3GPP TSG-RAN WG1 Meeting #107-e Draft R1-2112503

e-Meeting, 11th – 19th November 2021

Agenda Item: 8.16.6

Title: FL summary on LS on capability related RAN2 agreements for RedCap

Source: Moderator (Ericsson)

Document for: Discussion, Decision

# 1 Introduction

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

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| [107-e-R17-UE-features-REDCAP-02] Discussion on RAN2 LS (in R1-2108714) on REDCAP UE capability – Johan (Ericsson)   * 1st check point: November 15 * Final check point: November 19 |

This email discussion concerns the questions raised by RAN2 in the LS in [3]. An initial email discussion took place in the previous RAN1 meeting and it is captured in [4]. Contributions related to this topic can be found in [9] – [20]. The issues in focus in this round of the discussion in this meeting are tagged FL5.

Follow the naming convention in this example:

* *RedCapCapabilityLsFLS-v000.docx*
* *RedCapCapabilityLsFLS-v001-CompanyA.docx*
* *RedCapCapabilityLsFLS-v002-CompanyA-CompanyB.docx*
* *RedCapCapabilityLsFLS-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 *RedCapCapabilityLsFLS-v002-CompanyA-CompanyB.docx*.
* CompanyC uploads an empty file named *RedCapCapabilityLsFLS-v003-CompanyB-CompanyC.checkout*
* CompanyC checks that no one else has created a checkout file simultaneously, and if there is a collision, CompanyC tries to coordinate with the company who made the other checkout (see, e.g., contact list below).
* CompanyC then has 30 minutes to upload *RedCapCapabilityLsFLS-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 [R1-2110752](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2110752.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 in the table below.

**FL5 Question 1-1a: Please consider entering contact info below for the points of contact for this email discussion.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
| Intel Corporation | Debdeep Chatterjee | debdeep.chatterjee@intel.com |
| Qualcomm | Jing Lei | leijing@qti.qualcomm.com |
| vivo | Xueming Pan | panxueming@vivo.com |
| FUTUREWEI | Vip Desai | vipul.desai@futurewei.com |
| Ericsson | Sandeep Narayanan Kadan Veedu | sandeep.narayanan.kadan.veedu@ericsson.com |
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| MediaTek | Mohammed AI-Imari | mohammed.al-imari@mediatek.com |

# 2 Feedback on RAN2 agreements

The LS from RAN2 [3] informs about the following RAN2 agreements (where a typo has been corrected) and asks RAN1 and RAN4 to provide feedback, if any, on the agreements.

RAN2#114-e:

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| 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 |

RAN2#115-e:

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| Agreements:  1. The number of DRBs supported by RedCap UEs is less than legacy value (which is 16). There will be a single mandatory value (FFS if 4 or 8). FFS if it will be possible to have an optional capability  2. “RRC processing delay” is not relaxed for RedCap UE  3. PDCP/RLC AM 12 bits SN is mandatory for RedCap UE, and PDCP/RLC AM 18bits SN is optional supported by RedCap UE; FFS on how to capture this in specification  4. NE-DC, and (NG)EN-DC are not supported by RedCap UE; FFS on how to capture it in the specification  5. DAPS and ~~CAPC~~ CPC related capabilities are not applicable for RedCap UE; [8/20] FFS on CHO. FFS on how to capture this in the specification  Agreements via email - from offline 109:  1. Maximum 8 DRBs is mandatory supported by RedCap UEs.  2. From RAN2 perspective, inter RAT mobility related capabilities are applicable for RedCap UE  3. From RAN2 perspective, measurement related capabilities are applicable for RedCap UE  4. From RAN2 perspective, URLLC related capabilities are applicable for RedCap UE except those affected by CA/DC  5. From RAN2 perspective, IAB related capabilities are not applicable for RedCap UE, i.e., the RedCap UE is not expected to act as IAB node  6. Do not introduce capability signalling on the supported Rx number for RedCap UE since the number of Rx branches for RedCap is implicitly indicated by the corresponding capability parameter *maxNumberMIMO-LayersPDSCH* in the existing UE capability framework |

Based on the discussion captured in [4], there does not seem to be a need to provide any feedback on the RAN2 agreements listed in the LS.

**FL1 High Priority Question 2-1a: Is there a need for RAN1 to provide feedback on the above RAN2 agreements? If yes, please elaborate in the Comments field.**

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| **Company** | **Y/N** | **Comments** |
| Intel | N |  |
| Qualcomm |  | For RedCap UE capability signaling regarding the supported RX number, it should be reported as “per band”, considering the potential UE testing differentiation among licensed, unlicensed and NTN bands.  If the existing UE capability signaling for *maxNumberMIMO-LayersPDSCH* is not consistent with “per band”, a new FG for RedCap UE needs to be specified. |
| FUTUREWEI | N |  |
| Ericsson | N |  |
| Samsung | N |  |
| FL2 | The comments from Qualcomm can be addressed in the Rel-17 RedCap RAN1 UE feature list discussion [107-e-R17-UE-features-REDCAP-01]. | |
| MediaTek | Based on the following text in Clause 4.2.xx (RedCap Parameters) in a previous running CR (R2-2109668) for TS38.306 in RAN2, we think RAN1 does not need to provide an exhausted list of L1 feature groups that are related CA, DC, NE-DC, (NG)EN-DC, DAPS, CPAC, and IAB.   |  | | --- | | - 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 are not supported by RedCap UEs. 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, unless indicated otherwise. |   If this is the common understanding in RAN1, in our opinion, most discussions in 3.1 except for wider bandwidth are not necessary. In addition, section 3.3 is not needed, either. However, if the understanding is different among RAN1 companies, maybe we can clarify with RAN2 regarding how they are going to capture RedCap’s UE featues and what they expect RAN1 to deliver. | |
| Ericsson | Agree with MediaTek’s comment | |
| FL3 | There does not seem to be a need for RAN1 to provide feedback on the above RAN2 agreements within this email discussion. | |

# 3 Applicability of Rel-15/16 features

The LS from RAN2 [3] asks RAN1 and RAN4 whether there are any Rel-15/16 UE features or capabilities which should not be applicable for RedCap UEs.

The WID [1] indicates that the following capabilities are not applicable for RedCap UEs:

* Carrier aggregation
* Dual connectivity
* UE bandwidths wider than 20 MHz in FR1 or wider than 100 MHz in FR2
* More than 2 UE Rx branches or more than 2 DL MIMO layers

RAN1#106-e made the following agreement [2]:

* For the RedCap UE capabilities, current definition of Rel-15/16 L1 UE capabilities mandatory without capability signalling in TR38.822 is reused by default, unless any update is agreed
  + Note: UE capabilities related to CA, DC and wider max UE bandwidth are not applicable to RedCap UEs
  + FFS: whether any L1 UE capabilities mandatory/optional with capability signalling are not applicable to RedCap UEs

RAN#93-e made the following agreements [5] which may be relevant for the RAN1 response to RAN2:

* In Rel-17, there will be no work on any RedCap specific specification update for any of the following:
  + RedCap UEs also supporting V2X/PC5 on n47
  + RedCap UEs operating in unlicensed bands
  + RedCap UEs supporting SUL
* The specification will not contain any explicit restriction to prevent implementation of RedCap UEs with these features.
* Note: The consequence of this agreement would be:
  + If any spec change/addition is found necessary in order to enable one of the options above, then it will not happen in Rel-17.

The RAN2 agreements listed in the LS [3] indicate that the following capabilities (where a typo has been corrected) are not applicable for RedCap UEs:

* More than [4 or 8] DRBs
* NE-DC and (NG)EN-DC
* DAPS and ~~CAPC~~ CPC related capabilities
* IAB related capabilities

The FL questions below use the following categorization (according to Alternative 1 in clause 10.1 in RedCap SI TR [7]) of RedCap UE capability requirements that are different from those for non-RedCap UEs:

1. Mandatory features for non-RedCap UEs that are not applicable for RedCap UEs
2. Mandatory features for non-RedCap UEs that are optional for RedCap UEs
3. Mandatory features for non-RedCap UEs that are supported for RedCap UEs but with different value
4. Optional features for non-RedCap UE that are not applicable for RedCap UE
5. Optional features for non-RedCap UE that are mandatorily supported for RedCap UE

In the following subsections, we first turn our focus to the capabilities that are not supposed to be applicable for RedCap UEs according to the WID or other earlier agreements, and then we turn to other features that could potentially be agreed to not be applicable for RedCap UEs, using the 5 categories listed above.

