3GPP TSG-RAN WG1 Meeting #106 bis-e R1-210xxxx

e-Meeting, 11th – 19th October 2021

**Agenda Item: 8.6.2**

**Title: FL summary #1 on RAN1 aspects for RAN2-led features for RedCap**

**Source: Moderator (Apple)**

**Document for: Discussion, Decision**

# Introduction

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

This document summarizes contributions [3] – [33] submitted to agenda item 8.6.2, agenda item 8.6.3 and captures this email discussion on RAN1 aspects for RAN2-led features for RedCap:

|  |
| --- |
| [106bis-e-NR-R17-RedCap-04] Email discussion regarding RAN1 aspects for RAN2-led features (except those related to UE features which will be handled under 8.17.6) – Hong (Apple)* 1st check point: October 14
* Final check point: October 19
 |

The issues in this document are tagged and color coded with High Priority or Medium Priority.

In this round of the email discussion, please comment on the issues tagged ‘FL1’ before Tuesday 12th October 05:00 (AM) UTC.

Follow the naming convention in this example:

* *RedCapR2ledFLS1-v000.docx*
* *RedCapR2ledFLS1-v001-CompanyA.docx*
* *RedCapR2ledFLS1-v002-CompanyA-CompanyB.docx*
* *RedCapR2ledFLS1-v003-CompanyB-CompanyC.docx*

If needed, you may “lock” the discussion document for 30 minutes by creating a checkout file, as in this example:

* Assume CompanyC wants to update *RedCapBwFLS1-v002-CompanyA-CompanyB.docx*.
* CompanyC uploads an empty file named *RedCapBwFLS1-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 in Annex).
* CompanyC then has 30 minutes to upload *RedCapBwFLS1-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 [R1-2106403](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106403.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.

The following is an outline of the summary:

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# Early indication of RedCap UEs

## Early indication in 2-step RACH

### Issue 1: Early indication for Redcap by MsgA PRACH in 2-Step RACH

The following was agreed in RAN1 105 e-meeting that 2-step RACH [2]:

|  |
| --- |
| Agreements:* Support 2-step RACH for RedCap UEs as an optional feature
	+ FFS details of early indication in MsgA, e.g.:
		- Separation of 2-step RACH resources or MsgA preambles
		- Separation of initial UL BWP
		- Using a new indication in MsgA PUSCH part
	+ Note: Discussion on 4-step RACH for early indication should be prioritised
 |

In addition, the following was agreed in RAN1 106-e meeting to enable early indication of Redcap UEs in 4-step RACH procedure [2]:

|  |
| --- |
| Agreements:Confirm the following working assumption with the modifications in red:* For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.
	+ The early indication in Msg1 can be configured to be enabled/disabled via SIB
	+ From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP (if supported)
		- separate PRACH resource
		- PRACH preamble partitioning

Whether/how to support early indication of RedCap UEs in Msg3 in Rel-17 is up to RAN2. |

Many contributions [5, 6, 9, 10, 11, 12, 14, 16, 17, 22, 23, 24, 29] discussed the details of early indication for Redcap UEs for 2-step RACH. Companies’ positions are briefly summarized in Table 1 below.

**Table 1: Early indication of RedCap UEs in PRACH resource of 2-step RACH**

|  |  |  |
| --- | --- | --- |
| Description | Yes | No |
| Companies | Num. of companies | Companies | Num. of companies |
| * Separate PRACH resource in Msg.A
* PRACH preamble Partitioning in Msg.A
 | Ericsson [5], Spreadtrum [6], CATT [9], China Telecom [10], CMCC [11], ZTE [14], Samsung [16], Intel [17], IDC [22], LGe [23], Sharp [24], Lenovo [29]  | 12 | Nokia ([12], less useful, only 4-step RACH fallback case) | 1 |

Contribution [5,10,14, 24] additionally propose that the early indication in MsgA preamble should be configured to be enabled/disabled via SIB, as handled for 4-step RACH. The rationale in [5] is that the indication in MsgA PUSCH is enough for early indication of Redcap in most cases. The indication in MsgA preamble is needed only to Case 4 where coverage recovery of MsgB PDSCH carrying fallback RAR when MsgA preamble is detected but MsgA PUSCH is not decoded correctly (or if MsgA PUSCH is not transmitted).

