**3GPP TSG-RAN WG2 Meeting #118electronic R2-2206623**

**Online, May 9th – May 20th, 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | 38.321 | **CR** | 1301 | **rev** | - | **Current version:** | 17.0.0 |  |
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| *For* [***HE******LP***](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 on MBS |
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| ***Source to WG:*** | OPPO, Huawei, Nokia, Samsung, vivo |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_MBS-Core |  | ***Date:*** | 2022-05-20 |
|  |  |  |  |  |
| ***Category:*** | ***F*** |  | ***Release:*** | *Rel-17* |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | 1. In 4.2.2, the two figures for MAC structure are not correct.
2. In 5.3.1, the text about MAC entity shall indicate the presence of a downlink assignment and redundancy version to the HARQ entity for MCCH and broadcast MTCH reception is missing.
3. In 5.3.2.2, the text about HARQ process handling for MCCH and broadcast MTCH is missing.
4. In 5.7, based on following RAN2 agreement in RAN2#118.

🡺When allowCSI-SRS-Tx-MulticastDRX-Active and csi-Mask are configured, the UE does not report CSI on PUCCH when both drx-onDurationTimer and drx-onDurationTimerPTM are not running.🡺DCP monitoring can be configured together with multicast DRX.🡺If allowCSI-SRS-Tx-MulticastDRX-Active is configured, UE shall report CSI/SRS even when the conditions for DCP and unicast DRX in TS 38321 are satisfied, if multicast DRX is in Active Time.🡺When MAC PDU or PDCCH for unicast is received, stop both drx-RetransmissionTimerDL and drx-RetransmissionTimerDL-PTM in section 5.7 if multicast DRX is configured.1. In 5.7a, based on following RAN2 agreement in RAN2#118.

🡺Clarify in specifications that DRX control is always based on the SFN of the cell where the MBS broadcast service is provided [MAC TS]. (UE anyway read MIB of Scell to maintain knowledge of timing)1. In 5.7b, based on following RAN2 agreement in RAN2#118.

🡺Stopping drx-RetransmissionTimerDL and drx-RetransmissionTimerDL-PTM always regardless of HARQ feedback enabling.1. In 5.8.1a, the MBS SPS can be configred on one serving cell, PCell or one SCell.
2. In 5.12, Broadcast reception is regardless of RRC state, and broadcast reception should be considered when performing MAC reset.
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| ***Summary of change:*** | 1. In 4.2.2, the HARQ process resources are shared between broadcast, unicast and multicast and the data from/to MCCH and broadcast MTCH should be processed HARQ entities.
2. In 5.3.1, when a downlink assignment for a PDCCH occasion has been received on the PDCCH for the MCCH-RNTI and broadcast G-RNTI, the MAC entity shall indicate the presence of a downlink assignment and redundancy version to the HARQ entity.
3. In 5.3.2.2, for the received TB for MCCH or broadcast MTCH, and this is the first received transmission for the TB according to the scheduling information indicated by RRC or DCI; consider this transmission to be new, otherwise, to be retransmission for this HARQ process.
4. In 5.7, based on following RAN2 agreement in RAN2#118.

🡺When allowCSI-SRS-Tx-MulticastDRX-Active and csi-Mask are configured, the UE does not report CSI on PUCCH when both drx-onDurationTimer and drx-onDurationTimerPTM are not running.🡺DCP monitoring can be configured together with multicast DRX.🡺If allowCSI-SRS-Tx-MulticastDRX-Active is configured, UE shall report CSI/SRS even when the conditions for DCP and unicast DRX in TS 38321 are satisfied, if multicast DRX is in Active Time.🡺When MAC PDU or PDCCH for unicast is received, stop both drx-RetransmissionTimerDL and drx-RetransmissionTimerDL-PTM in section 5.7 if multicast DRX is configured.1. In 5.7a, based on following RAN2 agreement in RAN2#118.

🡺Clarify in specifications that DRX control is always based on the SFN of the cell where the MBS broadcast service is provided [MAC TS]. (UE anyway read MIB of Scell to maintain knowledge of timing)1. In 5.7b, based on following RAN2 agreement in RAN2#118.

