**3GPP TSG-RAN2 Meeting #124** **R2-** **2313843**

**Chicago, USA, 13th – 17th Nov., 2023**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **38.321** | **CR** | 1699 | **rev** | **2** | **Current version:** | 17.6.0 |  |
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| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:***  | Introduction of MT-SDT and CG-SDT enhancement for MAC spec [CG-SDT-enh] |
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| ***Source to WG:*** | Huawei, HiSilicon, Ericsson, Intel Corporation, ZTE Corporation |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_MT\_SDT-Core, TEI18  |  | ***Date:*** | 2023-12-01 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-18 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | =====================MT-SDT================================* **MT-SDT#Issue1:** Abbreviation should be added for MO-SDT and MT-SDT
* **MT-SDT#Issue2:** The current spec is written in the background of MO-SDT. In this introduction of MT-SDT, it needs to be clarified that the small data transmission procedure can be triggered for either MO-SDT or MT-SDT according to TS 38.331.
* **MT-SDT#Issue3:** We have agreed that CCCH message can be transmitted on CG-SDT without data when triggered by MT-SDT. The legacy conditions for SDT for logical channel restriction needs to be revised.
	+ Another agreement has been made during RAN2#122: ***LCH restrictions are checked for DRBs as in MO-SDT (if UL data is available during SDT procedure). Ensure CCCH can be transmitted in CG-SDT when MT-SDT is triggered in stage 3 discussion.***
* **MT-SDT#Issue4:** it is still pending whether the legacy DVT condition is needed when the SDT procedure is triggered for MT-SDT
* **MT-SDT#Issue5:** RAN2#122 has agreed on the following ***A separate sdt-RSRP threshold for MT-SDT can be configured, at least in the case where MO-SDT is not configured in the cell***.
	+ When legacy RACH is triggered for MT-SDT, the UE should check this RSRP condition. If the condition is not satisfied, the UE should indicate to the upper layer that the condition to trigger legacy RACH for MT-SDT cannot be satisfied.
* **MT-SDT#Issue6:** RAN2#122 has agreed on the following ***RA-SDT resources are not used for MT-SDT initiation RACH***
	+ When checking the conditions for initiating RA-SDT during SDT type selection procedure, condition needs to be added that the SDT procedure is not triggered for MT-SDT
* **MT-SDT#Issue7: Voided MT-SDT#Issue8:** RAN2#123 has agreed that ***Sdt-RSRP threshold is included in MT-SDT configuration. Optional IE, but mandatorily present if only MT-SDT is configured. The network can configure the MT and MO SDT threshold differently if it wants***
* **MT-SDT#Issue9:** RAN2#123 has agreed that ***Confirm that the condition for data volume threshold is not applicable for Small Data Transmission procedure triggered for MT-SDT***
* **MT-SDT#Issue10:** voided.

====================CG-SDT enhancement====================* **CG-SDTenh#issue1**: RAN2 has agreed that CG\_SDT periodicities beyond 10.24s can be supported by the following agreement
	+ ***RAN2#123bis: For the extended CG-SDT period, specify at least the following values (1280, 2560, 5120, 10240, 61440, 122880, 307200, 604160, 1208320, 1802240, 3604480 msec).***
* **CG-SDTenh#issue2:** RAN2#122 has agreed on the following ***For both MO and MT-SDT, if the next CG-SDT resource is too far, then RACH resource can be selected first. This is checked at the point of initial resource selection (e.g. CG SDT selection). FFS what is too far and how this is configured. Assumption is that we will continue this discussion in SDT session.***
	+ Hence, a condition needs to be added for initiating CG-SDT for both MO-SDT and MT-SDT
* **CG-SDTenh#issue3:** During RAN2#123bis, the following has been agreed for the condition to perform CG-SDT”: ***cg-SDT-MaxDurationToNext-CG-Occassion is configured per LCH. When there are multiple LCHs mapped to CG-SDT resource the shortest time is chosen.***
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| ***Summary of change:*** | The following changes have been applied in the current CR*For MT-SDT** **MT-SDT#Change1:** Add abbreviation for MT-SDT and MO-SDT
* **MT-SDT#Change2:** Voided.
* **MT-SDT#Change3:** For the condition of *configuredGrantType1Allowed* for CG-SDT type selection, specify that it is only for the case when the SDT procedure is triggered for MO-SDT
* **MT-SDT#Change4:** For the DVT condition, add the condition that it is used for MO-SDT
* **MT-SDT#Change5:** Voided
* **MT-SDT#Change6a:** Clarify in the selection of the set of RA resource and availability of RA resource that SDT is not applicable for Random Access procedure triggered by upper layer for MT-SDT
* **MT-SDT#Change6b:** When SDT procedure is triggered by upper layer for MT-SDT, RA-SDT cannot be used.
* **MT-SDT#Change7a:** voided.
* **MT-SDT#Change7b:** voided.
* **MT-SDT#Change8a:** Add a new RRC parameter for the RSRP threshold for MT-SDT and modify on the name of the legacy threshold for MO-SDT
* **MT-SDT#Change8b:** Add the condition for triggering the SDT procedure in the MAC spec for MT-SDT for the RSRP threshold
* **MT-SDT#Change9:** Remove the previous editor’s NOTE and confirm that DVT condition is not used for MT-SDT.
* **MT-SDT#Change10:** voided.

