**3GPP TSG-RAN WG1 Meeting #110bis-e R1-22xxxxx**

**e-Meeting, Oct 10th - 19th, 2022**

**Agenda Item: 8.17**

**Source: Moderator (ZTE)**

**Title: Summary on remaining issues of SDT**

**Document for: Discussion**

# Introduction

This document contains the summary of remaining issues identified in RAN1#110bis-e meeting. The following email thread is used:

[110bis-e-R17-Others-04] Email discussion on maintenance issues for SDT by October 17 – Ziyang (ZTE)

         Issue#2 Redundancy versions of repetitions for CG-SDT

         Issue#3 Repetitions for CG-SDT

         Issue#4 Editorial correction on parameter name (for alignment CR)

         Issue#5 Power offset of feature combination

# Remaining issues

## Issue#2 Redundancy versions of repetitions for CG-SDT

### First round discussion

In RAN1#110, the impact of the following agreement made by RAN2 for RV version has been captured in TS 38.213.

RAN2#117e agreements

=> For autonomous re-tx, fix the RV to be 0 for both the initial and retransmission of initial CG-SDT transmission.

In R1-2208624, vivo proposes that when repK-RV is configured, the RV version should be determined according to clause 6.1.2.3 of 38.214.

According to RAN2’s discussion, the motivation to fix the RV to be 0 is that, soft combination is not useful for autonomous re-transmission of initial SDT transmission, since the re-transmission is autonomously operated by UE if initial transmission fails, gNB is even not aware of whether the re-transmission happens or not. In such case, even when repK-RV is configured, it’s not beneficial to apply different RV for repetitions of autonomous re-transmissions.

In addition, for autonomous re-transmission, if different RVs for repetitions are needed, it also requires spec impact in TS 38.214 since for legacy CG there is no such re-transmission.

From FL’s perspective, for initial transmission or autonomous retransmission of initial transmission,

* Option 1: The RV is always fixed to be 0 no matter whether repetition is configured or not
  + No spec impact for this option.
* Option 2: The RV is determined by repK-RV if repetition is configured
  + Draft CR in R1-2208624 and potential impact in TS 38.214

Any views on the above 2 options for RV determination?

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| Company | Comment |
| Intel | We support Option 1. We do not think we need to revert the RAN2 agreement at very late stage during maintenance phase. |
| Qualcomm | We think Option 1 should be supported. |
| New H3C | We support option 1 |
| ZTE | We support Option 1. RAN2’s motivation to fix RV to be 0 for autonomous re-transmission is that, gNB can not be aware of such re-transmission if the initial transmission failed, then soft combination is not useful in this case. Even if repetition is configured, it’s also possible that some of the repetitions are missed by gNB, then it’s safer to also fix the RV of these repetitions to be 0. |
| Samsung | We agree FL’s assessment, and support option 1. |
| Huawei | Option 1 |
| Ericsson | We support Option 1. |
| vivo | For the argument from FL, could you clarify how soft combining is not useful among repetitions of one single retransmission? I can understand soft combining among different retransmissions may be a problem if RV other than 0 could be used and not self-decodable, but for repetitions of one retransmission, I do not understand why different RV can not be applied while RV of first repetition would still be RV0.  *According to RAN2’s discussion, the motivation to fix the RV to be 0 is that, soft combination is not useful for autonomous re-transmission of initial SDT transmission, since the re-transmission is autonomously operated by UE if initial transmission fails, gNB is even not aware of whether the re-transmission happens or not. In such case, even when repK-RV is configured, it’s not beneficial to apply different RV for repetitions of autonomous re-transmissions.*  Technically we do not see why there would be issue for reusing legacy to determine RV for 2nd and latter repetitions. If we force all repetitions must be RV0, this is something new that requires RAN1/2 agreement in my understanding.  If all other companies would allow this RV to be just 0, we’re also fine. But this should be clarified in the spec. as the current text in 38.213 conflicts with 38.214, eg. Update as following   |  | | --- | | 19.1 Configured-grant based PUSCH transmission For initial transmission or autonomous retransmission, including repetitions, of an initial transport block provided for the PUSCH transmission as described in clause 18.0 in [19, TS 38.300], the UE encodes the transport block using redundancy version number 0. | |
| FL | To vivo,  The decision of fixing RV to be 0 is under the assumption that the SDT initial transmission and autonomous re-transmission may be missed by gNB, follow this logic, some of the repetitions of re-transmission may not be realized by gNB since it’s autonomous and purely triggered by UE, so gNB may only detect part of the repetitions, then it’s better to set all repetitions to be 0. |
| Huawei, HiSilicon2 | After further considerations, we think vivo’s point is valid and we’d like to support.  The repetitions have different purpose as autonomous reTx. Both initial transmission and autonomous reTx is for initial Tx of a TB, thus it may be failed and unknown by gNB. While repetitions are useful for coverage - if configured, gNB may want to utilize that instead of fixed RV. The RV determination for CG is already in the spec, same as SDT, there is no fundamental difference.  The RV determination for repetitions has nothing to do with RAN2 agreements – it’s for initial Tx of a TB.  RAN2#117e agreements  => For autonomous re-tx, fix the RV to be 0 for both the initial and retransmission of initial CG-SDT |
| Samsung | We understand the FL’s assessment that when gNB did not even know the detected PUSCH is first transmission or re-transmission, it can only assume it’s for RV 0, otherwise, multiple blind detection/decoding will be needed. That’s why different RV seems not work so well.  VIVO’s CR is acceptable to us. Though we think the “initial transmission” “retransmission” already imply the repetitions if any. |
| Huawei | According to the resource configuration for configured grant in Rel-15, the possible initial transmission occasion is pre-configured by gNB using an offset wrt SFN, so gNB certainly knows whether a potential UL transmission at certain resource is an initial transmission or not.  I’m not aware of other approaches for configured grant resource configurations w.r.t RV has been discussed for SDT. |

