1.2.2 of TS 36.321 [xz] at the time of the transmission, and neither the transmission of NR sidelink communication is prioritized as described in clause 5.x.1.3.2 nor the transmissions of V2X sidelink communication is prioritized as described in clause 5.4.2.2 of TS 36.321 [xz]; or

2> if there are both a sidelink grant for transmission of NR sidelink communication and a configured grant for transmission of V2X sidelink communication on SL-SCH as described in clause 5.14.1.2.2 of TS 36.321 [xz] at the time of the transmission, and the value of the highest priority of the logical channel(s) in the MAC PDU is lower than *ul-PrioritizationThres* if *ul-PrioritizationThres* is configured; or

2> if there are both a sidelink grant for transmission of NR sidelink communication and a configured grant for transmission of V2X sidelink communication on SL-SCH as described in clause 5.14.1.2.2 of TS 36.321 [xz] at the time of the transmission, and the MAC entity is able to perform this UL transmission simultaneously with both the transmission of NR sidelink communication which is prioritized as described in clause 5.x.1.3.2 and the transmissions of V2X sidelink communication which are prioritized as described in clause 5.14.1.2.2 of TS 36.321 [xz]; or

2> if there is a configured grant for transmission of V2X sidelink communication on SL-SCH as described in clause 5.14.1.2.2 of TS 36.321 [xz] at the time of the transmission, and either none of the transmissions of V2X sidelink communication is prioritized as described in clause 5.4.2.2 of TS 36.321 [xz] or the MAC entity is able to perform this UL transmission simultaneously with the transmissions of V2X sidelink communication which are prioritized as described in clause 5.14.1.2.2 of TS 36.321 [xz]; or

2> if there is a sidelink grant for transmission of NR sidelink communication at the time of the transmission, and if the transmission of NR sidelink communication is not prioritized as described in clause 5.x.1.3.2, or the value of the highest priority of the logical channel(s) in the MAC PDU is lower than *ul-PrioritizationThres* if *ul-PrioritizationThres* is configured, or there is a sidelink grant for transmission of NR sidelink communication at the time of the transmission, and the MAC entity is able to perform this UL transmission simultaneously with the transmission of NR sidelink communication which is prioritized as described in clause 5.x.1.3.2:

NOTE: Among the UL transmissions where the MAC entity is able to perform the transmission of NR sidelink communication prioritized simultaneously, if there are more than one UL transmission which the MAC entity is not able to perform simultaneously, it is up to UE implementation whether this UL transmission is performed.

NOTE: Among the UL transmissions that the MAC entity is able to perform simultaneously with all transmissions of V2X sidelink communication prioritized, if there are more than one UL transmission which the MAC entity is not able to perform simultaneously, it is up to UE implementation whether this UL transmission is performed.

NOTE: Among the UL transmissions where the MAC entity is able to perform the transmission of NR sidelink communication prioritized simultaneously with all transmissions of V2X sidelink communication prioritized, if there are more than one UL transmission which the MAC entity is not able to perform simultaneously, it is up to UE implementation whether this UL transmission is performed.

NOTE: If there is a configured grant for transmission of V2X sidelink communication on SL-SCH as described in clause 5.14.1.2.2 of TS 36.321 [xz] at the time of the transmission, and the MAC entity is not able to perform this UL transmission simultaneously with the transmission of V2X sidelink communication, and prioritization-related information is not available prior to the time of the transmission due to processing time restriction, it is up to UE implementation whether this UL transmission is performed.

3> instruct the physical layer to generate a transmission according to the stored uplink grant.

NEXT CHANGE

##### 5.4.3.1.3 Allocation of resources

The MAC entity shall, when a new transmission is performed:

1> allocate resources to the logical channels as follows:

2> logical channels selected in clause 5.4.3.1.2 for the UL grant with *Bj* > 0 are allocated resources in a decreasing priority order. If the PBR of a logical channel is set to *infinity*, the MAC entity shall allocate resources for all the data that is available for transmission on the logical channel before meeting the PBR of the lower priority logical channel(s);

2> decrement *Bj* by the total size of MAC SDUs served to logical channel *j* above;

2> if any resources remain, all the logical channels selected in clause 5.4.3.1.2 are served in a strict decreasing priority order (regardless of the value of *Bj*) until either the data for that logical channel or the UL grant is exhausted, whichever comes first. Logical channels configured with equal priority should be served equally.

NOTE: The value of *Bj* can be negative.

If the MAC entity is requested to simultaneously transmit multiple MAC PDUs, or if the MAC entity receives the multiple UL grants within one or more coinciding PDCCH occasions (i.e. on different Serving Cells), it is up to UE implementation in which order the grants are processed.

The UE shall also follow the rules below during the scheduling procedures above:

- the UE should not segment an RLC SDU (or partially transmitted SDU or retransmitted RLC PDU) if the whole SDU (or partially transmitted SDU or retransmitted RLC PDU) fits into the remaining resources of the associated MAC entity;

- if the UE segments an RLC SDU from the logical channel, it shall maximize the size of the segment to fill the grant of the associated MAC entity as much as possible;

- the UE should maximise the transmission of data;

- if the MAC entity is given a UL grant size that is equal to or larger than 8 bytes while having data available and allowed (according to clause 5.4.3.1) for transmission, the MAC entity shall not transmit only padding BSR and/or padding.

The MAC entity shall not generate a MAC PDU for the HARQ entity if the following conditions are satisfied:

- the MAC entity is configured with *skipUplinkTxDynamic* with value *true* and the grant indicated to the HARQ entity was addressed to a C-RNTI, or the grant indicated to the HARQ entity is a configured uplink grant; and

- there is no aperiodic CSI requested for this PUSCH transmission as specified in TS 38.212 [9]; and

- the MAC PDU includes zero MAC SDUs; and

- the MAC PDU includes only the periodic BSR and there is no data available for any LCG, or the MAC PDU includes only the padding BSR.

Logical channels shall be prioritised in accordance with the following order (highest priority listed first):

- C-RNTI MAC CE or data from UL-CCCH;

- Configured Grant Confirmation MAC CE;

- Sidelink Configured Grant Confirmation MAC CE;

- MAC CE for SL-BSR prioritized according to clause 5.x.1.6;

- MAC CE for BSR, with exception of BSR included for padding;

- Single Entry PHR MAC CE or Multiple Entry PHR MAC CE;

- MAC CE for SL-BSR, with exception of SL-BSR prioritized according to clause 5.x.1.6 and SL-BSR included for padding;

- data from any Logical Channel, except data from UL-CCCH;

- MAC CE for Recommended bit rate query;

- MAC CE for BSR included for padding;

- MAC CE for SL-BSR included for padding.

NEXT CHANGE

### 5.4.4 Scheduling Request

The Scheduling Request (SR) is used for requesting UL-SCH resources for new transmission.

The MAC entity may be configured with zero, one, or more SR configurations. An SR configuration consists of a set of PUCCH resources for SR across different BWPs and cells. For a logical channel, at most one PUCCH resource for SR is configured per BWP.

Each SR configuration corresponds to one or more logical channels. Each logical channel may be mapped to zero or one SR configuration, which is configured by RRC. The SR configuration of the logical channel that triggered the BSR (clause 5.4.5) (if such a configuration exists) is considered as corresponding SR configuration for the triggered SR.

RRC configures the following parameters for the scheduling request procedure:

- *sr-ProhibitTimer* (per SR configuration);

- *sr-TransMax* (per SR configuration).

The following UE variables are used for the scheduling request procedure:

- *SR\_COUNTER* (per SR configuration).

If an SR is triggered and there are no other SRs pending corresponding to the same SR configuration, the MAC entity shall set the *SR\_COUNTER* of the corresponding SR configuration to 0.

When an SR is triggered, it shall be considered as pending until it is cancelled.

All pending SR(s) triggered according to the BSR procedure (clause 5.4.5) prior to the MAC PDU assembly shall be cancelled and each respective *sr-ProhibitTimer* shall be stopped when the MAC PDU is transmitted and this PDU includes a Long or Short BSR MAC CE which contains buffer status up to (and including) the last event that triggered a BSR (see clause 5.4.5) prior to the MAC PDU assembly. All pending SR(s) triggered according to the BSR procedure (clause 5.4.5) shall be cancelled and each respective *sr-ProhibitTimer* shall be stopped when the UL grant(s) can accommodate all pending data available for transmission.

Only PUCCH resources on a BWP which is active at the time of SR transmission occasion are considered valid.

As long as at least one SR is pending, the MAC entity shall for each pending SR:

1> if the MAC entity has no valid PUCCH resource configured for the pending SR:

2> initiate a Random Access procedure (see clause 5.1) on the SpCell and cancel the pending SR.

