3GPP TSG RAN WG2 Meeting #114 [Draft] R2-2106528

**Electronic meeting, 19th-27th May 2021**

**Agenda item:** 8.12.2.1

**Source:** Intel Corporation

**Title:** Summary of [AT114-e][105][RedCap] Definition of RedCap UE and reduced capabilities (Intel)

**Document for:**  Discussion and decision

# Introduction

This document is the summary of following offline discussion:

* [AT114-e][105][RedCap] Definition of RedCap UE and reduced capabilities (Intel)

Updated scope: Continue the discussion on proposals from [R2-2106521](file:///C%3A%5CData%5C3GPP%5CRAN2%5CInbox%5CR2-2106521.zip) marked as "continue offline"

Updated intended outcome: Summary of the offline discussion with e.g.:

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

Updated deadline (for companies' feedback): Tuesday 2021-05-25 08:00 UTC

Updated deadline (for rapporteur's summary in R2-2106528): Tuesday 2021-05-25 12:00 UTC

Proposals marked "for agreement" in R2-2106528 not challenged until Tuesday 2021-05-25 22:00 UTC will be declared as agreed via email by the session chair.

For the rest the discussion will continue online in the Wednesday CB session.

FYI: proposals marked as “continue in offline 105”

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| Proposals for potential discussion onlineProposal 5. [To discuss] [12/19] introduce an explicit capability bit to indicate RedCap UE in the UE capability when the UE is a RedCap UE (as per option 1).* continue in offline 105

Proposal 9. [To discuss] [11] Send LS to SA2/CT1 to check subscription solution, whether core network should know the UE is a RedCap UE.Proposals for potential discussion in future meetingsProposal 2. [FFS] Continue the offline discussion on capability design principle:Proposal 2.1. [FFS] [13/20] For RedCap UE’s mandatory without signaling features, which are optional or mandatory with capability signaling or mandatory without capability signaling but with different value(s) for non-RedCap UE or newly introduced in R17 (if any), clarify in TS 38.306 in the new section for RedCap Ues; FFS on the need of new section;Proposal 2.2. [FFS] [15/20] For RedCap UE’s optional features, which are mandatory without capability ignaling for non-RedCap Ues (if any), or newly introduced in R17 for RedCap, add new UE capability ignaling in TS 38.331 and capture them in the new section for RedCap Ues in TS 38.306; FFS on the need of new section;Proposal 2.3. [FFS] [12/20] For RedCap UE’s optional features, which are optional for non-RedCap UE but with different value (if any), either add new capability signaling or extend the legacy capability ignaling, and also capture them in TS 38.306 in the new section for RedCap Ues ; FFS on the need of new section;Proposal 2.5. [FFS] [16/20] For the features not applicable to RedCap UE but mandatory without capability signaling supported by non-RedCap UE, clarify in TS 38.306 in the new section for RedCap Ues. FFS on the need of new section;* continue in offline 105

Proposal 3. [FFS] Postpone the discussion on the handling of RedCap specific capabilities (e.g. Maximum BW, Max Rx, MIMO-Layer, 256QAM, CA/DC, HD-FDD, etc) until RAN2 has conclusion on capability design principle.Proposal 4. [FFS] Discuss under capability design principle whether we should reuse existing capability signaling with clarifications in 38.306 when it is possible:* continue in offline 105

Proposal 6. [FFS] postpone the discussion on the definition of RedCap UE type although [16/20] companies support “Option 4: The corresponding minimum set of the reduced capabilities that one RedCap UE type shall mandatorily support.”* continue in offline 105
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# Discussion

## Definition and capability signaling

### Capability design principle

Proposal 4. [FFS] Discuss under capability design principle whether we should reuse existing capability signaling with clarifications in 38.306 when it is possible:

* continue in offline 105

During 1st round of discussion [21], when we discussed how to capture RedCap specific capability, companies (Ericsson, Apple) mentioned that if there is related existing capability signalling, we should reuse it for RedCap UE with necessary clarification in TS38.306 (e.g. clarify the restriction that some values are not applied for RedCap or not applied for non-RedCap UE). MediaTek, Sequans also mentioned that “As far as possible, we should reuse existing capability signaling with clarifications in 38.306”. It would be good to confirm this principle.

