**3GPP T****SG-RAN WG2 Meeting #114-electronic R2-210xxxx**

**Online, May 19th – May 27th, 2021**

**Agenda item: 8.6.1**

**Source: vivo**

**Title:** **Report of [Post113bis-e][507][SDT] Resource configuration aspects**

**Document for: Discussion and Decision**

# 1 Introduction

This contribution is aimed at reporting the discussion and results of the following email discussion:

* **[POST113bis-e][507][SDT] Resource configuration aspects (Vivo)**
  + - For RA (details of RACH resource configuration, and search space for SDT (USS vs CSS – see RAN1 LS in R2-2102620))
    - For CG (details of CG configuration and also the FFS on CG-SDT resource to be configured on BWPs other than initial BWP)

Then, the rapporteur would like to point out the deadline for companies inputs to May 7th (Friday) 23:59 PDT, as per the Chairman’s clarification on the submission deadline of long email discussion.

# 2 Participants

|  |  |  |
| --- | --- | --- |
| Company | Participant name | E-mail |
| vivo | Yitao Mo (Stephen) | yitao.mo@vivo.com |
| OPPO | Xue Lin | linxue@oppo.com |
| LG Electronics | SeungJune Yi | seungjune.yi@lge.com |
| ASUSTeK | Erica Huang | Erica\_Huang@asus.com |
| TCL | Hejun Wang | hejun.wang@tcl.com |
| Samsung | Anil Agiwal | anilag@samsung.com |
| Sharp | Chongming Zhang | chongming.zhang@cn.sharp-world.com |
| Ericsson | Henrik Enbuske | Henrik enbuske @ ericsson.com |
| Qualcomm | Ruiming Zheng | rzheng@qti.qualcomm.com |
| Lenovo | Jie Shi | Shijie4@lenovo.com |
| Google | Shiangrung Ye | Shiangrungye@google.com |
| ITRI | Lin, Jung-Mao | moumou3@itri.org.tw |
| APT | HsinHsi Tsai | hsin-hsi.tsai@fginnov.com |
| InterDigital | Faris Alfarhan | faris.alfarhan@interdigital.com |
| Huawei, HiSilicon | Yinghao Guo | yinghaoguo@huawei.com |

# 3 Resource configuration for RA-SDT

## 3.1 RACH resource configuration

### 3.1.1 Dedicated RACH resource configuration

In RAN2#112-e and RAN2#113-e, the following agreements regarding RA-SDT resource configuration were achieved [1][2]:

|  |
| --- |
| RAN2#112-e Agreement:  As a baseline, the RACH resource i.e. (RO+preamble combination) is different between SDT and non-SDT   * If ROs for SDT and non SDT are different, preamble partitioning between SDT and non SDT is not needed. * If ROs for SDT and non SDT are same, preamble partitioning is needed   FFS if common configuration should be allowed  RAN2#113-e Agreement:  RAN2 continues to progress the work based the separate RACH resources for SDT (i.e. explicit mechanisms to support common resources won’t be pursued unless there is sufficient support for this. However, use of common RACH resources will not be precluded if possible via implementation |

In NR, for both 4-step and 2-step RACH, the network can configure CBRA resource (via SIB) and/or CFRA resource (via RRC dedicated signaling) to a UE. For RA-SDT in RRC INACTIVE, it might be also feasible for the network to provide CBRA resource (via SIB) and/or CFRA resource (via RRC Release message) from the signaling point of view. In this sense, it is worthy to collect companies’ views on whether it is possible to configure dedicated CFRA resources for a given UE for RA-SDT.

#### Q1: Do companies agree dedicated RACH resources can be configured for RA-SDT?

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | No | No, we think CBRA is enough for Rel-17. |
| OPPO | No |  |
| LG | No | If the dedicated resource is needed, the network can configure CG-SDT. Thus, for RA-SDT, CBRA is enough. |
| ASUSTeK | No | Share the view with LG. |
| TCL | Comments | Generally we agree with LG that CG can be tanke into account if dedicated resource is needed. however, dedicated RACH resource, especially the dedicated resource for CFRA, can be utilized to avoid RA-SDT failures because of the contention failure. Thus we should not preclude the dedicated RACH resource and postpone it to the discussion of SDT failure handling. |
| Samsung | No | CBRA is enough. |
| Sharp | No | Common RACH resource for RA-SDT could be a baseline.  Dedicated RACH resouces could only be used in the same cell and introduce complexity for the RA-SDT.  Furthermore, dedicated CFRA will consum additional preambles which is unacceptable. |
| Ericsson | No |  |
| Qualcomm | No |  |
| Lenovo | Yes | It could be considered if the network has UE traffic model and could predict when the CFRA will be used in the SDT. This could make SDT more flexible, CG resource is precious and is released until TAT is expired, which may be not suitable to one shot SDT transmission. |
| Google | No |  |
| ITRI | No | We share the same views with LG. |
| APT | No | There is dedicated UL resource in CG-SDT, so dedicated RACH resource in RA-SDT is not essential. |
| InterDigital | No | CBRA is enough for R17, provided there are no tight latency requirements that requires configuring CFRA resources. |
| Huawei, HiSilicon | No | The dedicated RA resource provided in RRCRelease will not be suitable RACH resource after the UE moves in RRC\_INACTIVE with the UE’s mobility. CFRA 2-step RA is only used for handover and there is no handover for UE in RRC\_INACTIVE. If the UE’s TA is invalid at the initiation of SDT procedure, contention-based RA-SDT resource can be used. There is no need to reserve scarce PRACH resources for SDT Procedure |

**Summary:**

### 3.1.2 Separate RACH resource configuration

As it was agreed that ROs can be shared with SDT and non-SDT with separate preambles, then we would consider how to indicate the separate SDT preambles for 4-step/2-step RA-SDT.

