3GPP TSG-RAN WG2 Meeting #115e Tdoc draftR2-2108892

Online, August 16th – 27th 2021

Agenda: 8.12.2.2

Source: Ericsson (rapporteur)

Title: [AT115-e][104][RedCap] Identification, access and camping restrictions (Ericsson)

Document for: Discussion, Decision

# 1 Introduction

This document captures the following discussion and summary:

**\* [AT115-e][104][RedCap] Identification, access and camping (Ericsson)**

Initial scope: Continue the discussion on p3, p6, p9-p12

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)

Initial deadline (for companies' feedback): Monday 2021-08-23 10:00 UTC

Initial deadline (for rapporteur's summary in R2-2108892): Monday 2021-08-23 16:00 UTC

Proposals marked "for agreement" in R2-2108892 not challenged until Tuesday 2021-08-24 0800 UTC will be declared as agreed via email by the session chair (for the rest the discussion will further continue online).

Status: Ongoing

This template for discussion is based on the pre-meeting summary in [R2-2109023](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2109023.zip). Original text (excluding “Introduction”) is kept intact and questions and tables for company inputs are inserted for proposals P3, P6, P9-P12. Please note that the existing arguments are summarized above each question.

The parts from the original summary which are most relevant for agreements already made have been greyed out.

New rapporteur comments made after the pre-meeting summary and after the initial online discussion are marked as [Rapporteur].

# 2 Summary of remaining issues

## 2.1 Early identification of RedCap UEs

Early identification and RedCap indication in Msg1/Msg3 and/or MsgA is discussed in [1], [4], [5], [6], [7], [8], [9], [11], [13], [14], [15], [18], [19], [22], [23] and [27] (16 papers).

Early identification in Msg1

RAN1 has informed RAN2 in LS [R1-2106329](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2106329.zip) on RAN1 working assumption that Msg1 indication can be configured to be enabled/disabled. Thus, the rapporteur understanding is that Msg1 indication will be specified in one form or another. RAN2 can confirm the Msg1 indication but the details need to be discussed further, also taking into the discussion in AI 8.18 RACH indication and partitioning.

No company in RAN2 proposes to not support Msg1 indication.

Details of Msg1-based indication are discussed e.g. by HW [4], Spreadtrum [6], Intel [13], ZTE [15], Nokia [22]. There seems to be common understanding that both dedicated ROs for RedCap as well as dedicated PRACH preambles in case of shared ROs can be supported. Couple of companies propose to wait further RAN1 progress e.g. vivo [7], ZTE [15] before discussing further details.

The following are proposed, first based on RAN1 working assumption and second as basis for further discussion:

1. [Easy] Msg1 indication which can be configured to be enabled/disabled can be specified from RAN2 point of view.
2. [To discuss] Both dedicated ROs and dedicated PRACH preambles in case of shared ROs are supported. Details are FFS and discussions in AI 8.18 should be taken into account.

[Rapporteur] P1 and P2 have been treated online.

Early identification in Msg3

One open issue is whether a Msg3 indication is specified. The companies input and views on this open issue are divided like follows (one company per paper mentioned):

* **Do not specify Msg3 indication (assuming Msg1 indication is specified)**: OPPO [1], Spreadtrum [6], Xiaomi [8], Apple [11], Intel [13], LG [14], ZTE [15], NEC [19]

The main arguments for this view are that Msg1 indication covers more scenarios and that there would be limited benefit using Msg3 indication or that it would be redundant. There would be no possibility to affect Msg2/3 scheduling and earliest possible indication is preferred for that reason. Also, more specification effort in RAN2, security issues and that reject based on Msg3 indication should not be preferred as access control mechanism were mentioned.

* **Specify Msg3 indication (i.e. both optional Msg1 and Msg3)**: Huawei [4], Qualcomm [5], Sierra [9], DENSO [18], Nokia [22], Ericsson [23]

The main arguments for supporting Msg3 indication include ability to use early indication in the case Msg1 indication is not configured e.g. when avoiding further PRACH fragmentation. The mentioned benefits include possibility to affect Msg4/5 scheduling in case Msg1 indication is not configured, possibility to configure PUCCH frequency hopping for Msg4 feedback, and the possibility to use RRC reject. It was also mentioned that in most scenarios Msg1 based indication wouldn’t be needed and configured.