## 3.1 Capabilities related to CA, DC, NE-DC, (NG)EN-DC, DAPS, CPC, or wider UE bandwidths

In this subsection, we focus on capabilities related to CA, DC, and similar features, which are not supposed to be applicable for RedCap UEs.

**FL1 High Priority Question 3.1-1a: What Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **are related to CA, DC, NE-DC, (NG)EN-DC, DAPS, CPC, or wider UE bandwidths (i.e., wider than 20 MHz in FR1 or wider than 100 MHz in FR2) and should therefore not be applicable to RedCap UEs? (If you feel a need to also list L2/L3 features or RF/RRM features, make sure to prefix them clearly with L2/L3 or RF/RRM.)**

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| **Company** | **Comments** | |
| Intel | We prefer to focus on L1 features in RAN1.  At least the following Rel-15 features related to CA/DC are NOT applicable for RedCap UEs:   * + FGs #6-5, 6-5a, 6-6, 6-7, 6-8, 6-9, 6-9a, 6-10, 6-10a, 6-11, 6-12, 6-13, 6-19, 6-21, 6-22, 6-23, 6-24, 6-25, 6-25a     - Relevant to CA/DC support   + FGs # 8-1, #8-2     - Relevant to EN-DC support | |
| Qualcomm | For DAPS HO, the UE capabilities belonging to 21-x are not expected for RedCap UE. | |
| ZTE, Sanechips | CA/DC related FGs includes   * 1-10,1-11, 4-25, 4-26, 6-5a to 6-13, 6-21 to 6-25a, 8-1, 8-2 * FG 9-3 * FG 10-9c * 11-2a to 11-2g, 11-7a, 11-7b * FGs 13-15a, 13-19 and 13-19a * FGs 15-16, 15-24 and 15-25 * 16-1b-1, 16-1b-2, 16-1f, 16-x RAN2, 16-z RAN2 * FGs 22-5a~22-7c * **Rel-16 feature 18 MR-DC/CA enhancement is not supported.**   DAPS Related   * Rel-16 feature 21 Mobility Enhancement including all the FGs is not supported.   Exceeding the Bandwidth:   * FG 10-20, FG 10-20a, and FG 10-29 | |
| vivo | Regarding Rel-15 CA/DC related features (not applicable to RedCap UEs), agree with Intel’s list in general, and FG 8-1a should be added to the list.  Regarding Rel-16 CA/DC related features, 18-x should be excluded for RedCap UEs. Agree with Qualcomm to also exclude FG 21-x (mobility enhancements). | |
| FUTUREWEI | (CA): 1-10, 1-11, 3-8, 4-25, 4-26  (CA): 6-5, 6-5a, 6-6; (CA, EN-DC): 6-7, 6-8; (CA, EN-DC/NE-DC, DC): 6-9, 6-9a; (CA): 6-10, 6-10a; (CA, EN-DC): 6-11; (CA, EN-DC): 6-12, 6-13; (CA): 6-21, 6-22, 6-23; (EN-DC): 6-24; (DC) 6-25, 6-25a  (EN-DC): 8-1, 8-2  (CA): 9-3, 11-2a, 11-2b, 11-2c, 11-2d, 11-2e, 11-2f, 11-2g, 11-7,11-7a, 11-7b  (CA): 13-2b, 13-3b, 13-4b, 13-15, 13-15a, 13-19, 13-19a, 14-5  (CA): 16-1b-1, 16-1b-2, 16-1f, 16-x RAN2, 16-z RAN2,  (MR-DC/CA): 18-1, 18-1a, 18-1b, 18-4, 18-4a, 18-5, 18-5a, 18-5b, 18-5c, 18-5d, 18-6, 18-6a, 18-7, 18-8, 18-9, 18-2, 18-2a, 18-2b, 18-3, 18-3a, 18-3b, 18-7a  (DAPS): 21-1a, 21-1b, 21-2, 21-2a, 21-2b, 21-2d  (CA): 22-1; (EN-DC): 22-2; (CA): 22-5a, 22-5b, 22-5c, 22-5d; (DC combinations, CA): 22-6, 22-6a; (CA): 22-7, 22-7a, 22-7b, 22-7c, 22-10  With our understanding of the RANP decision, we should not be discussing features for NR-U (10-x) and SL (15-x).  Some clarification on whether 2-56 (SRS carrier switch) is applicable for inter-band CA | |
| Nokia, NSB | * 1-10 Support of SCell without SS/PBCH block * 6-13 Case 1 Single Tx UL LTE-NR DC * 8-1 Dynamic power sharing for LTE-NR DC * 8-2 Operation A with single UL Tx case 1   Also including any FGs having those as pre-requisites. | |
| Samsung | We can focus on RAN 1 features.  Other than listing all features, can we add some notes in UE features in general for RedCap, e.g., “CA/DC related features are not applicable for RedCap UEs”. | |
| FL2 | Based on the received responses, the following proposal can be considered. Capabilities related to V2X/PC5, NR-U, or SUL are not discussed since the RAN#93-e meeting agreed that in Rel-17 there will be no work on any RedCap-specific specification but that the specification will not contain any specific restriction to prevent implementation of RedCap UEs with these features.  **High Priority Proposal 3.1-1b: The following Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **are related to CA, DC, NE-DC, (NG)EN-DC, DAPS, CPC, or wider UE bandwidths (i.e., wider than 20 MHz in FR1 or wider than 100 MHz in FR2) and should therefore not be applicable to RedCap UEs.**   * **L1 FGs for capabilities related to CA, DC, NE-DC, and (NG)EN-DC:**   + **1-10**   + **1-11**   + **2-56**   + **3-8**   + **4-25**   + **4-26**   + **6-5 – 6-13**   + **6-19**   + **6-21 – 6-25a**   + **8-1a**   + **9-3**   + **11-2a – 11-2g**   + **11-7**   + **11-7a**   + **11-7b**   + **13-2b**   + **13-3b**   + **13-4b**   + **13-15**   + **13-15a**   + **13-19**   + **13-19a**   + **14-5**   + **16-1b-1**   + **16-1b-2**   + **16-1f**   + **16-x RAN2**   + **16-z RAN2**   + **22-1 – 22-2**   + **22-5a – 22-7c**   + **22-10** * **L1 FGs for EN-DC related capabilities:**   + **8-1**   + **8-2** * **L1 FGs for MR-DC/CA enhancements:**   + **18-1 – 18-7a** * **L1 FGs for DAPS related capabilities:**   + **21-1a – 21-2d** | |
| **Company** | **Y/N** | **Comments** |
| vivo |  | Fine with most of the items, except the following   * 11-7 ”UL cancelation scheme for self-carrier” includes the single carrier case as well. Is it the understanding that 11-7 is excluded due to the following agreement? If so, it would be good to list 11-7 seperately as it is not excluded due to CA/DC   Agreements: (completing the FFS of the agreement for Case 2, i.e., FFS on PDCCH carrying ULCI)   * For Case 2 (semi-statically configured DL reception vs. dynamically scheduled UL transmission), a HD-FDD RedCap UE is not required to monitor ULCI   + No special handling on the priority rule for PDCCH carrying ULCI * Prefer not to list RAN2 FGs (related to 16-x RAN2, 16-z RAN2), and focus on RAN1 FGs * Suggest to list Rel-15 and Rel-16 FGs seperately, currently they were mixed together. |
| Samsung |  | We still don’t think need to list every FG as below. In current RAN 2 ongoing CR, they plan to capture the no support of CA/DC and other features in a general way as in R2-2109668.  4.2.xx RedCap Parameters  RedCap UE is the UE with reduced capability:   * The maximum bandwidth is 20 MHz for FR1, and is 100 MHz for FR2; * The maximum mandatory supported DRB number is 8; * The mandatory supported PDCP SN length is 12 bits while 18 bits being optional; * The mandatory supported RLC AM SN length is 12 bits while 18 bits being optional; * 1 DL MIMO layer if 1 Rx branch is supported, and 2 DL MIMO layers if 2 Rx branches are supported; * 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 are not supported by RedCap UEs. 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.   Editor's Note: May be updated based on latest RAN1 and RAN4 agreements. |
