**3GPP TSG RAN WG 2 Meeting #121bis electronic R2-23xxxxx**

**17th - 26th April, 2023**

**Source:** Fujitsu

**Title:** Summary of [AT121bis-e][016][eMob] Reply LS on L1 measurement RS configuration and PDCCH ordered RACH for LTM (Fujitsu)

**Agenda Item:** 7.4.1

**Document for:** Discussion and decision

# 1 Introduction

This document is a summary of:

* [AT121bis-e][016][eMob] Reply LS on L1 measurement RS configuration and PDCCH ordered RACH for LTM (Fujitsu)

Scope: Based on Meeting Agreements, provide agreeable draft LS

Intended outcome: Agreeable Draft LS

Deadline: CB online W2 Wednesday

The rapporteur sets two phases of discussions.

* The first phase (Deadline W1 Friday 21st April, 6:00UTC): discuss the feasibility and potential RAN2 specs impact and additional information to be included in the reply LS.
* The second phase (Deadline W2 Tuesday 25th April, 6:00UTC): discuss texts of the reply LS.

Company contact persons for this discussion are invited to fill one entry in the table below:

|  |  |  |
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# 2 Background

RAN2 received an LS from RAN1 on L1 measurement RS configuration and PDCCH ordered RACH for LTM [1]. In the LS, RAN1 provides their agreements and asks RAN2 and RAN3 to check the feasibility and their potential specs impact especially for the agreements of PDCCH ordered RACH for LTM.

|  |
| --- |
| To RAN2 and RAN3 group.  ACTION: RAN 1 respectfully asks RAN2 and RAN3 to check the feasibility and potential impact on specs of RAN2 and RAN 3 of all options, i.e. with RAR (from serving or candidate cell) and without RAR, in the agreement described in section B. Also, RAN1 respectfully asks RAN2 and RAN3 to take the RAN1 agreements into consideration for their work. |

The agreements in section B (PDCCH ordered RACH) are as follows.

|  |
| --- |
| B. PDCCH ordered RACH  Regarding the configuration/indication of RAR reception for PDCCH ordered-RACH, RAN1 achieved the following agreement  For PDCCH ordered-RACH for candidate cell(s), RAR reception can be configured/indicated   * If reception of RAR is not configured/indicated (without RAR)   + TA value of candidate cell is indicated in cell switch command   + FFS: whether UE should re-transmit PRACH when reception of RAR is not configured/indicated   + FFS: how UE determine the transmit power of subsequent PRACH triggered by PDCCH order * If reception of RAR is configured/indicated (with RAR), FFS   + whether RAR is received from serving cell or candidate cell     - if RAR is received from candidate cell, whether Type1-PDCCH CSS of the candidate cell is configured to the UE   + content of RAR * FFS: signaling for configuration/indication of whether RAR needs to be received * UE can report the support combination of with RAR only and without RAR only, where support of one default scheme is the baseline UE approach for LTM * Send LS to RAN2 and RAN3 to check the feasibility about this agreement * Note: Definition of candidate cells is up to RAN2     As the feasibility of schemes included in the agreement above is related to the designs of RAN2 and RAN3, RAN 1 respectfully asks RAN2 and RAN3 to check the feasibility and potential impact on specs of RAN2 and RAN 3 of all options, i.e. with RAR (from serving or candidate cell) and without RAR, in this agreement. |

Also, the following related agreements for the PDCCH ordered RACH should also be taken into consideration.

