3GPP TSG-RAN WG2 Meeting#111-e Draft\_R2-2008192

Online, 17th - 28th August 2020

Agenda Item: 8.12.2.2

Source: Huawei

Title: [Draft] Summary of offline 110 - Identification and access restriction

Document for: Discussion and Decision

# Introduction

This document is for the following offline discussion on identification and access restriction for REDCAP UEs:

* [AT111e][110][REDCAP] Identification and access restriction (Huawei)

Scope: Discuss the proposals in [R2-2007345](file:///C:\Data\3GPP\RAN2\Docs\R2-2007345.zip), [R2-2006661](file:///C:\Data\3GPP\RAN2\Docs\R2-2006661.zip), [R2-2006786](file:///C:\Data\3GPP\RAN2\Docs\R2-2006786.zip) and [R2-2007493](file:///C:\Data\3GPP\RAN2\Docs\R2-2007493.zip). The intention is to identify design alternatives, collect company views and, whenever possible, also narrow down the proposals.

Initial intended outcome: summary of the offline discussion with e.g.:

* + - List of agreeable proposals (if any)
    - List of proposals that require online discussions

Initial deadline (for companies' feedback): Monday 2020-08-24 22:00 UTC

Initial deadline (for rapporteur's summary in R2-2008192): Tuesday 2020-08-25 02:00 UTC

The following contributions are summarised in this document:

[R2-2006661](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2006661.zip) Coexistence between legacy UEs and RedCap UEs Samsung

[R2-2006786](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2006786.zip) Discussion on RedCap UE’s identification and access control OPPO

[R2-2007345](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007345.zip) Identification and access restriction of REDCAP UE Huawei, HiSilicon

[R2-2007493](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007493.zip) On UE identification and access restrictions MediaTek Inc.

# Discussion

According to the proposals in above contributions, the following issues are summarised:

* Camping criteria for REDCAP UE
* When/How to identify REDCAP UE
* UAC for REDCAP UE
* How to ensure REDCAP UEs for intended use cases

## Camping criteria

Regarding whether the REDCAP UE is allowed to camp on a cell, corresponding proposals in above contributions are listed as follows:

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| **Tdoc number** | **Company name** | **Proposals** |
| R2-2006661 | Samsung | Proposal 1: RAN2 to confirm that a gNB that supports RedCap UEs also supports legacy UEs simultaneously.  Proposal 2: The legacy MIB signalling is re-used to accommodate legacy UEs.  Proposal 3: The legacy UE determines whether it can access the cell based on the legacy values of controlResourceSetZero.  Proposal 4: If a RedCap UE does not support the bandwidth from the controlResourceSetZero of a cell, it considers the cell as barred.  Proposal 5: The field intraFreqReselection is reused to determine whether a RedCap UE performs cell selection/reselection to intra-frequency cells if the cell is barred. |
| R2-2006786 | OPPO | Proposal 1 A separate cellBarred indication can be added in MIB/SIB1 for RedCap UEs, to differentiate from cellBarred indication for normal UEs. |
| R2-2007345 | Huawei, HiSilicon | Proposal 1: Allow a REDCAP UE to camp on a cell with larger initial DL/UL BWP than supported by REDCAP UE to avoid negative impact on legacy UEs.  Proposal 4: Consider to indicate whether REDCAP UEs are allowed to camp on in MIB/SIB1 to avoid REDCAP UE camping in a legacy network and allow network to bar all REDCAP UE. |
| R2-2007493 | MediaTek Inc. | Proposal 1: A RedCap UE only camps on a cell that indicates support of RedCap operation  Proposal 2: Support of RedCap operation in a cell is broadcasted by the network  Proposal 3: RAN2 to discuss further if RedCap support is indicated per cell or per frequency by the network. |

Above proposals are summarised as 3 camping criterions and the use of *intraFreqReselection* if the UE cannot camp on.

**Criterion 1: The bandwidth of CORESET#0**

This criterion corresponds to proposals 1 to 4 in R2-2006661.

According to the following RAN1 agreements, for FR2, it is possible that the maximum bandwidth of REDCAP UE is smaller than the bandwidth of CORESET#0 indicated by MIB.

