3GPP TSG-RAN WG2 #116-e R2-210xxxx

Online, 01-12 November 2021

Agenda Item: xx

Source: Xiaomi Communications

**Title: Summary of [Post115-e][509][SDT] CG open issues (Xiaomi)**

Document for: Discussion, decision

# 1 Introduction

This document is a report on the following email discussion, initiated after RAN2#115-e:

* [Post115-e][509][SDT] CG open issues (Xiaomi)

 Scope: Discuss the open issues for CG including:

 CG frame work for unlicensed and licensed spectrum, Whether to support UE autonomous retransmission, Detailed UE behaviours regarding the start/stop/expiry of the timer after the CG/DG transmission for CG-SDT, CG resource/HARQ process which can be selected during initial CG transmission phase or subsequent CG transmission phase, UE request/assistance information for CG SDT, Whether switching between CG and RA-SDT is allowed (after having selected CG-SDT for the initial UL and othre FFS for CG

 Intended outcome: agreeable proposals

 Deadline: Long

Email discussion deadline: October 21st, 0900 UTC

The email discussion deadline for company feedbacks is one day earlier than the tdoc submission deadline (i.e. October 22nd) of RAN2#116-e, so as to allow the email discussion rapporteur to have extra time to provide the summary of the email discussion.

The previous RAN2 agreements on the CG SDT are provided in the Annex section.

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

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| Company | Name | Email Address |
| Xiaomi | Yumin Wu | wuyumin@xiaomi.com |
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# 3 Discussion



Figure 1: Different transmission phases of CG-SDT

As the UE behaviours regarding the use of the CG for SDT are quite different in different CG transmission phases, we would like to divide the CG-SDT into the following phases (as illusrtrated above):

* Initial CG transmission phase
	+ Initial CG new transmission phase
	+ Initial CG retransmission phase (i.e. after the UE autonomously triggers the CG retransmission)
* subsequent CG transmission phase (i.e. after the UE has received response from the gNB)

Due to the discussion on the support of either licensed band or unlicensed band, the following questions are divided into three different categories:

* Questions only for licensed band: are marked with “licensed band”.
* Questions only for unlicensed band: are marked with “unlicensed band”
* Questions for both licensed band and unlicensed band: are not added with any band specific marker.

## 3.1 Support of the licensed band

According to the RAN1 LS provided below, the CG configuration in licensed band is reused for CG-SDT.

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| In RAN1#104b-e* It is RAN1’s common understanding that the CG configuration mechanism in licensed band can be reused for CG-SDT in principle.
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From the rapporteur’s understanding, the Rel-16 UE behaviours (e.g. *configuredGrantTimer*) in RAN2 can be reused to manage the HARQ initial transmission, and to support the dynamic grant retransmission. The details on the UE autonomous retransmission is to be discussed in Setion 3.3.

#### Question 1: Can the Rel-16 CG configuration mechanism (e.g. *configuredGrantTimer*) in licensed band be reused for CG-SDT?

(Companies not providing the answer “Yes” are encouraged to **indicate which aspect(s) of the Rel-16 CG of the licensed band needs to be changed**.)

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## 3.2 Support of the unlicensed band

According to the work item description [25] of SDT, the solutions designed for licensed frequency are reused for the unlicensed frequency if applicable.

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| Focus of the WID should be on licensed carriers and the solutions can be reused for NR-U if applicable.  |

According to the CG configuration (e.g. CG type-1), the CG configuration and the UE behaviours are quite different between the licensed band and the unlicensed band. Here we listed a few examples on the differencese between the licensed band and the unlicensed band as follows:

Table 1: Comparesion between the CG of licensed band and the CG of the unlicensed band

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| **Example functions** | **Licensed band** | **Unlicensed band** |
| Handling of HARQ | The HARQ process ID of CG PUSCH is determined by the CG resource location of the time domain. | The HARQ process ID of CG PUSCH is selected by the UE. The HARQ process ID and RV selected by the UE is indicated via the UCI in the CG PUSCH. |
| Channel access | NA | Need to consider the CAPC (Channel Access Priority Classes) for different PHY channels and different contents (e.g. DRB, SRB and MAC CE). |
| Handling of LBT failure  | NA | Need to consider how/when to start/restart/stop the corresponding timer (e.g. configuredGrantTimer and cg-RetransmissionTimer) of CG at LBT failure. |
| UE autonomous retransmission | NA | Need to retransmit MAC PDU after the expiry of the cg-RetransmissionTimer. |
| RRC configuration paramters | Licensed band specific configuration:***repK-RV*** | Unlicensed band specific configuration:***cg-COT-SharingList******cg-COT-SharingOffset******cg-minDFI-Delay******cg-RetransmissionTimer******CG-COT-Sharing******CG-StartingOffsets*** |

As RAN1 already agreed to reuse the CG configuration mechanism in licensed band, RAN2 could discuss further whether/how the CG-SDT can be supported for the unlicensed band. If RAN2 agreed to support CG-SDT for the unlicensed band, RAN1 needs to be informed to evaluate whether the CG configuration mechanism in unlicensed band can be reused.

