3GPP TSG-RAN WG1 Meeting #106-e R1-210xxxx

e-Meeting, 16th – 27th August 2021

**Agenda Item: 8.6.2**

**Title: (draft) FL summary #3 on RAN1 aspects for RAN2-led features for RedCap**

**Source: Moderator (NTT DOCOMO, INC.)**

**Document for: Discussion, Decision**

# Introduction

This document summarizes contributions [1] – [26] submitted to agenda item 8.6.2 and relevant parts of contributions [27] – [34] submitted to agenda item 8.6.3 and captures the following email discussion for the RedCap WI.

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| [106-e-NR-R17-RedCap-05] Email discussion regarding RAN1 aspects for RAN2-led features – Shinya (DoCoMo)   * 1st check point: August 19 * 2nd check point: August 24 * Final check: August 27 |

The issues in this document are tagged and colour coded with High priority, Medium priority, or Low priority.

In this round of the discussion, companies are requested to provide comments on the proposals and questions tagged FL2.

Follow the naming convention in this example:

* *RedCapBwFLS1-v000.docx*
* *RedCapBwFLS1-v001-CompanyA.docx*
* *RedCapBwFLS1-v002-CompanyA-CompanyB.docx*
* *RedCapBwFLS1-v003-CompanyB-CompanyC.docx*

If needed, you may “lock” a spreadsheet file for 30 minutes by creating a checkout file, as in this example:

* Assume CompanyC wants to update *RedCapR2ledFLS1-v002-CompanyA-CompanyB.docx*.
* CompanyC uploads an empty file named *RedCapR2ledFLS1-v003-CompanyB-CompanyC.checkout*
* CompanyC then has 30 minutes to upload *RedCapR2ledFLS1-v003-CompanyB-CompanyC.docx*
* If no update is uploaded in 30 minutes, other companies can ignore the checkout file.
* Note that the file timestamps on the server are in UTC time.

In file names, please use the hyphen character (not the underline character) and include ‘v’ in front of the version number, as in the examples above and in line with the general recommendation (see slide 10 in [R1-2106403](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106-e/Docs/R1-2106403.zip)), otherwise the sorting of the files will be messed up (which can only be fixed by the RAN1 secretary).

To avoid excessive email load on the RAN1 email reflector, please note that there is NO need to send an info email to the reflector just to inform that you have uploaded a new version of this document. Companies are invited to enter the contact info into the Annex.

# Definition of RedCap UE type

The WID [35] has the following objective on the definition of RedCap UE type:

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| * Specify definition of one RedCap UE type including capabilities for RedCap UE identification and for constraining the use of those RedCap capabilities only for RedCap UEs, and preventing RedCap UEs from using capabilities not intended for RedCap UEs including at least carrier aggregation, dual connectivity and wider bandwidths. [RAN2, RAN1]   + The existing UE capability framework is used; changes to capability signalling are specified only if necessary. |

Following working assumption/conclusion related to the definition of RedCap UE type were made at RAN1#105-e:

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| **Working assumption:**   * RedCap UE type is defined based on one of the following options   + Option 2: Only include the reduced capabilities that the network needs to know during initial access, if any.   + Option 4: The corresponding minimum set of the reduced capabilities that one RedCap UE type shall mandatorily support   + FFS: details of the set of reduced capabilities   **Conclusion:**   * RAN1 postpones the discussion on constraining of reduced capabilities, and if deemed necessary, RAN1 can come back |

Many contributions [2, 3, 4, 8, 9, 11, 12, 13, 14, 15, 16, 18, 19, 20, 22, 23, 24, 25] discuss the above working assumption. A few contributions such as [3] support Option 2 because Option 4 may cause underestimation on some RedCap UE capabilities. On the other hand, many of others [2, 8, 9, 11, 12, 13, 16, 20, 22, 23, 24, 25] support Option 4 because it shows ‘what a RedCap UE should be’ and includes Option 2, while Option 2 may vary depending on the configuration and deployment. One contribution [4] suggests clarification is needed for these options. One contribution [11] suggests focusing on the basic FG structure. Another contribution [13] suggests waiting for RAN2 discussion. In addition, one contribution [15] propose another alternative that it includes the minimum set of mandatory UE capabilities that the NW can assume during initial access. Some contributions [1, 14, 18, 19] suggest directly defining the RedCap UE type by the maximum UE bandwidth (i.e., 20MHz for FR1 and 100MHz for FR2) which would fulfil both option 2 and option 4. One contribution [3] proposes relative criterion(s) compared between the UE capability and cell operating parameters; at least the comparison on maximum channel bandwidth for a UE can support and a cell can operate (e.g. as specified in Table 5.3.5-1 for FR1 in TS 38.101-1 and Table 5.3.5-1 for FR2 in TS 38.101-2) should be used as one criterion. One contribution [3] suggest that UE declaration of RedCap/non-RedCap is band-specific. Note that following agreement was made RAN1#103-e and hence, maximum UE bandwidth is already included without any further agreements.

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| Agreements:   * If early identification during initial access is supported, at least maximum supported UE BW during initial access is included in the set of L1 capabilities of the device type for RedCap early identification   + Note: 20 MHz for FR1 and 100 MHz for FR2   + ~~Identification of UEs optionally supporting bandwidths larger than 20 MHz in FR1 or larger than 100 MHz in FR2 after initial access, if supported, is not supported by early identification during initial access~~   + FFS other L1 capabilities   + Note: This does not preclude the case where the early indication only indicates whether it is a Redcap UE or which type of the Redcap UEs if multiple UE types are defined |

Given the situation, we can try to down-select to Option 4 having majority support with a note clarifying at least maximum supported UE BW is included. Whether/which other L1 capabilities are included is still FFS, and to be further discussed in Proposal 2-2 (i.e., no other L1 capabilities may be included).

**FL2 Medium Priority Proposal 2-1:**

* RedCap UE type is defined based on
  + Option 4: The corresponding minimum set of the reduced capabilities that one RedCap UE type shall mandatorily support
  + Note: At least maximum supported UE BW (20 MHz for FR1 and 100 MHz for FR2) is included
  + FFS whether/which other L1 capabilities are included

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| **Company** | **Y/N** | **Comments** |
| Huawei, HiSilicon |  | It would be anyway necessary to review which exact capability is included, i.e. the FFS would be the next discussion point (i.e. Q2-2). Thus, we suggest to take Q 2-2 as next step of discussion prior to agreeing on Option 4. |
| OPPO | Y | The minimum set of the reduced capabilities that one RedCap UE type shall mandatorily support is FFS in Q2-2. |
| CATT | Y |  |
| CMCC |  | We think the Note and FFS are sub bullet of option4, that is the reduced capabilities that one RedCap UE type shall mandatorily support at least including maximum supported UE BW, and others as FFS. |
| Nokia, NSB | Y |  |
| NEC | Y |  |
| Qualcomm | Y |  |
| FUTUREWEI | Y | RAN1 can start to design the basic feature group for FR1 and FR2 UEs |
| LG | Y |  |
| Xiaomi |  | We are OK with option 4. But Before we go to the conclusion, we should figure out the exact capability included. So we think **Question 2-2** should have high priority**.** |
| China Telecom | Y | We think RedCap UE type can be based on Option 4. And the details of the set of reduced capabilities and other L1 capabilities need further discussion. |
| Samsung | Y |  |
| SPRD | Y |  |
| Nordic | Y |  |
| Ericsson | Y |  |
| ZTE, Sanechips | Y |  |
| Intel | Y |  |
| Apple | Y | As other companies commented, we would like to first discuss Q2-2 to better understand the rationale of adding other components than BW. |
| vivo | Y | We are fine to take option 4 based on the majority view. |
| Sierra Wireless | Y | Support |
| Lenovo, Motorola Mobility | Y |  |

Regarding the FFS in the above working assumption, several contributions [1, 2, 3, 6, 8, 9, 11, 12, 14, 16, 22, 24] discuss the reduced capabilities included in the definition of the RedCap UE type. As mentioned above, maximum supported UE BW, which is suggested to be included in the definition by many of them [1, 2, 3, 6, 8, 11, 14, 16, 22, 24], is already agreed. Some contributions [2, 6, 16, 22, 24] suggest that the capabilities of minimum number of Rx branches (1 Rx branches) and maximum number of DL MIMO layers (1 layer) are included, while some others [8, 11] suggest that reduced number of Rx branches (either 1 or 2 Rx branches) and maximum number of DL MIMO layers (1 or 2 layers) are included. Some contributions [2, 6, 16, 22, 24] suggest that maximum DL modulation order (64QAM) is included. Some contributions [2, 6, 8, 22] suggest that duplex operation (HD-FDD and TDD) are also included. One contribution [9] suggests that following capabilities are included:

* Reduced baseline capability FG5-1 to max 8 HARQ processes
* No support of supplemental uplink and CBG
* Mandatory support of dynamic repetition for PDSCH, PUCCH and PUSCH

Another contribution [12] suggests waiting for RAN2 discussion.