* **RAN to confirm that network should identify RedCap UE before Msg4**: CATT [27]

Argument for this option is that the NW should identify RedCap UE at least in Msg1 or Msg3 (not later).

* **Wait for further RAN1 discussion**: vivo [7]

Argument for this option is that the reasons for early indication are mostly RAN1.

Possible solution for Msg3 indication was discussed in few papers e.g. by HW [4], QC [5], Ericsson [23]. All these propose to use an LCID-based solution which would not result in large specification impact or larger Msg3 size. Such solution is also preferred by Nokia [22].

*Rapporteur comment:* There is support for both not specifying and specifying a Msg3-based solution. With the proposed LCID-based solution the specification impact would be low and Msg3 size the same as currently, and the drawback of Msg3-based indication would be that it is later compared to Msg1 indication. There doesn’t seem to be other technical reasons for not supporting, which would be different for Msg3 compared to Msg1 (e.g. RRC reject based on indication, even if not preferred, is also possible with Msg1-based solution). If Msg1 indication is not configured at all, the situation with scheduling Msg2/3 would be the same regardless solution, i.e. no network knowledge, but with no possibility to impact Msg4/5 scheduling either if there is no Msg3 indication.

Therefore, it is proposed to further discuss whether the following proposal is acceptable:

1. [To discuss] A Msg3 early indication based on LCID is supported.

[Rapporteur]: P3 was discussed online with the following captured in chair minutes:

|  |
| --- |
| *Proposal 3 [To discuss] A Msg3 early indication based on LCID is supported.*- DT thinks this is not essential but ok if some companies think 2 mechanisms are needed- vivo thinks that RAN1 does not see the need for this and we also did not see the motivation for this.- Ericsson thinks there is huge support for this and no drawback- QC/CMCC/ZTE/Mediatek support p3- Apple thinks that RAN1 discussed that there has to be some handling of msg2 that needs msg1 identification and also thinks that there would be security concerns. Ericsson thinks that if we need to do something for msg2, then of course msg1 identification would be needed.- VC thinks that a decision should be taken in RAN2 by the end of this meeting.* Continue in offline 104
 |

Based on this, companies are asked whether P3 is agreeable for them, and whether they have any relevant new arguments. Companies are respectfully asked to see above summary where arguments for both sides have been summarized.

