**3GPP TSG-RAN WG2 Meeting #110-e *draft1\_R2-200***

**Online, 1– 12 June 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  | **38.321** | **CR** | **0730** | **rev** | **2** | **Current version:** | **16.0.0** |  |
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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:***  | Corrections to 5G V2X with NR Sidelink |
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| ***Source to WG:*** | LG Electronics Inc. |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | 5G\_V2X\_NRSL |  | ***Date:*** | 2020-06-16 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***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:*** | The following agreements need to be captured in 38.321:**RAN1#100e agreements****Mode 1 resource allocation:*** Only one new TB can be transmitted in one period of the configured grant.
* The DCI scheduling the retransmissions uses the HARQ process ID corresponding to the first transmission of the TB
* The specification supports having multiple HARQ ID processes for a given SL configured grant.
* The HARQ process ID for each transmission in a resource corresponding to a SL configured grant is determined based on the formula used for UL configured grants.
	+ The mapping with the values of HPN in SCI is fixed for a TB, and is up to UE implementation.

Note: This corresponds to the HARQ process ID for the interaction between gNB and UE, if any distinction is made.* The mapping between the values of HPN signaled in DCI and HPN signaled in SCI is fixed for a TB, and is up to UE implementation.
* For dynamic grant, the toggling of NDI in DCI is used as the toggling of NDI in SCI for the first SL transmission scheduled by the DCI. The SCI for the remaining transmissions scheduled by the DCI, if any, have the NDI untoggled with respect to the first SL transmission.
* The TX UE reports NACK to the gNB in the following cases:
	+ When it does not transmit the corresponding PSCCH/PSSCH due to intra-UE prioritization.
	+ When it does not receive the corresponding PSFCH due to intra-UE prioritization.
* For groupcast option 2 in the case where there are multiple PSFCHs corresponding to multiple PSCCH/PSSCH transmissions of a single TB, the TX UE reports ACK to the gNB if it has received ACK at least once from each RX UE. Otherwise, it reports NACK to the gNB.
* For groupcast option 2, the TX UE reports NACK to the gNB when it does not detect some expected PSFCH.
* For configured grant, the TX UE reports ACK to the gNB in case no PSCCH/PSSCH is transmitted in a set of resources.

**Mode 2 resource allocation*** For re-evaluation of a pre-selected resource contained in a slot ‘k’ to be first time signaled in a slot ‘m’, where k ≥ m,
	+ Step 1 of the resource (re-)selection procedure is performed at least at the moment ‘m-T3’, and if the pre-selected resource is not in the identified candidate resource set, Step 2 is triggered for reselection of the resource
		- Re-evaluations before the moment ‘m-T3’ or after ‘m-T3’ but before ‘m’ are not precluded and are up to UE implementation
* For pre-emption, both full and partial frequency domain overlap in the same slot are considered as the overlapping condition to trigger resource reselection, wherein the whole resource is reselected even if the partial overlap happened
* (Re-)selection procedure for an already reserved but pre-empted resource to be used for transmission in a slot ‘m’ is not required to be triggered at moment > ‘m – T3’
	+ T3 here is identical to T3 introduced for the re-evaluation
* In Step 2, a UE ensures a minimum time gap Z = a + b between any two selected resources of a TB where a HARQ feedback for the first of these resources is expected
	+ ‘a’ is a time gap between the end of the last symbol of the PSSCH transmission of the first resource and the start of the first symbol of the corresponding PSFCH reception determined by resource pool configuration and higher layer parameters of MinTimeGapPSFCH and periodPSFCHresource
	+ ‘b’ is a time required for PSFCH reception and processing plus sidelink retransmission preparation including multiplexing of necessary physical channels and any TX-RX/RX-TX switching time and is determined by UE implementation

**Physical layer procedures*** For TX-RX distance calculation, RX UE uses the distance between the center location of the indicated zone nearest to the RX UE and its own location.

**RAN1#100B-e agreement:*** Finalize the RRC parameter for pre-emption activation per resource pool by
* Disabled
* Enabled. Default is without a priority level (i.e., pre-emption is applicable to all levels).
	+ Can optionally configuring a priority level p\_preemption {1…8} (the value range is a working assumption), and (as a working assumption regarding “<”) if prioRX < p\_preemption, and prioTX > prioRX, then pre-emption can be triggered
		- Note: In the inequalities it is assumed that the lowest priority value corresponds to the highest priority/importance traffic
		- prioRX is the priority associated with the resource indicated in SCI, as per 8.1.4 in 38.214
		- prioTX is L1 priority within a UE associated with the reserved resources, as per 8.1.4 in 38.214
* The procedure to check whether a reserved resource to be signaled in slot ‘m’ should be re-selected due to pre-emption:
* A regular Step 1 (as in 8.1.4 in 38.214) of the resource (re-)selection procedure is performed
* If the reserved resource is still in the identified candidate resource set after the Step 1 execution, then Step 2 for reselection of the reserved resource(s) is not triggered
* If the reserved resource is NOT in the identified candidate resource set after the Step 1 execution
	+ If the resource is excluded by comparison with the RSRP measurement for an SCI associated with a priority which can trigger pre-emption, then Step 2 for reselection of the reserved resource(s) is triggered
	+ If the resource is excluded by comparison with the RSRP measurement for an SCI associated with a priority which cannot trigger pre-emption, then Step 2 for reselection of the reserved resource(s) is not triggered
* Once pre-emption re-selection condition is met at the UE, re-selection is performed for all resources which satisfy the pre-emption re-selection condition
* A UE ensures the HARQ RTT related minimum time gap Z agreed in RAN1#100-e, between re-selected and non-preempted resources during the re-selection triggered by pre-emption

**RAN1#101-e Agreements:** * The formula for determining the resources for CG Type-1 uses logical slots (periodicity is in units of ms, which is converted to logical slots using the same formula to be decided in mode 2)
* The gNB can configure between the following options for configurated grant type-1:
	+ SFN indexing is used for deriving the slots.
* Reuse LTE rule to calculate C\_resel from SL\_RESOURCE\_RESELECTION\_COUNTER:
	+ C\_resel=10\*SL\_RESOURCE\_RESELECTION\_COUNTER
* Introduce the following scaling to SL\_RESOURCE\_RESELECTION\_COUNTER range and inform RAN2 about this decision:
	+ SL\_RESOURCE\_RESELECTION\_COUNTER is the value randomly selected from the range

 (the range as a working assumption)* In Step 2, a UE shall select resources so that HARQ retransmission resources can be reserved by a prior SCI, except that
	+ In case no resource can be found for reservation (e.g., based on the identified candidate set after Step 1) for a retransmission of a TB, the re-transmission can be transmitted on a resource that is not reserved
	+ For a reserved resource to be signalled in slot ‘m’, the procedure to check whether it is re-selected due to pre-emption, the UE follows the same behavior in terms of the timing of checking as in that of the re-evaluation case.

