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

**Toulouse, France, August 22th - 26th, 2022**

**Agenda Item: 8.17**

**Source: Moderator (ZTE)**

**Title: Summary on remaining physical layer issues of small data transmission**

**Document for: Discussion**

# Introduction

This document contains the summary of RAN2 LS related issues, editorial corrections, RedCap related issues and other remaining issues in RAN1#110 meeting. The following email thread is used:

[110-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)

# RAN2 LS related issues

## Redundancy version

### First round discussion

In RAN2 LS R1-2205736, RAN2 has informed RAN1 that they made an agreement “For autonomous re-tx, fix the RV to be 0 for both the initial and retransmission of initial CG-SDT transmission” and asks RAN1 to consider corresponding impact on RAN1 spec.

In R1-2206079, ZTE thinks according to the RAN2 discussion in last meeting, it’s concluded 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. Therefore, during SDT procedure, redundancy version needs to be fixed to 0 for both initial and autonomous retransmission of initial CG-SDT transmission, which needs to be captured in TS 38.214 as shown in TP #2.1-1.

**TP#2.1-1**

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| ***Reason for change:*** RAN2 agrees that during SDT procedure, redundancy version needs to be fixed to 0 for both initial transmission and autonomous retransmission of initial CG-SDT transmission***Summary of change:*** descriptions for fixing the RV to be 0 for both initial transmission and autonomous retransmission of initial CG-SDT transmission are added in section 6.1.2.3.1 and 6.1.2.3.2.***Consequences if not approved:*** RV for initial transmission and autonomous retransmission of initial CG-SDT transmission is not clear.**TS38.214****< Unchanged text omitted >**6.1.2.3.1 Transport Block repetition for uplink transmissions of PUSCH repetition Type A with a configured grant**< Unchanged text omitted >**The procedures described in this clause apply to PUSCH transmissions of PUSCH repetition Type A with a Type 1 or Type 2 configured grant. The higher layer parameter *repK-RV* defines the redundancy version pattern to be applied to the repetitions. If *cg-RetransmissionTimer* is provided, the redundancy version for uplink transmission with a configured grant is determined by the UE. If CG-SDT procedure is initiated as described in clause 5.27 of [10, TS 38.321], the redundancy version for initial transmission and autonomous retransmission of initial configured-grant based PUSCH transmission shall be set to 0. If the parameter *repK-RV* is not provided in the *configuredGrantConfig* and *cg-RetransmissionTimer* is not provided, the redundancy version for uplink transmissions with a configured grant shall be set to 0. If the parameter *repK-RV* is provided in the *configuredGrantConfig* and *cg-RetransmissionTimer* is not provided, for the *n*th transmission occasion among *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod((n-mod(n, N))/N,4)+1)th* value in the configured RV sequence, where *N*=1. If a configured grant configuration is configured with *startingFromRV0* set to *'off'*, the initial transmission of a transport block may only start at the first transmission occasion of the *K* repetitions. Otherwise, the initial transmission of a transport block may start at - the first transmission occasion of the *K* repetitions if the configured RV sequence is {0,2,3,1},- any of the transmission occasions of the *K* repetitions that are associated with RV=0 if the configured RV sequence is {0,3,0,3},- any of the transmission occasions of the *K* repetitions if the configured RV sequence is {0,0,0,0}, except the last transmission occasion when *K≥8*. **< Unchanged text omitted >**6.1.2.3.2 Transport Block repetition for uplink transmissions of PUSCH repetition Type B with a configured grant**< Unchanged text omitted >**The procedures described in this Clause apply to PUSCH transmissions of PUSCH repetition type B with a Type 1 or Type 2 configured grant.For PUSCH transmissions with a Type 1 or Type 2 configured grant, the nominal repetitions and the actual repetitions are determined according to the procedures for PUSCH repetition Type B defined in Clause 6.1.2.1. The higher layer configured parameters *repK-RV* defines the redundancy version pattern to be applied to the repetitions. If CG-SDT procedure is initiated as described in clause 5.27 of [10, TS 38.321], the redundancy version for initial transmission and autonomous retransmission of initial configured-grant based PUSCH transmission shall be set to 0. If the parameter *repK-RV* is not provided in the *configuredGrantConfig*, the redundancy version for each actual repetition with a configured grant shall be set to 0. Otherwise, for the *n*th transmission occasion among all the actual repetitions (including the actual repetitions that are omitted) of the *K* nominal repetitions, it is associated with *(mod((n-mod(n, N))/N,4)+1)th* value in the configured RV sequence, where *N* = 1. If a configured grant configuration is configured with *startingFromRV0* set to 'off', the initial transmission of a transport block may only start at the first transmission occasion of the actual repetitions. Otherwise, the initial transmission of a transport block may start at - the first transmission occasion of the actual repetitions if the configured RV sequence is {0,2,3,1},- any of the transmission occasions of the actual repetitions that are associated with RV=0 if the configured RV sequence is {0,3,0,3},- any of the transmission occasions of the actual repetitions if the configured RV sequence is {0,0,0,0}, except the actual repetitions within the last nominal repetition when *K≥8*.  |

In R1-2206773, vivo also proposes a draft CR to capture the RAN2 agreement in clause 19.1 in TS 38.213 as shown below.

