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

**e-Meeting, 16th-27th August 2021**

**Source: email discussion Rapporteur (ZTE Corporation)**

**Title: [Post114-e][505][SData] RRC/MAC modeling and RRC running CR (ZTE): Modeling discussion**

**Agenda item:** **8.6.1**

**Document for:** **Discussion and Decision**

# Introduction

This document contains summary of email discussion to collect comments on the RRC/MAC modelling for SDT:

* [Post114-e][505][SData] RRC/MAC modeling and RRC running CR (ZTE)

**Scope:**

Phase 1: Modeling discussion for RRC/MAC Review running stage 2 CR

i. Feedback on existing modelling used by the running CRs

ii. Identify any issues with the current modelling and any potential changes

iii. Updated running CRs can be provided based on the outcome of this discussion

Phase 2: Review running RRC CR after some agreements from phase 1

**Intended outcome:** CR ready to be endorsed in RAN2115-e

**Deadline for company comments on the modelling issues:** Monday 26th July

**Discussion summary**

* TBD

# Discussion

For the triggering of SDT, a number of conditions were agreed in the previous meetings. We need to agree how to split the specification of these conditions between MAC and RRC. In the latest RRC (R2-2105927) and MAC (R2-2105032) running CRs submitted to RAN2#114-e, the following split has been implemented:

RRC determines whether the pending UL data/NAS message(s) are mapped to SDT RB(s).

MAC performs all other checks

* Data volume threshold check
* SDT RSRP threshold check
* Determining whether to use RA-SDT or CG-SDT
  + CG resource validation
  + RA resource validation

The overall modelling between MAC and RRC hance is as depicted in Figure below (reproduced from R2-2105847):



Figure 1: Overall modelling of MAC and RRC for determining SDT vs non-SDT (see R2-2105847)

So, according to the above modelling, once RRC determines that all the pending UL data/NAS message(s) are mapped to SDT RB(s), the remaining checks to determine the initial SDT vs non-SDT selection are performed in MAC. The first question is to check whether there are any issues with the above modelling.

