**3GPP TSG-RAN2 #113bis-e R2-210xxxx**

**Electronic meeting, April 12 – April 20, 2021**

**Agenda item:**8.6.2 (NR\_SmallData\_INACTIVE-Core)

**Source:** LG Electronics (Rapporteur)

**Title:** Report of [AT113bis-e][501][SDT] UP SDT open issues

**Document for:** Discussion and Decision

# 1. Introduction

This document summarizes issues identified in documents submitted to A.I. 8.6.2 User plane common aspects, except for the issues related to Post113-e[501][502][503][504].

This document is to report the result of the following email discussion in RAN2#113bis-e Meeting.

* [AT113bis-e][501][SDT] UP SDT open issues (LG)

Scope:

* + - Discuss open UP SDT open issues AI 8.6.2

Intended outcome:

* + - Agreeable Proposals in R2-2104395

Deadline for providing comments:

* + - Companies inputs April 15th
    - Rapporteur Proposals – April 16th
    - Comments on Proposals and final proposals – April 19th

# 2 Contact Information

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| Company | Contact: Name (E-mail) |
| LG Electronics | SeungJune Yi (seungjune.yi@lge.com) |
| Samsung | anilag@samsung.com |
| Xiaomi | Yumin Wu (wuyumin@xiaomi.com) |
| ZTE | Huang He (Huang.he4@zte.com.cn) |
| Ericsson | Henrik enbuske@ericsson.com |
| Huawei | Dawid Koziol (dawid.koziol@huawei.com) |
| Panasonic | Rikin Shah (rikin.shah@eu.panasonic.com) |
| Nokia, Nokia Shanghai Bell | Samuli Turtinen (samuli.turtinen@nokia.com) |
| Fujitsu | Ohta ([ohta.yoshiaki@fujitsu.com](mailto:ohta.yoshiaki@fujitsu.com)) |
| Sharp | Chongming Zhang(chongming.zhang@cn.sharp-world.com) |
| NEC | Wangda (wang\_da@nec.cn) |
| ITRI | Lin Jung-Mao(moumou3@itri.org.tw) |
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# 3. Discussion

## 3.1 PDCP re-establishment

According to current specification, the UE performs PDCP re-establishment if the *reestablishPDCP* is configured. Whether this explicit configuration is needed for SDT RB requires further discussion [2], [4], [12].

**Q1: Which option do you prefer?**

**- Option 1: The UE performs PDCP re-establishment implicitly when the UE initiates SDT procedure.**

**- Option 2: Whether to perform PDCP re-establishment is explicitly indicated by the network.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 1 | Upon initiating RESUME procedure for SDT initiation (i.e. for first SDT transmission), the UE shall always re-establish the SDT PDCP entities and resume the SDT RBs. So, explicit indication is not needed |
| Xiaomi | Option 2 | Option 1 seems a signalling optimization which is no necessary. |
| ZTE | Option 1 | Considering the security key will be updated in case the SDT is initialized, we think the PDCP re-establishment will be required anyway, thus no explicitly indication is needed. |
| Ericsson | Option 1 | Agree w ZTE |
| Huawei, HiSilicon | Option 1 | PDCP re-establishment is always required when SDT is triggered, so there is no use of having it configurable. |
| Panasonic | Option 1 | When UE initiates resume procedure for SDT, the security keys are always changed and PDCP re-established, hence explicit indication is not needed. |
| Nokia, Nokia Shanghai Bell | Option 1 | We see no case to not re-establish, hence, can apply this always. |
| Fujitsu | Option 1 | In the Rel-15 RRC, PDCP for SRB is re-established. What needs to be added for SDT is that PDCP for DRB is re-established. |
| Sharp | Option 1 |  |
| NEC | Option 1 |  |
| ITRI | Option 1 |  |
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## 3.2 PDCP status report

According to current specification, the PDCP status report will be generated when the PDCP entity re-establishment is requested by the upper layer and the *statusReportRequired* is configured. And the PDCP re-establishment will be performed when SDT procedure is initiated. Then, even if there is no status to be reported, the UE has to send PDCP status report, which will increase unnecessary overhead.

Thus, whether and how the PDCP status report is suppressed for SDT requires further discussion [1], [2], [3], [4], [5], [6], [9], [11], [12].