**RAN2#109B-e Agreements:** * Sending HARQ ACK after checking the Layer-1 IDs in the SCI of the received MAC PDU, regardless of a result of checking the Layer-2 IDs in the MAC header, like sending HARQ NACK.
* HARQ feedback on PSFCH is not support for (re-)transmission of a MAC PDU only carrying CSI reporting MAC CE. i.e. TX UE disables HARQ feedback for transmission of a MAC PDU only carrying CSI reporting MAC CE.
* If a SL CSI Reporting MAC CE is multiplexed with data from logical channels, whether to enable or disable HARQ feedback for transmission of the MAC PDU depends on logical channel configuration about enabling or disabling HARQ feedback.
* RAN2 confirms that UE is configured only with a single number of symbols in length for PSSCH transmissions and a single SCS value per SL BWP as in RAN1 agreements.
* PSSCH duration based LCP restriction is not supported for NR SL in REL-16.
* If the highest priority logical channel of the destination selected in SL LCP is configured with ‘HARQ enabled’, UE selects only logical channels with ‘HARQ enabled’ for the entire TB.
* If the highest priority logical channel of the destination selected in SL LCP is configured with ‘HARQ disabled’, UE selects only logical channels with ‘HARQ disabled’ for the entire TB.
* UE can be configured with either both LTE mode 3 and NR mode 2 or both LTE mode 4 and NR mode 1, i.e. mixed mode can be supported only for inter-RAT sidelink.
* The PDB is determined for SL CSI report.
* UE in SL mode 2 may trigger resource reselection due to latency of CSI report, depending on UE implementation.
* A UE cancels a triggered SL CSI report if the latency bound associated to the triggered CSI report has been exceeded prior to transmission of the report.
* UE does not expect collision between configured grant and dynamic grant.
* RAN2 assumes that collision between SL configured grants can occur. How to handle collision across multiple SL configured grants was left to UE implementation.
* PUCCH resource cannot be configured without PSFCH resource.
* For mode 1, MAC select either LCHs with FB disabled or LCHs with FB enabled for a SL grant configured with both PSFCH and PUCCH in SL LCP.
* For mode1, MAC select only LCHs with FB disabled for a SL grant configured with neither PSFCH nor PUCCH in SL LCP.
* For mode1, if UE only has SL data on LCHs with FB enabled for a SL grant configured without PSFCH, the SL grant is skipped and so not used for transmission.
* Groupcast HARQ option 2 can be selected only when the following conditions are met:

 - The V2X layer passes the group size and the member ID to the AS layer; and - The group size is not greater than the number of candidate PSFCH resources associated with the selected PSSCH resource.* Which HARQ option is used for groupcast is up to the MAC layer of TX UE (even though the V2X layer passes the group size and the member ID to the AS layer.)
* If the V2X layer dose not pass the group size and the member ID to the AS layer, UE selects Option 1 for HARQ feedback if LCH is HARQ FB enabled. Whether we need additional condition for HARQ option1 is to be further discussed.
* UE does not report the group size to NG-RAN.
* A TX UE can use distance HARQ feedback only when the TX UE’s location is available (as agreed in RAN1). When the TX UE’s location is not available, TX UE enables HARQ feedback without the distance-based operation.

**RAN2#110-e Agreements:** * SR shall be triggered if there are UL-SCH resources available for a new transmission, and if the maxPUSCH-Duration configured for the sidelink logical channel that triggered the SL-BSR is smaller than the PUSCH transmission duration associated to the UL-SCH resources.
* SR shall be triggered if there are UL-SCH resources available for a new transmission, and if the allowedSCS-List configured for the sidelink logical channel that triggered the SL-BSR does not include the subcarrier Spacing index associated to the UL-SCH resources.
* Add one NOTE: a UE operating in Mode 1 may trigger SR transmission if transmission of a pending CSI report with the configured sidelink grant(s) cannot fulfil the latency bound associated to the CSI report.
* cg-RetransmissionTimer is not applicable for SL transmissions regardless of whether configuredGrantTimer is used for SL CG.
* No configuredGrantTimer is introduced for SL CG operation. TX UE flushes a TB for the buffer of the Sidelink process associated to a HARQ Process ID before the next CG resource associated to the HARQ Process ID.
* For mode1, if a TB has been transmitted with disabled SL HARQ feedback, the UE reports NACK to request further resources for blind retransmission and ACK otherwise.
* MAC can select either LCHs with FB disabled or LCHs with FB enabled for a SL grant configured with PSFCH but without PUCCH in SL LCP for SL mode 1.
* MAC select only LCHs with FB disabled for a SL grant configured with neither PSFCH nor PUCCH in SL LCP for SL mode 2.
* The following additional condition is needed for HARQ option1:

 - The group size is greater than the number of candidate PSFCH resources associated with the selected PSSCH resource. * Add the following condition in clause 5.4.4 of TS 38.321 for SR.

 “3> if the MAC entity is able to perform this SR transmission simultaneously with the transmission of the SL-SCH resource; or”* Upon MAC reset, the MAC entity sets the NDIs for all HARQ process IDs to the value 0 to receive the PDCCH for the MAC entity’s SL-RNTI and SLCS-RNTI in SL mode 1, as specified for UL HARQ.
* RAN2 does not specify the case that the MAC entity cancels triggered configured sidelink grant confirmation, upon MAC reset.
* SL specific MAC reset is introduced and specified in 38.321 and 38.331.
* Upon release of each PC5-RRC connection, UE RRC performs SL specific MAC reset.
* Upon MAC reset, the MAC entity flushes the soft buffers for all Sidelink processes for all TB(s) associated to the PC5-RRC connection.
* Upon MAC reset, the MAC entity cancels, if any, triggered Scheduling Request procedure only associated to the PC5-RRC connection (e.g. SR triggered by SL CSI Reporting).
* Upon MAC reset, the MAC entity cancels, if any, triggered Sidelink Buffer Status Reporting procedure only associated to the PC5-RRC connection.
* The UE shall discard the received subPDU and any remaining subPDUs in the MAC PDU for unicast, when a MAC entity receives a MAC PDU on SL-SCH containing a Reserved LCID value.
* If the SL BWP is deactivated, the MAC entity shall perform the following actions:

 2> not transmit PSBCH on the BWP, if configured; 2> not transmit PSCCH on the BWP; 2> not transmit SL-SCH on the BWP; 2> not receive PSFCH on the BWP, if configured. 2> not receive PSBCH on the BWP, if configured; 2> not receive PSCCH on the BWP; 2> not receive SL-SCH on the BWP; 2> not transmit PSFCH on the BWP, if configured.* When RRC configures multiple resource pools, NR MAC performs TX resource pool (re)selection procedure.
* UE expects that PSFCH configuration is always present in at least one resource pool configuration in case that sl-HARQ-FeedbackEnabled of at least one SL LCH for the UE is set to enabled.
* Change the term ‘a configured sidelink grant’ for NR SL mode 2 in 38.321
* ‘a selected sidelink grant’ replaces ‘a configured sidelink grant’ for NR SL mode 2.
* For NR sidelink mode 1, only SL CG Type 1 and 2 create ‘a configured sidelink grant’ while dynamic SL grant creates ‘a dynamic grant’.
* The maximum number of transmitting Sidelink processes associated with each Sidelink HARQ Entity is ‘16’ in NR sidelink communication.
* For transmissions of multiple MAC PDUs in NR sidelink communication, the maximum number of transmitting Sidelink processes associated with each Sidelink HARQ Entity is ‘4’. (We are not going to change the modeling of mode2 booking process, which is inherited from LTE V2X)
* Any MAC CE is allowed to be mapped to CG Type 1 without any explicit configuration.
* Mapping restriction between LCHs and SL configured grants in LCH configuration is introduced as specified in 38.331 and 38.321 for IIOT.
* Any MAC CE is allowed to be mapped to CG Type 2 without any explicit configuration.
* Add the following change in 38.321 for SL CSI reporting:

 “2> if the MAC entity has SL resources allocated for new transmission and the SL resources can accommodate the SL CSI reporting MAC CE and its subheader as a result of logical channel prioritization:* Use ‘sidelink resource allocation mode 1 and 2’ in 38.321 and 38.331 to be aligned with RAN1 specifications (noting that detailed wording for CR implementation can be further discussed)
* When TX UE enabled distance-based HARQ feedback by a SCI but RX UE’s location information is not available, RX UE sends HARQ feedback according to the decoding status of the MAC PDU.
* Prioritization of UL transmission over SL transmission in 5.4.2.2 of TS 38.321 is changed as captured in Proposal 1C. Some editorial comments provided by companies can be further discussed during CR implementation.
* UE does not expect DRX configuration if SL mode1 is configured in Rel-16.
* For SL mode2, UE considers mapping between LCH and HARQ feedback enable/disable attribute to select TX resource pool. If UE is configured with multiple TX resource pools with the same HARQ feedback enable/disable attribute, it’s up to UE implementation to select one out of them.
* gNB configure one SR configuration ID associated with the Sidelink CSI reporting. (i.e. the “zero” case is not supported).
* Reallocate SL specific MAC CE (Sidelink Configured Grant Confirmation) from LCID space to one-octet eLCID space.
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| ***Summary of change:*** | * In 2 and corresponding clauses, new references, TS 23.287 and TS 38.215 are added.
* In 3.1, the definition of Sidelink transmission control is updated.
* In 5.4.2.2, UL prioritization over SL transmission is updated.
* In 5.8.3, a new parameter *nrofHARQ-Processes* and *sl-harq-procID-offset* are added and how to determine configured sidelink grants is specified with new equations.
* In 5.12, SL specific MAC reset is introduced and NDI for SL mode 1 is clarified.
* In 5.13, handling of unknown, unforeseen and erroneous protocol data for sidelink unicast is specified.
* In 5.15.2, deactivation of SL BWP is specified.
* In 5.22, new terms, i.e. ‘selected sidelink grant’, ‘SL resource allocation mode 1 or 2’ are used as agreed in RAN2.
* In 5.22.1.1, agreements on configured sidelink grants with calculation of HARQ Process IDs are specified for SL mode 1.
* In 5.22.1.1, agreements on resource pool selection, resource reservation interval, the minimum time gap and retransmissions not reserved by a prior SCI are specified for SL mode 2.
* In 5.22.1.2, resource reselection for re-evaluation, pre-emption and dropped transmissions due to prioritization and sidelink congestion control are specified as agreed in RAN1.
* In 5.22.1.3.1, agreements on groupcast HARQ feedback option selection, HARQ enabled/disabled and UE location information availbility are specified and a few corrections are made.
* In 5.22.1.3, some HARQ precedural texts which have been missing in the middle of RAN2#109-e are recoved in 5.22.1.3.1 and 5.22.1.3.2. In addition, new clause 5.22.1.3.x is added.
* In 5.22.1.3.2, agreements on HARQ feedback report are specified.
* In 5.22.1.3.2, if TAT is running, SL HARQ feedback on PUCCH is sent as in 5.3.2 for DL HARQ feedback.
* In 5.22.1.3.y, HARQ-based Sidelink RLF detection is introduced.
* In 5.22.1.4.1.2, HARQ feedback enabled/disabled and mapping between CG and logical channels are specified.
* In 5.22.1.6, some indent are changed, two steps are re-ordered and agreements on allowedSCS-List and maxPUSCHduration are specified.
* In 5.22.1.7, agreements on SL CSI reporting are specified.
* In 5.22.2.2,1, a few corrections are made.
* In 5.22.2.2.2, agreements on groupcast HARQ feedback are captured and a few corrections are maded. In addition, only destination is used for broadcast and groupcast in packet filtering.
* In 6.1.6, SL-SCH subheader fields are confirmed by removal of brackets.
* In 6.2.1, SL CG Confirmation MAC CE is moved to one-octet eLCID space.
* In 6.2.4, 4 bits are confirmed for V field by removal of backets.
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| ***Consequences if not approved:*** | UE will not correctly perform NR sidelink transmission and reception. |
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| ***Clauses affected:*** | 2, 3.1, 5.4.2.2, 5.8.3, 5.12, 5.13, 5.15.2, 5.22.1.1, 5.22.1.2, 5.22.1.3.1, 5.22.1.3.x, 5.22.1.3.2, 5.22.1.4, 5.22.1.5, 5.22.1.6, 5.22.1.7, 5.22.2, 6.1.6, 6.2.1, 6.2.4 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 36.321 CR xxx |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  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".

[18] 3GPP TS 37.213: "Physical layer procedures for shared spectrum channel access".

[19] 3GPP TS 23.287: "Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services ".

[20] 3GPP TS 23.285: "Architecture enhancements for V2X services".

[21] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[22] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC); Protocol specification".

[23] 3GPP TS 37.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)".

[xx] 3GPP TS 38.215: "NR; Physical layer measurements".

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

# 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].

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

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

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

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

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

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

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

**NR sidelink communication**: AS functionality enabling at least V2X Communication as defined in TS 23.287 [19], 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.

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

**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, cast type, and Sidelink QoS information including a priority, a communication range requirement and Zone ID.

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

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

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

NOTE: 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).

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 PDCCH or indicated in the Random Access Response (i.e. MAC RAR or fallbackRAR), or signalled in RRC or determined as specified in clause 5.1.2a for MSGA payload. 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, or on stored configured uplink grant resources and stored MCS when *cg-RetransmissionTimer* is configured. Retransmissions with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS.

When *cg-RetransmissionTimer* is configured and the HARQ entity obtains a MAC PDU to transmit, the corresponding HARQ process is considered to be pending. A pending HARQ process is pending until a transmission is performed on that HARQ process or until the HARQ process is flushed.

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 the MAC PDU was obtained from the MSGA 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 or the MSGA 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 the transmission of the MAC PDU is prioritized over sidelink transmission:

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

If a HARQ process receives downlink feedback information, the HARQ process shall:

1> stop the *cg-RetransmissionTimer*, if running;

1> if acknowledgement is indicated:

2> stop the *configuredGrantTimer*, if running.

If the *configuredGrantTimer* expires for a HARQ process, the HARQ process shall:

1> stop the *cg-RetransmissionTimer*, if running.

The transmission of the MAC PDU is prioritized over sidelink transmission if one of the following conditions is met:

only(s)

only

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 or for SCell beam failure recovery (see clause 5.17) and for consistent LBT failure (see clause 5.21), at most one PUCCH resource for SR is configured per BWP.

Each SR configuration corresponds to one or more logical channels or to SCell beam failure recovery and/or to consistent LBT failure. Each logical channel, and consistent LBT failure, may be mapped to zero or one SR configuration, which is configured by RRC. The SR configuration of the logical channel that triggered a BSR other than Pre-emptive BSR (clause 5.4.5) or the SCell beam failure recovery or the consistent LBT failure (clause 5.21) (if such a configuration exists) is considered as corresponding SR configuration for the triggered SR. Any SR configuration may be used for an SR triggered by Pre-emptive BSR (clause 5.4.5).

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.

Except for SCell beam failure recovery, all pending SR(s) for BSR 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, regardless of LBT failure indication from lower layers, 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. Except for SCell beam failure recovery, all pending SR(s) for BSR 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. Pending SR triggered prior to the MAC PDU assembly for beam failure recovery of an SCell shall be cancelled when the MAC PDU is transmitted and this PDU includes an SCell BFR MAC CE or truncated SCell BFR MAC CE which contains beam failure recovery information of that SCell. If all the SR(s) triggered for SCell beam failure recovery are cancelled the MAC entity shall stop *sr-ProhibitTimer* of corresponding SR configuration.

The MAC entity shall for each pending SR triggered by consistent LBT failure:

1> if a MAC PDU is transmitted, regardless of LBT failure indication from lower layers, and the MAC PDU includes an LBT failure MAC CE that indicates consistent LBT failure for the Serving Cell that triggered this SR; or

1> if the corresponding consistent LBT failure is cancelled (see clause 5.21):

2> cancel the pending SR and stop the corresponding *sr-ProhibitTimer*.