According to the email discussion in [26], it is still FFS whether NR-U related parameters are need or not. From the rapporteur’s understanding, the CG configuration mechanism in licensed band cannot be reused for the unlicensed band, and many RRC configuration parameters which are unlicensed band specific cannot be used for the licensed band, according to the comparision examples given in the above table.

#### Question 2: Should the CG-SDT be supported for the unlicensed band in Rel-17?

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#### Question 3: If the CG-SDT is supported for the unlicensed band, can the Rel-16 CG (e.g. Handling of HARQ process, channel access, handling of LBT failure, UE autonomous retransmission and RRC configuration parameters) of the unlicensed band be reused for CG-SDT?

(Companies not providing the answer “Yes” are encouraged to **indicate which aspect(s) of the Rel-16 CG of the unlicensed band needs to be changed**.)

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## 3.3 UE autonomous retransmission in licensed band

[7] considers that “the UL CCCH transmission can not be detected by NW in case the initial CG transmission fail, thus no retransmission can be scheduled by NW”, and proposes a “timer based CG retransmission mechanism” as follows:

* The timer will be started once the MAC PDU to transmit has been obtained by the HARQ entity for the CG grant.
* If successful feedback is received, the UE should stop the timer
* If no successful feedback can be received before the expiration of the timer, the UE should consider the CG transmission fail and trigger the retransmission of the HARQ process with coming CG resources.

According to the RAN2#114-e meeting agreements as quoted in the Annex, L1 feedback is to be provided from the gNB to the UE after the CG transmission. As an example, the autonomous retransmission of the *cg-RetransmissionTimer* for the unlicensed band is quoted below.

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| 38.321: start/restart condition of *cg-RetransmissionTimer*6> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers. |
| 38.321: stop condition of *cg-RetransmissionTimer*If a HARQ process receives downlink feedback information, the HARQ process shall:1> stop the *cg-RetransmissionTimer*, if running; |
| 38.321: expiry of *cg-RetransmissionTimer*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. |

#### Question 4: Is the UE autonomous retransmission needed for CG-SDT in licensed band?

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#### Question 5: If the UE autonomous retransmission is not needed for CG-SDT in licensed band, what is the expected behaviour (e.g. whether the UE will do nothing until T319 expires or some other behvaiours) if the UE does not receive the feedback from the gNB?

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#### Question 6: If the UE autonomous retransmission in licensed band is needed for CG-SDT, is the UE autonomous retransmission only required in the initial CG transmission phase?

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If the UE autonomous retransmission is needed for CG-SDT, RAN2 needs to decide the HARQ process and the uplink grant used for retransmitting the MAC PDU. According to the legacy UE behaviours for the UE autonomous retransmission in 3GPP TS 38.321, we could have the following options:

Option1: UE autonomous (re)transmission specified in Rel-16 URLLC (i.e. UE perform the retransmission on the CG occasion associated to the same HARQ process)

Option 2: Rel-16 NR-U based UE autonomous retransmission (i.e. HARQ process is indicated in UCI)

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| Option 1 (38.321): For each uplink grant, the HARQ entity shall:1> identify the HARQ process associated with this grant, and for each identified HARQ process:…3> else if this uplink grant is a configured grant configured with *autonomousTx*; and3> if the previous configured uplink grant, in the BWP, for this HARQ process was not prioritized; and3> if a MAC PDU had already been obtained for this HARQ process; and3> if the uplink grant size matches with size of the obtained MAC PDU; and3> if none of PUSCH transmission(s) of the obtained MAC PDU has been completely performed:4> consider the MAC PDU has been obtained. |
| Option 2 (38.321):2> if, for the corresponding HARQ process, the *configuredGrantTimer* is not running and *cg-RetransmissionTimer* is not configured (i.e. new transmission):3> consider the NDI bit for the corresponding HARQ process to have been toggled;3> 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. |

#### Question 7: If the UE autonomous retransmission is supported in licensed band, which of the following options is used?

