**3GPP TSG-RAN WG1 Meeting #109-e R1-220xxxx**

**e-Meeting, May 9th - 20th, 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 remaining issues related to the physical layer aspects of small data transmission in RAN1#109-e meeting.

[109-e-NR-R17-SDT-01]  Email discussion on Rel-17 SDT maintenance by May 18 – Ziyang (ZTE)

* Issue#1 Association period determined by CG period less than 5ms
* Issue#2 SSBs for TA validation and mapping in HD-FDD
* Issue#3 Editorial correction on PRACH configuration for RA-SDT
* Issue#4 Editorial correction on USS set for CG-SDT
* Issue#6 Validation rule for CG-SDT overlapping with MsgA PUSCH
* Issue#11 Type 1A CSS set overlapping with Type 1 CSS set

The above 6 issues are summarized in section 2.1~2.6.

## Proposals for May 13 email approval

The TPs and conclusion in this section are approved through email.

#### TP#2.1-1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Reason for change:*** CG period values less than 5ms will not be included in Table 19.1-1 in TS 38.213, but the description says “except when PUSCH configuration period is less than 5 msec”.***Summary of change:*** The sentence in bracket “except when PUSCH configuration period is less than 5 msec” is removed from Table 19.1-1 in TS 38.213***Consequences if not approved:*** The sentence in Table 19.1-1 in bracket “except when PUSCH configuration period is less than 5 msec” will cause confusion since no CG period values less than 5ms are included in the table.**------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >**19.1 Configured-grant based PUSCH transmission**< Unchanged text omitted >**Table 19.1-1: Mapping between PUSCH configuration period and SS/PBCH block to configured PUSCH resource association period

|  |  |
| --- | --- |
| PUSCH configuration period $T\_{cg}$ (msec) | Association period (number of PUSCH configuration periods ~~except when PUSCH configuration period is less than 5 msec~~) |
| 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} |

**< Unchanged text omitted >** |

#### TP#2.3-2

|  |
| --- |
| ***Reason for change:*** Description error for parameter *sdt-CB-PreamblesPerSSB-PerSharedRO/sdt-msgA-CB-PreamblesPerSSB-PerSharedRO*. ***Summary of change:*** a number of SSB indexes is replaced by a number of preambles. ***Consequences if not approved:*** description error.**------------------------------ TS 38.213-----------------------------------****< 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 ~~SS/PBCH block indexes associated with one PRACH occasion~~ by *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-SharedRO-MaskIndex* or *sdt-msgA-SSB-SharedRO-MaskIndex* according to [11, TS 38.321]. **< Unchanged text omitted >** |

#### ***Conclusion 2.5-2***

RAN1 cannot reach consensus on whether to define validation rule for CG-PUSCH overlapping with MsgA PUSCH.

# Discussion on small data transmission

## Association period determined by CG period less than 5ms

In RAN1#108-e meeting, the table of association period between SSB and CG PUSCH has been defined in clause 19.1 in TS38.213 as shown below. However, the table only includes CG period value larger than or equal to 5ms, smaller values are still FFS as reflected in highlighted part as well.

Table 19.1-1: Mapping between PUSCH configuration period and SS/PBCH block to configured PUSCH resource association period

|  |  |
| --- | --- |
| PUSCH configuration period $T\_{cg}$ (msec) | Association period (number of PUSCH configuration periods except when PUSCH configuration period is less than 5 msec) |
| 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 } |

In R1-2203244, ZTE has mentioned that there is no clear motivation to preclude CG period values smaller than 5ms and proposed to include these values in the Table 19.1-1. The proposed change is shown in TP#2.1-1.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Reason for change:*** The table of association period between SSB and CG PUSCH does not include CG period values less than 5ms, which is FFS.***Summary of change:*** Table 19.1-1 in TS 38.213 is revised to include CG period values less than 5ms.***Consequences if not approved:*** Table 19.1-1 would be incomplete and the sentence in bracket “except when PUSCH configuration period is less than 5 msec” cannot match the content of the table.**------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >**19.1 Configured-grant based PUSCH transmission**< Unchanged text omitted >**Table 19.1-1: Mapping between PUSCH configuration period and SS/PBCH block to configured PUSCH resource association period

|  |  |
| --- | --- |
| PUSCH configuration period $T\_{cg}$ (msec) | Association period (number of PUSCH configuration periods ~~except~~ when PUSCH configuration period is ~~less than 5~~ larger than 1 msec) |
| ≦1 | {5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 320, 640}ms  |
| 2 | {4, 5, 8, 10, 16, 20, 40, 80, 160, 320} |
| 4 | {2, 4, 5, 8, 10, 16, 20, 40, 80, 160} |
| 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 } |

**< Unchanged text omitted >** |

In R1-2203540, vivo thinks it would be good to send an LS to RAN2 to see whether it possible to not support such small CG period values.

In R1-2203885, Samsung suggests to preclude CG period less than 1ms and include 1, 2, 4ms into the table and adopts the following table.

Association period table from Samsung

|  |  |
| --- | --- |
| **CG period  (msec)** | **Association period (number of CG periods ~~except when CG period is less than 5 ms~~)** |
| 1 | {1,2,4,5,8,10,16,20,32,40,64,80,128,160,320,640} |
| 2 | {1, 2, 3, 4, 5, 8, 10, 16, 20, 32, 40, 80, 160, 320} |
| 4 | {1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 80, 160} |
| 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 } |

In R1-2204784, Intel thinks CG period less than 5ms may require further spec effort and it’s not desirable, so Intel proposes to not support CG period values less than 5ms.

### First round discussion

According to the 4 contributions, the main concern of introducing CG period less than 5ms for mapping is the spec effort, i.e. a number of rows need to be added in the association table, some companies think the corresponding spec effort is not desirable since smaller CG periods may not be the typical use cases of SDT. However, some companies think that smaller CG period values will lead to

Since the issue has been discussed for several times, Moderator suggests we can firstly use the following discussion point to collect companies’ initial views on how to deal with CG period values less than 5ms, then in second round discussion, detailed text proposal can be discussed focusing on the most preferred option.

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

How to deal with CG period values less than 5ms for association period table:

* Option 1: Capture CG period values less than 5 ms in Table 19.1-1 in TS 38.213
	+ TP#2.1-1 from ZTE in section 2.1 can be a starting point for further discussion
* Option 2: Capture CG period values {1, 2, 4}ms and preclude CG period values less than 1 ms in Table 19.1-1 in TS 38.213
	+ Association period table from Samsung in section 2.1 can be a starting point for further discussion
* Option 3: Preclude CG period values less than 5 ms
	+ Remove “except when PUSCH configuration period is less than 5 msec” in Table 19.1-1 in TS 38.213

Regarding whether to further send an LS to RAN2, Moderator thinks it’s not needed and the decision can be made in RAN1. Any other comments?