*For CG-SDT enhancement** **CG-SDTenh#Change1:** Modified the formulas for HARQ Process Id and uplink grant occasion in 5.4.1 and 5.8.2 to be adapted for H-SFN and longer periodicities, as well as necessary introduction of timeReferenceH-SFN.
* **CG-SDTenh#Change2a:** RRC parameter added for the condition that “the next CG-SDT resource is not too far”
* **CG-SDTenh#Change2b:** MAC procedure added for SDT procedure that the next CG-SDT resource cannot be too far when initiating CG-SDT for SDT procedure
* **CG-SDTenh#Change3:** Implement the RAN2 agreement on per LCH condition for performing CG-SDT
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| ***Consequences if not approved:*** | The new feature MT-SDT and CG-SDT enhancement cannot be well supported by the MAC spec |
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| ***Clauses affected:*** | 3.2, 5.1.1b, 5.1.1c, 5.4.1, 5.8.2, 5.27.1 |
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|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | *MT-SDT*TS 38.331 CR 4194 TS 38.300 CR 0711*CG-SDT enh*TS 38.331 CR 4471TS 38.300 CR 0743*Capabilities*TS 38.306 CR 1015TS 38.331 CR 4510 |
| ***affected:*** |  | **X** |  Test specifications |  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications |  |
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| ***Other comments:*** | The changes made for MT-SDT/CG-SDT enhancement aspects are made under the author’s names "NR\_MT\_SDT-Core", and "TEI18", respectively.The CG-SDT enhancements in TEI18 are enhancements of MO-SDT functionality introduced under REL-17 WI NR\_SmallData\_INACTIVE-Core. The enhancements are commonly applicable for R18 WI MT-SDT and R17 WI MO-SDT. |
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| ***This CR's revision history:*** | *For MT-SDT*Ver0 in RAN2#124: R2-2312252Ver1 in RAN2#124: R2-2313592*For CG-SDT enhancements:*Ver0 in RAN2#124: R2-2313173Ver1 in RAN2#124: R2-2313890Ver2 in RAN2#124: R2-2313925 |

================================CHANGE BEGINS======================================

3.2 Abbreviations

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

AP Aperiodic

BFR Beam Failure Recovery

BSR Buffer Status Report

BWP Bandwidth Part

CE Control Element

CG Cell Group

CG-SDT Configured Grant-based SDT

CI-RNTI Cancellation Indication RNTI

CSI Channel State Information

CSI-IM CSI Interference Measurement

CSI-RS CSI Reference Signal

CS-RNTI Configured Scheduling RNTI

DAPS Dual Active Protocol Stack

DCP DCI with CRC scrambled by PS-RNTI

DL-PRS DownLink-Positioning Reference Signal

G-CS-RNTI Group Configured Scheduling RNTI

G-RNTI Group RNTI

IAB Integrated Access and Backhaul

INT-RNTI Interruption RNTI

LBT Listen Before Talk

LCG Logical Channel Group

LCP Logical Channel Prioritization

MBS Multicast/Broadcast Services

MCCH MBS Control Channel

MCCH-RNTI MBS Control Channel RNTI

MCG Master Cell Group

MO-SDT Mobile Originated SDT

MPE Maximum Permissible Exposure

MTCH MBS Traffic Channel

MT-SDT Mobile Terminated SDT

NCD-SSB Non Cell Defining SSB

NSAG Network Slice AS Group

NUL Normal Uplink

NZP CSI-RS Non-Zero Power CSI-RS

PDB Packet Delay Budget

PEI-RNTI Paging Early Indication RNTI

PHR Power Headroom Report

PS-RNTI Power Saving RNTI

PTAG Primary Timing Advance Group

PTM Point to Multipoint

PTP Point to Point

QCL Quasi-colocation

PPW PRS Processing Window

PRS Positioning Reference Signal

RA-SDT Random Access-based SDT

RS Reference Signal

SCG Secondary Cell Group

SDT Small Data Transmission

SFI-RNTI Slot Format Indication RNTI

SI System Information

SL-RNTI Sidelink RNTI

SL-CS-RNTI Sidelink Configured Scheduling RNTI

SpCell Special Cell

SP Semi-Persistent

SP-CSI-RNTI Semi-Persistent CSI RNTI

SPS Semi-Persistent Scheduling

SR Scheduling Request

SRI SRS Resource Indicator

SS Synchronization Signals

SSB Synchronization Signal Block

STAG Secondary Timing Advance Group

SUL Supplementary Uplink

TAG Timing Advance Group

TCI Transmission Configuration Indicator

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

TRIV Time Resource Indicator Value

TRP Transmit/Receive Point

TRS CSI-RS for tracking

U2N UE-to-Network

UCI Uplink Control Information

V2X Vehicle-to-Everything

ZP CSI-RS Zero Power CSI-RS

================================NEXT CHANGE========================================

5.1.1b Selection of the set of Random Access resources for the Random Access procedure

The MAC entity shall:

1> if the BWP selected for Random Access procedure is configured with both set(s) of Random Access resources with *msg3-Repetitions* set to *true* and set(s) of Random Access resources without *msg3-Repetitions* set to *true* and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg3*; or

1> if the BWP selected for Random Access procedure is only configured with the set(s) of Random Access resources with *msg3-Repetitions* set to *true*:

2> assume Msg3 repetition is applicable for the current Random Access procedure.