| MediaTek |  | As we mentioned in Section 2, we are not sure whether providing a full list of features that are related to CA, DC, NE-DC, (NG)EN-DC, DAPS, CPAC, and IAB is necessary. Our current understanding based on reading of RAN2’s running CR is that it is not expected by RAN2 which of course can be further discussed and clarified.  For wider bandwidth aspect, we have provided our view on FG 10-20. However, it is related to NR-U. Hence we agree with Futurewei that we don’t need to discuss it following RAN plenary’s decision. |
| Intel |  | 11-7 should not be precluded. The agreement quoted by vivo does NOT say that UL CI cannot be supported by RedCap UEs.  Also, prefer to limit the exercise to RAN1 features only. |
| FUTUREWEI | Y | Thanks for preparing a comprehensive list, we think it may be good to provide to RAN2 and they can decide whether and how to use it. We are ok to remove 11-7 from the list for now and consider it more. We are ok with vivo’s suggestion for 16-x RAN2 and 16-z RAN2 |
| Ericsson |  | We tend to agree with Samsung and MediaTek that it may not be necessary to provide the complete list of FGs related to non-applicable capabilities such as CA, DC, etc. |
| Huawei, HiSi |  | * What is FG 8-1a? * Also, similar comment as Intel on FG 11-7 * For positioning capabilities, e.g. 13-2b, why they are proposed for exclusion? Our view is they do not rely on CA. |
| Nokia, NSB |  | We agree with the statements above that it is not need to provide a complete list of features, as they are supposed to be clear from the general rules already, and a ”complete” list is bound to have errors, thus being incomplete. For example, 9-4 is missing (SUL related), and 11-7 doesn’t belong to this list. Also 8-1a does not exist, apparently. |
| FL3 | Based on the received responses, the following updated proposal can be considered.  **High Priority Proposal 3.1-1c: RAN1 does not provide a complete list of Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that should not be applicable to RedCap UEs because they are related to CA, DC, NE-DC, (NG)EN-DC, DAPS, CPC, or wider UE bandwidths (i.e., wider than 20 MHz in FR1 or wider than 100 MHz in FR2).** | |
| FUTUREWEI | Y | We can accept for progress, although we still believe that it would be beneficial to provide to RAN2 for information. After all, if RAN1 cannot even agree as to which FGs are not applicable and remove errors in the complete list, how can we expect RAN2 or those implementing to do so?  As a followup, we agree that 11-7 and positioning capabilities do not need to be included. We think 8-1a could be "8-1 (Rel 16) Dynamic power sharing for LTE-NR DC”. For FG9-4, no need to discuss SUL related per RAN. |
| ZTE, Sanechips |  | We still prefer to provide a feature list for RAN2 reference. We are not sure whether RAN2 and RAN1 have the common understanding on each feature. For example, for FG 1-11, according to the RAN2 agreement, the measurement related capabilities should be applicable for RedCap UE and this FG 1-11 should be supported. However, it is also related to CA/DC. Therefore, there would be a conflict.  Therefore, providing such a list can help us avoid this kind of conflict between different agreements and have a common understanding between RAN2 and RAN1.  Additionally, we also agree 11-7 and positioning capability 13-2b can be precluded. |
| Qualcomm |  | We are ok with the proposal. However, what would happen if a RedCap UE signals a “prohibited” capability in its report ? Will it be left to NW implementation ? |
| vivo |  | We would like to understand what is the plan for the next step from moderator/WI Rapporteur perspective, do we continue the exercise to provide a full list of features that are not applicable to RedCap UEs, or we leave the whole thing to RAN2. For the latter case, the concern would be that if RAN2 is not fully familiar with the RAN1 feature list, i.e which FG are CA/DC/larger bandwidth related especially some of them are not independent FG but as a component within a FG (UE can report certain value in a range of values), and further LS may came to RAN1 in the future asking for details. |
| Nokia, NSB |  | OK |
| MediaTek |  | Just to be clear, we also prefer to provide RAN2 a full list of UE features that are not applicable to RedCap UEs including those related to DC/CA, DAPS, IAB, etc. However, if RAN2 is not going to implement everything from the list provided by RAN1, our efforts in RAN1 would be in vain. At this point, we are not 100% sure what RAN2 is going to do and expecting RAN2 to do. Maybe we can postpone agreeing on Proposal 3.1-1c. |
| Ericsson | Y | RAN1 can indicate in the reply LS to RAN2 that RAN1 is willing to provide more details if needed. |
| FL4  FL5 | Based on the received responses, the following updated proposal can be considered.  **High Priority Proposal 3.1-1d: RAN1 does not provide a complete list of Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that should not be applicable to RedCap UEs because they are related to CA, DC, NE-DC, (NG)EN-DC, DAPS, CPC, or wider UE bandwidths (i.e., wider than 20 MHz in FR1 or wider than 100 MHz in FR2), but RAN1 indicates in the reply LS to RAN2 that RAN1 is willing to provide more details if needed.** | |
| HW, HiSi |  | We doubt if there is much value with the answer to RAN2 as they clearly know CA/DC/Wider BW is not in the scope but are not aware of any/many detailed FGs – even RAN1 needs some discussion to confirm some FG are really related to e.g. CA, e.g. FG 13-2b for positioning. |
| Qualcomm | Y | Support proposal |
| MediaTek |  | We are in principle fine with the proposal. Considering how it is drafted in RAN2’s running CR for TS38.306, we think features related to wider UE bandwidth still should be identified and provided by RAN1.  We hence suggest to remove ”wider UE bandwidths (i.e., wider than 20 MHz in FR1 or wider than 100 MHz in FR2)” from Proposal 3.1-1d. |
| vivo | OK |  |
| FUTUREWEI | Y |  |
| Intel | Y |  |

