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

**Electronic meeting, 21 Feb- 3 March, 2022**

**Agenda item:** 8.12.5.1

**Source:** Intel Corporation

**Title:** Report of [AT117-e][107][RedCap] UE caps open issues (Intel)

**Document for:**  Discussion and decision

# Introduction

This is the report of following offline discussion:

2nd round:

* [AT117-e][107][RedCap] UE caps open issues (Intel)

Updated scope:

1. Continue the discussion on capability open issues
2. Update the RRC and 38.306 CRs

Updated intended outcome: Updated RRC and 38.306 CRs and summary of the offline discussion with e.g.:

* + - List of proposals for agreement (if any)
		- List of proposals that require online discussions
		- List of proposals that should not be pursued (if any)

Deadline (for RRC and 38.306 CRs): Thursday 2022-03-03 1000 UTC

# Annex: companies’ point of contact

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| **Company** | **Point of contact** | **Email address** |
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# Discussion

**Back ground: Unresolved comments in first/second round discussion;**

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| **Company’s name** | **Section** | **Identified issues** | **Change suggestion** |
| Ericsson | channelBWs / supportedBandwidth |  | These texts are still not easy to read in our view. Also, the text for channelBWs seems to be incorrect, as the UE should be able to indicate also lower BWs than the maximum supported? That is, not just indicating the maximum BW, but other lower BWs can be possible as well (depending on the band).We had a proposal earlier and we think these formulations should capture the intention correctly (can add reference to RAN4 specs as well): On FR1, RedCap Ues shall not support more than 20 MHz; they shall support 20 MHz defined for the band or the next lower bandwidth otherwise; they may additionally support lower bandwidths.On FR2, RedCap Ues shall not support more than 100 MHz; they shall support 100 MHz if defined for the band or the next lower bandwidth otherwise; they may additionally support lower bandwidths.[Rapp] Let’s avoid to discuss this again since RAN2 has agreed this.[Ericsson] The current text for channelBW-DL/UL still hints the UE only reports the maximum supported BW, although, in the legacy case, UE may report all supported BWs also below that (including the maximum). At least this should be clarified, it is not clear from the included text. |
| T-Mobile |  |  | Now that we are at the end of the R17 there’s a need to clearly define a what is a REDCAP UE.  This is challenging because REDCAP UE’s have limits on channel BW’s and at the same time prohibit the use of optional MBB features i.e. carrier aggregation. Our suggestion cleans up the language in the CR and replaces “not supported” with “prohibited”. The very nature of an optional feature means that it is “not supported” in some UE’s.  RedCap UE is has the following limitations/features:* The maximum bandwidth is 20 MHz for FR1, and is 100 MHz for FR2. UE features and corresponding capabilities related to UE bandwidths wider than 20 MHz in FR1 or wider than 100 MHz in FR2 are not supported by RedCap UEs;
* Number of supported DRB’s is either 8 or 16.
* A RECAP PDCP SN length is either 12 bits or 18 bits
* A REDCAP UE  RLC AM SN length is either 12 bits or 18 bits
* Number of MIMO layers is restricted to 1 DL MIMO layer if 1 Rx branch is supported, and 2 DL MIMO layers if 2 Rx branches are supported. UE features and corresponding capabilities related to more than 2 UE Rx branches and more than 2 DL MIMO layers, as well as UE features and capabilities related to more than 2 UE Tx branches and more than 2 UL MIMO layers prohibited for use in RedCap UEs;
* REDCAP UE’s are prohibited from supporting CA, MR-DC, DAPS, CPAC and IAB ( i.e., the RedCap UE is not expected to act as IAB node) related UE features and corresponding capabilities. All other feature groups or components of the feature groups as captured in TR 38.822 [24] as well as capabilities specified in this specification remain applicable for RedCap UEs same as non-RedCap UEs, unless indicated otherwise.
* RedCap UE must support early indication based on Msg1, MsgA and Msg3 for RACH;

We also have concerns with the definition of ***supportOfRedCap-r17***  in the current version of 38.306, this needs to point to a definition like the one shown above.