* <1st Round Comments>

Given the almost unanimously proposals for 2-step RACH and the configurability can address the concern of usefulness in [12], FL therefore proposes the following for PRACH in 2-step RACH, which is aligned with the agreements made for 4-Step RACH

**FL1 High Priority Proposal 2.1-1:**

* **For 2-step RACH, support the early indication of RedCap UEs at least in MsgA PRACH.**
	+ **The early indication in MsgA PRACH can be configured to be enabled/disabled via SIB**
	+ **From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP (if supported)**
		- **separate MsgA PRACH resource**
		- **MsgA PRACH preamble partitioning**

Companies are invited to provide feedback with briefly justification if change is needed.

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
|  |  |  |
|  |  |  |
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### Issue 2: Early indication for Redcap by MsgA PUSCH in 2-Step RACH

On early indication of Redcap using MsgA PUSCH, companies views are captured in Table 2. One contribution [5] stated that there is no need to have a “configurable” MsgA PUSCH indication, i.e., RedCap UEs should always indicate CCCH using the RedCap-specific LCID.

**Table 2: Early indication of RedCap UEs in MsgA PUSCH of 2-step RACH**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Description | Companies | # Of Companies |
| Alt.1:  | Up to RAN2 | Ericsson [5], China Telecom [10], Nokia [12], ZTE [14], | 4 |
| Alt.2 | Support | Spreadtrum [6], CATT ([9], same as Msg3 of 4-step RACH), Intel [17], IDC [22], Sharp [24, Same dedicated LCID],  | 6 |

* <1st Round Comments>

For early indication of Redcap in 4-step RACH procedure, it was agreed to leave for RAN2 to decide whether and how to use Msg3. It is moderator’s understanding that similarly MsgA PUSCH for early indication can leave for RAN2 for the consistency. .

**FL1 High Priority Question 2.1-1:** **Which one of the following alternatives do you support for early indication by MsgA PUSCH in 2-step RACH?**

* **Alt.1: It is up to RAN2 regarding whether/how to support early indication of RedCap UEs in MsgA PUSCH in Rel-17**
* **Alt.2: Early indication of RedCap UEs in MsgA PUSCH is supported by indicating CCCH using the RedCap-specific LCID.**

Please provide brief justification for the preferred alternative.

|  |  |  |
| --- | --- | --- |
| **Company** | **Alternative** | **Comments** |
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## Early indication in 4-step RACH

In RAN1 106 e-Meeting, the following was agreed:

|  |
| --- |
| Agreements:Confirm the following working assumption with the modifications in red:* For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.
	+ The early indication in Msg1 can be configured to be enabled/disabled via SIB
	+ From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP (if supported)
		- separate PRACH resource
		- PRACH preamble partitioning

Whether/how to support early indication of RedCap UEs in Msg3 in Rel-17 is up to RAN2. |

RAN2 #115-e Meeting made the following agreement for Msg1-based and Msg3-based early identification:

|  |
| --- |
| Agreements:* Msg1 identification which can be configured to be enabled/disabled can be specified from RAN2 point of view.