🡺Stopping drx-RetransmissionTimerDL and drx-RetransmissionTimerDL-PTM always regardless of HARQ feedback enabling.1. In 5.8.1a, the MBS SPS can be configred on one serving cell, PCell or one SCell.
2. In 5.12, Broadcast reception is regardless of RRC state, and broadcast reception should be considered when performing MAC reset.
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| ***Consequences if not approved:*** | Some text for NR MBS are missing. |
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| ***Clauses affected:*** | 4.2.2, 5.3.1, 5.3.2.2, 5.7, 5.7a, 5.7b, 5.8.1a, 5.12 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ... |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |
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| ***This CR's revision history:*** |  |

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| *The first of change* |

4.2.2 MAC Entities

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

- Broadcast Channel (BCH);

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

- Paging Channel (PCH);

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

- Random Access Channel(s) (RACH).

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

When the UE is configured with DAPS handover, two MAC entities are used by the UE: one for the source cell (source MAC entity) and one for the target cell (target MAC entity).

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

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

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

Figure 4.2.2-1 illustrates one possible structure of the MAC entity when SCG is not configured and for each MAC entity during DAPS handover.



**Figure 4.2.2-1: MAC structure overview**

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



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

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

- Sidelink Shared Channel (SL-SCH);

- Sidelink Broadcast Channel (SL-BCH).

Figure 4.2.2-3 illustrates one possible structure for the MAC entity when sidelink is configured.

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**Figure 4.2.2-3: MAC structure overview for sidelink**

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| *The next of change* |

## 5.3 DL-SCH data transfer

### 5.3.1 DL Assignment reception

Downlink assignments received on the PDCCH both indicate that there is a transmission on a DL-SCH for a particular MAC entity and provide the relevant HARQ information.

When the MAC entity has a C-RNTI, Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion during which it monitors PDCCH and for each Serving Cell:

1> if a downlink assignment for this PDCCH occasion and this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI, or Temporary C‑RNTI, or G-RNTI:

2> if this is the first downlink assignment for this Temporary C-RNTI:

3> consider the NDI to have been toggled.

2> if the downlink assignment is for the MAC entity's C-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity's CS-RNTI or G-CS-RNTI, or a configured downlink assignment for unicast or MBS multicast; or

2> if the downlink assignment is for the MAC entity's G-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity's CS-RNTI or G-CS-RNTI, or other G-RNTI, or C-RNTI, or a configured downlink assignment for unicast or MBS multicast:

3> consider the NDI to have been toggled regardless of the value of the NDI.

2> if this is the first downlink assignment after initial transmission for CG-SDT with CCCH message as in clause 5.4.1:

3> stop the *cg-SDT-RetransmissionTimer* for the corresponding HARQ process for initial transmission with CCCH message.

2> indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity.

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI or G-CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> indicate the presence of a downlink assignment for this Serving Cell and deliver the associated HARQ information to the HARQ entity.

2> if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate SPS deactivation:

4> clear the configured downlink assignment for this Serving Cell (if any);

4> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is running:

5> indicate a positive acknowledgement for the SPS deactivation to the physical layer.

3> else if PDCCH content indicates SPS activation:

4> store the downlink assignment for this Serving Cell and the associated HARQ information as configured downlink assignment;

4> initialise or re-initialise the configured downlink assignment for this Serving Cell to start in the associated PDSCH duration and to recur according to rules in clause 5.8.1;

For each Serving Cell and each configured downlink assignment, if configured and activated, the MAC entity shall:

1> if the PDSCH duration of the configured downlink assignment does not overlap with the PDSCH duration of a downlink assignment received on the PDCCH for this Serving Cell:

2> instruct the physical layer to receive, in this PDSCH duration, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;

2> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

2> consider the NDI bit for the corresponding HARQ process to have been toggled;

2> indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity.