1> else:

2> assume Msg3 repetition is not applicable for the current Random Access procedure.

NOTE 1: Void.

1> if neither contention-free Random Access Resources nor Random Access Resources for SI request have been provided for this Random Access procedure and one or more of the features including RedCap and/or Slicing and/or SDT and/or MSG3 repetition is applicable for this Random Access procedure:

NOTE 2: The applicability of SDT is determined by MAC entity according to clause 5.27. The applicability of *NSAG-ID* is determined by upper layers when the Random Access procedure is initiated. The applicability of RedCap is also determined by upper layers when Random Access procedure is initiated and it is applicable to the Random Access procedures initiated by PDCCH orders and any Random Access procedure initiated by the MAC entity.

NOTE 3: SDT is not applicable for the Random Access procedure initiated by upper layers for MT-SDT.

2> if none of the sets of Random Access resources are available for any feature applicable to the current Random Access procedure (as specified in clause 5.1.1c):

3> select the set(s) of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else if there is one set of Random Access resources available which can be used for indicating all features triggering this Random Access procedure:

3> select this set of Random Access resources for this Random Access procedure.

2> else (i.e. there are one or more sets of Random Access resources available that are configured with indication(s) for a subset of all features triggering this Random Access procedure):

3> select a set of Random Access resources from the available set(s) of Random Access resources based on the priority order indicated by upper layers as specified in clause 5.1.1d for this Random Access Procedure.

1> else if contention-free Random Access Resources have been provided for this Random Access procedure and RedCap is applicable for the current Random Access procedure and there is one set of Random Access resources available that is only configured with RedCap indication:

2> select this set of Random Access resources for this Random Access procedure.

1> else:

2> select the set of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for the current Random Access procedure.

================================NEXT CHANGE========================================

5.1.1c Availability of the set of Random Access resources

The MAC entity shall for each set of configured Random Access resources for 4-step RA type and for each set of configured Random Access resources for 2-step RA type:

1> if *redCap* is set to *true* for a set of Random Access resources:

2> consider the set of Random Access resources as not available for a Random Access procedure for which RedCap is not applicable.

1> if *smallData* is set to *true* for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure which is not triggered for RA-SDT by MO-SDT as specified in TS 38.331 [5].

1> if *NSAG-List* is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure unless it is triggered for any one of the *NSAG-ID*(s) in the *NSAG-List*.

1> if *msg3-Repetitions* is set to *true* for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure if Msg3 repetition is not applicable.

1> if a set of Random Access resources is not configured with *FeatureCombination*:

2> consider the set of Random Access resources to not associated with any feature.

================================NEXT CHANGE========================================

### 5.4.1 UL Grant reception

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* or a running *cg-SDT-TimeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured;

3> stop the *cg-RetransmissionTimer* for the corresponding HARQ process, if running.

2> stop the *cg-SDT-RetransmissionTimer* for the corresponding HARQ process, if running.

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's 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> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured;

3> stop the *cg-RetransmissionTimer* for the corresponding HARQ process, if running;

3> stop the *cg-SDT-RetransmissionTimer* for the corresponding HARQ process, if running;

3> deliver the uplink grant and the associated HARQ information to the HARQ entity;

3> if a logical channel associated with a DRB configured with *survivalTimeStateSupport* is multiplexed in the MAC PDU stored in the HARQ buffer for the corresponding HARQ process:

4> trigger activation of PDCP duplication for all configured RLC entities of the DRB.

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

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured uplink grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured uplink grant confirmation;

4> store the uplink grant for this Serving Cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this Serving Cell to start in the associated PUSCH duration and to recur according to rules in clause 5.8.2;

4> stop the *configuredGrantTimer* for the corresponding HARQ process, if running;

4> stop the *cg-RetransmissionTimer* for the corresponding HARQ process, if running.

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> if the MAC entity is configured with *lch-basedPrioritization*, and the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received in a Random Access Response or with the PUSCH duration of an uplink grant addressed to Temporary C-RNTI or the PUSCH duration of a MSGA payload for this Serving Cell; or

1> if the MAC entity is not configured with *lch-basedPrioritization*, and the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH or in a Random Access Response or the PUSCH duration of a MSGA payload for this Serving Cell:

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

2> if, for the corresponding HARQ process, the *configuredGrantTimer* is not running and *cg-RetransmissionTimer* is not configured and *cg-SDT-RetransmissionTimer* is not configured (i.e. new transmission):

3> if there is an on-going CG-SDT procedure and PDCCH addressed to the MAC entity's C-RNTI has been received; or

3> if there is no on-going CG-SDT procedure:

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

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

2> else if the *cg-RetransmissionTimer* for the corresponding HARQ process is configured and not running, then for the corresponding HARQ process:

