**3GPP TSG-RAN WG1 #108-e R1-220xxxx**

**e-Meeting, February 21st - March 3rd, 2022**

**Agenda Item: 8.6.2**

**Title: FL summary #1 on RAN1 aspects for RAN2-led features for RedCap**

**Source: Moderator (Apple)**

**Document for: Discussion, Decision**

# Introduction

This feature lead (FL) summary (FLS) concerns the Rel-17 work item (WI) for support of reduced capability (RedCap) NR devices [1]. Earlier RAN1 agreements for this WI are summarized in [2].

This document summarizes contributions [4] – [16] submitted to agenda item 8.6.2 and captures this email discussion on RAN1 aspects for RAN2-led features for RedCap:

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| [108-e-R17-RedCap-03] Email discussion for maintenance on RAN1 aspects for RAN2-led features – Hong (Apple)   * 1st check point: February 25 * Final check point: March 3 |

In this round of the email discussion, please comment on the issues tagged ‘FL1’ before Feb, 22nd, Tuesday, UTC 16:59.

# Early indication of RedCap UEs in Two-Step RACH

### Issue 1: Early indication for Redcap by Dedicated PUSCH in 2-Step RACH

The following was agreed in RAN1 107 e-meeting for 2-step RACH [2]:

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| Agreement:   * For 2-step RACH, support the early indication of RedCap UEs at least in MsgA PRACH.   + The early indication in MsgA PRACH can be configured to be enabled/disabled via SIB.   + From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP     - separate MsgA PRACH resource     - MsgA PRACH preamble partitioning |

In addition, the following was agreed in RAN2 116-e meeting for 2-step RACH procedure early identification [3]:

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| Agreements:   * […] * At least the dedicated LCID (i.e. the Msg3 early identification solution) can be supported for MsgA early identification. It is up to RAN1 on the need of dedicated preamble and/or dedicated PUSCH resource configuration. * [...] |

Contribution [6, 7, 9, 10, 12] discussed the need of dedicated resource configuration for the MsgA PUSCH to early identification. Companies’ proposals on this issue are briefly summarized in Table 1 below:

**Table 1: Views on dedicated MsgA PUSCH resource of 2-step RACH for early identification**

|  |  |
| --- | --- |
| Company | Proposals |
| OPPO [6] | * Proposal 1: For early indication of RedCap UE in MsgA PRACH, dedicated MsgA PUSCH resource is configured and mapped to dedicated MsgA PRACH preamble for RedCap UE. * Proposal 2: For early indication of RedCap UE in MsgA PUSCH, neither dedicated MsgA PUSCH resource nor dedicated MsgA PRACH configuration is needed for RedCap UE. |
| CATT [7] | * Proposal 4: For 2-step RACH, support the early indication of RedCap UEs in MsgA PUSCH. * Reuse the same mechanism of Msg3 early indication of 4-step RACH. |
| Ericsson [9] | * Observation 1 It is enough to support early RedCap UE indication in MsgA PRACH part and in MsgA PUSCH part using the RedCap-specific LCID. * Proposal 1 Do not support early RedCap UE indication in MsgA PUSCH part using dedicated resource configuration. |
| CMCC [10] | * Observation: A separate MsgA PUSCH resource configuration only without dedicated MsgA PRACH resource and MsgA PRACH preamble partitioning can not realized early indication of RedCap UEs. * Proposal 1: For 2-step RACH, support separate MsgA PRACH resource and MsgA PRACH preamble partitioning with associated MsgA PUSCH resource for early indication of RedCap UEs. * Proposal 2: For 2-step RACH, dedicated PUSCH resource configuration but shared RACH resource or PRACH preamble for early indication of RedCap UEs is not supported. * Proposal 3: 2 step RACH only configuration on uplink UL BWP is not allowed, if configured, it is always on the same BWP as four-step RACH. |
| Lenovo, Motorola Mobility [12] | * Proposal 1: The POs and/or PRUs for RedCap UEs 2-step RACH can be separately configured, or shared with non-RedCap UEs. * Proposal 2: The MsgA preambles for RedCap UEs can be separately ordered or unified ordered with those for non-RedCap UEs. |

