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:/Data/3GPP/RAN2/Inbox/R2-2106521.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 online  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).   * 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 meetings  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 2.5. [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 |

# 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** |
| Intel | Yes |  |
| ZTE | See comments | Clarification may be needed.  When we say “RedCap specific capabilities”, our understanding is these capabilities are only applicable to RedCap, they are not supported for non-RedCap UEs, which means there is no existing capability can be reused.  Since we have the working assumption:   * extend UE-NR-Capability using NCE to capture RedCap capabilities   So at least for TS 38.331, we understand people are now fine with “reusing related existing capability signalling” as much as possible. Regarding the modification to TS 38.306, since the detailed principles will be discussed under Discussion Point 3, maybe there is no need to discuss this high level principle? (also avoid wasting time on polishing the wording)    But please correct us if we misunderstood the intention. ;-) |
| Huawei, HiSilicon | See comments | We need to clarify what’s the additional principle besides below agreement and WID objective:  => 1. Extend UE-NR-Capability using NCE to capture RedCap capabilities  => o The existing UE capability framework is used ; changes to capability signalling are specified only if necessary.  Based on this principle, is it still FFS whether to use a new section or not? |
| MediaTek | Yes |  |
| Apple | Pls see comments | Same view as Huawei. |
| Qualcomm | No | We share similar view with Huawei. And we prefer grouping all RedCap-specific capability in a single “place”, for easier implementation and testing. |
| OPPO |  | Agree with Huawei. Whether to use the same section or a new section for RedCap in TS38.306 should be FFS. |
| Samsung | Yes |  |
| Ericsson | Yes in principle, see comments | Agree with intention to re-use existing signaling and signaling framework as much as possible, as also stipulated by WID.  Agree with ZTE that “RedCap specific capabilities” sounds like new capabilities, which would need to be defined. The intention of the formulation should be clarified.  For existing capabilities, where RedCap UEs support different values or should not use some of the existing values, we should clarify e.g. in the field descriptions. Existing signaling should be re-used where possible and not duplicated in other branches, this would just mean extra work and would not be a simplification. |
| Sequans | Yes, but | We understand this to be applicable to capabilities that already exist in some form. New capabilities are not covered by this and could still be in a new section. Agree with ZTE that in light of the next questions it may not be necessary to spend time on exactly wording this |
| Fujitsu | Yes |  |
| CATT | Yes |  |
| Spreadtrum | See comments | No need of such a general principle.  And we share OPPO’ view, how to capture in TS38.306 should be FFS. |
| Sharp | Yes |  |
| T-Mobile USA | Yes |  |
| vivo | See comments | We agree with Huawei. The open issue is how to capture capabilities for RedCap UEs, e.g. in a separate section or not, how to organize them. |
| Lenovo | Yes |  |
| Xiaomi | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes |  |
| DENSO | Yes | We could envisage the same exercise as for eMTC in Rel-13. A new UE capability introduced for eMTC was defined as CE parameters, and the condition of supporting features was stated in the field description. The field description for the features with capability signaling (including FGI bits) was updated to state the applicability to eMTC. |