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| **------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >**19.1 Configured-grant based PUSCH transmissionA UE determines a power of a PUSCH transmission as described in clause 7.1.1, where the UE obtains $PL\_{b,f,c}(q\_{d})$ 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 *sdt-CG-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, the UE encodes the transport block using redundancy version number 0.**< Unchanged text omitted >** |

#### ***Discussion point 2.1-1***

Whether and how to capture the RAN2 agreement about redundancy version:

* Option 1: Adopt TP#2.1-1 for TS 38.214
* Option 2: Adopt draft CR in R1-2206773 for TS 38.213
* Option 3: Other versions?

Any comments?

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## SDT common search space

In RAN2 LS R1-2205736, RAN2 has informed RAN1 that RAN2 has implemented the signalling using a choice structure between configuration of a SearchSpace and SearchSpaceId. Thus network can either configure an existing search space (using searchSpaceId) or configure a new search space (using searchSpace). RAN2 requests RAN1 to kindly confirm whether this is aligned with RAN1 understanding.

### 2.2.1 First round discussion

Huawei and vivo think existing search space is enough, if needed, UE specific search space can be used.

Ericsson thinks SDT common search space should be a new search space, so no need to configure an existing search space id.

ZTE, Intel and Xiaomi think that using a choice structure between configuration of SearchSpace and SearchSpaceId, can be a good compromise to give network flexibility to configure the SDT common search space.

FL thinks that RAN1’s original intention is to define a new common search space dedicated for SDT, so it’s a new search space instead of an existing common search space. If only existing search space id is configured, that means one of these 4 search spaces below has to be replaced by SDT common search space, however, these 4 CSS are also essential during SDT procedure. So FL suggests to confirm current RAN2’s solution to use a choice structure.

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|  commonSearchSpaceList SEQUENCE (SIZE(1..4)) OF SearchSpace OPTIONAL, -- Need R searchSpaceSIB1 SearchSpaceId OPTIONAL, -- Need S searchSpaceOtherSystemInformation SearchSpaceId OPTIONAL, -- Need S pagingSearchSpace SearchSpaceId OPTIONAL, -- Need S ra-SearchSpace SearchSpaceId OPTIONAL, -- Need S |

#### ***Discussion point 2.2-1***

Whether RAN1 confirms that using a choice structure between an existing search space or a new search space is aligned with RAN1’s understanding.

Any comments?

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## UE specific search space for CG-SDT

In RAN2 LS R1-2205736, RAN2 has informed RAN1 that the parameter named sdt-CG-SearchSpace-r17 used in 3GPP TS 38.213 does not exist in the RAN2 signalling. Instead, RAN2 signalling uses the existing field names for the search space configuration. RAN2 kindly requests RAN1 to update the RAN1 specs to refer to the search space configured using the BWP-Uplink-Dedicated-SDT-r17 for the above parameter hence, instead of using the new name sdt-CG-SearchSpace-r17.

### First round discussion

It’s an editorial issue, ZTE, Huawei, vivo, Intel and Xiaomi have proposed corresponding revisions on USS set for CG-SDT, FL’s suggestion is to take the following TP from Huawei, since it’s more aligned with RAN2’s requirements.

TP#2.3-2

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| **------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >**- a USS set configured by - *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *ue-Specific* for DCI formats with CRC scrambled by C-RNTI, MCS-C-RNTI, SP-CSI-RNTI, CS-RNTI(s), SL-RNTI, SL-CS-RNTI, or SL Semi-Persistent Scheduling V-RNTI, or - *~~sdt-CG-SearchSpace~~ SearchSpace* in *BWP-DownlinkDedicatedSDT-r17* for DCI formats with CRC scrambled by C-RNTI or CS-RNTI as described in clause 19.1.**< Unchanged text omitted >**A UE can be provided a USS set by *~~sdt-CG-SearchSpace~~ SearchSpace* in *BWP-DownlinkDedicatedSDT-r17*, 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]. **< Unchanged text omitted >** |

#### ***Discussion point 2.3-1***

Whether to adopt TP#2.3-1 for TS 38.213.