1> else, for the SR configuration corresponding to the pending SR:

2> when the MAC entity has an SR transmission occasion on the valid PUCCH resource for SR configured; and

2> if *sr-ProhibitTimer* is not running at the time of the SR transmission occasion; and

2> if the PUCCH resource for the SR transmission occasion does not overlap with a measurement gap:

3> if the PUCCH resource for the SR transmission occasion overlap with neither a UL-SCH resource nor a SL-SCH resource; or

3> if a SL-SCH resource overlaps with the PUCCH resource for the SR transmission occasion for the pending SR triggered as specfied in clause 5.4.5, and the MAC entity is not able to perform this SR transmission simultaneously with the transmission of the SL-SCH resource, and either transmission on the SL-SCH resource is not prioritized as described in clause 5.x.1.3.2 or the priority value of the logical channel that triggered SR is lower than *ul-Prioritizationthres*, if configured; or

3> if a SL-SCH resource overlaps with the PUCCH resource for the SR transmission occasion for the pending SR triggered as specfied in clause 5.x.1.5, and the MAC entity is not able to perform this SR transmission simultaneously with the transmission of the SL-SCH resource, and the priority of the triggered SR determined as specified in clause 5.x.1.5 is higher than the priority of the MAC PDU determined as specified in clause 5.x.1.3.1 for the SL-SCH resource:

4> if *SR\_COUNTER* < *sr-TransMax*:

5> increment *SR\_COUNTER* by 1;

5> instruct the physical layer to signal the SR on one valid PUCCH resource for SR;

5> start the *sr-ProhibitTimer*.

4> else:

5> notify RRC to release PUCCH for all Serving Cells;

5> notify RRC to release SRS for all Serving Cells;

5> clear any configured downlink assignments and uplink grants;

5> clear any PUSCH resources for semi-persistent CSI reporting;

5> initiate a Random Access procedure (see clause 5.1) on the SpCell and cancel all pending SRs.

NOTE 1: The selection of which valid PUCCH resource for SR to signal SR on when the MAC entity has more than one overlapping valid PUCCH resource for the SR transmission occasion is left to UE implementation.

NOTE 2: If more than one individual SR triggers an instruction from the MAC entity to the PHY layer to signal the SR on the same valid PUCCH resource, the SR\_COUNTER for the relevant SR configuration is incremented only once.

The MAC entity may stop, if any, ongoing Random Access procedure due to a pending SR which has no valid PUCCH resources configured, which was initiated by MAC entity prior to the MAC PDU assembly. Such a Random Access procedure may be stopped when the MAC PDU is transmitted using a UL grant other than a UL grant provided by Random Access Response, and this PDU includes a BSR MAC CE which contains buffer status up to (and including) the last event that triggered a BSR (see clause 5.4.5) prior to the MAC PDU assembly, or when the UL grant(s) can accommodate all pending data available for transmission.

NEXT CHANGE

### 5.8.x Sidelink

There are two types of transmission without dynamic grant:

- configured grant Type 1 where an sidelink grant is provided by RRC, and stored as configured sidelink grant;

- configured grant Type 2 where an sidelink grant is provided by PDCCH, and stored or cleared as configured sidelink grant based on L1 signalling indicating configured sidelink grant activation or deactivation.

Type 1 and/or Type 2 are configured with a single BWP. Multiple configurations of up to [8] configured grants (including both Type 1 and Type 2, if configured) can be active simultaneously on the BWP.

RRC configures the following parameters when the configured grant Type 1 is configured, as specified in TS 38.331 [5] or TS 36.331 [xy]:

- *sl-ConfigIndexCG*: the identifier of a configured grant for sidelink;

- *sl-CS-RNTI*: SLCS-RNTI for retransmission;

- *sl-periodCG*: periodicity of the configured grant Type 1;

- *sl-TimeOffsetCGType1*: Offset of a resource with respect to [SFN = 0] in time domain;

- *sl-TimeResourceCGType1*: time resource location of the configured grant Type 1;

- *sl-CG-MaxTransNumList*: the maximum number of times that a TB can be transmitted using the configured grant.

RRC configures the following parameters when the configured grant Type 2 is configured, as specified in TS 38.331 [5]:

- *sl-ConfigIndexCG*: the identifier of a configured grant for sidelink;

- *sl-CS-RNTI*: SLCS-RNTI for activation, deactivation, and retransmission;

- *sl-periodCG*: periodicity of the configured grant Type 2;

- *sl-CG-MaxTransNumList*: the maximum number of times that a TB can be transmitted using the configured grant.

Upon configuration of a configured grant Type 1, the MAC entity shall for each configured sidelink grant:

1> store the sidelink grant provided by upper layers as a configured sidelink grant;

1> initialise or re-initialise the configured sidelink grant to determine PSCCH duration(s) and PSSCH duration(s) according to *sl-TimeOffsetCGType1* and *sl-TimeResourceCGType1*, and to reoccur with *sl-periodCG* for transmissions of multiple MAC PDUs according to clause 8.1.2 of TS 38.214 [7].

When a configured sidelink grant is released by upper layers, all the corresponding configurations shall be released and all corresponding sidelink grants shall be cleared.

The MAC entity shall:

1> if the configured sidelink grant confirmation has been triggered and not cancelled; and

1> if the MAC entity has UL resources allocated for new transmission:

2> instruct the Multiplexing and Assembly procedure to generate a Sidelink Configured Grant Confirmation MAC CE as defined in clause 6.1.3.y;

2> cancel the triggered configured sidelink grant confirmation.

For a configured grant Type 2, the MAC entity shall clear the corresponding configured sidelink grant immediately after first transmission of Configured Grant Confirmation triggered by the configured sidelink grant deactivation.

NEXT CHANGE

## 5.12 MAC Reset

If a reset of the MAC entity is requested by upper layers, the MAC entity shall:

1> initialize *Bj* for each logical channel to zero;

1> stop (if running) all timers;

1> consider all *timeAlignmentTimer*s as expired and perform the corresponding actions in clause 5.2;

1> set the NDIs for all uplink HARQ processes to the value 0;

1> stop, if any, ongoing RACH procedure;

1> discard explicitly signalled contention-free Random Access Resources, if any;

1> flush Msg3 buffer;

1> cancel, if any, triggered Scheduling Request procedure;

1> cancel, if any, triggered Buffer Status Reporting procedure;

1> cancel, if any, triggered Power Headroom Reporting procedure;

1> cancel, if any, triggered Sidelink Buffer Status Reporting procedure;

1> flush the soft buffers for all DL HARQ processes;

1> for each DL HARQ process, consider the next received transmission for a TB as the very first transmission;

1> release, if any, Temporary C-RNTI;

1> reset *BFI\_COUNTER*.

## 5.13 Handling of unknown, unforeseen and erroneous protocol data

When a MAC entity receives a MAC PDU for the MAC entity's C-RNTI or CS-RNTI, or by the configured downlink assignment, containing a Reserved LCID value, or an LCID value the MAC Entity does not support, the MAC entity shall at least:

1> discard the received subPDU and any remaining subPDUs in the MAC PDU.

When a MAC entity receives a MAC PDU for the MAC entity's C-RNTI or CS-RNTI, or by the configured downlink assignment, containing an LCID value which is not configured, the MAC entity shall at least:

1> discard the received subPDU.

When a MAC entity receives a MAC PDU on SL-SCH containing a Reserved LCID value, or an LCID value which is not configured, the MAC entity shall:

1> discard the received subPDU.

NEXT CHANGE

## 5.15 Bandwidth Part (BWP) operation

### 5.15.x Downlink and Uplink

In addition to clause 12 of TS 38.213 [6], this clause specifies requirements on BWP operation.

A Serving Cell may be configured with one or multiple BWPs, and the maximum number of BWP per Serving Cell is specified in TS 38.213 [6].

The BWP switching for a Serving Cell is used to activate an inactive BWP and deactivate an active BWP at a time. The BWP switching is controlled by the PDCCH indicating a downlink assignment or an uplink grant, by the *bwp-InactivityTimer*, by RRC signalling, or by the MAC entity itself upon initiation of Random Access procedure. Upon RRC (re-)configuration of *firstActiveDownlinkBWP-Id* and/or *firstActiveUplinkBWP-Id* for SpCell or activation of an SCell, the DL BWP and/or UL BWP indicated by *firstActiveDownlinkBWP-Id* and/or *firstActiveUplinkBWP-Id* respectively (as specified in TS 38.331 [5]) is active without receiving PDCCH indicating a downlink assignment or an uplink grant. The active BWP for a Serving Cell is indicated by either RRC or PDCCH (as specified in TS 38.213 [6]). For unpaired spectrum, a DL BWP is paired with a UL BWP, and BWP switching is common for both UL and DL.

For each activated Serving Cell configured with a BWP, the MAC entity shall:

1> if a BWP is activated:

2> transmit on UL-SCH on the BWP;

2> transmit on RACH on the BWP, if PRACH occasions are configured;

2> monitor the PDCCH on the BWP;

2> transmit PUCCH on the BWP, if configured;

2> report CSI for the BWP;

2> transmit SRS on the BWP, if configured;

2> receive DL-SCH on the BWP;

2> (re-)initialize any suspended configured uplink grants of configured grant Type 1 on the active BWP according to the stored configuration, if any, and to start in the symbol according to rules in clause 5.8.2.

1> if a BWP is deactivated:

2> not transmit on UL-SCH on the BWP;

2> not transmit on RACH on the BWP;

2> not monitor the PDCCH on the BWP;

2> not transmit PUCCH on the BWP;

2> not report CSI for the BWP;

2> not transmit SRS on the BWP;

2> not receive DL-SCH on the BWP;

2> clear any configured downlink assignment and configured uplink grant of configured grant Type 2 on the BWP;

2> suspend any configured uplink grant of configured grant Type 1 on the inactive BWP.