**Discussion point 1: Do you support the general principle that “*To capture RedCap specific capabilities, we should reuse related existing capability signalling (i.e. for non-RedCap UEs) with necessary clarification in TS38.306 (e.g. clarify the restriction that some values are not applied for RedCap or not applied for non-RedCap UE)*”; If not, please justify your response.**

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| **Company’s name** | **Yes/No** | **Comments, if any** |
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Proposal 2. [FFS] Continue the offline discussion on capability design principle:

Proposal 2.1. [FFS] [13/20] For RedCap UE’s mandatory without signaling features, which are optional or mandatory with capability signaling or mandatory without capability signaling but with different value(s) for non-RedCap UE or newly introduced in R17 (if any), clarify in TS 38.306 in the new section for RedCap Ues; FFS on the need of new section;

Proposal 2.2. [FFS] [15/20] For RedCap UE’s optional features, which are mandatory without capability ignaling for non-RedCap Ues (if any), or newly introduced in R17 for RedCap, add new UE capability ignaling in TS 38.331 and capture them in the new section for RedCap Ues in TS 38.306; FFS on the need of new section;

Proposal 2.3. [FFS] [12/20] For RedCap UE’s optional features, which are optional for non-RedCap UE but with different value (if any), either add new capability signaling or extend the legacy capability ignaling, and also capture them in TS 38.306 in the new section for RedCap Ues ; FFS on the need of new section;

Proposal 2.4. [FFS] [15/20] For the features not applicable to RedCap UE but optional supported or mandatory supported with capability signaling by non-RedCap UE, clarify in the definitions for parameters in TS 38.306 that “This capability is not applicable to RedCap UE; FFS whether explicit exclusion is used;

Proposal 2.5. [FFS] [16/20] For the features not applicable to RedCap UE but mandatory without capability signaling supported by non-RedCap UE, clarify in TS 38.306 in the new section for RedCap Ues. FFS on the need of new section;

* continue in offline 105

Note: Rapporteur noticed proposal 2.4 was missing in the report and added it back.

During 1st round of discussion [21], the discussion situation is:

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| **Summary on the Discussion point 2 on RedCap capability design principle.** 20 companies provided inputs to this discussion point:* *“Proposal 2.1 For RedCap UE’s mandatory without signaling features, which are optional or mandatory with capability signaling or mandatory without capability signaling but with different value(s) for non-RedCap UE or newly introduced in R17 (if any), clarify in TS 38.306 in the new section for RedCap Ues;”* is supported by 13 companies (OPPO, ZTE, MediaTek, Qualcomm, Lenovo, LG, Huawei, HiSilicon, CATT, Spreadtrum, Nokia, DENSO, vivo).

Apple, Sequans commented that “If there is already a capability defined for nonRedCap, we can say that RedCap should mandatorily signal this capability.”Intel commented that “*the clarification should be in the definition for new RedCap UE capability bit in TS 38.306 instead of new section*”Samsung commented that “if there is existing capability bit or field already, that can be re-used even if the value/range is different from non-RedCap Ues.”Sharp commented “the extended capability or the capability with different characteristic (e.g. optional for RedCap but mandatory for non-RedCap etc.) which has described in the spec does not need new section”DENSO commented that “there could be one more category that for both RedCap UEs and non-RedCap UEs, a feature is mandatory without capability signaling”. Rapporteur assumes it can be covered by proposal 2.1.* *“Proposal 2.2 For RedCap UE’s optional features, which are mandatory without capability ignaling for non-RedCap Ues (if any), or newly introduced in R17 for RedCap, add new UE capability ignaling in TS 38.331 and capture them in the new section for RedCap Ues in TS 38.306;”* is supported by 15 companies (OPPO, ZTE, Apple, MediaTek, Qualcomm, Lenovo, LG, Samsung, Huawei, HiSilicon, CATT, Spreadtrum, Nokia, DENSO, vivo).