Any comments?

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## Repetitions for CG-SDT

In RAN2 LS R1-2205736, RAN2 has informed RAN1 that for 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.

### First round discussion

Given that RAN2 has agreed to allow repetitions for CG-SDT, the only left over issue it how to map the repetitions to SSBs. ZTE and Intel think that repetitions are considered as a bundle to map to the same SSB(s). While Xiaomi proposes to only associate the first repetition to SSB, the other repetitions have no relationship with SSBs.

FL suggests to consider repetitions as a bundle to map to the same SSBs, Xiaomi’s proposal seems to leave the rest of repetitions with arbitrary beam directions, no sure what is the benefit to do so.

The TP from Intel can be considered as a starting point:

TP#2.4-1

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| **------------------------------ TS 38.213-----------------------------------**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 $N\_{PUSCH}^{SS/PBCH}$ 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 $N\_{PUSCH}^{SS/PBCH}$ from the value of *ssb-PositionsInBurst* in *SIB1* or by *ServingCellConfigCommon*. A UE can be provided by *repK* a number of repetitions for a PUSCH transmission. The UE determines a redundancy version and RBs for each repetition as described in [6, TS 38.214]. 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 $N\_{PUSCH}^{SS/PBCH}$ 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 $N\_{PUSCH}^{SS/PBCH}$ 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 $N\_{PUSCH}^{SS/PBCH}$ 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>** |

#### ***Discussion point 2.4-1***

For CG-SDT, the repetitions are considered as a bundle of transmission occasions that are mapped to the same SSB(s).

Whether to adopt TP#2.4-1

Any comments?

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# Editorial corrections

## Power control parameter name misalignment

In current spec, Power control parameters in TS 38.213, *p0-PUSCH, alpha,* parameter name is not consistent with TS 38.331. ZTE and Interdigital have proposed the same revision for correction of these 2 parameters. As for changing $P\_{O\\_NOMINAL,PUSCH,f,c}\left(1\right) $to $P\_{O\\_UE\\_PUSCH,b,f,c}\left(1\right) $, after further checking previous SDT CR, it seems editor incorrectly captures the parameter name when merging CRs from different topic, FL suggests to take the following TP.

TP from Interdigital:

### TP#3.1-1

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| **------------------------------ TS 38.213-----------------------------------****7.1.1 UE behaviour****< Unchanged text omitted >**- else, $P\_{O\\_NOMINAL,PUSCH,f,c}\left(1\right)$ $P\_{O\\_UE\\_PUSCH,b,f,c}\left(1\right)$ is provided by *p0* obtained from *p0-PUSCH-Alpha* in *ConfiguredGrantConfig* that provides an index *P0-PUSCH-AlphaSetId* to a set of *P0-PUSCH-AlphaSet*, or by *sdt-P0-PUSCH-r17* *~~p0-PUSCH~~* for a PUSCH (re)transmission as described in clause 19.1, for active UL BWP $b$ of carrier $f$ of serving cell $c$...- else $α\_{b,f,c}(1)$ is provided by *alpha* obtained from *p0-PUSCH-Alpha* in *ConfiguredGrantConfig* providing an index *P0-PUSCH-AlphaSetId* to a set of *P0-PUSCH-AlphaSet*, or by *sdt-Alpha-r17* *~~alpha~~* for a PUSCH (re)transmission as described in clause 19.1, for active UL BWP $b$ of carrier $f$ of serving cell $c$**< Unchanged text omitted >** |

Any comments?

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## RA-SDT parameter name misalignment

In TS 38.213, parameters *sdt-CB-PreamblesPerSSB-PerSharedRO* o*sdt-msgA-CB-PreamblesPerSSB-PerSharedRO, sdt-SSB-SharedRO-MaskIndex* and *sdt-msgA-SSB-SharedRO-MaskIndex* are not aligned with TS 38.331.

TP from vivo:

### TP#3.2-1

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| **------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >**8.1 Random access preamblePhysical random access procedure is triggered upon request of a PRACH transmission by higher layers or by a PDCCH order. A configuration by higher layers for a PRACH transmission includes the following: - A configuration for PRACH transmission [4, TS 38.211]. - A preamble index, a preamble SCS, $P\_{PRACH,target}$, a corresponding RA-RNTI, and a PRACH resource. A PRACH is transmitted using the selected PRACH format with transmission power $P\_{PRACH,b,f,c}(i)$,as described in clause 7.4, on the indicated PRACH resource.For Type-1 random access procedure, a UE is provided a number $N$ of SS/PBCH block indexes associated with one PRACH occasion and a number $R$ of contention based preambles per SS/PBCH block index per valid PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*. For Type-2 random access procedure with common configuration of PRACH occasions with Type-1 random access procedure, a UE is provided a number $N$ of SS/PBCH block indexes associated with one PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB* and a number $Q$ of contention based preambles per SS/PBCH block index per valid PRACH occasion by *msgA-CB-PreamblesPerSSB-PerSharedRO*. The PRACH transmission can be on a subset of PRACH occasions associated with a same SS/PBCH block index within an SSB-RO mapping cycle for a UE provided with a PRACH mask index by *msgA-SSB-SharedRO-MaskIndex* according to [11, TS 38.321].For Type-2 random access procedure with separate configuration of PRACH occasions with Type-1 random access procedure, a UE is provided a number $N$ of SS/PBCH block indexes associated with one PRACH occasion and a number $R$ of contention based preambles per SS/PBCH block index per valid PRACH occasion by *msgA-SSB-PerRACH-OccasionAndCB-PreamblesPerSSB* when provided; otherwise, by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*.For a random access procedure associated with a feature combination indicated by *FeatureCombinationPreambles*, a UE is provided a number $N$ of SS/PBCH block indexes associated with one PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB* or *msgA-SSB-PerRACH-OccasionAndCB-PreamblesPerSSB* when provided and a number $S$ of contention based preambles per SS/PBCH block index per valid PRACH occasion by *startPreambleForThisPartition* and *numberOfPreamblesPerSSB-ForThisPartition*. The PRACH transmission can be on a subset of PRACH occasions associated with a same SS/PBCH block index within an SSB-RO mapping cycle for a UE provided with a PRACH mask index by *ssb-SharedRO-MaskIndex* according to [11, TS 38.321].<Unchanged text omitted>8.1A PUSCH for Type-2 random access procedureFor a Type-2 random access procedure, a UE transmits a PUSCH, when applicable, after transmitting a PRACH. The UE encodes a transport block provided for the PUSCH transmission using redundancy version number 0. The PUSCH transmission is after the PRACH transmission by at least $N$ symbols where $N=2$ for $μ=0$ or $μ=1$, $N=4$ for $μ=2$ or $μ=3$, $N=16$ for $μ=5$, $N=32$ for $μ=6$, and $μ$ is the SCS configuration for the active UL BWP.A UE does not transmit a PUSCH in a PUSCH occasion if the PUSCH occasion associated with a DMRS resource is not mapped to a preamble of valid PRACH occasions or if the associated PRACH preamble is not transmitted as described in clause 7.5 or clause 11.1. A UE can transmit a PRACH preamble in a valid PRACH occasion if the PRACH preamble is not mapped to a valid PUSCH occasion.A mapping between one or multiple PRACH preambles and a PUSCH occasion associated with a DMRS resource is per PUSCH configuration.A UE determines time resources and frequency resources for PUSCH occasions in an active UL BWP from *msgA-PUSCH-Config* or *separateMsgA-PUSCH-Config* for the active UL BWP. If the active UL BWP is not the initial UL BWP and *msgA-PUSCH-Config* or *separateMsgA-PUSCH-Config* is not provided for the active UL BWP, the UE uses the *msgA-PUSCH-Config* or *separateMsgA-PUSCH-Config* provided for the initial UL BWP.<Unchanged text omitted>19.2 Random-access based PUSCH transmissionA UE indicated to release a dedicated RRC connection can be provided a configuration for a Type-1 and/or a Type-2 random access procedure on the initial UL BWP [12, TS 38.331]. PRACH occasions can have either a common configuration as, or a separate configuration from, PRACH occasions for Type-1 or Type-2 random access procedure as described in clause 8.1. The UE procedure is as described in clause 8, including clauses 8.1 through 8.4. The UE transmits a PRACH preamble with a power determined as described in clause 7.4.For a common configuration of PRACH occasions and a Type-1 or a Type-2 random access procedure, a UE can be provided a number of contention based preambles per SS/PBCH block index per valid PRACH occasion by *startPreambleForThisPartition* and *numberOfPreamblesPerSSB-ForThisPartition* when *smallData* is present in corresponding *FeatureCombination ~~sdt-CB-PreamblesPerSSB-PerSharedRO~~* ~~or~~ *~~sdt-msgA-CB-PreamblesPerSSB-PerSharedRO~~*~~, respectively~~. A PRACH transmission can be on a subset of PRACH occasions associated with a same SS/PBCH block index within an SSB-RO mapping cycle as determined by a PRACH mask index provided by *~~sdt-SSB~~ssb-SharedRO-MaskIndex* ~~or~~ *~~sdt-msgA-SSB-SharedRO-MaskIndex~~*according to [11, TS 38.321].**< Unchanged text omitted >** |