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| According to the latest RRC and MAC running CRs, **once RRC determines that all the pending UL data/NAS message(s) are mapped to SDT RB(s), the remaining checks to determine the initial SDT vs non-SDT selection are performed in MAC**.  Q1: Is the above split between RRC and MAC acceptable?   * In the comments, companies can highlight any issues and provide any alternative split between RRC and MAC explaining the reasons for the change. | |
| Company | Comments on the modelling and any identified issues and provide alternative split between RRC/MAC (if there is an issue) |
| CATT | We have identified the following issues:  1. If Data volume calculation is calculated at MAC, how to estimate the data volume before transmission if PDCP/RLC MAC header are taken into account.  2. CG validation will check whether TAT is running. If TAT is defined in RRC, there will be layer interactions. This is not yet captured in the figure above.  3. When SDT condition is not satisfied, MAC should indicate to RRC. Then, RRC performs legacy RRC Resume procedure. It is not reasonable for MAC directly goes to legacy Resume procedure. Whether the legacy resume procedure is initiated or not should be decided by RRC.  4. The agreement from RAN2#112 is that “For both RACH and CG based solutions, upon initiating RESUME procedure for SDT initiation (i.e. for first SDT transmission), the UE shall re-establish at least the SDT PDCP entities and resume the SDT DRBs that are configured for small data transmission (along with the SRB1). FFS for non-SDT DRBs.”  However the flow chart above has not captured this correctly in our understanding. According to the flow chart above, MAC indicates RRC whether SDT is selected after SDT selection performed at MAC layer. Afterward, RRC will perform SDT initiation procedure including resuming SDT RBs, applying PDCP/RLC/MAC configurations and etc.  After selection of SDT, MAC should inidicate RRC and CG-SDT/RA-SDT should be performed after resuming all SDT RBs by RRC..  We have modified the figure as below to capture point 3 and 4 above. |
| Intel | In our understanding, RRC or MAC cannot determine whether there is UL data in suspended RBs. Moreover, RRC or MAC cannot differentiate whether the UL data belongs or not to SDT RBs or the amount of data on SDT RB waiting to be conveyed. If this level of operations were specified, SDAP layer is the best to determine them while UE is in RRC\_INACTIVE.  However it seemed that companies may be OK not to specify how UE detects that there is SDT or non-SDT data in the RBs, or determines if SDT operation can be used (as otherwise, lower layers of UE would need to have knowledge of data belonging to suspended RBs). Therefore all these details could be left up to UE implementation. If so, MAC specification would not introduce any new checks for SDT operation and RRC specification would only define conditions that UE needs to meet in order to start the SDT operation (but defining them as general description of the condition instead than actual new checks from modeling perspective). On summary, UE is allowed to initiate SDT procedure when the list of the different conditions captured in RRC are met.  RAN2 may need to have further considerations on this depending on CT1’s input. |
| Google | The split is acceptable to us. We think if all arriving data are mapped to SDT, RRC should indicate SDT data arrival event to MAC. The MAC should select SDT or non-SDT and indicate its selection back to RRC. If MAC selects SDT, RRC submits a resume request to MAC and starts the new T319 timer. When MAC receives data from RRC, MAC initiates its selected procedure. In Fig. 1, if MAC selects legacy resume procedure, it should indicate to RRC. |
| NEC | We understand thatone of the intention of data volume calculation performed at MAC layer is to rely on exisiting PDCP/RLC data volume calculation, however, we have the we have some concerns:   1. Since the radio bearers configured with SDT are not resumed when perform data volume calculation, we are not sure if the new data can be seen as PDCP SDUs, such that the existing PDCP data volume can be used for to calculated the new data. At RAN2 #114-e, there is some discussion on the modeling of suspended DRBs at the main session [AT114-e][002][NR15] User Plane, it seems companies may have different understanding on the behavior of suspended radio bearer. 2. There may be stored data at PDCP and RLC entities (e.g. the data which is not transmissted before UE is released to INACTIVE state), which will be discarded by PDCP/RLC re-establishment upon SDT initialization. However, if the data volume check is performed by MAC before PDCP/RLC re-establishment, how to handle these buffered data? If they are taken account, we can not obtain a correct data volume value.   In addition, we also agree with bullet 3 of CATT’s comment, which is when SDT condition is not satisfied, MAC should indicate to RRC, such that RRC can submit RRCResumeRequest message to MAC layer, and start failure detection timer (T319) for non-SDT. |
