3GPP TSG RAN WG2 Meeting #117-e R2-220xxxx

**Electronic, 21st February – 3rd March 2022**

**Agenda item:** 6.1.4.1.5

**Source:** Samsung

**Title:** Report from email discussion [AT117-e][033][NR1615] RRC Other (Samsung)

**Document for:**  Discussion and decision

# Introduction

This is a report of following offline discussion:

* [AT117-e][033][NR1615] RRC Other (Samsung)

 Scope: Treat R2-2202296, R2-2202297, R2-2202298, R2-2202763, R2-2202990, R2-2202991, R2-2203439, R2-2203441, R2-2203442. Ph1 Determine agreeable parts, Ph2 for agreeable parts, progress CRs.

 Intended outcome: Report, Agreed CRs.

# References

The following documents are treated in this email discussion:

1. [R2-2202296](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2202296.zip) Discussion on RRC message segmentation Samsung discussion Rel-16
2. [R2-2202297](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2202297.zip) Correction to RRC message segmentation Samsung CR Rel-16 38.331 16.7.0 2886 - F TEI16
3. [R2-2202298](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2202298.zip) Correction to RRC message segmentation Samsung CR Rel-16 36.331 16.7.0 4757 - F TEI16
4. [R2-2202763](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2202763.zip) Discussion on parallel transmission of segmented RRC messages Lenovo, Motorola Mobility discussion Rel-16 TEI16
5. [R2-2202990](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2202990.zip) Correction on UL message segmentation Samsung CR Rel-16 38.331 16.7.0 2920 - F RACS-RAN-Core
6. [R2-2202991](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2202991.zip) Correction on UL message segmentation Samsung CR Rel-16 36.331 16.7.0 4768 - F RACS-RAN-Core
7. [R2-2203439](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203439.zip) UL RRC segmentation capability Ericsson discussion
8. [R2-2203441](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203441.zip) Correction on Non-numerical K1 Value vivo CR Rel-16 38.321 16.7.0 1216 - F NR\_unlic-Core
9. [R2-2203442](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203442.zip) Correction on Non-numerical K1 Value vivo CR Rel-16 38.331 16.7.0 2959 - F NR\_unlic-Core

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# Discussion

## RRC message segmentation

In RAN2#116-e meeting, an issue for RRC message segmentation was discussed as below.

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| R2-2109803 Discard of received segments of RRC messages Samsung CR Rel-16 36.331 16.6.0 4725 - F TEI16* The CR can be agreed with the following modifications:
* • Keep only the 1st change.
* • Add on coversheet some description of the cases in which the UE discards received segments of RRC messages upon leaving connected or inactive state.
* The 2nd issue (general question on multiple parallel segmented DL RRC messages) can be raised up in NR session (to be discussed jointly for NR and LTE) in the next meeting.
* Revised in R2-2111318

R2-2111318 Discard of received segments of RRC messages Samsung CR Rel-16 36.331 16.6.0 4725 1 F TEI16* [205] Agreed
 |

As per TS 38.331 RRC specification,

*The UE shall:*

*1> process the received messages in order of reception by RRC, i.e. the processing of a message shall be completed before starting the processing of a subsequent message;*

*NOTE: Network may initiate a subsequent procedure prior to receiving the UE's response of a previously initiated procedure.*

Contribution [1] discusses the issue related to DL RRC message segmentation and provides TS 38.331 CR [2] as below and an analogous TS 36.331 CR [3]. It is mentioned that the intended operation at UE RRC should be to discard all the segments of the assembled RRC message only. This is pointed that there is a possibility that UE may have segments stored corresponding to more than one RRC message at a time.

It is to be noted this issue does not assume parallel transmission of segments of RRC messages. UE RRC always receive in-sequence delivery of segments from the underlying AM RLC and PDCP, however, it is still possible for UE RRC to receive segments corresponding to more than one RRC message at a time (as RLC/PDCP can deliver multiple packets at a time post reassembly and reordering to RRC). Expected behaviour is that UE RRC assembles first RRC message and process it and then discard the pertinent segments only.