Option1: UE autonomous (re)transmission specified in Rel-16 URLLC (i.e. UE perform the retransmission on the CG occasion associated to the same HARQ process)

Option 2: Rel-16 NR-U based UE autonomous retransmission (i.e. HARQ process is indicated in UCI)

Option 3: Some other mechanism (companies can explain.)

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## 3.4 “CG-SDT timer” in licensed band

According to the Rel-16 CG procedure, the RACH procedure and the LTE PUR procedure, the timers related to the CG-SDT operation could serve the following functions:

* Function 1: The retransmission of a MAC PDU is triggerd by the expiry of a timer, alike *cg-RetransmissionTimer* and *ra-ResponseWindow*/*msgB-ResponseWindow*.
* Function 2: The CG-SDT failure is trigger by the expiry of a timer, alike T319 and *pur-ResponseWindowTimer*.
* Function 3: The UE monitors x-RNTI PDCCH or the feedback from the gNB, alike *pur-ResponseWindowTimer* and *ra-ResponseWindow*/*msgB-ResponseWindow*.
* Function 4: The HARQ initial transmission of the CG can only be triggerd when the timer associated to the correposnding HARQ process is not running, alike configuredGrantTimer.

As RAN2 agreed that “UE starts a window after CG/DG transmission for CG-SDT” in RAN2#113bis-e, the detailed UE behaviours regarding the window of the CG-SDT would include the PDCCH monitoring during the running period of ther “CG-SDT timer”, the starting/restarting time of the “CG-SDT timer”, the stopping condition of the “CG-SDT timer” and the UE behaviours at the expiry of the “CG-SDT timer”. From the rapporteur’s understanding, RAN2 can firstly agree on the detailed UE behaivours/functions (e.g. Function 1/2/3) regarding the “CG-SDT timer”, and then decide whether the introduction of one or more new timer(s) are needed.

Regarding the expiry of the the “CG-SDT timer”, we could have the following options:

* Option 1: The UE autonomously retransmits the MAC PDU of CG-SDT upon the expiry of the “CG-SDT timer”.
* Option 2: The CG-SDT failure is triggered upon upon the expiry of the “CG-SDT timer”.
* Option 3: Others

For Option 1, the UE behaviours is alike the expiry of the *cg-RetransmissionTimer* or the *ra-ResponseWindow/ msgB-ResponseWindow*. For Option 2, the UE would stop the CG-SDT procedure, like the LTE PUR as quoted below. The RRC procedure details on the handling of the CG-SDT failure of Option 2 would need more discussion in RAN2.

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| 36.321:- if the *pur-ResponseWindowTimer* expires:- indicate to upper layers the transmission using PUR has failed;- discard the PUR-RNTI. |
| 36.331:Upon reception of PUR fallback or PUR failure indication from lower layers, the procedure ends.NOTE: For transmission using PUR, further UE actions upon reception of PUR fallback or PUR failure indication from lower layers (see TS 36.321 [6]) is left up to implementation. |
| 36.331:3> if PUR failure indication is received from lower layers:4> consider the PUR occasion as skipped;4> if *pur-ImplicitReleaseAfter* number of consecutive PUR occasions have been skipped:5> if *pur-TimeAlignmentTimer* is configured, indicate to lower layers that *pur-TimeAlignmentTimer* is released;5> release *pur-Config*;5> discard previously stored *pur-Config*. |

#### Question 8: What would be the expected UE behaivours regarding the expiry of the the “CG-SDT timer”?

* Option 1: The UE autonomously retransmits the MAC PDU of CG-SDT upon the expiry of the “CG-SDT timer” .
* Option 2: The CG-SDT failure is triggered upon upon the expiry of the “CG-SDT timer”.
* Option 3: Others

 (Multiple selection is allowed. Companies selecting Option 3 are encouraged to provide the information details in the “Comments” column.)

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Regarding the PDCCH monitoring during the running period of the “CG-SDT timer”, we could have the following candidate PDCCH(s):

* Option 1: CS-RNTI PDCCH
* Option 2: C-RNTI PDCCH
* Option 3: L1 ACK
* Option 4: Other

Option 1 is used for the dynamic grant retransmission of the CG-SDT. Option 2 can be used for the dynamic grant new transmission, which can be used to schedule the *RRCRelease* message when the gNB wants to release the UE without the subsequent data transmission. Option 3 is used for the gNB feedback of the CG-SDT, which could be via x-RNTI (e.g. CS-RNTI, C-RNTI or other RNTIs) PDCCH, depending on the RAN1 design of the L1 feedback. According 3GPP TS 36.331, the *pur-ResponseWindowTimer* of LTE PUR is used for both Option 1 and Option 3, as highlighted in yellow below. As the LTE PUR also uses the PUR-RNTI for the downlink PDSCH (as highlighted in green), the *RRCConnectionRelease* message can be scheduled via the PUR-RNTI.