3> if the *configuredGrantTimer* is not running, and the HARQ process is not pending (i.e. new transmission):

4> consider the NDI bit to have been toggled;

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

3> else if the previous uplink grant delivered to the HARQ entity for the same HARQ process was a configured uplink grant (i.e. retransmission on configured grant):

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

2> else if the *cg-SDT-RetransmissionTimer* is configured and not running for the corresponding HARQ process;

3> if the configured uplink grant is for the initial transmission for the CG-SDT with CCCH message (i.e., initial new transmission); or

3> if the *configuredGrantTimer* is not running or not configured, and PDCCH addressed to the MAC entity's C-RNTI has been received after the initial transmission of the CG-SDT with CCCH message (i.e., subsequent new transmission):

4> consider the NDI bit to have been toggled;

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

3> else if the previous uplink grant delivered to the HARQ entity for the same HARQ process was a configured uplink grant for initial transmission of CG-SDT with CCCH message or for its retransmission; and

3> if PDCCH addressed to the MAC entity's C-RNTI has not been received (i.e., retransmission for initial CG-SDT transmission):

4> consider the NDI bit to have not been toggled;

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For configured uplink grants neither configured with *harq-ProcID-Offset2* nor with *cg-RetransmissionTimer*, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

 HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *nrofHARQ-Processes*

For configured uplink grants with *harq-ProcID-Offset2*, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

 HARQ Process ID = [floor(CURRENT\_symbol / *periodicity*)] modulo *nrofHARQ-Processes* + *harq-ProcID-Offset2*

where CURRENT\_symbol if *cg-SDT-PeriodicityExt* (as defined in TS 38.331 [5]) is not configured = (SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slot number in the frame × *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

Alternatively, if *cg-SDT-PeriodicityExt* (as defined in TS 38.331 [5]) is configured, CURRENT\_symbol = ((H-SFN × *numberOfSFNperH-SFN* + SFN) × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slot number in the frame × *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSFNperH-SFN*, *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive frames per H-SFN, the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

For configured uplink grants configured with *cg-RetransmissionTimer*, the UE implementation selects an HARQ Process ID among the HARQ process IDs available for the configured grant configuration. If the MAC entity is configured with *intraCG-Prioritization*, for HARQ Process ID selection, the UE shall prioritize the HARQ Process ID with the highest priority, where the priority of HARQ process is determined by the highest priority among priorities of the logical channels that are multiplexed (i.e. the MAC PDU to transmit is already stored in the HARQ buffer) or have data available that can be multiplexed (i.e. the MAC PDU to transmit is not stored in the HARQ buffer) in the MAC PDU, according to the mapping restrictions as described in clause 5.4.3.1.2. If the MAC entity is configured with *intraCG-Prioritization*, for HARQ Process ID selection among initial transmission and retransmission with equal priority, the UE shall prioritize retransmissions before initial transmissions. The priority of a HARQ Process for which no data for logical channels is multiplexed or can be multiplexed in the MAC PDU is lower than the priority of a HARQ Process for which data for any logical channels is multiplexed or can be multiplexed in the MAC PDU. If the MAC entity is not configured with *intraCG-Prioritization*, for HARQ Process ID selection, the UE shall prioritize retransmissions before initial transmissions. The UE shall toggle the NDI in the CG-UCI for new transmissions and not toggle the NDI in the CG-UCI in retransmissions.

NOTE 1: CURRENT\_symbol refers to the symbol index of the first transmission occasion of a bundle of configured uplink grant.

NOTE 2: A HARQ process is configured for a configured uplink grant where neither *harq-ProcID-Offset* nor *harq-ProcID-Offset2* is configured, if the configured uplink grant is activated and the associated HARQ process ID is less than *nrofHARQ-Processes*. A HARQ process is configured for a configured uplink grant where *harq-ProcID-Offset2* is configured, if the configured uplink grant is activated and the associated HARQ process ID is greater than or equal to *harq-ProcID-Offset2* and less than sum of *harq-ProcID-Offset2* and *nrofHARQ-Processes* for the configured grant configuration.

NOTE 3: If the MAC entity receives a grant in a Random Access Response (i.e. MAC RAR or fallbackRAR), or addressed to Temporary C-RNTI or determines a grant as specified in clause 5.1.2a for MSGA payload and if the MAC entity also receives an overlapping grant for its C-RNTI or CS-RNTI, requiring concurrent transmissions on the SpCell, the MAC entity may choose to continue with either the grant for its RA-RNTI/Temporary C-RNTI/MSGB-RNTI/the MSGA payload transmission or the grant for its C-RNTI or CS-RNTI.

NOTE 4: 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 uplink grants.

NOTE 5: If *cg-RetransmissionTimer* is not configured, a HARQ process is not shared between different configured grant configurations in the same BWP.