TP from ZTE:

### TP#3.2-2

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| **------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >****19.2 Random-access based PUSCH transmission**A UE indicated to release a dedicated RRC connection can be provided a configuration for a Type-1 and/or a Type-2 random access procedure on the initial UL BWP [12, TS 38.331]. PRACH occasions can have either a common configuration as, or a separate configuration from, PRACH occasions for Type-1 or Type-2 random access procedure as described in clause 8.1. The UE procedure is as described in clause 8, including clauses 8.1 through 8.4. The UE transmits a PRACH preamble with a power determined as described in clause 7.4.For a common configuration of PRACH occasions and a Type-1 or a Type-2 random access procedure, a UE can be provided a number of contention based preambles per SS/PBCH block index per valid PRACH occasion by *numberOfPreamblesForThisPartition-r17 ~~sdt-CB-PreamblesPerSSB-PerSharedRO~~* ~~or~~ *~~sdt-msgA-CB-PreamblesPerSSB-PerSharedRO~~*~~, respectively~~. A PRACH transmission can be on a subset of PRACH occasions associated with a same SS/PBCH block index within an SSB-RO mapping cycle as determined by a PRACH mask index provided by *ssb-SharedRO-MaskIndex-r17 ~~sdt-SSB-SharedRO-MaskIndex~~* ~~or~~ *~~sdt-msgA-SSB-SharedRO-MaskIndex~~* according to [11, TS 38.321]. **< Unchanged text omitted >** |

TP from Huawei:

### TP#3.2-3

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| **------------------------------ TS 38.213-----------------------------------**19.2 Random-access based PUSCH transmission========================= Unchanged parts =========================For a common configuration of PRACH occasions and a Type-1 or a Type-2 random access procedure, a UE can be provided a number of contention based preambles per SS/PBCH block index per valid PRACH occasion by *numberOfPreamblesPerSSB-ForThisPartition-r17* in *RACH-ConfigCommon* or *RACH-ConfigCommonTwoStepRA*, respectively. A PRACH transmission can be on a subset of PRACH occasions associated with a same SS/PBCH block index within an SSB-RO mapping cycle as determined by a PRACH mask index provided by *ssb-SharedRO-MaskIndex-r17* in *RACH-ConfigCommon* or *RACH-ConfigCommonTwoStepRA* according to [11, TS 38.321].========================= Unchanged parts ========================= |

Which TP is preferred? Any comments?

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## TDRA table determination for Type 1A CSS set

Xiaomi has noticed that, after introducing Type 1A CSS set, TDRA table 5.1.2.1.1-1 in TS 38.214 has not been revised accordingly, so the following TP is proposed:

TP from Xiaomi:

### TP#3.3-1

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| **------------------------------ TS 38.214-----------------------------------****<Unchanged parts omitted>**5.1.2.1.1 Determination of the resource allocation table to be used for PDSCHTable 5.1.2.1.1-1 and Table 5.1.2.1.1-1A define which PDSCH time domain resource allocation configuration to apply. Either a default PDSCH time domain allocation A, B or C according to tables 5.1.2.1.1-2, 5.1.2.1.1-3, 5.1.2.1.1-4 and 5.1.2.1.1-5 is applied, or the higher layer configured *pdsch-TimeDomainAllocationList* or [*pdsch-TimeDomainAllocationListForMultiPDSCH-r17]* or *pdsch-TimeDomainAllocationListDCI-1-2* is applied. For operation with shared spectrum channel access in frequency range 1, as described in [16, TS 37.213], UE reinterprets *S* and *L* in row 9 of Table 5.1.2.1.1-2 as *S=6* and *L=7*.Table 5.1.2.1.1-1: Applicable PDSCH time domain resource allocation for DCI formats 1\_0, 1\_1, 4\_0, 4\_1 and 4\_2