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| 36.331:After transmission using PUR, the MAC entity shall monitor PDCCH identified by PUR-RNTI in the PUR response window using timer *pur-ResponseWindowTimer*, which starts at the subframe that contains the end of the corresponding PUSCH transmission plus 4 subframes, and has the length *pur-ResponseWindowSize.* While *pur-ResponseWindowTimer* is running, the MAC entity shall:- if the PDCCH transmission is addressed to the PUR-RNTI and contains an UL grant for a retransmission:- restart *pur-ResponseWindowTimer* at the last subframe of a PUSCH transmission corresponding to the retransmission indicated by the UL grant plus 4 subframes.- if L1 ACK for transmission using PUR is received from lower layers; or- if PDCCH transmission is addressed to the PUR-RNTI and the MAC PDU is successfully decoded: |

#### Question 9: Which of the following L1 signaling(s)/channel(s) need to be monitored during the running period of the “CG-SDT timer” in the initial CG transmission phase?

* Option 1: CS-RNTI PDCCH
* Option 2: C-RNTI PDCCH
* Option 3: L1 ACK
* Option 4: Others

 (Multiple selection is allowed. Companies selecting Option 4 are encouraged to provide the information details in the “Comments” column.)

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#### Question 10: If the “CG-SDT” timer can be started in the subsequent CG transmission phase, which of the following L1 signaling(s)/channel(s) need to be monitored during the running period of the “CG-SDT timer” in the subsequent CG transmission phase?

* Option 1: CS-RNTI PDCCH
* Option 2: C-RNTI PDCCH
* Option 3: L1 ACK
* Option 4: Others

 (Multiple selection is allowed.)

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Regarding the starting time of the “CG-SDT timer”, we could have the following options:

* Option 1: The “CG-SDT timer” starts at the first “valid” PDCCH occasion from the end of the CG-SDT PUSCH transmission.
* Option 2: The “CG-SDT timer” starts at at the beginning of the first symbol of the CG-SDT PUSCH transmission.

For Option 1, the “the first “valid” PDCCH occasion” would be defined in the RAN1 specification, similar as the *ra-ResponseWindow* quoted below:

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| 38.321:2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission; |

For Option 2, the starting time of the “CG-SDT timer” is like the *cg-RetransmissionTimer*, as quoted below:

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| 38.321:When *configuredGrantTimer* or *cg-RetransmissionTimer* is started or restarted by a PUSCH transmission, it shall be started at the beginning of the first symbol of the PUSCH transmission. |

The reason for the *cg-RetransmissionTimer* to use Option 2 is that the *cg-RetransmissionTimer* is used for the UE autonomous retransmission and not used for monitoring the dynamic grant retransmission (i.e. CS-RNTI PDCCH).

#### Question 11: When does the UE start the “CG-SDT timer”?

* Option 1: The “CG-SDT timer” starts at the first “valid” PDCCH occasion from the end of the CG-SDT PUSCH transmission.
* Option 2: The “CG-SDT timer” starts at at the beginning of the first symbol of the CG-SDT PUSCH transmission.
* Option 3: Others

(Single selection is expectd for the above question. )

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If the “CG-SDT timer” is only used for receiving the L1 ACK of the gNB, or only used for the UE autonomous retranmission in the initial transmission phase, it seems that “CG-SDT timer” does not need to be started/restarted in the subsequent CG transmission phase.

#### Question 12: Is the “CG-SDT timer” started/restarted only in the initial CG transmission phase?

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Regarding the restarting condition of the “CG-SDT timer”, the “CG-SDT timer” can restart upon the PUSCH transmission indicated by the CS-RNTI PDCCH, alike the *pur-ResponseWindowTimer* of the LTE PUR as quoted below. The intention of restarting the “CG-SDT timer” by the CS-RNTI PDCCH is to allow more time for the subsequent retransmission of the CS-RNTI PDCCH. The exact timing of restarting the “CG-SDT timer” may need further study and to be confirmed by RAN1.