For configured downlink assignments without *harq-ProcID-Offset*, the HARQ Process ID associated with the slot where the DL transmission starts is derived from the following equation:

HARQ Process ID = [floor (CURRENT\_slot × 10 / (*numberOfSlotsPerFrame* × *periodicity*))] modulo *nrofHARQ-Processes*

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

For configured downlink assignments with *harq-ProcID-Offset*, the HARQ Process ID associated with the slot where the DL transmission starts is derived from the following equation:

HARQ Process ID = [floor (CURRENT\_slot × 10 / (*numberOfSlotsPerFrame* × *periodicity*))] modulo *nrofHARQ-Processes* + *harq-ProcID-Offset*

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

NOTE 1: In case of unaligned SFN across carriers in a cell group, the SFN of the concerned Serving Cell is used to calculate the HARQ Process ID used for configured downlink assignments.

NOTE 2: CURRENT\_slot refers to the slot index of the first transmission occasion of a bundle of configured downlink assignment.

When the MAC entity needs to read BCCH, the MAC entity may, based on the scheduling information from RRC:

1> if a downlink assignment for this PDCCH occasion has been received on the PDCCH for the SI-RNTI;

2> indicate a downlink assignment and redundancy version for the dedicated broadcast HARQ process to the HARQ entity.

When the MAC entity needs to read MCCH, the MAC entity may, based on the scheduling information from RRC:

1> if a downlink assignment for this PDCCH occasion has been received on the PDCCH for the MCCH-RNTI;

2> indicate a downlink assignment and redundancy version for the selected HARQ process to the HARQ entity.

When the MAC entity needs to read broadcast MTCH, the MAC entity may, based on the scheduling information from RRC and DCI:

1> if a downlink assignment for this PDCCH occasion has been received on the PDCCH for the G-RNTI configured for broadcast MTCH;

2> indicate a downlink assignment and redundancy version for the selected HARQ process to the HARQ entity.

### 5.3.2 HARQ operation

#### 5.3.2.1 HARQ Entity

The MAC entity includes a HARQ entity for each Serving Cell, which maintains a number of parallel HARQ processes. Each HARQ process is associated with a HARQ process identifier. The HARQ entity directs HARQ information and associated TBs received on the DL-SCH to the corresponding HARQ processes (see clause 5.3.2.2).

The number of parallel DL HARQ processes per HARQ entity is specified in TS 38.214 [7]. The dedicated broadcast HARQ process is used for BCCH.

The HARQ process supports one TB when the physical layer is not configured for downlink spatial multiplexing. The HARQ process supports one or two TBs when the physical layer is configured for downlink spatial multiplexing.

When the MAC entity is configured with *pdsch-AggregationFactor* > 1, the parameter *pdsch-AggregationFactor* provides the number of transmissions of a TB within a bundle of the downlink assignment. Bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. After the initial transmission, *pdsch-AggregationFactor* – 1 HARQ retransmissions follow within a bundle.

The MAC entity shall:

1> if a downlink assignment has been indicated:

2> allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.

1> if a downlink assignment has been indicated for the broadcast HARQ process:

2> allocate the received TB to the broadcast HARQ process.

NOTE: It is up to UE impletentation to allocate the received TB for MCCH or broadcast MTCH to one HARQ process.

#### 5.3.2.2 HARQ process

When a transmission takes place for the HARQ process, one or two (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

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

1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or

1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or

1> if the HARQ process is associated with a transmission indicated with a MCCH-RNTI for MBS broadcast, and this is the first received transmission for the TB according to the MCCH schedule indicated by RRC; or

1> if the HARQ process is associated with a transmission indicated with a G-RNTI for MBS broadcast, and this is the first received transmission for the TB according to the MTCH schedule indicated by RRC or according to the scheduling indicated by DCI as specified in TS 38.214 [7]; or

1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):

2> consider this transmission to be a new transmission.

1> else:

2> consider this transmission to be a retransmission.

The MAC entity then 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 the HARQ process is equal to the broadcast process:

3> deliver the decoded MAC PDU to upper layers.