In Rel-16, when ROs are shared between 4-step and 2-step RACH, *msgA-CB-PreamblesPerSSB-PerSharedRO-r16* is configured to indicate the number of CBRA preambles associated with each SSB for 2-step RACH. And these 2-step RACH preambles are allocated from the beginning of non 4-step CBRA preambles based on TS 38.213. An example of preamble partition for 4-step and 2-step RACH is shown in the following figure.



Figure 1: example of preamble partition when ROs are shared between 4-step and 2-step RACH

For RA-SDT with shared ROs between SDT and non-SDT, it seems a spontaneous logic that the number of contention-based RACH preambles associated with per SSB shall be configured.

#### Q2: Do companies support configuring the number of contention-based 4-step/2-step RACH preambles per SSB for RA-SDT when ROs are shared between SDT and non-SDT?

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | Yes | Yes, this seems fairly straightforward to agree.  However, the stage-3 details for signalling would need further discussion in RAN2 and may need some coordination across WIs  which require the separate configuration of RA resource pool.  For example, we may have a flat structure, in which the possible usage of preambles is configured for each preamble range. One possible structure can be as follows:  Preamble range   * Start preamble index * Number of preambles * SDT indication (whether SDT is allowed for such preambles) * Slice list (which slice(s) can be supported) * REDCAP indication (whether the related preambles can be used for REDCAP)   In the example above, the number of preambles is not only given for SDT but is shared between other use cases too. If we have a number specifically for SDT preambles, then we may need a layered structure, which may look like:  SDT preamble range   * Start preamble index * Number of preambles * Support Slice list (which slice can be supported) * REDCAP indication (whether the related preambles can be used for REDCAP)   Non-SDT preamble range   * Start preamble index * Number of preambles * Support Slice list (which slice can be supported) * REDCAP indication (whether the related preambles can be used for REDCAP)   We think the first structure provides better flexibility and is preferred. |
| OPPO | Yes |  |
| LG | Comments | Leave it up to RAN1. |
| ASUSTeK | Yes | The preamble configuration can use the same logic of 2-step and 4-step RA. The NW can configure a parameter to indicate the number of preambles associated with each SSB for SDT. And the start preamble index of SDT can follow the range of preamble for non-SDT. |
| TCL | Comments | Leave it up to RAN1. |
| Samsung | Yes |  |
| Sharp | Yes |  |
| Ericsson | Yes | In principle yes, but before deciding in detail we should sort out cross-WI issue with the preamble and RACH partitioning since this is a common aspects between several Rel-17 Wis. |
| Qualcomm | Comments | This can be discussed in RAN1. |
| Lenovo | Comments | Leave it to RAN1. |
| Google | Yes |  |
| ITRI | Yes |  |
| APT | Yes | The details can be studied in stage 3. |
| InterDigital | Yes | Details can be left for stage 3, and in consideration of other usecases for PRACH partitioning listed by ZTE (with the addition of indicating the capability of Msg3 repeatition agreed in the coverage enhancements WI). |
| Huawei, HiSilicon | Yes | We would like to reuse the legacy rules to configure the number of CB preambles per SSB for 4-step/2-step RA-SDT.  A more direct answer to the question is that we should have two parameters of CB-PreamblesPerSSB for 4stepSDT and 2-stepSDT. |
|  |  |  |

**Summary:**

Further, for RA-SDT with shared RO between SDT and non-SDT, the CBRA preamble configuration is varied. For example, the network may simultaneously configure legacy 4-step CBRA preambles and at least one type of preambles in the following for one shared RO: 1) legacy 2-step CBRA preambles; 2) 4-step SDT CBRA preambles; 3) 2-step SDT CBRA preambles.



Figure 2: example of preamble configuration when ROs are shared between SDT and non-SDT

On the UE side, an SDT-capable UE may not be aware of the legacy 2-step preambles due to limited capability. As a result, the UE cannot assume the SDT CBRA preamble is allocated from the beginning of non 2-step CBRA preambles. Then an explicit starting preamble index for 4-step/2-step SDT preambles would be needed. Companies are invited to answer the following question for whether a preamble starting index is introduced for 4-step/2-step RA-SDT configuration.

#### Q3: Do companies support introducing a preamble starting index for RA-SDT when ROs are shared between SDT and non-SDT?

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | Yes | Yes, this parameter will be necessary. The RAN2 discussion needs to focus on whether we have a separate parameter for each WI requiring RACH partition or we share the preambles (see the answer to Q2 above). |
| OPPO | Yes | Agree with ZTE. |
| LG | Comments | Leave it up to RAN1. |
| ASUSTeK | No | UE could be aware of preambles for non-SDT 2-step RA from system information. The SDT preambles could be allocated after the non-SDT 2-step CBRA preambles if non-SDT 2-step is configured, and could be allocated after the non-SDT 4-step CBRA preambles if non-SDT 2-step is not configured. A starting index for RA-SDT is redundant. |
| TCL | Yes with comments | Generally agree with ZTE, parameters to specify the subset of preambles for RA-SDT should defined, e.g. start index, number of preambles, etc. However, it belongs to RAN1 scope and we should leave it to RAN1. |
| Samsung | Yes | Network can set starting index considering various RA configurations |
| Sharp | Yes with comments | When ROs are shared between SDT and non-SDT, preamble partitioning is necessary. A preamble starting index could be a way forward. However, other partitioning way could be also discussed. |
| Ericsson | Yes, comment | In principle yes (at least it should be backwards compatible), but before deciding in detail we should sort out cross-WI dependencies with preambles |
| Qualcomm | Comments | This can be discussed in RAN1. |
| Lenovo | Comments | Leave it to RAN1. |
| Google | Yes | It may be simple to introduce a starting index to indicate the starting preamble for RA-SDT. |
| ITRI | Comments | Leave it up to RAN1. |
| APT | Yes |  |
| InterDigital | Yes | Details can be left for stage 3, and in consideration of other usecases for PRACH partitioning |
| Huawei, HiSilicon | No | The SDT UE may not support 2-stepRA but it still can read the configuration in system information for 2-step RA.  It would be good we can reuse configuration principles that we have already instead of intrioducing new parameters. From implementation point view, implementing reading new index parameter or implementing reading the parameter giving the number of parameters for 2-step RA seems equally easy/difficult. |