For the MAC entity configured with *lch-basedPrioritization*, priority of an uplink grant is determined by the highest priority among priorities of the logical channels that are multiplexed (i.e. the MAC PDU to transmit is already stored in the HARQ buffer) or have data available that can be multiplexed (i.e. the MAC PDU to transmit is not stored in the HARQ buffer) in the MAC PDU, according to the mapping restrictions as described in clause 5.4.3.1.2. The priority of an uplink grant for which no data for logical channels is multiplexed or can be multiplexed in the MAC PDU is lower than either the priority of an uplink grant for which data for any logical channels is multiplexed or can be multiplexed in the MAC PDU or the priority of the logical channel triggering an SR.

For the MAC entity configured with *lch-basedPrioritization*, if the corresponding PUSCH transmission of a configured uplink grant is cancelled by CI-RNTI as specified in clause 11.2A of TS 38.213 [6] or cancelled by a high PHY-priority PUCCH transmission as specified in clause 9 of TS 38.213 [6], this configured uplink grant is considered as a de-prioritized uplink grant. If this de-prioritized uplink grant is configured with *autonomousTx*, the *configuredGrantTimer* for the corresponding HARQ process of this de-prioritized uplink grant shall be stopped if it is running. If this de-prioritized uplink grant is configured with *autonomousTx*, the *cg-RetransmissionTimer* for the corresponding HARQ process of this de-prioritized uplink grant shall be stopped if it is running.

When the MAC entity is configured with *lch-basedPrioritization*, for each uplink grant delivered to the HARQ entity and whose associated PUSCH can be transmitted by lower layers, the MAC entity shall:

1> if this uplink grant is received in a Random Access Response (i.e. in a MAC RAR or fallback RAR), or addressed to Temporary C-RNTI, or is determined as specified in clause 5.1.2a for the transmission of the MSGA payload:

2> consider this uplink grant as a prioritized uplink grant.

1> else if this uplink grant is addressed to CS-RNTI with NDI = 1 or C-RNTI:

2> if there is no overlapping PUSCH duration of a configured uplink grant which was not already de-prioritized, in the same BWP, whose priority is higher than the priority of the uplink grant; and

2> if there is no overlapping PUCCH resource with an SR transmission which was not already de-prioritized and the simultaneous transmission of the SR and the uplink grant is not allowed by configuration of *simultaneousPUCCH-PUSCH* or *simultaneousPUCCH-PUSCH-SecondaryPUCCHgroup* or *simultaneousSR-PUSCH-diffPUCCH-Groups*, and the priority of the logical channel that triggered the SR is higher than the priority of the uplink grant:

3> consider this uplink grant as a prioritized uplink grant;

3> consider the other overlapping uplink grant(s), if any, as a de-prioritized uplink grant(s);

3> consider the other overlapping SR transmission(s), if any, as a de-prioritized SR transmission(s), except for the SR transmission(s) whose simultaneous transmission is allowed by configuration of *simultaneousPUCCH-PUSCH* or *simultaneousPUCCH-PUSCH-SecondaryPUCCHgroup* or *simultaneousSR-PUSCH-diffPUCCH-Groups*;

3> if the de-prioritized uplink grant(s) is a configured uplink grant configured with *autonomousTx* whose PUSCH has already started:

4> stop the *configuredGrantTimer* for the corresponding HARQ process of the de-prioritized uplink grant(s);

4> stop the *cg-RetransmissionTimer* for the corresponding HARQ process of the de-prioritized uplink grant(s).

1> else if this uplink grant is a configured uplink grant:

2> if there is no overlapping PUSCH duration of another configured uplink grant which was not already de-prioritized, in the same BWP, whose priority is higher than the priority of the uplink grant; and

2> if there is no overlapping PUSCH duration of an uplink grant addressed to CS-RNTI with NDI = 1 or C-RNTI which was not already de-prioritized, in the same BWP, whose priority is higher than or equal to the priority of the uplink grant; and

2> if there is no overlapping PUCCH resource with an SR transmission which was not already de-prioritized and the simultaneous transmission of the SR and the uplink grant is not allowed by configuration of *simultaneousPUCCH-PUSCH* or *simultaneousPUCCH-PUSCH-SecondaryPUCCHgroup* or *simultaneousSR-PUSCH-diffPUCCH-Groups*, and the priority of the logical channel that triggered the SR is higher than the priority of the uplink grant:

3> consider this uplink grant as a prioritized uplink grant;

3> consider the other overlapping uplink grant(s), if any, as a de-prioritized uplink grant(s);

3> if the de-prioritized uplink grant(s) is a configured uplink grant configured with *autonomousTx* whose PUSCH has already started:

4> stop the *configuredGrantTimer* for the corresponding HARQ process of the de-prioritized uplink grant(s);

4> stop the *cg-RetransmissionTimer* for the corresponding HARQ process of the de-prioritized uplink grant(s).

3> consider the other overlapping SR transmission(s), if any, as a de-prioritized SR transmission(s), except for the SR transmission(s) whose simultaneous transmission is allowed by configuration of *simultaneousPUCCH-PUSCH* or *simultaneousPUCCH-PUSCH-SecondaryPUCCHgroup* or *simultaneousSR-PUSCH-diffPUCCH-Groups*.

NOTE 6: If the MAC entity is configured with *lch-basedPrioritization* and if there is overlapping PUSCH duration of at least two configured uplink grants whose priorities are equal, the prioritized uplink grant is determined by UE implementation.