**Question 1:** Is P3: “A Msg3 early indication based on LCID is supported”, agreeable?

|  |  |  |
| --- | --- | --- |
| **Company** | **P3 agreeable?** | **Comments / new arguments** |
| Qualcomm | Yes | The current WID says that early identification between Msg4 is supported. Therefore, supporting Msg3 early identification gives network an option of not configuring Msg1 early indication. Otherwise, Msg1 early identification has to be always configured. That is against the existing agreement that Msg1 early indication is optional/configurable  |
| Ericsson | Yes | Agree with QC comment, it may not be viable to always configure Msg1 indication, as discussed online. Additionally, we think Msg3 indication may save trouble later if in deployments it is observed Msg4/5 need special handling. If Msg3 indication possibility is not specified, and Msg1 is not configured, it would mean either possible performance degradation for all UEs or performance degradation for such RedCap UEs which would need special treatment. Neither of these options are desirable, and it is easy to provide the means to avoid this now. Note that it would be too late for enhancement on this in later releases. |
| Apple | No, but an additional comment | We have already provided our view online, and so we do not have to repeat them here. But there is also a RAN2 item on unified RACH concept that is planned to be discussed (with slice-based RACH etc..). We are not sure how it would work with the delegation of RedCap detection to MSG3 when for other features RACH preambles does the separation. Infact we have to check how a mix of MSG1 and MSG3 base detection of RedCap would work (as we assume that some NWs would use MSG1 based as well).Also, we may need to get SA3 views on having the UE advertise it’s capability as RedCap in a MAC CE (and not an L3 msg) without any protection. |
| Huawei, HiSilicon | Yes | First, Msg1 early identify can be disabled/not-configured, per R1 and R2 agreement. It is also R1 understanding that Msg2 does not have to be handled specially.Second, Msg3 early identification is essential in case gNB has shortage on the dedicated RA resource for Msg1 early identification. This is more important if we consider the R17 RACH partitioning for so many feature combinations (see the discussion in AI 8.18.).Third, to the comments from Apple, this is not capability indication. This is the UE type indication. If there is no security issue to indicate this UE type even in Msg1, there got to be no security issue in Msg3.Just one wording polishing:” A Msg3 early identification based on dedicated LCID is supported”. |
| Sierra Wireless | Yes | Agree with QC and Ericsson, Msg1 may not always viable or desired so Msg3 would be needed. |
| vivo | No | Msg3 early identification is motivated by RAN1, which has no consensus on whether msg3 early identification is needed. It is a bit strange for RAN2 to discuss how to specified a function for RAN1 aspect purpose before RAN1 decides the function is needed. Besides, it would quite strange and complex for a UE to support duplicated functions for a same purpose.  |
| Nokia | Yes | We agree with comments by Qualcomm and Ericsson.RAN1 asked RAN2 to decide on Msg3 so the Msg3 indication is RAN2 motivated.It is rather obvious that RACH partitioning cannot be always used for RedCap identification given the number of features requiring RACH partitioning already. It should be noted that RedCap UEs would likely use also the Coverage Enhancement feature. |
| Sharp | Yes | Agree with Ericsson and Huawei. |
| Fujitsu | Yes, but | We want to clarify that if MSG1 indication is configured, MSG1 early indication should be used by UE and UE is free to use MSG3 early indication based on LCID. Because MSG1 has more benefit than MSG3 indiation in MSG2/MSG3 scheduling.  |
| BT | Yes | Agree with QC and Ericsson.We want to avoid early indication in Msg1 as much as possible due to RACH partitioning. Msg1 should be used under very specific circumstances.We don’t see any technical reason to support that Msg3 raises security concerns but not Msg1.  |
| Thales | Yes | Msg3 solution should be supported, as MSg1 solution may not always be needed/preferred solution. |
| Futurewei | Yes | We agree with Qualcomm, Ericsson, and Huawei. Also, there is no security advantage, one way or the other, between Msg1-based early identification and Msg3-based early identification.  |
| Xiaomi | No | A reason that proponents want Msg3 early identification rather than Msg1 is that gNB has shortage on the dedicated RA resource.We want to point out this is not an exclusive issue for Redcap, as it is well know that RAN2 is discussing a unified RACH, not limiting to Redcap but silces, CE... Also, RAN1 is discussing msg1 early indication can be implemented by a separate initial UL BWP. In that case we will get the Redcap UE early indication for free.Some people may say Msg4/5 need special handling. We do not quite understand this.In our understanding, Msg1 can be beneficial that gNB schedules the Msg.3 /PUCCH within of Redcap’s bandwidth if network configures the initial UL BWP of legacy UE wider than Redcap’s bandwidth. However, if network restricts the initial UL BWP of legacy UE within Redcap’s bandwidth, there is no need for the early indication of Redcap devices via Msg1 as well as Msg3. Is Msg4 special handling for PUCCH hopping for msg4 feedback? In this case, msg3 also has such problem in which case, msg1 is anyway configured.Since the msg4/msg5 special handling is related to RAN1, we think more RAN1’s input is needed. And we are not sure how much gain it is for msg4/msg5 special handling and whether it worthy the effort we take for a new LCID. |
| Intel | No | With early identification during Msg1, the benefits can be realized for Msg2 PDCCH/PDSCH, PDCCH for Msg3 reTx, and Msg4 PDCCH/PDSCH as well as for UL transmissions (Msg3, PUCCH-for-Msg4, Msg5). However with early identification during Msg3, the only benefits can be realized for Msg4 PDCCH/PDSCH as well as for UL transmissions (PUCCH-for-Msg4, Msg5).We do not see the need to specify a duplicated solution, especially when MSG3 based solution can only cover partial scenarios.  |
| Sequans | Yes | Agree with comments by HW, Nokia.The unified RACH solution is not relevant here, exactly because Msg3 identification targets the case when Msg1 identification is not used. From the unified RACH discussion it is also clear that all possible combinations cannot always be covered.We do not see Msg3 identification as a duplicate solution as it still has its benefits when Msg1 identification is not configured.  |
| ZTE | Yes | Agree with QC and Ericsson. Regarding the security concern from Apple. We think there is no security issue with including this in Msg1 or in Msg3. The security requirement defined in TS 38.331 is:“Network does not forward UE capabilities that were retrieved before AS security activation to the CN“ So network is allowed to retrieve such capability for local use before SMC, but network should not forward it to CN.  |
| NEC | No | It is not entirely clear for what purpose Msg3 identification is necessary. Some companies show Msg4/5 may need special treatment but it definitely RAN1 issue, for which RAN1 does not have consensus and thus has not agreed to support it. RAN2 should not use it as motivation to support.One possible purpose according to companies opinion would be to reject Msg3 from RedCap UEs (or maybe reject Msg3 from non-RedCap UEs). However, this is not really necessary, as RAN2 agreed already access barring can be done for RedCap UEs separately:“Specify separate indications in SIB1 for barring RedCap UEs with 1 Rx chain and 2 Rx chains.“ There seems to be no motivation to support Msg3 early identification from RAN2 point of view. If any (other), we are open to discuss. |
| NTTDOCOMO | Yes | We see benefits to have Msg3 soluton in case network is in shortage of RACH resource for partitioning. |
| MediaTek | Yes | We see a msg3 based solution as beneficial when RACH resource partitioning is not configured (e.g. when the network does not have sufficient RACH resources to spare).  |
| Spreadtrum | No | Agree with vivo. And the main concern of msg1 early indication solution is PRACH resource partitioning. However, we RAN2 has a item which is discussing how to mitigate the PRACH resouce partitioning issue cased by supporting the indication of multiple UE features vis Msg1. We suggest to wait the progress of the item. |
| OPPO | No | Msg1 identification is sufficient. The shortage of RACH resources is not a good argument since it exists for any Msg1 indications, e.g. for slicing, coverage enhancement, 2-step RA, etc. RAN1 has made much effort to specify Msg1 Identification and it would be up to NW to use it or not. We don’t need any further solutions. |
| CMCC | Yes | Agree with comments by Qualcomm and Ericsson. RACH portioning may not be viable all the time in a gNB, considering many features requiring RACH partitioning. Besides, it was agreed that Msg1 early identification solution is configurable. Besides, as rapporteur summarized, with the proposed LCID-based solution, the specification impact would be low and Msg3 size is the same as currently, therefore, Msg3 early indication based on LCID could be supported. |
| ChinaTelecom | Yes,but | If Msg1 indication is not configured at all, Msg3 solution should be supported. |