## 3.2 Capabilities related to more than 2 UE Rx branches or more than 2 DL MIMO layers

In this subsection, we focus on capabilities related to more than 2 UE Rx branches, more than 2 DL MIMO layers, and similar features, which are not supposed to be applicable for RedCap UEs.

**FL1 High Priority Question 3.2-1a: What Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **are related to more than 2 UE Rx branches or more than 2 DL MIMO layers and should therefore not be applicable to RedCap UEs? (If you feel a need to also list L2/L3 features or RF/RRM features, make sure to prefix them clearly with L2/L3 or RF/RRM.)**

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| **Company** | **Comments** | |
| Intel | None, since FG #4-12 (HARQ-ACK spatial bundling for PUCCH or PUSCH per PUCCH group) is already defined as not applicable for RedCap UEs. | |
| ZTE, Sanechips | 4-12 is not applicable for RedCap UE.  Additionally, for the 2Tx support and related capabilities, it should be discussed also. | |
| vivo | Rel-15 mandatory feature but not applicable to RedCap UEs (related to more than 2 DL MIMO layer): FG 4-12  Rel-16 optional feature but not applicable to RedCap UEs (related to more than 2 DL MIMO layer): FG16-3a-3 and FG16-3b-2 | |
| FUTUREWEI | 4-12  Several companies identified that FG 16-3a-3 and 16-3b-2 deal with rank 3 and rank 4 uplink transmissions. If the number of Rx branches is no greater than two and if it is assumed that the number of Tx branches should not exceed the number of Rx branches, then these two features may not be applicable to RedCap UEs | |
| Ericsson | We can agree that capabilities related to more than 2 UE Tx branches or more than 2 UL MIMO layers can be considered not applicable for RedCap UEs, but we think that capabilities related to up to 2 UE Tx branches and up to 2 UL MIMO layers should remain applicable as optional features for RedCap UEs since we do not see a reason to preclude a RedCap UE from supporting these features. | |
| Nokia, NSB | 4-12 HARQ-ACK spatial bundling for PUCCH or PUSCH per PUCCH group  We agree with Ericsson on the optional support to up to 2 UE Tx branches. | |
| Samsung | Agree with Ericsson | |
| FL2 | Based on the received responses, the following proposal can be considered.  **High Priority Proposal 3.2-1b: The following Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **are related to more than 2 UE Rx branches or more than 2 DL MIMO layers and should therefore not be applicable to RedCap UEs.**   * **4-12** * **16-3a-3** * **16-3b-2** | |
| **Company** | **Y/N** | **Comments** |
| vivo | Y |  |
| Samsung |  | If majory companies perfer to not allow RedCap UE to support more than 2 Rx, we can live with it.  However, similar as the comments for above question, we think this can be general captured in the spec, and no need to spend time to check whether UE can report to support each optional features that related to the number or Rx or MIMO layers. |
| MediaTek |  | We agree with Proposal 3.2-1b that 4-12, 16-3a-3, and 16-3b-2 are not applicable to RedCap.  Furthermore, following Ericsson’s comments, we think RAN1 should discuss the following proposal to make things more clear for RedCap UEs.  Proposal: More than 2 UE Tx branches or more than 2 UL MIMO layers are not applicable for RedCap UEs. |
| FUTUREWEI | Y |  |
| Ericsson |  | We are fine with MediaTek’s proposal above. (We can also be fine with Proposal 3.2-1b.) |
| Spreadtrum | Y |  |
| Huawei, HiSi | Y and | 2Tx is not in the WID scope and we don’t think they shall be applicable to RedCap UE. |
| Nokia, NSB |  | Support, and we are fine with Mediatek’s proposal, though such agreement should be done within the main WI AIs instead of UE feature discussion. |
| FL3 | Based on the received responses, the following proposal can be considered again. The issue raised by MediaTek is addressed by the new Proposal 3.2-2a.  **High Priority Proposal 3.2-1b: The following Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **are related to more than 2 UE Rx branches or more than 2 DL MIMO layers and should therefore not be applicable to RedCap UEs.**   * **4-12** * **16-3a-3** * **16-3b-2** | |
| FUTUREWEI | Y |  |
| ZTE, Sanechips | Y |  |
| Qualcomm | Y |  |
| vivo | Y |  |
| Nokia, NSB | Y |  |
| MediaTek | Y |  |
| Ericsson | Y | We would also be fine with just indicating to RAN2 that capabilities related to more than 2 UE Rx branches or more than 2 DL MIMO layers are not applicable to RedCap UEs (similar to Proposal 3.1-1c regarding capabilities related to CA, DC, etc.). |
| FL4 | Based on the received responses, it seems that the proposal can be accepted.  **High Priority Proposal 3.2-1b: The following Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **are related to more than 2 UE Rx branches or more than 2 DL MIMO layers and should therefore not be applicable to RedCap UEs.**   * **4-12** * **16-3a-3** * **16-3b-2** | |
| Qualcomm | Y | It is endorsed by RAN1 chair already 😊 |
| FL5 | The following agreement was made on the RAN1 email reflector 18th November 2021:  Agreement:  The following Rel-15/16 capabilities (FGs) for L1 UE features in [TR 38.822 V16.1.0](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) are related to more than 2 UE Rx branches or more than 2 DL MIMO layers and should therefore not be applicable to RedCap UEs.   * 4-12 * 16-3a-3 * 16-3b-2 | |

**FL3 High Priority Proposal 3.2-2a: A RedCap UE does not support capabilities related to more than 2 UE Tx branches or more than 2 UL MIMO layers.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| FUTUREWEI |  | Can accept this proposal or Mediatek's version |
| ZTE, Sanechips |  | Fine with the proposal for more than 2 Tx branches. However, whether 2 Tx branches is supported need further decision. |
| Qualcomm |  | Whether or not a RedCap UE needs to support 2 TX branches and 2 UL MIMO layers can be further discussed. We can live with the FL3 proposal if that is the majority view. |
| vivo |  | Agree with ZTE that we need to decide whether RedCap UE can support features relatd to 2Tx in UL. Our prefernce would be to not allow 2Tx for RedCap UEs. |
| Huawei, HiSi |  | 2Tx is not considered during the study phase – many efforts were spent on whether to support lower than 2Rx while now simply jump to 2Tx is not deirable and can create marketing fragement. |
| Nokia, NSB | Y | This is fine, no company proposed more than 2 UE Tx branches for RedCap. The discussion on 2TX is separated. For the record, our view is that 2TX should be optional for RedCap. |
| MediaTek |  | * After reading companies’ comments and thinking from the work-scope perspective, we think it is better to discuss the maximum number of TX in UL for RedCap in the RedCap WI agenda (eg. 8.6.1.2). * If this is to be discussed here, we also prefer to limit the maximum number of Tx for R17 RedCap to one to reduce RedCap UE’s complexity. |
| Ericsson | Y | We would also be fine with NOT making this agreement, meaning that >2 UE Tx branches or >2 UL MIMO layers can optionally be supported by RedCap UEs. |
| FL4 | Based on the received responses, it seems that the proposal can be accepted. A new Proposal 3.2-3a on the support of 2 UE Tx branches or 2 UL MIMO layers can be found further down in Section 3.2 of this document.  **High Priority Proposal 3.2-2a: A RedCap UE does not support capabilities related to more than 2 UE Tx branches or more than 2 UL MIMO layers.** | |
| HW, HiSi | Y |  |
| Qualcomm | Y | It is endorsed by RAN1 chair already 😊 |
| FL5 | The following agreement was made on the RAN1 email reflector 18th November 2021:  Agreement:   * A RedCap UE does not support capabilities related to more than 2 UE Tx branches or more than 2 UL MIMO layers. | |

**FL5 High Priority Proposal 3.2-3a: A RedCap UE does not support capabilities related to 2 UE Tx branches or 2 UL MIMO layers.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| HW, HiSi | Y | 2Tx is not considered during the study phase – many efforts were spent on whether to support lower than 2Rx while now simply jump to 2Tx is not deirable and can create marketing fragement. |
| Qualcomm | Y | If a RedCap UE does not support more than 1 TX branches, it is not necessary to introduce SRS (and other UL signals) swtiching capability across N>1 TX antennas. Besides, it is not necessary to support CSI measurements/reporting associated with UL MIMO. |
| MedaiTek | Y | Yes, we prefer to limit the maximum number of Tx for RedCap to one at least for R17. For future release, we can futther study whether there is a need. |
| vivo | Y | Agree with the comments above... |
| Nokia, NSB | N | We do not agree with the proposal. Any concerns on market fragmentation are same (actually much less!) than for regular NR UEs, as we are not discussing introduction of a new functionality. The concerns from Qualcomm can be avoided by simply choosing not to implement the support for 2TX. |

## 3.3 Capabilities related to IAB

In this subsection, we focus on IAB related capabilities, which are not supposed to be applicable for RedCap UEs.

**FL1 High Priority Question 3.3-1a: What Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **are related to IAB and should therefore not be applicable to RedCap UEs? (If you feel a need to also list L2/L3 features or RF/RRM features, make sure to prefix them clearly with L2/L3 or RF/RRM.)**

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Intel | FGs 20-x related to IAB are not applicable to RedCap. | |
| ZTE, Sanechips | Feature 20 NR\_IAB including all the FGs is not supported. | |
| vivo | FGs 20-x related to IAB are not applicable to RedCap. | |
| FUTUREWEI | 20-2, 20-3, 20-5a, 20-5b, 20-6, 20-7, 20-8 | |
| Nokia, NSB | These are clearly isolated in FGs 20-x. Also note that R17 31-x series is not applicable either. | |
| FL2 | Based on the received responses, the following proposal can be considered.  **High Priority Proposal 3.3-1b: The following Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **are related to IAB and should therefore not be applicable to RedCap UEs.**   * **20-2 – 20-8** | |
| **Company** | **Y/N** | **Comments** |
| vivo | Y |  |
| Samsung |  | We think RAN 2 is handling it. No need to spend time to discuss this in RAN 1. |
| FUTUREWEI | Y |  |
| Ericsson | Y | We also agree with Samsung’s comment above. |
| Nokia, NSB |  | Agree that this is clear already. |
| FL3 | Based on the received responses, the following updated proposal can be considered.  **High Priority Proposal 3.3-1c: RAN1 does not provide a complete list of Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that should not be applicable to RedCap UEs because they are related to IAB.** | |
| FUTUREWEI | Y |  |
| ZTE, Sanechips |  | No strong view if the RAN2 agreement only refers to feature 20 in Rel-16. However, if it also refers to Rel-17 31-x series, it is better to list the features for understanding. |
| Qualcomm | Y |  |
| vivo |  | No strong view, as the IAB related FGs are quite clear, RAN2 should able to figure out easily. |
| Nokia, NSB | Y |  |
| MediaTek | Y | Share a similar view with vivo. |
| Ericsson | Y |  |
| FL4 | Based on the received responses, it seems that the proposal can be accepted.  **High Priority Proposal 3.3-1c: RAN1 does not provide a complete list of Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that should not be applicable to RedCap UEs because they are related to IAB.** | |
| Qualcomm | Y |  |
| vivo | OK |  |
| FL5 | The following agreement was made on the RAN1 email reflector 18th November 2021:  Agreement:   * RAN1 does not provide a complete list of Rel-15/16 capabilities (FGs) for L1 UE features in [TR 38.822 V16.1.0](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) that should not be applicable to RedCap UEs because they are related to IAB. | |

## 3.4 Mandatory features for non-RedCap UEs that are not applicable for RedCap UEs

In this subsection, we focus on mandatory features for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) that should not be applicable for RedCap UEs.