Given the situation, there would be no common understanding whether/which other L1 capabilities are included. Moderator suggests coming back to the following question 2-2 after **Medium Priority Proposal 2-1** is converged.

**FL2 Low Priority Question 2-2:**

* Which reduced capabilities other than maximum supported UE BW should be included in the definition of RedCap UE type?

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| **Company** | **Comments** |
| Huawei, HiSilicon | Do not see strong need to include other items. |
| Nokia, NSB | The definition of the “RedCap Type”, should provide sufficient information to enable the network to configure itself for the worst case RedCap device it can expect to handle before receipt of full UE capability information.  In our view, this would include in addition to maximum BW support:   * The minimum number of Rx branches/DL MIMO layers supported * The minimum DL modulation order supported |
| LG | The reduced number of Rx branches, the maximum number of DL MIMO layers, the maximum DL modulation order and duplex operation could be additionally included in the definition of RedCap UE type. Other reduced capabilities than those reduced capabilities seem not essential to be considered in definition of RedCap UE type. |
| Xiaomi | We think the following capability should be included for the RedCap UE definition   |  |  | | --- | --- | | **UE capability** | **RedCap UE** | | Maximum UE bandwidth | 20MHz in FR1  100MHz in FR2 | | Minimum number of Rx branches / MIMO layers | 1/1 | | Maximum modulation order | 64QAM | | Duplex mode | HD-FDD in FDD frequency bands  TDD in TDD frequency bands | |
| China Telecom | We have the same view with LG and xiaomi. |
| SPRD | Can be left to RAN2 to get the whole picture of the reduced capabilities of RedCap UE type. |
| ZTE, Sanechips | RedCap UE definition refer to the characters of RedCap UE which are used for differentiating with other UEs. From our perspective, the Rx (MIMO layer) and 64QAM should be viewed as the another characters of RedCap at least. |
| Intel | None, since, for all the other features/capabilities, they do not uniquely identify a RedCap UE since these are all optional for RedCap UEs. |
| Apple | We do not see the need of adding any as part of ‘Redcap Type’ definition.  Note that the other components are NOT ‘real’ UE capability, instead of minimum requirements that are mandated to be supported by all UEs. This can be assumed by gNB anyway regardless it is included in device type or not. |
| vivo | Agree with Huawei, Intel, Apple, no additional capability is included. |
| Nordic | all that differ from eMBB UE |
| Ericsson | We do not see a need for further RAN1 agreements on this in this meeting. We can await RAN2 progress, including running CRs for 38.306 and 38.331. |
| FUTUREWEI2 | In addition to the maximum BW, all RedCap UE should be either 1RX or 2RX |
| Qualcomm | In addition to max UE BW, the UE capabilities that need to be supported as mandatory UE features (before capability signaling of R17 RedCap devices) should be considered. |
| Sierra Wireless | If the above proposal 2-1 is agreed where a Redcap UE type is defined by the set of mandatory features, then no additional capabilities need to be included as only 20MHz is mandatory to be supported. |

# Early indication of RedCap UEs

The WID [35] has the following objective on early indication of RedCap Ues:

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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] |

Following agreements/working assumption related to the definition of RedCap UE type were made at RAN1#105-e:

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| Working assumption:   * For 4-step RACH, support the early indication of RedCap Ues at least in Msg1.   + The early indication in Msg1 can be configured to be enabled/disabled     - FFS How to support enable/disable the early indication   + FFS details e.g.:     - separate initial UL BWP     - separate PRACH resource     - PRACH preamble partitioning   + FFS the possibility of supporting Msg3 for the early indication   Agreement: (if the above working assumption is confirmed)   * Early indication of RedCap Ues in Msg1 can be enabled/disabled via SIB   Agreement:   * Support 2-step RACH for RedCap Ues as an optional feature   + FFS details of early indication in MsgA, e.g.:     - Separation of 2-step RACH resources or MsgA preambles     - Separation of initial UL BWP     - Using a new indication in MsgA PUSCH part   + Note: Discussion on 4-step RACH for early indication should be prioritised |

Regarding early indication of RedCap Ues in Msg1, many contributions [1, 2, 4, 7, 9, 11, 12, 13, 15, 16, 18, 19, 21, 22, 23, 24, 26] suggest confirming the working assumption to support the early indication of RedCap Ues in Msg1. For the details, several companies support the indication through separate initial BWP, which is being discussed in AI8.6.1.1. However, as pointed out by some contributions such as [1], separate initial BWP itself cannot be used to indicate whether the UE is RedCap or not if PRACH resource is shared by initial UL BWP for non-RedCap Ues and separate initial UL BWP for RedCap Ues. Many contributions support separate RO [1, 2, 4, 5, 6, 8, 9, 13, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26] either for separate initial UL [2, 6, 8, 9, 16, 19, 21, 22, 23, 24] and/or shared initial UL BWP [4, 8, 9, 16, 19, 20, 21, 22, 23, 24]. Similarly, many contributions support separate PRACH preamble [1, 2, 4, 5, 6, 8, 13, 16, 18, 19, 20, 21, 22, 23, 24, 25] either for separate initial UL [2, 16, 24] and/or shared initial UL BWP [2, 4, 6, 16, 19, 20, 21, 22, 23, 24]. Therefore, as many contributions suggest, both of separate RO and separate PRACH preamble can be supported for Msg1 early indication from RAN1 perspective. Note that, as some contributions pointed out, RAN2 will discuss RACH indication and partitioning aspects common for multiple Wis such as SDT, CovEnh, RedCap, and RAN slicing in this RAN2 meeting. Therefore, moderator expects the relationship of early indication during initial access between RedCap and other features, which is raised by some contributions [2, 6, 8, 10], will be discussed in RAN2. In addition, a few contributions [2, 26] point out that it is necessary to address RA-RNTI overlapping issue caused by RO time/frequency configurations (see details in their contributions).

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| **8.18 RACH indication and partitioning**  *Time budget: Equivalent to 0.5-1 TU*  *Tdoc Limitation: 1 tdocs*  *Expected to cover Wis SDT, CovEnh, RedCap, RAN slicing .. Initial discussion on what should be treated in common and what design could be common.* |

**FL1 High Priority Proposal 3-1:**

Confirm the following working assumption with the modifications in red:

* For 4-step RACH, support the early indication of RedCap Ues at least in Msg1.
  + The early indication in Msg1 can be configured to be enabled/disabled via SIB
    - ~~FFS how to support enable/disable the early indication~~
  + ~~FFS details e.g.:~~ From RAN1 perspective, followings can be used for early indication
    - Both for shared initial UL BWP and separate initial UL BWP (if supported)
      * separate PRACH resource
      * PRACH preamble partitioning
      * FFS: how to address RA-RNTI overlapping issue
  + FFS the possibility of supporting Msg3 for the early indication