|  |
| --- |
| Agreement  For Rel-18 LTM, Random Access Preamble indices and indication of RACH occasions with the associated SSB indices are configured for each candidate cell.  Note: the detailed signalling is left to RAN2  Agreement   * For PDCCH-order based RACH for TA measurement for candidate cells, legacy CBRA is not supported   Agreement  on whether UE should initiate re-transmit PRACH when reception of RAR is not configured/indicated, down select one from the following alternatives.   * Alt 1: UE autonomous re-transmission of PRACH is not allowed (e.g., by setting the number of allowed PRACH transmission to the minimum value of PreambleTransMax=1) * Alt 2: UE autonomous Re-transmission of PRACH is allowed,   + The number of PRACH transmission will be defined e.g. set the times of RACH transmission to the minimum value of PreambleTransMax   Agreement  Whether RAR needs to be received is configured by RRC.  Agreement  study at least the following issues on PDCCH-order based PRACH for candidate cell that is not UL serving cell, i.e. without PUCCH/PUSCH configured   * Whether gap between the DCI and PRACH longer than timeline defined in spec is needed * Any impact/interruption on UL Tx of serving CCs due to the PRACH Tx   Working Assumption  UE-based TA measurement (UE derives TA based on Rx timing difference between current serving cell and candidate cell as well as TA value for the current serving cell) is supported.   * Corresponding UE capability is to be introduced to support UE-based TA measurement * For a UE reports support of this capability, configuration of UE-based TA measurement is supported * FFS: other impacts on RAN1 spec |

# 3 Discussion

## 3.1 Feasibility and potential RAN2 specs impact

RAN2 needs to check the feasibility and potential RAN2 specs impact for the following cases, and include the result in the reply LS.

Case A: Without RAR

Case B: With RAR, and

- the RAR is received from the serving cell

- the RAR is received from the candidate cell

Although RAN2 assumed “with RAR and RAR is received from candidate cell” is not needed in Rel-18, it would be better to include the feasibility and potential RAN2 specs impact for this case to explain why RAN2 reached the consensus for the assumption. (If this is not agreeable, please provide your comment under Q7 or Q8)

For the feasibility and potential RAN2 specs impact, the contact companies of the LS provided a discussion paper [2]

### 3.1.1 RAN2 specs impact

#### 3.1.1.1 Without RAR

RAN1 agreements on the case reception of RAR is not configured/indicated (without RAR) are:

* + TA value of candidate cell is indicated in cell switch command
  + FFS: whether UE should re-transmit PRACH when reception of RAR is not configured/indicated
  + FFS: how UE determine the transmit power of subsequent PRACH triggered by PDCCH order

In the discussion paper [2], it is observed at least the following aspects will be potential RAN2 specs impact.

It needs to be specified whether/how the UE knows the Msg.1 is successfully received by the gNB or failed. RAN2 understands RAN1 will decide it, and RAN2 will specify the decision in RAN2 specs.

**Q1: Does company agree the above observation? Any comments?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Huawei, HiSilicon | No | There seems to be a mistake in this summary, [2] lists the above questions for the case "with RAR", not for "without RAR".  [rapp] Thanks for pointing this out. I revised the observation. |
| Futurewei | Yes | In principle, the modified text looks fine at high level. |
| CATT | Yes | Up to RAN1 |
| MediaTek | Yes |  |
| OPPO | Yes |  |
| Qualcomm | Yes | RAN1 is already examining two alternatives on how to determine whether Msg1 transmission is successful based on the RAN1 agreement:  Agreement: On whether UE should initiate re-transmit PRACH when reception of RAR is not configured/indicated, down select one from the following alternatives.   * Alt 1: UE autonomous re-transmission of PRACH is not allowed (e.g., by setting the number of allowed PRACH transmission to the minimum value of PreambleTransMax=1) * Alt 2: UE autonomous Re-transmission of PRACH is allowed,   The number of PRACH transmission will be defined e.g. set the times of RACH transmission to the minimum value of PreambleTransMax |
| Xiaomi | No sure | Whether the UE needs to know the successful reception of Msg1 should be up to RAN1. For CFRA without RAR, the gNB knows the transmission occassion of the Msg1, and can trigger the retransmission of Msg1 if the Msg1 is not recevied by the gNB. The UE does not need to know the successful reception of Msg1 at the gNB side. |
| LGE | Yes |  |
| vivo | Yes | It’s up to RAN1. |
| ZTE | No, see comments | This is not a concret spec impact from RAN2 perspective which relies on the outcome of the RAN1 discussion. there is no need for us to send this kind of uncertain observation. |
| CMCC | Yes |  |