2> else if this is the first successful decoding of the data for this TB:

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

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 the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see clause 5.1.5); or

1> if the HARQ process is associated with a transmission indicated with a MSGB-RNTI and the Random Access procedure is not yet successfully completed (see clause 5.1.4a); or

1> if the HARQ process is equal to the broadcast process; or

1> if the HARQ process is associated with a transmission indicated with a MCCH-RNTI or a G-RNTI for MBS broadcast; or

1> if the HARQ process is associated with a transmission indicated with a G-RNTI or a G-CS-RNTI for MBS multicast and HARQ feedback is disabled; or

1> if the HARQ process is associated with a transmission indicated with a G-RNTI or a G-CS-RNTI for MBS multicast and NACK only HARQ feedback is configured and the data for this TB is successfully decoded; or

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 and if the *cg-SDT-TimeAlignmentTimer*, if configured, is not running; or

1> if the HARQ process is configured with disabled HARQ feedback:

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

1> else:

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

The MAC entity shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

NOTE: If the MAC entity receives a retransmission with a TB size different from the last TB size signalled for this TB, the UE behavior is left up to UE implementation.

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| *The next of 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, TPC-SRS-RNTI, AI-RNTI, SL-RNTI, SLCS-RNTI and SL Semi-Persistent Scheduling V-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].

NOTE 1: Void

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;

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

- *drx-HARQ-RTT-TimerSL* (per SL HARQ process): the minimum duration before an SL 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-TransmitOtherPeriodicCSI* (optional): the configuration to report periodic CSI that is not L1-RSRP on PUCCH 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 CSI that is L1-RSRP on PUCCH during the time duration indicated by *drx-onDurationTimer* in case DCP is configured but associated *drx-onDurationTimer* is not started;

- *uplinkHARQ-Mode* (optional): the configuration to set the HARQ mode per UL HARQ process.

Serving Cells of a MAC entity may be configured by RRC in two DRX groups with separate DRX parameters. When RRC does not configure a secondary DRX group, there is only one DRX group and all Serving Cells belong to that one DRX group. When two DRX groups are configured, each Serving Cell is uniquely assigned to either of the two groups. The DRX parameters that are separately configured for each DRX group are: *drx-onDurationTimer*, *drx-InactivityTimer*. The DRX parameters that are common to the DRX groups are: *drx-SlotOffset*, *drx-RetransmissionTimerDL*, *drx-RetransmissionTimerUL*, *drx-LongCycleStartOffset*, *drx-ShortCycle* (optional), *drx-ShortCycleTimer* (optional), *drx-HARQ-RTT-TimerDL*, *drx-HARQ-RTT-TimerUL*, and *uplinkHARQ-Mode* (optional).

When DRX is configured, the Active Time for Serving Cells in a DRX group includes the time while:

- *drx-onDurationTimer* or *drx-InactivityTimer* configured for the DRX group is running; or

- *drx-RetransmissionTimerDL*, *drx-RetransmissionTimerUL* or *drx-RetransmissionTimerSL* is running on any Serving Cell in the DRX group; or

- *ra-ContentionResolutionTimer* (as described in clause 5.1.5) or *msgB-ResponseWindow* (as described in clause 5.1.4a) is running; or

- a Scheduling Request is sent on PUCCH and is pending (as described in clause 5.4.4 or 5.22.15). If this Serving Cell is part of a non-terrestrial network, the Active Time is started after the first Scheduling Request transmission plus the UE-gNB RTT; 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 clauses 5.1.4 and 5.1.4a).

When DRX is configured, the MAC entity shall:

1> if a MAC PDU is received in a configured downlink assignment (excluding configured downlink multicast assignments):

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;

NOTE 1a: If Serving cell is configured with *downlinkHARQ-FeedbackDisabled* and DL HARQ feedback is disabled, *drx-HARQ-RTT-TimerDL* is not started for the corresponding HARQ process.

NOTE 1b: If this Serving Cell is part of a non-terrestrial network, the latest UE-gNB RTT value shall be used to set *drx-HARQ-RTT-TimerDL* and *drx-HARQ-RTT-TimerUL* length prior to timer start (see TS 38.331 [5] clause [X]).