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| 36.331:- if the PDCCH transmission is addressed to the PUR-RNTI and contains an UL grant for a retransmission:- restart *pur-ResponseWindowTimer* at the last subframe of a PUSCH transmission corresponding to the retransmission indicated by the UL grant plus 4 subframes. |

#### Question 13: When does the UE restart the “CG-SDT timer”?

* Option 1: The “CG-SDT timer” is restarted upon the PUSCH retransmission indicated by the CS-RNTI PDCCH.
* Option 2: The “CG-SDT timer” is restarted after each CG-SDT transmission. [5]
* Option 3: Other trigger conditions for restarting the “CG-SDT timer”.
* Option 4: No need to restart “CG-SDT timer”.

(Multiple selection (e.g. Option 1, Option 2 and Option 3) is allowed when company considers that restarting the “CG-SDT timer” is needed. Companies selecting Option 3 are encouraged to provide the information details in the “Comments” column.)

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Regarding the stopping condition of the “CG-SDT timer” in the initial CG transmission phase, the “CG-SDT timer” can be stopped when the feedback from the gNB is received, as the *pur-ResponseWindowTimer* of the LTE PUR or the *cg-RetransmissionTimer* for unlicensed band as quoted below. The feedback can be one of the followings:

* Option 1: L1 ACK for CG-SDT
* Option 2: Successfully decoded MAC PDU scheduled by “X-RNTI” PDCCH

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| 36.321:- if L1 ACK for transmission using PUR is received from lower layers; or- if PDCCH transmission is addressed to the PUR-RNTI and the MAC PDU is successfully decoded:- stop *pur-ResponseWindowTimer*; |
| 38.321:If a HARQ process receives downlink feedback information, the HARQ process shall:1> stop the *cg-RetransmissionTimer*, if running; |

#### Question 14: Which of the following option(s) is used to stop the “CG-SDT timer”?

* Option 1: L1 ACK for CG-SDT
* Option 2: Successfully decoded MAC PDU scheduled by “X-RNTI” PDCCH
* Option 3: RRC feedback messages (e.g. RRCResume, RRCSetup, RRCRelease and RRCReject)
* Option 4: Others

 (Multiple selection is allowed. Companies selecting Option 4 are encouraged to provide the information details in the “Comments” column.)

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## 3.5 CG resource(s)/HARQ process(es) used in different CG-SDT phases

The Rel-16 calculation on the HARQ process ID is quoted as follows:

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| 38.321: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 = (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]. |

#### Question 16: Can the Rel-16 calculation on the HARQ process ID of the CG type-1 for licensed band be reused for CG-SDT?

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According to the RAN2 agreement made in the RAN2#113bis-e meeting, multiple HARQ processes can be supported for CG-SDT. In the initial CG transmission phase, if the UE is allowed to use multiple HARQ processes (or multiple CG resources) in parallel, the UE needs to include multiple CCCH messages in each CG transmission, so as to allow the gNB to identify the UE. From the rapporteur’s understanding, transmitting multiple CCCH messages in parallel will cause security isssues (e.g. replay attack) and require more changes in either RRC or MAC to trigger the transmission of multiple CCCH messages in multiple CG PUSCH(s). One may consider that RAN2 can only allow a single SDT session in MAC during the initial CG transmission phase. Thus after the CG PUSCH transmission in the initial CG transmission phase, the UE has to wait for the reception of the gNB feedback and the triggering of the UE autonomous retransmission before selecting another CG resource for transmission.

#### Question 17: Is the UE allowed to initiate subsequent UL data transmission only after the reception of the feedback (e.g. L1 ACK) from the gNB?

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| **Company** | **Answer (Yes/No)** | **Comments** |
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In the subsequent CG transmission phase, according to [24], the UE can use multiple CG resources (i.e. multiple HARQ processes) in parallel, as the legacy CG. Thus, after the transmission of a CG PUSCH in the subsequent CG transmission phase, there is no need for the UE to wait for the feedback from the gNB before selecting another CG resource for transmission.

#### Question 18: Can the UE use multiple CG resources for the HARQ initial transmission as Rel-16 in the subsequent CG transmission phase?

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| **Company** | **Answer (Yes/No)** | **Comments** |
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## 3.6 Switch from CG-SDT to RA-SDT in the initial CG transmission

During the initial CG transmission phase, after the UE selects the CG-SDT, the conditions for selecting the CG-SDT may not be fulfilled. Then RAN2 needs to decide whether the UE can switch from CG-SDT to RA-SDT. If switching from CG-SDT to RA-SDT is not allowed, the UE may have to terminate the SDT procedure when any of the conditions for selecting the CG-SDT is not fulfilled.