Agreements online:1. A Msg3 early identification based on dedicated LCID is supported (if SA3 confirms there is no problem) |

### Issue 3: Configuration of Msg1-based and Msg3-based early indication

UE behavior regarding early indication of Redcap UEs using Msg-1 and/or Msg-3 are discussed by a few contributions [9, 13, 19]. Companies’ views can be summarized as follows

* P1 [CATT, 9]: For 4-step RACH,
	+ If RedCap-dedicated RO/preambles are configured, the RedCap UE shall indicate RedCap UE type during Msg1. In this case, the RedCap UE will not indicate RedCap UE type during Msg3.
	+ If RedCap-dedicated RO/preambles are NOT configured and if separate initial UL BWP is configured, the RedCap UE shall indicate RedCap UE type during Msg3.
	+ For 4-step RACH, if RedCap-dedicated RO/preambles are NOT configured and if separate initial UL BWP is NOT configured, the RedCap UE does not indicate RedCap UE type during Msg3
* P2 [Lenovo,13] [LGe, 23]:
	+ The enable/disable of early identification of RedCap UEs in Msg1 is implicitly signalen by whether separate RACH resource is configured for RedCap UEs.
* P3 [Sierra Wireless, 19]:
	+ Msg3 early RedCap UE indication can be configured to be enabled/disabled via SIB
	+ SIB can indicate which RedCap devices will use Msg1 or Msg3 early indication based on UE capabilities. UE Capabilities at least include
		- 1 RX or 2 RX Antenna
		- FD-FDD or HD-FDD
		- FFS: Other capabilities
	+ One example was provided in [19] regarding the SIB indication approach as shown in Table below:

|  |  |
| --- | --- |
| **SIB Configurations** | **Interpretation** |
| Msg 1 and Msg3 are not used  | Network does not need to know RedCap early indication b/c system BW is 20MHz and coverage is not an issue |
| Msg 1 – 1 RX RedCap UEsNothing – All Other Redcap UEs | Network needs to apply additional coverage for 1 RX devices but not for 2 RX device. No issue with scheduling all devices within 20MHz. |
| Msg 1 – 1 RX RedCap UEsMsg 3 – All Other Redcap UEs | Network needs to apply additional coverage for 1 RX devices but not for 2 RX device. Network wants to schedule RedCap devices differently than legacy UEs.  |
| Msg 1 – 1 RX RedCap UEsMsg 3 – HD-FDD RedCap UEs | Network needs to apply additional coverage for 1 RX devices but not for 2 RX device. Network wants to schedule HD-FDD differently than FD-FDD RedCap UEs and legacy UEs |

Table 3: Example SIB configurations for Msg1 and Msg3 early indication [19]

* P4 [Sierra Wireless, 19]:
	+ If more than one LCID is available for signaling of RedCap, then it can be used to inform the network of other capabilities, such as FD-HDD.
* P5: [Sharp, 24]
	+ For 4-step RACH, RedCap UEs shall indicate CCCH using the dedicated LCID in Msg3 PUSCH, regardless of whether the RedCap UEs perform early indication in Msg 1 or not.
* <1st Round Comments>

**FL1 High Priority Question 2.2-1: Which one(s) among the listed P1/P2/P3/P4/P5 above should be discussed and decided in RAN1, instead of RAN2?**

Please provide justification for your preference.

|  |  |
| --- | --- |
| **Company** | **Comments** |
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### Issue 4: PRACH preamble partitioning for Msg1-based early indication

PRACH partitioning for 4-step and 2-step RACH procedure was discussed by several contributions [4,12,13,23,26,28,29, 30]. Contribution [12,13,23,30] indicates that PRACH resource handling across multiple new features was discussed in RAN2 115 Meeting under AI ‘8.18 RACH indication and partitioning’ and the following was concluded by RAN2 [34].