#### 2.1.1.1 Summary

All companies except vivo support Option 1, i.e. for initial transmission or autonomous retransmission of initial transmission, the RV is always fixed to be 0 no matter whether repetition is configured or not.

Vivo can accept Option 1 but they think it also requires spec change as follows:

TP from vivo

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| 19.1 Configured-grant based PUSCH transmission For initial transmission or autonomous retransmission, including repetitions, of an initial transport block provided for the PUSCH transmission as described in clause 18.0 in [19, TS 38.300], the UE encodes the transport block using redundancy version number 0. |

Given the clear majority, instead of triggering another round discussion, FL would like to check via email that if any other companies think the TP from vivo is necessary, if so, second round discussion will be triggered.

### 2.1.2Second round discussion

Given the replies from Samsung and Huawei, FL thinks it needs further discussion, and the comments from Samsung and Huawei are copied in this round as well for companies to further think about it.

TP#2.1 for TS 38.213

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| 19.1 Configured-grant based PUSCH transmission For initial transmission or autonomous retransmission, including repetitions, of an initial transport block provided for the PUSCH transmission as described in clause 18.0 in [19, TS 38.300], the UE encodes the transport block using redundancy version number 0. |

Is TP#2.1 acceptable? Any comments?

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| Company | Comment |
| Huawei, HiSilicon2 | After further considerations, we think vivo’s point is valid and we’d like to support.  The repetitions have different purpose as autonomous reTx. Both initial transmission and autonomous reTx is for initial Tx of a TB, thus it may be failed and unknown by gNB. While repetitions are useful for coverage - if configured, gNB may want to utilize that instead of fixed RV. The RV determination for CG is already in the spec, same as SDT, there is no fundamental difference.  The RV determination for repetitions has nothing to do with RAN2 agreements – it’s for initial Tx of a TB.  RAN2#117e agreements  => For autonomous re-tx, fix the RV to be 0 for both the initial and retransmission of initial CG-SDT |
| Samsung | We understand the FL’s assessment that when gNB did not even know the detected PUSCH is first transmission or re-transmission, it can only assume it’s for RV 0, otherwise, multiple blind detection/decoding will be needed. That’s why different RV seems not work so well.  VIVO’s CR is acceptable to us. Though we think the “initial transmission” “retransmission” already imply the repetitions if any. |
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## Issue#3 Repetitions for CG-SDT

### First round discussion

In RAN1#108-e, after several meetings’ discussion, RAN1 still cannot reach consensus on whether to support repetitions or not, so in RAN1 LS R1-2202656, RAN1 asked RAN2 to make decision on repetitions for CG-SDT:

“For CG-SDT, RAN1 cannot reach consensus on whether to support repetition or not, it’s up to RAN2 to decide on it.”

