**3GPP TSG-RAN2 #113bis-e R2-2104395**

**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

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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 |  |
| CMCC | Option 1 |  |
| Qualcomm | Option 1 |  |
| Lenovo | Option 1 |  |
| Spreadtrum | Option 1 |  |
| ASUSTeK | Option 1 |  |
| LG | Option 1 | PDCP re-establishment is always required when SDT is triggered. |
| APT | Option 1 | PDCP re-establishment is mandatory for SDT. |
| OPPO | Option 1 |  |
| InterDigital | Option 1 |  |
| China Telecom | Option 1 | Upon initiating resume procedure for SDT, UE needs to generate the new security key as per TS33.501, and re-establish PDCP entities and resume SDT RB, so there is no need to introduce an explicit indication/configuration to UE. |
| Apple | Option 1 |  |
| Intel | Option 2 | Our preference is to keep the NR specification model where PDCP re-establishment is done explicitly (via a PDCP re-establishment flag sent along with the NCC in *RRCRelease* message for SDT operation). We don’t see a strong reason here to break that convention. However, we are ok to go with majority view on this. |
| CATT | Option 1 | We think there is no necessity to indicate UE to perform PDCP re-establishment explicitly. UE can perform PDCP reestablishment before SDT autonomously. |
| TCL | Option 1 | Agree with ZTE |
| Rakuten Mobile | Option1 |  |
| Convida | Option 2 | No strong reason to deviate from legacy behaviour. |
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**Conclusion on Q1**

- Option 1: 24

- Option 2: 3

Clear majority companies think that the UE performs PDCP re-establishment implicitly when the UE initiates SDT procedure.

**Proposal 1: The UE performs PDCP re-establishment implicitly, i.e. without explicit indication for PDCP re-establishment, when the UE initiates SDT procedure.**

## 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. |
| CMCC | Option 1 |  |
| Qualcomm | Option 1 | Option 1 is simple and enough. |
| Lenovo | Option 2 | No strong view, but we think legacy behaviour is sufficient.  |
| Spreadtrum | Option 2 | The UE can follow the configuration of the network as legacy procedure and PDCP status report can be avoided in SDT by proper configuration from the network. |
| ASUSTeK | Option 1 |  |
| LG | Option 2 | We can reuse legacy behavior. |
| APT | Option 2 | Network can configure it properly. |
| OPPO | Option 2 | We prefer to follow legacy behaviour. UE generates the PDCP status report according to the explicit indication from network. |
| InterDigital | Option 2 | Can rely on NW to suspend such reporting before sending the UE to INACTIVE. |
| China Telecom | Option 1 | Generally, there is no DL data transmission during SDT procedure. So, the PDCP status report is not needed. |
| Apple | Option 1 |  |
| Intel | See comment | We prefer aligning mechanism approach used for the handling of PDCP re-establishment and suppression of the PDCP status report. If Q1 is done implicitly, our preference for Q2 is to also do it implicitly for consistency. |
| CATT | Option 1 | PDCP entity will set RX\_NEXT and RX\_DELIV to the initial value when the PDCP entity is suspended. If the PDCP status report is triggered during PDCP re-establishment, the content is not useful to the network. Therefore, we think the simpler way is that UE implicitly disables PDCP status report when UE initiates SDT procedure. |
| TCL | Option 2 | As ZTE said there is no need to send an “empty” PDCP status report. However, we don’t see significant gain with such optimization. So reuse the legacy principle is enough and no specification change is needed. |
| Sony | Option 1 | A very slight preference for option 1 to avoid unnecessary overhead. |
| Rakuten Mobile | Option 2 | We would prefer legacy method. |
| Convida | Option 2 |  |
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**Conclusion on Q2**

- Option 1: 13 (Intel is counted for Option 1 considering the outcome of Q1)

- Option 2: 14

- No strong view: 1

Views are quite evenly split, and it is difficul to make any conclusion on it. It is proposed to discuss futher whether the UE can implicitly disable PDCP status report when the UE initiates SDT procedure.