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| 5.6.25.3 Reception of *DLDedicatedMessageSegment* by the UEUpon receiving *DLDedicatedMessageSegment* message, the UE shall:1> store the segment;1> if all segments of the message have been received:2> assemble the message from the received segments and process the message according to 5.3.5 for the *RRCConnectionReconfiguration* message or 5.3.3.4a for the *RRCConnectionResume* message; 2> discard all segments of the message. |

**Question 1:** Do companies agree on the proposed change to TS 38.331 R16 [2] and TS 36.331 R16 [3]?

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| **Company** | **Yes/No** | **Additional comments** |
| Qualcomm Incorporation | Yes | Common understanding, good to clarify it |
| Huawei, HiSilicon | No | Not essential, we think the current specification would not lead to confusion on this. |
| MediaTek | No | We don’t understand why this is not related to parallel transmission of segments of RRC messages. If no parallel transmission, how come RRC will receive segments for other message. If parallel transmission is NOT supported, we think that the CR is not necessary. |
| Ericsson | Not necessary | The change is not necessary in our view, the NW should send all the segments before starting to send the next message and the NW should ensure it does not send segments of the next message unless UE has received all the previous segments. |
| Nokia | Yes | We are fine to clarify this but should we say “discard all segments of this message” |
| Samsung | Yes (Proponent) | It is clearly stated in RRC spec that “Network may initiate a subsequent procedure prior to receiving the UE's response of a previously initiated procedure.”. We further illustrate the issue with an example below:It is right that network would send sequentially the segments (say, segments S0, S1, S2) of the first RRC message followed by segments of second RRC message (say, segments S0, S1). However, on receiving side it is very much possible that UE RRC may be provided with segments S0, S1 and S2 of first message and segment S0 of second message from the lower layer at the same time, once they are received/reassembled/reordered at lower layers and these segments are stored. Then desired behaviour at UE RRC is to assemble and process first message and discard stored segments S0, S1 and S2 of first message and not discard stored segment S0 of second message.Impact would be severe if unwanted discard of segment(s) of RRC message happens. The proposed change is simple and makes it clear and full proof. Wordings from Nokia are acceptable |
| Docomo | Yes |  |
| Lenovo | No | We are quite confused now. To our understanding the LTE discussion was about parallel transmission of segmented DL RRC messages. But if this is not assumed then there is no issue with the current descriptions in 38.331/36.331, i.e. it cannot happen that the UE RRC receives segments corresponding to more than one RRC message at a time. The network will not send segments of the second RRC message prior to receiving the UE response for the successful reception of the first RRC message. |
| vivo | No | The level 2 action of “discard all segments” is under the level 1 action of “1> if all segments of the message have been received:”. We don’t see ambiguity for UE to implement the correct discard behavior. |

## Parallel transmission of DL RRC message segments

Contribution [4] discusses the parallel transmission of DL RRC message segments and proposes:

**Proposal: RAN2 to confirm that parallel transmission of segmented DL RRC messages is not supported in R16.**

Reasoning given is

*“the current ASN.1 format of the DLDedicatedMessageSegment message does not allow the UE to identify the original RRC message that is contained in a single segment. As consequence, the UE may not be able to reassemble the received segments correctly and thus may not be able to successfully reconstruct the original RRC messages.”*

Also it is proposed to capture in subclause 5.1.2 in TS 38.331 and also in TS 36.331 by adding a new note (in RED) as shown below.

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| The UE shall:1> process the received messages in order of reception by RRC, i.e. the processing of a message shall be completed before starting the processing of a subsequent message;NOTE: Network may initiate a subsequent procedure prior to receiving the UE's response of a previously initiated procedure.NOTE: The initiation of a subsequent procedure prior to receiving the UE's response of a previously initiated procedure is not supported for segmented RRC messages in this release of specification. |

Rapporteur has same understanding and thinks parallel transmission of DL RRC message segments was not even the issue raised in RAN2#116-e meeting. It was rather about the segments belonging to the sequentially transmitted multiple DL RRC messages that are received at the UE.

Following options could be considered as way forward:

**Option 1:** Nothing is really needed (i.e. no spec impact and no new behaviour).

**Option 2:** RAN2 confirms the understanding “parallel transmission of segmented DL RRC messages is not supported in R16”. No NOTE is added to specification.

**Option 3:** RAN2 confirms the proposal “parallel transmission of segmented DL RRC messages is not supported in R16” and add a NOTE to specification.