**Q2: Which option do you prefer?**

**- Option 1: The UE implicitly disables PDCP status report when the UE initiates SDT procedure.**

**- Option 2: Whether to trigger PDCP status report is explicitly indicated by the network.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 1 | There is no case where PDCP status report is useful. So UE can simply not trigger PDCP status report when PDCP entity re-establishment of an AM DRB is triggered for small data transmission. |
| Xiaomi | Option 2 | Option 1 seems a signalling optimization which is no necessary. |
| ZTE | Option 1 | We don’t see any use case for an “empty” PDCP status report. |
| Ericsson | Option 2 | Just reuse the legacy principle although similarly to legacy, the usefulness is low as the UE anyway sets the variables to initial value when RRCRelease message with suspend configuration is received. This is then an optimization not really needed. |
| Huawei, HiSilicon | Option 1 | Upon SDT initiation, the UE has nothing to report, so SR is just unnecessary overhead at this stage. |
| Panasonic | Option 1 | We agree with ZTE that there is no benefit to send empty PDCP status report to network as there is no ongoing data transmission when SDT procedure is initiated. |
| Nokia, Nokia shanghai Bell | No strong view | We agree with Option 2 the NW needs to update the PDCP-config in case PDCP status report was required for the current config. Hence, Option 1 could be OK as well. |
| Fujitsu | Option 2 | Network should control PDCP SR as legacy. |
| Sharp | Option 1 |  |
| NEC | Option 2 | No specification change is needed, the network can configure properly before release UE to INACTIVE state. |
| ITRI | Option 2 | We share the same views as Ericsson. |
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## 3.3 ROHC continuity

According to current specification, if *drb-ContinueROHC* has been provided and the RRC connection is resumed on the same cell where the connection was suspended, the UE will continue the ROHC context for the DRBs configured with the ROHC.

It has to be discussed first whether to support ROHC continuity for SDT [3], [4], [5], [6], [12].

**Q3: Which option do you prefer?**

**- Option 1: ROHC continuityis not supported for SDT.**

**- Option 2: Whether to support ROHC continuityis explicitly indicated by the network.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 2 |  |
| Xiaomi | Option 2 |  |
| ZTE | Option 2 | We see some benefit in ROHC to keep the data packet “small”, thus we prefer to support ROHC continuity in SDT. To minimize the impact, we think the ROHC continuity can be configured per RNA. |
| Ericsson | Option 2 | Under same RNA |
| Huawei, HiSilicon | Option 2 | ROHC is useful for overhead reduction. The network should be able to indicate in which area ROHC can be continued. It cannot always be assumed ROHC can be continued in the same RNA as RNA can cover more than one gNB-CU and there is no RoHC context fetching specified. |
| Panasonic | Option 2 |  |
| Nokia, Nokia Shanghai Bell | Option 2 | Can just follow what we had for RRC resume. |
| Fujitsu | Option 2 | Network should control ROHC continuity as legacy. |
| Sharp | Option 2 |  |
| NEC | Option 2 |  |
| ITRI | Option 2 |  |
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## 3.4 PDCP duplication

The PDCP duplication is used for increasing reliability of data transmission. However, it is not decided yet whether the PDCP duplication should be supported for SDT. Thus, whether to support PDCP duplication for SDT requires further discussion [3], [7].

**Q4: Which option do you prefer?**

**- Option 1: Both CA duplication and DC duplication are supported for SDT.**

**- Option 2: Only CA duplication is supported for SDT.**

**- Option 3: PDCP duplication is not supported for SDT.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 3 |  |
| Xiaomi | Option 3 | The PDCP duplication is for URLLC service, which should be kept in RRC\_CONNECTED. |
| ZTE | Option 3 | PDCP duplication is mainly for URLLC services, which are not in the scope of SDT. |
| Ericsson | Option 3 | We do not really see the need for duplication in SDT as the reliability should be met in CONNECTED instead (e.g. SDT DRB not configured). |
| Huawei, HiSilicon | Option 3 | SDT transmissions are limited to a single cell only, so there is no possibility to use PDCP duplication. Furthermore, SDT is not targeted at URLLC use cases, so PDCP duplication is not required. |
| Panasonic | Option 3 | Agree with Xiaomi and ZTE. |
| Nokia, Nokia Shanghai Bell | Option 3 | No multiple carriers should be used for SDT at least in Rel-17. |
| Fujitsu | Option 2 | We see a use case for URLLC, where gPTP message is exchanged in IIoT/URLLC. Them, RAN2 has agreed in this meeting that only MN terminated MCG bearer is supported for SDT. So DC duplication is already impossible and only CA duplication should be allowed. |
| Sharp | Option 3 |  |
| NEC | Option 3 |  |
| ITRI | Option 3 |  |
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## 3.5 RLC failure