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** |
| Intel | Option 1 | We believe only few capabilities cannot be supported for non-RedCap UE, mainly Bandwidth, Rx, modulation, MIMO related features. |
| ZTE | Option 2, or not to decide now | We think it is risk to assume RedCap UE should support all UE features by default.  As everyone knows CA/DC are excluded in the WID, because RedCap is intended for industry sensor, surveillance camera and wearables. So the requirement to RedCap devices is not as high as normal NR devices.  So besides CA/DC, we also see no need to support NTN, IAB, Mob-enh… and Rel-18 onwards functions for RedCaps.  Companies may argue that the capabilities are optional, so UE has the rights to not support it. Then the question is why CA/DC must be excluded? And how can network do capability match for constraining RedCap UE from using non intended use cases. As a RedCap device can ‘pretend’ itself as a smart phone that supporting advanced functions, this will also bring many problems in deploying RedCap devides.  So we would suggest companies to think more about it, then decide which way is better for RedCap. And we see no hurry to agree one way or the other at this meeting. |
| Huawei, HiSilicon | Option 1 | Whether one capability applies to RedCap UE indeed should be clarified in our WI discussion. Even for the future release, we should also be clear whether new features applies to RedCap anyway. The discuss will happen.  RedCap UE is the type with reduced capability. So the baseline should also be the whole capabilities of legacy UE, i.e. by default applied, and then to reduce. |
| MediaTek | Option 1 | Agree with Intel that we only expect few capabilities to be not supported by RedCap UEs. |
| Apple | Option 1 is ok for us | We anyway need to discuss capabilities, and option 1 is one way to go. |
| Qualcomm | Option 1 | There are far less number of capabilities that are not applicable to RedCap or RedCap takes different values than capabilities that are shared between RedCap and non-RedCap UEs. Hence Option 1 is a more efficient way to specify the differences. |
| OPPO | Option 1 | Option 1 can be the starting point. |
| Samsung | Option 1 | We also think that there would be only few capabilities that cannot be supported by RedCap UE, so Option 1 would be a good starting point. |
| Ericsson | Option 1 | Option 1 as the baseline and we can further discuss whether there are features which should not be supported. |
| Sequans | Option 2, OK to wait | Agree with ZTE. Especially with regards to forward compatibility, when looking at eMTC as reference, it is clear that when discussing new LTE features it was many times not considered if eMTC UEs should support them or not (recently, e.g. CHO). This may cause issues of differentiation with non/RedCap UEs.  Since most companies seem to think there is a large number of overlap, it may be wiser to first look into the actual capabilities and then decide which approach is simpler |
| Fujitsu | Option 1 |  |
| BT | Option 1 | We consider most of features should apply to RedCap so we consider option 1 is the baseline. |
| Futurewei | Option 1 |  |
| CATT | Option 1 | For similar reason mentioned by the others… |
| Spreadtrum | Option 1 with modification. | We share the view that option 1 is more efficient.  In addition, a note is suggested to be added for Option 1.   * 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;   Notes: for the non-RedCap UE capability which is applicable for RedCap UE, the capability parameters value/range for RedCap UE  can be different from the existing capability bit or field from non-RedCap UE. |
| Sharp | Option 1 | Agree with rapporteur. |
| T-Mobile USA | Option 1 | Agree with Qualcomm’s comments |
| vivo | Option 1 | We agree we should explicitly clarify in the specification that which features are not supported by RedCap. As in our understanding, we are not sure whether RAN1/RAN2 have enough time to go through all the optional features for non-RedCap UEs one by one. In this way, all optional features defined for non-RedCap UEs except the explicitly mentioned ones (e.g. not supported) should be optionally supported by RedCap. |
| Lenovo | Option 1 | Agree to above comments to option.1. |
| Xiaomi | Option1 | Agree with Qualcomm’s comments |
| Nokia, Nokia Shanghai Bell | Option1 |  |
| DENSO | Option 1 | Agree that Option 1 is a baseline and so the features not applicable to RedCap UEs are to be analysed throughout the features introduced up to now. This is also what RAN2 did for eMTC in Rel-13. |