**Option 4:** Any other?

**Question 2:** Which option do companies prefer?

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| **Company** | **Option 1/2/3/4** | **Additional comments (if 4, please specify further)** |
| Qualcomm Incorporation | 3 | Given that the parallel transmission of multiple segmented RRC messages might be supported in future release, there is a need to document that this behaviour/feature/enhancement is not supported in Rel.16.  |
| Huawei, HiSilicon | Option 2 | Not essential to capture such things in the spec. Can be captured in the chair notes if companies want. |
| MediaTek | 3 | We prefer to have clear description in SPEC. |
| Ericsson  | Option 1/2 | As indicated for Q1, we think parallel transmissions is not supported. It was discussed during RACS, but not introduced. The sender of segmented RRC messages (UL or DL) will when generating a too large RRC message, split it up in segments and then forward (in sequence) all segments of the message in one go. The node (gNB or UE) will not generate another message and send those segments interspersed.  |
| Nokia | Option 3, 2 | Clarifying this is good in the specification as this seems to cause confusion to implementation and we don’t have such capability even so difficult to align. We agree that it was also discussed in RACS that interleaving of segments is not allowed across different RRC messages that may be each individually segmented. |
| Samsung | Option 2 | Similar opinion as Huawei.  |
| Docomo | Option 3 | This would lead to cause confusion in implementation and operation. |
| Lenovo | Option 3 or Option 2 | Option 3 is the safest solution. |
| vivo | Option 1 | We think that PDCP reordering and in-order delivery from to RRC layer can avoid the raised issue. For example, there are segments 1,2,3 of message 1 and segments 1,2 of message 2. When they are delivered to PDCP layer, each segment is numbered with a sequential SN. Therefore, at the UE side, the RRC layer will receive segments 1,2,3 of message 1 and then segments 1,2 of message 2 in order. Given that the maximum number of segments is relatively small (i.e., 5 for one message) compared with the PDCP reordering window size (i.e., 2[*pdcp-SN-SizeDL*] – 1, *pdcp-SN-SizeDL* equals to 12 bits for SRB), wrongly assembling segment 1 of message 1 and segment 2 of message 2 within the window will not happen. |

## Parallel transmission of UL RRC message segments

Contribution [4] further mentions that for R16 there is no issue with parallel transmission of UL RRC messages as *UECapabilityInformation* message is always triggered by the network and such a scenario should not arise.

However, [4] thinks with Rel17 NR QoE feature, it may happen that UE needs to transmit *UECapabilityInformation* message and *MeasurementReportAppLayer* message in parallel, and both messages may exceed the maximum PDCP SDU size limit in NR. In this case both messages then need to be segmented and each segment needs to be transmitted on the *ULDedicatedMessageSegment* message.

It is proposed that RAN2 discusses the below options for solving the issue on parallel transmission of segmented RRC messages in R17.

**Option 1**: Not to support parallel transmission of segmented UL RRC messages in R17. That means the UE shall initiate a new transmission of a segmented UL RRC message only when the previous transmission of a segmented UL RRC message has been completed successfully.

**Option 2:** QoE measurement reports are sent in single MeasurementReportAppLayer messages without segmentation if possible.

**Option 3:** If the MeasurementReportAppLayer message needs to be segmented then the segments of the message shall be transmitted on the ULDedicatedMessageSegment message via SRB4.

**Option 4:** A new R17 version of the ULDedicatedMessageSegment message is specified which allows the network to identify the original RRC message in the received segment, e.g. by introducing a new message type field in the ULDedicatedMessageSegment message.

However, Rapporteur also thinks it should be checked how likely is the case for *UECapabilityInformation* message and *MeasurementReportAppLayer* message transmitted together, as the support for *QoE-Parameters* is itself indicated in the *UECapabilityInformation* message.

**Question 3:** Which option do companies prefer?

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| **Company** | **Option 1/2/3/4** | **Additional comments** |
| Qualcomm Incorporation | Option-4 | Just to share our reasoning:Option-1: seems not feasible as some segments of 1st message in L2 buffer are being retransmitted while UE is processing the 2nd message, which will still cause overlap between 1st and 2nd message. Option-2: we don’t see how to ensure that message size won’t exceed limitOption-3: implicitly mandating the support of SRB4 in case QoE feature is supported Option-4: seems the most forward compatible approach and addressing the issue.  |
| Huawei, HiSilicon | Option 1 | We do not see there are wide scenarios that the UE must support multiple RRC messages segmentation in parallel. If to enhance, we think it should be discussed using a common solution which should go for Rel-18. |
| MediaTek | Option-4 or nothing | As indicated by rapporteur, we think it is unlikely to have *UECapabilityInformation* message and *MeasurementReportAppLayer* message transmitted together. So, no solution is fine to us.If some solution is needed, we agree with QC that solution 4 is most forward compatible. |
| Ericsson | Option 1 | We think this is already clear from the RRC spec. From the RRC point of view, when the UE initiates a procedure (e.g. sending the UE capability message) the UE performs that procedure from start to end. And before that procedure ends, the UE does not initiate other procedures (unless other procedures are explicitly "called" from the original procedure).So Option 1 is already clear from the current spec. And with this, there is no need to change the spec in any way even though we have QoE UL segmentation. |
| Nokia | Option 1 | Indeed this seems to be rather late optimization which we can defer to Rel-18 after a proper discussion on the underlying use case and the different aspects. |
| Samsung  | Option 1 | It is unlikely scenario, at least in Rel-17, as *UECapabilityInformation* message and *MeasurementReportAppLayer* message need not be transmitted together. Firstly *UECapabilityInformation* message carries the support for *QoE-Parameters.* |
| Lenovo | Option 3 | We noticed that this option has been already adopted in the NR QoE RRC running CR. |
| vivo | Option 1 or nothing | First of all, parallel transmission of segmented RRC messages for UL can be avoided by the network. As the support for *QoE-Parameters* is itself indicated in the *UECapabilityInformation* message, the network will configure the UE with the QoE measurement configurations and then receive *MeasurementReportAppLayer* message only after successful reception of the *UECapabilityInformation* message. And also as elaborated in our answer to Question 2, we find no issue even if parallel transmission of segmented UL RRC messages may happen. |