For 2-step RACH procedure, as defined in Rel-16, a UE determines time resources and frequency resources for PUSCH occasions in an active UL BWP based on the msgA-PUSCH-Config. Two cases exist, one is dedicated MsgA preamble reserved for Redcap early identification (Case 1) and the other is shared MsgA preambles for Redcap and non-Redcap UEs (Case 2). For Case 1, the MsgA PUSCH resources associated with the dedicated preamble resource are determined based on the existing Rel-16 association rule and used for 2-step RACH procedure by Redcap UE [6,7].

For Case 2, different views were observed based on the proposal listed above:

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| --- | --- | --- | --- | --- |
|  |  | Justification | Companies | Num. of Companies |
| Opt.1 | Do not support early RedCap UE indication in MsgA PUSCH part using dedicated resource configuration | * Using the RedCap-specific LCID in Msg3 is sufficient for Redcap early identification. | * OPPO [6] * CATT [7] * Ericsson [9] * CMCC [10] | 4 |
| Opt.2 | Separate MsgA PUSCH resource can be configured for Redcap UE for early indication. |  | -Lenovo [12] | 1 |

# <1st Round Comments>

**FL1 High Priority Question 1-1: For Case 2 (i.e., no dedicated MsgA preamble and MsgA PRACH resource is configured for early indication**, **which one of the proposals (i.e., Opt.1, Opt.2) do you support for MsgA PUSCH resource used for early indication:**

* Opt.1: Do not support early RedCap UE indication in MsgA PUSCH part using dedicated resource configuration.
* Opt.2: Separate MsgA PUSCH resource can be configured for Redcap UE for early indication.

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| **Company** | **Which Opt.?** | **Comments** |
| Lenovo, Motorola Mobility | Opt.1 | We’d like to clarify that we do NOT support opt.2 of using separate MsgA PUSCH resource for early identification of RedCap UEs.  Proposal 1 in our contribution is regarding **when separate MsgA RACH preamble is configured for 2-step RACH for RedCap UEs**, separate POs or PRUs for MsgA PUSCH can be configured for RedCap UEs, or they are shared with non-Redcap UEs. |
| OPPO | Opt.1 | As raised in our contribution, for shared MsgA preamble and MsgA PRACH resource, it is not necessary to support separate MsgA PUSCH resource configuration for early indication, since dedicated LCID has already been agreed for the same purpose. |
| vivo | Opt.1 | Since dedicated LCID (i.e. the Msg3 early identification solution) is supported for MsgA early identification, there is no need to configure or use dedicated MsgA PUSCH resource for Redcap UE early indication. |
| Spreadtrum | Option 1 | According to RAN2’s agreement, Msg3 early indication is always ‘enabled’ for the case of CBRA via LCID, there is no need to introduce a redundant function. In addition, separate MsgA PUSCH resource for early indication may increase the complexity, we don’t see the benefit for separate MsgA PUSCH resource used for early indication. |
| CATT | Opt. 1 | We only have concern in the case when MsgA PRACH preamble and RO are totally shared but MsgA PUSCH is separated. If one of dedicated MsgA PRACH preamble or dedicated MsgA PRACH occasion is configured for early indication, it seems no harm (and natual) if separate PUSCH resource can be configured for RedCap. |
| Noridc | Option 1 |  |
| ZTE, Sanechips |  | If 2-step RACH is configured in separate initial DL/UL BWP, seems it is nature to have separate MsgA PUSCH resource. However, whether it is only used for early indication can be further discussed, since the early indication by LCID is realized by RAN2 and the separate MsgA PUSCH resource also can be used to extend the capacity and avoid resource collision. |
| Nokia, NSB | Opt. 1 | Opt. 1, because dedicated LCID has already been agreed for the same purpose. |
| Intel | Opt. 1 | As cited by others above in support of Opt. 1, use of dedicated LCID has been introduced for this purpose and always available. |
| FUTUREWEI | Opt. 1 |  |
| Qualcomm | Option 1 |  |
| LG Electronics | Opt.1 | If MsgA preambles are shared for Redcap and non-Redcap UEs, early indication in MSGA PUSCH part can be supported by LCID field of PUSCH part. |
| DOCOMO | Opt.1 |  |
| Sharp | Opt.1 |  |
| CMCC | Opt.1 | For 2-step RACH, RAN1 has agreed early indication of RedCap UEs through MsgA PRACH by separate MsgA PRACH resource and MsgA PRACH preamble partitioning, which is aligned with the Msg.1 solutions of 4-step RACH. And also RAN2 has agreed to support dedicated LCID for MsgA early identification, which is aligned with Msg3 early identification solution for 4-step RACH. With such agreements, the early indication has been well realized for 2-step RACH, either by PRACH part or PUSCH part.  We also wonder how dedicated PUSCH resource configuration only can realize early identification. |