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** |
| Intel | Yes |  |
| ZTE | (right now)  No to P4 | For Principle 4, it depends on the outcome of Q2.  For other principles, we would like to clarify the newly added part first.   1. For “the definitions for parameters”, does it mean the field description of existing capability parameter? 2. For “the definition for new RedCap UE capability bit”, it is a bit unclear, for P1 and P5, the mandatory without signalling features has not corresponding capability bit, so does it mean we will add a new bit for it? 3. For P3, maybe we should discuss it case by case. To us, the cleanest way is to define a new capability bit for RedCap (ignore the old one). So it is unclear what does “the restriction in the definitions for parameters” mean?   More comments will be provided later (based on the response to above clarification questions). |
| Huawei, HiSilicon | Generally fine. See comments | For principle 1, it is not clear on “the definition for new RedCap UE capability bit”. We believe it is quite unreadable if we capture the whole mandatory features in just one box of parameter definition of this bit 38.306, if I understand this correct.  We would prefer to formulate principle 1 as below (same comment to principle 5)  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 (FFS in the existing definitions section or a new section for RedCap); * 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 (FFS in a new section);   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 (FFS in a new section); |
| MediaTek | Yes | We are fine with these principles |
| Qualcomm | See comment | P1: We are fine with the first bullet, i.e. “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”. But we are not fine with the 2nd bullet, i.e. “ – 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;”. We prefer to capture those type of capabilities in a new section in 38.306 that is specifically for RedCap (e.g. what defines RedCap and differentiate them non-RedCap Ues).  P2: We are fine with P2.  P3: We prefer to capture those type of capabilities in the new NCE for RedCap in 38.331 and define them in a new section for RedCap in 38.306.  P4 and P5: We prefer to capture those type of capabilities in the new section for RedCap in 38.306, for easier implementation and testing. |
| OPPO | Yes |  |
| Samsung | Yes |  |
| Ericsson |  | In general, we think it is not productive to agree to exact principles other than that re-using existing signaling is the baseline. It depends on the existing signaling whether it is reasonable to re-use or introduce something new. We would prefer to evaluate the capabilities case-by-case for easier agreement. We can start with the capabilities which define RedCap UE, e.g. BW, Rx and MIMO layers, support for 256QAM.  Agree with HW that the “the definition for new RedCap UE capability bit” part is not clear. Also P1 seems to be about “mandatory without signaling” for RedCap UEs, but what would those features actually be? Why would they be without signaling if there is existing signaling already which can be (possibly) re-used?  P2 seems fine where the exact definition on how to capture is FFS.  P3 depends on the feature – e.g. there is capability bit for 256QAM support in DL already which is mandatory, this can be made optional for RedCap UE to indicate.  P4 we can discuss further whether we just capture these in the definition instead to similar to what P5 says. This may also depend on the number of features we would need to list or which actually needs to be indicated are not possible to signal by a RedCap UE. |
| Sequans | See comments | P1, P5: Agree with HW’s comments  P2: Yes  P3: Yes. OK to leave open for a new NCE in 38.331 if companies want  P4’s dependence is not only on DP2, but also on the number of capabilities.  Also, there could also be more than one way to specify this. For example, it may be easier to have an additional column in 38.306 for applicability to RedCap.  So, would suggest rephrasing: “For the features not applicable to RedCap UE but optional supported or mandatory supported with capability signaling by non-RedCap UE, explicitly state their applicability to RedCap, at least in the cases not covered by default behavior” |
| Fujitsu | Yes | We are fine with these principles. |
| Futurewei | Yes |  |
| CATT | Yes | We are generally fine with these. if any issues we can discuss on a case by case basis. |
| Spreadtrum | See comments on P3 | We are fine with P1/P2/P4/P5.  For P3, we would like clarify the meaning of “different value”: can the Redcap UE use a subset of the values for non-Redcap UE; or can the Redcap UE use some new values? |
| Sharp | Yes |  |
| T-Mobile USA | No | Agree with Ericsson’s comment. It’s not clear what mandatory features without capability signaling are going to change. Other than channel Bandwidth, REDCAP defines a new minimal set of capabilities. We see no reason to exclude any of the optional features not explicitly called out in the WID i.e channel BW.  It’s possible that mandatory capabilities definitions could be covered by a single capability bit covering multiple features. |
| vivo | Yes | We are fine to agree these principles. |
| Lenovo | Yes |  |
| Xiaomi | Yes |  |
| Nokia | Yes |  |
| DENSO | See comments | P1: Agree with Ericsson and Huawei. If capability signaling has already been present in the UE-NR-Capability container, why can’t we use it? For RedCap UEs, mandatory without capability signaling should be applied if the feature is mandatory without capability signaling for non-RedCap UEs, as well. We agree that there could be a case that supported value is different between RedCap UEs and non-RedCap UEs in terms of the features supported as mandatory without capability signaling.  P2 looks fine.  P3 seems O.K, but could be discussed how to capture it in details if such a feature is discovered.  P4 and P5 seem O.K, too but how to capture them should be discussed for further, e.g. to improve readability, as Qualcomm commented. |