**Summary:**

Furthermore, in Rel-16, when ROs are shared between 4-step and 2-step RACH, *msgA-SSB-SharedRO-MaskIndex-r16* can be configured to indicate the subset of 4-step type ROs that are shared with 2-step random access type. Similar to 2-step RACH, for RA-SDT, companies are invited to answer the following question for whether a shared RO mask index is introduced for 4-step/2-step RA-SDT configuration to indicate the subset of 4-step/2-step type ROs that are shared with 4-step/2-step RA-SDT.

#### Q4: Do companies support introducing a shared RO mask index for RA-SDT?

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | Yes | In general, this also is required, but again stage-3 signalling aspects need to be coordinated for other WIs |
| OPPO | Yes |  |
| LG | Comments | Leave it up to RAN1. |
| ASUSTeK | Yes |  |
| TCL | Comments | Leave it up to RAN1. |
| Samsung | Comments | Can be discussed in RAN1 |
| Sharp | Yes |  |
| Ericsson | Yes | In principle yes (at least it should be backwards compatible), but before deciding in detail cross WG and WI discussions needed |
| Qualcomm | Comments | This can be discussed in RAN1. |
| Lenovo | Comments | Leave it to RAN1. |
| Google | Comments | Leave it to RAN1 |
| ITRI | Comments | Leave it up to RAN1. |
| APT | Yes |  |
| InterDigital | Stage 3 | Leave it for stage-3 design |
| Huawei, HiSilicon | Yes | We would like to reuse the RO mask in R16 2-step RACH only for indicating the shared RO  This also depends on what kind of sharing do we allow. For example, do we allow sharing of RO between 2-step and 4-step RA SDT? But the indication should indicate whether the sharing is between RO for SDT/non-SDT or 2-stepSDT/4-stepSDT. |

**Summary:**

For separate ROs configured for SDT, the question comes to how to indicate the separate RACH configuration for SDT. In Rel-16, to configure a separate ROs, the network can configure *msgA-prach-ConfigurationIndex*, *MsgA-RO-FDM* and *msgA-RO-FrequencyStart* for UE performing 2-step RACH. Alternatively, the network can configure *prach-ConfigurationPeriodScaling-IAB*, *prach-ConfigurationFrameOffset-IAB*, *msgA-prach-ConfigurationSOffset-IAB* for IAB-MT node.

Based on the existing mechanism, to configure separate ROs for RA-SDT, RAN2 might consider the following two options (for possible down-selection or combination(s) of these options):

* Option 1: network can configure a separate prach-ConfigurationIndex, RO-FDM, and RO-FrequencyStart for RA-SDT (same as separate RO configuration for 2-step RACH);
* Option 2: network can configure a separate prach-ConfigurationPeriodScaling, prach-ConfigurationFrameOffset, prach-ConfigurationSOffset (same as separate RO configuration for IAB).

And companies are invited to provide their preferences.

#### Q5: Which option(s) do companies prefer for separate RO configuration for RA-SDT?

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Option 1/2/**  **Comments)** | **Detailed comments** |
| ZTE |  | We prefer to support separate RACH-ConfigCommon and msgA-ConfigCommon-r16 for SDT. |
| OPPO | Option1 |  |
| LG | Comments | Leave it up to RAN1. |
| ASUSTeK | Option 1 | Detail can be decided by RAN1. |
| TCL | Comments | No strong view, leave it up to RAN1. |
| Samsung | Comments | Option 1 should be baseline. Note that option 2 is not standalone. These are additional parameters which can be configured by network on top of option1 |
| Sharp | Option 1 |  |
| Ericsson | Option 1, comment | Option 1 may be more flexible since it allows different formats.e.g using more preamble formats which give better coverage for SDT, RNTI issues need to be sorted out. |
| Qualcomm | Comments | This can be discussed in RAN1. |
| Lenovo | Comments | Leave it to RAN1. |
| Google | Option 1 | It is simper to have another configuration for RA-SDT. |
| ITRI | Comments | Leave it up to RAN1. |
| APT | Option 1 |  |
| InterDigital | Option 1 | RRC signalling details can wait for stage-3 |
| Huawei, HiSilicon | Option1 | The motivation to introduce the scaling for IAB is because IAB may not need RACH resource of short periodicity configured by PRACH configuration index. This motivation does not hold here.  The same approach to configure separate RO for 2-step RACH can be reused |

**Summary:**

Similar to separate RACH configuration in legacy 2-step RACH, if Option 1 mentioned above is chosen for RA-SDT, then the number of SSBs per RO and the number of contention-based preambles for each SSB might be optionally configured for 2-step/4-step RA-SDT.

#### Q6: Do companies agree that the number of contention-based 4-step/2-step RACH preambles per SSB and the number of SSBs per RO can be configured for RA-SDT when ROs for SDT and non-SDT are separate?