**FL1 High Priority Question 1-2: For Case 1 (i.e., there is dedicated MsgA preamble and MsgA PRACH resource is configured for early indication**, **do you think anything needs to be discussed or concluded for MsgA PUSCH?**

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| --- | --- |
| **Company** | **Comments** |
| Lenovo, Motorola Mobility | For case 1, it needs to discuss how MsgA PUSCH resource is determined, e.g., separate configured or shared with non-RedCap UEs, see also our reply for Q1-1. |
| OPPO | For case 1, the RedCap and non-RedCap UE may share the same PO and PRU, which will have interference with each other. It needs to discuss the MsgA PUSCH configuration in this case. |
| vivo | No |
| Spreadtrum | No |
| CATT | For case 1, it should be allowed to configure separate MsgA PUSCH resource dedicated for RedCap UE. But if MsgA PUSCH resource dedicated for RedCap is not configured, then they share the MsgA PUSCH. |
| Nordic | No |
| ZTE, Sanechips | FFS: dedicated MsgA PRACH resource vs shared MsgA PUSCH, in my initial understanding, it may bring the MsgA PUSCH resource collision issue. |
| Nokia, NSB | No |
| Intel | No. |
| Qualcomm | No |
| LG Electronics | If dedicated MsgA preambles are reserved for Redcap early identification, MsgA PUSCH part can be based on dedicated resource configuration. |
| DOCOMO | No. If RAN2 needs RAN1 decision, it can be communicated via LS. |
| Sharp | No. |
| CMCC | No |

### Issue 2: Cell Access Control for HD-FDD UEs

Contribution [14] states that HD-FDD and FD-FDD are both optional feature for Redcap UE based on the UE features and WID. As a consequence, if a cell allows a HD-FDD RedCap UE to access, the cell needs to indicate such access information explicitly in SI. Therefore, the following was proposed in [14]:

* Proposal: For a cell with paired spectrum, it needs to explicitly indicate whether or not it allows a HD-FDD RedCap UE to access in SI.

# <1st Round Comments>

**FL1 High Priority Question 2-1: Can we agree the following proposal for cell access of HD-FDD Redcap device?**

* For a cell with paired spectrum, it needs to explicitly indicate whether or not it allows a HD-FDD RedCap UE to access in SI.