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 overlaps with neither a UL-SCH resource nor an SL-SCH resource; or

3> if the MAC entity is able to perform this SR transmission simultaneously with the transmission of the SL-SCH resource; or

3> if the MAC entity is configured with *lch-basedPrioritization*, and the PUCCH resource for the SR transmission occasion for the pending SR triggered as specfied in clause 5.4.5 overlaps with any UL-SCH resource(s), and the priority of the logical channel that triggered SR is higher than the priority of the uplink grant(s) for any UL-SCH resource(s) where the priority of the uplink grant is determined as specified in clause 5.4.1; or

3> if the PUCCH resource for the SR transmission occasion for the pending SR triggered as specfied in clause 5.22.1.5 overlaps with any UL-SCH resource(s) carrying a MAC PDU, and either the priority of the triggered SR determined as specified in clause 5.22.1.5 is lower than *sl-Prioritizationthres* or the value of the highest priority of the logical channel(s) in the MAC PDU is higher than or eqaul to *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 5.4.5, 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 5.22.1.3.1 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 5.22.1.5, 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 5.22.1.5 is higher than the priority of the MAC PDU determined as specified in clause 5.22.1.3.1 for the SL-SCH resource:

4> the other overlapping uplink grant(s), if any, is a de-prioritized uplink grant;

4> if SR\_COUNTER < sr-TransMax:

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

5> if LBT failure indication is not received from lower layers:

5> increment *SR\_COUNTER* by 1;

6> 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: Except for SR for SCell beam failure recovery, 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.

NOTE 3: When the MAC entity has pending SR for SCell beam failure recovery and the MAC entity has one or more PUCCH resources overlapping with PUCCH resource for SCell beam failure recovery for the SR transmission occasion, the MAC entity considers only the PUCCH resource for SCell beam failure recovery as valid.

NOTE 4: For a UE operating in a semi-static channel access mode as described in TS 37.213 [18], PUCCH resources overlapping with the idle time of a fixed frame period are not considered valid.

The MAC entity may stop, if any, ongoing Random Access procedure due to a pending SR for BSR which has no valid PUCCH resources configured, which was initiated by MAC entity prior to the MAC PDU assembly. The ongoing Random Access procedure may be stopped when the MAC PDU is transmitted, regardless of LBT failure indication from lower layers, using a UL grant other than a UL grant provided by Random Access Response or a UL grant determined as specified in clause 5.1.2a for the transmission of the MSGA payload, 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. The ongoing Random Access procedure due to a pending SR for BFR of an SCell 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 contains an SCell BFR MAC CE or truncated SCell BFR MAC CE which includes beam failure recovery information of that SCell.

Editor's Note: It is FFS how Random Access procedures started due to consistent LBT failures are cancelled.

NEXT CHANGE

## 5.7 Discontinuous Reception (DRX)

The MAC entity may be configured by RRC with a DRX functionality that controls the UE's PDCCH monitoring activity for the MAC entity's C-RNTI, CI-RNTI, CS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, and TPC-SRS-RNTI. When using DRX operation, the MAC entity shall also monitor PDCCH according to requirements found in other clauses of this specification. When in RRC\_CONNECTED, if DRX is configured, for all the activated Serving Cells, the MAC entity may monitor the PDCCH discontinuously using the DRX operation specified in this clause; otherwise the MAC entity shall monitor the PDCCH as specified in TS 38.213 [6]. If Sidelink resource allocation mode 1 is configured by RRC, the MAC entity is not configured by RRC with a DRX functionality.

RRC controls DRX operation by configuring the following parameters:

- *drx-onDurationTimer*: the duration at the beginning of a DRX Cycle;

- *drx-SlotOffset*: the delay before starting the *drx-onDurationTimer*;

- *drx-InactivityTimer*: the duration after the PDCCH occasion in which a PDCCH indicates a new UL or DL transmission for the MAC entity;

- *drx-RetransmissionTimerDL* (per DL HARQ process except for the broadcast process): the maximum duration until a DL retransmission is received;

- *drx-RetransmissionTimerUL* (per UL HARQ process): the maximum duration until a grant for UL retransmission is received;

- *drx-LongCycleStartOffset*: the Long DRX cycle and *drx-StartOffset* which defines the subframe where the Long and Short DRX Cycle starts;

- *drx-ShortCycle* (optional): the Short DRX cycle;

- *drx-ShortCycleTimer* (optional): the duration the UE shall follow the Short DRX cycle;

- *drx-HARQ-RTT-TimerDL* (per DL HARQ process except for the broadcast process): the minimum duration before a DL assignment for HARQ retransmission is expected by the MAC entity;

- *drx-HARQ-RTT-TimerUL* (per UL HARQ process): the minimum duration before a UL HARQ retransmission grant is expected by the MAC entity;

- *ps-Wakeup* (optional): the configuration to start associated *drx-onDurationTimer* in case DCP is monitored but not detected;

- *ps-Periodic\_CSI\_Transmit* (optional): the configuration to report periodic CSI during the time duration indicated by *drx-onDurationTimer* in case DCP is configured but associated *drx-onDurationTimer* is not started;

- *ps-TransmitPeriodicL1-RSRP* (optional): the configuration to transmit periodic L1-RSRP report(s) during the time duration indicated by *drx-onDurationTimer* in case DCP is configured but associated *drx-onDurationTimer* is not started.

When a DRX cycle is configured, the Active Time includes the time while:

- *drx-onDurationTimer* or *drx-InactivityTimer* or *drx-RetransmissionTimerDL* or *drx-RetransmissionTimerUL* or *ra-ContentionResolutionTimer* (as described in clause 5.1.5) is running; or

- a Scheduling Request is sent on PUCCH and is pending (as described in clause 5.4.4); or

- a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the Random Access Preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in clause 5.1.4).

When DRX is configured, the MAC entity shall:

1> if a MAC PDU is received in a configured downlink assignment:

2> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;

2> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

1> if a MAC PDU is transmitted in a configured uplink grant:

2> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission;

2> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

1> if a *drx-HARQ-RTT-TimerDL* expires:

2> if the data of the corresponding HARQ process was not successfully decoded:

3> start the *drx-RetransmissionTimerDL* for the corresponding HARQ process in the first symbol after the expiry of *drx-HARQ-RTT-TimerDL*.

1> if a *drx-HARQ-RTT-TimerUL* expires:

2> start the *drx-RetransmissionTimerUL* for the corresponding HARQ process in the first symbol after the expiry of *drx-HARQ-RTT-TimerUL*.

1> if a DRX Command MAC CE or a Long DRX Command MAC CE is received:

2> stop *drx-onDurationTimer*;

2> stop *drx-InactivityTimer*.

1> if *drx-InactivityTimer* expires or a DRX Command MAC CE is received:

2> if the Short DRX cycle is configured:

3> start or restart *drx-ShortCycleTimer* in the first symbol after the expiry of *drx-InactivityTimer* or in the first symbol after the end of DRX Command MAC CE reception;

3> use the Short DRX Cycle.

2> else:

3> use the Long DRX cycle.

1> if *drx-ShortCycleTimer* expires:

2> use the Long DRX cycle.

1> if a Long DRX Command MAC CE is received:

2> stop *drx-ShortCycleTimer*;

2> use the Long DRX cycle.

1> if the Short DRX Cycle is used, and [(SFN × 10) + subframe number] modulo (*drx-ShortCycle*) = (*drx-StartOffset*) modulo (*drx-ShortCycle*):

2> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe.

1> if the Long DRX Cycle is used, and [(SFN × 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*:

2> if DCP is configured for the active DL BWP:

3> if DCP indication associated with the current DRX Cycle received from lower layer indicated to start *drx-onDurationTimer*, as specified in TS 38.213 [6]; or

3> if all DCP occasion(s) in time domain, as specified in TS 38.213 [6], associated with the current DRX Cycle occurred in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to start of the last DCP occasion, or within BWP switching interruption length, or during a measurement gap; or

3> if *ps-Wakeup* is configured with value *true* and DCP indication associated with the current DRX Cycle has not been received from lower layers:

4> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe.

2> else:

3> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe.

NOTE 1: In case of unaligned SFN across carriers in a cell group, the SFN of the SpCell is used to calculate the DRX duration.