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

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

1> if a MAC PDU is transmitted in a configured uplink grant and LBT failure indication is not received from lower layers:

2> if this Serving Cell is not configured with *uplinkHARQ-Mode*; or

2> if this Serving Cell is configured with *uplinkHARQ-Mode* and the corresponding HARQ process is configured as HARQ Mode A:

3> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first transmission (within a bundle) of the corresponding PUSCH transmission;

2> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process at the first transmission (within a bundle) of the corresponding PUSCH transmission.

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-HARQ-RTT-TimerSL* expires:

2> if a HARQ NACK feedback for the corresponding HARQ process is transmitted on PUCCH; or

2> if a HARQ NACK feedback for the corresponding HARQ process is not transmitted on PUCCH due to UL/SL prioritization:

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

2> else if the PUCCH resource is not configured and PSFCH is configured for the SL grant:

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

NOTE 1c: The UE handles the *drx-RetransmissionTimerSL* operation when *sl-PUCCH-Config* is configured by RRC but PUCCH resource is not scheduled same as when *sl-PUCCH-Config* is not configured.

1> if a DRX Command MAC CE with DCI scrambled with C-RNTI for unicast transmission or a Long DRX Command MAC CE is received:

2> stop *drx-onDurationTimer* for each DRX group;

2> stop *drx-InactivityTimer* for each DRX group.

1> if *drx-InactivityTimer* for a DRX group expires:

2> if the Short DRX cycle is configured:

3> start or restart *drx-ShortCycleTimer* for this DRX group in the first symbol after the expiry of *drx-InactivityTimer*;

3> use the Short DRX cycle for this DRX group.

2> else:

3> use the Long DRX cycle for this DRX group.

1> if a DRX Command MAC CE with DCI scrambled with C-RNTI for unicast transmission is received:

2> if the Short DRX cycle is configured:

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

3> use the Short DRX cycle for each DRX group.

2> else:

3> use the Long DRX cycle for each DRX group.

1> if *drx-ShortCycleTimer* for a DRX group expires:

2> use the Long DRX cycle for this DRX group.

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

2> stop *drx-ShortCycleTimer* for each DRX group;

2> use the Long DRX cycle for each DRX group.

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

2> start *drx-onDurationTimer* for this DRX group after *drx-SlotOffset* from the beginning of the subframe.

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

2> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3:

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 during a measurement gap, or when the MAC entity monitors for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while the *ra-ResponseWindow* is running (as specified in clause 5.1.4); 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* for this DRX group after *drx-SlotOffset* from the beginning of the subframe.

NOTE 2: 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 a DRX group is in Active Time:

2> monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213 [6];

2> if the PDCCH indicates a DL transmission; or

2> if the PDCCH indicates a one-shot HARQ feedback as specified in clause 9.1.4 of TS 38.213 [6]; or

2> if the PDCCH indicates a retransmission of HARQ feedback as specified in clause 9.1.5 of TS 38.213 [6]:

3> start or restart the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process(es) whose HARQ feedback is reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;

NOTE 3: When HARQ feedback is postponed by PDSCH-to-HARQ\_feedback timing indicating an inapplicable 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(es) whose HARQ feedback is reported

3> stop the *drx-RetransmissionTimerDL-PTM* for the corresponding HARQ process(es) whose HARQ feedback is reported;

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

4> start the *drx-RetransmissionTimerDL* in the first symbol after the (end of the last) PDSCH transmission (within a bundle) for the corresponding HARQ process.