Upon initiation of the Random Access procedure on a Serving Cell, after the selection of carrier for performing Random Access procedure as specified in clause 5.1.1, the MAC entity shall for the selected carrier of this Serving Cell:

1> if PRACH occasions are not configured for the active UL BWP:

2> switch the active UL BWP to BWP indicated by *initialUplinkBWP*;

2> if the Serving Cell is an SpCell:

3> switch the active DL BWP to BWP indicated by *initialDownlinkBWP*.

1> else:

2> if the Serving Cell is an SpCell:

3> if the active DL BWP does not have the same *bwp-Id* as the active UL BWP:

4> switch the active DL BWP to the DL BWP with the same *bwp-Id* as the active UL BWP.

1> stop the *bwp-InactivityTimer* associated with the active DL BWP of this Serving Cell, if running.

1> if the Serving Cell is SCell:

2> stop the *bwp-InactivityTimer* associated with the active DL BWP of SpCell, if running.

1> perform the Random Access procedure on the active DL BWP of SpCell and active UL BWP of this Serving Cell.

If the MAC entity receives a PDCCH for BWP switching of a Serving Cell, the MAC entity shall:

1> if there is no ongoing Random Access procedure associated with this Serving Cell; or

1> if the ongoing Random Access procedure associated with this Serving Cell is successfully completed upon reception of this PDCCH addressed to C-RNTI (as specified in clauses 5.1.4 and 5.1.5):

2> perform BWP switching to a BWP indicated by the PDCCH.

If the MAC entity receives a PDCCH for BWP switching for a Serving Cell while a Random Access procedure associated with that Serving Cell is ongoing in the MAC entity, it is up to UE implementation whether to switch BWP or ignore the PDCCH for BWP switching, except for the PDCCH reception for BWP switching addressed to the C-RNTI for successful Random Access procedure completion (as specified in clauses 5.1.4 and 5.1.5) in which case the UE shall perform BWP switching to a BWP indicated by the PDCCH. Upon reception of the PDCCH for BWP switching other than successful contention resolution, if the MAC entity decides to perform BWP switching, the MAC entity shall stop the ongoing Random Access procedure and initiate a Random Access procedure after performing the BWP switching; if the MAC decides to ignore the PDCCH for BWP switching, the MAC entity shall continue with the ongoing Random Access procedure on the Serving Cell.

Upon reception of RRC (re-)configuration for BWP switching for a Serving Cell while a Random Access procedure associated with that Serving Cell is ongoing in the MAC entity, the MAC entity shall stop the ongoing Random Access procedure and initiate a Random Access procedure after performing the BWP switching.

The MAC entity shall for each activated Serving Cell configured with *bwp-InactivityTimer*:

1> if the *defaultDownlinkBWP-Id* is configured, and the active DL BWP is not the BWP indicated by the *defaultDownlinkBWP-Id*; or

1> if the *defaultDownlinkBWP-Id* is not configured, and the active DL BWP is not the *initialDownlinkBWP*:

2> if a PDCCH addressed to C-RNTI or CS-RNTI indicating downlink assignment or uplink grant is received on the active BWP; or

2> if a PDCCH addressed to C-RNTI or CS-RNTI indicating downlink assignment or uplink grant is received for the active BWP; or

2> if a MAC PDU is transmitted in a configured uplink grant or received in a configured downlink assignment:

3> if there is no ongoing Random Access procedure associated with this Serving Cell; or

3> if the ongoing Random Access procedure associated with this Serving Cell is successfully completed upon reception of this PDCCH addressed to C-RNTI (as specified in clauses 5.1.4 and 5.1.5):

4> start or restart the *bwp-InactivityTimer* associated with the active DL BWP.

2> if the *bwp-InactivityTimer* associated with the active DL BWP expires:

3> if the *defaultDownlinkBWP-Id* is configured:

4> perform BWP switching to a BWP indicated by the *defaultDownlinkBWP-Id*.

3> else:

4> perform BWP switching to the *initialDownlinkBWP*.

NOTE: If a Random Access procedure is initiated on an SCell, both this SCell and the SpCell are associated with this Random Access procedure.

1> if a PDCCH for BWP switching is received, and the MAC entity switches the active DL BWP:

2> if the *defaultDownlinkBWP-Id* is configured, and the MAC entity switches to the DL BWP which is not indicated by the *defaultDownlinkBWP-Id*; or

2> if the *defaultDownlinkBWP-Id* is not configured, and the MAC entity switches to the DL BWP which is not the *initialDownlinkBWP*:

3> start or restart the *bwp-InactivityTimer* associated with the active DL BWP.

### 5.15.y Sidelink

In addition to clause xx of TS 38.213 [6], this clause specifies requirements on BWP operation for sidelink.

The MAC entity is configured with at most a single SL BWP where sidelink transmission and reception are performed.

For a BWP, the MAC entity shall:

1> if the BWP is activated:

2> transmit PSBCH on the BWP, if configured;

2> transmit PSCCH on the BWP;

2> transmit SL-SCH on the BWP;

2> receive PSFCH on the BWP, if configured.

2> receive PSBCH on the BWP, if configured;

2> receive PSCCH on the BWP;

2> receive SL-SCH on the BWP;

2> transmit PSFCH on the BWP, if configured.

NEXT CHANGE

## 5.x SL-SCH Data transfer

### 5.x.1 SL-SCH Data transmission

#### 5.x.1.1 SL Grant reception and SCI transmission

Sidelink grant is received dynamically on the PDCCH, configured semi-persistently by RRC or autonomously selected by the MAC entity. The MAC entity shall have a sidelink grant on an active SL BWP to determine a set of PSCCH duration(s) in which transmission of SCI occurs and a set of PSSCH duration(s) in which transmission of SL-SCH associated with the SCI occurs.

If the MAC entity has been configured by RRC to transmit using a SL-RNTI or SLCS-RNTI as indicated in TS 38.331 [5] or TS 36.331 [xy], the MAC entity shall for each PDCCH occasion and for each grant received for this PDCCH occasion:

1> if a sidelink grant has been received on the PDCCH for the MAC entity's SL-RNTI:

2> if the NDI received on the PDCCH has been not toggled compared to the value in the previously received HARQ information for the HARQ Process ID:

3> use the received sidelink grant to determine PSCCH duration(s) and PSSCH duration(s) for one or more retransmissions of a single MAC PDU for the corresponding Sidelink process according to clause 8.1.2 of TS 38.214 [7];

2> else:

3> use the received sidelink grant to determine PSCCH duration(s) and PSSCH duration(s) for initial transmission and, if available, retransmission(s) of a single MAC PDU according to clause 8.1.2 of TS 38.214 [7];

2> consider the received sidelink grant to be a configured sidelink grant;

2> if a configured sidelink grant is available for retransmission(s) of a MAC PDU which has been positively acknowledged as specified in clause 5.x.1.3.3:

3> clear the PSCCH duration(s) and PSSCH duration(s) corresponding to retransmission(s) of the MAC PDU from the configured sidelink grant;

1> else if a sidelink grant has been received on the PDCCH for the MAC entity's SLCS-RNTI:

2> if PDCCH contents indicate retransmission(s) for an activated configured sidelink grant:

3> use the received sidelink grant to determine PSCCH duration(s) and PSSCH duration(s) for one or more retransmissions of a single MAC PDU according to clause 8.1.2 of TS 38.214 [7];

2> else if PDCCH contents indicate configured grant Type 2 deactivation for a configured sidelink grant:

3> clear the configured sidelink grant, if available;

3> trigger configured sidelink grant confirmation for the configured sidelink grant;

2> else if PDCCH contents indicate configured grant Type 2 activation for a configured sidelink grant:

3> trigger configured sidelink grant confirmation for the configured sidelink grant;

3> store the configured sidelink grant;

3> initialise or re-initialise the configured sidelink grant to determine the set of PSCCH durations and the set of PSSCH durations for transmissions of multiple MAC PDUs according to clause 8.1.2 of TS 38.214 [7].

If the MAC entity has been configured by RRC to transmit using pool(s) of resources in a carrier as indicated in TS 38.331 [5] or TS 36.331 [xy] based on sensing or random selection, the MAC entity shall for each Sidelink process:

NOTE: If the MAC entity has been configured by RRC to transmit using neither SL-RNTI nor SLCS-RNTI but is configured by RRC to transmit using a pool of resources in a carrier as indicated in TS 38.331 [5], the MAC entity can create a configured sidelink grant on the pool of resources only after releasing other configured sidelink grant(s), if any.

1> if the MAC entity has selected to create a configured sidelink grant corresponding to transmissions of multiple MAC PDUs, and SL data is available in a logical channel:

2> perform the TX resource (re-)selection check as specified in clause 5.x.1.2;

NOTE: The MAC entity continuously performs the TX resource (re-)selection check until the corresponding pool of resources is released by RRC or the MAC entity cancels selecting to create a configured sidelink grant corresponding to transmissions of multiple MAC PDUs.