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | Yes | Yes, this seems fine. See also comments to Q2. |
| OPPO | Yes |  |
| LG | Comments | Leave it up to RAN1. |
| ASUSTeK | Yes |  |
| TCL | Yes with comments | See comments to Q3, we should leave details to RAN1. |
| Samsung | Yes |  |
| Sharp | Yes |  |
| Ericsson | Yes | Seems reasonable. But as above Qs, details should be postponed. Needed if number of preambles should be allowed to be different for SDT vs. non-SDT |
| Qualcomm | Comments | This can be discussed in RAN1. |
| Lenovo | Comments | Leave it to RAN1. |
| Google | Yes |  |
| ITRI | Comments | Leave it up to RAN1. |
| APT | Yes |  |
| InterDigital | Yes |  |
| Huawei, HiSilicon | Yes, but | If it is separate RO, another independent set of RACH configuration should be provided. We are not sure why this needs to be discussed. |

**Summary:**

Considering both 4-step type and 2-step RA type are supported for RA-SDT, it might be deserved to consider the relation of PRACH resource between 2-step RA-SDT and 4-step RA-SDT. In general, the rapporteur thinks that the existing rule (i.e. separate RO or shared RO but separate preambles) can be reused for 2-step RA-SDT and 4-step RA-SDT. Specifically,

* For the relation of PRACH resources between 4-step RA-SDT and 2-step RA-SDT, the following two option can be configured by the network
  + Option 1: Separate ROs are configured for 4-step RA-SDT and 2-step RA-SDT;
  + Option 2: Shared RO but separate preambles for 4-step RA-SDT and 2-step RA-SDT.



Figure 3: Relation of PRACH resources for SDT and non-SDT

A graphical representation about a potential relation of PRACH resource for SDT and non-SDT is given in Figure 3. Companies are invited to provide their views on the above relation.

#### Q7: Do companies agree that RO(s) for 4-step RA-SDT and 2-step RA-SDT can be either separate or shared with separate preambles?

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | Yes | As already agreed, the RO + preamble combination can be unique for SDT vs non-SDT. This means ROs can be either separate (with shared preambles) or ROs can be shared (with separate preambles). |
| OPPO | Yes |  |
| LG | Comments | Leave it up to RAN1. |
| ASUSTeK | Yes |  |
| TCL | Comments | Leave it up to RAN1. |
| Samsung | Yes | We have already agreed this |
| Sharp | Yes |  |
| Ericsson | Yes | Should follow legacy principle. |
| Qualcomm | Yes | Already agreed. |
| Lenovo | Yes | This has been agreed. |
| Google | Yes |  |
| ITRI | Comments | Leave it up to RAN1. |
| APT | Yes | This has been agreed in RAN2#112 to be the baseline. |
| InterDigital | Yes | Already agreed. Same view as ZTE |
| Huawei, HiSilicon | Yes, but see the comments | The question is a bit confusing. Preamble is transmitted on PRACH occaions and it only makes sense to discusses seprated/shared preamble when transmitted on the same RO.  For the sharing of RACH resource between 2step-RA SDT and 4-stepRA SDT, we support both Option1 and Option2, which is the same as the relationship between legacy 2-step RA and 4-step RA. |

**Summary:**

### 3.1.3 Common RACH resource configuration

In the previous RAN2 meeting, RAN2 generally agree that RA-SDT can only be triggered only when RA-SDT resources are configured. In another word, the RA-SDT procedure might not be triggered by UE if only common RACH resource (i.e. same ROs and same problems are used) for SDT and non-SDT is configured. This is because the UE might consider RA-SDT resource configured (i.e. it seems impossible to support RA-SDT with common RACH resources by implementation).

|  |
| --- |
| RAN2#113-e agreement:  8 *FFS on the order and missing pieces (e.g. failure, fallback) of the high level procedure. The details of the procedures are left for stage 3. FFS on the procedure below, but copied for information.*  A. Upon arrival of data only for DRB/SRB(s) for which SDT is enabled, the high level procedure for selection between SDT and non SDT procedure is as follows:  If CG-SDT criteria is met: UE selects CG-SDT. UE initiate SDT procedure  Else if RA-SDT criteria is met: UE selects RA-SDT. UE initiate SDT procedure  Else: UE initiate non SDT procedure.  B. CG-SDT criteria is considered met, if all of the following conditions are met,  1) available data volume <= data volume threshold  2) RSRP is greater than or equal to a configured threshold  FFS 3) CG-SDT resources are configured on the selected UL carrier and are valid  C. RA-SDT criteria is considered met, if all of the following conditions are met,  1) available data volume <= data volume threshold  2) RSRP is greater than or equal to a configured threshold  3) 4 step RA-SDT resources are configured on the selected UL carrier and criteria to select 4 step RA SDT is met; or 2 step RA-SDT resources are configured on the selected UL carrier and criteria to select 2 step RA SDT is met |

Based on the above, the rapporteur would like to collect companies’ views on the support of RA-SDT procedure with common RACH resources for SDT and non-SDT (to see whether we have sufficient support to design explicit mechanisms if needed for RA-SDT). Generally, from the technical point of view, if common RACH resources for SDT are applied, UE could use the current Preamble Group B when initiating RA-SDT procedure if the TBS of the associated Msg3/MsgA grant is large. Then UE could transmit the SDT data together with CCCH-SDU in Msg3/MsgA, potentially include BSR if the UL grant is not sufficient. Then small data could be further sent over subsequent SDT transmissions. It seems the common RACH resources solution is feasible and efficient, which helps the NW vendors to easily manage the RACH resources allocation.