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| ***supportOfRedCap-r17***Indicates that the UE is a RedCap UE which meets all of the requirements specified in 38.306 section 4.2.XX i.e. * Maximum FR1 RedCap UE bandwidth is 20 MHz;
* Maximum FR2 RedCap UE bandwidth is 100 MHz;
* Support of RedCap early indication based on Msg1, MsgA and Msg3 for RACH;

~~A RedCap UE shall always set the capability to “1”.~~  |

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| Rapporteur |  |  | **Issue 1:** For the changes “* Number of supported DRB’s is either 8 or 16.
* A RECAP PDCP SN length is either 12 bits or 18 bits
* A REDCAP UE  RLC AM SN length is either 12 bits or 18 bits ”

[Yi] This is not aligned with agreements. We have agreed 8 DRBs, 12 bits SN are mandatory. But looks like they are optional or conditional mandatory (if large one is not supported) based on your change. Therefore I would suggest to keep it as it is. **Issue 2:** For the changes “* Number of MIMO layers is restricted to 1 DL MIMO layer if 1 Rx branch is supported, and 2 DL MIMO layers if 2 Rx branches are supported. UE features and corresponding capabilities related to more than 2 UE Rx branches and more than 2 DL MIMO layers, as well as UE features and capabilities related to more than 2 UE Tx branches and more than 2 UL MIMO layers are prohibited for use in RedCap UEs;”

[Rapp] Looks good to me ( “are” should be added). Let’s hear other companies’ view. **Issue 3:** For the changes “* REDCAP UE’s are prohibited from supporting CA, MR-DC, DAPS, CPAC and IAB ( i.e., the RedCap UE is not expected to act as IAB node) related UE features and corresponding capabilities. All other feature groups or components of the feature groups as captured in TR 38.822 [24] as well as capabilities specified in this specification remain applicable for RedCap UEs same as non-RedCap UEs, unless indicated otherwise.“

[Rapp] Looks good to me. Let’s hear other companies’ view.**Issue 4:** For the change “* RedCap UE must support early indication based on Msg1, MsgA and Msg3 for RACH;”

[Rapp] The issue was discussed in RAN2#116bis, offline 105, see R2-2201737. There was no consensus on whether to capture it in 4.2.xx. It would be good to not repeat the discussion. Therefore I would suggest to keep it as it is for now.**Issue 5:** Regarding the definition of ***supportOfRedCap-r17***  [Rapp] current version is based on the version provided by RAN1 in UE feature list as following and RAN2 agreements on MSG3 based early identification. We will update it if RAN1 agreed more information. Therefore I would suggest to keep it as it is for now.

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| Index | Components |
| 28-1 | 1. Maximum FR1 RedCap UE bandwidth is 20 MHz.2. Maximum FR2 RedCap UE bandwidth is 100 MHz.3. Early indication of RedCap UE in Msg.1 for 4-step RACHFFS whether to add any other basic features for RedCap UE |

**Issue 6:** Remove “A RedCap UE shall always set the capability to “1”.” From the definition of ***supportOfRedCap-r17***  [Rapp]This was added based comments received in [Post116bis-e][105], see R2-2201893. Would be good to keep it as it is. Huawei As to the comments on replacing “not supported” with “prohibited”, we are a little bit hesitate. This “prohibited” was never used in 38.306, where we have also lots of case of not supported features. We may need to hear more companies’ view on this.Another way to somehow address John’s comment is that we can use “xx are not supported by all RedCap UEs”, instead of using “prohibited”. |

For **issue 2/issue 3,** T-Mobile suggested to change “support” to “prohibit” and cleans up the language as following:

**Issue 2/issue 3:**

* Number of MIMO layers is restricted to 1 DL MIMO layer if 1 Rx branch is supported, and 2 DL MIMO layers if 2 Rx branches are supported. UE features and corresponding capabilities related to more than 2 UE Rx branches and more than 2 DL MIMO layers, as well as UE features and capabilities related to more than 2 UE Tx branches and more than 2 UL MIMO layers are prohibited for use in RedCap UEs;”
* REDCAP UE’s are prohibited from supporting CA, MR-DC, DAPS, CPAC and IAB ( i.e., the RedCap UE is not expected to act as IAB node) related UE features and corresponding capabilities. All other feature groups or components of the feature groups as captured in TR 38.822 [24] as well as capabilities specified in this specification remain applicable for RedCap UEs same as non-RedCap UEs, unless indicated otherwise.“

Huawei commented that we should not use “prohibited”, and we can use “xx are not supported by all RedCap UEs” instead.