MsgA indication

RAN1 has agreed to support 2-step RACH, and it remains to be discussed how the early indication is provided in that case. Few of the submitted papers, e.g. by HW [4], Intel [13], Nokia [22] and CATT [27] propose to specify a MsgA early indication. However, one company prefers LCID based solution (assuming such is specified for Msg3), one company prefers similar solution as Msg1 (assuming no Msg3 indication), one company prefers to have solution with both MsgA preamble and PUSCH indications and one company prefers to leave details up to RAN1 discussion.

As the solution for Msg1/Msg3 discussion may impact the details of MsgA solution, it is proposed to confirm that a solution will be specified but discuss the details further.

1. [Easy] Solution for early indication in MsgA will be specified.
2. [Postpone] Discuss the details of MsgA based early indication after Msg1/Msg3 discussion has progressed.

[Rapporteur]: P4 was agreed online, P5 outcome may depend on P3 discussion.

## 2.2 Access/camping restrictions

The following papers discuss access restrictions, cell barring or network support for RedCap UEs and relevant indications in MIB/SIB1: [2], [7], [8], [9], [10], [12], [13], [14], [16], [18], [19], [21], [23], [24], [25], [26] and [27] (17 papers).

On cellBarred in MIB

It is stipulated by the WID and agreed in RAN2 already that SIB1 indicates barring for 1 Rx and 2 Rx branches separately for RedCap UEs. However, and open issue is what to do with the relevant *cellBarred* and IFRI indications broadcasted in MIB.

The following have been proposed by companies in the submitted papers:

* **UE ignores the existing *cellBarred* in MIB:** OPPO [2], vivo [7], Apple [10], CATT [27]

The main arguments for this option include no need for UE to check barring indication twice (in MIB and SIB1), thus simpler for implementation, more future proof considering possible RedCap-only cells or SSBs, similar solution as IAB-MT adopted.