| OPPO | The issues that need to be further discussed are identified as follows from our side:   1. We have not made consensus on whether MAC or AS is capable to calculate a proper data volume, i.e., same as BS, without the radio bearers resumed. If this is not achievable for MAC/AS after further study, we suggest to follow the LTE behavior, i.e., it is up to UE implementation to check the data volume criteria of SDT and the text is specified in RRC. 2. It was agreed that RSRP threshold is used to select between SDT and non-SDT but we did not make it clear whether this RSRP threshold is configured per cell or per carrier (SUL/NUL)? In our understanding, how to configure the RSRP threshold for SDT and non-SDT selection would have impacts on the modeling, i.e., the RSRP checking is performed before or after carrier selection. 3. The condition to perform carrier selection is not clear in the figure. We can interpret it in two different ways. Option1: UE performs carrier selection when both NUL and SUL are configured; Option2: UE performs carrier selection when both NUL and SUL are configured with SDT resources. If the intention isthe former, we think the next step after carrier selection should be the checking of whether there is SDT resources, which is missed from the figure. Otherwise, for the latter, the description of ‘UE carrier selection for SDT if both NUL and SUL are configured’is not proper. Furthermore, another case regarding how to handle the case that there is only one carrier configured with SDT resources is not considered. 4. According to the agreements that have been made so far, there are three criteria to determine whether UE can do SDT, namely data volume, radio bearer and RSRP threshold. While we notice that the provided modeling involves the procedures which shall be treated as rescource selection into the SDT intiation stage. We are not sure whether this is acceptable for majority. |
| Samsung | 1. We prefer to have all checks to determine whether to perform SDT procedure or not in one layer. The interaction (such as indication from RRC to MAC upon data arrival and then from MAC to RRC whether to perform SDT or not) between RRC and MAC is unnecessary. There are two alternative approaches:  Approach 1: Define all conditions for SDT in RRC and depending on whether all conditions are met or not, RRC initiate SDT procedure or resume procedure.  Approach 2: Define all conditions for SDT in MAC. Upon data arrival, if criteria (as defined in section x/y of TS 38.321) to initiate SDT procedure is met, initiate SDT procedure. Other wise initiate resume procedure. No need of indications between MAC and RRC.  We have sligh preference for approach 1. |
| LG | 1. Regarding Figure 1, we have similar view with CATT. MAC indicates whether SDT condition is satisfied or not, and RRC makes the final decision whether to perform the legacy resume procedure or SDT procedure. Thus, we think that the following two cases should be considered in the flow chart.  * When SDT condition is not met, MAC indicates to perform legacy RRC resume procedure * When RRC determines to perform SDT procedure, RRC instructs to MAC to initiate SDT procedure  1. We think that the NAS data does not arrive at AS layer until that the corresponding RB has been resumed. Thus, if RBs configured for SDT are not resumed, MAC layer cannot performs the data volume check. In order to check data volume, RB configured for SDT should be resumed to receive NAS data as following modified figure (based on CATT’s figure). |
| ZTE | We think the current modelling is in general fine.   * If the SDT RBs are resumed before determining that SDT can be used, then we need additional mechanisms to ensure the SDT data is not actually included in the MSG3/MSGA payload (in case SDT is not eventually chosen). This will further complicate the procedure in MAC and RRC and this is unnecessary in our view. * In general, we think lower layers can have the visibility of data buffered at upper layers. This is a prerequisite for any scheme and we think how this is visible to lower layers is UE internal implementation that need not be specified. * We have some sympathy for comments that all the checks can be performed in one layer (i.e. kept in one spec). However, we don’t have strong view on this and we think the current modelling is a good compromise split without extensive interlayer interactions. We don’t think there is really much difference in capturing this in RRC/MAC or in SDAP. However, typically we capture such procedures when executing the RRCResume mainly in RRC. So, we don’t really think SDAP is suitable for this purpose and we prefer to keep SDAP unchanged. |
