**3GPP TSG-RAN2 #115e R2-210xxxx**

**Electronic meeting, August 16 – August 27, 2021**

**Agenda item:**8.6.4 (NR\_SmallData\_INACTIVE-Core)

**Source:** OPPO (Rapporteur)

**Title:** Summary of 8.6.4 – Aspects specific to RACH based shchemes

**Document for:** Discussion and Decision

# 1. Introduction

This document summarizes issues identified in documents submitted to A.I. 8.6.4 Aspects specific to RACH based schemes, except for the issues covered in Post114-e [504][505][506][507][508]. Before make the final conclusion, companies’ inputs for each identified issue is expected during the first week of 115 e-meeting.

# 2 Contact Information

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# 3. Configurations for RA-SDT

## 3.1 BWP used for RA-SDT

The company proposals related to this topic are summarized in the table below.

|  |  |
| --- | --- |
| Tdoc | Proposals |
| vivo [3] | Proposal 4: Only initial BWP is supported for RA-SDT. |
| ZTE [8] | Proposal 9: NW is allowed to configure 2-step SDT resource only on initial BWP without 4-step SDT RACH resource, in which case the fallback from 2-step RACH to 4-step RACH is not allowed in RA-SDT. |
| Apple [9] | Proposal 5: The RA-SDT resource is configured on the initial BWP or the separate SDT BWP, and the initial BWP is overlapped with the separate BWP.  |
| Sony [13] | Proposal 4: An additional “configurable” BWP (DL and UL) should be supported for RA-SDT• The additional BWP should overlap with the initial BWP operating with the same numerology• If agreed, RAN2 should send an LS to RAN1 to design layer 1 aspects (e.g. search space monitoring, switching) for UEs in INACTIVE state. |
| Ericsson [14] | Proposal 1: RA-SDT resources are configured on the initial BWP |
| Nokia [16] | Proposal 4: Support separate SDT BWP for RA-SDT along with initial BWP. |

It has been agreed that CG-SDT resources can be configured on either initial BWP or separate SDT BWP in RAN2#114e, while the same issue needs to be further discussed for RA-SDT. [9][13][16] think that a configurable BWP can be supported for RA-SDT considering the capacity of initial BWP, i.e., the RA-SDT resources can be configured on the separate SDT BWP in addition to initial BWP. [3][8][14] propose that RA-SDT shall be perform on initial BWP. Since there is no significant majority, views from more companies are expected.

**Q1: Whether RA-SDT can be configured on non-initial BWP?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | Yes | It introduces flexibility if non-initial BWP can be configured for RA-SDT. But we agreed that at least the UE needs to monitor the paging (for SI update and PWS indication). Hence, the dedicated BWP for RA-SDT should be configured some search spaces to allow the UE to monitor related behaviour. |
| Sony | Yes | Separate non-initial BWP (DL and UL) would increase the RA-SDT capacity in the cell. This non-initial BWP (DL and UL) can also be reused for the separate CG BWP as well, so in practice both RA-SDT and CG-SDT can locate on the same (separate) BWP.  |
| Samsung | - | No strong view. We are open to configure RA-SDT on either initial or non-initial BWP but not both. |
| Nokia | Yes | We agree with Samsung proposal. |
| Fujitsu | Yes | From the perspective that BWP configuration would be up to NW deployment, it is better that the RA-SDT resources can be configured on the separate SDT BWP. |
| ASUSTeK | Yes | We agree with Fujitsu. |
| LG | Yes | We think it is beneficial to configure a separate BWP for RA-SDT, with following reasons:- reduce collision between normal RA and RA-SDT- provide sufficiently large bandwidth for data transmissionAs RAN2 already agreed to introduce a separate BWP for CG-SDT, we don’t see any big problem to support it for RA-SDT. |
| Google | No | The reason to allow CG-SDT on non-initial BWP is to avoid shortage of radio resources on initial BWP. For RA-SDT, since BI can spread UEs in time so it may not be needed to configure RA-SDT on non-initial BWP.  |
| OPPO | No | We prefer to keep the RA-SDT on initial BWP. Since it may involve UE capability issue, i.e., not all UEs in RRC\_INACTIVE can work on non-initial BWP. |
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## 3.2 Signaling used to configure RA-SDT resources

The company proposals related to this topic are summarized in the table below.

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| Tdoc | Proposals |
| vivo [3] | Proposal 1: RA-SDT related PRACH resources are configured within SIB1. |
| Apple [9] | Proposal 6: The RA-SDT related configuration (including RACH and UE dedicated configuration) is provided via the SIB of the cell in which UE triggers the RA-SDT. |
| ASUSTek[22] | Proposal 1: RA-SDT configuration is contained in the system information. |

As agreed, CG-SDT resources are provided to UEs in RRC\_CONNECTED only within the RRCRelease message. However, it has not been discussed how to receive the RA-SDT resources. Considering that only contention-based RA-SDT is supported and UE can trigger the procedure in a cell other than the last serving one, all these three companies propose to configure the RA-SDT resources via system information, i.e., SIB1. Rapporteur thinks this can be easy agreement but it is better to collect companies’ views for confirmation.

**Q2.1: Do companies agree that the SDT related RACH resources are configured via system information, i.e., SIB1?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | Yes |  |
| Sony | Yes |  |
| Samsung | Yes |  |
| Nokia | Yes |  |
| Fujitsu | Yes | It’s ok but the question is if non-SDT capable UEs are not allowed to use SDT related RACH-resources. |
| ASUSTeK | Yes |  |
| LG | No | Though RA-SDT resource is common to SDT UEs in a cell, we think not all UEs in a cell are capable of SDT. Thus, it might be better to configure RA-SDT resource via RRCRelease message, similar to CG-SDT configuration. |
| Google | Comment | It is sufficient to configure RA-STD configuration in RRCRelease. Whether UE can continue RA-SDT after reselecting to other cell should be discussed.  |
| OPPO | Yes |  |
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Furthermore, [9] and [22] discuss to introduce the flexibility for network to control whether RA-SDT is enabled, i.e., per cell and/or per UE.