**Proposal 2: RAN2 discuss further whether the UE can implicitly disable PDCP status report when the UE initiates SDT procedure.**

## 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 |  |
| CMCC | Option 2 |  |
| Qualcomm | Option 2 |  |
| Lenovo  | Option 2 |  |
| Spreadtrum | Option 2 |  |
| ASUSTeK | Option 2 |  |
| LG | Option 2 |  |
| APT | Option 2 |  |
| OPPO | Option 2 |  |
| InterDigital | Option 2 |  |
| China Telecom | Option 2 | ROHC is used to reduce the packet size, so it is useful to support the ROHC continuity in SDT. However, ROHC continuity is only applicable to certain areas, such as in the same cell or multiple cells controlled by the same CU. Therefore, ROHC continuity should be configured by network.  |
| Apple | Option 2 |  |
| Intel  | Option 2 | This could be further restricted to continue only in a region such as same cell or same RNA. Both options can be allowed and configured using explicit signalling  |
| CATT | Option 2 | We think ROHC continuity is beneficial on reducing the header consumption which is especially helpful on small data. |
| TCL | Option 2 | Agree with Huawei |
| Sony | Option 2 |  |
| Rakuten Mobile | Option 2 | Prefer legacy approach |
| Convida | Option 2 |  |
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**Conclusion on Q3**

- Option 1: 0

- Option 2: 28

All companies agree that ROHC continuity is useful for SDT, and whether to support ROHC continuity is explicitly configured by the network as in legacy.

**Proposal 3: As in legacy, whether to support ROHC continuity is explicitly configured by the network.**

## 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 |  |
| CMCC | Option 3 |  |
| Qualcomm | Option 3 |  |
| Lenovo | Option 3 |  |
| Spreadtrum | Option 3 |  |
| ASUSTeK | Option 3 |  |
| LG | Option 3 | The PDCP duplication is for URLLC service, and the target of URLLC and SDT is different. |
| APT  | Option 3 | Reliability is not the critical issue for SDT. |
| OPPO | Option 3 |  |
| InterDigital | Option 3 | Reliability of data is not an objective of the WI. |
| China Telecom | Option 3 | PDCP duplication aims to improve the reliability of data transmission to support the URLLC services. However, SDT is designed to support the small data transmission during the INACTIVE state. Therefore, there is no need for PDCP duplication in SDT.  |
| Apple | Option 3 |  |
| Intel | Option 3 |  |
| CATT | Option 3 | We think if the DRB requires high reliability, SDT is not suitable. In order not to bring too much complexity, PDCP duplication is not supported for SDT. |
| TCL | Option 3 | Agree with ZTE and Huawei. In addition, RSRP threshold is used for SDT so that the SDT shall be performed over the qualified radio resource so that the reliability shall be guaranteed. So there is no need to utilize the PDCP Duplication which will lead to considerable cost. |
| Sony | Option 3 |  |
| Rakuten Mobile | Option 3 |  |
| Convida | Option 3 | Agree with other companies that duplication is for URLLC and outside of the scope of this WI. |
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**Conclusion on Q4**

- Option 1: 0

- Option 2: 1

- Option 3: 27

Almost all companies think PDCP duplication is not useful for SDT. Thus, it is proposed not to support PDCP duplication for SDT.

**Proposal 4: PDCP duplication is not supported for SDT.**

## 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 |  |
| CMCC | Option 1 | RLC failure handling can be supported for SDT. |
| Qualcomm | Option 2 | SDT failure timer can handle this. No need additional failure handling. |
| Lenovo | Option 1 | We think RLC should inform RRC of a RLC failure. |
| Spreadtrum | Option 2 | It is a rare case. |
| ASUSTeK | Option 1 |  |
| LG | Option 2 | RLC failure happens in very rare case, and there is no need for support such feature. |
| APT  | Option 1 | The fallback from SDT to non-SDT is agreed to support now. Thus, the failure handling by RLC retransmission count can be one of the failure cases. |
| OPPO | Option 2 | We prefer to make the procedure simple and T319-like timer can handle this failure case. |
| InterDigital | Option 1 | No reason to change this behaviour, and a failure indication to upper layers is anyway beneficial. |
| China Telecom | Option 1 | Agree with ZTE, it is reasonable to follow the legacy RLF mechanism in SDT. Upon reaching the maximum number of retransmissions, RLC shall inform upper layer the failure.  |
| Apple | For discussion | RLC layer should inform the failure indication to RRC, which could trigger the SDT failure procedure.  |
| Intel | See comment | We agree that RRC re-establishment is not supported as already agreed in this meeting. However, even though we think that RLC failure is a corner case, we can’t leave it unspecified. This can be discussed in conjunction with all other SDT failure handling scenarios as explained in R2-2102842 aiming to have a common mode of operation for the SDT failure triggered by different events. |
| CATT | Option 2 | We think SDT procedure may not go through a large scale of time. And other timers/windows also guarantees that UE can detect channel conditions deteriorate promptly. |
| TCL | No strong view | We agree with Option 2, for the RLC failure is rare case and the SDT failure timer is enough. Anyway we have no objection to Option 1. |
| Sony | Option 2 |  |
| Rakuten Mobile | Option 1 | Agree with Samsung. |
| Convida | Option 1 | Agree with Intel that even though RLC failure is a rare case it shouldn’t be left unspecified. |
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**Conclusion on Q5**