| vivo | We share a similar view with Samsung.  In Rel-16 PUR, if I remembered correctly, both PUR-TAT and PUR occasion maintenance are firstly modeled in MAC spec. Due to complex inter-lay interaction, all these modelings were moved to the RRC layer finally. Considering the RRC layer is generally used for radio resource control, we also prefer to specify the SDT triggering condition in the RRC layer. An example for SDT modeling is given as follows, |
| Nokia | In general, we see no big issue with splitting the checking criteria in RRC and MAC. The criteria common to RA-SDT and CG-SDT could already be checked in RRC, e.g. whether the data is from SDT-enabled bearer and RSRP threshold if the threshold is common for them. If any of the common criteria is not met, RRC could already initiate non-SDT directly without request MAC to do the further verification. Other CG/RA specific criteria could be checked in MAC.  If to keep all the verifications in one layer, our preference would be in MAC layer since the conditions are mostly MAC oriented.  Agree with CATT that if MAC verification fails, it should indicate to RRC. CCCH message is only delivered to MAC after the MAC verification regardless of SDT or non-SDT procedure is to be initiated, so MAC cannot initiate legacy resume by itself. Besides, RRC needs to be aware of which procedure is ongoing. |
| Huawei, HiSilicon | We think the proposed modelling is OK in general, with the following comments:   1. One thing that will have to be potentially rediscussed is handling of the SDT failure detection timer. In case RAN2 decides the timer should be restarted after each DL/UL transmission, the timer will probably fit better in the MAC layer or there will have to be some indications from MAC to RRC to restart the timer. 2. When it comes to CG TAT, we think CG TAT should be maintained in MAC layer, together with “regular” TAT (we understand it is already part of the “CG validation success” box in the current modelling). We should also discuss how both CG-TAT and TAT are used during subsequent data phase of the SDT procedure, e.g. do we need to rely on both of them or only a single one (i.e. CG-TAT would be only for initial CG-SDT transmission). 3. We agree with some other companies that updates to the modelling figure are needed to capture that it should be RRC layer which initates legacy resume procedure when the SDT conditions are not satisfied. 4. When it comes to the data volume calculation, we think it could be simply clarified that MAC receives this information from PDCP layer (or upper layers in general). We would like to avoid overspecifying this aspect (e.g. specifying that SDT RBs are resumed up front just for the sake of data volume calculation, without knowing whether SDT is possible or not, and potentially re-suspended afterwards). |
| Qualcomm | We have the following comments.   1. It is desiable to have as less as possible on the interaction between RRC and MAC layer. Thus, similar to many companies comments, it will be good to have all the condition checking for SDT in one layer. We prefer to do it in MAC layer. Because the parameter or verification procedure such as RSRP threshold, carrier selection and TA timer validation should be in MAC layer, just like the existing legacy RACH procedure. For the data valume threshold checking, we can follow the RRC spec for LTE EDT if needed, in 5.3.3.1b, i.e. *it is up to UE implementation how the UE determines whether the size of UL data is suitable for EDT.* 2. Similar view with CATT and Nokia, if MAC verification fails, it should indicate to RRC. It should be RRC layer iniates RRC resume prcoedreu if SDT criteria is not met. |
| Ericsson | Specified interaction (*detailed*) between layers should be avoided. Similar to QC, Nokia and other companies we think some simple interaction is needed though due to that RRC has the responsibility for overall configuration, RB resumption and procedure-type initiation (e.g. RRC determines that the pending UL data/NAS message(s) are mapped to SDT RB(s)); whereas MAC has the immidiate radio resource status knowledge (sync, rsrp, carrier, timers). I.e MAC should evaluate the availability/validity of a SDT resource(s) where also a volume estimation can be made (e.g. similar to preamble group selection) and have a “simple” indication to higher layers. |
| Xiaomi | Similar to the views provided by QC and other companies, we also prefer to have one layer (i.e. MAC) which verifies all the conditions. If the verification in MAC fails, the MAC can indicate the failure to the RRC. Then the RRC can initiate the legacy RRC resume procedure. The MAC could also indicate the success indication to the RRC when the verification for the SDT procedure is passed, so as to allow the RRC layer to resume the SDT DRB. |