#### Q8: Do companies support RACH common resources for SDT?

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | Yes  (but no explicit mechanism to support it – per the agreement) | RAN2 already agreed the following:   |  | | --- | | RAN2 continues to progress the work based the separate RACH resources for SDT (i.e. explicit mechanisms to support common resources won’t be pursued unless there is sufficient support for this. However, use of common RACH resources will not be precluded if possible via implementation |   This means that common RACH resources will be allowed. But, this needs no further enhancements to support it.  If common RACH resources are used then the network can still ensure that MSG3/MSGA has large enough resource to at least accommodate the BSR. This then will need no further mechanism to support common resources. With this approach, the network will know the SDT cause by MSG3/MSGA stage regardless of common or separate RACH resources and hence doesn’t need a new CCCH message or new cause.  Note that the moderator above explained that in this case group B could be used by UE. We think this is one option, but even the payload size for group A can be larger in this case. So, this is up to network implementation (and the network can adopt the correct strategy between common RACH resource and separate RACH resource depending on the coverage requirements).  With this assumption, we think no further discussion is needed on this topic and common RACH resources can also be supported. |
| LG | Comments | The question is not clear. We already agreed that RAN2 work is based on the assumption that separate RACH resource is configured for SDT. However, the network can configure RACH resource for SDT such that it is common for non-SDT. It is up to network implementation. But no special handling is needed to support common RACH resource. |
| ASUSTeK | No | As already agreed, we think there is no need to design explicit mechanisms for common resources. |
| TCL | Yes | Partially agree with ZTE. According to the agreement the common RACH resource shall be allowed.  However, how it will affect the legacy RACH procedure may be discussed, e.g. with part of the RACH resources utilized for RA-SDT, whether it shall affect the chances of legacy RACH, and how the gNB shall distinguish between the legacy RACH and RA-SDT with the common RACH resources, etc. The impact should be discussed in detail. |
| Samsung | No | Without any enhancements, its not clear how the common RACH resources (i.e both preamble and RO are common) works. |
| OPPO | Yes | We think this has already been agreed as quoted by ZTE. It is up to network implementation regarding whether the RA-SDT resources are common or separate. From UE perspective, these two configurations should make no difference to the overall SDT procedure. |
| Sharp | Yes | We share the same opionion with ZTE. |
| Ericsson | Yes, comment | We think the current status is sufficient. We do not see the need for optimizations in this case though. |
| Qualcomm | Yes | We should confirm RAN2 has agreed that common RACH resource configuration is allowed. RAN2 should further study to have a common solution considering the RACH partitioning across multiple WIs, such as SDT, RedCap, RAN slicing and etc.. Such hard RACH resource partitioning mechanism will be loss of efficiency and cause resource fragment from network point of view. We do see benefits to support this and we think further study is needed. |
| Lenovo | Yes, comment | Yes based on current agreement, but only via implementation. |
| Google | Yes | From our understanding RACH common resource is allowed via implemention. There should be no impact on spec. |
| ITRI | No | For common RACH resource, we think there is no need to design explicit mechanisms for RA-SDT. |
| APT | No | RAN2 has agreed that explicit mechanisms to support common RACH resources won’t be pursued, i.e., only possible via implementation. In this sense, some restrictions on Msg3/MsgA payload size should be required if there is no new CCCH for SDT. For example, the Msg3/MsgA PUSCH should be large enough to indicate either BSR MAC CE as an implicit indication or even other information to indicate the RA is for SDT. Since SDT already supports the subsequent data transmission, we don’t think we should restrict the payload size of Msg3/MagA. |
| InterDigital | Yes | Partioning for every single usecase results in limited RACH capacity for legacy UEs. Agree with the rapporteur’s view that the UE should initiate an SDT procedure if there are ROs commonly used for both SDT and legacy non-SDT, rather than initiating a non-SDT access procedure. This might indeed not require changes, as the UE simply includes the RRC resume request (and BSR if it fits) in Msg3/MsgA and the network can keep the UE in INACTIVE state. |
| Huawei, HiSilicon | Yes | Since flexible TBS is not supported, there isn’t much motivation left for supporting separate RACH resoruces for SDT and non-SDT. The only remaining motivation is to let the network distinguish between the size of the msg3/msgA for SDT and non-SDT.  We thinik it is important that we also support shared RACH resources between SDT and non-SDT |

**Summary:**

## 3.2 Search space configuration for RA-SDT

In the RAN1#104-e meeting, RAN1 had discussed CORESET and search space for monitoring the PDCCH addressed to the C-RNTI after successful completion of the RACH procedure during RA-SDT. And the following conclusions have been finally made [3].

|  |
| --- |
| **R1-2102125 Reply LS on physical layer aspects of small data transmission**   * From RAN1 perspective, at least a separate SearchSpace that is different from the existing common SearchSpace should be supported for monitoring the PDCCH addressed to the C-RNTI after successful completion of the RACH procedure during RA-SDT   + It is up to RAN2 decision if the separate SearchSpace is UE-specific or common to the UEs performing RA-SDT * If the separate SearchSpace is not configured, type-1 PDCCH CSS can be reused. * FFS UE-specific CORESET or common CORESET |

From the LS, RAN2 is requested to provide feedback on whether UE-specific (i.e. USS) or a separate common search space (i.e. separate CSS) can be configured for SDT. Thus, here comes the question:

### **Q9: Which kind of search space (e.g. USS or separate CSS) do companies prefer for RA-SDT?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (USS/separate CSS/Comments)** | **Detailed comments** |
| ZTE | CSS | USS only works in same cell case and we think such optimisation is not really important for Rel-17. |
| OPPO | CSS | As discussed in our contribution R2-2102751, the most significant issue to support USS is which message that can be used to indude the configuration.   * If USS configuration is included in RRCRelease and stored in the UE AS context, the receiving gNB can not obtain this information is anchor gNB decides not to perform the anchor relocation. * If USS configuration is included in MsgB/Msg4, there are two possible alternatives to embrace this information: MAC CE or RRC message. For MAC CE solution, USS configuration might be too large to be included in a MAC CE. For RRC message solution, the target gNB is not able to generate an RRC message without PDCP configuration in case of anchor without relocation.   Based on these two arguments, we support CSS solution. |
| LG | CSS | It seems to be better to follow legacy RA principle. |
| ASUSTeK | CSS |  |
| TCL | CSS | CSS is enough, the USS optimization is unnecessary and shall make the issue more complicated. |
| Samsung | CSS |  |
| Sharp | CSS |  |
| Ericsson | CSS | Drawbacks with USS is that it would be valid only in the cell where the UE was sent to inactive. |
| Qualcomm | CSS |  |
| Lenovo | CSS |  |
| Google | CSS |  |
| ITRI | CSS |  |
| APT | CSS |  |
| InterDigital | CSS |  |
| Huawei, HiSilicon | CSS |  |

**Summary:**

# 4 Resource configuration for CG-SDT

Firstly, the rapporteur would like to note the understanding that the legacy type-1 CG configuration mechanism in the licensed band is reused (e.g. HARQ process configuration and HARQ process ID determination are the same as Rel-16 NR) for the following discussion in principle (further enhancements for the association between SSB and CG PUSCH occasion is pending on RAN1’s further progress) [4][5].