**FL1 High Priority Question 3.4-1a: What Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that are mandatory for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) should not be applicable for RedCap UEs? (If you feel a need to also list L2/L3 features or RF/RRM features, make sure to prefix them clearly with L2/L3 or RF/RRM.)**

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Intel | The following should not be applicable or at least changed to OPTIONAL w/ capability signaling for RedCap:   * + *FG #2-16b (Support 1+2 DMRS (uplink))*     - *Relevant to support of more than one antenna port in the UL*   + *FG #2-55 (SRS Tx switch)*     - *Relevant to support of multiple UL APs* | |
| ZTE, Sanechips | Similar view with Intel. | |
| vivo | Not applicable to RedCap UEs: FG 2-16b *oneFL-DMRS-TwoAdditionalDMRS-UL* | |
| FUTUREWEI | Our understanding is FG2-55 cannot be removed. It is related to section 6.2.1.2 “UE sounding procedure for DL CSI acquisition”. For SRS, one of the usages (configured by RRC) is “antennaSwitching” which includes all the use cases to obtain DL CSI via SRS for TDD system even if no antenna switching is performed in 38.214. Note, we do think some values may have to be limited for RedCap UEs while “1T=1R” and “1T-2R” should at least be included | |
| Ericsson | As commented in Section 3.2, we can agree that capabilities related to more than 2 UE Tx branches or more than 2 UL MIMO layers can be considered not applicable for RedCap UEs, but we think that capabilities related to up to 2 UE Tx branches and up to 2 UL MIMO layers should remain applicable as optional features for RedCap UEs since we do not see a reason to preclude a RedCap UE from supporting these features. | |
| Nokia, NSB | * 1-10 Support of SCell without SS/PBCH block * 6-13 Case 1 Single Tx UL LTE-NR DC * 8-1 Dynamic power sharing for LTE-NR DC * 8-2 Operation A with single UL Tx case 1 * 4-12 HARQ-ACK spatial bundling for PUCCH or PUSCH per PUCCH group | |
| Samsung | Fine with making 2-16b and 2-55 as optional, but we shall not make it non-applicable. (**correct type. Sorry.** ) | |
| FL2 | Based on the received responses, the following proposal can be considered. FGs 1-10, 4-12, 6-13, 8-1 and 8-2 are not listed in this proposal since they are already captured in the proposals in subsections 3.1 – 3.3.  **High Priority Proposal 3.4-1b: The following Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that are mandatory for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) should not be applicable for RedCap UEs.**   * **2-16b** * **2-55** | |
| **Company** | **Y/N** | **Comments** |
| vivo | Y |  |
| Samsung | N | Sorry that I correct the comment in previous around.  In Rel-15, UE is only required to support 1 Tx for UL. Therefore, we don’t think **2-16b** is related to # of UL Tx. In our understanding, it is for robust time domain density for channel estimation. For this one, we perfer to keep it as current.  For 2-55, Futurewei’s comments makes sense. |
| FUTUREWEI | N | 2-16b: same comment as Samsung  2-55: same comment as we provided |
| Ericsson | N |  |
| Huawei, HiSi | N | FG 2-55 (particularly, *supportedSRS-TxPortSwitch*) shall be kept as mandatory with capability for UE supporting 1T2R or 1T1R to report. |
| Nokia, NSB | N | Do not agree, same reasons as Samsung and Futurewei. |
| FL3 | There does not seem to be support for making any Rel-15/16 capabilities (FGs) for L1 UE features that are mandatory for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) not be applicable for RedCap UEs. | |
| Apple | One of the component in the following feature should be not required for Redcap UEs  FG 0-1 CP-OFDM waveform for DL and UL  We proposed to not support CP-OFDM for UL for Redcap UE, which is one of two component of FG 0-1.  The justification is to save UE power due to smaller PAPR of DFT-S-OFDM waveform. | |

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## 3.5 Mandatory features for non-RedCap UEs that are optional for RedCap UEs

In this subsection, we focus on mandatory features for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) that should be optional for RedCap UEs.

**FL1 High Priority Question 3.5-1a: What Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that are mandatory for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) should be optional for RedCap UEs? (If you feel a need to also list L2/L3 features or RF/RRM features, make sure to prefix them clearly with L2/L3 or RF/RRM.)**