2> if the TX resource (re-)selection is triggered as the result of the TX resource (re-)selection check:

3> select one of the allowed values configured by RRC in *sl-ResourceReservePeriodList* and set the resource reservation interval with the selected value;

3> randomly select, with equal probability, an integer value in the interval [5, 15] for the resource reservation interval higher than or equal to 100ms and set SL\_RESOURCE\_RESELECTION\_COUNTER to the selected value;

3> select the number of HARQ retransmissions from the allowed numbers that are configured by RRC in *sl-MaxTxTransNumPSSCH* included in *sl-PSSCH-TxConfigList* and, if configured by upper layers, overlapped in *sl-MaxTxTransNumPSSCH* indicated in *sl-CBR-PSSCH-TxConfigList* for the highest priority of the logical channel(s) allowed on the carrier and the CBR measured by lower layers according to TS 38.2xx [xx] if CBR measurement results are available or the corresponding *sl-defaultTxConfigIndex* configured by RRC if CBR measurement results are not available;

3> select an amount of frequency resources within the range that is configured by RRC between *sl-MinSubChannelNumPSSCH* and *sl-MaxSubchannelNumPSSCH* included in *sl-PSSCH-TxConfigList* and, if configured by RRC, overlapped between *MinSubChannelNumPSSCH* and *MaxSubchannelNumPSSCH* indicated in *sl-CBR-PSSCH-TxConfigList* for the highest priority of the logical channel(s) allowed on the carrier and the CBR measured by lower layers according to TS 38.2xx [xx] if CBR measurement results are available or the corresponding *sl-defaultTxConfigIndex* configured by RRC if CBR measurement results are not available;

3> randomly select the time and frequency resources for one transmission opportunity from the resources indicated by the physical layer according to clause 8.1.4 of TS 38.214 [7], according to the amount of selected frequency resources and the remaining PDB of SL data available in the logical channel(s) allowed on the carrier.

3> use the randomly selected resource to select a set of periodic resources spaced by the resource reservation interval for transmissions of PSCCH and PSSCH corresponding to the number of transmission opportunities of MAC PDUs determined in TS 38.214 [7];

3> if one or more HARQ retransmissions are selected:

4> if there are available resources left in the resources indicated by the physical layer according to clause 8.1.4 of TS 38.214 [7] for more transmission opportunities:

5> randomly select the time and frequency resources for one or more transmission opportunities from the available resources, according to the amount of selected frequency resources, the selected number of HARQ retransmissions and the remaining PDB of SL data available in the logical channel(s) allowed on the carrier;

5> use the randomly selected resource to select a set of periodic resources spaced by the resource reservation interval for transmissions of PSCCH and PSSCH corresponding to the number of retransmission opportunities of the MAC PDUs determined in TS 38.214 [7];

5> [consider the first set of transmission opportunities as the new transmission opportunities and the other set of transmission opportunities as the retransmission opportunities;]

5> consider the set of new transmission opportunities and retransmission opportunities as the selected sidelink grant.

3> else:

4> consider the set as the selected sidelink grant;

3> use the selected sidelink grant to determine the set of PSCCH durations and the set of PSSCH durations according to TS 38.214 [7];

3> consider the selected sidelink grant to be a configured sidelink grant.

2> else if SL\_RESOURCE\_RESELECTION\_COUNTER = 0 and when SL\_RESOURCE\_RESELECTION\_COUNTER was equal to 1 the MAC entity randomly selected, with equal probability, a value in the interval [0, 1] which is less than or equal to the probability configured by upper layers in *sl-ProbResourceKeep*:

3> clear the configured sidelink grant, if available;

3> randomly select, with equal probability, an integer value in the interval [5, 15] for the resource reservation interval higher than or equal to 100ms and set SL\_RESOURCE\_RESELECTION\_COUNTER to the selected value;

3> use the previously selected sidelink grant for the number of transmissions of the MAC PDUs determined in TS 38.214 [7] with the resource reservation interval to determine the set of PSCCH durations and the set of PSSCH durations according to TS 38.214 [7];

3> consider the selected sidelink grant to be a configured sidelink grant.

1> if the MAC entity has selected to create a configured sidelink grant corresponding to transmission(s) of a single MAC PDU, and if SL data is available in a logical channel or a SL-CSI reporting is triggered:

2> perform the TX resource (re-)selection check as specified in clause 5.x.1.2;

2> if the TX resource (re-)selection is triggered as the result of the TX resource (re-)selection check:

3> select the number of HARQ retransmissions from the allowed numbers that are configured by RRC in *sl-MaxTxTransNumPSSCH* included in *sl-PSSCH-TxConfigList* and, if configured by RRC, overlapped in *sl-MaxTxTransNumPSSCH* indicated in *sl-CBR-PSSCH-TxConfigList* for the highest priority of the logical channel(s) allowed on the carrier and the CBR measured by lower layers according to TS 38.2xx [xx] if CBR measurement results are available or the corresponding *sl-defaultTxConfigIndex* configured by RRC if CBR measurement results are not available;

3> select an amount of frequency resources within the range that is configured by RRC between *sl-MinSubChannelNumPSSCH* and *sl-MaxSubChannelNumPSSCH* included in *sl-PSSCH-TxConfigList* and, if configured by RRC, overlapped between *sl-MinSubChannelNumPSSCH* and *sl-MaxSubChannelNumPSSCH* indicated in *sl-CBR-PSSCH-TxConfigList* for the highest priority of the logical channel(s) allowed on the carrier and the CBR measured by lower layers according to TS 38.2xx [xx] if CBR measurement results are available or the corresponding *sl-defaultTxConfigIndex* configured by RRC if CBR measurement results are not available;

3> randomly select the time and frequency resources for one transmission opportunity from the resources indicated by the physical layer according to clause 8.1.4 of TS 38.214 [7], according to the amount of selected frequency resources and the remaining PDB of SL data available in the logical channel(s) allowed on the carrier;

3> if one or more HARQ retransmissions are selected:

4> if there are available resources left in the resources indicated by the physical layer according to clause 8.1.4 of TS 38.214 [7] for more transmission opportunities:

5> randomly select the time and frequency resources for one or more transmission opportunities from the available resources, according to the amount of selected frequency resources, the selected number of HARQ retransmissions and the remaining PDB of SL data available in the logical channel(s) allowed on the carrier;

5> [consider a transmission opportunity which comes first in time as the new transmission opportunity and a transmission opportunity which comes later in time as the retransmission opportunity];

5> consider both of the transmission opportunities as the selected sidelink grant;

3> else:

4> consider the set as the selected sidelink grant;

3> use the selected sidelink grant to determine PSCCH duration(s) and PSSCH duration(s) according to TS 38.214 [7];

3> consider the selected sidelink grant to be a configured sidelink grant.

1> if a configured sidelink grant is available for retransmission(s) of a MAC PDU which has been positively acknowledged as specified in clause 5.x.1.3.3:

2> clear the PSCCH duration(s) and PSSCH duration(s) corresponding to retransmission(s) of the MAC PDU from the configured sidelink grant.

The MAC entity shall for each PSSCH duration:

1> for each configured sidelink grant occurring in this PSSCH duration:

2> if the MAC entity has been configured by RRC to transmit using a SL-RNTI or SLCS-RNTI:

3> select a MCS which is, if configured, within the range that is configured by RRC between *sl-MinMCS-PSSCH* and *sl-MaxMCS-PSSCH* included in *SL-ScheduledConfig*;

2> else:

3> select a MCS which is, if configured, within the range that is configured by RRC between *sl-MinMCS-PSSCH* and *sl-MaxMCS-PSSCH* included in *sl-PSSCH-TxConfigList* and, if configured by RRC, overlapped between *sl-MinMCS-PSSCH* and *sl-MaxMCS-PSSCH* indicated in *sl-CBR-PSSCH-TxConfigList* for the highest priority of the sidelink logical channel(s) in the MAC PDU and the CBR measured by RRC according to TS 38.2xx [xx] if CBR measurement results are available or the corresponding *sl-defaultTxConfigIndex* configured by RRC if CBR measurement results are not available;

NOTE: MCS selection is up to UE implementation if the MCS or the corresponding range is not configured by upper layers.

2> deliver the sidelink grant, the selected MCS, and the associated HARQ information to the Sidelink HARQ Entity for this PSSCH duration.

#### 5.x.1.2 TX resource (re-)selection check

If the TX resource (re-)selection check procedure is triggered for a Sidelink process according to clause 5.x.1.1, the MAC entity shall for the Sidelink process:

1> if SL\_RESOURCE\_RESELECTION\_COUNTER = 0 and when SL\_RESOURCE\_RESELECTION\_COUNTER was equal to 1 the MAC entity randomly selected, with equal probability, a value in the interval [0, 1] which is above the probability configured by upper layers in *sl-ProbResourceKeep*; or

1> if a pool of resources is configured or reconfigured by upper layers; or

1> if there is no configured sidelink grant; or

1> if neither transmission nor retransmission has been performed by the MAC entity on any resource indicated in the configured sidelink grant during the last [second]; or

1> if *sl-ReselectAfter* is configured and the number of consecutive unused transmission opportunities on resources indicated in the configured sidelink grant is equal to *sl-ReselectAfter*; or

1> if the configured sidelink grant cannot accommodate a RLC SDU by using the maximum allowed MCS configured by upper layers in *sl-MaxMCS-PSSCH* and the MAC entity selects not to segment the RLC SDU; or

NOTE: If the configured sidelink grant cannot accommodate the RLC SDU, it is left for UE implementation whether to perform segmentation or sidelink resource reselection.

1> if transmission(s) with the configured sidelink grant cannot fulfil the latency requirement of the data in a logical channel according to the associated priority, and the MAC entity selects not to perform transmission(s) corresponding to a single MAC PDU; or

NOTE: If the latency requirement is not met, it is left for UE implementation whether to perform transmission(s) corresponding to single MAC PDU or sidelink resource reselection.