In RAN1#110, in RAN2 reply LS R1-2205736, RAN2 has the following reply on repetitions:

“With regards to the above issue about repetition for CG-SDT, the signalling in TS 38.331 reuses the existing ConfiguredGrantConfig and hence the signalling allows configuration of parameters related to repetition (i.e. repK, repK-RV (including repK-r17), pusch-RepTypeIndicator-r16 and frequencyHoppingPUSCH-RepTypeB-r16) within this IE.”

Based on RAN2’s reply on repetitions, RAN1 should discuss how to capture repetitions in RAN1 spec.

In R1-2208711, ZTE proposes to capture the configuration of the basic parameter of repetition, i.e. repK, in TS 38.213.

In R1-2209710 and R1-2209711, Samsung proposes that if the repetition is configured, the PUSCH repetitions in one CG PUSCH configuration period are regarded as one PUSCH occasion. Such PUSCH occasion is invalid if any repetition within this occasion is invalid.

In R1-2209255, Xiaomi proposes to associate the first TO with the SSBs.

From FL’s understanding, it’s possible to consider a combination of these draft CRs, i.e. repK can be configured and the repetitions are considered as one PUSCH occasion, then there is no mapping issue. So the following TP is proposed:

**TP#2.2-1 for TS 38.213**

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| **Reason for change:**  In RAN1#110, in RAN2 reply LS R1-2205736, RAN2 has the following reply on repetitions:  “With regards to the above issue about repetition for CG-SDT, the signalling in TS 38.331 reuses the existing ConfiguredGrantConfig and hence the signalling allows configuration of parameters related to repetition (i.e. repK, repK-RV (including repK-r17), pusch-RepTypeIndicator-r16 and frequencyHoppingPUSCH-RepTypeB-r16) within this IE.”  So in RAN1 spec TS 38.213, the repetition related description should be captured.  **Summary of change:**  In section 19.1, the description of repK is added: “A UE can be provided by repK a number of repetitions for a PUSCH transmission. If the repetition is configured, all the PUSCH repetitions in one CG PUSCH configuration period are regarded as one PUSCH occasion. The PUSCH occasion is invalid if any repetition within this occasion is invalid. ”  **Consequences if not approved:**  Misalignment between RAN1 spec and RAN2 signaling on repetitions for CG-SDT  **< Unchanged text omitted >** 19.1 Configured-grant based PUSCH transmission A UE indicated to release a dedicated RRC connection can be provided one or more configurations by respective one or more *ConfiguredGrantConfig*, for configured grant Type 1 PUSCH transmissions on the initial UL BWP [12, TS 38.331]. For the remaining of this clause, PUSCH transmissions refer to configured grant Type-1 PUSCH transmissions for a configuration provided by *ConfiguredGrantConfig*.  A UE can be provided by *sdt-SSB-Subset* a number of SS/PBCH block indexes to map to a number of valid PUSCH occasions for PUSCH transmissions over an association period. If the UE is not provided *sdt-SSB-Subset*, the UE determines from the value of *ssb-PositionsInBurst* in *SIB1* or by *ServingCellConfigCommon*. A PUSCH occasion for a PUSCH transmission is defined by a time resource and a frequency resource and is associated with a DM-RS provided by *cg-DMRS-Configuration* for the configuration of PUSCH transmissions. A UE can be provided by *repK* a number of repetitions for a PUSCH transmission. If the repetition is configured, all the PUSCH repetitions in one CG PUSCH configuration period are regarded as one PUSCH occasion. The PUSCH occasion is invalid if any repetition within this occasion is invalid.  An association period, starting from frame with SFN 0, for mapping SS/PBCH block indexes, from the number of SS/PBCH block indexes, to valid PUSCH occasions and associated DM-RS resources is the smallest value in the set determined by the PUSCH configuration period provided by *periodicity* in *ConfiguredGrantConfig* according to Table 19.1-1 such that SS/PBCH block indexes are mapped at least once to valid PUSCH occasions and associated DM-RS resources within the association period. A UE is provided a number of SS/PBCH block indexes associated with a PUSCH occasion and a DM-RS resource by *sdt-SSB-perCG-PUSCH*. If after an integer number of SS/PBCH block indexes to PUSCH occasions and associated DMRS resources mapping cycles within the association period there is a set of PUSCH occasions and associated DMRS resources that are not mapped to SS/PBCH block indexes, no SS/PBCH block indexes are mapped to the set of PUSCH occasions and associated DMRS resources. An association pattern period includes one or more association periods and is determined so that a pattern between PUSCH occasions with associated DMRS resources and SS/PBCH block indexes repeats at most every 640 msec. PUSCH occasions and associated DMRS resources not associated with SS/PBCH block indexes after an integer number of association periods, if any, are not used for PUSCH transmissions. |