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| **Company** | **Y/N** | **Comments** |
| vivo |  | For “separate initial UL BWP” case, the following may not be needed?   * separate PRACH resource * PRACH preamble partitioning   For “FFS: how to address RA-RNTI overlapping issue”, we prefer to leave it to RAN2 for further study as there are multiple other use cases requiring PRACH resource partitioning currently under RAN2 discussion, a unified solution would be desirable, if justified. |
| Huawei, HiSilicon | Y |  |
| OPPO | Y | The necessities of these issues can be identified in RAN1, and LS is sent to RAN2 for information. We are fine with the revised working assumptions. |
| CATT | Y |  |
| CMCC | Y |  |
| Nokia, NSB | Y | Slight wording improvement suggested:    From the RAN1 perspective, the following methods can be used for early indication  ♣ Both for shared initial UL BWP and for separate initial UL BWP (if supported)   * separate PRACH resource * PRACH preamble partitioning * FFS: how to address RA-RNTI overlapping issue |
| Sharp | Y |  |
| Lenovo, Motorola Mobility | Y | For this bullet “The early indication in Msg1 can be configured to be enabled/disabled via SIB.”, we don’t think there should be an explicit signalling to enable/disable the early identification. The early identification is enabled if there are separate preambles configured for RedCap Ues. |
| NEC | Y |  |
| Qualcomm | Y | We think “separate PRACH resource” is general enough for msg1-based early indication of RedCap UE, since it can include separate PRACH configuration index, separate Ros in separately configured initial UL BWP, or PRACH preamble partitioning on shared RO.  Besides, we are open to discuss in RAN1/2 how to address the RA-RNTI overlapping issues (if any). |
| FUTUREWEI | Y | Editorial: can the bullets be combined (using Nokia’s proposed revision)?  “From the RAN1 perspective, the following methods can be used for early indication for shared initial UL BWP and for separate initial UL BWP (if supported)” |
| LG |  | We understand that separate PRACH resource or PRACH preamble partitioning can be used even for separate initial UL BWP. However, it could be also possible for gNB to configure separate initial UL BWP without separate PRACH resource and PRACH preamble partitioning. How to configure those options could be up to gNB implementation. |
| Xiaomi | Y | * We share the same view with Lenovo that the enable/disable can be carried out in implicit way. There is no need for explicit indication * As for the RA-RNTI issue, in our view, RAN1 could continue discuss this case. Whether there is collision issue, it depends on the CSS configuration. For example, if separate CSS is defined for RedCap and non-RedCap, then there is no collision problem. If RAN1 confirm that this problem can’t be avoided by RAN1 solution, then we can send LS to RAN2 |
| China Telecom | Y |  |
| Samsung |  | Support of PRACH separate resources/preamble partitioning can be for shared BW only.  We suggest to address the FFS’s before confirming the WA:   * Whether to support Msg3 for early indication, and if supported whether disabling Msg1 early indication means relying on Msg3 indication or no early indication * RA-RNTI overlapping issue can be discussed in RAN1/2. |
| Panasonic | Y |  |
| SPRD | Y | We share the same view with Lenovo. Early indication in Msg1 can be implicitly enabled or disabled by whether separate PRACH resource or preamble for RedCap is configured or not. |
| Nordic |  | Add FFS on how to handle/accommodate with partitioning for other purposes, such as MSG3 repetitions |
| Ericsson | OK as WA | We prefer to keep it as the working assumption until the potential PRACH fragmentation issue due to the many legacy and Rel-17 features and their combinations that need to use Msg1 indication has been addressed probably. But we are OK with the updated wording.  In the case of separate initial UL BWP, separate PRACH resource/preamble partitioning is needed only when the ROs are overlapped. We suggest clarifying this.  Regarding “FFS: how to address RA-RNTI overlapping issue”, we are fine with leaving this to RAN2, as some companies above have suggested. |
| ZTE, Sanechips | Y | Before we have the conclusion to address the RA-RNTI overlapping issue, we should confirm whether this issue exists. Therefore, it is suggested to use the following wording:  FFS: Whether/how to address RA-RNTI overlapping issue  Additionally, it is worth to point out that if the separate initial UL BWP is configured, separate PRACH occasions or separate preamble should be configured for identification, otherwise, the gNB still can not identify the RedCap UE. |
| Intel | Y |  |
| Sierra Wireless | Y | For the “FFS: how to address RA-RNTI overlapping issue“, we think it should be left up to RAN2, hence the FFS could be removed. |
| Apple | Y |  |
| FL | * Regarding the separate PRACH resource and PRACH preamble partitioning in a separate initial UL BWP for RedCap, here the intention is that even if gNB configures separate initial UL BWP for RedCap, corresponding ROs may be overlapped with those for non-RedCap UEs. Therefore, to identify RedCap UEs, at least one of separate ROs or separate PRACH preambles in shared ROs is necessary for separate initial UL BWP for RedCap. How to configure those options would be up to RAN2 discussion, and hence, the proposal says “followings **can be used** for early indication”.   @Lenovo/Motorola Mobility: regarding the sub-bullet “The early indication in Msg1 can be configured to be enabled/disabled via SIB”, it is based on the following agreement in the last RAN1 meeting. Moderator thinks RAN2 can discuss whether explicit or implicit indication is adopted for enabling/disabling since it is detail design of SIB contents.  Agreement: (if the above working assumption is confirmed)   * Early indication of RedCap UEs in Msg1 can be enabled/disabled via SIB * Regarding FFS on RA-RNTI overlapping issue, “whether” is added based on the comments from some companies * Some editorial updates are applied based on the comments from Nokia/NSB, FUTUREWEI   **High Priority Proposal 3-1:**  Confirm the following working assumption with the modifications in red:   * For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.   + The early indication in Msg1 can be configured to be enabled/disabled via SIB     - ~~FFS how to support enable/disable the early indication~~   + ~~FFS details e.g.:~~ From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP (if supported)     - separate PRACH resource     - PRACH preamble partitioning     - FFS: whether/how to address RA-RNTI overlapping issue   + FFS the possibility of supporting Msg3 for the early indication | |
| FL2 | Following agreement was achieved in the GTW session on 18th August:  ---  **Agreement:**  Confirm the following working assumption with the modifications in red:   * For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.   + The early indication in Msg1 can be configured to be enabled/disabled via SIB     - ~~FFS how to support enable/disable the early indication~~   + ~~FFS details e.g.:~~ From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP (if supported)     - separate PRACH resource     - PRACH preamble partitioning     - ~~FFS: whether/how to address RA-RNTI overlapping issue~~   + ~~FFS the possibility of supporting Msg3 for the early indication~~   Whether/how to support early indication of RedCap UEs in Msg3 in Rel-17 is up to RAN2  ---  The sub-bullet “FFS: whether/how to address RA-RNTI overlapping issue” was deleted in the GTW session as we need more time to have common understanding on this potential issue. Therefore, companies are invited to provide their views on the following new question:  **High Priority Question 3-1a:**   * Does RAN1 need to further study how to address RA-RNTI overlapping issue for the early indication of RedCap UEs in Msg1? If yes, please provide potential solutions which RAN1 need to further study.   Note that whether to send an LS to RAN2 to inform the above agreement will be discussed in **Proposal 7-1**. Also, remaining discussion point for Msg3 early indication whether to send an LS to RAN2 to inform potential RAN1 observations, which was proposed by some companies in the GTW session, will be discussed in **Question 3-2a**. | |
| vivo | N | The RA-RNTI overlapping issue, if any, is purely RAN2 topic. |
| Nokia, NSB | N | RAN2 issue |
| Nordic | N | RAN1 issue |
| Ericsson |  | We are fine with discussing the RA-RNTI overlapping issue in RAN2. |
| FUTUREWEI2 |  | RAN2 issue |
| Qualcomm | N | We can leave the RA-RNTI discussion to RAN2, unless there is any additional request/LS from RAN2. |
| Sierra Wireless | N | This is a RAN2 topic |
| Intel | N | Agree with vivo that it is a topic for RAN2. |
| Lenovo, Motorola Mobility |  | RAN1 could identify if the issue is valid, and up to RAN2 to resolve the issue. |

Regarding the FFS on the possibility of supporting Msg3 for the early indication, a number of contributions [1, 2, 4, 7, 9, 10, 13] support the early indication of RedCap UEs in Msg3 to avoid PRACH capacity reduction, which can be configured to be enabled/disabled by SIB [13], and suggest to send an LS to RAN2 [10], while some others [3, 5, 8, 12, 14, 18, 23, 25] do not support it because RedCap-specific handling cannot be applied before Msg3 and it is not necessary to specify duplicated functions. Given the situation and the detail of Msg3 indication would be mainly RAN2 matter, moderator suggests discussing whether/which scenarios the early indication in Msg 3 is worth specifying from RAN1 perspective and trying to send an LS to ask RAN2 to decide whether to support or not.