**Q2: What will be other potential RAN2 spec impact of without RAR?**

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| --- | --- |
| Company | Comments |
| Huawei, HiSilicon | If this is to be supported for inter-DU, there will be the need to provide the TA from the target DU to the source DU, so the target DU needs to identify the source DU and provide the TA. This is extra RAN3 work. |
| Futurewei | There maybe more detailed impact to RAN2 spec after RAN1 determined the preamble retransmission procedure including way of power ramping in case Msg1 failure is determined by the source gNB. A RACH/TA response window should be used by the source cell for Msg 1. Do we assume it is decided by network implementation?  Also agree with Huawei, in inter DU case, there will be network interface impact for delivering the target cell TA from the target DU to the CU, and then from the CU to the source DU. This have impact to RAN3. |
| OPPO | If RAR is not received, the legacy RACH procedure may not be fully reused. RAN2 shall futher study the potential impacts on RACH procedure completion condition as well as preamble retransmission scheme according to RAN1 progress. |
| Qualcomm | Agree with HW on RAN3 impact. Other RAN2 spec impact is pending RAN1 progress. |
| Xiaomi | We think that the procedure on the preamble transmission without RAR can be all included in the RAN1 specification, as the RACH procedure does not applie.  We can wait for further RAN1 inputs. |
| LGE | There may be RAN2 impact by UE autonomous re-transmission of PRACH, but this can be analysed after RAN1 concluding this issue first. |
| vivo | Agree with Futurewei that detailed RAN2 spec impact may be needed after RAN1 determined the procedure for PDCCH-order based RACH without RAR. |
| ZTE | we indicate that the potential the spec impact is, in the case of the RAR early RACH without RAR, whether the coming back indication is needed for UE to notify the source DU after the preamble transmission at the target DU is finished. |
| CMCC | New UE behaviour should be specified since UE will not perform the following procedure like monitoring the RAR window. Related to RAN1, the re-transmission mechanism should be modified as mentioned by other companies. Related to RAN3, the TA from the target DU is transmitted via CU to source DU. |

#### 3.1.1.2 With RAR

RAN1 agreements on the case reception of RAR is configured/indicated (with RAR) are:

FFS

* + whether RAR is received from serving cell or candidate cell
    - if RAR is received from candidate cell, whether Type1-PDCCH CSS of the candidate cell is configured to the UE
  + content of RAR

In the discussion paper [2], it is observed irrespective of whether the RAR is received from the serving cell or the candidate cell, at least the following aspects will be potential RAN2 specs impact.

RAN2 needs to discuss how to maintain the TA of candidate cell at UE side, i.e.,

- The needs of TA timer.

- Whether the TA of candidate is maintained after LTM

**Q3: Does company agree the above observation? Any comments?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes | We also need to discuss what happens to the TA if the serving cell TAT expires |
| Futurewei | Yes partially | Regarding TA timer, an alternative is the source cell maintains the TA validation timer. It can be started upon the early RACH order is issued. This avoid the need of UE reporting the expiry of the timer. |
| CATT | Yes |  |
| MediaTek | Yes |  |
| OPPO | Yes |  |
| Qualcomm | Yes |  |
| Xiaomi | Yes |  |
| LGE | Yes |  |
| vivo | Yes |  |
| ZTE | Yes |  |
| CMCC | Yes |  |

**Q4: What will be other potential RAN2 spec impact of with RAR which is common for “the RAR is received from the serving cell” and “the RAR is received from the candidate cell”?**

