**3GPP TSG-RAN WG1 Meeting #112 R1-23xxxxx**

**Athens, Greece, February 27th – March 3rd, 2023**

**Agenda Item: 8.17**

**Source: Moderator (ZTE)**

**Title: [Draft] Summary on Rel-17 SDT**

**Document for: Discussion**

# Introduction

This document contains the summary of remaining issues identified in RAN1#112 meeting. The following email thread is used:

[112-R17-Others] To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc – Ziyang (ZTE)

# Remaining issues on SDT

## Issue#1 Repetitions for CG-SDT

### First round discussion

In RAN1#111, the following agreement has been made:

**Agreement**

For CG-SDT, the repetitions in one CG period are mapped to the same SSB(s), the PUSCH occasions of these repetition are invalid if any of these repetitions is invalid.

However, due to limited time, the relevant CR was not completed in last meeting, so in this meeting, it’s necessary to figure out the spec change according to the agreement.

TP#1~4 from different companies are listed in Appendix as candidate text proposals. From FL’s understanding, all these TPs serve the same purpose but the wording in TP#2 is more aligned with the spirit of the agreement, e.g. SSB mapping, each repetition is a PUSCH occasion, invalid etc.

**FL suggestion:**

Take TP#2 as starting point to further refine the wording.

Companies are encouraged to provide comment and and suggested priority (Low/Medium/High). In addition, if companies suggest any updates on TP#2, please directly provide the wording in the comment part.

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| Company | Priority | Comment |
| Huawei |  | In general ok to discuss. Prefer TP#1 as starting point since the added sentence should be along with SDT, instead of being a standalone as in TP#2. |
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## Issue#2 SSB to CG PUSCH mapping

### First round discussion

In R1-2300435, vivo mentions that UEs in RRC inactive state can not be provided SSBs configured by ServingCellConfigCommon, so vivo suggests to preclude the the SSBs configured by ServingCellConfigCommon for SSB to CG PUSCH resource mapping.

From FL’s understanding, it's correct that only connected UEs can be configured with ServingCellConfigCommon, however, FL wonders whether it’s possible that UE can maintain the context when UE enters RRC inactive state, in this way, the SSB configuration for SDT can be obtained by ServingCellConfigCommon.

**FL suggestion:**

Companies are encouraged to check whether ServingCellConfigCommon provided in connected state can be used for UE in inactive state for SDT

Any comment on TP#5 and suggested priority (Low/Medium/High)?

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| Company | Priority | Comment |
| Huawei |  | RAN2 discuss. |
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## Issue#3 QCL assumption for PDCCH and PDSCH

### 2.3.1 First round discussion

In R1-2301769, Xiaomi thinks that during subsequent SDT procedure, legacy RACH can be initiated for UL resources request when the PUSCH resources is not available. Then it’s not clear whether the QCL assumption for PDCCH and PDSCH is compared with SSB associated with CG PUSCH or PRACH. Similar issue happens for RA-SDT.

FL thinks that the QCL assumption for PDCCH and PDSCH related to normal RACH procedure has been specified in section 8 in TS 38.213, the QCL assumption defined in section 19 only refers to the PDCSCH and PDCCH related to SDT procedure, there is no need to mix the QCL for SDT and QCL for normal PRACH.

**FL suggestion:**

Companies are encouraged to check whether TP#6 is needed.

Any comment on TP#6 and suggested priority (Low/Medium/High)?

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## Issue#4 Redundancy version

### First round discussion

In R1-2301769, Xiaomi proposes that for autonomous re-tx, fix the RV to be 0 for both the initial and retransmission of initial CG-SDT transmission, regardless of whether repK-RV is configured. In addition, Xiaomi suggests to send LS to RAN2 to revise the field description of repK-RV.

From FL’s perspective, the RV issue has been discussed in last meeting and no consensus can be achieved. Besides, even repK-RV is configured, based on current RAN1 spec, there is no ambiguity on the RV, i.e. always 0, so no need to send LS to RAN2 to change repK-RV.