#### Question 20: Which condition(s) is used to trigger the switch from CG-SDT to RA-SDT in the initial CG transmission phase after having selected CG-SDT?

* Option 1: The switch from CG-SDT to RA-SDT after having selected CG-SDT in the initial CG transmission phase is **NOT allowed**.
* Option 2: If the UE has not received an acknowledgement to the first uplink CG-SDT message. [5]
* Option 3: If no beam and CG-SDT resource meet the criteria for the CG-SDT transmitting the first UL message using CG-SDT. [9]
* Option 4: When none of SSB’s RSRP is above the RSRP threshold and the time difference between the current CG occasion and the next CG occasion is larger than the Timer. [11]
* Option 5: After a configured number of consecutive failures on a CG SDT resource. [12]
* Option 6: Others

(Mulitple selection is allowed for Option 2-6. Companies providing the support for Option 1 is not expect to provide support for other options, as Option 1 is contradictive to other options. Companies providing the support for Option 7 are encouraged to provide the details on the trigger condition.)

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| **Company** | **Answer****(Option 1 or Option 1-7)** | **Comments** |
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## 3.7 RA-SDT RA resources in the subsequent data transmission phase

According to the CG-SDT discussion in the RAN2#115-e meeting, RAN2 agreed to support the legacy RACH procedure during the subsequent CG transmission phase. As the RA resource for the RA-SDT would be separate from the RA resource the legacy RACH procedure, companies consider that the RA-SDT RA resource could be also used in the subsequent data transmission phase. From the rapporteur’s understanding, if RAN2 agreed to use the RA-SDT RA resource for the subsequent CG transmission phase, there should be not technical blockage of using the RA-SDT RA resource for the subsequent data transmission phase of RA-SDT. The corresponding RAN2 agreement is quoted as follows:

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| During subsequent CG transmission phase (i.e. after the UE has received response from NW) UE can initiate at least legacy RACH procedure (e.g. trigger due to no UL resources). No MAC PDU rebuilding is required. FFS if the RA-SDT RA resources can be used for subsequent data. a. At least the following conditions are agreed: (1) no qualified SSB when the evaluation is performed; (2) when TA is invalid; (3) when SR is triggered due to lack of UL resource |

#### Question 21: Can the UE use RA-SDT RA resources in the subsequent data transmission phase?

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| **Company** | **Answer (Yes/No)** | **Comments** |
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## 3.8 CS-RNTI

In RAN2#115-e, RAN2 agreed to support CS-RNTI based dynamic retransmission. However it is still FFS on how the CS-RNTI is provided to the UE. The corresponding RAN2 agreement is quoted as follows:

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| CS-RNTI based dynamic retransmission mechanism can be reused for CG-SDT. FFS whether CS-RNTI is the same one as the one previously configured in RRC\_CONNECTED or a new CS-RNTI one is provided to the UE |

#### Question 22: Which of the following option(s) is used to configure the CS-RNTI for CG-SDT?

* Option 1: The CS-RNTI for CG-SDT is the same as the one previously configured in RRC\_CONNECTED.
* Option 2: A new CS-RNTI is provided to the UE (e.g. via RRCRelease message).
* Optiion 3: Others

(Multiple selection is allowed. Companies providing the support for Option 3 is encouraged to provide the solution details in the “Comments” column.)

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| **Company** | **Answer (Option 1/2/3)** | **Comments** |
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## 3.9 SSB re-evaluation in the subsequent CG transmission

According to the discussion in the RAN2#115-e meeting, RAN2 agreed to require the UE to re-evaluates the SSB for subsequent CG transmission. However it is possible that no RSRP of any SSB is above the configured threshold for CG-SDT. This could be caused by the case that no sample is available or no SSB is available. From the rapporteur’s understanding, when no RSRP of any SSB is above the configured threshold for CG-SDT, the CG resource for SDT should not be used, and the UE could trigger the legacy RACH due to no UL resources, as RAN2 already agreed to allow the UE to trigger the legacy RACH in the subsequent CG transmission. The corresponding RAN2 agreement is quoted as follows:

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| During the subsequent new CG transmission phase, for the purpose of CG resource selection, UE re-evaluates the SSB for subsequent CG transmission. FFS what happens if no SSBs are valid or if no sample is available |

#### Question 23: What would be the expect UE behaviours if no RSRP of any SSB is above the configured threshold for CG-SDT (e.g. no valid SSB or no available measurement sample) during the the subsequent new CG transmission phase?