## Correction on UL message segmentaton

Contributions [5] and [6] provide a clarification for procedure of UL segmentation as shown below:

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| 5.7.7.3 Actions related to transmission of *ULDedicatedMessageSegment* messageThe UE shall segment the encoded RRC PDU based on the maximum supported size of a PDCP SDU specified in TS 38.323 [5]. UE shall minimize the number of segments and set the contents of the *ULDedicatedMessageSegment* messages as follows:1> for each new UL DCCH message,2> set the *segmentNumber* to 0 for the first message segment and increment the *segmentNumber* for each subsequent RRC message segment;2> for each *ULDedicatedMessageSegment* message,3> set *rrc-MessageSegmentContainer* to include the segment of the UL DCCH message corresponding to the *segmentNumber*;3> if the segment included in the *rrc-MessageSegmentContainer* is the last segment of the UL DCCH message:4> set the *rrc-MessageSegmentType* to *lastSegment*;3> else:4> set the *rrc-MessageSegmentType* to *notLastSegment*;2> submit all the *ULDedicatedMessageSegment* messages generated for the segmented RRC message to lower layers for transmission in ascending order based on the *segmentNumber*; |

**Question 4:** Do companies agree on the proposed change to TS 38.331 R16 [5] and TS 38.331 R16 [6]?

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| **Company** | **Yes/No** | **Additional comments** |
| Qualcomm Incorporation | No | “*for each ULDedicatedMessageSegment message*" is already implied in the existing text "*for each new UL DCCH message*”. If this causing some confusion, example of a suggested change is to replace “*UL DCCH message*” by “*ULDedicatedMessageSegment*” |
| Huawei, HiSilicon | Yes |  |
| MediaTek | No strong view | We understand the change does not really change the function of UL segment. |
| Ericsson | No | The new condition “2> for each *ULDedicatedMessageSegment* message” seems not necessary and is redundant as above we have already “set the contents of the *ULDedicatedMessageSegment* message as follows” and “for each new UL DCCH message”.The other changes are fine but could be captured in rapporteur CR as they are editorial corrections. |
| Nokia | No strong view | We are fine to go with majority as anyway the underlying functionality is not being impacted but rather the way of capturing |
| Samsung | Yes (Proponent) | There is an ambiguity in the procedure description |
| Docomo | Maybe yes | Fine to have it merged in another CR.Regarding QC and E///’s comments, on first look my reading (without the context of R16 standardization discussion) on “*for each new UL DCCH message*” is that this is about the original RRC message before segmentation, not *ULDedicatedMessageSegment* after segmentation. |
| Lenovo | No | Same as for DL parallel transmission of segmented UECapabilityInformation messages cannot happen.  |
| vivo | Yes with comments | We agree with the proposed changes. Just some minor changes on top of the above TP, see annotations as below, but we are fine to discuss the details in Phase 2.1> for each new UL DCCH message,2> set the *segmentNumber* to 0 for the first message segment and increment the *segmentNumber* for each subsequent RRC message segment;2> for each *ULDedicatedMessageSegment* message,3> set *rrc-MessageSegmentContainer* to include the segment of the UL DCCH message corresponding to the *segmentNumber*;3> if the segment included in the *rrc-MessageSegmentContainer* is the last segment of the UL DCCH message:4> set the *rrc-MessageSegmentType* to *lastSegment*;3> else:4> set the *rrc-MessageSegmentType* to *notLastSegment*;2> submit all the *ULDedicatedMessageSegment* messages generated for the segmented RRC message to lower layers for transmission in ascending order based on the *segmentNumber*; |