|  |
| --- |
| **Agreements:**1. Preamble partitioning is defined on a feature and/or feature combination basis. FFS on signalling. 2step RA and CE is excluded, if RAN1 decided to exclude2. Preambles associated with a Rel-17 feature should never be chosen by legacy UEs in the case of RO sharing. 3. New feature and/ feature combination specific preambles can be defined in a) Separate time-frequency resources, not defined through legacy RRC signalling, b) Within the Contention free preamble resources (i.e. within the preambles not used for contention based) defined through legacy RRC signalling. FFS on c) Within the “not available” preambles defined at the end of a RO through the legacy totalNumberOfRA-Preambles4. A common RRC CR capturing the signalling framework for RACH resource configuration across all the WIs should be used and this CR should be maintained as part of the common RACH agenda item. Each WI is expected to provide the necessary parameters to include in the signalling.5. A common MAC CR capturing the changes to sections 5.1.1 and section 5.1.1a of the MAC spec can also be considered and if agreeable, this CR should also be maintained as part of the common RACH agenda item.6. As a baseline, the RA procedure design for Rel-17 should adhere to the following general principles: a: Carrier selection (between NUL/SUL) should happen ahead of the initial RACH resource selection (i.e. feature combination is not considered in carrier selection). b: Initial RACH resource should be selected based on the selected carrier for the selected feature combination (i.e., selected slice, SDT or not, REDCAP or not etc). Only the RACH resource matching the feature and/or feature combination of current RACH procedure will be considered as available in the RACH resource selection.c: As a general rule, all RACH retransmissions (if any are needed, until RACH failure happens) shall be performed over the same RACH resources (and same carrier – NUL/SUL) as the one selected for initial RACH resource. However, we can discuss fallback on a case by case basis if there is a strong motivation and discuss them together in this AI. |

Given the RAN2 conclusion and ongoing discussion, contributions [12,13,23,28] further suggest deferring the discussion of PRACH preamble partitioning to RAN2, including support of Redcap early indication. One contribution [26] proposes to explicitly configure offset and number of consecutive preambles for the RedCap UE early identification irrespective of ROs are shared with non-RedCap UEs or not. However, one contribution [30] proposed to at least support the following PRACH resource configuration: 1) “RedCap UE with CE’, ‘RedCap UE without CE”, ‘non-RedCap UE with CE’ and ‘non-RedCap UE without CE’ to have different PRACH resources; 2) ‘RedCap UE without CE’ and ‘non-RedCap UE with CE’ to have different PRACH resources.

* <1st Round Comments>

**Medium Priority Proposal 2.2-1:**

* **It is up to RAN2 for PRACH preamble partitioning for Msg1-based early indication**

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| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
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One contribution [6] states that the configuration of early indication in 2-step RACH should be in line with 4-step RACH, which is motivated by the operation that a UE may fall back to 4-step RACH. one example provided in [6] is that if early indication in Msg1 is configured, for 2-step RACH early indication in MsgA preamble part is also configured.

# Definition of Redcap UE Type

## Issue 4: Redcap UE Type Definition

The WID stipulates that only one RedCap UE type should be specified [1]. Moreover, the following agreement was also made by RAN2 during RAN2#114-e [3].

|  |
| --- |
| Agreements:1. […]
2. At least for early identification there will be only one RedCap UE (no need to define separate RedCap UE types for FR1 and FR2)
3. […]
 |

With regards to the definition of the RedCap UE type, the following agreement was made by RAN1 during RAN1#106-e [4]:

|  |
| --- |
| Agreements:* A RedCap UE type from RAN1 point of view supports a maximum bandwidth of 20MHz for FR1 and 100MHz for FR2
* Further discuss whether to capture also one or more of the following capabilities to RedCap UE type description
	+ Supports either 1 or 2 Rx branches and corresponding maximum DL MIMO layers
	+ Supports either FD-FDD or Type A HD-FDD operation for FR1 FDD bands
	+ Supports either DL up to 64 QAM or up to 256 QAM for FR1
	+ Does not support CA/DC
 |

Table 3 summarized companies’ preference on Redcap UE type definition with brief notes:

**Table 3: Definition of Redcap UE Type**

|  |  |  |  |
| --- | --- | --- | --- |
| Proposal | ‘Yes’, or Partially ‘Yes’ | ‘No’ | Others |
| Adding the following components for Redcap device type definition: * Supports either 1 or 2 Rx branches and corresponding maximum DL MIMO layers
* Supports either FD-FDD or Type A HD-FDD operation for FR1 FDD bands
* Supports either DL up to 64 QAM or up to 256 QAM for FR1
* Does not support CA/DC
 | Ericsson [5], CATT [9, no need CA/DC], China Telecom [10], CMCC [11], Nokia [12], Lenovo [13], ZTE [14, no need HD-FDD, no need DL Modulation order], Xiaomi [15], Sierra Wireless [19], Panasonic ([21], No need of HD-FDD/FD-FDD); Sharp [24], Nordic [26] (capture *“Supports reduced number of Rx branches in bands where 4Rx branches are required*) | Only capabilities related to initial access procedure need to be included in the minimum capability set for RedCap UEs: * Huawei [3], vivo [7], Intel [17], DCM [18, defined by FG 28-1 in R1-2108679], NEC [20]
 | * Samsung [16]: Discuss in UE feature AI.
 |

It was observed by moderator that preferences from companies were almost no change compared to RAN1 #106 e-Meeting. Instead continue debating here, it seems more efficient to discuss this under ‘UE features for Redcap’ AI as recommended by [16] as well. It is moderator’s understanding that any components that agreed as part of ‘basic feature groups’ for Redcap device are essentially part of ‘Redcap device type’ as it can be assumed by network once UE claims to be ‘Redcap device’.

* <1st Round Comments>

**FL1 High Priority Question 3-1: Which Alternative is preferred by**

* + **Alt.1: Add support reduced number of Rx branches (i.e., 1 Rx/2 Rx branches) in addition to reduced BW**
	+ **Alt.2: Leave ‘Redcap Device Type’ definition to UE features of Redcap AI.**
		- **Note that: UE features that are defined as part of ‘Basic feature group’ for Redcap are included in the ‘Redcap Device Type’ definition.**
	+ **Alt.3: No additional component to be added for ‘Redcap Device Type’ definition.**

Moderator strongly recommends companies to compromise as much as possible on this issue, given the fact of lengthy and extensive discussions in past and only two meetings were left. Sticking to own preference is really no way to progress and move forward.

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
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# 4. Cell Access Restriction

## Issue 5: Cell Access Restriction

One of objectives for Redcap WI is to support to indicate through SIB information about cell camping for Redcap UE as follows [1]:

|  |
| --- |
| * Specify a system information indication to indicate whether a RedCap UE can camp on the cell/frequency or not; it shall be possible for the indication to be specific to the number of Rx branches of the UE. [RAN2, RAN1]
 |

RAN1 106-e Meeting made the following conclusion related to cell camping indication for Redcap [2]:

|  |
| --- |
| Conclusion* There is no consensus in RAN1 on whether to have the access barring indication in DCI scheduling SIB1, and RAN1 can come back if triggered by RAN2.
 |

Contributions [3] discussed the cell access restriction with the following proposals:

|  |  |  |
| --- | --- | --- |
|  | Proposals | Motivations |
| P1 [3] | Consider to restrict the access of RedCap UEs via SIB1* Access control specific to RedCap UEs with 1Rx or 2Rx via DCI associated with SIB1
 | Beneficial for power saving of the UEs and control flexibility of the gNB.  |
| P2 [3] | Different cell selection/reselection time for 1Rx or 2Rx can be configured by gNB. |

* <1st Round Comments>

**Medium Priority Proposal 4-1:**

* **Can we agree ‘P1’ and/or ‘P2’ listed above?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
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# 5. Other aspects

## Issue 6: Need of separate SIB1 for Redcap

Contribution [31,32] discussed SIB1 for Redcap UEs. In [31], it prefers to reuse the existing SIB1 and incorporate the new system information for RedCap. It was also pointed out in [31] that some modifications on short message field ‘*systemInfoModification*’ in paging DCI need to be discussed to improve the power consumption for SIB update when only Redcap-specific SIB information is updated in the shared SIB1. Contribution [32] proposed to introduce a new SIB1 (e.g., SIB1-R) used by REDCAP UEs. Several advantages of separate SIB1 for Redcap were listed in [32] including SIB1 size limitation and SIB1 transmission optimization for Redcap UEs. Regarding the separate SIB1 scheduling, it was stated in [32] that DCI format 1\_0 with CRC scrambled by SI-RNTI can be used to schedule both legacy SIB1 and new SIB1-R by using some reserved bits in DCI to differentiate between these two SIBs.