**Discussion point 3.1: Do you agree the above change on issue 2, issue 3?**

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| **Company’s name** | **Yes/No** | **Remark** |
| Qualcomm | No | We prefer “are not supported”, which is more consistent with the style used in similar scenarios in 306 |
| OPPO | No | We prefer “are not supported”. |
| Ericsson |  | We don’t think there is previous case of “prohibited” thus prefer not to use that formulation.  |

For other issues, Issue 1, issue 4, issue 5, issue 6, Rapporteur do not see the need to change.

**Issue 1:** For the changes “

* Number of supported DRB’s is either 8 or 16.
* A RECAP PDCP SN length is either 12 bits or 18 bits
* A REDCAP UE  RLC AM SN length is either 12 bits or 18 bits ”

[Rapp] This is not aligned with agreements. We have agreed 8 DRBs, 12 bits SN are mandatory. But looks like they are optional or conditional mandatory (if large one is not supported) based on your change. Therefore I would suggest to keep it as it is.

**Issue 4:** For the change “

* RedCap UE must support early indication based on Msg1, MsgA and Msg3 for RACH;”

[Rapp] The issue was discussed in RAN2#116bis, offline 105, see R2-2201737. There was no consensus on whether to capture it in 4.2.xx. It would be good to not repeat the discussion. Therefore I would suggest to keep it as it is for now.

**Issue 5:** Regarding the definition of ***supportOfRedCap-r17***

[Rapp] current version is based on the version provided by RAN1 in UE feature list as following and RAN2 agreements on MSG3 based early identification. We will update it if RAN1 agreed more information. Therefore I would suggest to keep it as it is for now.

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| Index | Components |
| 28-1 | 1. Maximum FR1 RedCap UE bandwidth is 20 MHz.2. Maximum FR2 RedCap UE bandwidth is 100 MHz.3. Early indication of RedCap UE in Msg.1 for 4-step RACHFFS whether to add any other basic features for RedCap UE |

**Issue 6:** Remove “A RedCap UE shall always set the capability to “1”.” From the definition of ***supportOfRedCap-r17***

[Rapp]This was added based comments received in [Post116bis-e][105], see R2-2201893. Would be good to keep it as it is.

**Discussion point 3.1: Do you agree the above change on Issue 1, issue 4, issue 5, issue 6?**

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| **Company’s name** | **Yes/No** | **Remark** |
| Qualcomm | No | We prefer the existing text for those issues |
| OPPO | No | We prefer the existing text for those issues |
| Ericsson | Partly | Issues 4,5 and 6 look reasonable to us.For issue 6, why do we need to have “RedCap UE always set the capability to “1”” if the description already says it is for RedCap UE? Also, again, “set to “1”” is only used for bitmaps in existing TS 38.306, and this capability should not be a bitmap in ASN.1 encoding in our understanding, therefore, suggest at least revising the wording. But we’d prefer to remove this completely as it is not needed. |

**Discussion point 3.3: Companies are invited to provide further view on running TS38.306 and TS38.331 CR?**

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| **Company’s name** | **Section** | **Identified issues** | **Change suggestion** |
| Ericsson | 4.2.4 / 4.2.5 | The same issue discussed online on shortSNs and “RedCap UE shall always report ‘1’” | Same opinion as before on the need to have this – we don’t think this is needed, on the contrary, it is misleading. In previous text in TS 38.306 “report ‘1’” is only used in the context of bitmaps, therefore, it should at least be changed to “indicate support” or similar.  |
| Ericsson | 4.2.xx.1 | In field description for *supportOfRedCap-r17,* “Msg1, MsgA and Msg3 for RACH” should refer to process instead of channel | RACH = Random access channelChange “Support of RedCap early indication based on Msg1, MsgA and Msg3 for RACH;”To “Support of RedCap early indication based on Msg1, MsgA and Msg3 for random access;” |