**FL suggestion:**

Companies are encouraged to check whether there is a need to discuss RV issue again

Any comment and suggested priority (Low/Medium/High)?

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| Company | Priority | Comment |
| Huawei |  | OK to discuss however we think the current spec is also fine and we share a different understanding as FL.  Firstly, the repetitions are defined different from retransmission, where the latter one is always corresponding to a grant or a reTx timer, as specified in 300 and 213/214, so the current 214 for RV of initial CG-SDT and autonomous reTx does not apply to repetitions.  *“Retransmissions other than repetitions are explicitly allocated via PDCCH(s) or via configuration of a retransmission timer.”*  Secondly, for determination of RV of CG, 214 clearly said 6.1.2.3 applies as below. If rep-RV does not apply, this needs to be specifically mentioned in spec as licensed spectrum did. Now 331 and 214 clearly say rep-RV can be configured and is used for determining. E.g.  “- read redundancy version field (*rv*) in the DCI to determine the redundancy version for PUSCH scheduled by DCI, or determine the redundancy version according to Clause 6.1.2.3.1 for configured grant Type 1 and Type 2 PUSCH, ”  So our understanding is whenever repetitions are configured, and rep-RV is configured, UE follows this parameter. The RV=0 only corresponds to initial CG and autonomous reTx (defined for dynamic grant and reTx timer). |
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# Summary

The final proposals will be added later.

# References

1. [R1-2300434](file:///C:\3GPP\RAN1_112\Tdocs\R1-2300434.zip) Correction of CG PUSCH repetition in SDT vivo
2. [R1-2300435](file:///C:\3GPP\RAN1_112\Tdocs\R1-2300435.zip) Correction of SSBs mapped to CG PUSCH in SDT vivo
3. [R1-2300610](file:///C:\3GPP\RAN1_112\Tdocs\R1-2300610.zip) Correction on repetition for CG-SDT in TS 38.213 ZTE Corporation
4. [R1-2300931](file:///C:\3GPP\RAN1_112\Tdocs\R1-2300931.zip) Correction on CG-PUSCH repetitions for CG-SDT operation Intel Corporation
5. [R1-2301244](file:///C:\3GPP\RAN1_112\Tdocs\R1-2301244.zip) Maintenance on small data transmission Samsung
6. R1-2301769 Discussion on physical layer aspects of small data transmission xiaomi

# Appendix

## TP#1 in R1-2300434, vivo

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| **Reason for change:**  In RAN1#111, RAN1 made following agreement which should be captured in RAN1 spec.  Agreement  For CG-SDT, the repetitions in one CG period are mapped to the same SSB(s), the PUSCH occasions of these repetition are invalid if any of these repetitions is invalid.  **Summary of change:**  Include the description of CG PUSCH repetition according to the agreement made in RAN1 #111.  **Consequences if not approved:**  Repetition of CG PUSCH in SDT is not captured in RAN1 spec.  **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 number of repetitions of a PUSCH transmission, associated to the same SSBs, can be configured by higher layer parameter *repK* or *numberOfRepetitions*. The transmission of all repetitions shall be cancelled if the transmission of any one of the repetitions is cancelled.  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.  ***\*\*\*Unchanged text omitted\*\*\**** |

## TP#2 in R1-2300610, ZTE

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| **Reason for change:**  In RAN1#111, the following agreement has been made:  **Agreement**   * For CG-SDT, the repetitions in one CG period are mapped to the same SSB(s), the PUSCH occasions of these repetition are invalid if any of these repetitions is invalid.   The spec should be revised to reflect the above agreement.  **Summary of change:**  In section 19.1, the description of repetition is added: “A UE can be provided a number of repetitions for a PUSCH transmission by repK or numberOfRepetitions. If the number of repetitions is provided and larger than 1, the PUSCH repetitions for the PUSCH transmission are mapped to the same SS/PBCH block index(es). The PUSCH occasions of the PUSCH repetitions are invalid if any repetition 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.  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.  A UE can be provided a number of repetitions for a PUSCH transmission by *repK* or *numberOfRepetitions*. If the number of repetitions is provided and larger than 1, the PUSCH repetitions for the PUSCH transmission are mapped to the same SS/PBCH block index(es). The PUSCH occasions of the PUSCH repetitions are invalid if any repetition is invalid.  **< Unchanged text omitted >** |