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| --- | --- |
| Tdoc | Proposals |
| Apple [9] | Proposal 2: gNB indicates whether to support the RACH-SDT in SIB1 per serving cell.Proposal 3: If the INACTIVE UE is configured with RA-SDT via the RRCRelease message, UE is only allowed to trigger SDT procedure when the RA-SDT indication is in the SIB1 of current serving cell. |
| ASUSTek [22] | Proposal 2: FFS on whether enabling RA-SDT per UE is under network control. |

However, rapporteur thinks that it has already been feasible for network to enable or disable the RA-SDT in an implicit way by whether or not providing the resources and/or SDT-RBs configuration. Q2.2 is to ask for the inputs from companies on whether it is necessary to introduce an explicit indication to enable/disable the RA-SDT.

**Q2.3: Whether an explicit indication (other than RA-SDT configuration) to enable/disable RA-SDT is supported?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | No | The UE can be aware if RA-SDT is enable or disable based on RA-SDT configuration in SIB1. |
| Sony | No | UE has already read SIB1 from the cell, hence we think it indicates the RA-SDT is enabled in this cell. |
| Samsung | - | We are open to consider per UE control |
| Nokia | No | Ie., no need for explicit indication by the NW for the support. Per UE control comes from configuring the SDT radio bearers. |
| Fujitsu | No | The baseline would be the rapporteur’s view. |
| ASUSTeK | - | We are open to the issue. |
| LG | No | We prefer RA-SDT configuration via RRCRelease message, and there is no need to introduce enable/disable signaling. |
| Google | No | The presence of RA-SDT configuration in SIB indicates the support of RA-SDT in the cell so there may be no need to have other indications.  |
| OPPO | No | The network can control the support of RA-SDT by whether or not providing the RA-SDT configuration, no other case that need explicit indication is observed. |
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## 3.3 SDT-specific parameters

The company proposals related to this topic are summarized in the table below.

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| --- | --- |
| Tdoc | Proposals |
| Samsung [2] | Proposal 1: powerRampingStepHighPrioritySDT and scalingFactorBISDT are signaled in RACH configuration for SDT. * + - * These parameters are separately signaled for 2 step RACH configuration for SDT and 4 step RACH configuration for SDT. UE applies these parameters when RACH is initiated for SDT
 |
| vivo [3] | Proposal 2: RSRP threshold for SSB selection is specific to SDT. |
| OPPO [4] | Proposal 1: For 4-step RA-SDT, when two preamble groups are configured, UE selects preamble groupB if the potential data size is larger than the data volume threshold as well as the measured RSRP is above the RSRP threshold, which is as legacy. The data volume threshold and RSRP threshold for preamble group selection are configured specific for SDT.Proposal2:  |
| ZTE [8] | Proposal 11: SDT specific configuration should be allowed for the following RACH parameters:* SSB selection

rsrp-ThresholdSSBmsgA-RSRP-ThresholdSSB* Power control related parameters

preambleReceivedTargetPowermsgA-PreambleReceivedTargetPowerpowerRampingStepmsgA-PreamblePowerRampingStep* Other RACH procedure related parameters

ra-ResponseWindowra-ContentionResolutionTimermsgB-ResponseWindowProposal 13: SDT specific RA-Prioritization is not needed. |
| Qualcomm [11] | Proposal 4: A different monitor/response window timer should be introduced which applies to RACH based small data transmission. |
| Ericsson [14] | Proposal 4: Postpone further detailed agreements on SDT RACH configuration until a course of action is agreed jointly with the other interested WIs |
| Huawei [15] | Proposal 4: When two preamble groups are configured for RA-SDT, the following parameters should be SDT specific: * the data volume threshold, i.e.:
* ra-sdt-Msg3SizeGroupA for 4-step RA-SDT
* ra-sdt-MsgA-SizeGroupA for 2-step RA-SDT.
* pathloss related parameters, i.e.:
* preambleReceivedTargetPower, msg3-DeltaPreamble, messagePowerOffsetGroupB for 4-step RA-SDT
* msgA-PreambleReceivedTargetPower, msgA-DeltaPreamble, messagePowerOffsetGroupB for 2-step RA-SDT;
 |

For the RACH resource configuration, the stage-3 signaling design will be discussed in the joint session together with other WI. While it is still necessary to identify those RACH-related parameters that can be configured specific for RA-SDT purpose in SDT session. The proposed parameters are categorized in the following table and companies are invited to make a further review.

|  |  |
| --- | --- |
| Category | Parameters |
| SSB selection  | * rsrp-ThresholdSSB [vivo, ZTE]
* msgA-RSRP-ThresholdSSB [vivo, ZTE]
 |
| Power control | * preambleReceivedTargetPower [ZTE, Huawei, OPPO]
* msgA-PreambleReceivedTargetPower [ZTE, Huawei]
* powerRampingStep [ZTE]
* msgA-PreamblePowerRampingStep [ZTE]
* msg3-DeltaPreamble [Huawei, OPPO]
* msgA-DeltaPreamble [Huawei]
 |
| Procedure related | * ra-ResponseWindow [ZTE]
* ra-ContentionResolutionTimer [ZTE]
* msgB-ResponseWindow [ZTE]
 |
| Preamble group related | * ra-Msg3SizeGroupA [Huawei, OPPO]
* ra-MsgA-SizeGroupA [Huawei]
* messagePowerOffsetGroupB for 4-step RA [Huawei]
* messagePowerOffsetGroupB for 2-sep RA [Huawei]
 |
| RA prioritization related  | * powerRampingStepHighPrioritySDT [Samsung]
* scalingFactorBISDT [Samsung]
 |

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**Q3.1: Do companies agree that all the parameters in the above table can be SDT-specific? If no, please point out which one(s) and why.**