NOTE 7: If the MAC entity is not configured with *lch-basedPrioritization* and if there is overlapping PUSCH duration of at least two configured uplink grants, it is up to UE implementation to choose one of the configured uplink grants.

NOTE 8: If the MAC entity is configured with *lch-basedPrioritization*, the MAC entity does not take UCI multiplexing according to the procedure specified in TS 38.213 [6] into account when determining whether the PUSCH duration of an uplink grant overlaps with the PUCCH resource for an SR transmission.

================================NEXT CHANGE========================================

### 5.8.2 Uplink

There are two types of transmission without dynamic grant:

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

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

Type 1 and Type 2 are configured by RRC for a Serving Cell per BWP. Multiple configurations can be active simultaneously in the same BWP. For Type 2, activation and deactivation are independent among the Serving Cells. For the same BWP, the MAC entity can be configured with both Type 1 and Type 2.

Only configured grant Type 1 can be configured for CG-SDT. CG-SDT can only be configured on initial BWP.

RRC configures the following parameters when the configured grant Type 1 is configured:

- *cs-RNTI*: CS-RNTI for retransmission;

- *cg-SDT-CS-RNTI*: CS-RNTI for CG-SDT retransmission;

- *cg-SDT-RSRP-ThresholdSSB*: an RSRP threshold configured for SSB selection for CG-SDT;

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

- *timeDomainOffset*: Offset of a resource with respect to SFN = *timeReferenceSFN* in time domain;

- *timeDomainAllocation*: Allocation of configured uplink grant in time domain which contains *startSymbolAndLength* (i.e. *SLIV* in TS 38.214 [7]) or *startSymbol* (i.e. *S* in TS 38.214 [7]);

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

- *harq-ProcID-Offset*: offset of HARQ process for configured grant configured with *cg-RetransmissionTimer* for operation with shared spectrum channel access;

- *harq-ProcID-Offset2*: offset of HARQ process for configured grant not configured with *cg-RetransmissionTimer*;

- *timeReferenceSFN*: SFN used for determination of the offset of a resource in time domain. The UE uses the closest SFN with the indicated number preceding the reception of the configured grant configuration.

- *timeReferenceH-SFN*: H-SFN used for determination of the offset of a resource in time domain. The UE uses the closest H-SFN with the indicated number preceding the reception of the configured grant configuration.

RRC configures the following parameters when the configured grant Type 2 is configured:

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

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

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

- *harq-ProcID-Offset*: offset of HARQ process for configured grant configured with *cg-RetransmissionTimer* for operation with shared spectrum channel access;

- *harq-ProcID-Offset2*: offset of HARQ process for configured grant not configured with *cg-RetransmissionTimer*.

RRC configures the following parameter when retransmissions on configured uplink grant is configured:

- *cg-RetransmissionTimer*: the duration after a configured grant (re)transmission of a HARQ process when the UE shall not autonomously retransmit that HARQ process;

- *cg-SDT-RetransmissionTimer*: the duration after a configured grant (re)transmission of a HARQ process of the initial CG-SDT transmission with CCCH message when the UE shall not autonomously retransmit the HARQ process.

Upon configuration of a configured grant Type 1 for a BWP of a Serving Cell by upper layers, the MAC entity shall:

1> store the uplink grant provided by upper layers as a configured uplink grant for the indicated BWP of the Serving Cell;

1> initialise or re-initialise the configured uplink grant to start in the symbol according to *timeDomainOffset*, *timeReferenceSFN*, and *S* (derived from *SLIV* or provided by *startSymbol* as specified in TS 38.214 [7]), and to reoccur with *periodicity*.

After an uplink grant is configured for a configured grant Type 1, the MAC entity shall consider sequentially that the Nth (N >= 0) uplink grant occurs in the symbol for which:

If *cg-SDT-PeriodicityExt* (as defined in TS 38.331 [5]) is not configured:

 [(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*)
 + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =
 (*timeReferenceSFN* × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*
 + *timeDomainOffset* × *numberOfSymbolsPerSlot* + S + N × *periodicity*)
 modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*)

Else:

 [(H-SFN × *numberOfSFNperH-SFN* + SFN) × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*
 + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =
 ((*timeReferenceH-SFN* × *numberOfSFNperH-SFN + timeReferenceSFN*) × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*
 + *timeDomainOffset* × *numberOfSymbolsPerSlot* + S + N × *periodicity*)
 modulo (1024 × 1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*)

For an uplink grant configured for configured grant Type 1 for CG-SDT on the selected uplink carrier as in clause 5.27, when CG-SDT is triggered and not terminated, for each configured uplink grant valid according to TS 38.214 [7] for which the above formula is satisfied, the MAC entity shall:

1> if, after initial transmission for CG-SDT with CCCH message has been performed according to clause 5.4.1, PDCCH addressed to the MAC entity's C-RNTI has not been received:

2> if the SSB corresponding to the configured UL grant has the same SSB index as the SSB selected for initial transmission for CG-SDT with CCCH message (i.e., retransmission of initial transmission of CG-SDT):

3> select this SSB;

3> indicate the SSB index corresponding to the configured uplink grant to the lower layer;

3> consider this configured uplink grant as valid.