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| * For FR1, study at least 20MHz maximum UE bandwidth at least for initial access   + Other bandwidths FFS * For FR2, study 50MHz and 100 MHz maximum UE bandwidth at least for initial access   + Other bandwidths FFS |

In this case, the UE should consider the cell as barred and do not camp on the cell.

**Question 1.** If the maximum bandwidth of REDCAP UE is smaller than the bandwidth of CORESET#0 indicated by MIB, do you agree that the UE should consider the cell as barred and do not camp on the cell?

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| ***Company name*** | ***Yes/No*** | ***Comments*** |
| Qualcomm | Yes | That’s how it works in legacy |
| Xiaomi | - | Even though the bandwidth of REDCAP UE can cover all the configurations of CORESET for Type0-PDCCH, it is hard to say the cell is barred or not for Redcap. It only means the Redcap UE can read CORESET#0 as the legacy UE. Whether the cell is barred or not depends on how the gNB gives UE the indication.  The question is related to Q2 and Q3. We prefer to wait for RAN1’s input. |
| Nokia | Yes |  |
| OPPO | - | RAN1 is still discussing whether RedCap UEs can read SIB1 even if its bandwidth is smaller then the CORESET#0 bandwidth. We prefer to wait for RAN1’s agreement on this. |
| Futurewei | - | We can wait for more RAN1 progress on RedCap handling of CORESET#0. |
| Ericsson | FFS (RAN1) | For FR1, there should be no issue but further discussion is being done in RAN1 for FR2. Even if the supported BW is lower compared to CORESET#0, it could be possible for UE to monitor and acquire the necessary information but possibly with some performance penalty. In any case, this should be discussed in more detail in RAN1 and RAN2 should wait for RAN1 conclusion. |
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**Criterion: REDCAP UEs are allowed to access the cell**

This criterion corresponds to proposal 1 in R2-2006786, proposal 4 in R2-2007345 and proposals 1, 2 in R2-2007493.

The existing NR cell works based on the assumptions that the 100M minimum bandwidth and (2 or 4) RX antennas are mandatory for the UE. For REDCAP UEs, above requirements for legacy NR devices will be relaxed. Thus, on one hand, a REDCAP UE should not camp on a legacy NR cell which does not support REDCAP operation. On another hand, it should be possible for the network to bar the access of REDCAP UE.

Based on above, an indication is needed in system information to indicate whether a REDCAP UE is allowed to camp on the cell.

**Question 2.** Do you agree that an indication is needed in system information to indicate whether a REDCAP UE is allowed to camp on the cell?

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| ***Company name*** | ***Yes/No?*** | ***Comments*** |
| Qualcomm | Yes | gNB may want to dynamically control whether RedCap UEs can access it or not, e.g. base on its loading etc. So we think such an indication in system information is necessary. |
| Xiaomi | - | We agree that not all the network implement the Redcap functions. Therefore, it suggests the gNB can indicates the reduced capability NR devices that it is allowed to access or not.  However, the gNB can give UE the indication explicitly or implicitly. A possible way is putting an indication SI, e.g., MIB or RSMI to indicate whether Redcap UEs should be allowed to camp on the cell. Another implicit way is by the presence of Redcap specific configuration e.g. Initial DL BWP configured by RMSI exceeding Redcap bandwidth means to bar the Redcap UE.  We need some RAN1’s inputs. |
| Nokia | Yes | Network may want to restrict the access of RedCap UEs and this would be efficient way. |
| OPPO | Yes | This indication is new and separate from the existing cellBarred indication. |
| Futurewei | Yes | The exact format, explicit or implicit, can be decided after more details on RedCap design (for various use cases) become available. |
| Ericsson | Yes | Agree with Futurewei. Details can be decided in normative phase. |
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The following options for the indication is mentioned in the contributions:

* MIB
* SIB1

Thus, if the answer to Question 2 is Yes, please indicate which option do you prefer to introduce the indication:

**Question 2a.** If the answer to Question 2 is Yes, which system information should be used to indicate whether a REDCAP UE is allowed to camp on? MIB/SIB1/other?