* <1st Round Comments>

**Medium Priority Proposal 5-1:**

* **Alt.1: Reuse the existing SIB1 and incorporate the new system information for RedCap.**
* **Alt.2: Introduce a new SIB1 (e.g., SIB1-R) used by REDCAP UEs**
* **Alt.3: Whether to introduce new SIB1 for Redcap UE is left up to RAN2.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
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* P1 [7]: Relative criterion that the comparison on maximum channel bandwidth for a UE can support and the cell is operating (i.e. by locationAndBandwidth) should be used by the UE to determine whether it is a RedCap UE or not.

## Issue 7: Measurements for Redcap with reduced number of Rx branches

One contribution [8] suggest discussing measurement related issues caused by reduced numbrer of Rx branches with the following proposals:

* P1 [8]: A relaxed RSRP thresholds is used for RedCap UEs to select SSB for performing random access.
* P2 [8]: Other measurement related thresholds are configured specifically for RedCap UEs with reduced Rx branches number.
* <1st Round Comments>

**Medium Priority Question 5-2: Which of P1/P2 can be agreed for Redcap measurement? If none, please provide brief justification.**

* **P1 [8]: A relaxed RSRP thresholds is used for RedCap UEs to select SSB for performing random access.**
* **P2 [8]: Other measurement related thresholds are configured specifically for RedCap UEs with reduced Rx branches number.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
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**SSB/CORESET#0 and initial UL/DL Configuration**

Contribution [25] discussed various aspects for Redcap device, including system information configuration (e.g., PUCCH resource), BWP Configuration (e.g., CORESET#0/SSB in a separate initial DL BWP and associated CSS for Redcap device) and L2 buffer size reduction. These topics have been handled in other Redcap agendas already (e.g., AI 8.6.1.1 and AI 8.6.1.3) and it is reasonable to continue discussing over there to avoid duplicated efforts.

**RA-RNTI Overlapping handling**

One contribution [27] provides different solutions to address the RA-RNTI collision issue. However, the following was agreed in RAN1 106-e meeting to leave this problem for RAN2 [2]:

|  |
| --- |
| **Conclusion:*** Whether there is RA-RNTI overlapping issue and how to address RA-RNTI overlapping issue in the early indication of RedCap UEs in Msg1 in Rel-17 is up to RAN2.
 |