**FL1 High Priority Question 3-2:**

* For 4-step RACH, which scenarios is the early indication of RedCap UEs in Msg3 applicable from RAN1 perspective?
  + Note: This question is aiming to identify the scenarios where early indication of RedCap UEs in Msg3 is applicable, and if identified, to send an LS to ask RAN2 to decide whether to support the early indication of RedCap UEs in Msg3 or not

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| **Company** | **Comments** | |
| vivo | We do not see much benefit by specifying MSG 3 based early indication in addition to MSG1 based solution, and duplicated spec effort should be avoided as much as possible.  We think the question should be aiming to identify the scenario where where early indication of RedCap UEs in Msg3 is applicable in addition to Msg 1…. | |
| Huawei, HiSilicon | There has been several cases identified during the study phase and, e.g. when PARCH capacity is concerned. From our perspective Msg3 is also one of the options that specification shall support and up to network to configure. The detailed solution can be up to RAN2. | |
| OPPO | Share the same view with Huawei. RAN2 is discussing how to support the indication of UE with multiple UE features through PRACH. The partitioning of PRACH resource and PRACH capacity are main concerned issues. For the early indication in Msg1, it is working assumption that it can be configured to be enabled/disabled via SIB. Network may disable early indication in Msg1 if the PRACH capacity is limited. In this case Msg3 can be configured to support early indication during initial access. | |
| CATT | We do not think identifying RedCap UE in Msg3 is very useful in 4-step RACH.  It seems only happens when the PRACH resources and preambles are fully shared. But this also means that the gNB does not rely on early indication of RedCap for scheduling of Msg2 and Msg3 for RedCap, e.g. the initial DL/UL BWP are shared, and are both no larger than the maximum RedCap UE BW. It is natural that the gNB does not rely on early indication of RedCap for scheduling of Msg4, either. This, again, makes early indication in Msg3 unnecessary. | |
| CMCC | When Msg.1 identification is disabled due to capacity consideration, gNB can configure early identification by Msg.3 for access control or proper scheduling. | |
| Nokia, NSB | Early identification of RedCap with Msg3 could help improve Msg4 feedback in the absence of Msg1 early identification.   We do not support a combined Msg1 and Msg3 early capability indication scheme.  If the majority of RAN1 do not see sufficient benefit in supporting Msg3 early indication, we support a LS to RAN2, seeking their opinion on Msg3 early indication. | |
| Sharp | For scenario where both UL and DL initial BWPs are shared between RedCap UE and non-RedCap UEs, early indication of RedCap UEs in Msg3 can be applicable. In this scenario, there is no different scheduling handling of Msg2 unless gNB separates Type 1 CSS for RedCap UE from that for non-RedCap UE. Early indication of RedCap UEs in Msg3 can help to avoid additional PRACH resource configuration for RedCap if PRACH capacity is concerned. | |
| Lenovo, Motorola Mobility | From RAN1 point of view, we don’t see strong motivation to have early identification in Msg3. | |
| NEC | In case msg3 is used for early indication, gNB cannot take into account of RedCap type until msg3 is successfully received. SO, in our opinion, early indication via msg3 is not so useful. A separate initial UL BWP/separate RACH resources, e.g. can also be used to mitigate over PRACH resource partitioning. | |
| Qualcomm | We don’t see much benefit to support early indication of RedCap UE type based on msg3 only, or by both msg1 and msg3.  We think msg1-based early indication should be supported for RedCap UE at least when:   1. initial DL/UL BWPs are separately configured for RedCap UE   and/or   1. DL/UL coverage recovery are needed for msg2/msg3.   If msg1-based early indication is not supported but msg3-based early indication is supported, it suggests:   1. initial DL/UL BWPs are NOT separately configured for RedCap UE   and   1. DL/UL coverage recovery are not needed for msg2/msg3   However, if RedCap UE is not configured with a separate initial UL BWP (msg1-based early indication is not supported), it is not necessary to disable the FH of PUCCH carrying HARQ feedback for msg4. Therefore, msg3-based early indication is not much useful for disabling FH of PUCCH during initial access. | |
| FUTUREWEI | While Msg1 is preferable for early identification (BW and/or whether to address DL performance), Msg3 provides an alternative when RACH resources are limited for Msg1. We also note that RAN2 should understand that Msg3 is up to them, we could just leave to them unless asked. | |
| Xiaomi | When Msg.1-based early indication is disabled, it implies there is no need to handle the restriction from reduced UE bandwidth. Then in this case, the purpose to ultilize Msg.3-based solution is to enable gNB to know the channel status of RedCap, for that point, we think it can be handled by coverage enhancement project. | |
| China Telecom | If early identification for RedCap UEs is supported, Msg1 is preferred. However, if early identification via Msg1 is not configured, gNB can optionally configure early identification via Msg3 for better performance of initial access. | |
| Samsung | The main reason for identification in Msg3 is to avoid an overhead increase that is needed for a RedCap UE identification in Msg1. Early identification in Msg1 can be disabled and identification can be done in Msg3. Also, some RedCap UE capabilities can be identified in Msg1 and some others in Msg3, although it is not clear there is a need for early indication of several capabilities. | |
| Panasonic | For the purpose of coverage recovery, it is more beneficial that early indication is via Msg1 than via Msg3. Therefore, the only scenario to use Msg3 has the benefit in our view is the situation that PRACH resource/preamble cannot be separated due to the resource/preamble limitation. Whether a RedCap UE can camp on the cell under such a congested scenario may need to be considered by RAN2. | |
| SPRD | We share the view with vivo.  In addition, the additional benefit is marginal. From RAN1’s perspective, early indication is introduced for two reasons. One is for coverage recovery. But it is Msg2 which needs coverage compensation most. The other reason is to enable the scheduling of non-RedCap UE in an UL BWP larger than the maximum RedCap UE BW. In this scenario, we think NW should identify the UE type before Msg3, otherwise the scheduling of Msg3 will be an issue as RedCap and non-RedCap UEs configured with different initial UL BWPs will have different understanding on the UL grant for Msg3 and DCI for Msg3 retransmission. In summary, early indication in Msg3 is unnecessary from the point of RAN1. | |
| Nordic | MSG3 identification allows gNB to provide RedCap UE with a specific configuration. In scenarios where coverage is not an issue, MSG3 is an efficient way for gNB to operate. | |
| Ericsson | In many scenarios, it may not be suitable to enable Msg1 indication, for example, due to concerns on significant reduction in PRACH capacity or increase in UL overhead. Note that there are legacy features (2-step RACH, preamble group A/B) and many Rel-17 features (SDT, CovEnh, RAN slicing, and their different combinations) and that also require Msg1 indication via separation of PRACH resources/preamble partitioning. This will fragment the PRACH resources/preambles among many different features, which is not desired. Therefore, the network will enable Msg1 indication only when it is absolutely needed. For example, in deployments where Msg2 is not coverage limiting, indication in Msg1 will not be enabled.  In such scenarios, Msg3 indication of RedCap UEs can still be useful. For example, to properly scheduled the RedCap UEs after Msg3 and until specific UE capabilities are known, to enable the network to disable PUCCH frequency hopping for Msg4 feedback, to enable RRC connection rejection of RedCap UEs for access restriction, and to enable prioritization of non-RedCap UEs over RedCap UEs during contention resolution.  We would also like to highlight that Msg3 indication may not cost any extra bits to be transmitted in Msg3 if, for example, RedCap-specific LCID for CCCH is used (similar solution was also adopted in LTE for indication of Cat-0 UEs in Msg3). To this end, RAN1 can ask RAN2 to specify solutions for Msg3 indication that would not lead to additional overhead in Msg3. | |
| ZTE, Sanechips | The benefits for msg3 identification may including the following:   1. If the msg1 identification is disabled, msg3 based identification is the only way to identify the RedCap UE earlier, which help gNB to adjust the scheduling strategy, e.g.,msg4 scheduling. 2. Msg1 identification for RedCap UE , CE UE and other features requiring msg1 identification may cause serious PRACH performance degradation. Msg3 based identification can help compensate the performance loss caused by congestion.   If the overhead for msg3 identification is not an issue, then msg3 identification can be considered for the above benefits. It is suggested to send an LS to ask RAN2 to decide whether to support the early indication of RedCap UEs in Msg3 or not, based on the summarized scenarios by RAN1. | |
| Intel | We do not see the need to support RedCap UE identification via Msg3.  Companies are citing PRACH capacity impact to justify RedCap UE identification via Msg3. However, as elaborated by QC and others, there is hardly any benefit in UE identification at the stage of Msg3 transmission if identification is not available during Msg1 – it would be a small optimization as against relying on UE capability reporting.   * Limited help to DL scheduling as UEs cannot be distinguished for Msg2 scheduling. Msg4 PDCCH and PDSCH can be scheduled the same way as for Msg2 scheduling. * Not necessary towards disabling PUCCH FH for Msg4 feedback, etc., as disabling PUCCH FH should be applicable only when configured with separate initial UL BWP and not when initial UL BWP is shared between RedCap and non-RedCap UEs (no issue with max RedCap UE BW) * The benefit in providing “appropriate RRC configuration” to the UE before UE capability reporting is negligible. In any case, the RRC configuration would most likely need to be updated depending on reported UE capabilities, and the time period from after Msg4 scheduling until UE capability reporting is rather short for any perceptible impact from this “early RRC configuration”.   Thus, at this point we do not see a need for RedCap UE identification via Msg3 that goes beyond minor optimization. If identification via Msg1 is not possible due to PRACH capacity/UL resource OH considerations and the RA procedure can function until Msg3 transmission, the gNB can simply wait until two more messages are exchanged until the UE capability report is received. | |
| Sierra Wireless | As mentioned above, there are benefits to early indication of RedCap with Msg3 (including reducing PRACH partitioning and Msg4 feedback), when Msg1 early indication is not configured. The early indication in Msg3 should be specified and available for the network to use. The network can select either Msg1 or Msg3, but not both. | |
| Apple | We prefer to leave Msg3 related to RAN2, which is the working group handling Msg-3 related discussion in general and more familiar the usage of Msg3. Also, as commented by other companies, whether/how to use Msg3 is being discussed in RAN2. Duplicated discussion should be avoided. | |
| FL | Based on the comments from companies, following scenarios can be considered where the early indication of RedCap UEs in Msg3 is applicable:   * None: vivo, CATT, Lenovo/Motorola Mobility, NEC, Qualcomm, Xiaomi, SPRD, Intel * When PRACH capacity is concerned due to the indication of UE with multiple UE features through PRACH: Huawei/HiSilicon, OPPO, CMCC, Sharp, Samsung, Panasonic, Ericsson, ZTE/Sanechips, Sierra Wireless   + Objected because gNB does not rely on early indication of RedCap for scheduling of Msg4 and its HARQ-ACK feedback in this case, i.e., shared initial DL/UL BWP: CATT, Qualcomm, Intel   + Objected because separate initial UL BWP/separate RACH resources can be used in this case: NEC * Proper scheduling for Msg 4 and its HARQ-ACK feedback: Nokia/NSB, China Telecom, Ericsson, ZTE/Sanechips¸ * When coverage is not an issue: Nordic   Given the situation, it may not be possible to identify the scenarios where early indication of RedCap UEs in Msg3 is applicable. Therefore, following conclusion is proposed. The intention is that no more discussion is expected in RAN1 in Rel-17 but RAN2 can decide whether to support early indication of RedCap UEs in Msg3.  **Proposed conclusion 3-2:**   * No consensus in RAN1 to support early indication of RedCap UEs in Msg3 in Rel-17 | |
| FL2 | Following agreement was achieved in the GTW session on 18th August:  ---  **Agreement:**  Confirm the following working assumption with the modifications in red:   * For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.   + The early indication in Msg1 can be configured to be enabled/disabled via SIB     - ~~FFS how to support enable/disable the early indication~~   + ~~FFS details e.g.:~~ From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP (if supported)     - separate PRACH resource     - PRACH preamble partitioning     - ~~FFS: whether/how to address RA-RNTI overlapping issue~~   + ~~FFS the possibility of supporting Msg3 for the early indication~~   Whether/how to support early indication of RedCap UEs in Msg3 in Rel-17 is up to RAN2  ---  Remaining discussion point for Msg3 early indication is whether to send an LS to RAN2 to inform potential RAN1 observations for the scenarios where the early indication of RedCap UEs in Msg3 is applicable, which was proposed by some companies in the GTW session. Based on companies input to **Question 3-2**, companies are invited to provide their views on the following new question:  **High priority Question 3-2a:**   * Q1: Should RAN1 send an LS to RAN2 to inform RAN1 observations for the scenarios where the early indication of RedCap UEs in Msg3 is applicable? * Q2: If yes, which of the following scenarios should be included in the LS?   + S1: When PRACH capacity is concerned due to the indication of UE with multiple UE features through PRACH   + S2: When proper scheduling for Msg 4 and its HARQ-ACK feedback are necessary   + S3: When coverage is not an issue   + S4: Any others   Note that Pros and cons for early indication of RedCap UEs in Msg3 was discussed in SI phase, as captured in Table 11.1.1-2 in TR38.875. | |
| Example | Q1: Y/N  Q2: S1/S2/S3/S4 | If S4 is included, please provide details |
| vivo | N | These questions should not be discussed now. It was explicitly clarified already by the Chair that MSG3 based early identification will not be treated in RAN1 until further progress in RAN2. |
| Nokia, NSB | N | Assuming **Medium Priority Proposal 7-1:** is agreed and the agreement for 4-step RACH is included in the LS sent to RAN2. Since that agreement states:  *Whether/how to support early indication of RedCap UEs in Msg3 in Rel-17 is up to RAN2*  We feel that the above statement is sufficient to:  (1) Indicate to RAN2, the lack of consensus in RAN1 for msg3 support.  (2) Encourage RAN2 to respond if they have further justification for msg3 support. |
| Nordic |  | No strong view, but of course people can share todays agreement with RAN2 colleagues |
| Ericsson | Q1: Y  Q2: S1/S2/S3 | S3 could be updated to say “When Msg2 coverage is not an issue”. |
| FUTUREWEI2 |  | No further discussion in RAN1 is needed now |
| Qualcomm | N | Agree with the comments of Nokia.  There is no consensus in RAN1 regarding the benefits of msg3-based early indication.  There is no consensus in RAN1 to support msg3-based early indication in both SI and WI phases. |
| Sierra Wireless | N | Although several scenarios were identified in RAN1 where early indication in Msg3 is beneficial, these are also defined within the TR38.875 which RAN2 can review thus no LS is needed. |
| Intel | N | Share the views from vivo and Nokia. Plus, most details were already covered in the RedCap TR and RAN2 is well-aware of these. |
| Lenovo, Motorola Mobility | N |  |