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Intel | The following should at least be changed to OPTIONAL w/ capability signaling for RedCap:   * + *FG #2-16b (Support 1+2 DMRS (uplink))*     - *Relevant to support of more than one antenna port in the UL*   + *FG #2-55 (SRS Tx switch)*     - *Relevant to support of multiple UL APs* | |
| ZTE, Sanechips | RF and RRM features 1-4 256QAM should be optional. | |
| vivo | * FG 1-7 of CSI-RS based RLM, i.e., *csi-RS-RLM*,   + For RedCap, UE can always perform radio link monitoring procedure based on measurement of SSB. The necessity of RedCap UE mandatorily support the CSI-RS based RLM may depend on whether RedCap UE can support a BWP without SSB [5]. * FG 2-4a/2-61of additional active TCI state/spatial relation for PDCCH/PUCCH, i.e., *additionalActiveTCI-StatePDCCH*/*additionalActiveSpatialRelationPUCCH*,   + For RedCap, it can be considered that the control and data channel can always use the same TCI state/spatial relation for complexity reduction. | |
| FUTUREWEI | None so far | |
| Ericsson | As commented in Section 3.2, we can agree that capabilities related to more than 2 UE Tx branches or more than 2 UL MIMO layers can be considered not applicable for RedCap UEs, but we think that capabilities related to up to 2 UE Tx branches and up to 2 UL MIMO layers should remain applicable as optional features for RedCap UEs since we do not see a reason to preclude a RedCap UE from supporting these features.  The following agreements may be relevant here unless they are captured in the Rel-17 RedCap RAN1 UE feature list discussion:  Agreements:   * For a RedCap UE, 64QAM MCS tables (Table 5.1.3.1-1 in TS 38.214 for DL and UL OFDM and Table 6.1.4.1-1 in TS 38.214 for UL w/ transform precoding respectively) are the “default” ones and are mandatory. * The following is optionally supported by RedCap UEs:   + 256QAM MCS tables (Table 5.1.3.1-2 in TS 38.214 for DL and UL OFDM)   + 64QAM low SE MCS tables (Table 5.1.3.1-3 in TS 38.214 for DL and UL OFDM and Table 6.1.4.1-2 in TS 38.214 for UL w/ transform precoding respectively)   Agreements:   * For a RedCap UE, “CQI table 1” (Table 5.2.2.1-2 in TS 38.214), that corresponds to MCS Table 5.1.3.1-1 in TS 38.214, is mandatory. * The following is optionally supported by a RedCap UE:   + “CQI table 2” (Table 5.2.2.1-3 in TS 38.214) that corresponds to MCS Table 5.1.3.1-2 in TS 38.214 (256QAM MCS table)   + “CQI table 3” (Table 5.2.2.1-4 in TS 38.214) that corresponds to MCS Table 5.1.3.1-3 in TS 38.214 (64QAM low SE MCS table)   Agreements:   * Both 256QAM MCS table for PDSCH and “CQI table 2” (Table 5.2.2.1-3 in TS 38.214) are supported by a RedCap UE indicating support of 256QAM for PDSCH.   Agreements:   * For a RedCap UE, support of 64QAM low SE MCS table for PDSCH and support of “CQI table 3” (Table 5.2.2.1-4 in TS 38.214) are not coupled and capability of each can be reported independent of the other.   Agreements:   * For a RedCap UE, support of 64QAM low SE MCS table for PDSCH (Table 5.1.3.1-3 in TS 38.214) and support of 64QAM low SE MCS tables for PUSCH (Table 5.1.3.1-3 in TS 38.214 for UL OFDM and Table 6.1.4.1-2 in TS 38.214 for UL w/ transform precoding respectively) are not coupled and capability of each can be reported independent of the other. | |
| Nokia, NSB | * 1-4 256QAM for PDSCH (in RF and RRM features) * 2-55 SRS Tx switch | |
| Samsung | Fine with making 2-16b and 2-55 as optional. | |
| FL2 | Based on the received responses, the following proposal can be considered.  **High Priority Proposal 3.5-1b: The following Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that are mandatory for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) should be optional for RedCap UEs.**   * **L1 FGs:**   + **1-7**   + **2-4a**   + **2-16b**   + **2-55**   + **2-61** * **RF/RRM FG:**   + **1-4** | |
| **Company** | **Y/N** | **Comments** |
| vivo | N | 2-16b, 2-55 has been included in **High Priority Proposal 3.4-1b,** therefore should not be listed here  Others are fine |
| Samsung | N | In general, for all the cases, except listed in WID, we don’t support to make mandatory as optional by default.  We perfer to keep 2-16b as mandatory due to the reason above.  We don’t agree 1-7 as optional, it should be kept as mandatory. Even NCD-SSB is supported, it doesn’t mean CSI-RS for RLM is not needed.  We don’t agree with FG 2-4a/2-61 as optional, this is no in the WID scope.  Fine with FG 1-4, which is aline with WID, although this could be part of RAN 4 UE feature. |
| MediaTek |  | We agree with FL’s Proposal 3.5-1b. |
| FUTUREWEI | N | For FG 2-16b and 2-55, same comments as provided in proposal 3.4-1a.  For 1-7 [CSI-RS based RLM], 2-4a [Additional active TCI state for PDCCH], 2-61 , similar reasons as provided by Samsung.  Ok to list RF/RRM 1-4. |
| Ericsson | N | Ok to list RF/RRM FG 1-4 |
| CMCC | N | For FG1-7, we share similar view with Samsung that it should not be optional. For non-RedCap UEs, even FG6-1a is optional, CSI-RS for RLM is still mandatory. |
| Nokia, NSB | N | The list goes way beyond the scope of the WID and it is not supported by agreements in RAN1 either. |
| FL3 | The following agreements have been made in the Rel-17 RedCap RAN1 UE feature list discussion in RAN1#106bis-e and RAN1#107-e:  Agreement:   * RedCap UE supports FG1-4 (256QAM for PDSCH) as optional with capability signalling both for FR1 and FR2   + Add a note in FG 1-4 (256QAM for PDSCH) that “For RedCap UEs, the 256QAM MCS table for PDSCH and CQI table 2 are only supported if the UE supports 256QAM for PDSCH”   Agreement:   * Add a note in FG 1-5 (256QAM for PUSCH) that “For RedCap UEs, the 256QAM MCS table for PUSCH is only supported if the UE supports 256QAM for PUSCH”   **High Priority Proposal 3.5-1d: Capture the following earlier RAN1 agreements regarding RF/RRM FGs 1-4 and 1-5 in the LS reply to RAN2:**   * **RedCap UE supports FG1-4 (256QAM for PDSCH) as optional with capability signalling both for FR1 and FR2**   + **Add a note in FG 1-4 (256QAM for PDSCH) that “For RedCap UEs, the 256QAM MCS table for PDSCH and CQI table 2 are only supported if the UE supports 256QAM for PDSCH”** * **Add a note in FG 1-5 (256QAM for PUSCH) that “For RedCap UEs, the 256QAM MCS table for PUSCH is only supported if the UE supports 256QAM for PUSCH”** | |
| ZTE, Sanechips | Y | OK to capture them in the LS. |
| vivo | Y |  |
| Nokia, NSB | Y |  |
| MediaTek | Y |  |
| Ericsson | Y |  |
| Qualcomm | Y |  |
| FL4 | Based on the received responses, it seems that the proposal can be accepted.  **High Priority Proposal 3.5-1d: Capture the following earlier RAN1 agreements regarding RF/RRM FGs 1-4 and 1-5 in the LS reply to RAN2:**   * **RedCap UE supports FG1-4 (256QAM for PDSCH) as optional with capability signalling both for FR1 and FR2**   + **Add a note in FG 1-4 (256QAM for PDSCH) that “For RedCap UEs, the 256QAM MCS table for PDSCH and CQI table 2 are only supported if the UE supports 256QAM for PDSCH”** * **Add a note in FG 1-5 (256QAM for PUSCH) that “For RedCap UEs, the 256QAM MCS table for PUSCH is only supported if the UE supports 256QAM for PUSCH”** | |
| Qualcomm | Y | It has been endorsed by RAN1 chair 😊 |
| FL5 | The following agreement was made on the RAN1 email reflector 18th November 2021:  Agreement:  Capture the following earlier RAN1 agreements regarding RF/RRM FGs 1-4 and 1-5 in the LS reply to RAN2:   * RedCap UE supports FG1-4 (256QAM for PDSCH) as optional with capability signalling both for FR1 and FR2   + Add a note in FG 1-4 (256QAM for PDSCH) that “For RedCap UEs, the 256QAM MCS table for PDSCH and CQI table 2 are only supported if the UE supports 256QAM for PDSCH” * Add a note in FG 1-5 (256QAM for PUSCH) that “For RedCap UEs, the 256QAM MCS table for PUSCH is only supported if the UE supports 256QAM for PUSCH” | |

## 3.6 Mandatory features for non-RedCap UEs that are supported for RedCap UEs but with different value

In this subsection, we focus on mandatory features for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) that should be supported for RedCap UEs but with different value.

**FL1 High Priority Question 3.6-1a: What Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that are mandatory for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) should be supported for RedCap UEs but with different value? (If you feel a need to also list L2/L3 features or RF/RRM features, make sure to prefix them clearly with L2/L3 or RF/RRM.)**