***Proposal 2.2:***

Adopt TP#2.2-1 for TS 38.213.

Any comments?

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| Company | Comment |
| Intel | We can support the proposal in principle. The wording in the TP can be improved.  A UE can be provided by *repK* a number of repetitions for a PUSCH transmission. If *repK* is provided and *repK>1* ~~the repetition is configured~~, ~~all the PUSCH~~*repK* repetitions for the PUSCH transmission ~~in one CG PUSCH configuration period~~ are regarded as ~~one~~ a PUSCH occasion. The PUSCH occasion is invalid if any repetition within ~~this~~ the occasion is invalid. |
| Qualcomm | We can live with this TP, if it is the majority view of companies. |
| New H3C | We are fine with this TP with intel’s modification. |
| ZTE | Fine with Intel’s modification. |
| Samsung | For the TP, we have different view, since both repetition type A and type B are supported, the “repK” is the direct repetition number for repetition type A, but for repetition type B , there could be the parameter in the configuration table,  TS38.213  “For PUSCH transmissions with a Type 1 or Type 2 configured grant, the number of (nominal) repetitions *K* to be applied to the transmitted transport block is provided by the indexed row in the time domain resource allocation table if *numberOfRepetitions* is present in the table; otherwise *K* is provided by the higher layer configured parameters *repK.*”  So suggested change as following (taken care of Intel’s revision):  A UE can be provided by *~~repK~~*a number of repetitions for a PUSCH transmission by *repK* or *numberOfRepetitions*. If the number of repetition is configured and larger than 1, ~~all~~ the PUSCH repetitions for the PUSCH transmission in ~~one~~ a CG PUSCH configuration period are regarded as ~~one~~ a PUSCH occasion. The PUSCH occasion is invalid if any repetition within ~~this~~ the occasion is invalid. |
| Huawei | Agree with Samsung. |
| Ericsson | What would be the reason to invalidate the entire PUSCH occasion if any repetition within this occasion is invalid? Wouldn’t that unnecessarily complicate the scheduling? |
| vivo | We’re do not support “The PUSCH occasion is invalid if any repetition within this occasion is invalid.”, validation should follow legacy, there’s no need to introduce such new UE behavior at this stage. |

#### 2.2.1.1 Summary

After modification by Intel and Samsung, it seems the TP is very close to agreeable, let’s further finalize the TP in next round.

To Ericsson and vivo,

The reason to introduce this validity from Samsung is that, if some of the repetitions are invalid in one CG period, then it may cause that the number of repetitions mapped to the same SSB would be different in different CG periods, which is consistently objected by Samsung. Actually this invalidity is not the most preferred option by many companies, but considering that it has been discussed for several RAN1 meetings and compromised solution probably may be the only we can have, could Ericsson and vivo accept this TP?

### Second round discussion

Based on the modification from Intel and Samsung, the following TP is used for discussion in second round.