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| ***Company name*** | MIB/SIB1/other? | ***Comments*** |
| Qualcomm | SIB1 | SIB1 is where access barring/control information is signalled and hence the right place for indicating whether access by RedCap UE is allowed or not. |
| Nokia | MIB or SIB1 | Both MIB and SIB1 can be considered. It would be more efficient to use MIB, because then the UE would not be required to decode SIB1 for this purpose. It needs to be discussed whether there is space available in MIB for this purpose. |
| OPPO | MIB or SIB1 | Both can be considered although MIB has only one spare bit left. |
| Futurewei | SIB1 | It doesn’t look necessary to use the only spar bit in MIB for RedCap UE, as its performance requirement would be less stringent. |
| Ericsson | SIB1 | At the moment, SIB1 seems viable as the space in MIB is limited and should be used only after throughout consideration.  We are open to discuss and study the alternatives and down select when we understand the pros and cons of each solution.  Note that in corresponding RAN1 discussion, other alternatives are also being discussed. |
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**Criterion 3: The bandwidth of initial UL/DL BWP configured by SIB1**

This Criterion corresponds to proposal 1 in R2-2007345.

Initial UL/DL BWP can be configured by SIB1, which may have larger bandwidth compared with the maximum bandwidth supported by REDCAP UEs. Whether a REDCAP UE can camp on the cell in this case needs to be discussed.

If a REDCAP UE is not allowed to camp on the cell with larger initial UL/DL BWP than supported by the UE, there will be restriction on the network configuration to support REDCAP UE, i.e. in case REDCAP UEs are supported in the cell, the network needs to guarantee that the configured initial UL/DL BWP is smaller or equal to the bandwidth supported by REDCAP UEs.

If a REDCAP UE is allowed to camp on in this case, the REDCAP UE needs to be identified at early stage as the gNB needs to schedule Msg3/Msg5 transmission properly.

**Question 3.** Do you agree with above analysis and whether a REDCAP UE should be allowed to camp on a cell with larger initial DL/UL BWP than supported by the UE?

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| ***Company name*** | ***Yes/No*** | ***Comments*** |
| Qualcomm | Yes/no | As long as a RedCap UE can support the coreset #0 in the initial DL BWP, it should be allowed to camp on it. Network implementation can ensure all PDSCH during paging or initial access is transmitted within the same frequency locations.  But we are not sure how UL may work out if a cell has wider initial UL BWP than the one supported by UE. |
| Xiaomi | - | See above. We need some RAN1’s inputs. |
| Nokia | Yes |  |
| OPPO | Yes | We think with early RedCap UE’s identification, NW can schedule UE within the CORESET#0’s bandwidth.  For UL, network can configure a separate PRACH resource for RedCap UEs to use. |
| Futurewei | Yes | We assume it is not a good practice to reduce initial DL/UL BWP just for the coexistent REDCAP UE, as it’d degrade the performance of normal UE. |
| Ericsson | Yes/FFS | In general, we should avoid any performance losses to the system when introducing Redcap.  Again, details are being discussed in RAN1, but in case the BWP would be larger than supported BW, there could be possibility for Redcap UE e.g. to retune within BWP so that no restrictions would be imposed on scheduling of existing NR UEs. This is not a RAN2 topic though, therefore we should wait before agreement. |
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**The use of *intraFreqReselection***

The use of *intraFreqReselection* is discussed by proposal 5 in R2-2006661 and proposal 4 in R2-2007493.

In NR, if the UE considers the cell is barred and cannot camp on the cell, the field *intraFreqReselection* in MIB can be used to indicate whether frequency is barred.

For a REDCAP UE, in case the UE considers the cell is barred and cannot camp on the cell due to any of above criteria, whether the current *intraFreqReselection* applies to REDCAP UE needs to be discussed.

**Question 4.** In case a REDCAP UE considers the cell is barred and cannot camp on:

* Option 1. The UE checks legacy *intraFreqReselection* to determine whether the frequency is barred
* Option 2. A separate flag in system information is introduced for REDCAP UE to determine whether the frequency is barred for REDCAP UEs

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| ***Company name*** | ***Option?*** | ***Comments*** |
| Qualcomm | Option 1 | We do not see strong use case that would require the use of a separate flag in system information for the same purpose but just for RedCap UE. |
| Xiaomi | Option 1 | The legacy flag is enough. |
| Nokia | Option 1 |  |
| OPPO | Option 2 | We think *intraFreqReselection* works with *cellBarred* in a paired manner. If a separate *cellBarred* is introduced for RedCap UEs, then we prefer also a separate *intraFreqReselction* flag for RedCap UEs. This allows for more flexibility in the network. |
| Futurewei | Option 1 | It is not clear that enhancement on this is warranted, as there should be less stringent performance on Redcap UE. |
| Ericsson | Option 1 | We haven't identified use case for Opt 2 yet |
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## When/How to identify REDCAP UE