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| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | No | Regarding the windows in RA-SDT, i.e. *ra-ResponseWindow*, *ra-ContentionResolutionTimer* and *msgB-ResponseWindow*, we think it is not necessary to be SDT specific. There is no LBT failure like issue happen in SDT. Therefore, it is not needed to introduce new values. |
| Sony | Yes, but | Some refinements of the parameters are needed  |
| Samsung | Yes | Up to network configuration  |
| Nokia | No | We don’t see a need for separate *ra-ResponseWindow*, *ra-ContentionResolutionTimer* and *msgB-ResponseWindow*. Neither we don’t see use for RA prioritization for SDT given this is INACTIVE and IDLE mode procedure. |
| Fujitsu | No | (1) msg3/msgA-DeltaPreamble has been RA procedure specific instead of use case specific (e.g. IAB). It is not sure if it would be SDT specific.(2) RA prioritization related parameters has been RA procedure specific instead of use case specific (e.g. IAB). It is not sure if it would be SDT specific. |
| ASUSTeK | No | We share the same view with Nokia. The RA windows and RA prioritization related parameters are not necessary be SDT-specific. |
| LG | Postpone | It is better to discuss stage-3 details later. |
| OPPO | No | We think RA prioritization related parameters may not be necessary since SDT is not focused on low latency service. We are fine with others, it can up to network configuration. |
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**Q3.2: In addition to the parameters discussed in Q3.1, do companies think that any parameters in RACH-ConfigCommon/RACH-ConfigGeneric (for 2-step RACH and for 4-step RACH) can not be SDT-specific? If yes, please point out which one(s) and why.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | No |  |
| ASUSTeK | No |  |
| LG | Postpone | It is better to discuss stage-3 details later. |
| OPPO | No |  |
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## 3.4 RACH configuration with shared ROs

The company proposals related to this topic are summarized in the table below.

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| Tdoc | Proposals |
| Huawei [15] | Proposal 1: To achieve the RACH configuration of shared ROs with separated preambles, the following configurations should be supported:* 4-step RA-SDT shares ROs with 4-step RA and/or 2-step RA
* 2-step RA-SDT shares ROs with 4-step RA and/or 2-step RA
* 2-step RA-SDT shares ROs with 4-step RA-SDT and/or 4-step RA and/or 2-step RA.
 |

As agreed, separation of RACH resources for SDT and non-SDT can be achieved by using a different RO+preamble combination, which can be further divided into two cases:

1. shared ROs with separate preambles
2. separated ROs with either separate or shared preambles

For a), the ROs for 4-step RA-SDT can be either shared with 4-step RA (case 1) or with 2-step RA (case 3), and the ROs for 2-step RA-SDT can be either shared with 4-step RA (case 2) or with 2-step RA (case 4), where all the specific configurations are all under the control of the network. Companies are invited to confirm there is no potential issue to support all these possible configurations.

**Q4: Do companies agree that all the following configurations shall be considered for shared ROs case? If no, please point out which one(s) and why.**

* **4-step RA-SDT shares ROs with 4-step RA and/or 2-step RA**
* **2-step RA-SDT shares ROs with 4-step RA and/or 2-step RA**
* **2-step RA-SDT shares ROs with 4-step RA-SDT and/or 4-step RA and/or 2-step RA.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | Yes | We think if the preambles are separately configured, all the above configurations shall be considered for shared ROs case. |
| Sony | Yes |  |
| Samsung | Yes | No need to limit any configuration |
| Nokia | Yes |  |
| Fujitsu | Yes | From the perspective that the configuration would be up to NW deployment, it is better to support all cases. |
| ASUSTeK | Yes |  |
| LG | Yes | Whether the normal RA resource is shared by RA-SDT is up to gNB implementation. We don’t see any reason to restrict the gNB implementation.However, it should be noted that sharing RO resource between normal RA and RA-SDT would increase the congestion for normal RA (e.g. due to preamble partitioning). Therefore, it is better to configure a separate BWP for RA-SDT. |
| Google | Yes |  |
| OPPO | Yes |  |
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# 4. Resource selection

## 4.1 Preamble group selection

The company proposals related to this topic are summarized in the table below.

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| --- | --- |
| Tdoc | Proposals |
| OPPO [4] | Proposal 1: For 4-step RA-SDT, when two preamble groups are configured, UE selects preamble groupB if the potential data size is larger than the data volume threshold as well as the measured RSRP is above the RSRP threshold, which is as legacy. The data volume threshold and RSRP threshold for preamble group selection are configured specific for SDT.Proposal 2: For 2-step RA-SDT, when two preamble groups are configured, UE makes the selection between the two groups based on the RSRP threshold and the payload size associated with each preamble group. Data volume threshold for preamble group selection is not configured for 2-step RA-SDT. |
| Huawei [15] | Proposal 3: For the RA-SDT preamble group selection, the UE should consider: CCCH SDU size plus MAC subheader + SDT data size plus MAC subheader and Pathloss. |

In order to support flexible TB size of Msg3/MsgA, up to two preamble groups as legacy can be configured for RA-SDT of each type, i.e. 2-step RACH type or 4-step RACH type. As a result, UE shall further make the selection between the two preamble groups after the RACH type is determined.

As listed in the following table, [4] and [15] think that both potential data size and pathloss shall be considered for preamble group selection. [4] further propose that data volume threshold may not be configured for 2-step RA-SDT in order to avoid unnecessary subsequent transmissions. [15] thinks that it is not enough to take the CCCH SDU size plus it MAC subheader and pathloss into account when make the selection, but also the size of SDT data plus MAC subheader. Rapporteur thinks that this change is necessary and more companies’ views are expected in order to reach an agreement.