* **UE follows the existing *cellBarred* in MIB:** Xiaomi [8], Intel [13], DENSO [18], Ericsson [23], CMCC [25]

The main arguments for this option include that there’s no need to support RedCap-specific cells and for such case other solutions exist already (e.g NPN), cellBarred should apply to all UEs e.g. when the cell is in maintenance, there can be negative impact on power consumption when UE needs to check SIB1 instead of just MIB for barring.

* **Depends on the agreement for IFRI**: NEC [20]

Arguments for this option is that barring should be done based on information in the same message i.e. MIB or SIB1.

*Rapporteur comment:* The views are split, and there seem to be valid technical points on both sides, thus it is difficult to formulate proposal on either direction.

1. [To discuss] Continue discussion on whether UE ignores or applies the existing *cellBarred* in MIB.

[Rapporteur]: P6 has not been discussed online in this meeting.

**Question 2:** Should UE apply or ignore the existing *cellBarred* in MIB?

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| --- | --- | --- |
| **Company** | **Q2:Apply / Ignore** | **Comments**  |
| Qualcomm | Neutral | We are neutral on this issue but have a slight preference for ignoring cellBarred in MIB, because it is desirable for UE to get all barring related information from a single message (SIB1). |
| Ericsson | Apply | We lean towards using the existing indication, e.g. if cell is in maintenance, it would benefit the UE to apply barring from MIB already. Nevertheless, both options can made to work, thus we do not have strong position and can agree majority view.  |
| Apple | Ignore | While we do agree there won’t be many RedCap specific cells, doing so would make it easier for NWs with wider (>20MHz) SIB1 initial BWP BW to handle RedCap UEs (which require no more than 20MHz initial BWP BW). We had issues in LTE (CRS muting etc..) where such logic was needed, and so it’s better to have all barring related info in SIB as this ensures back-ward compatiability and co-existence.  |
| Huawei, HiSilicon | Apply | No strong motivation to support the RedCap only cell, which is the intention of “ignoring”. |
| vivo | Ignore | It has been agreed that Specify a RedCap specific IFRI in SIB1 during online discussion. Hence, RedCap UE anyway needs to check SIB1 for IFRI even if the cellbar in MIB is applied to RedCap and set to barred. Applying Cellbar in MIB when the cell is in maintenance will not save any UE power consumption for RedCap UE. |
| Nokia | Neutral | Since RedCap specific barring indications will be provided over SIB1, it would be good to always read the SIB1. However, we don’t intend to introduce RedCap only cell. |
| Sharp | Neutral |  |
| Fujitsu | Neutral | Same view as Qualcomm.  |
| BT | Apply | When MIB cell barring is active, we don’t want any device to access into the cell and that includes RedCap.With this reasoning, if MIB is ignored, RedCap device will be forced to read SIB and it will find it is barred resulting in a waste of power consumption. |
| Thales | Neutral | No strong view, both options can work. Slight preference for UE to apply barring from MIB already. |
| Futurewei | Neutral | Same view as Qualcomm. |
| Xiaomi | Neutral | We don’t want to introduce Redcap only cell. So slightly prefer not to ignore. |
| Intel | Apply  | We do not see the need to introduce a new mechanism to support RedCap specific cell. And therefore legacy cell bar indicator in MIB shall also be applied for RedCap UEs.  |
| Sequans | Ignore | We anyway have more sympathy with the “ignore” considerations. Given that RedCap IFRI was agreed for SIB1, we think there is no drawback in having this indication only there as well.However, we are OK to agree based on majority. |
| ZTE | Ignore | Since RedCap UE anyway needs to read SIB1 to check RedCap specific IFRI, to ignore cellbar in MIB will not cause additional UE power. In addition, cell barring is rare case, reading SIB1 for RedCap specific cellbar should be acceptable. |
| NEC | Ignore | we thought both cellBarred and IFRI in MIB should be treated similarly, i.e. if cellBarred is applied, IFRI is also applied or vice versa. Now that RedCap specific IFRI in SIB1 has been agreed, cellBarred in MIB can be ignored.  |
| NTTDOCOMO | Apply | If the cell is in maintenance, it is more straightforward for UE to directly apply barring in MIB as legacy. |
| MediaTek | Apply | While both options can work, we do not see a strong justification for RedCap specific cells. Therefore, we would prefer to apply cell barring in MIB to RedCap UEs. |
| Spreadtrum | Neutral | This may depend on if there is Redcap only cell. A slight preference for ignoring cellBarred in MIB, to keep the possibility for Network operator to deploy Redcap only cell.  |
| OPPO | Ignore | This is the most straightforward and flexible way. |
| CMCC | Apply | We don’t intend to support RedCap only cell. |
| ChinaTelecom | Ignore | Same view as ZTE. |