# Summary report and proposals

# Open issues list for RedCap UE capabilities (R2-2201893)

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| **Topic** | **Open issues****Note:** Open Issues should be defined for aspects that need to be closed, important to make already agreed functionality work in a reasonable way. Not yet agreed optimizations that may not be needed shall not be listed as Open Issues. | **Remark**  | **To be handled by pre-117 discussion or company’s contribution**  |
| RAN1 led feature | To capture “introduce capability bit on Half-duplex FDD operation type A for RedCap UEs; ” | To be captured in Mega CR. (need to check latest RAN1 feature list after Jan meeting) | Mega CR directly. |
| To capture “introduce explicit bit to indicate the support of RedCap; ;” | RAN2 WA is per UE capability. (need to check latest RAN1 feature list after Jan meeting) | Has been captured in capability running CRs. May update if RAN1 has different agreements. No change for now.  |
| Support of NCD-SSB, it is unclear what capabilities are needed, e.g.[R2-2201753] *Proposal 15 Discuss whether a RedCap UE, which does not support CSI-RS, should be able to report “Not need NCD-SSB” as an optional UE capability.**Proposal 17 Discuss whether a non-RedCap UE should be able to use NCD-SSB instead of CD-SSB with an optional capability in this meeting.* | Wait for RAN1 and RAN4. P15/P17 may still be discussed in RAN2 | **Company’s contribution or to be considered in Pre-117 for RRC** |
| Handover UE to non-RedCap cell | For the LTE to NR handover, in case the target NR cell is a legacy cell, the RedCap UE should trigger RRC re-establishment procedure. FFS any specification impact or purely leave to implementation | Need to be resolved in RAN2;Note: Companies’ view and potential solutions can be found in R2-2201750. | **Company’s contribution or to be considered in Pre-117 for RRC** |
| RRM relaxation  | Is it applied for non-RedCap UE or not? | Need to be resolved in RAN2;Note: Companies’ view can be found in R2-2201752.*Proposal 5. [Discussion] (16/20) Rel-17 RRM relaxation can apply to any Rel-17 UE.* | **To be handled in Pre-117 for UE capability****Discussion point 3.1.1-1** |
| For IDLE/INACTIVE:* whether to capture it as optional without capability feature?
* To add additional descriptions in section 5.6 *Relaxed measurement or new section?*
 | Need to be resolved in RAN2; | **To be handled in Pre-117 for UE capability****Discussion point 3.1.2-1** |
| For RRC\_CONNECTED, * Is single bit sufficient?
* Granularity of RRM capability, e.g. per UE?
* FDD/TDD diff?
* FR1/FR2 diff?
* Any others?
 | Need to be resolved in RAN2; | **To be handled in Pre-117 for UE capability****Discussion point 3.1.3-1-Discussion point 3.1.3-4** |
| eDRX | For RRC\_INACTIVE, * What additional eDRX capability for RRC\_INACTIVE? E.g. long DRX cycle?
* Granularity of eDRX capability, .e.g.per UE? (legacy is per UE)
* FDD/TDD diff? (legacy yes)
* FR1/FR2 diff? (Legacy no)
* Any others?
 | Need to be resolved in RAN2;Note: RAN2 agreements:1. eDRX feature can be supported by non RedCap UEs.2. A UE in idle mode requests eDRX configuration via NAS signalling. FFS if capability signalling in RAN, as part of the UE capability message, is also needed.3. eDRX support is optional for the RedCap UE. | **To be handled in Pre-117 for UE capability****Discussion point 3.2.2-1-Discussion point 3.2.2-6** |
| For RRC\_IDLE:* A UE in idle mode requests eDRX configuration via NAS signalling. FFS if capability signalling in RAN, as part of the UE capability message, is also needed.
 | Need to be resolved in RAN2;Whether to capture it as optional features without UE capability under section 5 or capability signalling in RAN or nothing? | **To be handled in Pre-117 for UE capability****Discussion point 3.2.1-1** |
| CR implementation | channelBWs-DL/channelBWs-UL | Ericsson commented “The two sentences started with “For FR1…” are difficult to digest and don’t add anything to what the first sentence about RedCap already states.” And suggest to change it asRemove “For FR1 RedCap UE, the bit which indicates 20MHz shall be set to 1 unless the 20Mhz channel bandwidth is not supported for the operating band as specified in TS38.101 [2 ]. For FR2 RedCap UE, the bit which indicates 100MHz shall be set to 1.”Consider adding to the first sentence: “and set the corresponding bits in channelBWs-DL”Regarding how to handle EN Editor's Note: FFS on how to handle the case that the UE cannot support 20MHz BW as specified in TS38.101. Rapp added “1 unless the 20Mhz channel bandwidth is not supported for the operating band as specified in TS38.101 [2”, Huawei think it is not needed since Even if there is one band not supporting 20Mhz, RedCap UE will not consider that band as supported band. Then, RedCap UE will not report the filed at all, e.g. channelBWs-DL and others. Rapp: Would be good to check companies’ view.[Huawei]: In this version of CR, we change nothing compared to the last endorsed version. Add the open issue as “**FFS on how to handle the case that the UE cannot support 20MHz BW as specified in TS38.101. FFS if anything to be added in the field description**”.[Rapp1] This is the open issue table. [Ericsson] Our point is that with the new additions the overall sentence becomes a bit cumbersome – with new additions we should be able to update the overall text even if it was endorsed before. But if there is no consensus now, then we can discuss next time as it seems clear we need to discuss the addition anyways. | **To be handled in Pre-117 for UE capability****Discussion point 3.3.1-1** |