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | We prefer to send an LS to RAN2 to confirm the new configurations |
| New H3C | We slightly prefer Option 3 and we are open to discuss about Option 1 and Option 2. |
| Intel | We prefer Option 3. We also agree sending LS to RAN2 is not needed.  |
| vivo  | Option 3 is preferred. |
| Samsung | Although we do see some useful situation for short period (i.e., UE can have more timely resource then finish the SDT quickly), we can live with option 3 if that’s all the companies’ preference. Our preference is option 2 though.  |
| Ericsson | Option 3.We do not see a reason to support CG period values less than 5 ms for inactive state. For traffic with such low periodicities, it is better that the UE moves to connected state and be configured with CG Type 1/2. |
| Huawei, HiSilicon | Option 3 |

### Second round discussion

To Qualcomm, the table has already been sent to RAN2 in last meeting, if we adopt Option 3, we only need to update the description in bracket, it’s purely RAN1 issue.

All companies could accept Option 3 though it’s not the most preferred option for some companies, Given this situation, TP#2.1-1 is provided to reflect spec change of Option 3.

#### TP#2.1-1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Reason for change:*** CG period values less than 5ms will not be included in Table 19.1-1 in TS 38.213, but the description says “except when PUSCH configuration period is less than 5 msec”.***Summary of change:*** The sentence in bracket “except when PUSCH configuration period is less than 5 msec” is removed from Table 19.1-1 in TS 38.213***Consequences if not approved:*** The sentence in Table 19.1-1 in bracket “except when PUSCH configuration period is less than 5 msec” will cause confusion since no CG period values less than 5ms are included in the table.**------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >**19.1 Configured-grant based PUSCH transmission**< Unchanged text omitted >**Table 19.1-1: Mapping between PUSCH configuration period and SS/PBCH block to configured PUSCH resource association period

|  |  |
| --- | --- |
| PUSCH configuration period $T\_{cg}$ (msec) | Association period (number of PUSCH configuration periods ~~except when PUSCH configuration period is less than 5 msec~~) |
| 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} |

**< Unchanged text omitted >** |

Any comments?

|  |  |
| --- | --- |
| Company | Comment |
| vivo  | Fine with the TP and we assume that RAN2 would update the CG period values for SDT as well according to RAN1’s agreement. Is this correct understanding? |
| Intel | We are fine with the TP. We share similar view as Vivo that we may need to send LS to RAN2 to inform the decision for this.  |
| Qualcomm | Support the TP |
| Samsung  | Fine, and also support to let RAN2 know. |
| Moderator | Given that quite a few companies want to let RAN2 know about this RAN1 decision, a draft LS is prepared and uploaded in the draft folder. Please companies check whether this draft reply LS is acceptable as soon as possible, because we’d better try to make it stable and send it out by end of this week to leave some time for RAN2 to check the impact in this meeting, thanks! |
| New H3C | Support FL proposal. |
| Apple | Ok with the TP |
| Xiaomi | Fine with the TP and the draft reply LS. |
| Ericsson | Fine with the TP |

## SSBs for TA validation and mapping in HD-FDD

In R1-2203244, ZTE has the following statements:

In RedCap WI, for RedCap UE in idle/inactive state, two kinds of separate initial DL BWP may be configured. One is that separate initial DL BWP can include CORESET#0 and CD-SSB. The other is that separate initial DL BWP only includes CSS for RA, but does not include SSB, paging and SI reception. Then when the first kind of separate initial DL BWP is configured, CD-SSB can be used for mapping and TA validation. But for the second kind of separate initial DL BWP, since there is no SSB, CD-SSB in legacy initial BWP may be used for mapping and TA validation similar to RACH procedure in idle/inactive state.

***Proposal 2: For RedCap UE performing SDT, CD-SSB can be used for SSB to CG PUSCH mapping and TA validation.***

For Proposal 2, since CD-SSB is the only kind of SSBs that supported in RRC inactive state for RedCap UE no matter in separate initial BWP or initial BWP, there is no ambiguity even without any spec changes. However, for separate initial BWP not including SSBs, the behavior of RedCap UE performing SDT is different from legacy UE. So TP #2 can be adopted to specify which SSBs will be used for mapping if no SSBs are configured in separate initial BWP.

***Proposal 3: For RedCap UE performing SDT, if separate initial DL BWP does not include any SSBs, the SSBs associated with initial DL BWP can be used for SSB to CG PUSCH mapping.***

* ***Adopt TP#2 in Clause 19.1 for TS 38.213.***

### 2.2.1 First round discussion

ZTE has proposed 2 Issues for RedCap UEs performing SDT, the first is which type of SSBs(CD-SSB or NCD-SSB) will be used for SSB mapping and TA validation, since CD-SSB is the only kind of SSBs that can be configured in RRC inactive state, it might be good to clarify that CD-SSB can be used for CG PUSCH mapping and TA validation.

The second issue is if separate initial DL BWP does not include any SSBs, it may cause ambiguity on the behavior of RedCap UE performing SDT, which is different from legacy UE. In this case, the SSBs associated with initial DL BWP can be used for SSB to CG PUSCH mapping. TP#2.2-1 is also proposed to reflect the relevant spec change.

#### TP#2.2-1

|  |
| --- |
| ***Reason for change:*** for Redcap UE, associated SSB is not clear in case of no SSB associated with separate initial BWP.***Summary of change:*** if there is no SSB in separate initial BWP, CD-SSB in legacy initial BWP can be use for mapping.***Consequences if not approved:*** associated SSB is not clear.**------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >**19.1 Configured-grant based PUSCH transmissionA 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 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.For a RedCap UE, if it is configured with a BWP indicated by *initialDownlinkBWP-RedCap-r17* which is not associated with any SS/PBCH block, CG resource can be associated with SS/PBCH blocks in the BWP indicated by *initialDownlinkBWP*.**< Unchanged text omitted >** |

#### ***Proposal 2.2-1***

For RedCap UE performing SDT,

* CD-SSB can be used for SSB to CG PUSCH mapping and TA validation.
* if separate initial DL BWP does not include any SSBs, the SSBs associated with initial DL BWP can be used for SSB to CG PUSCH mapping.

Any comments?