1> if a sidelink transmission is scheduled by any received SCI indicating a higher priority than the prority of the logical channel and expected to overlap with a resource of the configured sidelink grant, and a measured result on SL-RSRP associated with the sidelink transmission is higher than [threshold]:

2> clear the configured sidelink grant associated to the Sidelink process, if available;

2> trigger the TX resource (re-)selection.

#### 5.x.1.3 Sidelink HARQ operation

##### 5.x.1.3.1 Sidelink HARQ Entity

The MAC entity includes at most one Sidelink HARQ entity for transmission on SL-SCH, which maintains a number of parallel Sidelink processes.

The maximum number of transmitting Sidelink processes associated with the Sidelink HARQ Entity is [TBD1]. A sidelink process may be configured for transmissions of multiple MAC PDUs. For transmissions of multiple MAC PDUs, the maximum number of transmitting Sidelink processes associated with the Sidelink HARQ Entity is [TBD2].

A delivered sidelink grant and its associated Sidelink transmission information are associated with a Sidelink process. Each Sidelink process supports one TB.

For each sidelink grant, the Sidelink HARQ Entity shall:

1> if the MAC entity determines that the the sidelink grant is used for initial transmission; and

1> if no MAC PDU has been obtained:

NOTE: For the configured grant Type 1 and 2, whether a sidelink grant is used for initial transmission or retransmission is up to UE implementation.

2> associate a Sidelink process to this grant, and for each associated Sidelink process:

3> obtain the MAC PDU to transmit from the Multiplexing and assembly entity, if any;

3> if a MAC PDU to transmit has been obtained:

4> determines Sidelink tranmssion information of the TB for the source and destination pair of the MAC PDU as follows:

5> set the Source Layer-1 ID to the 16 MSB of the Source Layer-2 ID of the MAC PDU;

5> set the Destination Layer-1 ID to the 8 MSB of the Destination Layer-2 ID of the MAC PDU;

5> consider the NDI to have been toggled and set the NDI to the toggled value;

NOTE: The initial value of the NDI set to the very first transmission for the Sidelink HARQ Entity is left to UE implementation.

5> associate the Sidelink process to a Sidelink process ID;

NOTE: How UE determine Sidelink process ID in SCI is left to UE implementation for NR sidelink.

5> enable HARQ feedback, if *sl-HARQ-FeedbackEnabled* has been set to *Enabled* for the logical channel(s) in the MAC PDU;

5> set the priority to the value of the highest priority of the logical channel(s) and a MAC CE, if any, if included, in the MAC PDU;

5> set the communication range to the value of the longest communication range of the logical channel(s) in the MAC PDU, if configured;

5> set the location information to the Zone\_id determined as specified in TS 38.331 [5], if configured;

4> deliver the MAC PDU, the sideink grant and the Sidelink transmission information of the TB to the associated Sidelink process;

4> instruct the associated Sidelink process to trigger a new transmission;

3> else:

4> flush the HARQ buffer of the associated Sidelink process.

1> else (i.e. retransmission):

2> identify the Sidelink process associated with this grant, and for each associated Sidelink process:

3> if *sl-MaxTransNum* corresponding to the highest priority of the logical channel(s) in the MAC PDU has been configured in *sl-CG-MaxTransNumList* for the sidelink grant by RRC and the maximum number of transmissions of the MAC PDU has been reached to *sl-MaxTransNum*; or

3> if a positive acknowledgement to a transmission of the MAC PDU has been received according to clause 5.x.1.3.3; or

3> if only a negative acknowledgement was enabled in the SCI and no negative acknowledgement was received prioritized as specified in clause 5.4.2.2, and the sidelink transmission is prioritized over uplink transmission:

2> instruct the physical layer to transmit SCI according to the stored sidelink grant with the associated Sidelink transmission information;

2> instruct the physical layer to generate a transmission according to the stored sidelink grant;

2> if *sl-HARQ-FeedbackEnabled* has been set to *enabled* for the logical channel(s) in the MAC PDU:

3> instructs the physical layer to monitor PSFCH for the transmission as specified in TS 38.2xx [x].

1> if this transmission corresponds to the last transmission of the MAC PDU:

2> decrement SL\_RESOURCE\_RESELECTION\_COUNTER by 1, if available.

The transmission of the MAC PDU is prioritized over uplink transmissions of the MAC entity or the other MAC entity if the following conditions are met:

1> if the MAC entity is not able to perform this sidelink transmission simultaneously with all uplink transmissions at the time of the transmission, and

1> if uplink transmission is neither prioritized as specified in clause 5.4.2.2 nor prioritized by upper layer according to TS [24.386] [xx]; and

1> if the value of the highest priority of logical channel(s) and a MAC CE in the MAC PDU is lower than *sl-PrioritizationThres* if *sl-PrioritizationThres* is configured.

NOTE: If the MAC entity is not able to perform this sidelink transmission simultaneously with all uplink transmissions as specified in clause 5.4.2.2 of TS 36.321 [xz] at the time of the transmission, and prioritization-related information is not available prior to the time of this sidelink transmission due to processing time restriction, it is up to UE implementation whether this sidelink transmission is performed.

##### 5.x.1.3.3 PSFCH reception

The MAC entity shall for each PSSCH transmission:

1> if an acknowledgement corresponding to the transmission in clause 5.x.1.3.2 is obtained from the physical layer:

2> deliver the acknowledgement to the corresponding Sidelink HARQ entity for the Sidelink process;

1> else:

2> deliver a negative acknowledgement to the corresponding Sidelink HARQ entity for the Sidelink process;

1> if *sl-PUCCH-Config* is configured by RRC:

2> instruct the physical layer to signal the acknowledgement corresponding to the transmission on the PUCCH according to clause 16.5 of TS 38.213 [x].

#### 5.x.1.4 Multiplexing and assembly

For PDU(s) associated with one SCI, MAC shall consider only logical channels with the same Source Layer-2 ID-Destination Layer-2 ID pair for one of unicast, groupcast and broadcast which is associated with the pair. Multiple transmissions for different Sidelink processes are allowed to be independently performed in different PSSCH durations.

##### 5.x.1.4.1 Logical channel prioritization

###### 5.x.1.4.1.1 General

The sidelink Logical Channel Prioritization procedure is applied whenever a new transmission is performed.

RRC controls the scheduling of sidelink data by signalling for each logical channel:

- *sl-Priority* where an increasing priority value indicates a lower priority level;

- *sl-PrioritisedBitRate* which sets the sidelink Prioritized Bit Rate (sPBR);

- *sl-BucketSizeDuration* which sets the sidelink Bucket Size Duration (sBSD).

RRC additionally controls the LCP procedure by configuring mapping restrictions for each logical channel:

- *sl-configuredSLGrantType1Allowed* which sets whether a configured grant Type 1 can be used for sidelink transmission.

The following UE variable is used for the Logical channel prioritization procedure:

- *SBj* which is maintained for each logical channel *j*.

The MAC entity shall initialize *SBj* of the logical channel to zero when the logical channel is established.

For each logical channel *j*, the MAC entity shall:

1> increment *SBj* by the product sPBR × T before every instance of the LCP procedure, where T is the time elapsed since *SBj* was last incremented;

1> if the value of *SBj* is greater than the sidelink bucket size (i.e. sPBR × sBSD):

2> set *SBj* to the sidelink bucket size.

NOTE: The exact moment(s) when the UE updates *SBj* between LCP procedures is up to UE implementation, as long as *SBj* is up to date at the time when a grant is processed by LCP.

###### 5.x.1.4.1.2 Selection of logical channels

The MAC entity shall for each SCI corresponding to a new transmission:

1> select a Destination associated to one of unicast, groupcast and broadcast, having the logical channel with the highest priority or the MAC CE, among the logical channels that satisfy all the following conditions and MAC CE(s), if any, for the SL grant associated to the SCI:

2> SL data is available for transmission; and

2> *SBj* > 0, in case there is any logical channel having *SBj* > 0; and

2> *sl-configuredSLGrantType1Allowed*, if configured, is set to *true* in case the SL grant is a Configured Grant Type 1.

NOTE: If multiple Destinations have the logical channels satisfying all conditions above with the same highest priority or if multiple Destinations have the MAC CE, which Destination is selected among them is up to UE implementation.

1> select the logical channels satisfying all the following conditions among the logical channels belonging to the selected Destination:

2> SL data is available for transmission; and

2> *sl-configuredSLGrantType1Allowed*, if configured, is set to *true* in case the SL grant is a Configured Grant Type 1; and

2> A logical channel has been equivalently set with the logical channel with the highest priority in *sl-HARQ-FeedbackEnabled*.

###### 5.x.1.4.1.3 Allocation of sidelink resources

The MAC entity shall for each SCI corresponding to a new transmission:

1> allocate resources to the logical channels as follows:

2> logical channels selected in clause 5.x.1.4.1.2 for the SL grant with *SBj* > 0 are allocated resources in a decreasing priority order. If the SL-PBR of a logical channel is set to *infinity*, the MAC entity shall allocate resources for all the data that is available for transmission on the logical channel before meeting the sPBR of the lower priority logical channel(s);

2> decrement *SBj* by the total size of MAC SDUs served to logical channel *j* above;

2> if any resources remain, all the logical channels selected in clause 5.x.1.4.1.2 are served in a strict decreasing priority order (regardless of the value of *SBj*) until either the data for that logical channel or the SL grant is exhausted, whichever comes first. Logical channels configured with equal priority should be served equally.