1> if the MAC entity is in Active Time:

2> monitor the PDCCH as specified in TS 38.213 [6];

2> if the PDCCH indicates a DL transmission:

3> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback, regardless of LBT failure indication from lower layers;

NOTE 2: When HARQ feedback is postponed by PDSCH-to-HARQ\_feedback timing indicating a non-numerical k1 value, as specified in TS 38.213 [6], the corresponding transmission opportunity to send the DL HARQ feedback is indicated in a later PDCCH requesting the HARQ-ACK feedback.

3> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

3> if the PDSCH-to-HARQ\_feedback timing indicate a non-numerical k1 value as specified in TS 38.213 [6]:

4> start the *drx-RetransmissionTimerDL* in the first symbol after the PDSCH transmission for the corresponding HARQ process.

2> if the PDCCH indicates a UL transmission:

3> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission, regardless of LBT failure indication from lower layers;

3> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

2> if the PDCCH indicates a new transmission (DL or UL):

3> start or restart *drx-InactivityTimer* in the first symbol after the end of the PDCCH reception.

1> if DCP is configured for the active DL BWP; and

1> if the current symbol n occurs within *drx-onDurationTimer* duration; and

1> if *drx-onDurationTimer* associated with the current DRX cycle is not started as specified in this clause; and

1> if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause:

2> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7];

2> not report semi-persistent CSI configured on PUSCH;

2> if *ps-Periodic\_CSI\_Transmit* is not configured with value *true*:

3> if *ps-TransmitPeriodicL1-RSRP* is not configured with value *true*:

4> not report periodic CSI on PUCCH.

3> else:

4> not report periodic CSI on PUCCH, except L1-RSRP report(s).

1> else:

2> in current symbol n, if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause:

3> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7];

3> not report CSI on PUCCH and semi-persistent CSI configured on PUSCH.

2> if CSI masking (*csi-Mask*) is setup by upper layers:

3> in current symbol n, if *drx-onDurationTimer* would not be running considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause:

4> not report CSI on PUCCH.

NOTE 3: If a UE multiplexes a CSI configured on PUCCH with other overlapping UCI(s) according to the procedure specified in TS 38.213 [6] clause 9.2.5 and this CSI multiplexed with other UCI(s) would be reported on a PUCCH resource outside DRX Active Time, it is up to UE implementation whether to report this CSI multiplexed with other UCI(s).

Regardless of whether the MAC entity is monitoring PDCCH or not, the MAC entity transmits HARQ feedback, aperiodic CSI on PUSCH, and aperiodic SRS defined in TS 38.214 [7] when such is expected.

The MAC entity needs not to monitor the PDCCH if it is not a complete PDCCH occasion (e.g. the Active Time starts or ends in the middle of a PDCCH occasion).

NEXT CHANGE

### 5.8.3 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 [21]:

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

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

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant;

- *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;

*- sl-harq-procID-offset*: offset of HARQ process for configured grant Type 1.

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;

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant;

- *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;

*- sl-harq-procID-offset*: offset of HARQ process for configured grant Type 2.

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].

NOTE 1: If the MAC entity is configured with multiple configured sidelink grants, collision among the configured sidelink grants may occur. How to handle the collision is left to UE implementation.

After a sidelink grant is configured for a configured grant Type 1, the MAC entity shall consider sequentially that the first slot of the Sth sidelink grant occurs in the logical slot for which:

[(SFN × *numberOfSLSlotsPerFrame*) + logical slot number in the frame] =
 (*timeReferenceSFN* × *numberOfSLSlotsPerFrame* *+ sl-TimeOffsetCGType1*+ S × *PeriodicitySL*) modulo (1024 × *numberOfSLSlotsPerFrame*).

where , and *numberOfSLSlotsPerFrame* and *N* refer to the number of logical slots that can be used for SL transmsission in the frame and 20ms, respectively, as specified in clause 8.1.7 of TS 38.214 [7].

After a sidelink grant is configured for a configured grant Type 2, the MAC entity shall consider sequentially that the first slot of Sth sidelink grant occurs in the logical slot for which:

[(SFN × *numberOfSLSlotsPerFrame*) + logical slot number in the frame] =
[(SFNstart time × *numberOfSLSlotsPerFrame* + slotstart time) + S × *PeriodicitySL*] modulo (1024 × *numberOfSLSlotsPerFrame*).

where SFNstart time and slotstart time are the SFN and logical slot, respectively, of the first transmission opportunity of PSSCH where the configured sidelink grant was (re-)initialised.

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 6.1.3.34;

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> sets the NDIs for all HARQ process IDs to the value 0 for monitoring PDCCH in Sidelink resource allocation mode 1;

1> stop, if any, ongoing RACH procedure;

1> discard explicitly signalled contention-free Random Access Resources for 4-step RA type and 2-step RA type, if any;

1> flush Msg3 buffer;

1> flush MSGA 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 consistent LBT failure;

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*;

1> reset *LBT\_COUNTER*.

If a Sidelink specific reset of the MAC entity is requested for a PC5-RRC connection by upper layers, the MAC entity shall:

1> flush the soft buffers for all Sidelink processes for all TB(s) associated to the PC5-RRC connection;

1> cancel, if any, triggered Scheduling Request procedure only associated to the PC5-RRC connection;

1> cancel, if any, triggered Sidelink Buffer Status Reporting procedure only associated to the PC5-RRC connection.

## 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 for broadcast or groupcast, or an LCID value which is not configured, the MAC entity shall:

1> discard the received subPDU.

When a MAC entity receives a MAC PDU on SL-SCH containing a Reserved LCID value for unicast, the MAC entity shall:

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

NEXT CHANGE

### 5.15.2 Sidelink

In addition to clause 16 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.

1> if the BWP is deactivated:

2> not transmit PSBCH on the BWP, if configured;

2> not transmit PSCCH on the BWP;

2> not transmit SL-SCH on the BWP;

2> not receive PSFCH on the BWP, if configured.

2> not receive PSBCH on the BWP, if configured;

2> not receive PSCCH on the BWP;

2> not receive SL-SCH on the BWP;

2> not transmit PSFCH on the BWP, if configured.

NEXT CHANGE

## 5.22 SL-SCH Data transfer

### 5.22.1 SL-SCH Data transmission

#### 5.22.1.1 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. A sidelink grant addressed to SLCS-RNTI with NDI = 1 is considered as a dynamic sidelink grant.

If the MAC entity has been configured with Sidelink resource allocation mode 1 as indicated in TS 38.331 [5] or TS 36.331 [21], 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> if a sidelink grant is available for retransmission(s) of a MAC PDU which has been positively acknowledged as specified in clause 5.22.1.3.3:

3> clear the PSCCH duration(s) and PSSCH duration(s) corresponding to retransmission(s) of the MAC PDU from the 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 the identifed HARQ process ID that has been set for an activated configured sidelink grant identified by *sl-ConfigIndexCG*:

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 with Sidelink resource allocation mode 2 to transmit using pool(s) of resources in a carrier as indicated in TS 38.331 [5] or TS 36.331 [21] based on sensing or random selection, the MAC entity shall for each Sidelink process:

NOTE 1: If the MAC entity is configured with Sidelink resource allocation mode 2 to transmit using a pool of resources in a carrier as indicated in TS 38.331 [5] or TS 36.331 [21], the MAC entity can create a selected sidelink grant on the pool of resources based on random selection or sensing only after releasing configured sidelink grant(s), if any.

NOTE 2: The MAC entity expects that PSFCH is always configured by RRC for at least one pool of resources in case that at least a logical channel configured with *sl-HARQ-FeedbackEnabled* is set to *enabled*.