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| **RNTI** | **PDCCH search space** | **SS/PBCH block and CORESET multiplexing pattern** | ***PDSCH-ConfigCommon* includes *pdsch-TimeDomainAllocationList*** | ***PDSCH-Config* includes *pdsch-TimeDomainAllocationList*** | ***PDSCH-Config-MCCH/PDSCH-Config-MTCH* includes *pdsch-TimeDomainAllocationList******Or*** ***pdsch-Config-Multicast* includes *pdsch-TimeDomainAllocationList*** | ***PDSCH-Config* includes *pdsch-TimeDomainAllocationListForMultiPDSCH-r17*** | **PDSCH time domain resource allocation to apply** |
| SI-RNTI | Type0 common | 1 | - | - | - | - | Default A for normal CP |
| 2 | - | - | - | - | Default B |
| 3 | - | - | - | - | Default C |
| SI-RNTI | Type0A common | 1 | No | - | - | - | Default A |
| 2 | No | - | - | - | Default B |
| 3 | No | - | - | - | Default C |
| 1,2,3 | Yes | - | - | - | *Pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon* |
| RA-RNTI, MSGB-RNTI, TC-RNTI | Type1 common | 1,2,3 | No | - | - | - | Default A |
| 1,2,3 | Yes | - | - | - | *Pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon* |
| C-RNTI | Type1A Common | 1,2,3 | No | - | - | - | Default A |
| 1,2,3 | Yes | - | - | - | *Pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon* |
| P-RNTI | Type2 common | 1 | No | - | - | - | Default A |
| 2 | No | - | - | - | Default B |
| 3 | No | - | - | - | Default C |
| 1,2,3 | Yes | - | - | - | *Pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon* |
| MCCH-RNTI  | Type 0/0B common for broadcast | 1 | No | - | No | *-* | Default A |
| 2 | No | - | No | *-* | Default B |
| 3 | No | - | No | *-* | Default C |
| 1,2,3 | Yes | - | No | *-* | *pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon* |
| 1,2,3 | No/Yes | - | Yes | *-* | *pdsch-TimeDomainAllocationList provided in pdsch-Config-MCCH* |
| G-RNTI for broadcast | Type 0/0B common for broadcast | 1 | No | - | No | *-* | Default A |
| 2 | No | - | No | *-* | Default B |
| 3 | No | - | No | *-* | Default C |
| 1,2,3 | Yes | - | No | *-* | *pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon* |
| 1,2,3 | No/Yes | - | Yes | *-* | *pdsch-TimeDomainAllocationList* provided in *PDSCH-Config-MTCH,* if configured, otherwise *TimeDomainAllocationList* provided in *PDSCH-Config-MCCH* |
| C-RNTI, MCS-C-RNTI, CS-RNTI | Any common search space associated with CORESET 0 | 1, 2, 3 | No | - | - | - | Default A |
| 1, 2, 3 | Yes | - | - | *-* | *pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon* |
| C-RNTI, MCS-C-RNTI, CS-RNTI | Any common search space not associated with CORESET 0UE specific search space | 1,2,3 | No | No | - | - | Default A |
| 1,2,3 | Yes | No | - | *-* | *pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon*  |
| 1,2,3 | No/Yes | Yes | - | *-* | *pdsch-TimeDomainAllocationList* provided in *PDSCH-Config* |
| 1,2,3 | No/Yes | - | - | Yes | *pdsch-TimeDomainAllocationListForMultiPDSCH-r17* provided in *PDSCH-Config (Note 2)* |
| G-RNTI, G-CS-RNTI (for multicast)  | Type-X common search space for multiast | 1,2,3 | No | - | No | - | *Default A* |
| 1,2,3 | Yes | - | No | - | *pdsch-TimeDomainAllocationList* provided in *PDSCH-ConfigCommon (Note 1)* |
| 1,2,3 | No/Yes | - | Yes | - | *pdsch-TimeDomainAllocationList* provided in *pdsch-Config-Multicast**(Note 1)* |
| Note 1: For a UE that supports multicast, the same TDRA table applies to all G-RNTIs (configured for multicast) if configured on a given serving cell.Note 2: If *pdsch-TimeDomainAllocationListForMultiPDSCH-r17* is provided, it is applicable to DCI format 1\_1 only. |

**<Unchanged parts omitted>** |

Any comments?

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# RedCap related issues

Based on companies’ input, RedCap related issues can be summarized as following:

## Collision handling for RedCap UE supporting SDT

Relevant proposals:

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| [Xiaomi]:**Proposal 1: For collision handling between CG-SDT PUSCH and DL resources in inactive states, adopts the same rule as CG PUSCH in connected states.** |

FL comment: Not sure whether there is spec impact on this.

Any comments?

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## SDT resource configuration for RedCap UE

Relevant proposal:

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| [Xiaomi]:**Proposal 2: Type 1A CSS set can be configured on the separate initial DL BWP for RedCap.****Proposal 3: RA-SDT resources can only be configured on separate initial BWP if it exists.****Proposal 4: Support to configure CG-SDT resources on either the separate initial BWP or the non-Redcap UE’s initial BWP in the case of both of them no larger than Redcap UE’s bandwidth.****Proposal 5: Don’t support BWP switch between legacy initial BWP and separate initial BWP during subsequent SDT procedure.****Proposal 6: UE doesn’t expect to be configured with CG-SDT resources on a separate initial BWP without CD-SSB.** |

FL comment: these proposals seem not essential correction, can be discussed as lower priority.

