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 FL1.

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.

**FL1 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 |
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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:

|  |
| --- |
| 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. |
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# 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 |

## 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. |
|  |  |

## 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. |
|  |  |

## 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. |
|  |  |

## 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. |
|  |  |

## 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. |
|  |  |

## 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.)**

|  |  |
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| **Company** | **Comments** |
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## 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.)**

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| --- | --- |
| **Company** | **Comments** |
| FL (v003) | The body text between the heading and the question in this subsection was corrected. |
| ZTE, Sanechips | 6-1a could be considered, which is related to the discussion of 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 (v002) |  | 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 |

# References

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2. [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)
3. [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
4. [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)
5. [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
6. [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)”
7. [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)”
8. [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.)
9. [R1-2110773](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2110773.zip), “UE features for RedCap”, Ericsson
10. [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
11. [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
12. [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
13. [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
14. [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
15. [R1-2111774](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2111774.zip), “UE feature for RedCap”, Samsung
16. [R1-2111910](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2111910.zip), “UE features for RedCap”, Apple
17. [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.
18. [R1-2112251](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2112251.zip), “UE features for RedCap”, Qualcomm Incorporated
19. [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.
20. [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