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | We are fine with the 1st bullet.Regarding the 2nd bullet, clarification is needed for “the SSBs associated with initial DL BWP” and a “separate initial DL BWP does not include any SSBs.”  |
| New H3C | In principal, we are fine with this proposal. Regarding second bullet, in my understanding, separate initial DL BWP is dedicated to redcap UE, is ti correct? |
| Intel | We are fine with the first bullet. For the second bullet, we share similar view as QC that clarification is needed.  |
| Spreadtrum | Share the similar view as QC |
| vivo  | Fine with the proposal. |
| Samsung  | Not sure if we get the issue correctly, as far as we know, even with separate initial DL BWP, the CD-SSB is common to both normal UE and Redcap UE. Even though there is case that separate initial DL BWP could cover CD-SSB or not. So we don’t see the need for this. The first bullet is not wrong but it also seems no other choice for UE.  |
| Ericsson | Fine. We think the proposal is consistent with the agreements in RedCap WI.  |
| Huawei, HiSilicon | The title mentions HD-FDD, but actually does not matter we assume.For the 2nd bullet, it seems to still say CD-SSB is to be used as the first bullet. We want to understand the impact of the following RAN2 conclusion*During the subsequent new CG transmission phase, for the purpose of CG resource selection, UE re-evaluates the SSB for subsequent CG transmission. FFS what happens if no SSBs are valid or if no sample is available.**Confirm earlier agreement: During subsequent CG transmission phase (i.e. after the UE has received response from NW), if there is no available SSB above the configured RSRP CG-SDT threshold, the HARQ entity doesn’t use the CG-SDT resource, and the UE triggers SR when there is no valid UL grant (UE falls back to legacy RA for SR)*The above seems to say for separate initial DL BWP without SSB, the UE has to either stop to use CG-SDT, or go to CD-SSB for re-evaluation. The former measn restriction of CG-SDT for RedCap UEs and the latter may require some calficiation of UE behavior. Moreover, besides TA validation, cell reselection, CG resource reselection also needs to be considered during Subsequent data transmission.Similarly, as agreed in RedCap, Paging is only in the BWP associated with CD-SSB. The following agreement are made in SDT, we think it is not clear if RAN2 intends to allow this possibility that a UE does not monitor SI change or PWS notification, especially when the separate initial DL BWP does not include any SSBs and CORESET#0*RAN2#116b-e Agreement for SDT**9. During the SDT procedure (i.e. while SDT timer is running), UE monitors SI change indication in any paging occasion at least once per modification period (i.e. same as legacy RRC\_CONNECTED).* *10. During the SDT procedure (i.e. while SDT timer is running), ETWS or CMAS capable Ues monitors PWS notification in any paging occasion at least once every defaultPagingCycle (i.e. same as legacy RRC\_CONNECTED).* |

### 2.2.2 Second round discussion

To Qualcomm, Intel and Spreadtrum, the second bullet is to address the issue that for RedCap UE configured with separate initial BWP, as we previously agreed in RAN1, RedCap UE could still perform SDT operation, if this separate initial BWP does not include SSB, then the only choice is that CG resource can be associated with the SSBs in initial BWP.

To New H3C: Yes.

To Samsung: Yes, your understanding is correct, CD-SSB is the only choice, no spec change is needed. The intention of first bullet is to make a clarification, but it seems companies have common understanding, so we can remove this bullet and focus on the TP of second bullet instead.

To Huawei: If the separate initial BWP does not include SSB, UE will probably evaluate SSBs in initial BWP instead of dropping the SDT because we have made agreement in previous meeting “RAN1 confirms that the separate BWP in case of RedCap may still be considered as the initial BWP and SDT resources(both CG-SDT and RA-SDT) can hence be configured on this BWP for RedCap UEs.” As for TA validation, cell-selection and paging, Moderator agrees that these should also be considered, but since they are RAN2 related issues, they can be addressed in RAN2 if needed.

#### TP#2.2-1

|  |
| --- |
| ***Reason for change:*** for Redcap UE, associated SSB is not clear in case of no SSB associated with separate initial BWP.***Summary of change:*** if there is no SSB in separate initial BWP, CD-SSB in legacy initial BWP can be use for mapping.***Consequences if not approved:*** associated SSB is not clear.**------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >**19.1 Configured-grant based PUSCH transmissionA 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 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.For a RedCap UE, if it is configured with a BWP indicated by *initialDownlinkBWP-RedCap-r17* which is not associated with any SS/PBCH block, CG resource can be associated with SS/PBCH blocks in the BWP indicated by *initialDownlinkBWP*.**< Unchanged text omitted >** |

With the above clarification, Moderator suggests to directly discuss the TP#2.2-1 which reflects the spec change of second bullet of Proposal 2.2-1.

Any comments?

|  |  |
| --- | --- |
| Company | Comment |
| vivo  | Fine with FL’s proposal. |
| Intel | We are fine with the conclusion, but our understanding is TP may not be necessary as UE would use the SSB in the initial BWP for SSB to CG-PUSCH association. Current spec seems clear.  |
| Qualcomm | The TP talks about the DL resource configuration of CG in RedCap-specific initial DL BWP, but 19.1 is entitled “Configured-grant based PUSCH transmission.” Shall the TP be modified to reflect the CG PUSCH resource configuration in RedCap-specific initial UL BWP, which can be linked to a RedCap-specific initial DL BWP ? |
| Samsung | Share the view as Intel. The spec already refers to the specific high layer parameter for the SSB determination. We don’t think the TP is needed. |
| New H3C | OK with FL proposal |
| Apple | Ok with FL’s proposal. |
| Huawei, HiSilicon | About the FL response below*To Huawei: If the separate initial BWP does not include SSB, UE will probably evaluate SSBs in initial BWP instead of dropping the SDT because we have made agreement in previous meeting “RAN1 confirms that the separate BWP in case of RedCap may still be considered as the initial BWP and SDT resources(both CG-SDT and RA-SDT) can hence be configured on this BWP for RedCap UEs.”* It is actually our concern whether RAN1 and RAN2 have agreement in conflict. According to RAN1 agreement, the UE consider the separate without SSB as initial BWP for CG-SDT.According to RAN2 agreement, *if there is no available SSB above the configured RSRP CG-SDT threshold, the HARQ entity doesn’t use the CG-SDT resource,*Therefore it is not clear what you mean by *UE will probably evaluate SSBs in initial BWP*On 🡺Which BWP? The separate RedCap initial BWP that does not include SSB? Then how the UE evaluate the SSB? Retuning to the legacy initial BWP is required everytime when the UE has CG-SDT transmission? |
| Xiaomi | Have the same concern as Huawei. Maybe the RAN1 agreement “*RAN1 confirms that the separate BWP in case of RedCap may still be considered as the initial BWP and SDT resources(both CG-SDT and RA-SDT) can hence be configured on this BWP for RedCap UEs.*” should be revisited and further clarified. Since there may be frequent UL data transmission after CG-SDT procedure initiating, frequent RF retuning is needed to perform SSB measurement before CG-SDT transmission, which is a complicate and energy wasting way, and not preferred by us.So, we recommend the following clarification for the above agreement: Only separate initial BWP with SSB for RedCap can be considered as initial BWP for CG-SDT.Based on above, one more issue needs to be considered just as mentioned in our contribution: Whether the CG resources must be configured on the separate initial UL BWP or it can also be configured on the legacy initial UL BWP when both of them is no larger than RedCap UE bandwidth? We think no limit on the flexibility of gNB configuration is more reasonable. |
| Ericsson | We are generally fine with the intention of this TP. However, we prefer to wait. To our understanding, there are some discussions in the RedCap maintenance regarding where a UE camps while in idle/inactive mode if the legacy DL BWP#0 is greater than RedCap UE BW and separate (RedCap-specific) initial DL BWP does not contain CD-SSB (it could be in the initial DL BWP defined by MIB-configured CORESET#0). |

### 2.2.3 Third round discussion

@ Qualcomm, the TP doesn’t mention whether the CG PUSCH is in initial UL BWP or separate initial UL BWP, it only focus on the case when the associated separate DL initial doesn’t include SSBs.

