3GPP TSG-RAN WG1 Meeting #107-e R1-21xxxxx

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 FL2.

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.

**FL2 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 |
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# 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]. | |

# 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   1. 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  1. Prefer not to list RAN2 FGs (related to 16-x RAN2, 16-z RAN2), and focus on RAN1 FGs 2. 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. |
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## 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.**   1. **4-12** 2. **16-3a-3** 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. |
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## 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.)**

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| **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.**   1. **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. |
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## 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.)**

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| **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.**   1. **2-16b** 2. **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. |
|  |  |  |

## 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.)**

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| --- | --- | --- |
| **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.**   1. **L1 FGs:**    1. **1-7**    2. **2-4a**    3. **2-16b**    4. **2-55**    5. **2-61** 2. **RF/RRM FG:**    1. **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. |
|  |  |  |

## 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. | |
| FUTUREWEI1 | 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.**   1. **2-33** 2. **2-35** 3. **2-51** 4. **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. |
|  |  |  |

## 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,   1. **Rel-15 UL MIMO related: FG2-13 and FG2-14;** 2. **Rel-16 SL rank 2: FG15-18.** 3. **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.**   1. **2-13** 2. **2-14** 3. **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. |
|  |  |  |

## 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.**   1. **5-17a** 2. **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 |
|  |  |  |
|  |  |  |

# 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 | 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. Use the template below.**   1. **NR NTN features** 2. **1024QAM** | |
| Template | 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:   * […] | |

# References

1. [RP-211574](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_92e/Docs/RP-211574.zip), “Revised WID on support of reduced capability NR devices”, Ericsson

1. [R1-2108271](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106-e/Docs/R1-2108271.zip), “RAN1 agreements for Rel-17 NR RedCap”, Rapporteur (Ericsson)

1. [R1-2108714](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2108714.zip), “LS on capability related RAN2 agreements for RedCap”, RAN2

1. [R1-2110382](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2110382.zip), “FL summary on incoming LS on capability related RAN2 agreements for RedCap”, Moderator (Ericsson)

1. [RP-212634](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_93e/Docs/RP-212634.zip), “Moderator's summary for discussion [93e-16-RedCap-WI]”, Intel

1. [TR 38.822 V16.1.0](https://www.3gpp.org/ftp/Specs/archive/38_series/38.822/38822-g10.zip), “NR; User Equipment (UE) feature list (Release 16)”

1. [TR 38.875 V17.0.0](https://www.3gpp.org/ftp/Specs/archive/38_series/38.875/38875-h00.zip), “Study on support of reduced capability NR devices (Release 17)”

1. [R1-2110587](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2110587.zip), “Updated RAN1 UE features list for Rel-17 NR after RAN1 #106bis-e”, Moderators (AT&T, NTT DOCOMO, INC.)

1. [R1-2110773](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2110773.zip), “UE features for RedCap”, Ericsson
2. [R1-2110803](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2110803.zip), “Rel-17 UE features for RedCap”, Huawei, HiSilicon

1. [R1-2110893](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2110893.zip), “Further discussion on UE features for REDCAP”, FUTUREWEI

1. [R1-2111072](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2111072.zip), “Discussion on RedCap UE features”, ZTE, Sanechips
2. [R1-2111157](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2111157.zip), “On UE features for REDCAP”, Nokia, Nokia Shanghai Bell
3. [R1-2111530](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2111530.zip), “On UE features for RedCap”, Intel Corporation

1. [R1-2111774](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2111774.zip), “UE feature for RedCap”, Samsung
2. [R1-2111910](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2111910.zip), “UE features for RedCap”, Apple
3. [R1-2112136](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2112136.zip), “Discussion on UE features for RedCap”, NTT DOCOMO, INC.
4. [R1-2112251](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2112251.zip), “UE features for RedCap”, Qualcomm Incorporated

1. [R1-2112289](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2112289.zip), “Views on UE features for RedCap”, MediaTek Inc.

1. [R1-2111022](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2111022.zip), “Remaining issues on L1 reduced capability signaling”, Vivo, Guangdong Genius