## UL RRC message segmentation capability

Contribution [7] argues that benefit of UL RRC segmentation feature cannot be fully utilized, since the UE does not include in *UECapabilityInformation* message the support of UL RRC segmentation. An example is given that, if the network needs to retrieve again UE capabilities (e.g. due to handover to a target node which may require different capabilities than the ones retrieved on the source node), it cannot know the support of UL RRC segmentation. Network may decide to use 2-step or 3-step approach for enquiring UE capability information. It proposes:

**Proposal: The support of UL RRC segmentation is indicated in both UE-NR-Capability and UE-EUTRA-Capability.**

Also, an example of change for TS 38.331 is provided as:

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| UE-NR-Capability-v1650 ::= SEQUENCE { mpsPriorityIndication-r16 ENUMERATED {supported} OPTIONAL, highSpeedParameters-v1650 HighSpeedParameters-v1650 OPTIONAL, nonCriticalExtension UE-NR-Capability-vxy OPTIONAL}UE-NR-Capability-vxy ::= SEQUENCE { ul-RRCSeg ENUMERATED {supported} OPTIONAL, nonCriticalExtension SEQUENCE {} OPTIONAL} |

**Question 5:** Do companies agree with the proposal?

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| **Company** | **Yes/No** | **Additional comments** |
| Qualcomm Incorporation | No | This solution does not allow the network to know the UE capability for RRC segmentation before it sends the first UE capability enquiry.We recall better solution was previously proposed by other company, which was to introduce such capability in Msg5. We supported the proposal and still believe it is a good solution. |
| Huawei, HiSilicon | No with comments | This has been discussed before and it was agreed not to have such capability reporting, and such capability reporting does not solve the problem as the first capability enquiry is still blind.If companies have interest to solve the issue, we believe MSG5 is the right choice. |
| MediaTek | No | As indicated by QC, the solution does not work. Indicator in Msg5 may help but we tend to think that it is not a critical issue to be resolved in R16. |
| Ericsson  | Yes (proponent) | We agree the solution does not allow the network to know the UE capability for RRC segmentation before it sends the first UE capability enquiry, but the network will then be aware of the capability for all the subsequent enquires due to e.g. handover or any other UE capability refresh.  |
| Nokia | No with comments | Agree with Qualcomm and Huawei |
| Samsung | No | Solution does not work when the first UE capability enquiry is made and the benefit achievable becomes limited. |
| Docomo | Maybe not | Open to discussion, but tend to agree with QC and Huawei. |
| Lenovo |  | We see some value for an explicit UL segmentation capability. However, it does not work for the case when gNB did not receive UE capability information from AMF upon INITIAL CONTEXT SETUP. It has then to retrieve the information from the UE but the gNB does not know whether the UE supports UL segmentation or not. |
| vivo | Partially Yes | Since the network implementation can avoid the potential issue e.g., by use 2-step or 3-step approach for enquiring UE capability information, we don’t see it critical to be fixed in R15 and R16. But we are open to address this issue in Rel-17 or later. |

## Correction on Non-numerical K1 Value

Contributions [8] and [9] proposed that the terminology “non-numerical value” is changed as “inapplicable value” in TS 38.321 and TS 38.331. Reason is as follows:

In Rel-16 NRU WI, the value -1 (i.e. non-numerical value) is used as an inapplicable value to indicate that HARQ-ACK feedback for the corresponding PDSCH is postponed until the applicable timing and resource for the HARQ-ACK feedback are provided by the gNB, as in TS 38.213. However, in the current RAN2 specs, the terminology “non-numerical value” has not been updated to “inapplicable value” yet, which leads to misalignment between the PHY spec and RAN2 specs.

**Question 6:** Do companies agree on the proposed change to TS 38.321 R16 [8] and TS 38.331 R16 [9]?

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| **Company** | **Yes/No** | **Additional comments** |
| Qualcomm Incorporation | Yes | Editorial change ..seems ok  |
| Huawei, HiSilicon | Yes |  |
| Ericsson | No | We do not see the need to align 331 and 321 to the terminology used in 213. The term “non-numerical k1” is fine, alternatively we may define -1 as “HARQ feedback transmission postponed” or something similar. Using “inapplicable” is not good. What if there are future new dl-DataToUL-ACK added that contains higher values, they will then be inapplicable to legacy UEs etc. Thus let RAN1 fix their ambiguous terminology. |
| Nokia | Yes | Could be merged to rapporteur CR as indeed inapplicable was used in PHY specification. This is non-essential as meaning does not change hopefully. |
| Samsung  | Yes | Editorial change |
| vivo | Yes | Align terminology with TS 38.213. |
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# Conclusion

Based on company’s feedback the following proposals are made:

<To be updated>