@Huawei, the agreement from RAN2 doesn’t conflict with RAN1’s agreement, because “*if there is no available SSB above the configured RSRP CG-SDT threshold, the HARQ entity doesn’t use the CG-SDT resource”* means that UE will evaluate the SSBs in initial BWP, but if the RSRP is not above the threshold, the HARQ entity will not use CG resource, it aligned with RAN1 agreement. If UE is not even allowed to evaluate the SSBs in initial BWP, how can UE know whether there is an available SSB above threshold?

According to the companies’ comments in the second rounds, it seems the intention of this proposal is clear, however, companies have different understanding on previous agreement. Companies have 3 different views on UE’s behavior if separate initial BWP doesn’t include SSBs:

#### ***Discussion point 2.2-3***

If separate initial BWP doesn’t include SSBs,

* Understanding 1: UE will use the SSBs in initial BWP for SSB to PUSCH mapping, there is no other choice and no spec impact is needed. -- Intel, Samsung
* Understanding 2: UE may use the SSBs in initial BWP for SSB to PUSCH mapping or drop SDT operation, according to the previous agreement, the former one should be selected and the decision should be reflected in the spec. -- ZTE, vivo, New H3C, Apple
* Understanding 3: UE may use the SSBs in initial BWP for SSB to PUSCH mapping or drop SDT operation, the latter one should be selected and previous agreement should be re-visited. -- Huawei, Xiaomi

For companies that hold the view on understanding 1 or 2, the difference is whether there is spec impact, however, according to understanding 3, some companies don’t think it’s the only choice to use SSBs in initial BWP for SSB to PUSCH mapping. Regarding Ericsson’s suggestion on whether to postpone the discussion, Moderator understands it depends on whether companies can align the understanding, if not, we will stop the discussion.

So the key issue would be whether there is possibility that the UE will drop the SDT operation if separate initial BWP doesn’t include SSBs, if so, whether previous agreement should be re-visited.

 Any comments?

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | To clarify, it is NOT our understanding that “the latter one should be selected and previous agreement should be re-visited”. Our intention is to clarify what the previous agreements mean and any additional impact. For example, when FL talks about ‘initial BWP’, our first assumption is that it is the “legacy initial BWP” instead of the “separate initial BWP”, although FL cite the below agreements:*“RAN1 confirms that the separate BWP in case of RedCap may still be considered as the initial BWP and SDT resources(both CG-SDT and RA-SDT) can hence be configured on this BWP for RedCap UEs.”*Based on this understanding, we probably can agree that the UE will (instead of may) use the SSB in the (legacy) initial BWP for SSB to PUSCH mapping, however in this case, we wonder if any other spec impact is needed, since obviously the UE needs to retune to the legacy initial BWP from the separate initial BWP. Or is it the understanding that the UE retuning is UE implementation – note this is perhaps more frequently happening in SDT, than the cases that RedCap UE retunes from legacy initial BWP to separate initial BWP in RedCap, because the former happens every time a new data transmission occurs. |
| vivo | In our view, spec. change is needed to select one of the 2 options as summarized by FL. The option of doing the mapping between SSBs in the legacy initial DL BWP and the CG PUSCH transmission in the separate initial UL BWP is preferred instead of dropping the SDT completely. |
| Intel | As we mentioned in the previous round, our view is that UE would need to use the SSBs in initial BWP for mapping between SSB and CG-PUSCH resource. In this case, UE would not drop SDT operation, which seems against the agreement that “SDT resources (both CG-SDT and RA-SDT) can hence be configured on this BWP for RedCap UEs” However, our view is that current spec is clear and no need to further change the spec.  |
| Ericsson | Our understanding is: If separate initial DL BWP doesn’t include SSB, * UE will use CD-SSB for SSB to PUSCH mapping

Indeed, for shorter periodicities of CG-SDT, retuning to the frequency location of CD-SSB may be problematic. Our understanding is that configuration of NCD-SSB cannot be provided in CG-SDT configuration as NCD-SSB is applicable only for a dedicated/UE-specific DL BWP (and CG-SDT can be configured only in an initial BWP).  |
| Qualcomm | We think UE can use CD-SSB for SSB to CG-PUSCH mapping. As long as UE has a valid TA, a valid PUSCH occasion and the CG-SDT timer is running, UE does not need to exit the SDT operation. |

## Editorial correction on PRACH configuration for RA-SDT

In R1-2203244, ZTE has proposed the following:

*msgA-CB-PreamblesPerSSB-PerSharedRO* is shown as below. However, this parameter is used to configure a number of preambles per SSB per shared RO, not a number of SSB indexes.

|  |
| --- |
| *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 SS/PBCH block indexes associated with one PRACH occasion by 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-SharedRO-MaskIndex or sdt-msgA-SSB-SharedRO-MaskIndex according to [11, TS 38.321].*  |

The paragraph in section 19.2 mainly refers to 2-step RACH specified in section 8.1 as shown below, it’s clear that the definition of *msgA-CB-PreamblesPerSSB-PerSharedRO* should be number of preambles instead of number of SSBs.

|  |
| --- |
| 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]. |

Besides, in TS 38.331 v17.0.0, for each feature combination, preamble number per SSB per shared RO and shared RO mask are defined as marked in green. In order to align with definition of TS 38.331, some modifications are needed.



### First round discussion

#### TP#2.3-1

|  |
| --- |
| ***Reason for change:*** Description error for parameter *sdt-CB-PreamblesPerSSB-PerSharedRO/sdt-msgA-CB-PreamblesPerSSB-PerSharedRO*. Parameter name is not consistent with TS 38.331.***Summary of change:*** a number of SSB indexes is replaced by a number of preambles. *sdt-CB-PreamblesPerSSB-PerSharedRO* or *sdt-msgA-CB-PreamblesPerSSB-PerSharedRO* is replaced by *numberOfPreamblesForThisPartition-r17*. *sdt-SSB-SharedRO-MaskIndex* or *sdt-msgA-SSB-SharedRO-MaskIndex* is replaced by *ssb-SharedRO-MaskIndex-r17.****Consequences if not approved:*** description error and parameter misalignment.**------------------------------ TS 38.213-----------------------------------****< 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 *numberOfPreamblesForThisPartition-r17*~~SS/PBCH block indexes associated with one PRACH occasion by~~ *~~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 >** |

Since it’s an editorial issue, companies are encouraged to directly check whether TP#2.3-1 is acceptable.