## 4.1 BWP operation

In the previous RAN2#113b-e meeting that had just ended, a popular discussion had been launched regarding whether an SDT specific BWP can be configured for INACTIVE UE performing CG-SDT. The corresponding online discussion record and related agreement made are listed below [2].

|  |
| --- |
| R2-2103533 Report from [POST113-e][504][SDT] CG Open Issues Huawei, HiSilicon discussion Rel-17 NR\_SmallData\_INACTIVE-Core  Proposal10: *CG-SDT resource can be configured on BWPs other than initial BWP configured by system information* (17/24).  - Nokia would like to discuss how it impacts the paging if it moves to another BWP. Huawei explains that there is network implementation to solve this problem. Qualcomm also sees some issues.  RAN2#113bis-e Agreement:  *FFS CG-SDT resource can be configured on BWPs other than initial BWP* |

The main concern on the SDT-specific BWP (e.g. non-initial BWP) is mainly about BWP switching due to paging and SI reception. To make progress, the following two options can be considered for CG-SDT:

* Option 1: CG resource can be configured on initial BWP.
* Option 2: CG resource can be configured on SDT BWP that fully contains the initial BWP.

Then, it should be up to NW implementation to adopt either Option 1 or Option 2 to a CG-SDT configuration for a given UE (depending on the UE capability as well). Companies are warmly invited to provide their views on the feasibility of the above two options.

### **Q10: Do companies agree that CG-SDT resources can be configured on either initial BWP or SDT BWP that fully contains the initial BWP?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | Partly yes (don’t think the restriction is needed) | We think separate SDT BWP can be supported. The UE anyway doesn’t need to monitor the UE specific paging ocacassion during SDT since RAN/CN paging is not applicable for SDT. Perhaps we should first agree this aspect (since network knows the UE is already performing SDT and hence it won’t page the UE for DL traffic but would rather send it to the UE or move to connected, CN paging is used to solve state-mismatch, but again since the UE is performing SDT, statemismatch is not applicable either).  We think first we **should agree whether or not UE needs to minotor UE specific paging whilst performing SDT:** It seems this is clearly not needed  Then the question is how to ensure the UE can receive the SI change indication in any paging occasion (for PWS etc). This can be done as long as there is common search space, with pagingSearchSpace in the configured active BWP and we think it is up to NW to ensure this if a separate BWP is configured.  **So, it seems separate BWP (not necessarily overlapping with initial BWP) is also feasible.**  Perhaps the question is whether companies support this or not. We think this is okay to relieve the congestion on initial BWP. |
| OPPO | See some comments | We have not made consensus on whether the CG-SDT resources can be configured on the BWP other than initial UL BWP. So we think we should firstly confirm that Option2 is indeed feasible before we discuss the resources can be configured on either of them, otherwise, we would not have this question. In addition, we think we need to ask RAN1/RAN4 to make further confirmation. |
| LG | Yes | During the CG-SDT procedure, the network can know that the UE monitors separate BWP. Then, the network can send paging and SI update request on the separate BWP using dedicated signaling. Thus, we think configuring separate BWP is feasible for CG-SDT.  On the other hand, we think we think configuring separate BWP is much beneficial in that it can provide enough bandwidth for SDT and also can reduce the congestion on the initial BWP. |
| ASUSTeK | Yes, but | The SDT BWP may not be necessary to fully contain the initial BWP. |
| TCL | Yes with comments | Agree with ZTE and OPPO. We should configrm the FFS fisrt that the option 2 is feasible, and the separate BWP can be discussed in detail. |
| Samsung | Yes, but | Same view as ZTE. The limitation "SDT BWP that fully contains the initial BWP" is not needed. |
| Sharp | Yes with comments | Agree with OPPO. RAN1’s input may be necessary. |
| Ericsson | Yes, comment | Not clear if any restrictions are needed as in Opt 2. |
| Qualcomm | No | We support option 1 (on initial BWP) and have concern on option 2. The Short Message (SI modification and PWS notification) has to be received in CORESET #0 which is important for UE to not miss them during SDT. So for a TDD system, the associated DL BWP should fully contain the CORESET #0. It is not only the common search space configuration issue.  In addition, since the use case is ‘small data’, the traffic profile should be the small size of packets with a short period. Considering power consumption and network resource allocation, we don’t see there is a strong need to configure CG resource in the separate BWP.  Finally, considering SDT is a typical traffic for RedCap, there is a parallel discussion in RedCap WI on configuring initial or dedicated BWP for RedCap. We think the BWP configuration should be aligned between two features. |
| Lenovo | See comments | We should first discuss whether paging is really an issue or not. In our view, it may work if CG-SDT resources are configured an a separate BWP, but it will bring some complexity to gNB.  Agree to ask RAN1/RAN4 to confirm whether the CG-SDT resources can be configured on the BWP other than initial UL BWP. |
| ITRI | Yes, but | Agree with OPPO that we should configrm the FFS fisrt. |
| APT | Yes (with no restriction) | In R2-2103533 [POST113-e][504][SDT] CG Open Issues (Huawei), three options are discussed, i.e.   * Option1: CG-SDT resource can only be configured on initial BWP. * Option2a: CG-SDT resource can be configured on BWPs other than initial BWP. * Option2b: CG-SDT resource can be configured on BWPs other than initial BWP for FDD and only if the CG-SDT BWP includes initial BWP for TDD.   The majority view is option 2a (17/24), so we should keep the same proposal (i.e., without restriction) as we have already discussed.  **Proposal: CG-SDT resource can be configured on BWPs other than initial BWP.** |
| InterDigital | Yes, but | RAN2 should indeed first discuss whether paging is anticipated during an SDT procedure or not. If it is, option 1 is preferred instead. |
| Huawei, HiSilicon | Yes, but see comments | For FDD operation, there is no impact on paging/SI if the CG is configured on another UL BWP than initial UL BWP.  For TDD operation, the paging/SI will also not be impacted if SDT BWP fully contains the initial DL BWP, since the CG-SDT BWP is configured according to UE’s bandwidth capability.  Nevetherless, it should be noted that for TDD, the only requirement is that the center frequency for UL and DL should be the same while the bandwidth can be different. Also, even for initial BWP, dedicated configuration can be provided after the initial access from the UE. To make it clear, we suggest  Option 2: CG resource can be configured on SDT BWP that fully contains the initial DL BWP configured by system information. |