* Option 1: Trigger the legacy RACH due to no UL resources (i.e. no CG based UL grant is provided to the HARQ process and SR/RACH will be triggered due to lack of UL resources)
* Option 2: Use any SSB (similar to RACH retransmission case)
* Option 3: Others (please explain)

(Companies providing the support for Option 3 is encouraged to provide the solution details in the “Comments” column.)

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| **Company** | **Answer (Option 1/2/3)** | **Comments** |
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## 3.10 CG-SDT configuration

Accoriding the CG-SDT discussion in the RAN2#115-e, a few parameters are agreed to be included in the CG-SDT configuration. However it is still FFS whether these parameters are “per CG-SDT configuration” or “for multiple CG-SDT configurations”, as RAN2 already agreed to support “multiple CG-SDT configurations per carrier in RRC\_INACTIVE” in RAN2#113-e meeting. The corresponding RAN2 agreement is quoted as follows:

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| From RAN2 perspective, at least the following parameters should be included in the CG-SDT configuration. FFS whether these parameters are common for multiple CG-SDT configurations or per CG-SDT configuration.* The new TA timer in RRC\_INACTIVE;
* The RSRP change threshold for TA validation mechanism in SDT (details dependent on RAN1);
* The SSB RSRP threshold for beam selection (i.e. UE selects the beam and associated CG resource for data transmission).
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#### Question 24: Which of the following parameters of CG-SDT are “per CG-SDT configuration” or “for multiple CG-SDT configurations”?

* Parameter 2: The new TA timer in RRC\_INACTIVE;
* Parameter 2: The RSRP change threshold for TA validation mechanism in SDT (details dependent on RAN1);
* Parameter 3: The SSB RSRP threshold for beam selection (i.e. UE selects the beam and associated CG resource for data transmission). (Companies providing the support for Option 2 is encouraged to provide the solution details in the “Comments” column.)

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| **Company** | **Answer for paramters “per CG-SDT configuration” (Parameter 1/2/3)** | **Answer for paramters “for multiple CG-SDT configurations” (Parameter 1/2/3)** | **Comments** |
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# 6 Conclusions

In the followings, we provide a few observations capturing the RAN1 impacts which could be brought by the potential RAN2 agreements.

**Rapporteur’s Observation 1: If RAN2 agreed to support the CG-SDT for the unlicensed band, RAN1 needs to be informed to provide unlicensed band specific functions for CG-SDT, e.g. the CG configuration parameters and the determination of HARQ process ID.**

**Rapporteur’s Observation 2: If RAN2 agreed that the “CG-SDT timer” starts at the first “valid” PDCCH occasion from the end of the CG-SDT PUSCH transmission, RAN1 needs to be informed to define “the first “valid” PDCCH occasion” for the “CG-SDT timer”.**

**Rapporteur’s Observation 3: If RAN2 agreed that the “CG-SDT timer” restarts upon the PUSCH transmission corresponding to the retransmission indicated by the CS-RNTI PDCCH, RAN1 may be informed to define the exact timing of restarting the “CG-SDT timer”.**

# 7 References

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# 8 Annex

RAN2#112-e meeting agreements:

**Agreements:**

1. The configuration of configured grant resource for UE uplink small data transfer is contained in the RRCRelease message. FFS if other dedicated messages can configure CG in INACTIVE CG. Configuration is only type 1 CG with no contention resolution procedure for CG.
2. The configuration of configured grant resource can include one type 1 CG configuration. FFS if multiple configured CGs are allowed
3. A new TA timer for TA maintenance specified for configured grant based small data transfer in RRC\_INACTIVE should be introduced. FFS on the procedure, the validity of TA, and how to handle expiration of TA timer. The TA timer is configured together with the CG configuration in the RRCRelease message.
4. The configuration of configured grant resource for UE small data transmission is valid only in the same serving cell. FFS for other CG validity criteria (e.g. timer, UL/SUL aspect, etc)
5. The UE can use configured grant based small data transfer if at least the following criteria is fulfilled (1) user data is smaller than the data volume threshold; (2) configured grant resource is configured and valid; (3) UE has valid TA. FFS for the candidate beam criteria.
6. From RAN2 point of view: An association between CG resources and SSBs is required for CG-based SDT. FFS up to RAN1 how the association is configured or provided to the UE. Send an LS to RAN1 to start the discussion on how the association can be made. Mention that one option RAN2 considered was explicit configuration with RRC Release message
7. A SS-RSRP threshold is configured for SSB selection. UE selects one of the SSB with SS-RSRP above the threshold and selects the associated CG resource for UL data transmission.