# 6. Conclusion

# Annex: Companies’ point of contact

**FL1 Question: Please consider entering contact info below for the points of contact for this email discussion.**

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

1. RP-211574 Revised WID on support of reduced capability NR devices Ericsson
2. R1-2108271, RAN1 agreements for Rel-17 NR RedCap Rapporteur (Ericsson)
3. [R1-2108755](file:///Users/honghe/Docs/R1-2108755.zip) RAN1 aspects of RedCap UE type and identification Huawei, HiSilicon
4. [R1-2108803](file:///Users/honghe/Docs/R1-2108803.zip) Discussion on the Capabilities of RedCap UEs FUTUREWEI
5. [R1-2108823](file:///Users/honghe/Docs/R1-2108823.zip) RAN1 aspects for RAN2-led features for RedCap Ericsson
6. [R1-2108915](file:///Users/honghe/Docs/R1-2108915.zip) Discussion on early indication for Redcap UE Spreadtrum Communications
7. [R1-2108983](file:///Users/honghe/Docs/R1-2108983.zip) Higher layer support for RedCap vivo, Guangdong Genius
8. [R1-2109084](file:///Users/honghe/Docs/R1-2109084.zip) Mechanism in higher&PHY layer for Reduced Capability NR Devices OPPO
9. [R1-2109233](file:///Users/honghe/Docs/R1-2109233.zip) Discussion on higher layer support of RedCap CATT
10. [R1-2109254](file:///Users/honghe/Docs/R1-2109254.zip) Discussion on RAN1 aspects for RAN2-led features for RedCap China Telecom
11. [R1-2109290](file:///Users/honghe/Docs/R1-2109290.zip) Discussion on RAN1 aspects for RAN2-led features for RedCap CMCC
12. R1-2109312 Higher layer support of Reduced Capability NR Devices Nokia, Nokia Shanghai Bell
13. [R1-2109327](file:///Users/honghe/Docs/R1-2109327.zip) RAN1 aspects for RAN2-led features for RedCap Lenovo, Motorola Mobility
14. [R1-2109335](file:///Users/honghe/Docs/R1-2109335.zip) Higher layer support of Reduced Capability NR devices ZTE, Sanechips
15. [R1-2109420](file:///Users/honghe/Docs/R1-2109420.zip) Discussion on the remaining issues of higher layer related topics for RedCap Xiaomi
16. [R1-2109499](file:///Users/honghe/Docs/R1-2109499.zip) RAN1 aspects for RAN2-led features for RedCap Samsung
17. [R1-2109620](file:///Users/honghe/Docs/R1-2109620.zip) On RAN1 aspects for RAN2-led objectives for RedCap Intel Corporation
18. [R1-2109687](file:///Users/honghe/Docs/R1-2109687.zip) Discussion on RAN1 aspects for RAN2-led features for RedCap NTT DOCOMO, INC.
19. [R1-2109726](file:///Users/honghe/Docs/R1-2109726.zip) Design consideration for Higher layer support of RedCap Sierra Wireless. S.A.
20. [R1-2109761](file:///Users/honghe/Docs/R1-2109761.zip) Discussion on RedCap Type definition NEC
21. [R1-2109854](file:///Users/honghe/Docs/R1-2109854.zip) RAN1 aspects for RAN2-led features for RedCap Panasonic Corporation
22. [R1-2109950](file:///Users/honghe/Docs/R1-2109950.zip) Remaining RAN1 aspects of RAN2-led RedCap features InterDigital, Inc.
23. [R1-2109978](file:///Users/honghe/Docs/R1-2109978.zip) RAN1 aspects for RAN2-led features for RedCap LG Electronics
24. [R1-2109998](file:///Users/honghe/Docs/R1-2109998.zip) RAN1 aspects for RAN2-led features for RedCap Sharp
25. [R1-2110196](file:///Users/honghe/Docs/R1-2110196.zip) Cross-Layer Design Considerations for RedCap Device Qualcomm Incorporated
26. [R1-2110282](file:///Users/honghe/Docs/R1-2110282.zip) On RAN1 aspects of RAN2-led RedCap features Nordic Semiconductor ASA
27. [R1-2110326](file:///Users/honghe/Docs/R1-2110326.zip) Discussion on higher layer support of Redcap UE WILUS Inc.
28. [R1-2109234](file:///Users/honghe/Docs/R1-2109234.zip) Views on remaining issues of RedCap CATT
29. [R1-2109328](file:///Users/honghe/Docs/R1-2109328.zip) 2-step RACH for RedCap Lenovo, Motorola Mobility
30. [R1-2109336](file:///Users/honghe/Docs/R1-2109336.zip) Consideration on PRACH resource configuration for RedCap and CovEnh ZTE, Sanechips
31. [R1-2109421](file:///Users/honghe/Docs/R1-2109421.zip) Discussion on the transmission of system information for RedCap Xiaomi
32. [R1-2109979](file:///Users/honghe/Docs/R1-2109979.zip) Discussion on other aspects of RedCap LG Electronics

1. [R2-2106472](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2106472.zip), “Report from Break-out session on R17 NTN and REDCAP”, Vice Chairman (ZTE Corporation), 3GPP TSG RAN2 #114-e, May 2021