1> else if at least one SSB configured for CG-SDT with SS-RSRP above *cg-SDT-RSRP-ThresholdSSB* is available:

2> if at least one SSB corresponding to the configured uplink grant with SS-RSRP above the *cg-SDT-RSRP-ThresholdSSB* is available:

3> if this is the initial transmission of CG-SDT with CCCH message after the CG-SDT procedure is initiated as in clause 5.27 (i.e., initial transmission for CG-SDT):

4> select an SSB with SS-RSRP above *cg-SDT-RSRP-ThresholdSSB* amongst the SSB(s) associated with the configured uplink grant.

3> else if PDCCH addressed to C-RNTI has been received after the initial transmission of CG-SDT with CCCH message (i.e., subsequent new transmission for CG-SDT):

4> if SS-RSRP of the SSB selected for the previous transmission for CG-SDT is above *cg-SDT-RSRP-ThresholdSSB* and this SSB is associated with this configured uplink grant:

5> select this SSB.

4> else if SS-RSRP of the SSB selected for the previous transmission for CG-SDT is not above *cg-SDT-RSRP-ThresholdSSB*:

5> select an SSB with SS-RSRP above *cg-SDT-RSRP-ThresholdSSB* amongst the SSB(s) associated with the configured uplink grant.

3> if SSB is selected above:

4> indicate the SSB index to the lower layer;

4> consider this configured uplink grant as valid.

1> else:

2> consider this configured uplink grant as not valid.

2> if PDCCH addressed to C-RNTI after the initial transmission of the CG-SDT with CCCH message has been received:

3> if there is data available for transmission for at least one RB configured for SDT:

4> initiate Random Access procedure in clause 5.1.

NOTE 1: When the UE determines if there is an SSB with SS-RSRP above *cg-SDT-RSRP-ThresholdSSB*, the UE uses the latest unfiltered L1-RSRP measurement.

After an uplink grant is configured for a configured grant Type 2, the MAC entity shall consider sequentially that the Nth (N >= 0) uplink grant occurs in the symbol for which:

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

where SFNstart time, slotstart time, and symbolstart time are the SFN, slot, and symbol, respectively, of the first transmission opportunity of PUSCH where the configured uplink grant was (re-)initialised.

If *cg-nrofPUSCH-InSlot* or *cg-nrofSlots* is configured for a configured grant Type 1 or Type 2, the MAC entity shall consider the uplink grants occur in those additional PUSCH allocations as specified in clause 6.1.2.3 of TS 38.214 [7].

NOTE 2: In case of unaligned SFN across carriers in a cell group, the SFN of the concerned Serving Cell is used to calculate the occurrences of configured uplink grants.

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

The MAC entity shall:

1> if at least one configured uplink grant confirmation has been triggered and not cancelled; and

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

2> if, in this MAC entity, at least one configured uplink grant is configured by *configuredGrantConfigToAddModList*:

3> instruct the Multiplexing and Assembly procedure to generate a Multiple Entry Configured Grant Confirmation MAC CE as defined in clause 6.1.3.31.

2> else:

3> instruct the Multiplexing and Assembly procedure to generate a Configured Grant Confirmation MAC CE as defined in clause 6.1.3.7.

2> cancel all triggered configured uplink grant confirmation(s).

For a configured grant Type 2, the MAC entity shall clear the configured uplink grant(s) immediately after first transmission of Configured Grant Confirmation MAC CE or Multiple Entry Configured Grant Confirmation MAC CE which confirms the configured uplink grant deactivation.

Retransmissions use:

- repetition of configured uplink grants; or

- received uplink grants addressed to CS-RNTI; or

- configured uplink grants with *cg-RetransmissionTimer* or *cg-SDT-RetransmissionTimer* configured.

================================NEXT CHANGE========================================

5.27.1 General

The MAC entity may be configured by RRC with SDT and the SDT procedure may be initiated by RRC layer for MO-SDT or MT-SDT. The SDT procedure initiated for MO-SDT can be performed either by Random Access procedure with 2-step RA type or 4-step RA type (i.e., RA-SDT) or by configured grant Type 1 (i.e., CG-SDT). The SDT procedure initiated for MT-SDT can be performed either by Random Access procedure with 2-step RA type or 4-step RA type (i.e., RA-SDT is not applicable as specified in clause 5.1.1b) or by configured grant Type 1 (i.e., CG-SDT).

RRC configures the following parameters for SDT procedure:

- *sdt-DataVolumeThreshold*: data volume threshold for the UE to determine whether to perform SDT procedure initiated for MO-SDT;

- *sdt-RSRP-Threshold*: RSRP threshold for UE to determine whether to perform SDT procedure initiated for MO-SDT;

- *sdt-RSRP-ThresholdMT*: RSRP threshold for UE to determine whether to perform SDT procedure initiated for MT-SDT;

- *cg-SDT-RSRP-ThresholdSSB*: an RSRP threshold configured for SSB selection for CG-SDT;

*- cg-MT-SDT-MaxDurationToNextCG-Occasion*: time threshold which is used by the UE to determine whether to perform CG-SDT for MT-SDT;

- *cg-SDT-MaxDurationToNextCG-Occasion*: time threshold configured per logical channel which is used by the UE to determine whether to perform CG-SDT for MO-SDT.