Ericsson, Intel, Sequans are not sure whether new section is needed;Intel commented “should capture *the restriction in the definitions for parameters, in TS 38.306 e.g. the capability is not applicable for non-RedCap UE;, but not in the new section*”* *“Proposal 2.3 For RedCap UE’s optional features, which are optional for non-RedCap UE but with different value (if any), either add new capability ignaling or extend the legacy capability ignaling, and also capture them in TS 38.306 in the new section for RedCap Ues “;* is supported by 12 companies (OPPO, ZTE, Qualcomm, Lenovo, LG, Huawei, HiSilicon, CATT , Spreadtrum, Nokia, DENSO, vivo).

Ericsson, Apple, MediaTek, Sequans, Intel are not sure whether new section is needed;Intel commented that “should capture *the restriction in the definitions for parameters, in* ***TS 38.306*** *e.g. the value is not applicable for RedCap UE or only applicable for RedCap UE****; but not in the new section***”Samsung commented that “if there is existing capability bit or field already, that can be re-used even if the value/range is different from non-RedCap Ues.”* *“Proposal 2.4 For the features not applicable to RedCap UE but optional supported or mandatory supported with capability ignaling by non-RedCap UE, clarify in the definitions for parameters in TS 38.306 that “This capability is not applicable to RedCap UE”;* is supported by 15 companies (OPPO, Apple, MediaTek, Qualcomm, Intel, Lenovo, LG, Samsung, Huawei, HiSilicon, Sharp, CATT, Nokia, DENSO, vivo ).

ZTE/ Sequans, Spreadtrum commented that we should only indicate which capability is applicable to RedCap UE instead of which cannot based on assumption the new capabilities introduced by other Wis cannot be supported by RedCap UE by default. * *“Proposal 2.5 For the features not applicable to RedCap UE but mandatory without capability ignaling supported by non-RedCap UE, clarify in TS 38.306 in the new section for RedCap Ues.”* is supported by 16 companies (OPPO, ZTE, Ericsson, Apple, MediaTek, Qualcomm, Lenovo, LG, Samsung, Huawei, HiSilicon, CATT, Spreadtrum, Nokia, DENSO, vivo ).

Sequans, Intel are not sure whether new section is needed;Intel commented that “*the clarification should be in the definition for new RedCap UE capability bit in TS 38.306 instead of new section*”**Rapporteur**: Seems there are clear support on the capability design principle proposed in proposal 2.1-2.5. However some issues need to be decided, e.g. * P2.4, whether explicit exclusion is used;
* P2.1, 2.2, 2.3, 2.5 whether new section is needed (Rapporteur considers this is stage 3 issue, we can leave it open for now)

Considering the wording still need to be polished, clarified, Rapporteur would suggest to continue the offline discussion on this instead of online discussion. |

During the first round discussion, companies had different view on how to handle UE capabilities:

* Option 1: 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;
* Option 2: by default, all non-RedCap UE capabilities are not applicable for RedCap UE, and therefore only for non-RedCap capabilities that are appliable for RedCap UE, we clarify in the definitions for parameters in TS38.306, the value or feature is applicable for RedCap UE;
* Option 3: different approach. If so, please explain your suggestion.