Regarding 2-step RACH, a number of contributions [1, 4, 8, 13, 18, 19, 34] support early indication in MsgA. Some of them [4, 8, 13, 18, 34] suggest Msg1/Msg3 indication for 4-step RACH is reused where applicable, such as Separate 2-step RACH resources, MsgA preambles or initial UL BWP. Some contributions [8, 13] support the indication in Msg A PUSCH part while one contribution [18] does not support it because it is infeasible when MsgA PUSCH may not be transmitted by the UE under certain conditions (e.g., when the MsgA PUSCH may be cancelled). In addition, some companies [2, 7] suggest postponing the discussion until 4-step RACH discussion is completed. Given the situation and based on the agreement in the last RAN1 meeting to prioritize 4-step RACH case, moderator suggests coming back to 2-step RACH case when further progress is made for 4-step RACH case.

**[Updated]** Based on the agreement for 4-step RACH, we can try similar proposal for 2-step RACH follows:

**FL2 Medium priority Proposal 3-3:**

* For 2-step RACH, support the early indication of RedCap UEs at least in MsgA preamble part.
  + The early indication in MsgA preamble part 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 (if supported)
    - separate PRACH resource
    - PRACH preamble partitioning
* Whether/how to support early indication of RedCap UEs in MsgA PUSCH part in Rel-17 is up to RAN2