- Option 1: 11

- Option 2: 13

- Discuss further: 3

- No strong view: 1

Views are quite evenly split, and it is difficul to make any conclusion on it. It is proposed to discuss futher whether the RLC failure handling should be supported for SDT.

**Proposal 5: RAN2 discuss further whether the RLC failure handling should be supported for SDT.**

## 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. |
| CMCC | Option 1 |  |
| Qualcomm | Option 4 | Similar to LTE EDT.  |
| Lenovo | Option 1 |  |
| Spreadtrum | Option 1 | We prefer the option with little impact on spec. |
| ASUSTeK | Option 3 |  |
| LG | Option 3 | We think Option 1 and Option 3 are essentially same because there would no RLC data volume at initiation of SDT procedure. Then, Option 3 is simple. |
| APT | Option 1 | The statements from BSR can be reused to minimize the specification impact. In addition, we agree with ZTE and Nokia that RLC may not have data since DVT is used on top level before initialization of SDT procedure. |
| OPPO | Option 4 | We are not sure whether the data volume at each layer is visible before the radio bears are resumed, so we prefer to follow the same behaviour as in LTE EDT.We suggest that we need to make consensus on whether AS is able to calculate a precise data volume size without radio bearer resumed before specifying the details as in Option1 to Option3. |
| InterDigital | Option 1 | For RBs configured for SDT. |
| China Telecom | Option 1 | Agree with Samsung. The header overhead is hard to calculate for subsequent data transmission. Moreover, option 1 has no impact on specification.  |
| Apple | Option 1 |  |
| Intel | Option 1 | Same as legacy BSR calculation |
| CATT | Option 3 or 4 | We think RLC and MAC headers may not be accurate at the start stage of SDT. We are also fine to follow the LTE behavior. |
| TCL | Not sure | We have same doubt with Nokia, whether the data volume would be calculated per RB or across RBs?  |
| Sony | Option 1 | Same as buffer status report calculations. |
| Rakuten Mobile | Option 1 | Same as legacy BSR Calculation. |
| Convida | Option 3 | Agree with LG that 1 and 3 are essentially the same, and it is better to go for the easier solution. |
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**Conclusion on Q6**

- Option 1: 15

- Option 2: 2

- Option 3: 5

- Option 4: 5

- Not sure: 2

Views are diverged, but considering that Option 3 is essentially same as Option 1, majority companies think that data volume used for SDT selection criteria can be calculated similar to legacy BS. Though the question does not explicitly say that data volume should be calculated as the total sum of BS across SDT RBs, the rapporteur think it is common understanding from companies. Thus, it is proposed to go with Option 1, with the assumption total sum of BS should be used for data volume calculation.