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| --- | --- |
| Company | Comments |
| Apple | Should the UE “save“ the TA value and reapply it if it moves this to cell again from other cell… we think this is not correct, but UE behaviour needs to be clearly specified on what happens to the TA values from “other“candidate cells at cell switch. |
| Qualcomm | Whether and how many TAGs to be supported by the UE, given that some candidate cells may share the same TA value. |
| LGE | The UE behaviour after TA timer expiry of candidate cell would be different from TA timer expiry for serviing cell. |
| ZTE | In the inter-DU case,  whether the coming back indication is needed for UE to notify the source DU that UE has returned back to serving cell after sending the preamble at target DU for the case of RAR present on serving cell or terminating the RACH at target DU for the case of RAR present on candidate cell. |
| CMCC | Whether the TA timers for different candidates share the same value. |
|  |  |

In the discussion paper [2], it is observed if RAR is received from the serving cell, at least the following aspects needs to be discussed in RAN2 and will be potential RAN2 specs impact.

1. RAN2 needs to discuss how to decide the start of the RAR window at UE side, and the UE behaviour if no RAR is received within the RAR window, and specify the result of the discussion.
2. For inter-DU case, RAN2 needs to wait RAN1 decision whether additional information for LTM RAR is introduced or not, e.g., whether a specific information to distinguish LTM RAR from normal RAR is introduced.  
   - If the additional information is introduced, legacy RAR cannot be used, RAN2 needs to discuss the format of the RAR and the UE behaviour to receive the RAR, and specify the result of the discussion  
   - If the additional information is not introduced, the legacy RAR can be used. Although RAN2 needs to discuss how to handle unnecessary information (e.g., UL grant, Temporary C-RNTI) in RAR and specify the result of the discussion. The spec impact may be smaller than the former case.
3. For inter-DU case, RAN2 (and/or RAN3) needs to discuss how to avoid potential preamble conflict and specify the result of the discussion.  
   - The conflict may occur when PDCCH ordered RACH for LTM is performed by a UE, another UE in the same serving cell performs CBRA using the same preamble.

**Q5: Does company agree the above observations? Any comments?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Huawei, HiSilicon | No | We don't see why "start of RACH window" is the only question, the whole RACH window is the question.  For other things, the list picks very precise details while there is no reason why only such details should be considered. So we propose to reword the issues as:  1) RA details:  - whether any modification of RAR window is needed  - the UE behaviour if no RAR is received within the RAR window  - whether RACH can be initiated to a different cell when RACH is ongoing and if so, how to deal with this  2) New RAR MAC CE containing additional information indicated by RAN1, if any  3) Partitioning of RACH resources of a cell for UEs served by the cell and UEs acquiring TA early from different neighbour cells. |
| Apple | Partly | #1 needs more discussion than just RAR window (similar to Huawei’s view).  #2 RAN2 is also invovled in distinguishing RAR from source and one that came from target… not just RAN1.  #3 we are not sure if CFRA resources given to the UE would be also allowed as CBRA in the target cell.. ofcourse the inter-node exchange (Ran3) needs to be done to ensure that the resulting PDCCH order provides UE with CFRA resources that are not in conflict with other UEs in the target cell. |
| Futurewei |  | It is not clear for us what is the benefit or advantage to have RAR from the serving cell comparing with the without-RAR option. In our view, with-RAR option should be only configured for the inter-DU candidate cells, more likely for the under DC enabled inter-DU candidate cells. We are wondering the need to work on the RAR from the serving cell option. |
| CATT | Yes |  |
| MediaTek | Yes |  |
| OPPO | Yes with comments | For 2, we think the issue also need to be discussed for intra-DU case. |
| Qualcomm | See comment | On issues 1 and 2:  The main difference b/w the no-RAR scheme and the RAR-from-serving-cell scheme is when the TA value is provided to the UE:   * If no-RAR, then within the LTM MAC CE * If with-RAR from serving cell, then before the LTM MAC CE   If RAN1 wants to support providing the TA value to the UE before LTM triggering, easiest would be to use a separate MAC CE than the LTM MAC CE. In this case, issues 1 and 2 would go away.  On issue 3: Agree with Apple. There should be no contention for those preamble IDs used for early TA acquistion. |
| Xiaomi | Yes |  |
| LGE | See comments | We don’t see clear benefit of the RAR reception. The RAR just provides TA of candidate cell to UE, while the TA can be provided by the cell switch command. Here, in our view, the TA is not too heavy to be included in the cell switch command. Further, as addressed in above observations, many things should be defined without clear benefits. So, we think the without-RAR option is sufficient for early TA.  Having said that, for the reply LS to RAN1, we agree with observation 1/2, but for observation 3, there should be no conflict between CFRA and CBRA preamble. |
| vivo | Yes, but | As “RAR is received from the serving cell“ brings the issues indicated in the above observations, we prefer to consider deliver the TA of candidate cell in the serving cell with siganlling other than RAR, e.g. via MAC CE. |
| ZTE | See comments | 1: not how to start, instead, we need to study whether the RAR window shall be prolonged compare to the legacy RACH due to the time consumption of the forwarding the TA from target DU to source DU.  2: This is still a FFS from RAN1 perspective, We prefer not to capture the uncertain things here.  3: To our understanding, RAN 3 must not be involved in the RACH resource indication, ran2 and RAN1 can handle it. |
| CMCC | See comments | The introduction of “with RAR” approach brings more issues that listed above. Besides issues mentioned by other companies, if the multiple TAs are conveyed in the same RAR, the RAR is only sent after node interactions between the target and source. We share the same view with LG that it is more reasonable to only have the “without RAR” approach. |