**Q5: Do companies agree that for the RA-SDT preamble group selection, the UE should consider SDT data size plus MAC subheader in addition to CCCH SDU size plus MAC subheader and pathloss?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | Yes | Regarding the pathloss threshold, we think the legacy threshold can be reused in SDT. But for *ra-Msg3SizeGroupA*, we think one new threshold is necessary for SDT.  |
| Sony | Yes |  |
| Samsung | - | The following conditions in current spec "if the potential Msg3 size (UL data available for transmission plus MAC subheader(s) and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB"*"if the potential MSGA payload size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) is greater than the *ra-MsgA-SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *msgA-PreambleReceivedTargetPower* – *msgA-DeltaPreamble* – *messagePowerOffsetGroupB"*should also be applied for small data transmission |
| Nokia | - | Agree with Samsung, the current condition is sufficient given we now can have DRB data also to consider from RRC\_INACTIVE (on top of the CCCH SDU). |
| Fujitsu | Yes | From the perspective that the configuration would be up to NW deployment, it is better to support all cases. |
| ASUSTeK | Yes | Same view with Samsung, we think this is already supported by current spec. |
| LG | - | We think total TB size, as explained by Samsung, should be considered in preamble group selection, same as in legacy. |
| Google | Yes | The potential Msg3 size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) should be considered.  |
| OPPO | Yes | It is beneficial to take the UL data into account when deciding the data size to be compared with data threshold for preamble group selection. In this way, UE can select a group with a payload size that can accommodate the data as much as possible in order to avoid subsequent transmissions. |
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## 4.2 SSB selection

The company proposals related to this topic are summarized in the table below.

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| --- | --- |
| Tdoc | Proposals |
| Intel [5] | Proposal 12. UE select any SSB when none of the SSBs meet the SS-RSRP thresholds for 2-step RA-SDT. Same approach is taken for 4-step RA-SDT. |

Legacy operation of the SSB selection is shown below from TS 38.321:

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> **select any SSB.**

….

1> else (i.e. for the contention-based Random Access Preamble selection):

2> if at least one of the SSBs with SS-RSRP above *msgA-RSRP-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*.

2> else:

3> **select any SSB.**

It is still unclear how to handle the case if there is no qualified SSB for RA-SDT. Two possible approaches are as follows:

1. UE selects any SSB and continues with RA-SDT procedure.
2. UE selects non-SDT procedure

**Q6: Which option do you prefer to handle the case if there is no qualified SSB for RA-SDT?**

* **Option1: UE selects any SSB and continues with RA-SDT procedure.**
* **Option2: UE selects non-SDT procedure**
* **Option3: Others, please specify**

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| --- | --- | --- |
| Company | Option1/2/3 | Detailed Comments |
| CATT | Option 2 | We think if the no SSB is beyond the configured threshold, it means that the RA-SDT criteria are not satisfied. So it is naturally that the UE goes to non-SDT procedure. |
| Sony | Option 1 | We should apply the same legacy mechanism, note that there is also SDT-RSRP threshold which ensures SDT to succeed in case of large cells. |
| Samsung | Option 1 | RA-SDT resources are provided for all transmitted SSBs. So we do not see any advantage in switching to non SDT procedure. UE still has to select any SSB and perform RACH. |
| Nokia | Option 1 | It seems such could only happen upon preamble re-transmission as generally the RSRP threshold to select SDT should be enough to qualify at least one beam to be used for the initial SDT transmission. |
| Fujitsu | Option 2 | No SSB would mean that RA-SDT should not be performed. It means that UE should perform non-SDT procedure. |
| ASUSTeK | Option 2 | As the agreement for CG, if none of the SSBs’ RSRP is above the RSRP threshold for CG-SDT in the type selection phase, the UE considers the CG-SDT criteria is not met and then check the RA-SDT criteria. We think that if none of the SSBs’ RSRP is above the RSRP threshold of RA-SDT, UE should also consider the RA-SDT criteria is not met. Then the UE goes to non-SDT procedure.  |
| LG | Option 2 | If there is no qualified SSB for RA-SDT, the SDT procedure should be dropped, and the UE should rely on normal RA procedure. |
| Google | Comment | Not sure the relation between the threshold for RA-SDT and the threshold for non-SDT procedure. If the two threshold value are the same, option 1 is fine.  |
| OPPO | Option 1 | Follow the same mechanism as legacy RACH. |
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# 5. Fallback and switching

## 5.1 RA type switching with SDT

The company proposals related to this topic are summarized in the table below.

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| Tdoc | Proposals |
| vivo [3] | Proposal 6: The Rel-16 fallback and switching mechanism for 2-step RACH are reused for 2-step RACH based SDT procedure. |
| Intel [5] | Proposal 4.To confirm the support to fallback from 2-step RA-SDT to 4-step RA-SDT or to 4-step RACH via fallbackRAR (following similar approach to legacy NR fallback from 2-step RACH to 4-step RACH).Proposal 5.Fallback from 2-step RA-SDT to 4-step RA-SDT via Msg.1 is supported same to legacy NR (i.e. preamble group selected should be the same and UE would expect that the size for Msg.A and Msg.3 sizes are the same). |
| ZTE [8] | Proposal 8: For the fallback from 2-step RACH to 4-step RACH within one RACH procedure, 2-step RACH with SDT resource can only fallback to 4-step RACH with SDT resource (i.e. 2-step SDT RACH can not fallback to 4-step normal (i.e. non-SDT) RACH.).Proposal 9: NW is allowed to configure 2-step SDT resource only on initial BWP without 4-step SDT RACH resource, in which case the fallback from 2-step RACH to 4-step RACH is not allowed in RA-SDT.Proposal 10: The MsgA-TransMax for the fallback from 2-stepSDT RACH to 4-step SDT RACH is specific to SDT. |
| NEC[10] | Proposal 1: Support fallback from 2-step RA-SDT to 4-step RA-SDT after N times of MsgA transmission.Proposal 2: The maximum number of MSG A transmission is specific to SDT (i.e. separately configured for SDT). |
| Huawei [23] | Proposal 3: Fallback can be explicitly indicated by the network: - For 2-step RA based SDT, UE falls back to 4-step RA-SDT procedure upon receiving fallbackRAR from the network. For 4-step RA based SDT, the fallback can be realized by the gNB providing a smaller grant in the first received RAR and optionally indicating that the UE should only include RRC message (no user data) in msg3 - For CG-based SDT, fallback indication is included in DCI.Proposal 4: UE falls back from 2-step RA SDT procedure to 4-step RA-SDT procedure upon reaching the maximum number of msgA transmissions. |

In Rel-16 2-step RACH, the fallback indication can be included in MsgB when the network can not decode the MsgA payload successfully. And the UE can be configured to switch to CBRA with 4-step RA type if the 2-step RACH is not completed after a number of MSGA transmissions, i.e., via MsgA-TransMax. For RA-SDT, it is still under discussion whether the fallback and switching procedure as legacy 2-step RACH are also supported in 2-step RA-SDT.