## TP#3 in R1-2300931, Intel

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| **Reason for change:**  At the RAN1#110 meeting, the following was agreed:  Agreement  For CG-SDT, the repetitions in one CG period are mapped to the same SSB(s), the PUSCH occasions of these repetition are invalid if any of these repetitions is invalid.  Based on the above agreement, the PUSCH occasions of the repetition are invalid if any of these repetitions is invalid, which can help improve the performance and ensure fairness among different CG-PUSCH repetitions associated with different SSBs.  **Summary of change:**  Support CG-PUSCH repetition for CG-SDT operation. For CG-SDT operation, the PUSCH occasions of these repetition are invalid if any of these repetitions is invalid.  **Consequences if not approved:**  The specification in RAN1 for CG-SDT is not aligned with RAN2 specification.  19.1 Configured-grant based PUSCH transmission  **<Unchanged parts are omitted>**  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*. 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 repetitions is provided and larger than 1, the PUSCH occasions of the repetition are invalid if any of these repetitions 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.  **<Unchanged parts are omitted>** |

## TP#4 in R1-2301244, Samsung

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| **Reason for change:**  The use of repetition parameter is agreed in RAN1#111 meeting, but corresponding spec description is missing.  **Summary of change:**  Add the corresponding spec description for the agreement  **Agreement**   * For CG-SDT, the repetitions in one CG period are mapped to the same SSB(s), the PUSCH occasions of these repetition are invalid if any of these repetitions is invalid.   **Consequences if not approved:**  Repetition part of CG-SDT will be missing, the spec is incomplete;  19.1 Configured-grant based PUSCH transmission  <Unchanged Text Omitted>  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 repetitions is provided and larger than 1, a whole PUSCH occasion consisting of all the PUSCH occasions of these repetitions for the PUSCH transmission in one CG period is mapped to the same SSB(s). The whole PUSCH occasion of these PUSCH repetitions are invalid if any PUSCH occasion(s) of these repetition 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.  <Unchanged Text Omitted> |