On SI barring indication

The details of the barring indication or cell support indication are discussed in number of papers and the following proposals are made:

* **System information indicates whether 1 Rx / 2 Rx branch RedCap UE is supported**: vivo [7] , Sierra [9]

Arguments for this option are that similar structure was adopted for IAB and that the default should be no Redcap support in the cell (thus no indication in SIB1).

* **Specify cell barring in SIB1 separately for UEs with 1 Rx / 2 Rx branch(es):** Fujitsu (barring or support can be discussed) [12], LG [14], Nokia [21], Ericsson [23], Futurewei [24], CMCC [25], China Telecom [26]

The main argument for this option is that this is the intention of WID.

* **Specify cell barring using one indication in SIB1 for all RedCap UEs, i.e. revise WID objective**: Samsung [16]

Argument for this option is that if UE can receive SIB1, it can also receive DL transmissions, thus there should be no difference in support protocol-wise between 1 Rx or 2 Rx.

* **Wait for RAN1 on how to provide barring indication:** Xiaomi [8]

Arguments for this option is that RAN1 is discussing how to provide barring indication.

*Rapporteur comment:* Details of such indication is in RAN2 domain and the need and differentiation has been discussed in plenary already. Rapporteur thinks it time to make a decision in RAN2. The support for barring indication is larger compared to a “support” indication, therefore the following is proposed:

1. [Easy] Specify separate indications in SIB1 for barring RedCap UEs with 1 Rx chain and 2 Rx chains.

Note that optimizations and slightly different solutions were proposed by different companies, the details can be discussed in stage-3 implementation.

[Rapporteur]: P7 has been agreed online.

On inter-frequency reselection indicator:

The following options have been proposed for IFRI handling for RedCap:

* **Introduce RedCap specific IFRI in SIB1 (ignore legacy IFRI when broadcast) and**
	+ **differentiate 1 Rx and 2 Rx**: Qualcomm [5], vivo [7], LG [14], IDT [17], Nokia [21], CATT [27]

The main arguments for this option are that RedCap UEs may impact NW capacity, thus separate indication is preferred flexibility and should follow similar agreement (and WID formulation) for barring. Interference avoidance and differentiation to avoid possible confusion together with barring indications were also mentioned.

* **do not differentiate Rx branches (or not explicitly mentioned):** OPPO [2], Xiaomi [8], Fujitsu [12], DENSO [18], NEC [20], Futurewei [24], China Telecom [26]

Some of the main arguments for this option apply also for the previous option, i.e., independence of IFRI for RedCap and non-RedCap, possibility to control need for coverage enhancement and that RedCap specific IFRI should be supported in any case. Some companies argue that differentiation between Rx branches would not be needed for IFRI, however.

* **Re-use existing IFRI in MIB for RedCap, do not introduce new fields in SIB1**: Intel [13], Samsung [16], Ericsson [23], CMCC [25]

The main arguments for this option include that separate treatment for IFRI is not needed, it is an optimization and all UEs can use the same indication as there should be no difference in IFRI configuration between RedCap and non-RedCap UEs.

* **RAN2 to discuss the need for RedCap specific IFRI**: Huawei [4]

Additionally, at least LG [14] points out that if the cell doesn’t support RedCap, then the existing IFRI indication in MIB should be supported. Rapporteur agrees that this case should also be discussed, i.e. the UE behavior in case the cell doesn’t support RedCap.

*Rapporteur comment*: Althought the view on different options is split, there is larger support for introducing a RedCap specific IFRI. It can be further discussed whether the IFRI should be differentiated on supported Rx branches or not. However, it should be noted that there is no agreement on any coverage enhancement requirement for 1 Rx vs 2 Rx UE.