**Summary:**

## 4.2 CG resource configuration

In Rel-15/16, either 4-step CFRA preamble or 2-step CFRA preamble are associated with beam(s) (i.e. SSB or CSI-RS), according to the following highlighted parts.

|  |
| --- |
| **TS 38.331 6.3.2 *RACH-ConfigDedicated***  CFRA ::= SEQUENCE {  occasions SEQUENCE {  rach-ConfigGeneric RACH-ConfigGeneric,  ssb-perRACH-Occasion ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}  OPTIONAL -- Cond Mandatory  } OPTIONAL, -- Need S  resources CHOICE {  ssb SEQUENCE {  ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource,  ra-ssb-OccasionMaskIndex INTEGER (0..15)  },  csirs SEQUENCE {  csirs-ResourceList SEQUENCE (SIZE(1..maxRA-CSIRS-Resources)) OF CFRA-CSIRS-Resource,  rsrp-ThresholdCSI-RS RSRP-Range  }  },  ...,  [[  totalNumberOfRA-Preambles INTEGER (1..63) OPTIONAL -- Cond Occasions  ]]  }  CFRA-TwoStep-r16 ::= SEQUENCE {  occasionsTwoStepRA-r16 SEQUENCE {  rach-ConfigGenericTwoStepRA-r16 RACH-ConfigGenericTwoStepRA-r16,  ssb-PerRACH-OccasionTwoStepRA-r16 ENUMERATED {oneEighth, oneFourth, oneHalf, one,  two, four, eight, sixteen}  } OPTIONAL, -- Need S  msgA-CFRA-PUSCH-r16 MsgA-PUSCH-Resource-r16,  msgA-TransMax-r16 ENUMERATED {n1, n2, n4, n6, n8, n10, n20, n50, n100, n200} OPTIONAL, -- Need S  resourcesTwoStep-r16 SEQUENCE {  ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource,  ra-ssb-OccasionMaskIndex INTEGER (0..15)  },  ...  } |

With this design, the network can ensure the reserved CFRA preamble and UL transmission with beamforming can be restricted to the specific beam direction(s) preferred by gNB. Besides, taking the following RAN1 agreement, it seems necessary to explicitly configure a set of SSB(s) (via an SSB list) that are associated with a CG configuration.

|  |
| --- |
| RAN1#103bis-e agreement:  CG resources per CG configuration are associated with a set of SSB(s) configured by explicit signalling.   * + FFS how to define an SSB-to-PUSCH resource mapping within the CG configuration.   FFS specific changes to the CG configuration to support the additional SSB-to-PUSCH mapping, if any. |

Based on the above, companies are invited to provide their views on the following question.

### **Q12: Do companies agree explicitly signaling a set of SSB(s) associated with a CG configuration (via RRC Release) is needed for CG-SDT?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | Yes | This seems fesible, and it seems this is one of the options on the table in RAN1. So, perhaps we could wait for their input. If the intention of the email rapporteur is to inform RAN1 about the feasibility of this option, we are fine with this intention. |
| OPPO | Maybe | This issue is under the discussion in RAN1, we can wait for the response from RAN1. |
| LG | Comments | Leave it up to RAN1. |
| ASUSTeK | Yes |  |
| TCL | Comments | Wait for RAN1 input. |
| Samsung | Yes |  |
| Sharp | Yes |  |
| Ericsson | Comment | This should be handled by RAN1 or left to stage 3 details |
| Qualcomm | Yes | A set of candidate beam for the CG should be configured in CG configuration. We are also fine to wait for RAN1. |
| Lenovo | Comments | Wait for RAN1 input. |
| Google | Yes |  |
| ITRI | Comments | Leave it up to RAN1. |
| APT | Comments | The configuration on explicit singnalling for a set of SSB(s) has been agreed in RAN1 while the details on the configuration or spec change, i.e., how to map the SSB to PUSCH, is FFS in RNA1. Thus, RAN2 can wait further inputs from RAN1. |
| InterDigital | Comments | Okay to wait for RAN1 to progress. |
| Huawei, HiSilicon | Yes | According to RAN1’s agreement, the set of SSB(s) is configured per CG configuration by explicit signalling. It is a straightforward logic to support explicitly signaling a set of SSB(s) associated with a CG configuration via RRC Release for the next SDT session or via a DL RRC Message during SDT procedure if this mapping needs to be reconfigured for subsequent transmissions.  Just to clarify, is the intention of the question just to confirm the RAN1 agreement “CG resources per CG configuration are associated with a set of SSB(s) configured by explicit signalling.”?  For the rest, since it is FFS in RAN1, RAN1 should continue to work on them |

**Summary:**

## 4.3 Search space configuration for CG-SDT

For Rel-16 LTE PUR, UE-specific search space is configured for response reception after the UL transmission, according to the following highlighted part quoted from 36.213.

|  |
| --- |
| **TS 36.213 sub-clause 9.1.5:**  If the UE has initiated a PUSCH transmission using preconfigured uplink resource ending in subframe *n*, the UE shall monitor the MPDCCH UE-specific search space in a search space window starting in *n+5* subframewith duration given by higher layer parameter *pur-MPDCCH-SS-window-duration*. Upon detection of a MPDCCH with DCI format 6-0A/6-0B with CRC scrambled by PUR C-RNTI intended for the UE within the search space window and the corresponding DCI is for PUR ACK/fallback indication (as defined in [4]), the UE is not required to monitor the MPDCCH UE-specific search space for the remaining search space window duration. |

For CG-SDT, the same logic might be reused in terms of scheduling flexibility, UE power saving, spec impacts, and the support of non-fallback DCI format. The following question is given to collect companies’ views on the search space configuration for CG-SDT.