Any comments?

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | OK with the TP |
| New H3C | We are fine with proposal TP. |
| Intel | For the TP, it seems to us only a single parameter is used to determine the number of preambles for both 4-step RACH and 2-step RACH. It may be good to clarify this.  |
| vivo  | Fine. |
| Samsung  | Not sure if RAN2 has finished the design and ASN.1 coding for the RACH partitioning work, if not, we may look at the full picture on how it works. |
| Ericsson | Similar view as Samsung. Perhaps we should wait until RAN2 sends back the list of used RRC parameter names. |

### Second round discussion

To Intel, as determined in RAN2 feature combination discussion, different features such as SDT, RedCap, CE will use the same parameter structure as follows, so the parameter name is not differentiated for 2-step SDT and 4-step SDT.



To Samsung, Ericsson, yes the parameter names would be more stable after the frozen of ASN.1, it’s also OK to consider the parameter name alignment after RAN Plenary in June.

#### TP#2.3-2

|  |
| --- |
| ***Reason for change:*** Description error for parameter *sdt-CB-PreamblesPerSSB-PerSharedRO/sdt-msgA-CB-PreamblesPerSSB-PerSharedRO*. ***Summary of change:*** a number of SSB indexes is replaced by a number of preambles. ***Consequences if not approved:*** description error.**------------------------------ TS 38.213-----------------------------------****< 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 ~~SS/PBCH block indexes associated with one PRACH occasion~~ by *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-SharedRO-MaskIndex* or *sdt-msgA-SSB-SharedRO-MaskIndex* according to [11, TS 38.321]. **< Unchanged text omitted >** |

Considering that 2 companies have the concern to align the parameter names, Moderator suggests to first fix the description error as in TP#2.3-2 and postpone the parameter name alignment after RAN Plenary in June.

Any comments?

|  |  |
| --- | --- |
| Company | Comment |
| vivo  | Fine. |
| Intel | We are fine with the proposal. |
| Qualcomm | Support the TP |
| Samsung | Fine to us. |
| New H3C | Fine  |
| Apple | ok |
| Xiaomi | OK |
| Ericsson | Fine |

## Editorial correction on USS set for CG-SDT

In R1-2203244, ZTE has proposed the following:

As agreed in RAN1 in previous meeting, UE specific search space set is supported for CG-SDT, in addition, RAN1 has sent RRC parameter list including sdt-CG-SearchSpace for this USS set for CG-SDT.

However, in TS 38.331 v17.0.0, the USS set for CG-SDT is configured by *pdcch-Config-r17* in *BWP-Downlink-Dedicated-SDT-r17*, which means that there is no specific parameter of USS set defined for CG-SDT, i.e. *sdt-CG-SearchSpace*. In order to align with definition in TS 38.331, *sdt-CG-SearchSpace* should be removed in the section 19.1 of TS 38.213.



In addition, in section 10.1 in TS 38.213, *sdt-CG-SearchSpace* is also used as below. Since the first sub-bullet has already included the second sub-bullet, it is feasible to remove the second bullet.



### First round discussion

#### TP#2.4-1

|  |
| --- |
| ***Reason for change:*** *sdt-CG-SearchSpace* is not defined in TS 38.331.***Summary of change:*** in the section 10.1, the bullet including *sdt-CG-SearchSpace* is removed. In the section 19.1, *sdt-CG-SearchSpace* is removed.***Consequences if not approved:*** *sdt-CG-SearchSpace* is not found in TS 38.331.**------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >**10.1 UE procedure for determining physical downlink control channel assignment **< 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~~* ~~for DCI formats with CRC scrambled by C-RNTI or CS-RNTI as described in clause 19.1.~~**< Unchanged text omitted >**19.1 Configured-grant based PUSCH transmission**< Unchanged text 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 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 text omitted >** |

Although this issue is also editorial, some companies in prep phase have suggested to wait for formal RAN2 reply LS and then to discuss the details. From Moderator’s understanding, the RRC parameter structure defined in RAN2 is relatively stable, introducing the whole pdcch-config in RRC release message is another kind of implementation method of parameter for USS set for CG-SDT, it should be fine to start to discuss relevant spec impact in RAN1.

Q1: Do you support TP#2.4-1?

Q2: Do you think we should wait for RAN2 LS before we make any change on parameter *sdt-CG-SearchSpace?*

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | Yes, let’s wait for the RAN2 LS. |
| New H3C | It is better to wait for RAN2 LS |
| Intel | We suggest to wait for RAN2 LS before any change on the parameter to avoid any discrepancy between RAN1 and RAN2.  |
| Spreadtrum | Yes, wait for the RAN2 LS |
| vivo  | Wait for RAN2. |
| Samsung  | Ok to wait for ran2 further progress.  |
| Ericsson | We should wait for RAN2 LS. |
| Moderator | Let’s wait for RAN2 LS before we make spec change on this. |

## Validation rule for CG-SDT overlapping with MsgA PUSCH

Companies’ views from the submitted contributions are collected in the following table.

|  |  |
| --- | --- |
| Tdocs | Proposals |
| R1-2203540 vivo [2] | **Proposal 3:** **For a UE that supports both CG-SDT and 2-step RACH, CG PUSCH occasions for SDT are treated as invalid when overlapping with MsgA PUSCH occasion, i.e. MsgA PUSCH occasion should be prioritized.****Proposal 4:** **For a UE that supports CG-SDT but doesn’t support 2-step RACH, CG PUSCH occasions for SDT can be treated as valid when overlapping with MsgA PUSCH occasions.** |
| R1-2203637 Ericsson [3] | [Proposal 1 For UEs supporting both CG-SDT and 2-step RACH, a CG PUSCH occasion is not valid if it overlaps with MsgA PUSCH occasion.](#_Toc101780019) |
| R1-2203767 Xiaomi [7] | **Proposal 1：For UEs with 2-step RACH feature, the CG-SDT POs are invalid if they are overlapping with msgA PUSCH resources.** |
| R1-2204785 [6] | **Proposal 1*** A CG PUSCH occasion is not valid if it overlaps with any valid MsgA PUSCH occasion.
* Agree on TP#1 for validation of CG PUSCH occasion for CG-SDT.
 |

### First round discussion

Validation rule for CG-SDT overlapping with MsgA PUSCH has been discussed for several meetings, in this meeting, 4 companies have discussed this issue and think that CG occasion is invalid if overlapping with MsgA PUSCH, so Proposal 2.5-1 is shown below.

#### ***Proposal 2.5-1***

For UEs supporting both CG-SDT and 2-step RACH, a CG PUSCH occasion is not valid if it overlaps with MsgA PUSCH occasion.

Moderator would like to check whether companies could accept this proposal, if it’s still controversial, the only way might be a conclusion of no consensus.

Any comments?