According to current specification, in case “RETX\_COUNT = maxRetxThreshold”, RRC will be informed that the max retransmission has been reached. Then, the RLF will be triggered and RRC re-establishment will be initiated.

For SDT, since RLC AM will be supported and UE specific RLC configuration will be used, one issue is whether the RLC failure will be detected and informed to upper layer in case “RETX\_COUNT = maxRetxThreshold”, and whether RRC re-establishment will be initiated [5].

**Q5: Which option do you prefer?**

**- Option 1: RLC failure handling is supported for SDT.**

**- Option 2: RLC failure handling is not supported for SDT.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 2 | We can simply rely on SDT timer expiry or existing cell reselection triggers |
| Xiaomi | Option 2 | This does not need to be discussed if PDCP duplication is not supported. |
| ZTE | Option 1 | To minimize the impact on specs, we think RLC should inform RRC the RLC failure anyway. For the handling in RRC level, we prefer to have a common solution for all failure cases. It can be FFS whether the UE should enter IDLE mode or initiate RRC re-establishment procedure or initiate another resume procedure in such failure case (we can decide this based on the final decision for the T319 failure/cell reselection handling – i.e. email 503). |
| Ericsson | Discuss | This depends a bit on suitable resulting procedure in 331 ( 5.3.10.3) etc. Even if RLC failure is supported the failure case is rare as we have timers and other critera that is acted upon beforehand. We think a failure notification to upper layers might be useful. |
| Huawei, HiSilicon | Option 1 | It should be supported, but RRC Re-establishment is not and adequate procedure to trigger for the UE in RRC INACTIVE state, so the behaviour upon reaching maximum number of retransmissions should be further discussed. |
| Panasonic | Option 2 |  |
| Nokia, Nokia Shanghai Bell | Option 2 | We agree with Samsung. This would be quite rare to happen as this would be possible only by multiple subsequent transmission attempts with feedback about failure from NW. |
| Fujitsu | Option 2 | RLC failure is rare case. |
| Sharp | Option 2 |  |
| NEC | Option 1 | As anyway the RLC will inform the RRC the failure, some proper handling can be performed to terminate the current SDT as early as possible. |
| ITRI | Option 2 |  |
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## 3.6 Data volume criteria

According to current specification, the BS field in the BSR indicates the total amount of data volume calculated in PDCP and RLC. Note that RLC and MAC headers are not considered in BS calculation. The issue is whether the data volume used for SDT selection criteria is equal to the BS in BSR or other defined value [1], [2], [3], [8], [10], [12], [13], [15], [17].

**Q6: Which option do you prefer?**

**- Option 1: Data volume used for SDT selection criteria is calculated same as BS, i.e. PDCP data volume + RLC data volume, without considering RLC and MAC headers.**

**- Option 2: Data volume used for SDT selection criteria is the size of MAC PDU, i.e. PDCP data volume + RLC data volume + MAC/RLC/PDCP/SDAP/RRC overhead.**