**Q6: What will be other potential RAN2 spec impact of with RAR and the RAR is received from the serving cell?**

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| --- | --- |
| Company | Comments |
| Huawei, HiSilicon | If supported for inter-DU, RAN3 need to discuss how to provide the TA to the source DU. |
| Qualcomm | Agree with HW |
| Xiaomi | Agree with Huawei’s comments, as RAN2 already agreed to exclude the RAR reception via candidate cell. |
| LGE | Agree with HW. |
| CMCC | Agree with HW. |
|  |  |

RAN2 already assumed “with RAR and RAR is received from candidate cell” is not needed in Rel-18. Therefore, the reason why RAN2 reached the consensus for the assumption may need to be explained.

In the discussion paper [2], it is observed if RAR is received from the candidate cell, at least the following aspects needs to be discussed in RAN2 and will be potential RAN2 specs impact.

RAN2 needs to discuss whether the caused data transmission interruption at the source is acceptable, or any specific handling is necessary to avoid it, and specify the result of the discussion.

**Q7: Does company agree the above observation? Any comments?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Huawei, HiSilicon | Yes but | RAN2 already agreed that this method is not preferred |
| Apple | Yes | Same view as Huawei |
| Futurewei | Yes and | The resolution to aviod serving cell interruption is to only configure with-RAR under DC enabled scenarios. The other use case would be the applications which are more tolerable to serving cell interruption but more care about the latency caused by the entire RACH and TA delivery process. In case serving cell interruption is high priority, just configure the without-RAR option.  But we understand, it appears RAN1, 2 already made the decision. |
| CATT | Yes | But only indicate RAN2 decision without the reason to RAN1 is also fine. |
| MediaTek | Yes, but | We should inducate that having RAR from candidate cell is infeasible |
| OPPO | Yes | R2 has assumed that RAR from candidate cell is not needed in Rel-18. |
| Qualcomm | Yes but | RAN2 just has to indicate that this scheme is precluded for Rel-18. |
| Xiaomi | Yes | According to the feedback from our RAN1 colleague, it seems taht RAN1 also made the same agreement. Maybe we simply inform RAN1 of the RAN2 decision. |
| LGE | Yes, but | We think it should be sufficient just to indicate RAN1 that “with RAR and RAR is received from candidate cell” is not needed in Rel-18 from RAN2 perspective. No need to address all reasons for this agreement. |
| vivo | Yes but | We think we only need to inform RAN1 our conclusion on this one. |
| ZTE | Yes, but | This solution has been precluded. |
| ZTE | Yes, but | Following the agreement in the meeting. |

**Q8: What will be other potential RAN2 spec impact of with RAR and the RAR is received from the candidate cell?**

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| Company | Comments |
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#### 3.1.1.3 Other specs impact

There may be other RAN2 specs impact that needs to report to RAN1 and/or RAN3.