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | It is not necessary to have such a validation criterion, because:1. For a given UE, it will not perform CG-SDT and 2-step RACH simultaneously.
2. Even if the CG PUSCH occasion selected by UE A overlaps with the msgA PUSCH occasion selected by UE B, NW can still differentiate/receive the transmissions of both UEs if they have separate DMRS resources and/or PUSCH scrambling IDs.
3. msgA PUSCH occasions may be configured in 2-step RA and/or RA-SDT. If a UE does not support SDT based on 2-step RA, it cannot apply such validation procedure when the CG-PUSCH occasion overlaps with msgA PUSCH occasions configured for RA-SDT.
 |
| New H3C | The motivation and scenario of this issue aren’t clear to us because 2-step RACH should be semi-static configured and NW can configure CG-SDT resource non- overlapping with msg-A PUSCH of 2-step RACH. |
| Intel | We support Proposal 2.5-1.  |
| vivo  | Fine. |
| Samsung  | Did not see the motivation to have this invalid rule.  |
| Ericsson | We support the proposal. |
| Huawei, HiSilicon | This can be left to gNB implementation or UE implementation. |

### Second round discussion

According to the comments, 3 companies support Proposal 2.5-1 while 4 companies think it’s not necessary. The situation is exactly the same for several meetings, Moderator cannot see any possibility of making progress on this issue, so instead of spending further effort on this issue, it’s suggested to make a conclusion to reflect the situation of this validation issue.

#### ***Conclusion 2.5-2***

RAN1 cannot reach consensus on whether to define validation rule for CG-PUSCH overlapping with MsgA PUSCH.

Any comments?

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | Fine with the conclusion |
| New H3C | OK with this conclusion |
| Apple | OK with this conclusion |
| Xiaomi | We are ok for progress. |
| Ericsson | Fine |

## Type 1A CSS set overlapping with Type 1 CSS set

In R1-2204518, Spreadtrum has proposed the following:

For Rel-15/Rel-16, for single cell operation or for operation with carrier aggregation in a same frequency band, when the QCL-TypeD property of PDCCH in Type-0/0A/2/3 CSS or USS set are different from the QCL-TypeD property of PDCCH in Type-1 CSS and, and both PDCCHs or associated PDSCH are overlapping or partially overlapping in time, a UE does not expect to monitor the PDCCH in a Type-0/0A/2/3 CSS or USS set.

In Rel-17, Type-1A CSS is introduced to support small data transmission. In our understanding, although the type of SS of Type-1A is common, the scheduling behaviour is kind of UE specific data scheduling, for the sake of PDCCH in Type-1A CSS with CRC scrambled by a C-RNTI or a CS-RNTI. Thus, taking USS as reference, the priority of Type-1A CSS can be regarded as being lower than Type-1 CSS when referring to collision issue of the QCL-Type D property of overlapped PDCCHs each in Type-1 CSS or Type-1A CSS.

When the QCL-TypeD property of PDCCH in Type-1A CSS is different from the QCL-TypeD property of PDCCH in Type-1 CSS and, and both PDCCHs or associated PDSCH are overlapping or partially overlapping in time, a UE does not expect to monitor the PDCCH in a Type-1A CSS.

### 2.6.1 First round discussion

As mentioned in [5], since Type 1A CSS set is introduced for SDT, it should be clarified whether Type 1A CSS set has lower priority then Type 1 CSS set, if so, TP# 2.6-1 can be considered as a starting point.

#### TP#2.6-1

|  |
| --- |
| ***Reason for change:*** For Rel-15/Rel-16, for single cell operation or for operation with carrier aggregation in a same frequency band, when the QCL-TypeD property of PDCCH in Type-0/0A/2/3 CSS or USS set are different from the QCL-TypeD property of PDCCH in Type-1 CSS and, and both PDCCHs or associated PDSCH are overlapping or partially overlapping in time, a UE does not expect to monitor the PDCCH in a Type-0/0A/2/3 CSS or USS set. In Rel-17, Type-1A CSS is introduced to support small data transmission. In our understanding, although the type of SS of Type-1A is common, the scheduling behaviour is kind of UE specific data scheduling, for the sake of PDCCH in Type-1A CSS with CRC scrambled by a C-RNTI or a CS-RNTI. Thus, taking USS as reference, the priority of Type-1A CSS can be regarded as being lower than Type-1 CSS when referring to collision issue of the QCL-Type D property of overlapped PDCCHs each in Type-1 CSS or Type-1A CSS.***Summary of change:*** When the QCL-TypeD property of PDCCH in Type-1A CSS is different from the QCL-TypeD property of PDCCH in Type-1 CSS and, and both PDCCHs or associated PDSCH are overlapping or partially overlapping in time, a UE does not expect to monitor the PDCCH in a Type-1A CSS.***Consequences if not approved:*** The UE behavior is not clear, when the QCL-TypeD property of PDCCH in Type-1A CSS is different from the QCL-TypeD property of PDCCH in Type-1 CSS and, and both PDCCHs or associated PDSCH are overlapping or partially overlapping in time.**------------------------------ TS 38.213-----------------------------------****< Unchanged text omitted >**10.1 UE procedure for determining physical downlink control channel assignment **< Unchanged text omitted >**For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not expect to monitor a PDCCH in a Type0/0A/0B/1A/2/3-PDCCH CSS set or in a USS set if a DM-RS for monitoring a PDCCH in a Type1-PDCCH CSS set is not configured with same *qcl-Type* set to 'typeD' properties [6, TS 38.214] with a DM-RS for monitoring the PDCCH in the Type0/0A/0B/1A/2/3-PDCCH CSS set or in the USS set, and if the PDCCH or an associated PDSCH overlaps in at least one symbol with a PDCCH the UE monitors in a Type1-PDCCH CSS set or with an associated PDSCH. **< Unchanged text omitted >** |

#### ***Discussion point 2.6-1***

Whether Type1A CSS set has lower priority than Type1 CSS set

* If so, whether TP#2.6-1 is acceptable.

Any comments?