**Discussion point 2: How to treat UE capabilities? Which option do you prefer** from the ones listed above**? Please justify your response.**

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| **Company’s name** | **Options** | **Comments, if any** |
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Regarding capability design principle, based on companies’ comments. Rapporteur would suggest to skip “ whether new section is introduced or not” and reuse existing parameters as much as possible, see below:

Principle 1: For RedCap UE’s mandatory without signaling features:

* which are optional or mandatory with capability signaling for non-RedCap UE, clarify in TS 38.306 in the definitions for parameters;
* which are mandatory without capability signaling but with different value(s) for non-RedCap UE, clarify in TS 38.306 in the definition for new RedCap UE capability bit;
* FFS on the need of new section

*Principle 2.For RedCap UE’s optional features, which are mandatory without capability signaling for non-RedCap Ues (if any), or newly introduced in R17 for RedCap, add new UE capability signaling in TS 38.331 and capture* *the new definition in TS 38.306;* FFS on the need of new section

Principle 3. For RedCap UE’s optional features, which are optional for non-RedCap UE but with different value (if any), extend the legacy capability signaling, and also capture the restriction in the definitions for parameters in TS 38.306; FFS on the need of new section

Principle 4. For the features not applicable to RedCap UE but optional supported or mandatory supported with capability signaling by non-RedCap UE, clarify in the definitions for parameters in TS 38.306 that “This capability is not applicable to RedCap UE;

Note: Related to Discussion point 2;

Principle 5. For the features not applicable to RedCap UE but mandatory without capability signaling supported by non-RedCap UE, clarify in TS 38.306 in the definition for new RedCap UE capability bit. FFS on the need of new section;

**Discussion point 3: Do you support the updated RedCap capability design principles 1-5 listed above?**

**If no, please justify your response.**

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| **Company’s name** | **Yes/No** | **Comments, if any** |
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### Others

Proposal 5. [To discuss] [12/19] introduce an explicit capability bit to indicate RedCap UE in the UE capability when the UE is a RedCap UE (as per option 1).

- QC wonders why this explicit capability bit is needed.

- Ericsson thinks we can come back to this later

* continue in offline 105

During 1st round of discussion [21], regarding the issue how the network is aware of RedCap UE, companies view are cited as below:

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| 19 companies provided inputs to this discussion point:* “introduce an explicit capability bit to indicate RedCap UE in the UE capability when the UE is a RedCap UE (as per option 1).” is supported by 12 companies (OPPO, Ericsson, Apple, Mediatek, Intel, LGE, Samsung, Huawei, Sharp, BT, DENSO, vivo).
* “Option 3 The network identifies RedCap UEs based on identification solution (see Section 11.1), e.g. during Msg1, Msg3, MsgA, etc, (pending RAN1 conclusion). The identification is forwarded it to target gNB during handover” is supported by 3 companies ( Lenovo, Sequans, Qualcomm).
* “Option 2 Define a new IE specifically for RedCap UEs containing RedCap-specific capabilities. The IE is included in the signalling only by Redcap UEs” is supported by 1 company ( Qualcomm, Spreadtrum).
* “Discuss later since it is related to early identification” is expressed by 2 companies (ZTE, CATT)

The following comments were raised by supporting companies of option 1:* Ericsson: This is a separate issue from early indication – a “RedCap capability” would make it unambiguous for the gNB capability processing function that the UE is a RedCap UE.

**Rapporteur**: propose to discuss in the meeting on introduce an explicit capability bit to indicate RedCap UE in the UE capability when the UE is a RedCap UE (as per option 1)..Proposal 5. [To discuss] [12/19] introduce an explicit capability bit to indicate RedCap UE in the UE capability when the UE is a RedCap UE (as per option 1). |

Regarding the question from Qualcomm on “why this explicit capability bit is needed”, as captured in the TR “The network needs to know the UE is a RedCap UE or not in order to handle UE capabilities properly including Handover case”, in addition, the network also needs to use this to prevent RedCap UE from using radio capabilities not intended for RedCap UE.