NOTE: The value of *SBj* can be negative.

The UE shall also follow the rules below during the SL scheduling procedures above:

- the UE should not segment an RLC SDU (or partially transmitted SDU or retransmitted RLC PDU) if the whole SDU (or partially transmitted SDU or retransmitted RLC PDU) fits into the remaining resources of the associated MAC entity;

- if the UE segments an RLC SDU from the logical channel, it shall maximize the size of the segment to fill the grant of the associated MAC entity as much as possible;

- the UE should maximise the transmission of data;

- if the MAC entity is given a sidelink grant size that is equal to or larger than 12 bytes while having data available and allowed (according to clause 5.x.1.4.1) for transmission, the MAC entity shall not transmit only padding;

- A logical channel configured with *sl-HARQ-FeedbackEnabled* set to *enabled* and a logical channel configured with *sl-HARQ-FeedbackEnabled* set to *disabled* cannot be multiplexed into the same MAC PDU.

The MAC entity shall not generate a MAC PDU for the HARQ entity if the following conditions are satisfied:

- there is no Sidelink CSI Reporting MAC CE generated for this PSSCH transmission as specified in clause 5.x.1.7; and

- the MAC PDU includes zero MAC SDUs.

Logical channels shall be prioritised in accordance with the following order (highest priority listed first):

- data from SCCH;

- Sidelink CSI Reporting MAC CE;

- data from any STCH.

##### 5.x.1.4.2 Multiplexing of MAC SDUs

The MAC entity shall multiplex MAC SDUs in a MAC PDU according to clauses 5.x.1.3.1 and 6.x.

#### 5.x.1.5 Scheduling Request

In addition to clause 5.4.4, the Scheduling Request (SR) is also used for requesting SL-SCH resources for new transmission when triggered by the Sidelink BSR (clause 5.x.1.6) or the SL-CSI reporting (clause 5.x.1.7). If configured, the MAC entity performs the SR procedure as specified in this clause unless otherwise specified in clause 5.4.4.

The SR configuration of the logical channel that triggered the Sidelink BSR (clause 5.x.1.6) (if such a configuration exists) is also considered as corresponding SR configuration for the triggered SR (clause 5.4.4). The priority of the triggered SR corresponds to the priority of the logical channel.

If the SL-CSI reporting procedure is enabled by RRC, the SL-CSI reporting is mapped to [zero or] one SR configuration for all PC5-RRC connections established by RRC. The SR configuration of the SL-CSI reporting triggered according to 5.x.1.7 is considered as corresponding SR configuration for the triggered SR (clause 5.4.4). The priority of the triggered SR corresponds to the priority of the SL-CSI reporting.

All pending SR(s) triggered according to the Sidelink BSR procedure (clause 5.x.1.6) prior to the MAC PDU assembly shall be cancelled and each respective *sr-ProhibitTimer* shall be stopped when the MAC PDU is transmitted and this PDU includes a Sidelink BSR MAC CE which contains buffer status up to (and including) the last event that triggered a Sidelink BSR (see clause 5.x.1.4) prior to the MAC PDU assembly.

All pending SR(s) triggered according to the Sidelink BSR procedure (clause 5.x.1.6) shall be cancelled and each respective *sr-ProhibitTimer* shall be stopped when the SL grant(s) can accommodate all pending data available for transmission in sidelink.

[The pending SR triggered according to the SL-CSI reporting shall be cancelled and each respective *sr-ProhibitTimer* shall be stopped when the SL grant(s) can accommodate all SL-CSI reporting(s) that have been triggered but not cancelled.] All pending SR(s) triggered by either Sidelink BSR or Sidelink CSI report shall be cancelled, when RRC configures autonomous resource selection.

#### 5.x.1.6 Buffer Status Reporting

The Sidelink Buffer Status reporting (SL-BSR) procedure is used to provide the serving gNB with information about SL data volume in the MAC entity.

RRC configures the following parameters to control the SL-BSR:

- *periodicBSR-Timer*;

- *retxBSR-Timer*;

- *sl-logicalChannelSR-DelayTimerApplied*;

- *logicalChannelSR-DelayTimer*;

- *sl-logicalChannelGroup*.

Each logical channel which belongs to a Destination is allocated to an LCG as specified in TS 38.331 [5] or TS 36.331 [xy]. The maximum number of LCGs is eight.

The MAC entity determines the amount of SL data available for a logical channel according to the data volume calculation procedure in TSs 38.322 [3] and 38.323 [4].

A SL-BSR shall be triggered if any of the following events occur:

1> if the MAC entity has a SL-RNTI or SLCS-RNTI:

2> SL data, for a logical channel of a Destination, becomes available to the MAC entity; and either

3> this SL data belongs to a logical channel with higher priority than the priorities of the logical channels containing available SL data which belong to any LCG belonging to the same Destination; or

3> none of the logical channels which belong to an LCG belonging to the same Destination contains any available SL data.

in which case the SL-BSR is referred below to as 'Regular SL-BSR';

2> UL resources are allocated and number of padding bits remaining after a Padding BSR has been triggered is equal to or larger than the size of the SL-BSR MAC CE plus its subheader, in which case the SL-BSR is referred below to as 'Padding SL-BSR';

2> *retxBSR-Timer* expires, and at least one of the logical channels which belong to an LCG contains SL data, in which case the SL-BSR is referred below to as 'Regular SL-BSR';

2> *periodicBSR-Timer* expires, in which case the SL-BSR is referred below to as 'Periodic SL-BSR'.

1> else:

2> An SL-RNTI is configured by RRC and SL data is available for transmission in the RLC entity or in the PDCP entity, in which case the Sidelink BSR is referred below to as "Regular Sidelink BSR".

For Regular SL-BSR, the MAC entity shall:

1> if the SL-BSR is triggered for a logical channel for which *sl-logicalChannelSR-DelayTimerApplied* with value *true* is configured by upper layers:

2> start or restart the *logicalChannelSR-DelayTimer*.

1> else:

2> if running, stop the *logicalChannelSR-DelayTimer*.

For Regular and Periodic SL-BSR, the MAC entity shall:

1> if *sl-PrioritizationThres* is configured and the value of the highest priority of the logical channels that belong to any LCG and contain SL data for any Destination is lower than *sl-PrioritizationThres*; and

1> if either *ul-PrioritizationThres* is not configured or *ul-PrioritizationThres* is configured and the value of the highest priority of the logical channels that belong to any LCG and contain UL data is equal to or higher than *ul-PrioritizationThres* according to clause 5.4.5:

2> prioritize the LCG(s) for the Destination(s).

1> if the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled according to clause 5.4.5 and the UL grant cannot accommodate a SL-BSR MAC CE containing buffer status only for all prioritized LCGs having data available for transmission plus the subheader of the SL-BSR according to clause 5.4.3.1.3, in case the SL-BSR is considered as not prioritized:

3> report Truncated SL-BSR containing buffer status for as many prioritized LCGs having data available for transmission as possible, taking the number of bits in the UL grant into consideration;

3> prioritize the SL-BSR for logical channel prioritization specified in clause 5.4.3.1;

1> else if the number of bits in the UL grant is expected to be equal to or larger than the size of a SL-BSR containing buffer status for all LCGs having data available for transmission plus the subheader of the SL-BSR according to clause 5.4.3.1.3:

2> report SL-BSR containing buffer status for all LCGs having data available for transmission;

1> else:

2> report Truncated SL-BSR containing buffer status for as many LCGs having data available for transmission as possible, taking the number of bits in the UL grant into consideration.

For Padding BSR:

1> if the number of padding bits remaining after a Padding BSR has been triggered is equal to or larger than the size of a SL-BSR containing buffer status for all LCGs having data available for transmission plus its subheader:

2> report SL-BSR containing buffer status for all LCGs having data available for transmission;

1> else:

2> report Truncated SL-BSR containing buffer status for as many LCGs having data available for transmission as possible, taking the number of bits in the UL grant into consideration.

For SL-BSR triggered by *retxBSR-Timer* expiry, the MAC entity considers that the logical channel that triggered the SL-BSR is the highest priority logical channel that has data available for transmission at the time the SL-BSR is triggered.

The MAC entity shall:

1> if the sidelink Buffer Status reporting procedure determines that at least one SL-BSR has been triggered and not cancelled:

2> if UL-SCH resources are available for a new transmission and the UL-SCH resources can accommodate the SL-BSR MAC CE plus its subheader as a result of logical channel prioritization according to clause 5.4.3.1:

3> instruct the Multiplexing and Assembly procedure in clause 5.4.3 to generate the SL-BSR MAC CE(s);

3> start or restart *periodicBSR-Timer* except when all the generated SL-BSRs are Truncated SL-BSRs;

3> start or restart *retxBSR-Timer*.

2> if a Regular SL-BSR has been triggered and *logicalChannelSR-DelayTimer* is not running:

3> if there is no UL-SCH resource available for a new transmission:

4> trigger a Scheduling Request.

NOTE: UL-SCH resources are considered available if the MAC entity has an active configuration for either type of configured uplink grants, or if the MAC entity has received a dynamic uplink grant, or if both of these conditions are met. If the MAC entity has determined at a given point in time that UL-SCH resources are available, this need not imply that UL-SCH resources are available for use at that point in time.