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| **Company** | **Yes/No,**  **if ‘no’, please provide brief reasoning in ‘Comment’ column** | **Comments** |
| Lenovo, Motorola Mobility | No | Cell barring configuration is applicable for both HD-FDD and FD-FDD UEs. |
| OPPO | No | Cell barring is applicable for RedCap UEs. Further cell barring configuration is not necessary. |
| vivo | No | This proposal is out of the WID scope (WID only requires to specify access barring specific to the UE Rx number, nothing else). For HD-FDD UE, the collision handling behavior is clearly specified, there is no strong reason to restrict the HD-FDD RedCap UE to access. |
| Spreadtrum | No strong view | In our understanding, for now, if a cell does not support HD-FDD operation, the cell needs to release the HD-FDD UE after the UE report its capability. The result is a waste of resource and power used in the random access process. Maybe it can be an optimization. |
| CATT | N | Agree on the companies above.  We also concern this will lead to some ‘unfairness’ among HD and FD RedCap UEs. |
| Nordic | No |  |
| ZTE, Sanechips | No |  |
| Nokia, NSB | No |  |
| Intel | No |  |
| FUTUREWEI | No | The network can drop the UE after capability exchange in such a case |
| Qualcomm |  | For a cell with paired spectrum and allowing RedCap UE to access, if it ALWAYS supports both FD and HD RedCap UE, we agree there is no need for such a proposal. |
| LG Electronics | No | gNB could assume HD-FDD operation for idle/inactive RedCap UEs before and during initial access, i.e. before acquiring actual UE capability. |
| DOCOMO | No |  |
| Sharp | No |  |
| CMCC | No |  |

### Issue 3: Clarification on the WID objective

Contribution [CATT, 7] observed that the following was agreed in RAN2 agreed

* Msg3 early indication is always ‘enabled’ for the case of CBRA, i.e., when Msg3 carries CCCH, regardless of whether Msg1 early indication is configured or not.
* A working assumption in RAN2 was also suggesting that Msg3 early indication shall be mandatorily supported by RedCap UE. That is to say, the gNB will always be able to acknowledge the RedCap UE type no later than Msg3 reception in 4-step RACH.

Nevertheless, the WID clearly requests that ‘early indication should be configurable’ by the network.

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| * Specify functionality that will enable RedCap UEs to be explicitly identifiable to networks through an early indication in Msg1 and/or Msg3, and Msg A if supported, including the ability for the early indication to be configurable by the network. [RAN2, RAN1] |

Thus, contribution [7] views the current design on early indication seems not completely align with the WID objective. It was further proposed two alternatives in [7] to be concluded in RAN1:

* Alt.1: ‘Early indication to be configurable’ in the WID is interpreted as the description dedicated for Msg1 only.
* Alt2: ‘Early indication to be configurable’ in the WID is interpreted as the description for both Msg1 and Msg3.

It is FL’s view that the need of making new conclusion above is not well justified since the situation is clear based on the agreement made in RAN2, i.e., Alt.1 and there is no other interpretation. The concern of potential WID discrepancy is expected to be raised in RAN2 when they made conclusion to make Msg3 based approach to be mandatory.

Nevertheless, the following question was formulated to collect inputs on this:

# <1st Round Comments>

**FL1 High Priority Question 3-1: Do you think any clarification below is needed in RAN1 for Msg1 and Msg3 based early indication?**

* Alt.1: ‘Early indication to be configurable’ in the WID is interpreted as the description dedicated for Msg1 only.
* Alt2: ‘Early indication to be configurable’ in the WID is interpreted as the description for both Msg1 and Msg3.

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| **Company** | **Yes/No, if yes, please state which Alt?** | **Comments** |
| Lenovo, Motorola Mobility | Yes, Atl.1 |  |
| OPPO | Yes, Alt.1 |  |
| vivo | No | Based on current progress in RAN1 and RAN2, without further debate, Alt.1 should be the interpretation. |
| Spreadtrum | No | The objective for early indication is led by RAN2, and the design for Msg3 early indication is also led by RAN2. Therefore, we suggest to leave this issue to RAN2. |
| CATT | Yes | As we are approaching to the end of Rel-17, we are fine to converge to Alt.1 to avoid additional work. |
| Nordic | Yes, Alt 2 | as WID is written it clearly includes both MSG3 and MSG1 |
| ZTE, Sanechips |  | Maybe we can wait for the conclusion for separate MsgA PUSCH. It also would impact the interpretation for this issue. |
| Nokia, NSB | Yes, Alt 2 | Same view as NORDIC wrt to the specific FL question.  However, moving forward, we are happy for RAN2 to handle the potential WID discrepancy. |
| Intel | No | As explained by the FL, Alt1 is the current status and if companies see a serious discrepancy against WID objectives (we do not think so), this should be discussed in RAN2. |
| FUTUREWEI | Alt 2 | The WID spplies to both Msg1 and Msg3 |
| Qualcomm | Alt2 |  |
| LG Electronics | No | We are fine with the RAN2 agreement. Whether to revise the WID could be up to RAN plenary. |
| DOCOMO | No | This should be discussed in RAN2 |
| Sharp | No | We share same view with Spreadtrum and Intel. |
| CMCC | No | We share the same view as FL that alt1 is the current situation. And we also think it is better for RAN2 to make conclusion since Msg3 indication is defined by RAN2. |