**Proposal 6: Data volume used for SDT selection criteria is calculated as the total sum of Buffer Size across SDT RBs.**

## 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 |  |
| CMCC | Option1  | Considering subsequent data transmission, PHR should be supported. |
| Qualcomm | Option 1 | We think PHR is beneficial for SDT for uplink transmission.  |
| Lenovo | Option 1 | We see some benefits in support PHR functionality for SDT transmission in particular given that subsequent data transmissions are supported.  |
| Spreadtrum | No strong view | Maybe RAN1’s input is needed. |
| ASUSTeK | Option 1 or 2 | If PHR is supported, PHR is only needed if there is subsequent transmission. If there is no subsequent transmission, PHR can be cancelled.If PHR is not supported, another default MAC configuration could be defined. |
| LG | Option 2 | We don’t think SDT procedure lasts long, so PHR may not be useful. |
| APT | Option 1 | Option 1 with some limitations can be taken into account. |
| OPPO | Option 1 | Follow legacy if it is configured. No extra work for SDT. |
| InterDigital | Optoin 1 | PHR can be reused as is, given it’s beneficial for scheduling subsequent SDT either in inactive or connected mode. |
| China Telecom | Option 1 | In order to support subsequent transmission, the PHR is needed, otherwise the network lacks accuracy information for uplink power control procedure.  |
| Apple | Option 1 or 2 | Same view as Ericsson. PHR is only useful for the subsequent transmission period.  |
| Intel | option 1 or 2  | We don’t think PHR is essential for SDT. But we are also OK to consider it if there is a majority support for it.  |
| CATT | Option 1 |  |
| TCL | Option 1 | It’s beneficial for the subsequent SDT. |
| Sony | Option 2 | As there is a RSRP threshold for SDT to exclude cell-edge UEs for SDT transmission, it seems not necessary to support for PHR. |
| Rakuten Mobile | Option 1 |  |
| Convida | Option 1 | It can further be discussed whether or not to send it when there is no subsequent data. |
|  |  |  |

**Conclusion on Q7**

- Option 1: 21

- Option 2: 8

- No strong view: 3

- RAN1 consultation: 1

Majority companies think that PHR is useful for SDT, at least for subsequent data transmission. It can be discussed further whether and how to suppress PHR if not necessary.

**Proposal 7: PHR functionality is supported for SDT.**

## 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.**

|  |  |  |
| --- | --- | --- |
| 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 |  |
| CMCC | Option 2, 3With comments | LCH restrictions should be supported and it can be indicated by the network. As to option3, LCH restrictions used in RRC\_CONNECTED can be kept used for SDT or LCH restrictins configuration can be included in *RRCRelease as* CG configuration. |
| Qualcomm | Option 1 | Same view with ZTE. |
| Lenovo | Option 1 or 2 | For uplink transmissions in RRC\_INACTIVE mode, i.e. small data transmission (SDT) occurring e.g. only on the initial UL BWP, most of the LCH mapping restrictions are actually not suitable and would rather prohibit the UE from using the configured uplink resources for small data transmissions, e.g. mapping restrictions related to allowed SCS, PUSCH duration and allowed serving cells. However there might be some (other) restrictions also applicable/useful for SDT |
| Spreadtrum | Option 1 | LCH restriction is not necessary for SDT. Non-SDT RBs can be configured for the related LCH. |
| ASUSTeK | Option 3 |  |
| LG | Option 2 | If multiple CGs are configured for SDT, LCH to CG mapping restriction may be required. |
| APT | Option 2,3 | We have agreed that multiple CG configurations can be configured for CG-SDT. At least “*allowedCG-List* ” may be useful. |
| OPPO | Option2 | Network can configure the LCH restriction for SDT if it is necessary.  |
| InterDigital | Option 2,3 | NW can reconfigure LCP restrictions before UE goes into inactive if needed, and also while in inactive state. |
| China Telecom | Option 1 | No use case to support LCH restriction for SDT |
| Apple | Option 2,3 |  |
| Intel | Option 3 | Motivation to define SDT specific LCH restriction is not clear to us. |
| CATT | Option 2, 3 | LCH restrictions, e.g. CG configurations, are helpful in SDT. |
| TCL | Option 2,3 | Agree with Ericsson and Huawei. For multiple CG configurations is supported for SDT, LCH restrictions are helpful. |
| Rakuten Mobile | Option 1 | Agree with ZTE |
| Convida | Option 2,3 | LCH restrictions are useful and legacy design should be re-used to the extent possible e.g. for CG. |
|  |  |  |

**Conclusion on Q8**

- Option 1: 12

- Option 2: 12

- Option 3: 12

Views are equally split among three options, and it is difficul to make any conclusion on it. It is proposed to discuss futher whether and how the LCH restriction is used for SDT..