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| **Company** | **Y/N** | **Comments** |
| vivo | N | The consideration for 2-step RACH here is quite different from 4-step RACH. In 2-step RACH, what is the motivation to potentially consider early indication in both preamble part and PUSCH part from specification perspective? |
| Nokia, NSB | Y |  |
| Nordic | N | We do not think that 4-step RACH early identification is done yet.  Agreement:   * Support 2-step RACH for RedCap UEs as an optional feature   + FFS details of early indication in MsgA, e.g.:     - Separation of 2-step RACH resources or MsgA preambles     - Separation of initial UL BWP     - Using a new indication in MsgA PUSCH part   + Note: Discussion on 4-step RACH for early indication should be prioritized |
| Ericsson | N | In our understanding, the only reason to have indication in the preamble part (instead of the PUSCH part) of MsgA is to enable coverage recovery of MsgB PDSCH, when MsgA preamble is detected but MsgA PUSCH is not decoded correctly (i.e., fallback RAR). However, coverage evaluations for this scenario were not carried out during the RedCap SI phase. Nevertheless, coverage recovery may be needed if MsgB (fallback RAR) and Msg2 have similar payload size. Therefore, we can come back to this proposal after coverage recovery needs for MsgB is understood.  We also wonder if it is not unnecessary complexity and optimization to support this corner case. It might be easier to let the UE fallback to 4-step RA if this becomes a problem. The only thing that would be achieved by early indication in MsgA preamble part is that if Msg PUSCH part is not received by gNB, it could see that the UE is RedCap, conclude that the MsgA PUSCH-part coverage might not be good enough where the UE is located, and accordingly send a fallback RAR in MsgB. However, if gNB does nothing, the UE would reach max attempts and fallback to 4-step anyway eventually. |
| FUTUREWEI2 | N | 4-step RACH should be completed first |
| Qualcomm |  | Early indication of RedCap UE type based on msg1 of 4-step RACH should be prioritized.  If 2-step RACH based early indication is supported, msgA preamble is preferred since the link budget of msgA PUSCH is much worse and the reliability of reporting is questionable. |
| Sierra Wireless | N | Adding the indication within the PUSCH of MsgA would be preferred as this doesn’t require additional PRACH partitioning. |
| Intel | Almost Y | We can agree to the first part of the proposal on using MsgA Preamble, but not the last part. In our view, indication in MsgA preamble part is aligned with that for 4-step and is the method that works.  In addition to duplicated functionality, in our understanding, the indication in MsgA PUSCH does not work whenever the PUSCH may be dropped (from TS 38.213: “*A UE can transmit a PRACH preamble in a valid PRACH occasion if the PRACH preamble is not mapped to a valid PUSCH occasion.*”) or just not received correctly at the gNB and the RA procedure falls back to 4-step (for that same RACH attempt). Thus, there is a lack of robustness for the option of using MsgA PUSCH for indication of RedCap UE.  In case gNB receives only the MsgA preamble (UE transmits only the MsgA preamble or transmitted MsgA PUSCH is not received correctly), the gNB would not know that this UE is RedCap, and may schedule a Msg2 (as it falls back to 4-step) with an UL grant in RAR that is not feasible for a RedCap UE. This results in a failed RA attempt and associated resource wastage in the UL and DL. Thus, the impact may not be negligible and possibly worse compared to if the gNB “does nothing” as suggested by Ericsson, due to improper fallback to 4-step RACH.  This aspect can be observed from RAN1 perspective, and thus, RAN1 should not be neutral and leave it entirely to RAN2 on this issue. |
| Lenovo, Motorola Mobility | Y |  |

# System information indication

The WID [35] has the following objective on system information indication:

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| * Specify a system information indication to indicate whether a RedCap UE can camp on the cell/frequency or not; it shall be possible for the indication to be specific to the number of Rx branches of the UE. [RAN2, RAN1] |

A few contributions [2, 8, 12] suggest that this topic is not considered further in RAN1 or RAN1 should wait for RAN2’s further progress. As discussed in the last RAN1 meeting, a number of contributions [1, 6, 12 (can be studied), 16, 17, 23] support the access control specific to RedCap UEs with 1Rx or 2Rx via DCI associated with SIB1 based on the following RAN2 agreement, which would obtain power saving benefits by skipping SIB1 reading, while a few contributions [2, 18] do not support it because it would not lead to substantial power saving benefits but would require separate treatment from all other features for RedCap and may incur large specification impact in RAN2.

Agreements:

1. SIB1 (not MIB) indicates cell barring for 1 Rx branch and 2 Rx branches separately for RedCap Ues. Further details of the solution are FFS

Given the situation, moderator suggests trying to make conclusion on the following proposal which was discussed in the last RAN1 meeting.

**FL2 Medium Priority Proposal 4-1:**

* For system information indication of access control for RedCap Ues,
  + FFS: Whether it is needed to have the indication in DCI scheduling SIB1

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| **Company** | **Y/N** | **Comments** |
| Huawei, HiSilicon | Y | Given RAN2 discussion/progress, RAN1 input seems necessary for this issue. |
| OPPO | Y | For DCI based indication of access control for RedCap Ues, RAN1 can discuss and make some decision on it. |
| CATT | N | As RAN2 is the leading group in cell access/barring, we think RAN1 should wait for RAN2’s progress until the design/signaling is clear. If RAN2 needs RAN1s assistance, it can trigger LS to RAN1. |
| CMCC | Y |  |
| Nokia, NSB | Y | We support the intention, however in our opinion the following wording is clearer    Access control information for RedCap Ues is supported using System Information.  FFS    Whether the DCI scheduling SIB1 is used to support RedCap Access information. |
| Lenovo, Motorola Mobility | N | Up to RAN2 decision. |
| NEC | N | We share the view of CATT and Lenovo/Motorola Mobility. |
| FUTUREWEI | N | Up to RAN2 |
| LG | Y | The indication in DCI scheduling SIB1 seems beneficial for UE power saving. |
| Xiaomi | Y | SIB DCI-based indication is enefi RAN1 scope. At least RAN1 could discuss the feasibility of this option. In our view, SIB1 DCI based indication is eneficial for UE power saving |
| China Telecom | N | We have the same view with CATT. |
| Samsung |  | Discuss in RAN2. |
| Ericsson | N | Access barring is a RAN2 issue. RAN1 does not need to discuss this further.  In our understanding, having the barring indication in the DCI scheduling SIB1 (instead of SIB1) would only have very limited power saving benefits. Moreover, RedCap should reuse functionalities as much as possible with non-RedCap and should not introduce separate behaviours for RedCap/non-RedCap when it is not strictly required.  By keeping the FFS, RAN1 is simply delaying the progress in RAN2.  Therefore, we propose the following conclusion:  **Conclusion: There is no consensus in RAN1 to have the access barring indication in DCI scheduling SIB1.** |
| ZTE, Sanechips | Y | We share the similar view with Xiaomi. |
| Intel | N | Share the same view as expressed by Ericsson. |
| Apple |  | Leave to RAN2. After the FFS aspects are addressed in RAN2, we can further discucss the need of DCI-based, if necessary. |
| Vivo | N | Agree with Ericsson on the proposed conclusion. |
| Nordic | N | Barring design is in RAN2 competence |
| Qualcomm |  | Access control belongs to the scope of RAN2’s work |
| Sierra Wireless | N | Agree with Ericsson |
| Lenovo, Motorola Mobility | N | And this should be up to RAN2 design. |

A number of contributions discuss what kind of system information indication is necessary, which would be discussed in RAN2. One contribution [1] suggests the indication whether NW supports RedCap Ues accessing or not is necessary, and different cell selection/reselection time for 1Rx or 2Rx can be configured by gNB. Some other contributions [16, 17] propose the access control specific to RedCap Ues with 1Rx or 2Rx. Another contribution [31] suggests that gNB can deprioritize RedCap Ues e.g. with 1-Rx capability by configuring lower RACH opportunity.

# Necessary updates of UE capabilities and RRC parameters

The WID [35] has the following objective on the necessary updates of UE capabilities and RRC parameters:

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| * Specify necessary updates of UE capabilities (38.306) and RRC parameters (38.331). [RAN2] |

One contribution [6] suggests RAN1 starts the email discussion on the UE features for RedCap Ues after RAN1#106e-meeting considering that only a few meetings are left before the end of Rle-17 and we do not have enough Tus to discuss the massive features. It is moderator’s understanding that Rel-17 UE feature discussion will start from RAN1#106bis-e meeting while the applicability of existing UE features to RedCap Ues can be discussed even before that, as we have done for some parts of them, such as basic BWP operation FG6-1, compact DCI, MCS/CQI tables, 2-step RACH, etc.

As discussed in the last RAN1 meeting, some contributions [11, 22] suggest agreeing on the following proposal, while some others [18, 29, 30] suggest further discussion on what features are applicable to RedCap Ues is necessary term by term. Another contribution [28] suggests all UE capabilities other than those related to carrier aggregation, dual connectivity and wider bandwidths can be supported by RedCap UE either as mandatory or as optional unless precluded by a specific RedCap feature. Some contributions [27, 29] also suggest RedCap Ues do not support the capabilities related to the carrier aggregation, dual connectivity, and wider bandwidths.