# 3. Other aspects

**The configuration of 2-Step RACH and 4-Step RACH for a given UL BWP**

In the RAN1 107 e-Meeting, 2-step RACH and 4-step RACH procedure configurations for a separate UL BWP or a legacy UL BWP for Redcap UEs were discussed without conclusion. As pointed out in [7, 8], this issue was further progressed in RAN2 with the following agreement [17]:

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| --- |
| ***• If a RedCap-specific initial UL BWP is configured for RACH, RedCap UEs shall use only the RedCap-specific initial UL BWP to perform RACH.***  ***• RedCap-specific two-step RACH, if configured, and four-step RACH are always configured in the same BWP.*** |

Given the above observation, there is no need for further discussion in RAN1 on this topic although it was brought up in contribution [15].

**Contributions to be handled under other Redcap agendas**

In addition, the following contributions were planned to be handled under relevant agenda of Redcap:

* To be handled in AI 8.6.1.1
  + R1-2200918 [Huawei], R1-2201138 [ZTE], R1-2202383 [Nordic]
  + Proposal 1 and Proposal 2 in R1-2202147 [Qualcomm]
* To be handled in AI 8.16.6
  + R1-2201957 [Xiaomi]

# 4. Conclusion

<To be updated>

# References

1. RP-211574 Revised WID on support of reduced capability NR devices Ericsson
2. R1-2112506, RAN1 agreements for Rel-17 NR RedCap Rapporteur (Ericsson)
3. [RP-212802](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_94e/Docs/RP-212802.zip), “Status report for WI Support of reduced capability NR devices”, RAN1, 3GPP TSG RAN #94-e, December 2021.
4. [R1-2200918](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2200918.zip) On RAN1 aspects of RAN2 led issues for RedCap Huawei, HiSilicon
5. [R1-2201138](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2201138.zip) Higher layer support of Reduced Capability NR devices ZTE, Sanechips
6. [R1-2201279](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2201279.zip) Higher layer related issues for Reduced Capability NR Devices OPPO
7. [R1-2201369](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2201369.zip) Remaining issues on higher layer support of RedCap CATT
8. [R1-2201406](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2201406.zip) Remaining Issues for Higher Layer Support of Reduced Capability NR Devices Nokia, Nokia Shanghai Bell
9. [R1-2201670](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2201670.zip) RAN1 aspects for RAN2-led features for RedCap Ericsson
10. [R1-2201863](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2201863.zip) Remaining issues for higher layer support of RedCap UE CMCC
11. [R1-2201957](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2201957.zip) Discussion on the remaining issues of RAN2-led features for RedCap Xiaomi
12. [R1-2201971](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2201971.zip) RAN1 aspects for RAN2-led features for RedCap Lenovo, Motorola Mobility
13. [R1-2202021](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2202021.zip) RAN1 aspects for RAN2-led features for RedCap Samsung
14. [R1-2202147](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2202147.zip) Remaining Issues on Cross-layer Design for RedCap Devices Qualcomm Incorporated
15. [R1-2202194](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2202194.zip) RAN1 aspects for RAN2-led features for RedCap Sharp
16. [R1-2202383](file:///D:\\Documents\\3GPP%20documents\\RAN1\\TSGR1_108-e\\Docs\\R1-2202383.zip) On RAN2 related aspects Nordic Semiconductor ASA
17. Draft report of 3GPP TSG RAN WG2 meeting #116bis-e, RAN2#116-e