In order to avoid any ambiguity in the following discussions, rapporteur proposes that the terminology ‘fallback’ refers to the procedure that UE receive a fallbackRAR in MsgB which is used to schedule Msg3 transmission, the terminology ‘switching’ means the UE switches from 2-step RA-SDT to 4-step RA-SDT after a configured number of unsuccessful attempts.

**Q7.1: Whether the fallbackRAR reception as legacy 2-step RACH is supported in 2-step RA-SDT?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | Yes | We support from 2-step RA-SDT to 4-step RA-SDT via fallbackRAR. |
| Sony | Yes | It should only be supported if both 2-step and 4-step are configured on the same BWP for SDT. |
| Samsung | Yes |  |
| Nokia | Yes |  |
| Fujitsu | Yes | As legacy 2-step RACH. |
| ASUSTeK | Yes |  |
| LG | Yes | If fallbackRAR is received during 2-step RA-SDT procedure, the UE should fallback to 4-step RA-SDT procedure, similar to normal RA procedure. However, fallback should not mean that fallback to normal 4-step RA procedure. |
| Google | Yes |  |
| OPPO | Yes |  |
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**Q7.2: Whether the switching procedure as legacy 2-step RACH is supported in 2-step RA-SDT, i.e., UE can switch from 2-step RA-SDT to 4-step RA-SDT after N times of MsgA transmissions?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | Yes | This is similar to the fallback procedure for 2-step common RA fallback to 4-step common RA. |
| Sony | Yes | Possibly the counter (N) can be reduced to a small value. |
| Samsung | Yes |  |
| Nokia | Yes |  |
| Fujitsu | Yes | As legacy 2-step RACH. |
| ASUSTeK | Yes |  |
| LG | Yes | But, switch should not mean that switch to normal 4-step RA procedure. |
| Google | Yes |  |
| OPPO | Yes |  |
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## 5.2 RA type switching between SDT and non-SDT

The company proposals related to this topic are summarized in the table below.

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| --- | --- |
| Tdoc | Proposals |
| Samsung [2] | Proposal2: Network can send indication in RAR/fallbackRAR/DCI to switch to non-SDT procedure. |
| Qualcomm [11] | Proposal 2: Network sends an indication in RAR or fallbackRAR to switch UE from RACH based SDT to legacy RRC resume procedure. |
| Sony [13] | Proposal 1: UE switches from SDT to non-SDT when initial UL transmission (in msgA/Msg3/CG resources) fails configured number of times. |
| Nokia [16] | Proposal 1: Support switching from SDT to non-SDT procedure for RA-SDT if initial UL transmission fails configured number of times (ie., PREAMBLE\_TRANSMISSION\_COUNTER = preambleTransMax +1).Proposal 2: Indication to switch from SDT to non-SDT over RAR/fallbackRAR is not supported. |
| ASUSTek [20] | Proposal 1: When the Msg1/MSGA transmission fails configured number of times in a RA-SDT procedure, the UE stops the ongoing SDT procedure and initiate a legacy RA procedure (i.e., without UL data). |
| Huawei [23] | Proposal 3: Fallback can be explicitly indicated by the network: * For 2-step RA based SDT, UE falls back to 4-step RA-SDT procedure upon receiving fallbackRAR from the network. For 4-step RA based SDT, the fallback can be realized by the gNB providing a smaller grant in the first received RAR and optionally indicating that the UE should only include RRC message (no user data) in msg3
* For CG-based SDT, fallback indication is included in DCI.
 |

In RAN2 #113bis, it was agreed that UE switches from SDT to non-SDT when UE receive indication from network to switch to non-SDT procedure. Network can send RRCResume. FFS whether network can send indication in RAR/fallbackRAR/DCI to switch to non-SDT procedure. Another FFS is whether a UE can switch from SDT to non-SDT if initial UL transmission (in msgA/Msg3/CG resources) fails for a configured number of times, but no agreement was reached. Ffurther discussion shall be focused on whether UE can switch from SDT to non-SDT by the following two ways:

Case1: Network triggered - via RAR/fallbackRAR/DCI

Case2: UE triggered - switching to non-SDT after a number of failures at the initial transmission stage

Companies are invited to answer the following questions to make a way forward on these issues.

**Q8: Whether network can send indication in RAR/fallbackRAR/DCI to switch to non-SDT procedure?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | No | We have agreed that the network can send RRCResume message if the network wants to switch the UE from SDT to non-SDT. We don’t need to an additional approach to switch to non-SDT by network. |
| Sony | Yes, partially | We only support the case of **RAR/fallbackRAR,** we think additional **DCI** is not needed. |
| Samsung | Yes | Network can send RRCResume only if it has received Msg3 or MsgA. However, the scenario for indication in RAR/fallbackRAR is the one where network has not received Msg3/MsgA. |
| Nokia | No | This cannot be UE specific indication and hence NW would arbitrarily direct subset of UEs to non-SDT procedure. We have backoff mechanism in RA procedure that we can use already. If something, directing UEs from 2-step RACH for SDT to 4-step RACH for SDT could be considered in RAR/fallbackRAR. |
| Fujitsu | No | Additional DCI would not be considered. |
| ASUSTeK | Yes | Agreed with Samsung. |
| LG | No | Additional DCI is not needed. |
| Google | No | It may be sufficient to make UE switch to non-SDT by sending it the RRCResume message.  |
| OPPO | No | Indicating UE to RRC\_CONNECTED by RRCResume is enough. We do not see strong motivation to support this function. |
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**Q9: Whether switching to non-SDT after a number of failure at the initial transmission stage is supported?**