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| The network should know whether the UE is a RedCap UE or not in order to handle UE capabilities properly (see also Section 11.1 on UE identification). The following options, which do not need to be mutually exclusive, can be considered for further analysis and down-selection:Option 1: RedCap device type is indicated as part of the capability signalling.Option 2: Define a new IE specifically for RedCap UEs containing RedCap-specific capabilities. The IE is included in the signalling only by Redcap UEs.Option 3: The network identifies RedCap UEs based on identification solution (see Section 11.1), e.g. during Msg1, Msg3, MsgA, etc, (pending RAN1 conclusion). The identification is forwarded it to target gNB during handover. Option 4: The network identifies RedCap UE based on the reported capabilities, assuming the identification can be done through RedCap-specific capabilities not used by non-RedCap UEs.  |

It would be good to confirm the need of this first.

**Discussion point 4: Do you support the observation that “*The network needs to know if the UE is a RedCap UE or not in order to handle UE capabilities properly including Handover case*”; If not, please justify your response.**

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**Relationship with option 3, early identification**: As clarified by company in [21], the option 1 is unrelated to early identification discussion. The intention to introduce an explicit capability bit to indicate RedCap UE in the UE capability is to “make it unambiguous for the gNB capability processing function that the UE is a RedCap UE”. In addition, we do not need to introduce new signalling to support handover case (option 3 needs to forward the identification to target gNB during handover.).

Regarding option 2, it may work if we introduce RedCap specific container and if the RedCap UE supports any of RedCap optional capabilities. However RAN2 just agreed the working assumption “Extend UE-NR-Capability using NCE to capture RedCap capabilities”. We should not introduce RedCap specific container just for RedCap identification. In addition, if RedCap UE does not support any RedCap optional capabilities, the container will not be present, and the network will have no idea whether the UE is RedCap UE or not, and then the mandatory features without capability bit for RedCap that is different to non-RedCap wont be possible.

Rapporteur would like to check companies’ view again.

**Discussion point 5: Do you support Rapporteur proposal to “*introduce an explicit capability bit to indicate RedCap UE in the UE capability when the UE is a RedCap UE (as per option 1).*”; If not, please justify your response.**

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| **Company’s name** | **Yes/No** | **Comments, if any** |
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Proposal 6. [FFS] postpone the discussion on the definition of RedCap UE type although [16/20] companies support “Option 4: The corresponding minimum set of the reduced capabilities that one RedCap UE type shall mandatorily support.”

* continue in offline 105

During 1st round of discussion [21], regarding the issue on the definition of RedCap UE type, companies view are cited as below:

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| **Summary on the Discussion point 5 on the definition of RedCap UE type.** 20 companies provided inputs to this discussion point:* “Option 4: The corresponding minimum set of the reduced capabilities that one RedCap UE type shall mandatorily support” is supported by 16 companies (ZTE, Ericsson, MediaTek, Sequans, Intel, Lenovo, LGE, Samsung, Huawei, HiSilicon, Sharp, Spreadtrum, Nokia, BT, DENSO, vivo ).
* “Option 2: Only include the reduced capabilities that the network needs to know during initial access, if any” is supported by 2 companies (CATT, vivo).
* “Option 4a: The set of mandatory features that all RedCap UEs shall support, as well as the set of features not supported by any RedCap UEs (e.g. CA, DC, etc)” is supported by 3 companies ( Qualcomm, Sequans, BT).
* “Option 5 no need to define different RedCap UE type” is supported by 1 company (Apple)
* “Wait for RAN1” is mentioned by 9 companies (OPPO, ZTE, Ericsson, Intel, LGE, Samsung, Sharp, Spreadtrum, BT, DENSO)

In addition, Huawei mentioned what specification impact will be? As commented by ZTE “*This is under RAN1 discussion, and all the options were listed by RAN1 during SI phase, so we are also fine to wait for RAN1’s input*.”, Rapporteur considers it is reasonable to wait for RAN1.**Rapporteur**: propose to postpone the discussion on the definition of RedCap type, and wait for RAN1 input. |

Rapporteur would like to check companies’ view again.