The following UE variable is used for the SDT procedure:

- *MAX\_DURATION\_TO\_NEXT\_CG\_OCCASION*;

- *RSRP\_THRESHOLD.*

The MAC entity shall, if initiated by the upper layers for SDT procedure:

1> if SDT procedure is initiated for MO-SDT as specified in TS 38.331 [5]:

2> set the *MAX\_DURATION\_TO\_NEXT\_CG\_OCCASION* to the shortest value of *cg-SDT-MaxDurationToNextCG-Occasion,* if configured, among all the logical channel configured with this parameter by upper layer and having data for transmission;

2> set the *RSRP\_THRESHOLD* to the value of *sdt-RSRP-Threshold,* if configured.

1> else if SDT procedure is initiated for MT-SDT as specified in TS 38.331 [5]:

2> set the *MAX\_DURATION\_TO\_NEXT\_CG\_OCCASION* to the value of *cg-MT-SDT-MaxDurationToNextCG-Occasion,* if configured;

2> if *sdt-RSRP-ThresholdMT* is configured:

3> set the *RSRP\_THRESHOLD* to the value of *sdt-RSRP-ThresholdMT.*

2> else if *sdt-RSRP-Threshold* is configured:

3> set the *RSRP\_THRESHOLD* to the value of *sdt-RSRP-Threshold*.

1> if the SDT procedure is initiated for MO-SDT as specified in TS 38.331 [5], and the data volume of the pending UL data across all RBs configured for SDT is less than or equal to *sdt-DataVolumeThreshold*, or if the SDT procedure is initiated for MT-SDT as specified in TS 38.331 [5]; and

NOTE 1: For SDT procedure, the MAC entity also considers the suspended RBs configured with SDT for data volume calculation. It is up to the UE's implementation how the UE calculates the data volume for the suspended RBs. Size of the CCCH message is not considered for data volume calculation

1> if the RSRP of the downlink pathloss reference is higher than *RSRP\_THRESHOLD* or if *RSRP\_THRESHOLD* is not set:

2> if the Serving Cell is configured with supplementary uplink as specified in TS 38.331 [5]; and

2> if the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdSSB-SUL*:

3> select the SUL carrier.

2> else:

3> select the NUL carrier.

2> if CG-SDT is configured on the selected UL carrier, and TA for CG-SDT is valid according to clause 5.27.2 in the first available CG occasion for initial CG-SDT transmission with CCCH message according to clause 5.8.2; and

2> if the SDT procedure is initiated for MO-SDT as specified in TS 38.331 [5], and, for each RB having data available for transmission, *configuredGrantType1Allowed*, if configured for CG-SDT, is configured with value *true* for the corresponding logical channel, or if the SDT procedure is initiated for MT-SDT as specified in TS 38.331 [5]; and

2> if at least one SSB configured for CG-SDT with SS-RSRP above *cg-SDT-RSRP-ThresholdSSB* is available, and if either the time gap between the initiation of the SDT procedure and first available CG occasion for initial CG-SDT transmission with CCCH message according to clause 5.8.2 is less than *MAX\_DURATION\_TO\_NEXT\_CG\_OCCASION*, or if the *MAX\_DURATION\_TO\_NEXT\_CG\_OCCASION* is not set:

3> indicate to the upper layers that the conditions for initiating SDT procedure are fulfilled;

3> perform CG-SDT procedure on the selected UL carrier according to clause 5.8.2.

2> else if a set of Random Access resources for RA-SDT is configured and can be selected according to clause 5.1.1b on the selected UL carrier on the BWP configured by *initialUplinkBWP-RedCap*, if configured for a RedCap UE; otherwise, on the BWP configured by *initialUplinkBWP*; or

2> if the SDT procedure is initiated for MT-SDT as specified in TS 38.331 [5]:

3> if *cg-SDT-TimeAlignmentTimer* is running, consider *cg-SDT-TimeAlignmentTimer* as expired and perform the corresponding actions in clause 5.2;

3> indicate to the upper layers that the conditions for initiating SDT procedure are fulfilled.

2> else:

3> indicate to the upper layers that the conditions for initiating SDT procedure are not fulfilled.

1> else:

2> indicate to the upper layers that the conditions for initiating SDT procedure are not fulfilled.

If Random Access procedure is selected above for SDT procedure initiated for MO-SDT or MT-SDT and after the Random Access procedure is successfully completed (see clause 5.1.6), the UE monitors PDCCH addressed to C-RNTI received in random access response until the SDT procedure is terminated. If CG-SDT is selected above and after the initial transmission for CG-SDT is performed, the UE monitors PDCCH addressed to C-RNTI as stored in UE Inactive AS context as specified in TS 38.331 [5] and CS-RNTI until the SDT procedure is terminated.

NOTE 2: When the UE determines if there is an SSB with SS-RSRP above *cg-SDT-RSRP-ThresholdSSB*, the UE uses the latest unfiltered L1-RSRP measurement.

================================CHANGE ENDS=========================================