 Any comments?

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## Paging monitoring for RedCap UE in separate BWP

Relevant proposal:

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| [Huawei]:***Observation 1:*** *A UE should attempt to monitor paging/SI update indication during SDT procedure, including RedCap UE in separate initial BWP.****Observation 2:*** *There will be significant scheduling constrain if paging/SI update indication monitoring is up to UE when separate initial DL BWP is configured for SDT procedure.* ***Observation 3:*** *There will be significant scheduling constrain for SSB measurement in the initial DL BWP for verifying the CG-SDT resources in the separate BWP.****Proposal 1:*** *If separate initial BWP does not include CD-SSB but configured for SDT, interruption time can be configured for paging/SI update indication monitoring or SSB measurement for CG-SDT resource validation.* |

FL comment: the issue is valid, paging or SSB measurement may require RF retuning from separate BWP to initial BWP, but it can be somehow alleviated by gNB scheduling and UE implementation on SDT triggering time, not sure whether interruption time can help more. Companies are encouraged to provide views on this issue.

Any comments?

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## CD-SSBs for RedCap UE

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| [vivo]:***Proposal 1:*** * ***RAN1 should conclude that only CD-SSBs in initial DL BWP is used for SSB to CG PUSCH mapping and further discuss whether any specification change is needed to explicitly restrict the SSBs to be only among the SSBs configured by ssb-PositionsInBurst in SIB1 or by ServingCellConfigCommon.***
 |

FL comment: It’s reasonable and companies are encouraged to discuss whether there is spec impact.

Any comments?

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# Other remaining issues

## SDT search space on initial BWP

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| [Spreadtrum]:***Proposal x: Clarify that sdt-SearchSpace is only configured in the initial DL BWP. Consider the Text Proposal in Appendix A.1.******Proposal x: Clarify that sdt-CG-SearchSpace is only configured in the initial DL BWP. Consider the Text Proposal in Appendix A.1.*** **<Start of Text Proposal>**19.1 Configured-grant based PUSCH transmission**<Unchanged parts are omitted>**A UE can be provided a USS set by *sdt-CG-SearchSpace*, or a CSS set by *sdt-SearchSpace*, to monitor PDCCH on the initial DL BWP 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.**<Unchanged parts are omitted>**19.2 Random-access based PUSCH transmission**<Unchanged parts are omitted>**A UE can be provided by *sdt-SearchSpace* a CSS set to monitor, after contention resolution as described in clause 8.4, PDCCH on the initial DL BWP 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 PRACH transmission are quasi co-located with respect to average gain and quasi co-location 'typeA' or 'typeD' properties.**<Unchanged parts are omitted>** |

FL comment: It seems such revision may preclude separate initial BWP for RedCap UE. Actually, the restriction of initial BWP can be reflected by RRC configurations.

Any comments?

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## Collision of PUCCH and PUSCH for SDT

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| [Sony]:**Proposal 1: RAN1 to discuss the following options for handling the collision/overlap between PUCCH carrying HARQ-ACK and PUSCH in time for SDT:**1. One of the overlapping channels should be dropped, i.e., either PUCCH or PUSCH is dropped
2. Multiplexing the HARQ-ACK on PUSCH
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FL comment: uci-on-PUSCH is not supported by RAN2, seems Option A is the only choice, maybe it can be up to UE implementation.

Any comments?

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## MsgA PUSCH occasion validation for 2-step RACH

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| [Huawei]:For R16 2-step RACH, A PUSCH occasion is valid if it does not overlap with the resource of any valid PRACH occasion. Within one BWP, a UE should consider resource for 2 RA types (2-step RACH and 4-step RACH if both are configured). In R17, as RedCap/SDT/CE/Slicing can be identified via RACH in combination or separately, the number of RACH resources configured within one BWP can be up to 256 as defined in TS38.331. Furthermore, one RACH configuration can contain PRACH resources for both 2-step RACH and 4-step RACH, so the total number of RACH resources within one BWP will arise up to 512. If all RACH resources has to be considered when verifying the PUSCH occasion, the porcessing complexity would be much higher, exceeding the supposed UE capability. As a matter of fact, since there would be at most one RACH procedure at a time, the UE does not necessarily verify all possible occasions configured for one of the feature combinations.8.1A PUSCH for Type-2 random access procedure========================= Unchanged parts =========================A PUSCH occasion is valid if it does not overlap in time and frequency with any valid PRACH occasion associated with either a Type-1 random access procedure or a Type-2 random access procedure, and the PUSCH occasion and PRACH occasion is provided in the same *AdditionalRACH-Config-r17* in *additionalRACH-ConfigList-r17* if configured. Additionally, for unpaired spectrum and for SS/PBCH blocks with indexes provided by *ssb-PositionsInBurst* in *SIB1* or by *ServingCellConfigCommon* ========================= Unchanged parts =========================19.1 Configured-grant based PUSCH transmission========================= Unchanged parts =========================A PUSCH occasion is valid if it does not overlap in time and frequency with any valid PRACH occasion associated with either a Type-1 random access procedure or a Type-2 random access procedure as described in clause 8.1, and the PUSCH occasion and PRACH occasion is provided in the same *AdditionalRACH-Config-r17* in *additionalRACH-ConfigList-r17* if configured.  |