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Intel | At least FG # 6-1 should be adapted for RedCap UEs such that operation without CORESET #0 within the active DL BWP is mandated for RedCap UEs. | |
| Qualcomm | We disagree with Intel’s comments on FG 6-1. FG 6-1 should be supported by R17 RedCap UE as a mandatory capability in FR1. Besides, a new FG for RRC-configured DL BWP can be introduced, which includes SSB but not the entire CORESET#0. | |
| vivo | * FG 2-33 of CSI-RS and CSI-IM reception for CSI feedback, i.e., *csi-RS-IM-ReceptionForFeedback* field. * Component 4) that Supported max # simultaneous NZP-CSI-RS resources in active BWPs across all CCs and component 6) that Supported max total # of CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCsand 6) are not applicable to RedCap UEs.      * FG 2-35 of CSI report framework, i.e., *csi-ReportFramework* field defines the maximum number of CSI report setting. * Component 9) is not applicable to RedCap UEs.      * FG 2-51 of TRS, i.e., *csi-RS-ForTracking field,* it contains four component field: *maxBurstLength, max****Simultaneous****ResourceSets****PerCC****, max****Configured****ResourceSets****PerCC,*** and *max****Configured****ResourceSets****AllCC*.** * Component 4) is not applicable. | |
| FUTUREWEI | Same set as vivo listed: 2-33, 2-35, 2-51 (there are some values for CA). it is up to RAN2 whether to note the values that RedCap should not report. | |
| Nokia, NSB | It is not clear if there are FGs requiring modification on signalling values for RedCap UEs. | |
| Samsung | We think FG 6-1 can be discussed later. | |
| FL2 | Based on the received responses, the following proposal can be considered.  **High Priority Proposal 3.6-1b: The following Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that are mandatory for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) should be supported for RedCap UEs but with different value.**   * **2-33** * **2-35** * **2-51** * **6-1** | |
| **Company** | **Y/N** | **Comments** |
| vivo |  | More discussion is needed 6-1, we may introduce new FG rather than revising FG6-1. |
| Samsung |  | For 2-33, 2-35, 2-51, we like to clarify that, there is no intention to change the value per CC. Since more CC is not applicable for Redcap, there is no need to change it either. But we can live with removing some of compoments for across all CC cases.  For 6-1, so far, we don;t see a need. It is defined per CC. |
| MediaTek |  | The following components of mandatory FGs are not applicable to RedCap.  • Components 4) and 6) of mandatory FG 2-33 are not applicable to RedCap.  • Component 9) of mandatory FG 2-35 are not applicable to RedCap.  • Component 4) of mandatory FG 2-51 are not applicable to RedCap.  Mandatory FG 6-1 for non-RedCap should be supported by RedCap as a mandatory UE feature without modifying its components. Depending on the final agreements in agenda 8.1.1, we can add a new feature group to capture the case where an active DL BWP contains SSB (CD-SSB or NCD-SS) but not CORESET#0. |
| Intel | Y | Fine with the FL2 proposal.  In our view, FG 6-1 should be updated for RedCap UEs; else, if a new FG is intrduced to replace 6-1, then FG 6-1 should be precluded (not applicable) for RedCap UEs. |
| FUTUREWEI |  | More discussion needed for FG6-1. Fine with listing 2-33, 2-35, 2-51 |
| Ericsson |  | Regarding 2-33, 2-35, and 2.51, it may not be necessary to provide the complete list of FGs related to non-applicable capabilities such as CA, DC, etc. Regarding 6-1, more discussion is needed. |
| Huawei, HiSi | N | 6-1 can be kept and new FG can be discussed based on Ran1 progress.  For other FGs than FG 6-1, basically for single CC case, there is no need to change the candidate values. Thus only components related to CA/across CCs is/are not applicable to RedCap. |
| CMCC |  | For FG6-1, it can wait for RAN1 progress. |
| Nokia, NSB | N | FG6-1 (Basic BWP operation with restriction) is mandatory without capability signaling. It is unclear what to change here. In general there is little value in giving feedback to RAN2 that some capabilities need different value without telling what those values are. We should not give such feedback before there is actual discussion and agreement on such different values. |
| FL3 | There does not seem to be support for making any Rel-15/16 capabilities (FGs) for L1 UE features that are mandatory for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) supported for RedCap UEs but with different value. | |
| Intel | We can accept this conclusion with the understanding that handling of FG 6-1 remains open – a RedCap UE should NOT expect CORESET #0 in active DL BWP. We are fine to capture as a separate mandatory FG for RedCap UEs on top of 6-1. | |
| Qualcomm | Agree with the comments of Vivo and Nokia.   * FG 6-1 should be mandaotry for R17 RedCap UE in FR1, which does not require capability signaling. * A new FG for RRC-configured DL BWP which includes SSB but not CORESET#0 can be additionally supported by a R17 RedCap UE. * If a RedCap UE supports FG 6-1a as an optional feature, it can operate in a RRC-configured active DL BWP without SSB. L1 measurement gap (for the CD-SSB of serving cell) needs to be specified for RedCap UEs supporting FG 6-1a. | |
| vivo | * + - 1. Agree with Intel that FG6-1 should be further discussed       2. As we commented before, 2-33/2-35/2-51 includes components that related to CA which may not be easily figured out by RAN2. | |
| Nokia, NSB | Y | |
| Ericsson | The reply LS to RAN2 should capture potential RAN1 agreements related to 6-1, 6-1, and similar FGs. | |
| FL4 | Once the BWP operation discussion under RAN1#107-e agenda item 8.6.1.1 has progressed further (related to FG 6-1, 6-1a, etc.), the outcome can be captured in the reply LS to RAN2. | |
| Qualcomm | Y | |
| Nokia, NSB | OK | |

## 3.7 Optional features for non-RedCap UE that are not applicable for RedCap UE

In this subsection, we focus on optional features for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) that should be not be applicable for RedCap UEs.

**FL1 High Priority Question 3.7-1a: What Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that are optional for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) should not be applicable for RedCap UEs? (If you feel a need to also list L2/L3 features or RF/RRM features, make sure to prefix them clearly with L2/L3 or RF/RRM.)**

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| vivo | Features related to UE 2Tx transmission are not applicable to RedCap UEs,   * **Rel-15 UL MIMO related: FG2-13 and FG2-14;** * **Rel-16 SL rank 2: FG15-18.** * **Rel-16 UE full power Tx: FG 16-5a, FG 16-5b, FG 16-5c, FG16-5c-2, FG16-5c-3** | |
| FUTUREWEI | None so far | |
| Ericsson | As commented in Section 3.2, we can agree that capabilities related to more than 2 UE Tx branches or more than 2 UL MIMO layers can be considered not applicable for RedCap UEs, but we think that capabilities related to up to 2 UE Tx branches and up to 2 UL MIMO layers should remain applicable as optional features for RedCap UEs since we do not see a reason to preclude a RedCap UE from supporting these features. | |
| Nokia, NSB | * 4-25 Parallel SRS and PUCCH/PUSCH transmission across CCs in inter-band CA (requires UL CA) * 4-26 Parallel PRACH and SRS/PUCCH/PUSCH transmissions across CCs in inter-band CA (requires UL CA) * 2-56 SRS carrier switch * 4-27 More than one group of overlapping channels for control multiplexing * 16-3a-3 Support of rank 3,4 * 16-3b-2 Support of rank 3,4 | |
| FL2 | Based on the received responses, the following proposal can be considered. FGs 2-56, 4-25 and 4-26 are not listed in this proposal since they are already captured in the proposals in subsections 3.1 – 3.3.  **High Priority Proposal 3.7-1b: The following Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that are optional for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) should not be applicable for RedCap UEs.**   * **2-13** * **2-14** * **16-5a – 16-5c-3** | |
| **Company** | **Y/N** | **Comments** |
| vivo |  | Agree with the listed item. FG15-18 should be added in the list as it is related to sidelink rank2 transmission. |
| Samsung | N | We don’t think there is a need to forbiden UE to support optional features other than the ones listed in WID. |
| MediaTek |  | According to WID description [RP-211574], complexity of RedCap devices should be lower compared to high-end eMBB and URLLC devices of Rel-15/Rel-16. Hence, we propose the following optional features for non-RedCap UEs are not applicable to RedCap UEs.   * UE processing time capability 2   + FGs 5-5a, 5-5b, 5-5c, 5-13, 5-13a-f   + Uplink CBG with UE processing capability 2: FGs 22-3a, 22-3b, 22-3c, 22-3d, 22-3e, 22-3f, 22-g, 22-h * Uplink CBG-based retransmission:   + FG 5-25: CBG-based re-transmission for UL using CBGTI   + FG 11-12: CBG-based re-transmission for UL using CBGTI with only in-order CBG-based re-transmission(s) for cancelled initial PUSCH transmission   + Uplink CBG with UE processing capability 2: FGs 22-3a, 22-3b, 22-3c, 22-3d, 22-3e, 22-3f, 22-g, 22-h   + Uplink CBG with UE processing capability 1: FGs 22-4a, 22-4b, 22-4c, 22-4d * URLLC:   + FG 11-2x: sub-slot based PDCCH monitoring   + FG 11-3x: support more than one PUCCH for HARQ-ACK in a slot   + FG 11-4x: support HARQ-ACK codebooks with different priorities at a UE   + FG 11-7x: UL cancellation * SCS of 60kHz in FR1   + RF/RRM 1-1: 60kHz of subcarrier spacing for FR1 * BWP adaptation with different numerologies   + FG 6-4: BWP adaptation with different numerologies |
| Intel | N | Same view as Samsung. There is no need to change optional features, except possibly for any necessary adjustments in case a RedCap UE supports an optional feature, to which we have not identified any yet. |
| FUTUREWEI | N | Support of 2 UL ports is not precluded in the WID for 2-13, 2-14 or in the other features. |
| Ericsson | N |  |
| Nokia, NSB | N | Support of 2 UL ports is not precluded for RedCap UEs, hence the list above is not correct. |
| FL3 | There does not seem to be support for making any Rel-15/16 capabilities (FGs) for L1 UE features that are optional for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) not applicable for RedCap UEs. | |
| vivo | Prefer to preclude 2Tx in UL for RedCap UEs. | |
| HW, HiSi | There shall be discussion on whether or not to support 2Tx for RedCap. | |
| Nokia, NSB | OK | |
| Qualcomm | OK | |
| FL4 | A new Proposal 3.2-3a on the support of 2 UE Tx branches or 2 UL MIMO layers can be found further down in Section 3.2 of this document. | |

## 3.8 Optional features for non-RedCap UE that are mandatorily supported for RedCap UE

In this subsection, we focus on optional features for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) that should be mandatory for RedCap UEs.