**Proposal 8: RAN2 discuss further whether and how the LCH restriction is used for SDT.**

## 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.**

|  |  |  |
| --- | --- | --- |
| 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. |
| Qualcomm | Option 2 | It is unclear whether SR source could be configured when UE in inactive. |
| Lenovo | Option 2 |  |
| Spreadtrum | Option 1 | The SR procedure can be supported. |
| ASUSTeK |  | We think dedicated SR resource is not supported in SDT but SR procedure can be supported as current spec. However, RACH should not be triggered due to SDT RB in case no available SR resource is configured. |
| LG | Option 2 | We think SR resource is not required for SDT. |
| APT | Option 2 | Reserving dedicated SR resources for INACTIVE UEs is not efficient. |
| OPPO | Option 2 |  |
| InterDigital | Option 1 (SR procedure) | The SR procedure in MAC can be reused as is to trigger a RA-SR when there is no PUCCH configured (the case in INACTIVE state), e.g. once a new BSR is triggered for SDT data arrival and the UE doesn’t have a grant. |
| China Telecom | Option 1 (SR procedure) | The SR procedure need to be supported for some cases to reduce latency and overhead, but dedicated SR resource is not supported in SDT. |
| Apple | Option 2 |  |
| Intel | Option 2 | In our view, SDT should be over a really short period to transfer pending UL data. So we don’t think SR is essential. Dedicated SR resources is not efficient as Nokia pointed out. For RACH based SR, we would need to define a prohibit timer. We think it is simpler not to support SR for SDT. |
| CATT | Option 2 | If SR resource for SDT is dedicated, it is not friendly to resource efficiency. If SR resource for SDT is common, then PUCCH resource will be occupied by some SDT UEs. Then it leads to negative impacts on other procedures using common PUCCH resources, e.g. MSG4 feedback. |
| TCL | Option 1 | For the case there is no UL resource, SR is needed to request UL grant. |
| Sony | Option 1 (SR procedure) | But no need for PUCCH resource for SR. |
| Rakuten Mobile | Option 2 | No need for PUCCH resource for SR. |
| Convida | Option 1 |  |
|  |  |  |

**Conclusion on Q9**

- Option 1: 13

- Option 2: 14

- No answer: 1

Views are diverged, and it is difficul to make any conclusion on it. The rapporteur think the question itself is not clear to companies. There are two aspects to consider:

- Whether the SR resource is configured for SDT

- Whether the SR procedure used in legacy is used for SDT

Regarding the first aspect, the rapporteur think that the general feeling from the companies is not to configure SR resource for SDT, although some companies see benefit in configuring the SR resource for SDT.

Regarding the second aspect, the rapporteur think that the general feeling from the companies is to support legacy SR procedure. Then, when the BSR is triggered by SDT data, the UE will trigger RA-SDT because SR resource is not available, same as legacy.

Therefore, it is proposed:

**Proposal 9: SR resource is not configured for SDT. When the BSR is triggered by SDT data, the UE will trigger RA-SDT because SR resource is not available, same as legacy.**

## 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.**

|  |  |  |
| --- | --- | --- |
| 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 |  |
| CMCC | Option 2 |  |
| Qualcomm | Option 2 |  |
| Lenovo | Option 2 |  |
| Spreadtrum | Option 2 |  |
| ASUSTeK | Option 1 | The UE needs to monitor the PDCCH for subsequent small data transmission, retransmission, and/or DL data reception (e.g. *RRCRelease*). Since SDT is introduced to save power consumption and signalling overhead, it would be better that the UE apply simplified DRX mechanisms to avoid unnecessary PDCCH monitoring. |
| LG | Option 2 | Though the DRX mechanism used in RRC\_CONNECTED is not needed, we think some way of controlling PDCCH monitoring needs to be considered for SDT. |
| APT | Option 1 | Subsequent data transmission period may be kept for a long time. DRX mechanism is helpful from power efficiency perspective. On the other hand, legacy DRX timers can be reused for PDCCH monitoring in subsequent data transmission period of both RA-SDT and CG-SDT without introducing a new timer/window. |
| OPPO | Option 2 |  |
| InterDigital | Option 2 |  |
| China Telecom | Option 2 |  |
| Apple | Option 1 | For the case of long subsequent transmission period, DRX mechanism is useful for power saving purpose.  |
| Intel | Option 2 |  |
| CATT | Option 2 | We think power saving is not needed in SDT due to only several transmission interactions may be performed. |
| TCL | Option 2 | Separate search space for SDT is enough. |
| Sony | Option 1 | For power saving reasons, DRX can be supported. |
| Rakuten Mobile | Option 2 |  |
| Convida | Option 2 |  |
|  |  |  |

**Conclusion on Q10**

- Option 1: 6

- Option 2: 21

- No answer: 1

Majority companies think that DRX is not useful for SDT. Separate search space defined in RAN1 may be enough.