### **Q13: Do companies agree UE-specific search space is configured for CG-SDT?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | Yes | This seems feasible. RAN1 has left the decision on USS vs CSS for RA-SDT to RAN2 it seems. Then, it seems we can make an agreement on this and inform RAN1 too? |
| OPPO | Yes |  |
| LG | Yes | The CG-SDT is UE-dedicated, and using USS is aligned with legcay principle. |
| ASUSTeK | Yes |  |
| TCL | Yes | Agree with LG. |
| Samsung | Yes |  |
| Sharp | Yes |  |
| Ericsson | Yes |  |
| Qualcomm | No | We prefer to CSS. There might be an issue for TCI state configuration for the CORESET associated to USS. Network can not preconfigure the TCI state for CG SS, since it can’t know in advance which beam UE will use when UE performing CG-SDT. But for CSS, network can preconfigure a set of TCI sates for the CSS, and UE can choose monitor the occasion(s) whose TCI state is QCLed with the beam UE has selected. It would to work similar to RA SS. But it is unclear whether it could be supported in current USS framework. This issue should also check with RAN1. |
| Lenovo | Yes | Yes, it is aligned to the legacy procedure. If there is any issue, it should be checked by RAN1. |
| Google | Yes |  |
| ITRI | Yes |  |
| APT | Yes | USS should be configured for dedicated CG-SDT. |
| InterDigital | Yes |  |
| Huawei, HiSilicon | Yes | In PUR, dedicated PDCCH configuration is provided in the RRCConnectionRelease message and the same principle can be reused for CG-SDT.  For the gNB implementation convenience, if USS is not configured, CSS (e.g. separate CSS for RA-SDT or type-1 CSS) can be also used. |

**Summary:**

## 4.4 CS-RNTI

For the existing NR system, CS-RNTI can be used for scheduling HARQ retransmission for a TB which is previously transmitted on CG PUSCH. In the past RAN2#113bis-e meeting, it was agreed that retransmission by DG is supported for CG-SDT. Then it is worthy to consider how to realize retransmission by DG for CG-SDT, taking the PUR mechanism for reference.

The following table summarizes how to interpret new transmission and retransmission when a UL grant is received in NR CG and LTE PUR, respectively.

Table 1 New transmission and retransmission in NR CG and LTE PUR

|  |  |  |
| --- | --- | --- |
|  | NR CG | LTE PUR |
| New transmission | C-RNTI regardless of NDI | preconfigured uplink grant for PUR |
| HARQ retransmission | CS-RNTI with NDI=1 | PUR-RNTI regardless of NDI |

For simplicity and flexibility, the legacy CS-RTNI based retransmission mechanism might be reused for CG-SDT. To realize this, the CS-RNTI shall be assigned along with the CG resources in the RRC Release message.

### **Q14: Do companies agree CS-RNTI is assigned along with CG-SDT resources?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Reply (Yes/No/**  **Comments)** | **Detailed comments** |
| ZTE | No | Since only one type of CG will be supported in INACTIVE state, it seems CS-RNTI is not needed? |
| OPPO | Yes | We want to confirm whether this CS-RNTI can be same as the one that used in RRC\_CONNECTED. |
| LG | Comments | Could be discussed later in stage-3. |
| ASUSTeK | Yes | The UE can receive a CS-RNTI in *RRCRelease* message if CS-RNTI is not used in RRC\_CONNECTED state, or can restore the CS-RNTI used in RRC\_CONNECTED state from the stored configuration. |
| TCL | Yes | Reuse the legacy CS-RNTI based retransmission mechanism is simple. |
| Samsung | Comments | Can be discussed later in stage-3 |
| Sharp | Yes |  |
| Ericsson | No | We see no need to use a CS-RNTI for CG-SDT. The C-RNTI is enough to handle CG Type1. |
| Qualcomm | Comments | Can be discussed later in stage-3 |
| Lenovo | Comments | Leave it in stage-3. |
| Google | No | It is simpler to use a new RNTI instead of C-RNTI or CS-RNTI. |
| ITRI | Comments | It can be discussed at stage-3. |
| APT | Yes | Based on current 38.321, C-RNTI can not be used for retransmission of a CG, since the UE will consider that the NDI to be toggled anyway if the UE receives an UL grant for C-RNTI and the previous transmission for the same HARQ process is CG.  2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:  3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.  To avoid introducing the specification impact, the legacy mechanism for CG retransmission, i.e., using CS-RNTI, should be needed. |
| InterDigital | Comments | It might be better to discuss this after some further progress on CG-SDT design is made, including how retransmissions are made. C-RNTI might be enough. |
| Huawei, HiSilicon | Yes, but see comments | The legacy CS-RNTI based retransmission mechanism can be reused for CG-SDT.  Not sure what it means by assigned along with CG-SDT resources. Does it mean the RNTI is per CG-SDT configuration? It is straightforward that we need a single CS-RNTI per UE for CG-SDT |

**Summary:**

# 5 Conclusion

The contribution is summarized with proposals as follows,

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