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

2> if the MAC entity has not selected a pool of resources allowed for the logical channel:

3> select any pool of resources among the pools of resources allowed for the logical channel by the Sidelink LCP mapping restriction (see clause 5.22.1.4.1.2) and upper layers according to TS 23.387 [yy];

2> perform the TX resource (re-)selection check on the selected pool of resources as specified in clause 5.22.1.2;

NOTE 3: 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 decides to cancel creating 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 or in the interval for the resource reservation interval lower than 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 clause 5.1.27 of TS 38.215 [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 clause 5.1.27 of TS 38.215 [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 as specified in 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 by ensuring the minimum time gap between any two selected resources in case that PSFCH is configured for this pool of resources and that a resource can be indicated by the time resource assignment of a SCI for a prior retransmission according to clause 8.3.1.1 of TS 38.212 [9];

5> if no resource(s) can be selected while ensuring that the resource(s) can be indicated by the time resource assignment of a SCI for one or more retransmissions according to clause 8.3.1.1 of TS 38.212 [9]:

6> 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].

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].

2> if the MAC layer decides not use the selected grant for transmission of the next TB, then set the resource reservation interval to the value 0 ms;

2> else set the resource reservation interval to the selected ,

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

2> if SL data is available in the logical channel:

3> select any pool of resources among the pools of resources allowed for the logical channel by upper layers;

2> else if a SL-CSI reporting is triggered:

3> select any pool of resources among the pools of resources;

2> perform the TX resource (re-)selection check on the selected pool of resources as specified in clause 5.22.1.2;

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 clause 5.1.27 of TS 38.215 [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 clause 5.1.27 of TS 38.215 [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 as specified in 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 by ensuring the minimum time gap between any two selected resources in case that PSFCH is configured for this pool of resources, and that a resource can be indicated by the time resource assignment of a prior SCI for a retransmission according to clause 8.3.1.1 of TS 38.212 [9];

5> if no resource(s) can be selected while ensuring that the resource(s) can be indicated by the time resource assignment of a SCI for one or more retransmissions according to clause 8.3.1.1 of TS 38.212 [9]:

6> 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].

2> set the resource reservation interval to the value 0 ms;

1> if a selected sidelink grant is available for retransmission(s) of a MAC PDU which has been positively acknowledged as specified in clause 5.22.1.3.3:

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

For a selected sidelink grant, the minimum time gap between any two selected resources comprises:

- a time gap between the end of the last symbol of a PSSCH transmission of the first resource and the start of the first symbol of the corresponding PSFCH reception determined by *MinTimeGapPSFCH* and *periodPSFCHresource* for the pool of resources; and

- a time required for PSFCH reception and processing plus sidelink retransmission preparation including multiplexing of necessary physical channels and any TX-RX/RX-TX switching time.

NOTE 4: How to determine the time required for PSFCH reception and processing plus sidelink retransmission preparation is left to UE implementation.

The MAC entity shall for each PSSCH duration:

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

2> if the MAC entity has been configured with Sidelink resource allocation mode 1:

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 lower layers according to clause 5.1.27 of TS 38.215 [xx] if CBR measurement results are available or the corresponding *sl-defaultTxConfigIndex* configured by RRC if CBR measurement results are not available.

NOTE 5: MCS selection is up to UE implementation if the MCS or the corresponding range is not configured by upper layers.

2> if the configured sidelink grant has been activated and this PSSCH duration corresponds to the first PSSCH transmission opportunity within this *sl-periodCG* of the configured sidelink grant:

3> set the HARQ Process ID to the HARQ Process ID associated with this PSSCH duration and, if available, all subsequent PSSCH duration(s) occuring in this *sl-periodCG* for the configured sidelink grant;

3> determine that this PSSCH duration is used for initial transmission;

3> if a dynamic sidelink grant associated to the HARQ Process ID has been received for retransmission(s):

4> clear the dynamic sidelink grant.

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

For configured sidelink grants, the HARQ Process ID associated with the first slot of a SL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_slot / *sl-periodCG*)] modulo *nrofHARQ-Processes* + *sl-harq-procID-offset*

where CURRENT\_slot = (SFN × *numberOfSlotsPerFrame* + slot number in the frame), and *numberOfSlotsPerFrame* refer to the number of consecutive slots per frame as specified in TS 38.211 [8].

#### 5.22.1.2 TX resource (re-)selection check

If the TX resource (re-)selection check procedure is triggered on the selected pool of resources for a Sidelink process according to clause 5.22.1.1, 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 the pool of resources is configured or reconfigured by upper layers; or

1> if there is no selected sidelink grant on the selected pool of resources; or

1> if neither transmission nor retransmission has been performed by the MAC entity on any resource indicated in the selected 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 selected sidelink grant is equal to *sl-ReselectAfter*; or

1> if the selected 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 1: If the selected 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 selected 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:

NOTE 2: 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.

NOTE 3: It is left for UE implementation whether to trigger the TX resource (re-)selection due to the PDB of the MAC CE triggered according to clause 5.22.1.7.

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

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

1> if a resource(s) of the selected sidelink grant is indicated for re-evaluation or pre-emption by the physical layer as specified in clause 8.1.4 of TS 38.214 [7]; or

1> if retransmission of a MAC PDU on the selected sidelink grant has been dropped by either sidelink congeston control as specified in clause 8.1.6 of TS 38.214 or de-prioritization as specified in clause 16.2.4 of TS 38.213 [6], clause 5.4.2.2 of TS 36.321 [22] and clause 5.4.4:

2> remove the resource(s) from the selected sidelink grant associated to the Sidelink process, if the resource(s) of the selected sidelink grant is indicated for re-evaluation or pre-emption by the physical layer;

2> randomly select the time and frequency resource from the resources indicated by the physical layer as specified in clause 8.1.4 of TS 38.214 [7] for either the removed resource or the dropped resource, according to the amount of selected frequency resources, the selected number of HARQ retransmissions and the remaining PDB of either SL data available in the logical channel(s) by ensuring the minimum time gap between any two selected resources of the selected sidelink grant in case that PSFCH is configured for this pool of resources, and that a resource can be indicated by the time resource assignment of a SCI for a retransmission according to clause 8.3.1.1 of TS 38.212 [9];

2> if no resource(s) is selected by ensuring that the resource(s) can be indicated by the time resource assignment of a SCI for one or more retransmissions according to clause 8.3.1.1 of TS 38.212 [9]:

3> 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;

2> replace the removed or dropped resource(s) by the selected resource(s) for the selected sidelink grant.

#### 5.22.1.3 Sidelink HARQ operation

##### 5.22.1.3.1 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 16. 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 is4.

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 sidelink grant is used for initial transmission; or

1> if no MAC PDU has been obtained:

NOTE 1: For the configured grant Type 1 and 2, only one new TB can be transmitted in a periodicity of the configured grant.

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> if a HARQ Process ID has been set for the sidelink grant:

5> associate the HARQ Process ID corresponding to the sidelink grant to the associated Sidelink process;

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 8 LSB of the Source Layer-2 ID of the MAC PDU;

5> set the Destination Layer-1 ID to the 16 LSB 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 2: 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 3: How UE determine Sidelink process ID in SCI is left to UE implementation for NR sidelink.

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

6> enable HARQ feedback;

5> else:

6> disable HARQ feedback;

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 cast type to the cast type of the MAC PDU.

5> if HARQ feedback is enabled for groupcast:

6> if both a group size and a member ID are provided by upper layers and the group size is not greater than the number of candidate PSFCH resources associated with this sidelink grant:

7> select either positive-negative acknowledgement or negative-only acknowledgement.

6> else:

7> select negative-only acknowledgement;

6> if negative-only acknowledgement is selected, UE’s location information is available, and *sl-TransRange* has been configured for a logical channel in the MAC PDU, and Zone\_id is determined as specified in TS 38.331 [5]:

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

8> set Zone\_id to the value of the determined Zone\_id.

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> if the HARQ Process ID corresponding to the sidelink grant received on PDCCH is associated to a Sidelink process of which HARQ buffer is empty; or

2> if the HARQ Process ID corresponding to the sidelink grant received on PDCCH is not associated to any Sidelink process:

3> ignore the sidelink grant.