Proposals in above contributions related to when and how to identify REDCAP UE are listed as following:

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| **Tdoc number** | **Company name** | **Proposals** |
| R2-2006786 | OPPO | Proposal 4 RAN2 wait for RAN1’s input before considering the need of early RedCap UE’s identification, e.g. in Msg1 or Msg3. |
| R2-2007345 | Huawei, HiSilicon | Proposal 2: REDCAP UE could be identified by Msg1/Msg A or by different initial UL BWP. |
| R2-2007493 | MediaTek Inc. | Proposal 6: A RedCap UE that is registered to a network is identified by the network at msg5.  Proposal 7: The UE can indicate that it is a RedCap UE as part of msg5. |

In above proposals, the following options were mentioned:

* Option 1: Separate initial UL/DL BWP for REDCAP UE
* Option 2: Msg1/A
* Option 3: Msg3
* Option 4: Msg5

Whether a REDCAP UE needs to be identified by the gNB at early stage depends on:

* Whether the UE is allowed to camp on a cell with larger initial UL/DL BWP than supported by the UE, see Question 3.
* Whether special handling is needed for scheduling of REDCAP UE during RACH procedure, e.g., scheduling of RAR or Msg4.

**Question 5.** Which option do you prefer for the gNB to identify RECCAP UE?

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| ***Company name*** | ***Option?*** | ***Comments*** |
| Qualcomm | Option 2 | RedCap UE has reduced coverage due to its reduced capabilities. Among the four messages in a RACH procedure, PUSCH Tx in msg3 hence is the bottleneck and repetition is very likely to be introduced for it to help recover the reduced coverage. But for network to decide whether to schedule repetition for msg3 for a UE, it has to be able to identify RedCap UE since msg1/A. |
| Xiaomi | - | Whether a REDCAP UE needs to be identified by the gNB at early stage depends on RAN1’s input.  And how to achieve this early identification still depends on RAN1’s input. |
| Nokia | Option 2/3 | The options are not necessarily exclusive, even in case the REDCAP UE had separate initial UL/DL BWP, likely the Option 2 and/or 3 is still required. |
| OPPO | - | We should wait for RAN1’s input on the need of early identification of RedCap UEs.  One note: option 1 can be categorized into option 2, since it is anyway Msg1/A, instead of the BWP, to be transmitted and identified by the network. |
| Futurewei | - | From RAN2 perspective, Option 2 seems more suitable. But the decision needs RAN1 input. |
| Ericsson | Option 3 / Msg A / based on capabilities | Should option 3 be Msg3/MsgA instead?  Among the listed options, we'd prefer option 3 if there is no compelling technical reason to adopt an even earlier indication – this depends on further RAN1 input. In short – if possible we would like to avoid Msg1 indication as that would require either fragmenting preamble space or defining new RACH resources or other similar solution.  However, after Msg3/MsgA it is also possible for gNB to receive the UE capabilities stored in CN, and determine whether the UE is a Redcap UE or not. This should be included as one of the options and studied – however details further depend on the UE type and capability discussion. |
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## UAC for REDCAP UE

In order to achieve load balancing, UAC mechanism for REDCAP UEs is proposed in above contributions as follows:

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| **Tdoc number** | **Company name** | **Proposals** |
| R2-2006786 | OPPO | Proposal 2 Existing UAC framework can be reused for RedCap UEs.  Proposal 3 After concluding on the number of RedCap UE types, RAN2 ask CT1 to define access identity(ies) for RedCap UEs. |
| R2-2007345 | Huawei, HiSilicon | Proposal 5: Study whether to enhance UAC mechanism for REDCAP UEs. |
| R2-2007493 | MediaTek Inc. | Proposal 4: The UAC mechanism is re-used to control the access of RedCap devices to the network.  Proposal 5: Send an LS to SA1 to determine if changes are needed to the UAC mechanism to support RedCap access control. |