**TP#2.2-2 for TS 38.213**

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| **Reason for change:**  In RAN1#110, in RAN2 reply LS R1-2205736, RAN2 has the following reply on repetitions:  “With regards to the above issue about repetition for CG-SDT, the signalling in TS 38.331 reuses the existing ConfiguredGrantConfig and hence the signalling allows configuration of parameters related to repetition (i.e. repK, repK-RV (including repK-r17), pusch-RepTypeIndicator-r16 and frequencyHoppingPUSCH-RepTypeB-r16) within this IE.”  So in RAN1 spec TS 38.213, the repetition related description should be captured.  **Summary of change:**  In section 19.1, the description of repK is added: “A UE can be provided by a number of repetitions for a PUSCH transmission by *repK* or *numberOfRepetitions*. If the number of repetition is configured and larger than 1, the PUSCH repetitions for the PUSCH transmission in a CG PUSCH configuration period are regarded as a PUSCH occasion. The PUSCH occasion is invalid if any repetition within the occasion is invalid. ”  **Consequences if not approved:**  Misalignment between RAN1 spec and RAN2 signaling on repetitions for CG-SDT  **< Unchanged text omitted >** 19.1 Configured-grant based PUSCH transmission A UE indicated to release a dedicated RRC connection can be provided one or more configurations by respective one or more *ConfiguredGrantConfig*, for configured grant Type 1 PUSCH transmissions on the initial UL BWP [12, TS 38.331]. For the remaining of this clause, PUSCH transmissions refer to configured grant Type-1 PUSCH transmissions for a configuration provided by *ConfiguredGrantConfig*.  A UE can be provided by *sdt-SSB-Subset* a number of SS/PBCH block indexes to map to a number of valid PUSCH occasions for PUSCH transmissions over an association period. If the UE is not provided *sdt-SSB-Subset*, the UE determines from the value of *ssb-PositionsInBurst* in *SIB1* or by *ServingCellConfigCommon*. A PUSCH occasion for a PUSCH transmission is defined by a time resource and a frequency resource and is associated with a DM-RS provided by *cg-DMRS-Configuration* for the configuration of PUSCH transmissions. A UE can be provided by a number of repetitions for a PUSCH transmission by *repK* or *numberOfRepetitions*. If the number of repetition is configured and larger than 1, the PUSCH repetitions for the PUSCH transmission in a CG PUSCH configuration period are regarded as a PUSCH occasion. The PUSCH occasion is invalid if any repetition within the occasion is invalid.  An association period, starting from frame with SFN 0, for mapping SS/PBCH block indexes, from the number of SS/PBCH block indexes, to valid PUSCH occasions and associated DM-RS resources is the smallest value in the set determined by the PUSCH configuration period provided by *periodicity* in *ConfiguredGrantConfig* according to Table 19.1-1 such that SS/PBCH block indexes are mapped at least once to valid PUSCH occasions and associated DM-RS resources within the association period. A UE is provided a number of SS/PBCH block indexes associated with a PUSCH occasion and a DM-RS resource by *sdt-SSB-perCG-PUSCH*. If after an integer number of SS/PBCH block indexes to PUSCH occasions and associated DMRS resources mapping cycles within the association period there is a set of PUSCH occasions and associated DMRS resources that are not mapped to SS/PBCH block indexes, no SS/PBCH block indexes are mapped to the set of PUSCH occasions and associated DMRS resources. An association pattern period includes one or more association periods and is determined so that a pattern between PUSCH occasions with associated DMRS resources and SS/PBCH block indexes repeats at most every 640 msec. PUSCH occasions and associated DMRS resources not associated with SS/PBCH block indexes after an integer number of association periods, if any, are not used for PUSCH transmissions. |

Any comments?