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| **Medium Priority Proposal 5-1:**   * For the necessary updates of UE capabilities, current definition of mandatory/optional support of L1 UE capabilities in TS38.306 is reused for RedCap Ues by default unless any update is identified   + Note: UE capabilities related to CA, DC and wider max UE bandwidth are not applicable to RedCap Ues |

In addition, some contributions [27, 28, 29] suggest at least for the features that are mandatory without capability signalling for non-RedCap Ues, the RedCap Ues should support mandatorily with the same value. Following features are also discussed:

* maxNumberMIMO-LayersPDSCH: Optional [27, 28]
* pdsch-256QAM-FR1: Optional [27, 28]
* csi-RS-RLM, additionalActiveTCI-StatePDCCH/additionalActiveSpatialRelationPUCCH: Optional [27]
* oneFL-DMRS-TwoAdditionalDMRS-UL, spatialBundlingHARQ-ACK: Not necessary [27]
* Capabilities related to power saving: FFS whether RedCap Ues mandatorily support [27]
* Capabilities related to the processing timeline: Use the same value as the one for non-RedCap Ues [27]
* Capabilities related to the SUL: Not necessary [28], further discuss whether there are any additional issues in order to optionally support SUL for RedCap, e.g. switching time to be discussed in RAN4 [32]
* Rel-16 UE capabilities: FFS [28]
* FG 6-1a (BWP operation without restriction on BW of BWP(s)): mandatory [28]

Given the situation, we can try to agree on the following proposal modifying Proposal 5-1 in the last RAN1 meeting:

**FL2 Medium Priority Proposal 5-1:**

* For the necessary updates of UE capabilities, current definition of L1 UE capabilities mandatory without capability signaling in TS38.306 is reused for RedCap Ues by default unless any update is identified
  + Note: UE capabilities related to CA, DC and wider max UE bandwidth are not applicable to RedCap Ues
  + FFS: applicability of L1 UE capabilities mandatory/optional with capability signaling to RedCap Ues

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| **Company** | **Y/N** | **Comments** |
| CATT | Y in principle | It may be important to avoid duplicated work with RAN2.  For information, RAN2 have the following agreements in the last meeting:   |  | | --- | | Agreements online:  1. RAN2 Working Assumption: by default, all non-RedCap UE capabilities are applicable for RedCap UE, and therefore only for non-RedCap capabilities that are not appliable for RedCap UE, we clarify in the definitions for parameters in TS38.306, the value or feature is not applicable for RedCap UE  2. We will have an email discussion until the next meeting to discuss which higher layer capabilities are not applicable for RedCap Ues (it could result in a draft 38.306 CR) and how to reflect the handling of RedCap specific capabilities (e.g. Maximum BW, Max Rx, MIMO-Layer, 256QAM, CA/DC, HD-FDD, etc) | |
| Nokia, NSB | Y |  |
| FUTUREWEI |  | We support the better approach following what RAN2 is doing, which provides a default to avoid checking hundreds of capabilities one by one |
| LG | Y | We could also add:  ‘FFS: any update is needed in the current definition of L1 UE capabilities mandatory without capability signaling in TS38.306’. |
| SPRD | Y | We suggest to discuss this topic in RAN2, as mentioned by CATT. RAN1 can focus on L1 UE capabilities that need updates and leave the signaling issues to RAN2. |
| Ericsson |  | We have similar views as CATT, FUTUREWEI, and SPRD. |
| ZTE, Sanechips | Y | We are fine with the proposal. For the mandatory feature with capability signaling and optional features, they should be discussed cases by case. |
| Intel | Y | While it would be important to avoid duplicated work across WGs, in our understanding, the L1 capabilities need to be decided by RAN1. RAN2 is only looking at the higher layer capabilities as well as some of the capabilities related to RedCap UE complexity reduction as identified in the WID.  However, RAN1 can take a similar approach as RAN2 as suggested by the proposal. |
| vivo |  | As mentioned by CATT and others, RAN2 already has the plan to discuss the issue, we could wait a bit to avoid duplicated discussion. |
| Nordic | N | 1. RAN1 should be competent to decide how to handle own designed capabilities 2. We prefer that all the capabilities are applicable unless consensus to change.   For the necessary updates of UE capabilities, current definition of L1 UE capabilities ~~mandatory without capability signaling~~ in TS38.306 is reused for RedCap Ues by default unless any update is identified   * 1. Note: UE capabilities related to CA, DC and wider max UE bandwidth are not applicable to RedCap Ues |
| Qualcomm | Y | @FL, thanks for the summary. A minor comment on our side:   * In terms of “current definition”, does it refer to NR R15/16 only ? Or, NR R17 is also included ? |
| Sierra Wireless | Y |  |
| Lenovo, Motorola Mobility | Y |  |

# Other aspects

**SI framework (other than system information indication in Section 4)**

* Study a mechanism for scheduling new SIB1 (e.g. SIB1-R) used by REDCAP Ues [17]
  + When CORESET0 is configured to be shared between RedCap Ues and non-RedCap Ues, the DCI format 1\_0 with CRC scrambled by SI-RNTI can be used to schedule both legacy SIB1 and new SIB1-R.
* gNB may provide different configurations for transmissions of other SI for REDCAP Ues and non-REDCAP Ues. (e.g. AL or separate DL BWP) [17]
  + REDCAP specific RACH resources can be configured for gNB to transmit on-demand SI message
* Reuse existing SIB1 to incorporate the new system information for RedCap [33]
  + consider the following options to improve the power efficiency during system information updating
    - Option 1: Define separate systeminfoModification field in paging DCI.
    - Option 2: Paging messages of RedCap devices and non-RedCap devices are not multiplexed in the same paging resource

**Measurement related issues by reduced number of Rx branches [13]**

* RedCap Ues specific RSRP thresholds are configured by gNB for SSB and UL carrier selection for performing random access
* Measurement related thresholds are configured specifically for RedCap Ues with reduced Rx branches number
* Send an LS to RAN2 to inform the above measurement related issues

# LS to RAN2 informing RAN1 agreements

Since an agreement in AI8.6.2 was achieved in the GTW session on 18th August, an LS to RAN2 would be beneficial to inform them RAN2-related agreements, similar to RAN1#105-e.

|  |
| --- |
| Send an LS to RAN2 informing them the above working assumption and the agreement for early indication, possibly also RAN2-related agreements – Shinya (DCM)  [**R1-2106216**](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2106216.zip)          [Draft] LS on RAN1 agreements on RAN2-led features for RedCap NTT DOCOMO  Which is approved, with final LS in [R1-2106329](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2106329.zip). |

**FL2 Medium Priority Proposal 7-1:**

* Send an LS to RAN2 informing RAN2-related agreements in AI8.6.2 in RAN1#106-e
  + FFS details

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| vivo |  | Generally fine with sending LS to RAN2, but prefer to determine the content of the LS in the next week. Ideally we can have an LS to RAN2 to include all the agreements with potential higher layer impact from different sub-agenda items. |
| Nokia, NSB | Y |  |
| Nordic |  | If LS should be send on Friday next week, then no need, RAN2 can read RAN1 agreements before next meeting. |
| Ericsson | Y | The LS can be sent towards the end of the meeting. |
| FUTUREWEI2 | Y | The LS can be sent at end of meeting |
| Qualcomm | Y | To improve the efficiency of team work, RAN1 agreements/conclusions for RAN2-led discussions can be sent to RAN2 when available. |
| Sierra Wireless |  | LS’s which only include copied RAN1 agreements are not needed. |

# Conclusions

[To be updated]

Following agreement was made in [106-e-NR-R17-RedCap-05]:

**Agreement:**

Confirm the following working assumption with the modifications in red:

* For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.
  + The early indication in Msg1 can be configured to be enabled/disabled via SIB
    - ~~FFS how to support enable/disable the early indication~~
  + ~~FFS details e.g.:~~ From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP (if supported)
    - separate PRACH resource
    - PRACH preamble partitioning
    - ~~FFS: whether/how to address RA-RNTI overlapping issue~~
  + ~~FFS the possibility of supporting Msg3 for the early indication~~

Whether/how to support early indication of RedCap UEs in Msg3 in Rel-17 is up to RAN2