One further aspect of the modelling is when to resume the RBs configured for SDT. As per the latest RRC running CR (see R2-2105927), the RBs configured for SDT are only resumed after MAC layer performs the data volume check and other relavent checks for SDT vs non-SDT selection and selects the SDT transmission. Companies are invited to comment on whether such modelling is acceptable.

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| According to the latest RRC and MAC running CRs, **the radio bearers configured for SDT are resumed only after the MAC layer performs the data volume check and other relavent checks for SDT vs non-SDT selection and SDT transmission is selected**.  Q2: Is the above modelling of the resumption of SDT RBs acceptable?   * In the comments, companies can highlight any issues and provide any alternative implementation for the resumption of SDT RBs. | |
| Company | Comments on when SDT RBs should be resumed in RRC and any alternative proposals (if there is any issue with the current modelling) |
| CATT | Same as our issue1 in Q1. If DRB is not resumed, how to estimate the data volume if the data volume is calculated at MAC layer taken into account PDCP/RLC/MAC headers? |
| Intel | See our related views provided in previous question Q1 in relation to how the running CR is done. Based on that, RRC would only capture a single statement with the SDT conditions met and then all SDT RBs could be resumed. In addition, MAC would address the CG/RA and carrier. |
| Google | In MAC, because data volume information is available for resumed DRBs, RRC should resume SDT DRBs before MAC uses the information. Otherwise, MAC have no data volume information to select SDT or non-SDT. |
| NEC | We are OK that the SDT radio bearers should be resumsed after the SDT conditions are fulfilled. |
| OPPO | UE shall resume SDT RBs once SDT is initiated as the agreement made in RAN2#112e. When and how to intiate SDT is discussed as a part of Q1.  For both RACH and CG based solutions, upon initiating RESUME procedure for SDT initiation (i.e. for first SDT transmission), the UE shall re-establish at least the SDT PDCP entities and resume the SDT DRBs that are configured for small data transmission (along with the SRB1). *FFS for non-SDT DRBs. FFS on implicit vs. explicit. FFS on whether we a new Resume cause. FFS on whether we need to deal with suppressing PDCP status report* |
| Samsung | Resumption should be performed after making the decision to initiate SDT procedure (i.e. all conditions are met) |
| LG | We think there is two option to check data volume.   * Optoin 1. NAS calculates the data volume and informs RRC of the calculated data volume. * Option 2. RBs configured for SDT is reumsed upon SDT data arrival before the data volume check.   In [AT113bis-e][501][SDT] UP SDT open issue, there was a consensus that data volume used for SDT selection criteria is calculated as the total sum of Buffer Size across SDT RBs, and this means that majority companies think that data volume used for SDT can be calculated similar to legacy BS. We thnk Option 2 is more aligned with legacy BS calculation and is acceptable from RAN2 point of view. |
| ZTE | We agree with Samsung and NEC. We think lower layers should have visibility of data from upper layers.  In general we also think that Option 2 above in LG’s reply works. However, we think option 2 is feasible with or without the RBs being resumed.  On the otherhand if the SDT RBs are resumed and if SDT is not eventually chosen then the data from these resumed RBs shall removed from the MAC PDU which would have been submitted to lower layers (along with the CCCH message). This in our view will create unnecessary complexity and hence the current modelling is simple and sufficient. |
| vivo | We also agree with Samsung and NEC. Additionally, we think it is up to RRC to play the role in checking the SDT triggering conditions, which is similar to LTE EDT and PUR. |
| Nokia | Agree SDT RBs should only be resumed after all the SDT verifications are done. |
| Huawei, HiSilicon | We are OK with this modelling. On the data volume calculation issue, we think it is not important which layer calculates the data volume, we just need to clarify this can happen for suspended RBs as it does not make sense to resume the RBs and potentially re-suspend them. Also, we still need to decide whether it is MAC which calculates data volume or the data volume is rather calculated at PDPC/RLC layer (as done currently for BSR) and just indicated to MAC layer. |
| Qualcomm | In current MAC spec, MAC eneity shall consider all radio bearers which are not suspended and not clear on whether might consider the radio bearers which are suspended. For the other releavent checks, i.e. RSRP, carrier, for SDT vs. non-SDT selection, they should be performed in MAC layer when data is arrived at upper layer no mater RBs configured for SDT are resumed or not. For the data volume check, similar to our comment in Q1, follow the LTE EDT, i.e. up to UE implmeeation how UE determine whether the size of UL data is suitable for EDT. |
| Ericsson | We agree a SDT RB is not resumed before verification. For the data volume check, details should be left to implementation but we would prefer that a simple model is assumed, perhaps as with BSRs or preamble group B selection where data volume also seems to be without definitive accuracy of higher layer headers etc. |
| Xiaomi | We share the same view with Samsung and NEC that SDT RBs should be resumed only after all the verifications for SDT are passed. |

Finally, companies are invited to provide any other comments on the modelling aspects between RRC and MAC (apart from Q1/Q2) above in the table below.

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| Q3: Are there any other comments/questions on modelling aspects between RRC and MAC (not covered by the scope of Q1/Q2 above)? | |
| Company | Comments on any other issues |
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# Conclusion and proposals

# References

1. [R2-2105032](file:///C:\\Users\\panidx\\OneDrive%20-%20InterDigital%20Communications,%20Inc\\Documents\\3GPP%20RAN\\TSGR2_114-e\\Docs\\R2-2105032.zip) Runnning MAC CR for small data Huawei, HiSilicon

1. [R2-2105927](file:///C:\\Users\\panidx\\OneDrive%20-%20InterDigital%20Communications,%20Inc\\Documents\\3GPP%20RAN\\TSGR2_114-e\\Docs\\R2-2105927.zip) RRC Running CR for SDT ZTE Corporation (rapporteur)
2. [R2-2105847](file:///C:\evutukuri\work\5G\RAN2\docs\R2-2105847.zip) Discussion on the spec modeling for Small Data Huawei, HiSilicon, ZTE corporation, Sanechips

# Annex (contact details for email discussions)

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