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| --- | --- |
| Company | Comment |
| Samsung | Thx FL for the further discussion and also pointing out our concern.  We have indeed presented our strong concern this uneven repetition number for each SSB for same UE or different UE in all past RAN1 meeting for SDT discussion. Only given the fact RAN2 leaves the parameter to be kept, RAN1 needs to in turn find the usage of them, if we cannot reach consensus on how to use them. We should inform them to remove all these related parameters.  Focusing on how to use the repetition parameters, we have discussed either regard them as repetition like normal or regard them as number of PUSCH occasion independently. Thus, we compromise to regard the repetitions as one PUSCH occasion. If we still keep the repetition validation individually, there is no point to agree the repetitions as one occasion and also there is no point for us to compromise to have repetition at all. |
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## Issue#4 Editorial correction on parameter name

### 2.3.1 First round discussion

In R1-2208712, ZTE proposes that parameter name sdt-SSB-perCG-PUSCH in TS 38.213 in section 19.1 is not aligned with TS 38.331.

FL thinks such editorial correction is quite straightforward, so the following proposal is suggested

***Proposal 2.3:***

Draft CR in R1-2208712 can be recommended to editor’s alignment CR.

Any comments?

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| --- | --- |
| Company | Comment |
| Intel | Agree. |
| Qualcomm | Support the proposal of FL |
| New H3C | Support |
| ZTE | Support |
| Samsung | Fine. |
| Huawei | Support |
| Ericsson | Support |
| Vivo | Fine. |

#### Summary

All companies support this proposal, it can be used for email approval.

## Issue#5 Power offset of feature combination

### First round discussion

In R1-2208713, ZTE proposes that in the feature combination, power offset between Msg3 or MsgA-PUSCH and RACH preamble transmission namely deltaPreamble is introduced. If configured, this parameter overrides msg3-DeltaPreamble or msgA-DeltaPreamble. But in the current spec, this parameter is missing in TS 38.213, then the power determination of Msg3 and MsgA PUSCH in feature combination is incorrect. So parameter deltaPreamble should be captured in section 7.1.1.

From FL’s perspective, this draft CR is to capture the RAN1 spec impact based on the newly introduced feature combination by RAN2, since

***Proposal 2.4:***

Draft CR in R1-2208713 can be agreed as individual CR.

Any comments?

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| --- | --- |
| Company | Comment |
| Intel | We think this can be also treated as alignment CR. |
| Qualcomm | Support the proposal of FL |
| New H3C | Support |
| ZTE | Support.  Slightly prefer to capture it as individual CR, since the power offset determination of feature combination can be regarded as a new feature introduced in RAN2 and has never been captured in RAN1 spec. In last meeting, the draft CR for preamble allocation of feature combination is approved as individual CR, then following the same logic, this issue can be individual CR as well although the spec change of this CR is simpler. |
| Samsung | Support and we can be ok it as individual CR. |
| Huawei | Ok with individual CR |
| Ericsson | Support |
| Vivo | Fine. |

#### Summary

All companies support this draft CR, while one company suggest to treat it as alignment CR. No need for next round discussion, Moderator suggest to agree on it as individual CR if Intel can accept it, otherwise, it will be recommended to editor’s alignment CR.

# Summary

The final proposals will be added later.

# References

1. [R1-2208624](file:///D:\zhoulei\3GPP\RAN1\Docs\R1-2208624.zip) Corrections of reduncancy version of repeated CG PUSCH for SDT vivo
2. [R1-2208711](file:///D:\zhoulei\3GPP\RAN1\Docs\R1-2208711.zip) Correction on repetitions for CG-SDT ZTE, Sanechips
3. [R1-2208712](file:///D:\zhoulei\3GPP\RAN1\Docs\R1-2208712.zip) Correction on SSB subset for CG-SDT ZTE, Sanechips
4. [R1-2208713](file:///D:\zhoulei\3GPP\RAN1\Docs\R1-2208713.zip) Correction on deltapreamble of feature combination ZTE, Sanechips
5. [R1-2209710](file:///D:\zhoulei\3GPP\RAN1\Docs\R1-2209710.zip) Discussion on the repetition aspect for SDT in active state Samsung
6. [R1-2209711](file:///D:\zhoulei\3GPP\RAN1\Docs\R1-2209711.zip) Draft CR for the repetition aspect for SDT in active state Samsung
7. [R1-2209255](file:///D:\zhoulei\3GPP\RAN1\Docs\R1-2209255.zip) Discussion on physical layer aspects of small data transmission xiaomi