2> else:

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

4> deliver the sidelink grant of the MAC PDU to the associated Sidelink process;

4> instruct the associated Sidelink process to trigger a retransmission.

##### 5.22.1.3.x Sidelink process

The Sidelink process is associated with a HARQ buffer.

New transmissions and retransmissions are performed on the resource indicated in the sidelink grant as specified in clause 5.x.1.1 and with the MCS selected as specified in clause 8.1.3.1 of TS 38.214 [7] and clause 5.x.1.1.

If the Sidelink process is configured to perform transmissions of multiple MAC PDUs the process maintains a counter SL\_RESOURCE\_RESELECTION\_COUNTER. For other configurations of the Sidelink process, this counter is not available.

If the Sidelink HARQ Entity requests a new transmission, the Sidelink process shall:

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

1> store the sidelink grant received from the Sidelink HARQ Entity;

1> generate a transmission as described below;

If the Sidelink HARQ Entity requests a retransmission, the Sidelink process shall:

1> generate a transmission as described below;

To generate a transmission, the Sidelink process shall:

1> if there is no uplink transmission; or

1> if the MAC entity is able to simultaneously perform uplink transmission(s) and sidelink transmission at the time of the transmission; or

1> if the other MAC entity and the MAC entity are able to simultaneously perform uplink transmission(s) and sidelink transmission at the time of the transmission respectively; or

1> if there is a MAC PDU to be transmitted for this duration in uplink, except a MAC PDU obtained from the Msg3 buffer or 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> instruct the physical layer to monitor PSFCH for the transmission and perform PSFCH reception as specified in clause 5.22.1.3.2.

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

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

1> 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

1> if a positive acknowledgement to a transmission of the MAC PDU has been received according to clause 5.22.1.3.2; or

1> if only a negative acknowledgement was enabled in the SCI and no negative acknowledgement was received for the the most recent (re-)transmission of the MAC PDU according to clause 5.x.1.3.2:

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

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 23.287[yy]; 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 [22] 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.

##### 5.22.1.3.2 PSFCH reception

The MAC entity shall for each PSSCH transmission:

1> if an acknowledgement corresponding to the PSSCH transmission in clause 5.22.1.3.x 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 the PSSCH transmission occurs for a pair of Source Layer-2 ID and Destination Layer-2 ID corresponding to a PC5-RRC connection which has been established by upper layer:

2> perform the HARQ-Based Sidelink RLF Detection procedure as specified in clause 5.22.1.3.y.

If *sl-PUCCH-Config* is configured by RRC, the MAC entity shall for a PUCCH transmission occasion:

1> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is stopped or expired:

2> not instruct the physical layer to generate acknowledgement(s) of the data in this TB.

1> else if a MAC PDU has been obtained for a sidelink grant associated to the PUCCH transmission occasion in clause 5.22.1.3.1, the MAC entity shall for each PSSCH transmission:

2> if the PSSCH transmission was not prioritized as specified in clause 5.22.1.3.x:

3> instruct the physical layer to signal a negative acknowledgement on the PUCCH according to clause 16.5 of TS 38.213 [6].

2> else:

3> instruct the physical layer to signal an acknowledgement corresponding to the transmission on the PUCCH according to clause 16.5 of TS 38.213 [6].

2> if *sl-HARQ-FeedbackEnabled* has been set to *disabled* for the logical channel(s) in the MAC PDU and no sidelink grant is available for next retransmission(s) of the MAC PDU, if any:

3> instruct the physical layer to signal a negative acknowledgement corresponding to the transmission on the PUCCH according to clause 16.5 of TS 38.213 [6].

2> else if *sl-HARQ-FeedbackEnabled* has been set to *disabled* for the logical channel(s) in the MAC PDU and next retransmission(s) of the MAC PDU is not required:

 3> instruct the physical layer to signal a positive acknowledgement corresponding to the transmission on the PUCCH according to clause 16.5 of TS 38.213 [6].

1> else:

2> instruct the physical layer to signal a negative acknowledgement on the PUCCH according to clause 16.5 of TS 38.213 [6].

##### 5.22.1.3.y HARQ-based Sidelink RLF detection

The HARQ-based Sidelink RLF detection procedure is used to detect Sidelink RLF based on a number of consecutive DTX on PSFCH reception occasions for a PC5-RRC connection.

RRC configures the following parameter to control HARQ-based Sidelink RLF detection:

- *maxNumConsecutiveDTX*.

The following UE variable is used for HARQ-based Sidelink RLF detection.

- *numConsecutiveDTX*, which is maintained for each PC5-RRC connection.

The Sidelink HARQ Entity shall (re-)initialize *numConsecutiveDTX* to zero for each PC5-RRC connection which has been established by upper layers, if any, upon (re)configuration of *maxNumConsecutiveDTX*.

The Sidelink HARQ Entity shall for each PSFCH reception occasion associated to the PSSCH transmission:

1> if PSFCH reception is absent on the PSFCH reception occasion:

2> increment *numConsecutiveDTX*;

2> if *numConsecutiveDTX* reaches *maxNumConsecutiveDTX*:

3> indicate HARQ-based Sidelink RLF detection to upper layers;

1> else:

2> re-initialize *numConsecutiveDTX* to zero.

#### 5.22.1.4 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.

##### 5.22.1.4.1 Logical channel prioritization

###### 5.22.1.4.1.1 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.

###### 5.22.1.4.1.2 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;

2> *sl-allowedCG-List*, if configured, includes the configured grant index associated to the SL grant; and

2> *sl-HARQ-FeedbackEnabled* set to *disabled*, if PSFCH is not configured for the SL grant associated to the SCI.

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> *sl-allowedCG-List*, if configured, includes the configured grant index associated to the SL grant; and

2> if the MAC entity has been configured with Sidelink resource allocation mode 1 and PSFCH is configured for the sidelink grant associated to the SCI:

3> *sl-HARQ-FeedbackEnabled* is set to *enabled*, if *sl-HARQ-FeedbackEnabled* is set to *enabled* for the highest priority logical channel satisfying the above conditions*;* or

3> *sl-HARQ-FeedbackEnabled* set to *disabled*,if *sl-HARQ-FeedbackEnabled* is set to *disabled* for the highest priority logical channel satisfying the above conditions.

2> else:

3> *sl-HARQ-FeedbackEnabled* set to *disabled*.

###### 5.22.1.4.1.3 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 5.22.1.4.1.2 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 5.22.1.4.1.2 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 5.22.1.4.1) 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 5.22.1.7; 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.

##### 5.22.1.4.2 Multiplexing of MAC SDUs

The MAC entity shall multiplex MAC SDUs in a MAC PDU according to clauses 5.22.1.3.1 and 6.1.6.

#### 5.22.1.5 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 5.22.1.6) or the SL-CSI reporting (clause 5.22.1.7). 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 5.22.1.6) (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 one SR configuration for all PC5-RRC connections established by RRC. The SR configuration of the SL-CSI reporting triggered according to 5.22.1.7 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 5.22.1.6) 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 5.22.1.4) prior to the MAC PDU assembly.

All pending SR(s) triggered according to the Sidelink BSR procedure (clause 5.22.1.6) 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.

#### 5.22.1.6 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 [21]. 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 been configured with Sidelink resource allocation mode 1:

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> Sidelink resource allocation mode 1 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:

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

2> 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.

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; or

3> if the set of allowed Subcarrier Spacing index values in *allowedSCS-List* configured for the logical channel that triggered the SL-BSR, if configured, does not include the Subcarrier Spacing index associated to the UL-SCH resources available for a new transmission; or

3> if *maxPUSCH-Duration* configured for the logical channel that triggered the SL-BSR, if configured, is smaller than the PUSCH transmission duration associated to the UL-SCH resources available for a new transmission:

4> trigger a Scheduling Request.

NOTE 1: 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 2: 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.