**- Option 3: Data volume used for SDT selection criteria is the PDCP data volume.**

**- Option 4: Data volume used for SDT selection criteria is left up to UE implementation.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 1 | Same as buffer status.  The data available can be transmitted using multiple TBs during SDT procedure (initial UL transmission in CG/Msg3/MsgA and subsequent UL transmission based on dynamic grant), header overhead cannot be known in advance. |
| Xiaomi | Option 2 | The data volume threshold should be used to evaluate whether the resulting MAC PDU can be transmitted via the uplink grant of SDT.  For Option 1 and 3, the data volume threshold + corresponding L2 headers has to be smaller than the resulting MAC PDU of the UL grant. Then the gNB would have to exclude the L2 header size while configuring the data volume threshold. However it is difficult for the gNB to know the expected L2 header size, as the UE may have more than one PDCP SDUs from one or more DRB(s). |
| ZTE | Option 1 | Since we have subsequent data transmission, the option 1 seems sufficient with minimal impact on specs. In addition, if the data volume is only used in the initialization phase of SDT, then the option 1 and option 3 seems the same, since there is no data in RLC in such phase. |
| Ericsson | Option 3 | Seems straightforward and sufficient for the top level DVT estimation. |
| Huawei, HiSilicon | Option 2 | We understand that “RRC overhead” will be anyway considered as it is visible at PDCP layer. However, there can be quite some overhead in the MAC layer, e.g. BSR, assistance information for subsequent data, so it is worth considering it. This is similar as in EDT, where the size of the TB intended for EDT transmission was used for data volume threshold check. |
| Panasonic | Option 1 | Data volume is calculated same as total data (buffer status) without considering headers. |
| Nokia, Nokia Shanghai Bell | Not sure | Since data volume should be calculated before initiating SDT procedure, obviously there would not be data in RLC buffer. However, does the question mean the data volume would be calculated per radio bearer? Our assumption has been the aggregated data volume across RBs configured for SDT. |
| Fujitsu | Option 1 | Same as total data (buffer status). |
| Sharp | Option 4 |  |
| NEC | Option 4 | As the non-SDT DRBs are not resumed, PDCP and RLC data volume are not available. |
| ITRI | Option 1 | Same as buffer status. |
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## 3.7 PHR

According to current specification, upon initiation of connection resume for SDT, UE applies default MAC Cell Group configuration. Then, for SDT, PHR is triggered and included ahead of DTCH SDU, which may be not optimal for SDT. Thus, whether to support PHR functionality for SDT requires further discussion [1], [5], [8], [12].

**Q7: Which option do you prefer?**

**- Option 1: PHR functionality is supported for SDT.**

**- Option 2: PHR functionality is not supported for SDT.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 2 | If option 1 is supported, PHR MAC CE priority should be considered lower than DTCH to prioritise small data transmission. |
| Xiaomi | Option 1 | Firstly we think that the default MAC configuration should be used for the SDT procedure. The PHR as part of the default MAC configuration can be reused as legacy RACH, and it is beneficial for the UL scheduling (e.g. dynamic grant retransmission). |
| ZTE | 1 or 2 | We don’t think PHR is essential for SDT, thus we think it can be considered as second priority issue. If it can be supported with limited effort, then we are fine to have it. |
| Ericsson | Option 1 or 2 | Useful only for subsequent SDT, and if UE is brought to connected. Question is therefore somewhat unclear. The PHR will have higher prio and needed before the DTCH PDU. |
| Huawei, HiSilicon | Option 1 | As subsequent data transmissions are supported for SDT, PHR is needed. We can check further whether any modifications for triggering conditions are needed, e.g. to avoid sending it when there is no subsequent data. |
| Panasonic | No strong view | We are fine with either options. |
| Nokia, Nokia Shanghai Bell | Option 1 | The PHR is beneficial for subsequent transmissions. |
| Fujitsu | RAN1 consultation | It’s good to hear RAN1 view. |
| Sharp | Option 1 |  |
| NEC | Option 1 with comment | PHR is beneficial for the subsequent transmission but not needed for one-shot SDT, therefore PHR can be cancelled or deprioritized if the UL grant can accommodate the data but not able to accommodate the PHR plus its header, otherwise it can be reported. |
| ITRI | No strong view |  |
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## 3.8 LCH Restrictions

According to current specification, in RRC\_CONNECTED, LCH restrictions are applied when performing LCP. The issue is whether the LCH restrictions used in RRC\_CONNECTED is still applied for SDT [1], [8].