The following enhancements are mentioned in above proposals

* Option 1: Introduce a set of additional UAC configuration including UAC parameters of all access categories and access identities for REDCAP UEs
* Option 2: Define new Access Identity for REDCAP UEs (need SA1 work)
* Option 3: Define new Access Categories for REDCAP UEs (need SA1 work)

**Question 5.** Do you agree to use UAC mechanism for REDCAP UEs?

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| ***Company name*** | ***Yes/No?*** | ***Comments*** |
| Qualcomm | Yes |  |
| Xiaomi | Yes | Existing UAC framework can be reused for RedCap UEs. More details need to be considered.  If the traffic models identified are different from the existing services related access categories, it is reasonable to add new access categories or reuse the reserved ones.  Regarding to new UE type, for instance, if new types of UEs can be identified for clearer UE categorization for industrial wireless sensor scenarios, additional access identities can be considered. |
| Nokia | No | SA/CT groups are not included in the study. We think that RAN based mechanism such as barring, RRC reject, MAC back off are sufficient on top of current UAC. |
| OPPO | Yes |  |
| Futurewei | Yes | It’d be better to apply a uniform approach to Redcap UE. |
| Ericsson | Yes | UAC is an extensible mechanism and should be included in the study from RAN2 perspective. If changes are eventually agreed to, we can coordinate such changes with SA/CT during the normative phase. |
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**Question 5a.** If the answer to Question 5 is Yes, do you think enhancements to the current UAC mechanism listed above are needed?

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| ***Company name*** | ***Option?*** | ***Comments*** |
| Qualcomm | Option 2 | We agree with Proposal 2 & 3 in R2-2006786. We don’t see any strong use case that would require introduction of new access categories. RedCap-specific access causes can be supported through operator defined access categories. |
| Xiaomi |  | If Redcap UEs requires coverage recovery and the additional enhancement will be carried out on the repetition transmission (depends on more RAN1’s input), it seems reasonable that the access could be configured to be more restrictive for Redcap UEs. It seems CE-level-based access class barring can be considered as in R15 narrowband. |
| OPPO | Option 1 and 2 | The existing UAC parameters are only applicable to access identities {1,2,11,12,13,14,15} and new UAC parameters need to be defined for the new access identity(ies) for RedCap UEs. |
| Futurewei | Options 1, 2, and 3 | All these options may be considered to accommodate a very diverse set of Redcap use cases |
| Ericsson | Option 2/3 | At the moment option 2 or 3 seem viable but we can study further what is the intended behaviour and what is needed to achieve that behaviour. |
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## Ensure REDCAP UEs for intended use cases

One objective of REDCAP SID is ensuring that REDCAP UEs are only used for intended use cases:

* Study standardization framework and principles for how to define and constrain such reduced capabilities – considering definition of a limited set of one or more device types and considering how to ensure those device types are only used for the intended use cases [RAN2, RAN1].

The following proposal is related to how to ensure that REDCAP UEs are only used for intended use cases:

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| **Tdoc number** | **Company name** | **Proposals** |
| R2-2007345 | Huawei, HiSilicon | Proposal 3: It is up to CN to ensure the device type is used for the intended use case. |

In general, use case is related to traffic information which is transparent to RAN. RAN schedules the UEs only based on QoS parameters, i.e. 5QI (data rate, latency, packet error rate, GBR or Non-GBR, etc.) provided by CN. Thus, it is difficult for RAN to identify the use case and there is proposal to let the CN to ensure that REDCAP UEs are only used for intended use cases.

**Question 6.** Do you agree to let CN to ensure that REDCAP UEs are only used for intended use cases?

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| ***Company name*** | ***Yes/No?*** | ***Comments*** |
| Qualcomm | Yes | This topic is also discussed in Offline-109. We probably should not duplicate the discussions. |
| Nokia | no | RAN2 needs to discuss whether traditional UE is allowed to indicate support for RedCap functionality |
| OPPO | No | This is out of RAN2’s scope. |
| Futurewei | Yes | The request service needs to be checked with UE/user’s subscription. |
| Ericsson | (Yes) | [Discussed in Offline#109] |
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# Summary

TBD

# Conclusion

This offline discussion focused on proposals for REDCAP:

**TBD**

# Contact delegates

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| --- | --- | --- |
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