|  | channelBW-90MHz | Ericsson commented We don’t think this kind of additions do ourselves any favour. It should be clear that RedCap UE shall not indicate such capability, as stated in the definition. And suggest Remove the statement about RedCap.Rapp: This has been discussed before and no conclusion to remove it. Would be good to check companies’ view. | **To be handled in Pre-117 for UE capability****Discussion point 3.3.1-2** |
|  | ***supportedBandwidthDL/supportedBandwidthUL*** | Ericsson commented “The two sentences starting at “For FR1…” are not needed (since covered by the first sentence about RedCap UEs) and are actually wrong since this field is not a bitmap. “And suggestRemove “For FR1 RedCap UE, the bit which indicates 20MHz shall be set to 1 unless the 20Mhz channel bandwidth is not supported for the operating band as specified in TS38.101 [2]. For FR2 RedCap UE, the bit which indicates 100MHz shall be set to 1”Rapp: Tend to agree with Ericsson. But the sentence was introduced before. Let’s check companies view on this. [Huawei]: Not agree to remove the sentence. This one has been endorsed after long discussion. See our comment/suggestion to above channelBWs-DL/channelBWs-UL[Ericsson] Same comment as before, with the addition it becomes unnecessary long. Also, we should not keep in text which is wrong.  | **To be handled in Pre-117 for UE capability****Discussion point 3.3.1-1** |
|  | ~~4.2.xx~~~~Location of RedCap general statements and the field descriptions~~ | ~~Ericsson commented~~ ~~Now looking at the structure, we think it would be better to capture all the field descriptions in the correct locations (e.g. PDPC parameters, RLC parameters, etc) instead of in a new section to keep the existing structure intact and not to spread out the descriptions. If all RedCap-specific parameters can be identified through the name (i.e. by including “RedCap” in the name) it woul be easy to find such RedCap-specific parameters.~~ ~~With such update, it could actually be reasonable to have the description of RedCap then as a subsection of 4.1. instead of 4.2 as well~~~~And suggest~~~~Move the field descriptions to their usual places in the existing structure. (Also consider moving RedCap description under 4.1 in such case).~~~~[Rapp] We discussed this in previous meeting and finally agreed current structure. Would be good to hear companies’ view.~~ ~~[Huawei]: Not OK to add this as open issue. But we are fine to discuss this in the next round of running CR discussion.~~ | **To be handled in Pre-117 for UE capability****Discussion point 3.3.4-1** |
|  | ***shortSN***Indicates whether the UE supports 12 bit length of PDCP sequence number. RedCap UE should always report "1".***am-WithShortSN***Indicates whether the UE supports AM DRB with 12 bit length of RLC sequence number. RedCap UE should always report "1". | Ericsson and Rapporteur commentsThe feature is Mandatory for all UEs, therefore all UEs shall support this. ‘Should’ seems to make it somewhat optional. Absence of this bit would make the UE unususable in any case. SuggestWe prefer to remove the addition completely as it is unnecessary. Agree with rapporteur comment. [Rapp] Agree with Ericsson. But Would be good to hear companies’ view. [FW] The signaling of these capabilities is mandatory, but the actually support of them is optional for non-RedCap UEs today. For RedCap UEs, we make the support of short SNs mandatory. Therefore, adding these text is necessary to highlight the difference for RedCap UEs.[Huawei]: Normally we use “This field shall be set to *supported*.” In 306 for mandatory feature. The debating on “shall” and “should” does not count as open issue. We prefer not to include this as open issue.[Rapp1] the debate is not “shall” or “should”. The discussion is whether we need to change anything since so far shortSN is mandatory feature. It is strange to say “it shall be set to 1” again for RedCap UE. [Ericsson]  There should be no debate between “shall” and “should”: “Shall” indicates requirement and “should” indicates recommendation. This case is about a rewuirement. HW suggestion would be also fine to us, if any addition is needed.  | **To be handled in Pre-117 for UE capability****Discussion point 3.3.2-1** |
|  | ***supportOf16DRB-r17***For legacy devices support of 16 DRBs is mandatory without capability signaling – the current wording does not explain this. Amend the description by: “ since support fo 16 DRBs is mandatory without capability signalling for other UEs”The field name could include “RedCap” for easy searching through capability names. [Rapp] updated in RRC v01, 306 v02. [Huawei]: There is no need to add “since xxx” to explain the reason in specification. It is clear this is only for RedCap UE. | [Rapp] discuss whether need to add “since xxx” for ***supportOf16DRB-r17, longSN-RedCap-r17 and am-WithLongSN-RedCap-r17******.*** ***,***  | **To be handled in Pre-117 for UE capability****Discussion point 3.3.3-1** |