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| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | - | We don’t see the strong motivation/benefit to support the UE autonomously switches from RA-SDT to non-SDT after a number of failure. But no strong view. |
| Sony | Yes | It should be possible a UE to move to connected mode (i.e., non-SDT procedure) |
| Samsung | No | Not essential. |
| Nokia | Yes | This would be beneficial before going to IDLE given the regular RA procedure should succeed with greater likelihood than SDT RA procedure. |
| Fujitsu | No | When the PREAMBLE\_TRANSMISSION\_COUNTER reaches preambleTransMax +1, it can be considered that the SDT procedure fails. In this case, the NW can fully control the switching to non-SDT by sending RRCResume or fallbacRAR. Therefore, it is not sure if new failure counter is needed. |
| ASUSTeK | Yes | It is possible that the network could not receive the first UL transmission in the initial SDT phase. Since the RA-SDT resources is not dedicated, the UE may transmit a Msg1 or MSGA but fail to receive network response. Considering that the new T319 may be extended or be restarted in SDT procedure, the timer may keep running for a long time. Instead of keep retransmitting Msg1/MSGA, the UE could attempt to resume to connected mode after a number of transmission failure. |
| LG | No | In this case, the SDT procedure is failed, and SDT failure handling procedure should be performed. |
| Google | No | We could rely on existing RACH procedure to handle RACH failure. |
| OPPO | No | For this case, UE can report RACH problem to upper layer and consider the RA-SDT is failed. |
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# 6. Subsequent transmissions

## 6.1 PDCCH monitoring

The company proposals related to this topic are summarized in the table below.

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| Tdoc | Proposals |
| Vivo [3] | Proposal 3: UE monitors PDCCH addressed to C-RNTI in the separate CSS for RA-SDT after successful contention resolution only if the SDT detection timer is running. Send an LS to RAN1 asking whether it is feasible. |
| OPPO [4] | Proposal 3 For RA-SDT, UE keeps monitoring PDCCH after the contention resolution until the reception of the indication to terminate the SDT. |
| APT [7] | Proposal 2: UE continuously monitors the PDCCH on the common search space for RA-SDT within the subsequent transmission phase of the RA-SDT. |
| Google [19] | Proposal 1: For RA-SDT, UE should start a window to monitor PDCCH as in CG-SDT.Proposal 2: Discuss whether CG-SDT and RA-SDT have the same window size and the same timer. |
| ASUSTek [21] | Proposal 1: In RA-SDT procedure, the UE monitors the PDCCH addressed to C-RNTI when a timer is running for subsequent transmission.Proposal 2: RAN2 should discuss when the timer is started: |
| Huawei [24] | Proposal 11: Similarly as for CG-SDT, a PDCCH monitoring timer is used for RA-SDT scheme. A common timer can be used for PDCCH monitoring of CG-SDT and RA-SDT. |

As agreed in RAN2#113bis-e, UE would start a window after CG/DG transmission for CG-SDT, during which the UE monitor PDCCH. It is still FFS whether a similar timer shall also be introduced for RA-SDT procedure.

**Q10.1: Whether a timer is started to control the PDCCH monitoring after contention resolution, i.e., a timer similar as that for CG-SDT?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | No | It is sufficient to use SCG failure detection timer or RRC message to end the PDCCH monitoring for SDT after contention resolution. |
| Sony | Comment | If the SDT detection timer is started/Restarted after each DL Grant/UL Grant, do we need another timer? |
| Samsung | No | Not needed. For CG-SDT timer is needed for retransmission using CG. However in case of RA-SDT, UE relies on dynamic grants for retransmission. |
| Nokia | No |  |
| Fujitsu | Yes | Power saving is important during INACTIVE mode. Currently, there is no means to control PDCCH monitoring e.g. DRX inactivity timer. We are supportive to introduce a new timer to control PDCCH monitoring. |
| ASUSTeK | Yes | We think the timer is used for control the PDCCH monitoring (i.e., for power saving), but not for failure detection. Since SDT is introduced to save power consumption and signalling overhead, it is not suitable to keep monitoring the PDCCH in the whole subsequent transmission phase. When the UE should monitor PDCCH during RA-SDT should be defined. |
| LG | Yes | This is a subsequent SDT case, and same mechanism introduced in CG-SDT can be used. |
| Google | Yes | UE should start a timer similar to CG-SDT and monitor PDCCH while timer is running.  |
| OPPO | No |  |
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**Q10.2: If the answer of Q10.1 is yes, whether a common timer can be used for PDCCH monitoring of CG-SDT and RA-SDT?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| Fujitsu | Yes | It is simple. |
| ASUSTeK | Yes | The UE needs to monitor PDCCH with power saving for subsequent small data transmission in both CG-SDT and RA-SDT. |
| LG | Yes |  |
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## 6.2 Beam management

The company proposals related to this topic are summarized in the table below.

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| --- | --- |
| Tdoc | Proposals |
| Samsung [2] | Proposal 4: After the completion of RA procedure initiated for SDT and until the SDT procedure is completed/terminated, UE measures (e.g. periodically) the SS-RSRP of SSB selected during the RA procedure. If SS-RSRP is below a threshold: -UE initiates RA procedure. During the RA procedure UE transmits C-RNTI MAC CE in Msg3/MsgA. The C-RNTI included in MAC CE is the C-RNTI received during the RA procedure initiated for SDT |
| Sony [13] | Proposal 2: RAN2 to send an LS to RAN1 to investigate how to address the beam failure detection (BFD) and beam failure recovery (BFR) for SDT. |

Upon completion of RA procedure for SDT, for subsequent UL/DL transmissions in RRC\_INACTIVE state, UE monitors PDCCH addressed to C-RNTI. Issues come to whether BFD and BFR procedure shall be introduced for SDT since there is a case that the selected SSB may be not qualified any more during the subsequent transmission phase. Considering RAN1 would be mainly involved if companies intend to support, it is suggested to send an LS to RAN1 for further progress instead of triggering detailed discussion in RAN2.