## TP#5 in R1-2300435, vivo

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| **Reason for change:**  The set of SSBs considered for SSB to CG PUSCH resource mapping in current spec. can be the SSBs configured by ServingCellConfigCommon which is not available for UEs in RRC inactive state.  **Summary of change:**  Preclude the the SSBs configured by ServingCellConfigCommon for SSB to CG PUSCH resource mapping.  **Consequences if not approved:**  SSBs configured by ServingCellConfigCommon is assumed available for SDT in RRC inactive state, which is wrong.  ***\*\*\*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*. 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.  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.  Table 19.1-1: Mapping between PUSCH configuration period and SS/PBCH block to configured PUSCH resource association period   |  |  | | --- | --- | | PUSCH configuration period (msec) | Association period (number of PUSCH configuration periods) | | 5 | {1, 2, 4, 8,16, 32, 64, 128} | | 8 | {1, 2, 4, 5, 8, 10, 16, 20, 40, 80} | | 10 | {1, 2, 4, 8,16, 32, 64} | | 16 | {1, 2, 4, 5, 8,10,20,40} | | 20 | {1, 2, 4, 8,16, 32} | | 32 | {1, 2, 4, 5, 10, 20} | | 40 | {1, 2, 4, 8, 16} | | 64 | {1, 2, 5, 10} | | 80 | {1, 2, 4, 8} | | 128 | {1, 5} | | 160 | {1, 2, 4} | | 320 | {1, 2} | | 640 | {1} |   SS/PBCH block indexes are mapped to valid PUSCH occasions and associated DMRS resources in the following order  - first, in increasing order of DMRS resource indexes within a PUSCH occasion, where a DMRS resource index is determined first in an ascending order of a DMRS port index and second in an ascending order of a DMRS sequence index [4, TS 38.211]  - second, in increasing order of PUSCH configuration period indexes  A PUSCH occasion is valid if it does not overlap with a valid PRACH occasion as described in clause 8.1.  For unpaired spectrum and for SS/PBCH blocks with indexes provided by *ssb-PositionsInBurst* in *SIB1*  - if a UE is not provided *tdd-UL-DL-ConfigurationCommon*, a PUSCH occasion is valid if the PUSCH occasion  - does not precede a SS/PBCH block in the PUSCH slot, and  - starts at least symbols after a last SS/PBCH block symbol, where is provided in Table 8.1-2  - if a UE is provided *tdd-UL-DL-ConfigurationCommon*, a PUSCH occasion is valid if the PUSCH occasion  - is within UL symbols  - starts at least symbols after a last downlink symbol, and at least symbols after a last SS/PBCH block symbol, where is provided in Table 8.1-2  A UE determines a power of a PUSCH transmission as described in clause 7.1.1, where the UE obtains using a RS resource from an SS/PBCH block with index associated with the PUSCH transmission.  A UE can be provided a USS set by *SearchSpace*, or a CSS set by *sdt-SearchSpace*, to monitor PDCCH for detection of DCI format 0\_0 with CRC scrambled by C-RNTI or CS-RNTI for scheduling PUSCH transmission or of DCI format 1\_0 with CRC scrambled by C-RNTI for scheduling PDSCH receptions [12, TS 38.331]. The UE may assume that the DM-RS antenna port associated with the PDCCH receptions, the DM-RS antenna port associated with the PDSCH receptions, and the SS/PBCH block associated with the PUSCH transmission are quasi co-located with respect to average gain and quasi co-location 'typeA' or 'typeD' properties. The UE transmits a PUCCH with HARQ-ACK information associated with the PDSCH receptions as described in clause 9.2.1 using a same spatial domain transmission filter as for the last PUSCH transmission.  For initial transmission or autonomous retransmission 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.  ***\*\*\*Unchanged text omitted\*\*\**** |

## TP#6 in R1-2301769, Xiaomi

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| 19.1 Configured-grant based PUSCH transmission  **<Unchanged parts omitted>**  A UE can be provided a USS set by *SearchSpace*, or a CSS set by *sdt-SearchSpace*, to monitor PDCCH for detection of DCI format 0\_0 with CRC scrambled by C-RNTI or CS-RNTI for scheduling PUSCH transmission or of DCI format 1\_0 with CRC scrambled by C-RNTI for scheduling PDSCH receptions [12, TS 38.331]. The UE may assume that the DM-RS antenna port associated with the PDCCH receptions, the DM-RS antenna port associated with the PDSCH receptions, and the SS/PBCH block associated with the last PUSCH or PRACH transmission are quasi co-located with respect to average gain and quasi co-location 'typeA' or 'typeD' properties. The UE transmits a PUCCH with HARQ-ACK information associated with the PDSCH receptions as described in clause 9.2.1 using a same spatial domain transmission filter as for the last PUSCH transmission.  **<Unchanged parts omitted>**  19.2 Random-access based PUSCH transmission  **<Unchanged parts omitted>**  A UE can be provided by *sdt-SearchSpace* a CSS set to monitor, after contention resolution as described in clause 8.4, PDCCH for detection of a DCI format 0\_0 or DCI format 1\_0 with CRC scrambled by C-RNTI for scheduling respective PUSCH transmissions or PDSCH receptions; otherwise, if the UE is not provided *sdt-SearchSpace*, the UE monitors PDCCH according to a Type1-PDCCH CSS set as described in clause 10.1. The UE may assume that the DM-RS antenna port associated with the PDCCH receptions, the DM-RS antenna port associated with the PDSCH receptions, and the SS/PBCH block associated with the last PRACH transmission are quasi co-located with respect to average gain and quasi co-location 'typeA' or 'typeD' properties.  **<Unchanged parts omitted>** |