A MAC PDU shall contain at most one SL-BSR MAC CE, even when multiple events have triggered a SL-BSR. The Regular SL-BSR and the Periodic SL-BSR shall have precedence over the padding SL-BSR.

The MAC entity shall restart *retxBSR-Timer* upon reception of an SL grant for transmission of new data on any SL-SCH.

All triggered SL-BSRs may be cancelled when the SL grant(s) can accommodate all pending data available for transmission. All BSRs triggered prior to MAC PDU assembly shall be cancelled when a MAC PDU is transmitted and this PDU includes a SL-BSR MAC CE which contains buffer status up to (and including) the last event that triggered a SL-BSR prior to the MAC PDU assembly. All triggered SL-BSRs shall be cancelled, and *retx-BSR-Timer* and *periodic-BSR-Timer* shall be stopped, when RRC configures autonomous resource selection.

NOTE: MAC PDU assembly can happen at any point in time between uplink grant reception and actual transmission of the corresponding MAC PDU. SL-BSR and SR can be triggered after the assembly of a MAC PDU which contains a SL-BSR MAC CE, but before the transmission of this MAC PDU. In addition, SL-BSR and SR can be triggered during MAC PDU assembly.

#### 5.x.1.7 CSI Reporting

The Sidelink Channel State Information (SL-CSI) reporting procedure is used to provide a peer UE with sidelink channel state information as specified in clause 8.5 of TS 38.214 [7].

The MAC entity shall for each pair of the Source Layer-2 ID and the Destination Layer-2 ID:

1> if the SL-CSI reporting has been triggered by a SCI and not cancelled:

2> if the MAC entity has SL resources allocated for new transmission:

3> instruct the Multiplexing and Assembly procedure to generate a Sidelink CSI Reporting MAC CE as defined in clause 6.1.3.z;

3> cancel the triggered SL-CSI reporting.

2> else if the MAC entity has been configured by RRC to transmit using a SL-RNTI or SLCS-RNTI:

3> trigger a Scheduling Request.

### 5.x.2 SL-SCH Data reception

#### 5.x.2.1 SCI reception

SCI indicate if there is a transmission on SL-SCH and provide the relevant HARQ information. A SCI consists of two parts: the 1st stage SCI on PSCCH and the 2nd stage SCI on PSSCH as specified in clause 8.1 of TS 38.214 [7].

The MAC entity shall:

1> for each PSCCH duration during which the MAC entity monitors PSCCH:

2> if a 1st stage SCI for this PSSCH duration has been received on the PSCCH:

3> determine the set of PSSCH durations in which reception of a 2nd stage SCI and the transport block occur using the received part of the SCI;

3> if the 2nd stage SCI for this PSSCH duration has been received on the PSSCH:

4> store the SCI as a valid SCI for the PSSCH durations corresponding to transmission(s) of the transport block and the associated HARQ information and QoS information;

1> for each PSSCH duration for which the MAC entity has a valid SCI:

2> deliver the SCI and the associated Sidelink transmission information to the Sidelink HARQ Entity.

#### 5.x.2.2 Sidelink HARQ operation

##### 5.x.2.2.1 Sidelink HARQ Entity

There is at most one Sidelink HARQ Entity at the MAC entity for reception of the SL-SCH, which maintains a number of parallel Sidelink processes.

Each Sidelink process is associated with SCI in which the MAC entity is interested. This interest is as determined by the Destination Layer-1 ID and the Source Layer-1 ID of the SCI. The Sidelink HARQ Entity directs Sidelink transmission information and associated TBs received on the SL-SCH to the corresponding Sidelink processes.

The number of Receiving Sidelink processes associated with the Sidelink HARQ Entity is defined in [TBD].

For each PSSCH duration, the Sidelink HARQ Entity shall:

1> for each SCI valid for this PSSCH duration:

2> if the NDI has been toggled compared to the value of the previous received transmission corresponding to this TB or this is the very first received transmission for this TB:

3> allocate the TB received from the physical layer and the associated Sidelink transmission information to an unoccupied Sidelink process, associate the Sidelink process with this SCI and consider this transmission to be a new transmission.

NOTE: When a new TB arrives, if there is no unoccupied Sidelink process in the Sidelink HARQ entity, how to manage receiving Sidelink processes is up to UE implementation.

1> for each Sidelink process:

2> if the NDI has been not toggled compared to the value of the previous received transmission corresponding to this TB for the Sidelink process according to its associated SCI:

3> allocate the TB received from the physical layer to the Sidelink process and consider this transmission to be a retransmission.

2> else if the HARQ buffer of the Sidelink process is not empty:

3> flush the HARQ buffer.

##### 5.x.2.2.2 Sidelink process

For each PSSCH duration where a transmission takes place for the Sidelink process, one TB and the associated HARQ information is received from the Sidelink HARQ Entity.

For each received TB and associated Sidelink transmission information, the Sidelink process shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

1> if the data which the MAC entity attempted to decode was successfully decoded for this TB; or

1> if the data for this TB was successfully decoded before:

2> if this is the first successful decoding of the data for this TB, if the SRC field of the decoded MAC PDU subheader is equal to the 16 MSB of any of the Source Layer-2 ID(s) of the UE for which the 8 LSB are equal to the Source ID in the corresponding SCI, and if the DST field of the decoded MAC PDU subheader is equal to the 8 MSB of any of the Destination Layer-2 ID(s) of the UE for which the 16 LSB are equal to the Destination ID in the corresponding SCI:

3> deliver the decoded MAC PDU to the disassembly and demultiplexing entity;

3> consider the Sidelink process as unoccupied.

1> else:

2> instruct the physical layer to replace the data in the soft buffer for this TB with the data which the MAC entity attempted to decode.

1> if HARQ feedback is enabled by the SCI:

2> if HARQ feedback corresponding to this TB is configured with [a separate PSFCH resource i.e. option 2]; or

2> if HARQ feedback corresponding to this TB is configured with [a shared PSFCH resource i.e. option 1] and the communication range calculated with the location information of the associated Sidelink transmission information according to TS 38.331 is smaller or equal to the communication range indicated in the associated Sidelink transmission:

3> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

#### 5.14.2.3 Disassembly and demultiplexing

The MAC entity shall disassemble and demultiplex a MAC PDU as defined in clause 6.x.

## 5.y SL-BCH data transfer

### 5.y.1 SL-BCH data transmission

When instructed to send SL-BCH, the MAC entity shall:

1> obtain the MAC PDU to transmit from SBCCH;

1> deliver the MAC PDU to the physical layer and instruct it to generate a transmission.

### 5.y.2 SL-BCH data reception

When the MAC entity needs to receive SL-BCH, the MAC entity shall:

1> receive and attempt to decode the SL-BCH;

1> if a TB on the SL-BCH has been successfully decoded:

2> deliver the decoded MAC PDU to upper layers.

NEXT CHANGE

#### 6.1.3.x 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 among index(es) associated to same destination reported in [*v2x-DestinationInfoList*]. If multiple such lists are reported, the value is indexed sequentially across all the lists in the same order as specified in TS 38.331 [5];

- 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 SL 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 and MAC headers 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 SL-BSR format and the Truncated SL-BSR format, the Buffer Size fields are included in ascending order based on the LCGi. For the Truncated SL-BSR format the number of Buffer Size fields included is maximised, while not exceeding the number of padding bits.

NOTE: The number of the Buffer Size fields in the SL-BSR and Truncated SL-BSR format can be zero.



Figure 6.1.3.x-1: SL-BSR and Truncated SL-BSR MAC control element

#### 6.1.3.y Sidelink Configured Grant Confirmation MAC CE

The Sidelink Configured Grant Confirmation MAC CE is identified by a MAC subheader with LCID as specified in Table 6.2.1-2. The Sidelink Configured Grant Confirmation MAC CE is defined as follows (Figure 6.1.3.y-1):

- Ci: If there is a configured grant Type 2 with *CGIndex* i configured for the MAC entity as specified in TS 38.331 [5], this field indicates the confirmation to activation/deactivation of the configured grant with *CGIndex* i, else the MAC entity shall ignore the Ci field. The Ci field is set to 1 to confirm that the configured grant with *CGIndex* i shall be activated. The Ci field is set to 0 to indicate that the configured grant with *CGIndex* i shall be deactivated;

- R: Reserved bit, set to 0.



Figure 6.1.3.y-1: Sidelink Configured Grant Confirmation MAC CE

#### 6.1.3.z Sidelink CSI Reporting MAC CE

The Sidelink CSI Reporting MAC CE is identified by a MAC subheader with LCID as specified in Table 6.2.x-1. The priority of the Sidelink CSI Reporting MAC CE is fixed to ‘1’. The Sidelink CSI Reporting MAC CE is defined as follows (Figure 6.1.3.z-1):

- RI: This field indicates the derived value of the Rank Indicator for sidelink CSI reporting as specified in clause 8.5 of TS 38.214 [7]. The length of the field is 1 bit;

- CQI: This field indicates the derived value of the Channel Quality Indicator for sidelink CSI reporting as specified in clause 8.5 of TS 38.214 [7]. The length of the field is 4 bit;

- R: Reserved bit, set to 0.