**FL1 High Priority Question 3.8-1a: What Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that are optional for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) should be mandatory for RedCap UEs? (If you feel a need to also list L2/L3 features or RF/RRM features, make sure to prefix them clearly with L2/L3 or RF/RRM.)**

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| ZTE, Sanechips | 6-1a could be considered, which is related to the discussion of 8.6.1.1. | |
| vivo | None | |
| FUTUREWEI | 5-17a (PDSCH repetitions over multiple slots). This provides additional scheduling flexibility and potentially reduces the number of HARQ-based retransmissions due to the reduced number of Rx branches | |
| Nokia, NSB | 6-1a BWP operation without restriction on BW of BWP(s) | |
| Samsung | 6-1a can be considered depends on the outcome of the meeting. | |
| FL2 | Based on the received responses, the following proposal can be considered.  **High Priority Proposal 3.8-1b: The following Rel-15/16 capabilities (FGs) for L1 UE features in** [**TR 38.822 V16.1.0**](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip) **that are optional for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) should be mandatory for RedCap UEs.**   * **5-17a** * **6-1a** | |
| **Company** | **Y/N** | **Comments** |
| vivo |  | 5-17a can be kept optional as SI concluded that no strong need for PDSCH coverage recovery, therefore relavent enhancement was not incldued in the WID.  6-1a is clearly not acceptable according to the ongoing discussion in AI 8.6.1.1 |
| MediaTek |  | We don’t support the proposal. We don’t see a need to mandate RedCap UEs to support optional features. |
| Intel |  | Fine to consider 5-17a, but 6-1a needs to wait for further progress in AI 8.6.1.1. |
| FUTUREWEI |  | We support 5-17a. We need to wait for additional progress in 8.6.1.1 for 6-1a |
| Ericsson |  | From the RedCap SI (TR 38.875) evalations, it seems that PDSCH is not a coverage bottleneck, except in some cases when Msg2 or Msg4 may potentially be coverage limiting, but in these cases it is expected that already mandatory functionality (TBS scaling for Msg2, HARQ retransmission for Msg4) will be enough, i.e. there may not be a need for FG 5-17a. FG 6-1a needs more discussion. |
| Spreadtrum |  | We share the similar view as vivo and MTK. |
| Nokia, NSB | Y | OK in principle |
| FL3 | There does not seem to be support for making any Rel-15/16 capabilities (FGs) for L1 UE features that are optional for non-RedCap UEs (other than the ones treated in subsections 3.1 – 3.3) mandatory for RedCap UEs. | |
| Qualcomm | FG 6-1a should NOT be mandatory for a R17 RedCap UE. | |
| MediaTek | Our view remains the same: RedCap UE should not be mandated to support optional features. | |
| FL4 | Once the BWP operation discussion under RAN1#107-e agenda item 8.6.1.1 has progressed further (related to FG 6-1, 6-1a, etc.), the outcome can be captured in the reply LS to RAN2. | |

# 4 Applicability of Rel-17 features

For each Rel-17 WI, a UE feature list is produced. The UE feature list for RedCap is discussed in the email discussion [107-e-R17-UE-features-REDCAP-01]. The UE feature lists for other Rel-17 WIs are discussed in other email discussions. The latest overall Rel-17 UE feature list is available in [8]. Some of the features developed in other Rel-17 WIs may have a different applicability for RedCap and non-RedCap UEs. The same categories can be used as in the previous section in this document, i.e.:

1. Mandatory features for non-RedCap UEs that are not applicable for RedCap UEs
2. Mandatory features for non-RedCap UEs that are optional for RedCap UEs
3. Mandatory features for non-RedCap UEs that are supported for RedCap UEs but with different value
4. Optional features for non-RedCap UE that are not applicable for RedCap UE
5. Optional features for non-RedCap UE that are mandatorily supported for RedCap UE

**FL1 Medium Priority Question 4-1a: Companies are invited to provide their views regarding whether there are Rel-17 features (developed in other WIs than RedCap) that have a different applicability for RedCap and non-RedCap UEs. Use the template below.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Template | <Y or N> | Mandatory features for non-RedCap UEs that are not applicable for RedCap UEs:   * […]   Mandatory features for non-RedCap UEs that are optional for RedCap UEs:   * […]   Mandatory features for non-RedCap UEs that are supported for RedCap UEs but with different value:   * […]   Optional features for non-RedCap UE that are not applicable for RedCap UE:   * […]   Optional features for non-RedCap UE that are mandatorily supported for RedCap UE:   * […] |
| Intel |  | While we would provide detailed feedback in a subsequent round, we suggest simplifying the categories as we do not expect any new UE capabilities to be defined in Rel-17 that may be mandatory for non-RedCap UEs. Thus, the first three categories above may be removed. |
| FL |  | Regarding Intel’s comment above, feel free to only copy the headings from the template above that you think are relevant. |
| Qualcomm |  | UE features of NR R17 UL coverage enhancement, power saving enhancement, SDT, ePOS and MBS can be optionally supported by R17 RedCap UE |
| vivo |  | Rel-17 NR features that are not applicable to RedCap UEs   * FeMIMO features that requires more that 2Rx or more than 2Tx at the UE side, detailed TBD * All NR NTN features * All IAB features |
| FUTUREWEI |  | This is a good start to begin discussing relevant Rel-17 features for RedCap UEs.  Optional features for non-RedCap UE that are not applicable for RedCap UE:  • (IAB) 31-x; (cross-carrier scheduling): 34-1, 34-2; (EN-DC) 35-1; (1024QAM) 36-1 |
| FL2  FL3  FL4 | Based on the received responses, the following question can be considered. Features related to IAB, CA, DC, EN-DC or other features that are already agreed not to be supported by RedCap UEs are not listed in the proposal below.  **Medium Priority Question 4-1b: Companies are invited to provide their views regarding whether there are Rel-17 features (developed in other WIs than RedCap) that have a different applicability for RedCap and non-RedCap UEs, in particular regarding the following features.**   * **NR NTN features** * **1024QAM** | |
| Intel | We think NR NTN can be optionally supported.  However the following may not be applicable to RedCap UEs:   * ***Above-52GHz*** * ***ePositioning*** * ***eIAB*** * ***SL/V2X enh*** * ***DSS enh*** * ***NR DC/CA further enhancements*** * ***DL 1024QAM*** | |
| HW, HiSi | OK with FL proposal and we think ePositioning related capabilities can be kept optioanl. | |
| Nokia, NSB | eIAB, NR DC/CA further enhancements, DSS, and DL 1024QAM should not be supported by RedCap UEs. The other WIs require more discussion. | |
| MediaTek | We agree that NR NTN and 1024QAM are not applicable to RedCap. Furthermore, we think the following Rel-17 features should not be applicable to RedCap to strive to reduce RedCap’s complexity.   * FGs 31-x in NR\_IAB\_enh * FGs 34-x in NR\_DSS * FGs 35-x in LTE\_NR\_DC\_enh2 * FGs 25-x in NR\_IIOT\_URLLC\_enh * FGs 27-x in NR\_pos\_enh * FFS details for FeMIMO | |
| Qualcomm | We are fine to exclude eIAB, NR DC/CA further enhancements, and DL 1024QAM from R17 RedCap UE features.  However, we think FGs of R17 NR NTN and ePositioning applicable to R17 RedCap UE can be optionally supported. | |

# 5 Draft reply LS

Based on the discussion in early sections of this document, the following proposal can be considered.

**FL5 High Priority Proposal 5-1a: Agree the draft LS in** [***RedCapDraftLSCapability-v000.docx***](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107-e/Inbox/drafts/8.16.6/%5B107-e-R17-UE-features-REDCAP-02%5D/DraftLS/RedCapDraftLSCapability-v000.docx)**.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| FUTUREWEI | Y | An editorial suggestion. After the sentence beginning with “Furthermore", we suggest to add “The addition of the notes for FGs 1-4 and 1-5 is a RAN1 recommendation, whether/how to add the notes is up to RAN2." |
| Intel | Y |  |
|  |  |  |

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