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | OK with TP#2.6-1 |
| New H3C | We are fine with this TP. |
| Intel | We do not think the TP is needed. As commented during the preparation phase, our understanding is that for SDT in RRC\_INACTIVE mode, UE is expected to assume same QCL assumption for both PDCCH in Type-1A CSS and Type-1 CSS. Tx/Rx beam is always determined based on SSB to latest CG-PUSCH association. In addition, the overlapping between PDCCH in Type-1A CSS and Type-1 CSS can be avoided by gNB proper scheduling.  |
| Spreadtrum | Agree with Type-1A CSS has lower priority than Type-1 CSS.Support the TP.Indeed, gNB proper scheduling is one way to avoid the overlapping between PDCCH in Type-1A CSS and Type-1 CSS. But actually it would set the restriction on gNB’s implementation. It can been seen that for Type-0/0A/2/3 CSS or USS set, we have already done collision handling rules, rather than up to gNB’s implementation. It would be very wired to only let Type-1A CSS up to gNB’s implementation. |
| vivo  | There seems no QCL assumption issue as pointed out by Intel. If this is the common understanding, the TP may be not necessary. |
| Samsung  | If type-1A is only for SDT, type 1 is for RACH related, if UE won’t have SDT procedure and RACH procedure at the same time, there is no chance UE will need to monitor both CSS at the same time. So there is no such collision from UE operation perspective.  |
| Ericsson | Similar view as Intel and Vivo. Also, it is not clear to us why would a UE need to monitor Type1-PDCCH CSS if it is configured with Type1A-PDCCH CSS.  |

### 2.6.2 Second round discussion

To Samsung and Ericsson, there is possibility that a UE may need to monitor Type 1 and Type 1A CSS set simultaneously during subsequent phase, because RAN2 has made this agreement previously “3. During subsequent CG transmission phase (i.e. after the UE has received response from NW) UE can initiate at least legacy RACH procedure (e.g. trigger due to no UL resources).”

Since at least 3 companies raise concern and think that gNB could avoid the overlapping or guarantee the same QCL assumption for Type 1 and Type 1A CSS set, the following alternative solutions can be further discussed. From Moderator’s understanding, each option has spec impact.

#### ***Discussion point 2.6-2***

How to handle the potential overlapping between Type 1 and Type 1A CSS set if they have different QCL assumption

* Option 1: Type1A CSS set has lower priority than Type1 CSS set, same handling as all other CSS sets and USS set.
* Option 2: UE expects the same QCL assumption for Type 1 and Type 1A CSS set.
* Option 3: UE expects that Type 1 CSS set will not overlap with Type 1A CSS set

Which option is preferred? If Option 2 or 3 is supported, please also provide corresponding TP, thanks!

|  |  |
| --- | --- |
| Company | Comment |
| vivo  | For CG SDT, UE will not monitor PDCCH in Type 1 CSS according to following spec. text:

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| 38.213 section 19.1: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. |

For RA-SDT, RA-RNTI/MsgB RNTI are still monitored in Type 1 CSS, according to following spec. text:

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| 38.213 section 10.1:- a Type1-PDCCH CSS set configured by *ra-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a RA-RNTI, a MsgB-RNTI, or a TC-RNTI on the primary cell- a Type1A-PDCCH CSS set configured by *sdt-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a C-RNTI or a CS-RNTI on the primary cell as described in clause 19.138.214 section 5.1:When receiving PDSCH scheduled with RA-RNTI, or MSGB-RNTI, the UE may assume that the DM-RS port of PDSCH is quasi co-located with the SS/PBCH block or the CSI-RS resource the UE used for RACH association as applicable, and transmission with respect to Doppler shift, Doppler spread, average delay, delay spread, spatial RX parameters when applicable.38.213 section 10.1:For a CORESET other than a CORESET with index 0, - if a UE has not been provided a configuration of TCI state(s) by *tci-StatesPDCCH-ToAddList* and *tci-StatesPDCCH-ToReleaseList* for the CORESET, or has been provided initial configuration of more than one TCI states for the CORESET by *tci-StatesPDCCH-ToAddList* and *tci-StatesPDCCH-ToReleaseList* but has not received a MAC CE activation command for one of the TCI states as described in [11, TS 38.321], the UE assumes that the DM-RS antenna port associated with PDCCH receptions is quasi co-located with the SS/PBCH block the UE identified during the initial access procedure, or for a most recent configured grant PUSCH transmission as described in clause 19 for a same HARQ process; - if a UE has been provided a configuration of more than one TCI states by *tci-StatesPDCCH-ToAddList* and *tci-StatesPDCCH-ToReleaseList* for the CORESET as part of Reconfiguration with sync procedure as described in [12, TS 38.331] but has not received a MAC CE activation command for one of the TCI states as described in [11, TS 38.321], the UE assumes that the DM-RS antenna port associated with PDCCH receptions is quasi co-located with the SS/PBCH block or the CSI-RS resource the UE identified during the random access procedure initiated by the Reconfiguration with sync procedure as described in [12, TS 38.331].For a CORESET with index 0, - if the UE is provided *DLorJoint-TCIState* and if *followUnifiedTCIstate* = '*enabled*' for the CORESET, the UE assumes that a DM-RS antenna port for PDCCH receptions in the CORESET and a DM-RS antenna port for PDSCH receptions scheduled by DCI formats provided by PDCCH receptions in the CORESET are quasi co-located with the reference signals provided by the indicated *DLorJoint-TCIState* [6, TS 38.214]- else, the UE assumes that a DM-RS antenna port for PDCCH receptions in the CORESET is quasi co-located with - the one or more DL RS configured by a TCI state, where the TCI state is indicated by a MAC CE activation command for the CORESET, if any, or- a SS/PBCH block the UE identified during a most recent random access procedure not initiated by a PDCCH order that triggers a contention-free random access procedure, if no MAC CE activation command indicating a TCI state for the CORESET is received after the most recent random access procedure, or a SS/PBCH block the UE identified during a most recent configured grant PUSCH transmission as described in clause 19. |

For subsequent SDT after contention resolution in RA-SDT, UE will monitor C-RNTI addressed PDCCH in Type 1A CSS if provided, or in Type 1 CSS otherwise, according to following text

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| 38.213 section 19.2: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 PRACH transmission are quasi co-located with respect to average gain and quasi co-location 'typeA' or 'typeD' properties. |

According to above, the collision mentioned by companies if I understand correctly is during RA-SDT when ra-SearchSpace is monitored. As can be seen, PDSCH scheduled with RA-RNTI, or MSGB-RNTI has same QCL assumption with the SS/PBCH block associated with the PRACH transmission specified in 38.214. QCL type of RAR/MsgB PDCCH depends on the related CORESET used and whether MAC CE would be received according to 38.213. In our understanding, the TCI activation MAC CE is not supported for SDT in RRC inactive state meaning that the PDCCH transmissions scheduling RAR/MsgB also have the same QCL assumption with the SS/PBCH block associated with the PRACH transmission for RA-SDT. If Above is the common/correct understanding, QCL assumption for Type 1 and Type 1A CSS set in RA-SDT will be the same. Hence, there will be no issue on the Type 1A/1 CSS in RA-SDT. |
| Intel | We share similar view as Vivo that these two should have same QCL assumption. Further, overlapping can be avoided by gNB scheduler for SDT operation considering infrequency small data transmission. We do not think the TP is needed.  |
| Qualcomm | We are fine with Option 1 or no TP. |
| Samsung | Thx FL for the explanation on the follow-up transmission and possible RACH procedure. In that case, we think the “collision” might be possible. But according to the spec vivo cited, the statement from spec that “a SS/PBCH block the UE identified during a most recent random access procedure” could solve the problem.  |
| New H3C | We support option 1. |
| Apple | According to vivo’s explanation, the QCL assumption is the same for type 1 and type1A search space, so the TP seems not neceeeary. |
| Spreadtrum | We share the same understanding with FL. We support option 1. It is consistent with current specification, and simple.Regarding QCL-TypeD collision issue, we think the collision can exist. The reasons are below:- For CG-SDT, the current specification just say UE may assume DMRS for PDCCH QCLed with SS/PBCH block associated with the PUSCH transmission, i.e., QCL-Type D RS for Type 1A is the SS/PBCH block associated with the PUSCH transmission. It cannot be inferred that UE would not monitor Type1 CSS.