### 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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| **Company’s name** | **Yes/No** | **Comments, if any** |
| Intel | Yes | Otherwise the network cannot configure/schedule UE properly. If there is no explicit bit, the mandatory features without capability bit for RedCap that is different to non-RedCap wont be possible. |
| ZTE | Yes | We understand network can distinguish RedCap in following ways:   1. early identification (will be supported); 2. Received RedCap specific capabilities. 3. Explicit indication included in UE capability (if supported).   We agree network needs to know whether the UE is RedCap or not, but we are not sure whether it is necessary to support all above 3 methods at the same time. |
| Huawei, HiSilicon | Yes |  |
| MediaTek | Yes | The network needs to know whether the UE is a RedCap UE or not, to correctly identify the set of mandatory features (i.e. baseline capabilities) that the UE supports. |
| Apple | Yes | The NW needs to know. |
| Qualcomm | Well… | Since RAN2 have agreed to the following WA:   * extend UE-NR-Capability using NCE to capture RedCap capabilities   network can identify a RedCap UE by the presence of this NCE from its UE capability report. If early identification is configured, network can identify a RedCap UE even before capability signaling. So we do not think any new 1-bit indication is necessary in UE capability report. |
| OPPO | Yes |  |
| Samsung | Yes |  |
| Ericsson | See comment | The NW needs to know whether the UE is RedCap or not.  However, it is not clear what is exactly meant by “handle UE capabilities properly”. The capability processing would be the same in principle, does this refer to e.g. cases where a RedCap UE signals some capabilities which is should not? |
| Sequans | Yes |  |
| Fujitsu | Yes | The network needs to know whether the UE is a RedCap UE or not. The identification of RedCap UE helps the network to obtain the set of mandatory features without capability signaling. |
| BT | Yes |  |
| Futurewei | Yes |  |
| CATT | Yes |  |
| Spreadtrum | Yes |  |
| Sharp | Yes |  |
| T-Mobile USA | Yes | This bit could be used to define minimum set of requirements for REDCAP UE’s. |
| vivo | Yes | Otherwise, how does network know which mandatory capabilities should be supported by RedCap UEs? |
| Lenovo | See comment | Yes, but we don’t think it is necessary to introduce a new indication to report RedCap type. |
| Xiaomi | Yes |  |
| Nokia | Yes | Yes, NW needs to know, but we don’t see need to introduce a new indication for RedCap type. |
| DENSO | Yes | Yes, for the handover case, whether a UE is RedCap or not need to be known to the network. The use of NCE depends on if the UE supports the features grouped into the NCE IE. Of course, the NULL NCE can be included, even though none of the features are supported. In that sense, it is equivalent to defining an explicit indicator. |