**Proposal 10: DRX is not supported for SDT.**

## 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.**

|  |  |  |
| --- | --- | --- |
| 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. |
|  |  |  |
| 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 |  |
| CMCC | Up to RAN1 | We share the same understanding as ZTE |
| Qualcomm | Option 2 | BFR is not essential for SDT which could be not long time. |
| Lenovo | Up to RAN1 |  |
| Spreadtrum | Option 1 | But it can be decided by RAN1. |
| ASUSTeK | Option 2 | However, the UE should be able to detect beam failure and fallback mechanisms can be performed upon detecting beam failure. |
| LG | Option 2 | We don’t think SDT procedure lasts long, so BFR may not be useful. |
| APT | Option 1 (determined by RAN1) | Currently, we have agreed that the switching from SDT to non-SDT is supported. BFR is helpful for triggering the fallback by UE within subsequent data transmission period. However, whether BFR can be supported in RRC\_INACTIVE should be determined by RAN1. |
| OPPO | Option 2 |  |
| InterDigital | Up to RAN1 |  |
| China Telecom |  | Leave to RAN1. |
| Apple | Option 2 |  |
| Intel | Option 2 | From RAN2 point of view, SDT session aims to be short and therefore SDT failure detection timer is sufficient. However, we are also open to consult RAN1 on their preference for this. |
| CATT | Option 2 (but final decision is up to RAN1) | We think it is not necessary as the duration for whole SDT procedure is not long. However, the final decision is up to RAN1. |
| TCL | Up to RAN1 | We prefer Option 1 for BFR may be needed to avoid that the SDT last for a long time, and the subsequent data transmissions also makes the BFR necessary. However, it can be up to RAN1 decision.  |
| Sony | Option 1 | Beam Failure Detection and recovery mechanism can be supported. |
| Rakuten Mobile | Leave to RAN1 |  |
| Convida | - | RAN1 to decide. |
|  |  |  |

**Conclusion on Q11**

- Option 1: 4

- Option 2: 12

- Up to RAN1: 13

- No strong view: 1

- Unclear: 1

Majority companies think that BFD and BFR need to be decided in RAN1.

**Proposal 11: Whether to support BFD and BFR for SDT is up to RAN1 decision.**

# 4. Conclusions

**For easy agreement:**

**Proposal 1: The UE performs PDCP re-establishment implicitly, i.e. without explicit indication for PDCP re-establishment, when the UE initiates SDT procedure. (24/3)**

**Proposal 3: As in legacy, whether to support ROHC continuity is explicitly configured by the network. (28/0)**

**Proposal 4: PDCP duplication is not supported for SDT. (27/1)**

**For potential agreement:**

**Proposal 6: Data volume used for SDT selection criteria is calculated as the total sum of Buffer Size across SDT RBs. (15/2/5/5)**

**Proposal 7: PHR functionality is supported for SDT. (21/8)**

**Proposal 9: SR resource is not configured for SDT. When the BSR is triggered by SDT data, the UE will trigger RA-SDT because SR resource is not available, same as legacy (14/13).**

**Proposal 10: DRX is not supported for SDT (21/6).**

**For further discussion:**

**Proposal 2: RAN2 discuss further whether the UE can implicitly disable PDCP status report when the UE initiates SDT procedure. (13/14)**

**Proposal 5: RAN2 discuss further whether the RLC failure handling should be supported for SDT. (11/13)**

**Proposal 8: RAN2 discuss further whether and how the LCH restriction is used for SDT (12/12/12).**

**Left for RAN1 decision:**

**Proposal 11: Whether to support BFD and BFR for SDT is up to RAN1 decision.**

# References

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[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

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[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.