2> if the PDCCH indicates a UL transmission:

3> if this Serving Cell is not configured with *uplinkHARQ-Mode*; or

3> if this Serving Cell is configured with *uplinkHARQ-Mode* and the corresponding HARQ process is configured as HARQ Mode A:

4> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first transmission (within a bundle) of the corresponding PUSCH transmission;

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

2> if the PDCCH indicates an SL transmission:

3> if the PUCCH resource is configured:

4> start the *drx-HARQ-RTT-TimerSL* for the corresponding HARQ process in the first symbol after the end of the corresponding PUCCH transmission carrying the SL HARQ feedback; or

4> start the *drx-HARQ-RTT-TimerSL* for the corresponding HARQ process in the first symbol after the end of the corresponding PUCCH resource for the SL HARQ feedback when the PUCCH is not transmitted due to UL/SL prioritization;

4> stop the *drx-RetransmissionTimerSL* for the corresponding HARQ process.

3> else:

4> start the *drx-HARQ-RTT-TimerSL* for the corresponding HARQ process at the first symbol after end of PDCCH occasion;

4> stop the *drx-RetransmissionTimerSL* for the corresponding HARQ process.

2> if the PDCCH indicates a new transmission (DL, UL or SL) on a Serving Cell in this DRX group:

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

NOTE 3a: A PDCCH indicating activation of SPS, configured grant type 2, or configured sidelink grant of configured grant Type 2 is considered to indicate a new transmission.

NOTE 3b: If the PDCCH reception includes two PDCCH candidates from corresponding search spaces, as described in clause 10.1 in 38.213, start or restart *drx-InactivityTimer* for this DRX group in the first symbol after the end of the PDCCH candidate that ends later in time.

2> if a HARQ process receives downlink feedback information and acknowledgement is indicated:

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

1> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3; 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:

2> 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; and

2> if *allowCSI-SRS-Tx-MulticastDRX-Active* is not configured or, if *allowCSI-SRS-Tx-MulticastDRX-Active* is configured and all multicast DRXs corresponding to the DRX group would not be in Active Time considering multicast assignments and DRX Command MAC CE for MBS multicast received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in Clause 5.7b and all multicasts are configured with multicast DRX:

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

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

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

4> not report periodic CSI that is L1-RSRP on PUCCH.

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

4> not report periodic CSI that is not L1-RSRP on PUCCH.

1> else:

2> in current symbol n, if a DRX group would not be in Active Time considering grants/assignments scheduled on Serving Cell(s) in this DRX group and 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; and

2> if *allowCSI-SRS-Tx-MulticastDRX-Active* is not configured or, in current symbol n, if all multicast DRXs corresponding to the DRX group would not be in Active Time considering multicast assignments and DRX Command MAC CE for MBS multicast received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in Clause 5.7b and all multicasts corresponding to the DRX group are configured with multicast DRX:

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

3> not report CSI on PUCCH and semi-persistent CSI configured on PUSCH in this DRX group.

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

3> in current symbol n, if *drx-onDurationTimer* of a DRX group would not be running considering grants/assignments scheduled on Serving Cell(s) in this DRX group and 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; and

3> if *allowCSI-SRS-Tx-MulticastDRX-Active* is not configured, or, if *allowCSI-SRS-Tx-MulticastDRX-Active* is configured and in current symbol n, if *drx-onDurationTimerPTM(s)* of all multicast DRXs corresponding to the DRX group would not be running considering multicast assignments and DRX Command MAC CE for MBS multicast received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in Clause 5.7b and all multicasts corresponding to the DRX group are configured with multicast DRX:

4> not report CSI on PUCCH in this DRX group.

NOTE 4: 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 either outside DRX Active Time of the DRX group in which this PUCCH is configured or outside the on-duration period of the DRX group in which this PUCCH is configured if CSI masking is setup by upper layers, 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 on the Serving Cells in a DRX group, the MAC entity transmits HARQ feedback, aperiodic CSI on PUSCH, and aperiodic SRS defined in TS 38.214 [7] on the Serving Cells in the DRX group 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).