**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** |
| Intel | Yes | It is clear solution and can cover handover case. It makes the mandatory features without capability bit for RedCap that is different to non-RedCap possible. |
| ZTE | Not sure | See our comments to Q4. |
| Huawei, HiSilicon | Yes |  |
| MediaTek | Yes | The NW should be able to unambiguously differentiate between RedCap UEs and non-RedCap UEs. The controversial aspect here is whether an explicit bit is needed. However this discussion can be sidestepped for now if we agree to the principle first, i.e.:  ‘*The network needs to unambiguously know whether the UE is a RedCap or a non-RedCap UE from its reported UE capability information’* |
| Apple | Yes | We tend to think the same way as MediaTek, but ok with an explicit capability in the UE capabilities. |
| Qualcomm | No | See our reply to Discussion Point 4. |
| OPPO | Yes |  |
| Samsung | Yes |  |
| Ericsson | Too early | Agree with MTK comment and formulation – we could agree to the principle now and once the details with capability signaling are clear we can revisit this and decide whether an explicit bit is needed or not.  Otherwise, it is not urgent to agree to such stage-3 detail at this point and we can come back to this later if needed. One option is to agree this as working assumption for now. |
| Sequans | No, but | Agree with comments from ZTE and QC in Q4. We don’t understand how this is not related to early identification – if at least Msg1 or Msg3 would be mandatory, then what is the point of having an additional indication?  However, we are OK to compromise if there is clear majority, or agree the principle: ‘*The network needs to unambiguously know whether the UE is a RedCap or a non-RedCap UE; an explicit capability bit will be introduced if early identification is not mandatory’* |
| Fujitsu | Yes | We understand the network can identify whether the UE is a RedCap or a non-RedCap UE either by early identification by Msg1 or by explicit indication bit in UE capability. However, the configuration for early indication of RedCap UE is optional as RAN1 decided. We think it’s necessary to introduce an explicit capability bit in the UE capabilities to indicate RedCap UE unambiguously. |
| BT |  | At this stage, we are fine with MediaTek proposal |
| Futurewei |  | The principle suggested by MediaTek is agreeable to us. Whether an explicit bit is required or not can be decided later. |
| CATT | See comments | We do not disagree if this is majority’s view, but it is a matter of fact that this depends on a few aspects such as early identification, redcap type definition, etc. Perhaps it is a bit too early to already conclude that we DO need an explicit bit… |
| Spreadtrum | No | The network can be aware of the redcap UE type via the RedCap-specific container IE.  So our view is a little different from Option 2 in the summary. I Copy below (the summary anyway is wrong):  “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). |
| Sharp |  | We are fine with MediaTek’s proposal. |
| T-Mobile USA | Yes | Agree with MediaTek, however we don’t see a need for RACH identification. UAC is a better option to restrict REDCAP access. |
| vivo | Yes | We think at least network need to identify the RedCap UEs by early identification and/or indication in capability. While for early identification, we are not sure whether some mandatory feature(s) will be indicated or the UE type. But anyway, this capability bit to indicate RedCap UE in the UE capability is needed.  We could add an FFS on whether it is explicit bit could be decided after we made the decision on the early identification. |
| Lenovo | No | See our view to point 4. |
| Xiaomi | See comments | Agree with Ericsson it is too early to decide this details. And early identification, redcap type definition are discussed in RAN1, we can wait for more input. |
| Nokia, Nokia Shanghai Bell | No | NW knows all necessary information from UE capabilities and we don’t see this indication necessary. |
| DENSO | Yes | Agree with MediaTek |

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:

|  |
| --- |
| **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** |
| Intel | Yes | Postpone considering RAN1 is also discussing it. |
| ZTE | Yes |  |
| Huawei, HiSilicon | Yes, but | Another way is try to agree something like:  **RAN2 observe that, on the definition of RedCap UE type, Option 4 (i.e., the corresponding minimum set of the reduced capabilities that one RedCap UE type shall mandatorily support) has the most supports.** |
| MediaTek | Ok to postpone |  |
| Apple | Ok to postpone | Would be clearer after RAN1 has progress. We are trying to see where the ‘RedCap UE Type’ would be needed, when UE transfers the capability, and SIB1 filters the RedCap UEs that are allowed to camp. We think there is no need to define ‘a type’ for signaling purposes.  But we can conclude this after RAN1 progresses. |
| Qualcomm | OK to postpone |  |
| OPPO | Yes |  |
| Samsung | OK to postpone |  |
| Ericsson | OK but | Tend to agree with HW view – this objective is RAN2-led and we could agree e.g. a working assumption conditional on being updated once there is more progress in the discussion in RAN1 (and RAN2). There seems to be strong support for Option 4 in RAN2 and it would be good to avoid repeated discussion on this. |
| Sequans | Yes |  |
| Fujitsu | OK to postpone |  |
| BT | Ok to postpone but | Agree with Huawei or based on majority support, make it a working assumption without precluding other options. |
| Futurewei | Ok to postpone but | Also support progressing Option 4 towards a working assumption if that is agreeable. |
| CATT | OK to postpone |  |
| Spreadtrum | OK to postpone |  |
| Sharp | Yes |  |
| T-Mobile USA | Ok to Postpone |  |
| Vivo | Yes | We are fine to postpone it to wait for RAN1 or we could accept the wording from Huawei first. |
| Lenovo | Yes | Wait the RAN1 progress. |
| Xiaomi | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes |  |
| DENSO | O.K to postpone but | It is rare that an observation is agreed by RAN2. Instead, it should be agreed as a working assumption, if RAN2 is aimed at progressing at this meeting. |

**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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# Reference

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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