#### 5.22.1.7 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].

RRC configures the following parameters to control the SL-CSI reporting procedure:

- *latencyBoundCsiReport-SL*, which is maintained for each PC5-RRC connection.

The MAC entity shall for each pair of the Source Layer-2 ID and the Destination Layer-2 ID corresponding to a PC5-RRC connection which has been established by upper layer:

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

2> if the latency requirement of the SL-CSI reporting in *latencyBoundCsiReport-SL* cannot be met:

3> cancel the triggered SL-CSI reporting.

2> else if the MAC entity has SL resources allocated for new transmission and the SL-SCH resources can accommodate the SL CSI reporting MAC CE and its subheader as a result of logical channel prioritization:

3> instruct the Multiplexing and Assembly procedure to generate a Sidelink CSI Reporting MAC CE as defined in clause 6.1.3.35;

3> cancel the triggered SL-CSI reporting.

2> else if the MAC entity has been configured with Sidelink resource allocation mode 1:

3> trigger a Scheduling Request.

NOTE: The MAC entity configured with Sidelink resource allocation mode 1 may trigger a Scheduling Request if transmission of a pending SL-CSI reporting with the sidelink grant(s) cannot fulfil the PDB associated to the SL-CSI reporting.

### 5.22.2 SL-SCH Data reception

#### 5.22.2.1 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.

#### 5.22.2.2 Sidelink HARQ operation

##### 5.22.2.2.1 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 the pair of the Destination Layer-1 ID and the Source Layer-1 ID of the SCI or this is the very first received transmission for the pair of the Destination Layer-1 ID and the Source Layer-1 ID of the SCI:

3> allocate the TB received from the physical layer and the associated Sidelink transmission information to an unoccupied Sidelink process;

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

4> flush the HARQ buffer.

3> 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 the pair of the Destination Layer-1 ID and the Source Layer-1 ID of the SCI 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.

##### 5.22.2.2.2 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:

3> if this TB is associated to unicast, the DST field of the decoded MAC PDU subheader is equal to the 8 MSB of any of the Source Layer-2 ID(s) of the UE for which the 16 LSB are equal to the Destination ID in the corresponding SCI, and the SRC field of the decoded MAC PDU subheader is equal to the 16 MSB of any of the Destination Layer-2 ID(s) of the UE for which the 8 LSB are equal to the Source ID in the corresponding SCI; or

3> if this TB is associated to groupcast or broadcast and 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:

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

2> 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 type 1 groupcast is indicated by the SCI according to clause 8.4.1 of TS 38.212 [9]:

3> if UE’s location information is available and distance beteween UE’s location and the central location of the nearest zone indicated by the *Zone\_id* in the SCI is smaller or equal to the communication range; or

3> if UE’s location information is not available:

4> if the data which the MAC entity attempted to decode was not successfully decoded for this TB or the data for this TB was not successfully decoded before:

5> instruct the physical layer to generate a negative acknowledgement of the data in this TB.

2> if type 1 groupcast is not indicated by the SCI according to clause 8.4.1 of TS 38.212 [9]:

3> if the data which the MAC entity attempted to decode was successfully decoded for this TB or the data for this TB was successfully decoded before:

4> instruct the physical layer to generate a positive acknowledgement of the data in this TB.

3> else:

4> instruct the physical layer to generate a negative acknowledgement of the data in this TB.

NEXT CHANGE

### 6.1.6 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 6.1.6-1: 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 6.1.6-2. 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 6.1.6-2. The size of padding can be zero.

 

Figure 6.1.6-2: Example of a SL MAC PDU

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

## 6.2 Formats and parameters

### 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. If the LCID field is set to 34, one additional octet is present in the MAC subheader containing the eLCID field and follow the octet containing LCID field. If the LCID field is set to 33, two additional octets are present in the MAC subheader containing the eLCID field and these two additional octets follow the octet containing LCID field;

- eLCID: The extended Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU as described in tables 6.2.1-1a, 6.2.1-1b, 6.2.1-2a and 6.2.1-2b for the DL-SCH and UL-SCH respectively. The size of the eLCID field is either 8 bits or 16 bits.

NOTE 1: The extended Logical Channel ID space using two-octet eLCID and the relevant MAC subheader format is used, only when configured, on the NR backhaul links between IAB nodes or between IAB node and IAB Donor.

- 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

|  |  |
| --- | --- |
| Codepoint/Index | LCID values |
| 0 | CCCH |
| 1–32 | Identity of the logical channel |
| 33 | Extended logical channel ID field (two-octet eLCID field) |
| 34 | Extended logical channel ID field (one–octet eLCID field) |
| 35 | Reserved |
| 36 | SP Positioning SRS Activation/Deactivation |
| 37 | Duplication RLC Activation/Deactivation |
| 38 | Absolute Timing Advance Command |
| 39 | CC list-based SRS Activation/Deactivation |
| 40 | PUSCH Pathloss Reference RS Activation/Deactivation |
| 41 | SRS Pathloss Reference RS Activation/Deactivation |
| 42 | AP SRS spatial relation Indication |
| 43 | Enhanced PUCCH spatial relation Activation/Deactivation |
| 44 | Enhanced TCI States Activation/Deactivation for UE-specific PDSCH |
| 45 | Number of Provided Guard Symbols |
| 46 | Timing Delta |
| 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 6.2.1-1a Values of two-octet eLCID for DL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 320 to (216 + 191) | Identity of the logical channel |
| (216 + 192) to (216 + 319) | Reserved |

Table 6.2.1-1b Values of one-octet eLCID for DL-SCH

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 0 to 255 | 64 to 319 | reserved |

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 | Extended logical channel ID field (two–octet eLCID field) |
| 34 | Extended logical channel ID field (one–octet eLCID field) |
| 35–40 | Reserved |
|  |  |
| 41 | Truncated Sidelink BSR |
| 42 | Sidelink BSR |
| 43 | Multiple Entry Configured Grant Confirmation |
| 44 | LBT failure (four octets) |
| 45 | LBT failure (one octet) |
| 46 | SCell BFR (four octets Ci) |
| 47 | SCell BFR (one octet Ci) |
| 48 | Truncated SCell BFR (four octets Ci) |
| 49 | Truncated SCell BFR (one octet Ci) |
| 50 | Number of Desired Guard Symbols |
| 51 | Pre-emptive 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 |

Table 6.2.1-2a Values of two-octet eLCID for UL-SCH

|  |  |
| --- | --- |
| Codepoint/IIndex | LCID values |
| 320 to (216 + 191) | Identity of the logical channel |
| (216 + 192) to (216 + 319) | Reserved |

Table 6.2.1-2b Values of one-octet eLCID for UL-SCH

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 0 | 64 | Sidelink Configured Grant Confirmation |
| 1 to 255 | 65 to 319 | reserved |

NOTE 2: For the eLCID space, the 16-bit codepoint 000…00 (all zeros) corresponds to the index value of 320, while the 16-bit codepoint 111…11 (all ones) corresponds to the index value of 216+ 319.

NEXT CHANGE

### 6.2.4 MAC subheader for SL-SCH

The MAC subheader consists of the following fields:

- V: The MAC PDU format version number field indicates which version of the SL-SCH subheader is used. 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 [19]. The length of the field is 16 bits;

- DST: The DST field carries the 8 most significant bits of the Destination Layer-2 ID set to the identifier provided by upper layers as defined in TS 23.287 [19]. [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 6.2.4-1 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 6.2.4-1 Values of LCID for SL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 0 | SCCH carrying PC5-S messages that are not protected |
| 1 | SCCH carrying PC5-S messages "Direct Security Mode Command" and "Direct Security Mode Complete" |
| 2 | SCCH carrying other PC5-S messages that are protected |
| 3 | SCCH carrying PC5-RRC messages |
| 4-19 | Identity of the logical channel |
| 20-61 | Reserved |
| 62 | Sidelink CSI Reporting |
| 63 | Padding |

END OF THE CHANGE