FL comment: The intention of the validation is to avoid PUSCH transmission impact on PRACH(probably from other UEs), not sure whether the TP can guarantee the intention. Companies are encouraged to provide views on this issue.

Any comments?

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## HARQ-ACK codebook for SDT

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| [Huawei]:When the Table Default A is used* If Type 1 HARQ-ACK codebook can be applied, which of the 3 bits can be feedback should be determined.
* If Type 2 HARQ-ACK codebook can be applied, no more than 2 bits of HARQ-ACK should be scheduled by gNB within one slot.

When the UE specific PDSCH time domain resource is configured: * If Type 1 HARQ-ACK codebook can be applied, gNB should consider the corresponding HARQ-ACK bits number, when configure time domain resource.
* If Type 2 HARQ-ACK codebook can be applied, no more than 2 bits of HARQ-ACK should be scheduled by gNB within one slot.

Thus, a simple and uniform solution is to apply Type 2 HARQ-ACK codebook only for SDT. The spec change in TS 38.213 can be as follows:========================= Unchanged parts =========================9.2.1 PUCCH Resource Sets========================= Unchanged parts =========================If a UE is not provided any of *pdsch-HARQ-ACK-Codebook*, *pdsch-HARQ-ACK-Codebook-r16*, or *pdsch-HARQ-ACK-OneShotFeedback*, the UE generates at most one HARQ-ACK information bit. Only type 2 HARQ-ACK codebook is applied during PUSCH transmission in RRC\_INACTIVE state. ========================= Unchanged parts =========================***Proposal 1:*** *Applying type2 HARQ-ACK codebook only during SDT procedure.*  |

FL comment: Such revision seems not essential.

Any comments?

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## QCL assumption for PDCCH and PDSCH

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| [Xiaomi]:Configured-grant based PUSCH transmission**<Unchanged parts omitted>**A UE can be provided a USS set~~by~~ *~~sdt-CG-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 transmission 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.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>** |

FL: Seems not needed.

Any comments?

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# Summary

The final proposals will be added later.

# References

1. R1-2205802 Discussion on RAN2 LS on L1 related agreements for SDT Huawei, HiSilicon
2. R1-2206079 Discussion on physical layer issues of small data transmission ZTE, Sanechips
3. R1-2206482 On the Reply LS on the L1 related agreements for SDT Ericsson
4. R1-2206529 Discussion on reply LS for SDT common search space Intel Corporation
5. R1-2206713 Draft LS reply on the L1 related agreements for SDT vivo
6. R1-2205800 Remaining issues on PUCCH feedback during SDT procedure Huawei, HiSilicon
7. R1-2205980 Remaining issues on physical layer aspects of small data transmission Spreadtrum Communications
8. R1-2206090 Correction on small data transmission in TS 38.213 ZTE, Sanechips
9. R1-2206109 Collison of PUCCH and PUSCH for SDT Sony
10. R1-2206568 Correction on CG-SDT search space Intel Corporation
11. R1-2206569 Correction on CG-PUSCH repetitions for CG-SDT operation Intel Corporation
12. R1-2206614 Discussion on physical layer aspects of small data transmission Xiaomi
13. R1-2206771 Remaining issues for NR small data transmissions in RRC INACTIVE state vivo
14. R1-2206772 Corrections of random-access based small data transmission vivo
15. R1-2206773 Corrections of reduncancy version for SDT vivo
16. R1-2206774 Corrections of search space for SDT vivo
17. R1-2206853 Correction on CG-SDT parameters InterDigital, Inc.
18. R1-2207525 Correction on MsgA PUSCH occasion validation for 2-step RACH Huawei, HiSilicon
19. R1-2207637 Remaining issues on paging monitoring and measurement during SDT procedure Huawei, HiSilicon
20. R1-2207655 Correction on PRACH configurations for SDT Huawei, HiSilicon