RAN2#113-e meeting agreements:

**Agreements**

1. CG-SDT resource configuration is provided to UEs in RRC\_Connected only within the RRCRelease message, i.e. no need to also include it in RRCReconfiguration message
2. CG-PUSCH resources can be separately configured for NUL and SUL. FFS if we allow them at the same time. This depends on the alignments CRs for Rel-16.
3. RRCRelease message is used to reconfigure or release the CG-SDT resources while UE is in RRC\_INACTIVEe
4. For CG-SDT the subsequent data transmission can use the CG resource or DG (i.e dynamic grant addressed to UE’s C-RNTI). Details on C-RNTI, can be the same as the previous C-RNTI or may be configured explicitly by the network can be discussed in stage 3
5. TAT-SDT is started upon receiving the TAT-SDT configuration from gNB, i.e. RRCrelease message, and can be (re)started upon reception of TA command.
6. From RAN2 point of view, assume similar to PUR, that we introduce a TA validation mechanism for SDT based on RSRP change, i.e. RSRP-based threshold(s) are configured. Ask RAN1 to confirm. FFS on how to handle CG configuration when TA expires or when is invalid due to RSRP threshold. Details of the TA validation procedure can be further discussed.
7. As a baseline assumption, it’s a network configuration issue whether to support multiple CG-SDT configurations per carrier in RRC\_INACTIVE (i.e. we will not restrict network configuration for now).
8. FFS Discuss further in stage 3 how to specify the agreement that CG-SDT resources are only valid in one cell (i.e. cell in which RRCRelease is received)
9. UE releases CG-SDT resources when TAT expires in RRC\_Inactive state

RAN2#113bis-e meeting agreements:

**Agreements:**

1 CG-SDT resources can be configured at the same time on NUL and SUL

2 Implicit release of CG-SDT resource is not supported

3 UE start a window after CG/DG transmission for CG-SDT. FFS whether to design a new timer or to reuse an existing timer.

4 Support retransmission by dynamic grant for CG-SDT.

5 Support multiple HARQ processes for uplink CG-SDT.

6 CG resource availability delay is not considered as a criterion for CG validation.

7 UL carrier selection is performed before CG-SDT selection

*8 FFS CG-SDT resource can be configured on BWPs other than initial BWP*

RAN2#114-e meeting agreements:

**Agreements:**

1. Release of CG-SDT configuration by system information indication is not supported
2. RAN2 thinks that some feedback may be beneficial in case CG is used for subsequent transmission. RAN2 assumes that existing mechanism can be used.
3. For initial CG transmission, UE does not select any SSB if none of the SSBs’ RSRP is above the RSRP threshold. FFS if re-evaluation for every CG transmission is necessary

RAN2#115-e meeting agreements:

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| **Agreements**1. If none of the SSBs’ RSRP is above the RSRP threshold of CG-SDT criteria in the type selection phase, UE should select RA-SDT if RA-SDT criteria is met2. MAC PDU rebuilding is not required (unless we find a case that is needed)3. During subsequent CG transmission phase (i.e. after the UE has received response from NW) UE can initiate at least legacy RACH procedure (e.g. trigger due to no UL resources). No MAC PDU rebuilding is required. FFS if the RA-SDT RA resources can be used for subsequent data. a. At least the following conditions are agreed: (1) no qualified SSB when the evaluation is performed; (2) when TA is invalid; (3) when SR is triggered due to lack of UL resource4. UE should release CG-SDT resource (if stored) when UE initiates RRC resume procedure from another cell which is different from the cell in which the RRCRelease is received.5. The C-RNTI previously configured in RRC\_CONNECTED state is used for UE to monitor PDCCH in CG-SDT. 6. CS-RNTI based dynamic retransmission mechanism can be reused for CG-SDT. FFS whether CS-RNTI is the same one as the one previously configured in RRC\_CONNECTED or a new CS-RNTI one is provided to the UE7. During the subsequent new CG transmission phase, for the purpose of CG resource selection, UE re-evaluates the SSB for subsequent CG transmission. FFS what happens if no SSBs are valid or if no sample is available8. From RAN2 perspective, at least the following parameters should be included in the CG-SDT configuration. FFS whether these parameters are common for multiple CG-SDT configurations or per CG-SDT configuration.* The new TA timer in RRC\_INACTIVE;
* The RSRP change threshold for TA validation mechanism in SDT (details dependent on RAN1);
* The SSB RSRP threshold for beam selection (i.e. UE selects the beam and associated CG resource for data transmission).
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