**Q11: Do companies think that it is necessary to send an LS to RAN1 to check whether BFD and BFR is supported for RA-SDT?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | Yes | This is also valid for CG-SDT. |
| Sony | Yes | RAN1 should be informed to investigate the necessity of BFD and BFR. |
| Samsung | Yes |  |
| Nokia | Yes | After initial beam selection through RA procedure, it would seem beneficial if the beam could be changed by the NW (or by the UE through recovery). |
| Fujitsu | Yes | It is good to ask RAN1. |
| ASUSTeK | Yes |  |
| LG | Yes | This issue is overlapped with other e-mail discussion [501] SDT UP issue. For BFR, RAN2 discussion is needed, as indicated in [501]. |
| Google | Yes | It is good to send an LS to RAN1 asking whether BFD is supported or not.  |
| OPPO | Yes |  |
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## 6.3 PUCCH resources for HARQ-ACK

The company proposals related to this topic are summarized in the Table below.

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| --- | --- |
| Tdoc | Proposals |
| OPPO [4] | Proposal 1: RAN2 confirms that HARQ-ACK is needed for the DL transmissions in SDT procedure.Proposal 2: Consult with RAN1 whether it is necessary to introduce a set of PUCCH resources dedicatedly for SDT usage. |

As agreed, when UE is in RRC\_INACTIVE, it should be possible to send multiple UL and DL packets as part of the same SDT mechanism without transitioning to RRC\_CONNECTED on dedicated grant. For DL transmission, HARQ-ACK is necessary to guarantee the reliability. In current specification, the pucch-ConfigCommnon is used to configure a set of cell-specific PUCCH resources. UE uses these resources until a dedicated PUCCH configuration is available. While the support of DL data transmission in SDT might heavy the burden of PUCCH resources. Further discussion on the PUCCH resources for HARQ-ACK during SDT might be necessary.

**Q12: Do companies think that it is necessary to send an LS to RAN1 to check the PUCCH resources used for HARQ-ACK during SDT?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed Comments |
| CATT | Yes | We think this is necessary in SDT considering subsequent transmission is agreed in SDT.  |
| Sony | Yes | We should also consider to include PUCCH for CG-SDT where a UE may receive further DL data (PDSCH). |
| Samsung | Yes |  |
| Nokia | Yes | RAN1 can determine if anything is needed. |
| Fujitsu | Yes | It is good to ask RAN1. |
| ASUSTeK | Yes |  |
| LG | Yes |  |
| Google | Yes | As in LTE, PUCCH resources for HARQ feedback are needed. |
| OPPO | Yes |  |
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## 6.4 TAT expiry

The company proposals related to this topic are summarized in the Table below.

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| --- | --- |
| Tdoc | Proposals |
| Samsung [2] | Proposal 3: RAN2 to discuss and agree on one of the following options for handling TAT expiry during the SDT procedure.- Option 1: UE terminates the ongoing SDT procedure- Option 2: UE does not terminates the ongoing SDT procedure. UE suspends the UL transmission (except Random Access Preamble and MSGA transmission). UE waits for PDCCH order from gNB. Upon receiving PDCCH order, UE initiates the RACH and TAT timer will get re-started. - Option 3: UE does not terminates the ongoing SDT procedure. UE suspends the UL transmission (except Random Access Preamble and MSGA transmission). UE initiates RACH. |

SDT procedure continues upon completion of random access procedure initiated for SDT. While the SDT procedure is ongoing, TAT timer may expire. How to handle this case needs further discussion.

**Q13: Which option do you prefer to handle the case when TAT expires during RA-SDT procedure?**

* **Option1: UE terminates the ongoing SDT procedure.**
* **Option2: UE suspends all UL transmissions and triggers RACH if any UL transmission is needed (same as in connected mode)**
* **Option3: Others, please specify.**

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| --- | --- | --- |
| Company | Option1/2/3 | Detailed Comments |
| CATT | Others | The network knows whether TAT expires at the side. So if the network is aware there is UL data left at the UE side and TAT nearly expires, it can send TA command to update TAT. |
| Sony | Option1 | If for some reason TAT expires, a UE initiates a new SDT. |
| Samsung | Option 2 | As in current specification |
| Nokia | Option 2 |  |
| Fujitsu | Option 2 > Option 1 | The preference order is Option 2 > Option 1 to follow legacy procedure. Providing that TAT command sent from gNB may not be reached to the UE due to PDCCH reception failure. It is good to specify consistent UE behaviour. |
| ASUSTeK | Option 2 |  |
| LG | Comments | In which case, the TAT timer expires during SDT procedure? If it is RA-SDT, the network provides TAC in Msg2/MsgB, and the UE will restart the TAT. Thus, there is no TAT expiry issue.If it is CG-SDT, the network can know that the TAT in the UE is about to expire when the data is received. Then, the network would provide TAC to the UE, and there is no TAT expiry issue.If it is CG-SDT and the TAT expires before initial CG-SDT transmission, the UE would not perform CG-SDT transmission.We want to know first in which case TAT expires during SDT procedure. |
| Google | Option 3 | If TAT expires during RA-SDT, UE does not need to do anything.  |
| OPPO | Option 2 |  |
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# 7. Support of anchor w/ and w/o relocation

## 7.1 Assistant information

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Tdoc | Proposals |
| OPPO [4] | Proposal 3 An indication to inform the anchor gNB that the procedure is for SDT should be included in RETRIEVE UE CONTEXT REQUEST, based on which the anchor gNB can decide whether to perform anchor relocation.Proposal 4 It is the receiving gNB to generate the indication after determining the procedure triggered by UE is for SDT.Proposal 5 The target gNB includes the security algorithms that it supports or prefers in RETRIEVE UE CONTEXT REQUEST message, based on which the anchor gNB can decide not to perform the anchor relocation if the security algorithms are not matched between the anchor gNB and target gNB. |
| Spreadtrum [6] | Proposal 2：UE assistant information can be included in the first UL message. |
| Qualcomm [11] | Proposal 7: The Retrieve UE Context Request message contains the assistance information provided by the serving gNB. It can be up to RAN3 to decide the details. |
| Sony [12] | Proposal 3: Assistance information may support the gNB to make the proper decision on Anchor relocation. |
| Huawei [15] | Proposal 5: Assistance information transferred from the receiving gNB to the last serving gNB for allowing the last serving gNB to take an informed decision whether to perform anchor relocation or not shall at least contain the following:* UE’s expected traffic pattern, e.g. number of packets to be transmitted for SDT DRB in UL/DL, single-shot/multi-shot transmission etc.
* Buffer status for data from SDT DRBs.