Figure 6.1.3.z-1: Sidelink CSI Reporting MAC CE

NEXT CHANGE

### 6.1.4 MAC PDU (transparent MAC)

A MAC PDU consists solely of a MAC SDU whose size is aligned to a TB; as described in Figure 6.1.4-1. This MAC PDU is used for transmissions on PCH, BCH, DL-SCH including BCCH, and SL-BCH.



Figure 6.1.4-1: Example of MAC PDU (transparent MAC)

NEXT CHANGE

### 6.1.x MAC PDU (SL-SCH)

A MAC PDU consists of one SL-SCH subheader and one or more MAC subPDUs. Each MAC subPDU consists of one of the following:

- A MAC subheader only (including padding);

- A MAC subheader and a MAC SDU;

- A MAC subheader and a MAC CE;

- A MAC subheader and padding.

The MAC SDUs are of variable sizes.

Each MAC subheader except SL-SCH subheader corresponds to either a MAC SDU, a MAC CE, or padding.

The SL-SCH subheader is of a fixed size and consists of the seven header fields [V/R/R/R/R/SRC/DST].



Figure 6.1.x-1: SL-SCH MAC subheader

A MAC subheader except for padding consists of the four header fields R/F/LCID/L as depicted in Figure 6.1.2-1 (with 8-bit L field) and Figure 6.1.2-2 (with 16-bit L field). A MAC subheader for MAC CE and padding consists of the two header fields R/LCID as depicted in Figure 6.1.2-3.

SL MAC subPDU(s) with MAC SDU(s) is placed after the SL-SCH subheader and before the MAC subPDU with a MAC CE and the MAC subPDU with padding in the MAC PDU as depicted in Figure 6.1.x-2. SL MAC subPDU with a MAC CE is placed after all the MAC subPDU(s) with MAC SDU and before the MAC subPDU with padding in the MAC PDU as depicted in Figure 6.1.x-2. The size of padding can be zero.

 

Figure 6.1.x-2: Example of a SL MAC PDU

A maximum of one MAC PDU can be transmitted per TB per MAC entity.

NEXT CHANGE

### 6.2.1 MAC subheader for DL-SCH and UL-SCH

The MAC subheader consists of the following fields:

- LCID: The Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU or the type of the corresponding MAC CE or padding as described in Tables 6.2.1-1 and 6.2.1-2 for the DL-SCH and UL-SCH respectively. There is one LCID field per MAC subheader. The LCID field size 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 subheaders corresponding to fixed-sized MAC CEs, padding, and MAC SDUs containing UL CCCH. 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 subheaders corresponding to fixed-sized MAC CEs, padding, and MAC SDUs containing UL CCCH. 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 6.2.1-1 Values of LCID for DL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 0 | CCCH |
| 1–32 | Identity of the logical channel |
| 33-46 | Reserved |
| 47 | Recommended bit rate |
| 48 | SP ZP CSI-RS Resource Set Activation/Deactivation |
| 49 | PUCCH spatial relation Activation/Deactivation |
| 50 | SP SRS Activation/Deactivation  |
| 51 | SP CSI reporting on PUCCH Activation/Deactivation |
| 52 | TCI State Indication for UE-specific PDCCH |
| 53 | TCI States Activation/Deactivation for UE-specific PDSCH |
| 54 | Aperiodic CSI Trigger State Subselection |
| 55 | SP CSI-RS/CSI-IM Resource Set Activation/Deactivation |
| 56 | Duplication Activation/Deactivation |
| 57 | SCell Activation/Deactivation (four octets) |
| 58 | SCell Activation/Deactivation (one octet) |
| 59 | Long DRX Command |
| 60 | DRX Command |
| 61 | Timing Advance Command |
| 62 | UE Contention Resolution Identity |
| 63 | Padding |

Table 6.2.1-2 Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 0 | CCCH of size 64 bits (referred to as "CCCH1" in TS 38.331 [5]) |
| 1–32 | Identity of the logical channel |
| 33–[48] | Reserved |
| [49] | Sidelink Configured Grant Confirmation |
| [50] | Truncated Sidelink BSR |
| [51] | Sidelink BSR |
| 52 | CCCH of size 48 bits (referred to as "CCCH" in TS 38.331 [5]) |
| 53 | Recommended bit rate query |
| 54 | Multiple Entry PHR (four octets Ci) |
| 55 | Configured Grant Confirmation |
| 56 | Multiple Entry PHR (one octet Ci) |
| 57 | Single Entry PHR |
| 58 | C-RNTI |
| 59 | Short Truncated BSR |
| 60 | Long Truncated BSR |
| 61 | Short BSR |
| 62 | Long BSR |
| 63 | Padding |

NEXT CHANGE

### 6.2.x 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. The V field size is 4 bits;]

- SRC: The SRC field carries the 16 most significant bits of the Source Layer-2 ID field set to the identifier provided by upper layers as defined in TS 23.287 [xx]. 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 [xx]. [If the V field is set to "1", this identifier is a unicast identifier. If the V field is set to "2", this identifier is a groupcast identifier. If the V field is set to "3", this identifier is a broadcast identifier] The length of the field is 8 bits;

- LCID: The Logical Channel ID field identifies the logical channel instance or the type of the corresponding MAC CE within the scope of one Source Layer-2 ID and Destination Layer-2 ID pair of the corresponding MAC SDU or padding as described in Tables 6.2.x-1 for SL-SCH. There is one LCID field per MAC subheader except for SL-SCH subheader. The LCID field size is 6 bits;

- L: The Length field indicates the length of the corresponding MAC SDU in bytes. There is one L field per MAC subheader except for subheaders corresponding to the SL-SCH subheader 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 subheaders corresponding to the SL-SCH subheader 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.x-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 |
| 20-61 | Reserved |
| 62 | Sidelink CSI Reporting |
| 63 | Padding |

NEXT CHANGE

## 7.1 RNTI values

RNTI values are presented in Table 7.1-1.

Table 7.1-1: RNTI values.

|  |  |
| --- | --- |
| Value (hexa-decimal) | RNTI |
| 0000 | N/A |
| 0001–FFF2 | RA-RNTI, Temporary C-RNTI, C-RNTI, MCS-C-RNTI, CS-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, TPC-SRS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, SL-RNTI, SLCS-RNTI and SL Semi-Persistent Scheduling V-RNTI |
| FFF3–FFFD | Reserved |
| FFFE | P-RNTI |
| FFFF | SI-RNTI |

Table 7.1-2: RNTI usage.

|  |  |  |  |
| --- | --- | --- | --- |
| RNTI | Usage | Transport Channel | Logical Channel |
| P-RNTI | Paging and System Information change notification | PCH | PCCH |
| SI-RNTI | Broadcast of System Information | DL-SCH | BCCH |
| RA-RNTI | Random Access Response | DL-SCH | N/A |
| Temporary C-RNTI | Contention Resolution(when no valid C-RNTI is available) | DL-SCH | CCCH, DCCH |
| Temporary C-RNTI | Msg3 transmission | UL-SCH | CCCH, DCCH, DTCH |
| C-RNTI, MCS-C-RNTI | Dynamically scheduled unicast transmission | UL-SCH | DCCH, DTCH |
| C-RNTI | Dynamically scheduled unicast transmission | DL-SCH | CCCH, DCCH, DTCH |
| MCS-C-RNTI | Dynamically scheduled unicast transmission | DL-SCH | DCCH, DTCH |
| C-RNTI | Triggering of PDCCH ordered random access | N/A | N/A |
| CS-RNTI | Configured scheduled unicast transmission(activation, reactivation and retransmission) | DL-SCH, UL-SCH | DCCH, DTCH |
| CS-RNTI | Configured scheduled unicast transmission(deactivation) | N/A | N/A |
| TPC-PUCCH-RNTI | PUCCH power control | N/A | N/A |
| TPC-PUSCH-RNTI | PUSCH power control | N/A | N/A |
| TPC-SRS-RNTI | SRS trigger and power control | N/A | N/A |
| INT-RNTI | Indication pre-emption in DL | N/A | N/A |
| SFI-RNTI | Slot Format Indication on the given cell | N/A | N/A |
| SP-CSI-RNTI | Activation of Semi-persistent CSI reporting on PUSCH | N/A | N/A |
| SL-RNTI | Dynamically scheduled sidelink transmission | SL-SCH | SCCH, STCH |
| SLCS-RNTI | Configured scheduled sidelink transmission(activation, reactivation and retransmission) | SL-SCH | SCCH, STCH |
| SLCS-RNTI | Configured scheduled sidelink transmission(deactivation) | N/A | N/A |
| SL Semi-Persistent Scheduling V-RNTI (NOTE y) | Semi-Persistently scheduled sidelink transmission for V2X sidelink communication(activation, reactivation and retransmission) | SL-SCH | STCH |
| SL Semi-Persistent Scheduling V-RNTI(NOTE y) | Semi-Persistently scheduled sidelink transmission for V2X sidelink communication(deactivation) | N/A | N/A |
| NOTE x: The usage of MCS-C-RNTI is equivalent to that of C-RNTI in MAC procedures (except for the C-RNTI MAC CE).NOTE y: The MAC entity uses SL Semi-Persistent Scheduling V-RNTI to control semi-persistently scheduled sidelink transmission on SL-SCH for V2X sidelink communication as specified in clause 5.14.1.1 of TS 36.321 [xz]. |

END OF THE CHANGE