**Q9: Are there any other RAN2 specs impact that needs to report to RAN1 and/or RAN3?**

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| Company | Comments |
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### 3.1.2 Feasibility

In the discussion paper [2], it is observed all cases, i.e., without RAR, with RAR and the RAR is received from the serving cell and with RAR and the RAR is received from the candidate cell, are feasible

**Q10: Does company agree the above observation? Any comment?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Huawei, HiSilicon | Yes but | RAN2 already agreed that RAR from candidate cell is not preferred |
| Ericsson | Yes with comment | Similar comment from Huawei. RAN2 already assumed that the case when RAR is received from candidate cell is not supported in Rel-18. Would be good to focus our efforts only on the case of TA acquisition without RAR and TA acquisition with RAR from serving cell. |
| CATT | Yes with comment | OK to indicate RAR fro candiate cell is excluded in RAN2,but do not mention whether it is feasible. |
| MediaTek | Paartially | Having RAR from candidate cell is infeasible |
| OPPO | Yes but | R2 has assumed that RAR from candidate cell is not needed in Rel-18. |
| Qualcomm | Partially | The feasibility of the scheme precluded by RAN2 agreement does not have to be noted. |
| Xiaomi | Yes, but | Since the RAR reception from the candidate cell is excluded, we do not need to include this option in the LS. |
| LGE | Yes, but | With RAN2 agreement, i.e., “with RAR and RAR is received from candidate cell” is not needed in Rel-18, RAN2 may not need to mention feasibility of RAR from candidate cell in the reply LS. |
| vivo | Yes but | We already preclude hte option from candidate cell. |
| ZTE | Yes but | RAR from candidate cell is precluded |
| CMCC | Yes but | Even RAN1 has agreed to preclude the from non-serving option during the two-TA discussion in the MIMO WI. |

## 3.2 Contents of reply LS

In addition to the feasibility and potential RAN2 specs impact, RAN2 may include the information that is useful for RAN1 in the reply LS, such as RAN2 agreements related to early TA acquisition.

**Q11: What information should additionally be included in the reply LS?**

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| --- | --- |
| Company | Comments |
| Huawei, HiSilicon | It sufficient to *only* include RAN2 agreements. |
| Ericsson | Our preference would be to include *only* the RAN2 agreements and state that the solutions of TA acquisition without RAR and TA acquisition with RAR from serving cell are feasible from RAN2 point of view. |
| CATT | It is OK to include RAN2 agreements related to early TA acquisition. |
| MediaTek | It’s OK to include only RAN2 agreements. |
| OPPO | It’s OK to include only RAN2 agreements. |
| Qualcomm | It is sufficient to indicate the feasibility of two agreed schemes and the list of relevant RAN2 agreements. Any RAN2 spec impact needs to be agreed first but not useful information for RAN1. |
| Xiaomi | We should also inform RAN3. Since RAN2 excludes the RAR reception via candidate cell, the target DU needs to inform the source DU on the RAR content, as the RAR is created by the MAC. |
| LGE | Ok to include RAN2 agreements |
| vivo | It’s OK to only include RAN2 agreements related to early TA acquisition. |
| Zte | It is OK to include only RAN2 agreements |
| CMCC | It is OK to include only RAN2 agreements |

# 4 Conclusion

TBA

# 5 References

1. R2-2302053/R1-2302194, "LS on L1 measurement RS configuration and PDCCH ordered RACH for LTM"
2. R2-2302946, “Discussion on replying to the RAN1 LS on L1 measurement RS configuration and PDCCH ordered RACH for LTM”, Fujitsu, CATT