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| *The next of change* |

## 5.7a Discontinuous Reception (DRX) for MBS Broadcast

For MBS broadcast, the MAC entity may be configured by RRC with a DRX functionality per G-RNTI that controls the UE's PDCCH monitoring activity for the MAC entity's G-RNTI(s) as specified in TS 38.331 [5]. When in RRC\_IDLE or RRC\_INACTIVE or RRC\_CONNECTED, if broadcast DRX is configured for a G-RNTI, the MAC entity is allowed to monitor the PDCCH for this G-RNTI discontinuously using the broadcast DRX operation specified in this clause; otherwise the MAC entity monitors each PDCCH for this G-RNTI as specified in TS 38.213 [6]. The broadcast DRX operation specified in this clause is performed independently for each G-RNTI and independently from the DRX operation specified in clauses 5.7 and 5.7b.

RRC controls broadcast DRX operation by configuring the following parameters:

- *drx-onDurationTimerPTM*: the duration at the beginning of a DRX cycle;

- *drx-SlotOffsetPTM*: the delay before starting the *drx-onDurationTimerPTM*;

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

- *drx-LongCycleStartOffsetPTM*: the long DRX cycle *drx-LongCycle-PTM* and *drx-StartOffset-PTM* which defines the subframe where the DRX cycle starts.

When broadcast DRX is configured for a G-RNTI, the Active Time includes the time while:

*- drx-onDurationTimerPTM* or *drx-InactivityTimerPTM* for this G-RNTI is running.

When broadcast DRX is configured for a G-RNTI, the MAC entity shall for this G-RNTI:

1> if [(SFN × 10) + subframe number] modulo (*drx-LongCycle-PTM*) = *drx-StartOffset-PTM*:

2> start *drx-onDurationTimerPTM* after *drx-SlotOffsetPTM* from the beginning of the subframe.

1> if the MAC entity is in Active Time for this G-RNTI:

2> monitor the PDCCH for this G-RNTI as specified in TS 38.213 [6];

2> if the PDCCH indicates a DL transmission for MBS broadcast:

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

NOTE X: If a SCell is configured for MBS broadcast reception, the SFN of this SCell is used to calculate the DRX duration, otherwise the SFN of the SpCell is used.

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| *The next of change* |

5.7b Discontinuous Reception (DRX) for MBS Multicast

For MBS multicast, the MAC entity may be configured by RRC with a DRX functionality per G-RNTI or per G-CS-RNTI that controls the UE's PDCCH monitoring activity for the MAC entity's G-RNTI(s) and G-CS-RNTI(s) as specified in TS 38.331 [5]. When in RRC\_CONNECTED, if multicast DRX is configured, the MAC entity is allowed to monitor the PDCCH for this G-RNTI or G-CS-RNTI discontinuously using the multicast DRX operation specified in this clause; otherwise the MAC entity monitors the PDCCH for this G-RNTI or G-CS-RNTI as specified in TS 38.213 [6]. The multicast DRX operation specified in this clause is performed independently for each G-RNTI or G-CS-RNTI and independently from the DRX operation specified in clauses 5.7 and 5.7a.

RRC controls multicast DRX operation per G-RNTI or per G-CS-RNTI by configuring the following parameters:

- *drx-onDurationTimerPTM*: the duration at the beginning of a DRX cycle;

- *drx-SlotOffsetPTM*: the delay before starting the *drx-onDurationTimerPTM*;

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

- *drx-LongCycleStartOffsetPTM*: the long DRX cycle *drx-LongCycle-PTM* and *drx-StartOffset-PTM* which defines the subframe where the long DRX cycle starts;

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

- *drx-HARQ-RTT-TimerDL-PTM* (per DL HARQ process for MBS multicast): the minimum duration before a DL multicast assignment for HARQ retransmission is expected by the MAC entity.

When multicast DRX is configured for a G-RNTI or G-CS-RNTI, the Active Time includes the time while:

- *drx-onDurationTimerPTM* or *drx-InactivityTimerPTM* or *drx-RetransmissionTimerDL-PTM* for this G-RNTI or G-CS-RNTI is running.

When multicast DRX is configured for a G-RNTI or G-CS-RNTI, the MAC entity shall for this G-RNTI or G-CS-RNTI:

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

2> if HARQ feedback is enabled:

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

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;

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

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

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

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

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

1> if a DRX Command MAC CE with DCI scrambled with a G-RNTI is received:

2> stop *drx-onDurationTimerPTM* of the DRX for this G-RNTI;

2> stop *drx-InactivityTimerPTM* of the DRX for this G-RNTI.