# Open issue list on MAC (From R2-2201891)

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| **1-2** | Confirm Working assumption or not on:**Working assumption:**1. **Msg3 early identification is mandatorily supported by RedCap UE**
 | This OI will be handled in RAN2 also considering MsgA early identification. | Type 1**Discussion point 3.4-1** |

# Reference

1. R2-2201737 [offline-105] RedCap capabilities Intel
2. R2-2201750 [offline-105] RedCap capabilities - second round Intel
3. R2-2201732 [Pre116bis-e][103][RedCap] Summary of NCD-SSB / Initial BWP aspects Ericsson
4. R2-2201738 [offline-106] NCD-SSB and Initial BWP aspects Ericsson
5. R2-2201753 [offline-106] NCD-SSB and Initial BWP aspects - second round Ericsson
6. R2-2201734 [offline-103] identification and access restriction aspects Huawei
7. R2-2201751 [offline-103] identification and access restriction aspects - second round Huawei
8. R2-2201735 [offline-104] RRM relaxations Samsung
9. R2-2201752 [offline-104] RRM relaxations - second round Samsung
10. R2-2201892 Running 38.331 CR on Capabilities
11. R2-2201968 Running 38.306 CR on Capabilities
12. R2-2201893\_Report of email discussion [Post116bis-e][105][RedCap] 38.306 running CR and list of open issues (Intel)
13. R2-2111586 Correction on PO determination for UE in inactive state ZTE corporation, Ericsson , vivo , CMCC , China Telecom , China Unicom ,Samsung, Sanechip s CR Rel-17 38.306 16.6.0 0665 1 F TEI17