**Q8: Which option do you prefer?**

**- Option 1: LCH restrictions is not used for SDT.**

**- Option 2: LCH restrictions used for SDT is explicitly indicated by the network.**

**- Option 3: LCH restrictions used in RRC\_CONNECTED is kept used for SDT.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 1 | Some LCH restrictions such as allowedServingCells are not valid during SDT procedure.  Given that we have agreed that network will indicate the DRBs for which SDT transmission is allowed, the simplest approach would be to not apply LCH restrictions in Logical channel configuration |
| Xiaomi | Option 3 | For CG-SDT, the LCH restriction as Rel-16 IIOT can be reused to reduce the transmission latency for certain services, and to avoid that multiple services are using the same configured grant resource. |
| ZTE | Option 1 | LCH restriction is mainly introduced for URLLC services. Since URLLC services are not expected to be carried through SDT, we don’t see strong need to support LCH restriction in SDT (i.e. the LCH which require LCH restriction shall be configured as non-SDT DRB) |
| Ericsson | Option 2,3 | As we also have resumption of SRB (config) and maybe other DRBs for SDT, one would likely want to have the possibility to restrict and control multiplexing at MAC. Just reuse legacy (e.g. for CG) |
| Huawei, HiSilicon | Option 2,3 | We agreed that “CG-SDT resource configuration is provided to UEs in RRC\_Connected only within the RRCRelease message”, so there is no possibility to completely reuse LCH restrictions from RRC Connected state.  However, in general, we think LCH restrictions are useful, especially LCH to CG mapping as we agreed to support multiple CG configurations for SDT and different CG configurations can be applied for different services. |
| Panasonic | Option 1 | We don’t see any use case to support LCH restriction for SDT. |
| Nokia, Nokia Shanghai Bell | Option 1 | We already have the SDT configuration for RBs which should suffice. |
| Fujitsu | Option 3 | As commented in 3.4, we see a use case of SDT in IIoT/URLLC. |
| Sharp | Option 1 |  |
| NEC | Option 1 | The LCH which require LCH restriction shall be configured as non-SDT DRB. |
| ITRI | Option 1 |  |
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## 3.9 SR

In RRC connected mode, SR is triggered when regular BSR is triggered but there is no UL grant available. If SR resource is not available, RA procedure will be triggered. However, it is not decided yet whether the SR resource is available for SDT. Thus, it has to be decided first whether SR is supported for SDT [5], [6], [12], [16].

**Q9: Which option do you prefer?**

**- Option 1: SR is supported for SDT.**

**- Option 2: SR is not supported for SDT.**

**- Option 3: SR is supported for SDT, but not triggered during subsequent SDT.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 2 | SR support is not essential for SDT operation |
| Xiaomi | Option 2 | The dedicated SR would be only applicable for a certain cell, and cause lots of resource waste as the subsequent packet transmission of the SDT procedure should be considered as infrequent. |
| ZTE | Option 1 | We think dedicated SR resource is not supported in SDT but SR procedure can be supported as it is in current MAC specs (i.e. RACH will be triggered in case no available SR resource is configured.). To avoid unnecessary RACH procedure (i.e., RACH triggered before the gNB has time to provide the UL grant), we think SR delay timer shall be supported as well. |
| Ericsson | Option 1 or 2 | This depends on the PUCCH resources and also the RA SR resources. Additionally, if other data can be indicated in SDT (BSR) is not decided. |
| Huawei, HiSilicon | Option 1 | If there is no SR that in case there is no UL grant and data arrives, the UE would have to wait until the end of the SDT procedure and trigger SDT again, which would impose additional delay and overhead. |
| Panasonic | Option 1 | For certain applications, traffic pattern is not deterministic by the network. In this case, gNB may configure SR resources for UE to request the UL grants from gNB easier in a contention free manner for the UL data transmission. |
| Nokia, Nokia Shanghai Bell | Option 1 (SR procedure) | The question is unclear if it refers to SR procedure or dedicated SR configuration.  Similarly to ZTE, we think the SR procedure shall be supported (ie., based on BSR trigger). Dedicated SR configuration seems rather inefficient unless means are specified how this could be configured after the contention resolution.  As the NW would likely schedule UL grant for such UE in SDT procedure, means to delay the RA procedure could be useful as discussed by ZTE. |
| Fujitsu | Option 1 (SR procedure) | It could be used for subsequent transmission. |
| Sharp | Option 1 | For the coming data during SDT, SR is benefit to inform gNB the SDT data coming. |
| NEC | Option 2 | There is no need to support SR resource for SDT considering the SDT traffic usually happens infrequently. |
| ITRI | Option 2 | Same views as Xiaomi. |
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## 3.10 DRX

The DRX is supported in RRC\_CONNECTED. Though RAN1 needs to be involved, it would be good to check whether the DRX needs to be supported for SDT from RAN2 point of view [13].