**Discussion point 6: Do you support Rapporteur proposal to “*postpone the discussion on the definition of RedCap UE type although [16/20] companies support “Option 4: The corresponding minimum set of the reduced capabilities that one RedCap UE type shall mandatorily support.*”; If not, please justify your response.**

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| **Company’s name** | **Yes/No** | **Comments, if any** |
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**Proposals not marked as “continue in offline 105”**

Proposal 9. [To discuss] [11] Send LS to SA2/CT1 to check subscription solution, whether core network should know the UE is a RedCap UE.

Proposal 3. [FFS] Postpone the discussion on the handling of RedCap specific capabilities (e.g. Maximum BW, Max Rx, MIMO-Layer, 256QAM, CA/DC, HD-FDD, etc) until RAN2 has conclusion on capability design principle.

# Conclusion

<Section to be updated by Rapporteur>

Aiming to help with the meeting discussion/progress, the proposals are categorized starting with:

* [To agree] when there is large support and hence proposed for easy agreement.
* [To discuss] when there is substantial level of support and agreement may be possible.
* [FFS] when there is low support or companies propose new solutions or other groups inputs are needed or options to possibly consider further e.g. if there is sufficient support (understanding that these topic have not been discussed by all companies when providing their views in the different discussion points).

The proposals also start with a number: for the format [x], ‘x’ represents the number of supportive companies (i.e. these solutions are marked as FFS as the proposed solutions were not discussed by all companies) and, for the format [x/y], ‘x’ represents the number of supportive companies, and (y-x) the number of companies with different view.

The proposals captured are the following:

**Proposal 1.** **[To agree]** xxx

**Proposal 2.** **[To discuss]** xxx

**Proposal 3.** **[FFS]** xxx

The following order is suggested for the online discussion:

**Proposals for potential agreement**

<To be updated by Rapporteur>

**Proposals for potential discussion online**

<To be updated by Rapporteur>

**Proposals for potential discussion in future meetings**

<To be updated by Rapporteur>

# Annex: companies’ point of contact

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| **Company** | **Point of contact** | **Email address** |
| Intel Corporation | Yi Guo | Yi.guo@intel.com |
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# Reference

1. R2-2104774 Definition and constrained use of RedCap UEs Qualcomm Incorporated
2. R2-2104808 Discussion on constraining of reduced capabilities OPPO
3. R2-2104910 UE type definition and constraining for RedCap UEs vivo, Guangdong Genius
4. R2-2104927 RedCap UE capability and constraining of reduced capabilities Intel Corporation
5. R2-2105136 Resolution on some basic mandatory capabilities for RedCap UEs for faster product development Apple Inc
6. R2-2105160 Define and Constrain Reduced Capability for RedCap ZTE Corporation, Sanechips
7. R2-2105234 Definition of RedCap UE and first look on capability signaling Ericsson
8. R2-2105319 On Redcap UE capabilities and type CATT
9. R2-2105471 Capability for RedCap UEs and its early indication Samsung
10. R2-2105539 Discussion on L2 buffer size reduction for Redcap UE Spreadtrum Communications
11. R2-2105634 Definition of RedCap UE type and reduced capabilities Huawei, HiSilicon
12. R2-2105882 How to prevent RedCap UEs from using capabilities not intended for RedCap Ues LG Electronics UK
13. R2-2105910 On RedCap UE capabilities Nokia, Nokia Shanghai Bell
14. R2-2106053 Constraint of RedCap UE to intended use cases InterDigital
15. R2-2106098 RedCap UE capability and constraining of reduced capabilities Intel Corporation
16. R2-2106230 Discussion on the definition and constraining of reduced capabilities CMCC
17. R2-2106276 The capability and the constrain of RedCap UE China Telecommunications
18. TR 38.875
19. RP-210918, “Revised WID on support of reduced capability NR devices”
20. R2-2106462 Summary 8.12.2.1 - Definition of RedCap UE and reduced capabilities (Intel)
21. R2-2106521 [offline 105] Definition of RedCap UE and reduced capabilities (Intel) Intel