1> if [(SFN × 10) + subframe number] modulo (*drx-LongCycle-PTM*) = *drx-StartOffset-PTM*:

2> start *drx-onDurationTimerPTM* after *drx-SlotOffsetPTM* from the beginning of the subframe.

1> if the MAC entity is in Active Time for this G-RNTI or G-CS-RNTI:

2> monitor the PDCCH for this G-RNTI or G-CS-RNTI as specified in TS 38.213 [6];

2> if the PDCCH indicates a DL multicast transmission:

3> if HARQ feedback is enabled:

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

4> 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;

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

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

2> if the PDCCH indicates a new multicast transmission for this G-RNTI or G-CS-RNTI:

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

NOTE: A PDCCH indicating activation of multicast SPS is considered to indicate a new transmission.

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).

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| *The next of change* |

### 5.8.1a Downlink for Multicast

MBS Semi-Persistent Scheduling (SPS) is configured by RRC on PCell or one SCell per BWP. Multiple assignments can be active simultaneously in the same BWP.

For the DL MBS SPS, a DL assignment is provided by PDCCH, and stored or cleared based on L1 signalling indicating SPS activation or deactivation.

RRC configures the following parameters when the MBS SPS is configured:

- *cs-RNTI*: CS-RNTI for MBS SPS deactivation, PTP for PTM retransmission if configured;

- *g-cs-RNTI*: G-CS-RNTI for activation, deactivation, and retransmission;

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

- *harq-ProcID-Offset*: Offset of HARQ process for MBS SPS;

- *periodicity*: periodicity of configured downlink assignment for MBS SPS.

When the MBS SPS is released by upper layers, all the corresponding configurations shall be released.

After a downlink assignment is configured for MBS SPS, the MAC entity shall consider sequentially that the Nth downlink assignment occurs in the slot for which:

(*numberOfSlotsPerFrame* × SFN + slot number in the frame) =
[(*numberOfSlotsPerFrame* × SFNstart time + slotstart time) + N × *periodicity* × *numberOfSlotsPerFrame* / 10] modulo (1024 × *numberOfSlotsPerFrame*)

where SFNstart time and slotstart time are the SFN and slot, respectively, of the first transmission of PDSCH where the configured downlink assignment was (re-)initialised.

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| *The next of 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> initialize *SBj* for each logical channel to zero if Sidelink resource allocation mode 1 is configured by RRC;

1> stop (if running) all timers, except MBS broadcast DRX timers;

1> consider all *timeAlignmentTimer*s, *inactivePosSRS-TimeAlignmentTimer*, and *cg-SDT-TimeAlignmentTimer*, if configured, 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 Random Access 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 BFR;

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

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

1> cancel, if any, triggered Timing Advance Reporting procedure;

1> cancel, if any, triggered Recommended bit rate query procedure;

1> cancel, if any, triggered Configured uplink grant confirmation;

1> cancel, if any, triggered configured sidelink grant confirmation;

1> cancel, if any, triggered Desired Guard Symbol query;

1> cancel, if any, triggered Positioning Measurement Gap Activation/Deactivation Request procedure;

1> cancel, if any, triggered SDT procedure;

1> flush the soft buffers for all DL HARQ processes, except for the DL HARQ process being used for MBS broadcast;

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 all *BFI\_COUNTER*s;

1> reset all *LBT\_COUNTERs*.

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> consider all Sidelink processes for all TB(s) associated to the PC5-RRC connection as unoccupied;

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;

1> cancel, if any, triggered Sidelink CSI Reporting procedure associated to the PC5-RRC connection;

1> stop (if running) all timers associated to the PC5-RRC connection;

1> reset the *numConsecutiveDTX* associated to the PC5-RRC connection;

1> initialize *SBj* for each logical channel associated to the PC5-RRC connection to zero.

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| *The end of change* |