**Q10: Which option do you prefer?**

**- Option 1: DRX is supported for SDT.**

**- Option 2: DRX is not supported for SDT.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 2 |  |
| Xiaomi | Option 2 | It seems RAN1 already agree to configure a separate search space for subsequent data transmission. The benefit of the DRX for SDT would be marginal. |
| ZTE | Option 2 | Considering the search space for SDT may be configured separately, we think a relatively sparse common search space can be configured to provide sufficient power efficiency and explicit support for DRX is not needed. |
| Ericsson | Option 2 | Only beneficial for subsequent SDT (e.g. CG) and then unclear benefit. Open to discuss but a base-line without. |
| Huawei, HiSilicon |  | We think some way of controlling when the UE monitors PDCCH has to be specified. Whether this is DRX or another mechanism should be further discussed. |
| Panasonic | Option 2 |  |
| Nokia, Nokia Shanghai Bell | Option 1 | Since SDT is defined also for power efficiency, applying DRX for subsequent transmissions should be looked at. |
| Fujitsu | Option 1 (Paging DRX) | “CONNECTED-mode DRX” is not supported, but so called “Paging DRX” seems to be supported for RAN paging. |
| Sharp | Option 2 |  |
| NEC | Option 2 |  |
| ITRI | Option 2 |  |
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## 3.11 BFR

The Beam Failure Recovery is supported in RRC\_CONNECTED. Though RAN1 needs to be involved, it would be good to check whether the BFR needs to be supported for SDT from RAN2 point of view [8], [12], [14].

**Q11: Which option do you prefer?**

**- Option 1: BFR is supported for SDT.**

**- Option 2: BFR is not supported for SDT.**

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| Company | Preferred option | Detailed Comments |
| Samsung | Option 2 |  |
| Xiaomi | No strong view | We need to at least ensure that the RRCRelease message is transmitted to the UE correctly. Otherwise the UE would be kept at the SDT procedure for quite a long time. BFR may not be the only solution. |
| ZTE | Option 2 (but final decision is up to RAN1) | Given that the SDT session is not expected to last too long, we think BFR need not be supported. However, we can leave the final decision on this up to RAN1. |
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| Ericsson |  | Leave to RAN1 |
| Huawei, HiSilicon | Option 1 | We think BFR may be needed due to subsequent data transmissions being allowed. The details could be discussed in RAN1. |
| Panasonic | Option 2 |  |
| Nokia, Nokia Shanghai Bell | Unclear | Does the BFR here also refer to BFD?  If the beam used for RACH deteriorates, only the T319-like timer can recover the situation. As the UE has C-RNTI, it would seem beneficial to update the beam in such a case. |
| Fujitsu | RAN1 consultation | It’s good to hear RAN1 view. |
| Sharp |  | RAN1’s input is preferred. |
| NEC | Option 2 | The SDT is not last very long time, relying on the timer is sufficient. |
| ITRI | Option 2 |  |
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# 4. Conclusions

To be filled later..

# References

[1] R2-2102708 User Plane Common Aspects of RACH and CG based SDT Samsung

[2] R2-2102750 Discussion on user plane issues of SDT Oppo

[3] R2-2102755 Discussion on User Plane Aspect of Small Data Transmission vivo

[4] R2-2102840 User plane aspects for SDT Intel Corporation

[5] R2-2103018 User plane open issues for SDT ZTE Corporation, Sanechips

[6] R2-2103102 Analysis on UP common aspects of SDT CATT

[7] R2-2103197 Support of CA and PDCP CA duplication Fujitsu

[8] R2-2103319 The UP common issues for small data transmissions Lenovo, Motorola Mobility

[9] R2-2103430 Discussion on user plane common aspects of NR small data transmission Qualcomm Incorporated

[10] R2-2103521 Common aspects for SDT Ericsson

[11] R2-2103528 User Plane common aspects Nokia, Nokia Shanghai Bell

[12] R2-2103531 User plane common aspects for SDT Huawei, HiSilicon discussion

[13] R2-2103583 Some aspects of User Plane for SDT in NR Sony Europe B.V.

[14] R2-2103674 Discussion on beam operations for small data transmission Google Inc.

[15] R2-2104220 Discussion on data volume calculation Xiaomi Communications

[16] R2-2103454 Avoid triggering RA during subsequent SDT ASUSTeK

[17] R2-2103672 Discussion on small data transmission Google Inc.