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| 38.213 section 19.1: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. |

* For RAR, as vivo points that PDSCH scheduled with RA-RNTI, or MSGB-RNTI has same QCL assumption with the SS/PBCH block associated with the PRACH transmission or QCL-TypeD RS of TCI state indicated by MAC CE.

In our understanding, the SS/PBCH block associated with the PUSCH transmission may be different the SS/PBCH block associated with the PRACH transmission. Thus, we think the QCL-TypeD collision between Type1A and Type1 may exist. |
| Xiaomi | For CG-SDT, agree with Spectrum that the SSB associated with the PUSCH transmission may be different from the SS/PBCH block associated with the PRACH transmission, considering that maybe only a subset of SSBs configured in SIB1 is associated with CG resources and the selected SSB may be different.For RA-SDT, the Type-1 CSS is QCLed with the selected SSB for PRACH transmission. And, during the RA-SDT procedure (after RACH and before SDT timer expires), legacy RACH procedure may be initiated (e.g. trigger due to no UL resources). In this way, the UE needs to monitor both Type 1 CSS and Type 1A CSS during this procedure. Since SSB measurement and selection should be performed before initiating the new RACH, the selected SSB for new RACH may not be the same as the one for first RACH for SDT. Thus, there is misalign on QCL relationship between Type-1 CSS and Type 1A CSS. But, from our point of view, the gNB can reasonably configure the Type 1 CSS and Type 1A CSS without any overlapping. Even if non-overlapping resources can’t be found by the gNB, as an optional supplement to Type 1 CSS, the Type 1A CSS can also not be configured. Anyway, it depends on gNB scheduling and no specification impact should be involved.From above, option 3 is preferred by us and No modification on the specification is needed. |
| Ericsson | Thanks for FL’s clarification on Discussion point 2.6-1. On Discussion point 2.6-2, we have similar concerns as others above. In addition, to our understanding, based on the RAN2 agreement, at least until the legacy RACH procedure is initiated (to trigger UL resources), the UE needs to monitor only Type-1A CSS (if configured) and not Type-1 CSS. If so, we think that this need to be clarified. *During subsequent CG transmission phase (i.e. after the UE has received response from NW) UE can initiate at least legacy RACH procedure (e.g. trigger due to no UL resources).* |

### 2.6.3 Third round discussion

Companies’ views are still quite divergent on this issue, regarding whether such collision may happen, i.e. whether QCL assumption is always the same for Type 1 and Type 1A CSS set, Moderator’s observations on companies’ views are summarized as below:

#### ***Discussion point 2.6-3***

Understanding 1: QCL assumption is not always the same for Type 1 and Type 1A CSS set

* For CG-SDT, they are probably not the same because only subset of SSBs may be associated with Type 1A CSS set. -- Spreadtrum, Xiaomi
	+ Ericsson points out that for CG SDT UE may not need to monitor Type 1 and Type 1A CSS set simultaneously, during subsequent transmission before RACH procedure, UE only monitors Type 1A,.
* For RA-SDT, they are probably not the same because SSB associated with normal RACH procedure may not be the same as SSB associated with RA-SDT. -- Spreadtrum, vivo
	+ Xiaomi points out that during the RA-SDT procedure (after RACH and before SDT timer expires), legacy RACH procedure may be initiated (e.g. trigger due to no UL resources). Since SSB measurement and selection should be performed before initiating the new RACH, the selected SSB for new RACH may not be the same as the one for first RACH for SDT.

Understanding 2: QCL assumption is always the same for Type 1 and Type 1A CSS set -- vivo, Intel, Apple

* For CG-SDT, UE will not monitor Type 1 CSS set -- vivo
* For RA-SDT, the SSBs associated with normal RACH and RA-SDT are always the same. -- vivo

Indeed if QCL assumption is always the same for Type 1 and Type 1A CSS set, that means such collision won’t happen, there is no need to consider any spec impact. Otherwise, Moderator understands we need to go with one of these 3 options. So Moderator suggests companies to first align the understanding on whether QCL assumption can be always the same for Type 1 and Type 1A CSS set based on other companies’ views in the 2nd round.

Companies are encouraged to provide views on these 2 understandings.

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| Company | Comment |
| Vivo | As we commented based on the current spec., UE will not monitor Type 1 CSS in CG-SDT.During RA-SDT, for both normal RA (to go back to RRC connected state) and RA for SDT, Type 1 CSS is monitored; for subsequent SDT (before going back to RRC connected state), UE will monitor C-RNTI addressed PDCCH in Type 1A CSS if provided, or in Type 1 CSS otherwise.For normal RA, when selected, the UE will go back to RRC connected state and will not monitor type 1A CSS, hence there’s no need to consider collision issue between Type 1 and Type 1A CSS.Therefore, the question is whether QCL assumption for Type 1A CSS is the same with the Type 1 CSS for monitoring subsequent SDT during RA SDT. According to the spec. text we cited in last round, it will be the same.As a conclusion, we do not see a TP is necessary and no issue has been identified according to above understandings which is aligned with current spec. |
| Intel | We share similar view as Vivo at least QCL assumption is always the same for Type 1 and Type 1A CSS set. Further, as mentioned above, we do not think this is a typical case for overlapping, which can be completely avoided by gNB scheduler implementation for SDT operation. We do not think the TP is needed.  |
| Ericsson | Fine to go with suggestions from Vivo and Intel, i.e., TP is not needed. |
| Qualcomm | We are fine with the suggestion/conclusion of Vivo |

## Others

If companies have any other comments, please provide that in the table below.

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| Company | Comment |
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# Summary

The final proposals will be added later.

# References

1. R1-2203244 Discussion on remaining physical layer issues of small data transmission ZTE Corporation
2. R1-2203540 Remaining issues for NR small data transmissions in RRC INACTIVE state and Tx switching enhancements vivo
3. R1-2203637 Maintenance issues for NR small data transmissions in inactive state Ericsson
4. R1-2203885 Maintenance on small data transmission Samsung
5. R1-2204518 Remaining issues on RAN1 aspects for small data transmission Spreadtrum Communications
6. R1-2204784 Remaining issues on physical layer aspects of small data transmission Intel Corporation
7. R1-2203767 Discussion on physical layer aspects of small data transmission xiaomi