RAN2 should send an LS to RAN3 on assistance information provided to last serving gNB. |
| CMCC [17] | Proposal 1: Subsequent data information, e.g. BSR, traffic pattern, should be informed to receiving gNB by UE; receiving gNB convey assistance information to anchor gNB in Xn for UE AS context retrieve procedure.Proposal 2: Contains the Assistance information as cause value provided by the UE in the RRC ResumeRequest or the RRCResumeRequest message. |
| CATT [18] | Proposal 1: For UE transition from SDT to RRC\_CONNECTED during SDT without anchor relocation, RAN2 asks RAN3 to consider:- which node (the current serving gNB and/or anchor gNB) can trigger the transition from SDT to RRC\_CONNECTED;- Some assistance info on dedicated radio resource configurations from the current serving gNB to anchor gNB needs to be considered. |

In RAN2#111e, it was confirmed that both anchor relocation and without anchor relocation will be considered in SDT for mobility scenario. For anchor without relocation solution, RNAU procedure can be taken as a reference. The anchor gNB may not relocate the UE context and keep the UE in RRC\_INACTIVE when UE is identified to perform an RANU procedure within the configured RNA. Otherwise, the UE context shall be always relocated from the anchor gNB to the target gNB when an RRC resume request is triggered by UE. The anchor gNB determines that the ongoing procedure is for RNAU by means of the ResumeCause IE included in RETRIEVE UE CONTEXT REQUEST. While as agreed in RAN2, SDT is transparent to NAS and an existing resume cause would be generated. Therefore, other assistant information needs to be provided from the serving gNB to the anchor gNB. Rapporteur thinks that this is mainly a RAN3 issue while discussion might be necessary on whether there is any information that shall be provided by UE.

**Q14.1: Regarding assistant information, which option do you support?**

* **Option 1: Existing assistance information (e.g. BSR) – i.e. no changes**
* **Option 2: New Assistance information (e.g. traffic pattern, RAI)**
* **Option 3: No assistance information (RAN3 discuss if any is needed)**

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| --- | --- | --- |
| Company | Option1/2/3 | Detailed Comments |
| CATT | Option 1/option 2 | If the UE predicts the incoming data, it can help the anchor gNB to decide whether to perform anchor relocation or not. |
| Sony | Option 2 | Additional information should be discussed that can help the anchor gNB to decide. Such information could be related to not only BSR, but if there are other information about subsequent data or not, of there are some latency or mobility aspects to be considered. |
| Samsung | Option 3 |  |
| Nokia | Option 3 | If anything, source gNB should be able to request for context (e.g., to bring the UE into CONNECTED). |
| Fujitsu | Option 1 | From RAN2 perspective, BSR seems to be enough. RAN3 should discuss if other information is needed. Probably, RAN2 is better to send an LS to RAN3. |
| ASUSTeK | Option 2 | UE assistant information is beneficial for gNB to determine anchor relocation. |
| LG | Option 3 | The discussion should be left up to RAN3. |
| OPPO | Option 3 | In our understanding, the assistant information provided by UE may not be that essential. The most important info that should be provided to the anchor gNB is that this is an SDT procedure, which be determined and generated by the serving gNB. |
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[3] R2-2107056 Supporting Small Data Transmission via RA Procedure vivo discussion Rel-17 NR\_SmallData\_INACTIVE-Core R2-2104763

[4] R2-2107248 Discussion on RACH-based SDT OPPO discussion Rel-17 NR\_SmallData\_INACTIVE-Core

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[8] R2-2107489 Open issues for RA-SDT ZTE Corporation, Sanechips discussion

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[11] R2-2107993 Open issues for RACH based SDT Qualcomm Incorporated discussion Rel-17 NR\_SmallData\_INACTIVE-Core R2-2105886

[12] R2-2108057 Discussion on context fetch and anchor relocation Sony discussion Rel-17 NR\_SmallData\_INACTIVE-Core R2-2105692

[13] R2-2108058 RACH-based SDT in NR Sony discussion Rel-17 NR\_SmallData\_INACTIVE-Core R2-2105693

[14] R2-2108085 RACH based small data transmission Ericsson discussion Rel-17 NR\_SmallData\_INACTIVE-Core

[15] R2-2108199 Small data transmission with RA-based schemes Huawei, HiSilicon discussion Rel-17 NR\_SmallData\_INACTIVE-Core

[16] R2-2108243 Details of RACH specific schemes Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_SmallData\_INACTIVE-Core

[17] R2-2108507 Discussion on RA-SDT CMCC discussion Rel-17 NR\_SmallData\_INACTIVE-Core

[18] R2-2108683 Transition from SDT to RRC\_CONNECTED CATT discussion Rel-17 NR\_SmallData\_INACTIVE-Core

[19] R2-2108702 Discussion on RA-based small data transmission Google Inc. discussion Rel-17 NR\_SmallData\_INACTIVE-Core Late

[20] R2-2108711 Discussion on fallback to non-SDT ASUSTeK discussion Rel-17 NR\_SmallData\_INACTIVE-Core

[21] R2-2108712 Discussion on PDCCH monitoring for RA-SDT ASUSTeK discussion Rel-17 NR\_SmallData\_INACTIVE-Core

[22] R2-2108713 Discussion on RA configuration reception ASUSTeK discussion Rel-17 NR\_SmallData\_INACTIVE-Core

[23] R2-2107491 Control plane common aspects for SDT Huawei, HiSilicon discussion Rel-17 NR\_SmallData\_INACTIVE-Core

[24] R2-2108200 User plane common aspects for SDT Huawei, HiSilicon discussion Rel-17 NR\_SmallData\_INACTIVE-Core