# Annex: Companies’ point of contact

**FL1 Question: Please consider entering contact info below for the points of contact for this email discussion.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
| vivo | Xueming Pan | [panxueming@vivo.com](mailto:panxueming@vivo.com) |
| CATT | Yongqiang FEI | [feiyongqiang@catt.cn](mailto:feiyongqiang@catt.cn) |
| Lenovo, Motorola Mobility | Yuantao Zhang | [zhangyt18@lenovo.com](mailto:zhangyt18@lenovo.com) |
| Xiaomi | Qin MU | [muqin@xiaomi.com](mailto:muqin@xiaomi.com) |
| China Telecom | Jing Guo | [guojing6@chinatelecom.cn](mailto:guojing6@chinatelecom.cn) |
| Nordic | Karol Schober | [karol.schober@nordicsemi.no](mailto:karol.schober@nordicsemi.no) |
| Ericsson | Johan Bergman | [johan.bergman@ericsson.com](mailto:johan.bergman@ericsson.com) |
| ZTE, Sanechips | Youjun Hu | [hu.youjun1@zte.com.cn](mailto:hu.youjun1@zte.com.cn) |
| Intel | Debdeep Chatterjee | [debdeep.chatterjee@intel.com](mailto:debdeep.chatterjee@intel.com) |
| Sierra Wireless | Serkan Dost | [sdost@sierrawireless.com](mailto:sdost@sierrawireless.com) |

# References

|  |  |  |  |
| --- | --- | --- | --- |
| [1] | [R1-2106462](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106462.zip) | RAN1 aspects of RedCap UE type and identification | Huawei, HiSilicon |
| [2] | [R1-2106567](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106567.zip) | RAN1 aspects for RAN2-led features for RedCap | Ericsson |
| [3] | [R1-2106604](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106604.zip) | Higher layer support for RedCap | vivo, Guangdong Genius |
| [4] | [R1-2106651](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106651.zip) | Higher layer support of Reduced Capability NR Devices | Nokia, Nokia Shanghai Bell |
| [5] | [R1-2106707](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106707.zip) | Discussion on early indication for RedCap | Spreadtrum Communications |
| [6] | [R1-2106845](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106845.zip) | Higher layer support of Reduced Capability NR devices | ZTE, Sanechips |
| [7] | [R1-2106897](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106897.zip) | UE capability report and access barring for Redcap UE | Samsung |
| [8] | [R1-2106981](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106981.zip) | Discussion on higher layer support of RedCap | CATT |
| [9] | [R1-2107043](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107043.zip) | On RedCap UE early identification and UE type | Nordic Semiconductor ASA |
| [10] | [R1-2107077](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107077.zip) | Design consideration for Higher layer support of RedCap | Sierra Wireless, S.A. |
| [11] | [R1-2107090](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107090.zip) | Discussion on the Identification of RedCap UEs | FUTUREWEI |
| [12] | [R1-2107130](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107130.zip) | Discussion on RAN1 aspects for RAN2-led features for RedCap | China Telecom |
| [13] | [R1-2107252](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107252.zip) | Mechanism in higher&PHY layer for Reduced Capability NR Devices | OPPO |
| [14] | [R1-2107302](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107302.zip) | RAN1 aspects for RAN2-led features for RedCap | NEC |
| [15] | [R1-2107355](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107355.zip) | Cross Layer Design Considerations for RedCap Device | Qualcomm Incorporated |
| [16] | [R1-2107412](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107412.zip) | Discussion on higher layer support of RedCap UE | CMCC |
| [17] | [R1-2107451](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107451.zip) | RAN1 aspects for RAN2-led features for RedCap | LG Electronics |
| [18] | [R1-2107598](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107598.zip) | On RAN1 aspects for RAN2-led objectives for RedCap | Intel Corporation |
| [19] | [R1-2107749](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107749.zip) | On Higher Layer Support of Redcap Devices | Apple |
| [20] | [R1-2107797](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107797.zip) | RAN1 aspects for RAN2-led features for RedCap | Sharp |
| [21] | [R1-2107812](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107812.zip) | Identification and restriction of RedCap UEs | InterDigital, Inc. |
| [22] | [R1-2107867](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107867.zip) | Discussion on RAN1 aspects for RAN2-led features for RedCap | NTT DOCOMO, INC. |
| [23] | [R1-2107930](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107930.zip) | Discussion on the remaining issues of the higher layer related topics for RedCap | Xiaomi |
| [24] | [R1-2107949](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107949.zip) | RAN1 aspects for RAN2-led features for RedCap | Lenovo, Motorola Mobility |
| [25] | [R1-2108043](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2108043.zip) | RAN1 aspects for RAN2-led features for RedCap | Panasonic Corporation |
| [26] | [R1-2108156](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2108156.zip) | Discussion on higher layer support of Redcap UE | WILUS Inc. |
| [27] | [R1-2106605](https://protect2.fireeye.com/v1/url?k=6f8c74e0-30174da3-6f8c347b-861fcb972bfc-e608a3999416fac6&q=1&e=45c00ecc-430b-456b-9498-17dadc753162&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2FTSG_RAN%2FWG1_RL1%2FTSGR1_106-e%2FDocs%2FR1-2106605.zip) | Discussion on L1 reduced capability signaling | vivo, Guangdong Genius |
| [28] | [R1-2106653](https://protect2.fireeye.com/v1/url?k=32c45c03-6d5f6540-32c41c98-861fcb972bfc-d82192a16287b291&q=1&e=45c00ecc-430b-456b-9498-17dadc753162&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2FTSG_RAN%2FWG1_RL1%2FTSGR1_106-e%2FDocs%2FR1-2106653.zip) | Discussion on RedCap UE capabilities | Nokia, Nokia Shanghai Bell |
| [29] | [R1-2106846](https://protect2.fireeye.com/v1/url?k=20ee1762-7f752e21-20ee57f9-861fcb972bfc-c1922847367b54c1&q=1&e=45c00ecc-430b-456b-9498-17dadc753162&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2FTSG_RAN%2FWG1_RL1%2FTSGR1_106-e%2FDocs%2FR1-2106846.zip) | NR UE features for RedCap | ZTE, Sanechips |
| [30] | [R1-2106982](https://protect2.fireeye.com/v1/url?k=8ae28b0e-d579b24d-8ae2cb95-861fcb972bfc-a54702c74ef70ee4&q=1&e=45c00ecc-430b-456b-9498-17dadc753162&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2FTSG_RAN%2FWG1_RL1%2FTSGR1_106-e%2FDocs%2FR1-2106982.zip) | Views on remaining issues of RedCap | CATT |
| [31] | [R1-2107452](https://protect2.fireeye.com/v1/url?k=89ca4ab9-d65173fa-89ca0a22-861fcb972bfc-0d20c9a11c50a38e&q=1&e=45c00ecc-430b-456b-9498-17dadc753162&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2FTSG_RAN%2FWG1_RL1%2FTSGR1_106-e%2FDocs%2FR1-2107452.zip) | Discussion on other aspects of RedCap | LG Electronics |
| [32] | [R1-2107669](https://protect2.fireeye.com/v1/url?k=959995f7-ca02acb4-9599d56c-861fcb972bfc-c57918a63fd26901&q=1&e=45c00ecc-430b-456b-9498-17dadc753162&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2FTSG_RAN%2FWG1_RL1%2FTSGR1_106-e%2FDocs%2FR1-2107669.zip) | On RedCap UL transmission | Huawei, HiSilicon |
| [33] | [R1-2107931](https://protect2.fireeye.com/v1/url?k=9bdfed9a-c444d4d9-9bdfad01-861fcb972bfc-d62b0c6dcf228ef4&q=1&e=45c00ecc-430b-456b-9498-17dadc753162&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2FTSG_RAN%2FWG1_RL1%2FTSGR1_106-e%2FDocs%2FR1-2107931.zip) | Discussion on the transmission of system information for RedCap | Xiaomi |
| [34] | [R1-2108050](https://protect2.fireeye.com/v1/url?k=02a7a31d-5d3c9a5e-02a7e386-861fcb972bfc-01b7019e4b53c29d&q=1&e=45c00ecc-430b-456b-9498-17dadc753162&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2FTSG_RAN%2FWG1_RL1%2FTSGR1_106-e%2FDocs%2FR1-2108050.zip) | Considerations on 2-step RACH for RedCap | Lenovo, Motorola Mobility |
| [35] | RP-211574 | Revised WID on support of reduced capability NR devices | Ericsson |