1. [Easy] Specify a RedCap specific IFRI in SIB1.
2. [To discuss] Specify IFRI separately for RedCap UEs with 1 Rx and 2 Rx branches.
3. [To discuss] If RedCap-specific IFRI is not broadcasted, the existing IFRI in MIB is followed.

[Rapporteur]: P8 has been agreed online and the discussion should continue for 9 and 10. Please see summary of previous arguments above.

**Question 3:** Should RedCap specific IFRI in SIB1 be separate for UEs implemented with 1 Rx and 2 Rx branches?

|  |  |  |
| --- | --- | --- |
| **Company** | **Q3: common/separate IFRI for 1 Rx/2 Rx** | **Comments**  |
| Qualcomm | Separate IFRI for 1 Rx/2 Rx | For the same reason why a separate IFRI for RedCap is agreed |
| Ericsson | Common | As also pointed out by some companies online, we don’t think separate IFRI would be needed at all, and we don’t expect the NW to differentiate IFRI between “normal” and RedCap UEs in deployments.Now we have agreed separate IFRI, but we don’t see use case for separate indications for 1 Rx and 2 Rx – we see this is an additional optimization for a case which should be rare (if ever used to start with).  |
| Apple | Separate IFRI | Same reason as Qualcomm, and also our resp to Q2. |
| Huawei, HiSilicon | No strong view |  |
| vivo | Separate IFRI for 1Rx /2Rx | Agree with Qualcomm. We see some use cases need separate IFRI for 1rx and 2rx. An example is following: Cells on freq A support 2rx RedCap, but bar 1rx RedCap. With common IFRI, these cells need to set Cellbar for 1rx to “barred”, and IFRI for RedCap to “not allowed”.If one of the cells, e.g. cellx, needs to bar 2rx RedCap temporarily, the 2rx RedCap in the cellx will consider all the cells on freq A are not allowed for cell re-selection by misunderstanding.  |
| Nokia | Separate | It seems this would be required by the WID already. |
| Sharp | No strong view |  |
| Fujitsu | Common | Same view as Ericsson.  |
| Thales | Separate IFRI for 1Rx /2Rx | Agree with Qualcomm. |
| Futurewei | Common | Similar to the IFRI in MIB, the RedCap-specific IFRI should be meaningful to a RedCap UE only when the RedCap UE is barred. Therefore, we think a common RedCap-specific IFRI is sufficient because an operator’s policy to bar 1Rx, 2Rx, or all RedCap UEs should be quite consistent throughout the area. It will be quite strange to see that, e.g., both 1Rx and 2Rx UEs are barred in one cell, and then 2Rx UEs are allowed but 1Rx UEs are not allowed in a neighboring cell. The table below shows how to interpret the common RedCap-specific IFRI in various scenarios:

|  |  |  |  |
| --- | --- | --- | --- |
| 1Rx cellBarring | 2Rx cellBarring | Common RedCap-IFRI | Scenarios |
| *barred* | *barred* | *notAllowed* | Both 1Rx and 2Rx UEs are barred on the frequency channel throughout an area. |
| *barred* | *barred* | *allowed* | Both 1Rx and 2Rx UEs are barred in the current cell but are allowed in neighboring cells on the same frequency channel (see Note1).  |
| *barred* | *notBarred* | *notAllowed* | 1Rx UEs are barred on the frequency channel throughout an area.2Rx UEs are not barred in the current cell and hence are deemed as allowed in neighboring cells on the same frequency channel (see Note1).  |
| *barred* | *notBarred* | *allowed* | 1Rx UEs are barred on the current cell and 2Rx UEs are not barred in the current cell.Both 1Rx and 2Rx UEs are allowed in neighboring cells on the same frequency channel (see Note1).  |
| *notBarred* | *notBarred* | N/A or absent | Both 1Rx and 2Rx UEs are not barred in the current cell and hence are deemed as allowed in neighboring cells on the same frequency channel (see Note1).  |
| *notBarred* | *barred* | *notAllowed* | (see Note2)2Rx UEs are barred on the frequency channel throughout an area.1Rx UEs are not barred in the current cell and hence are deemed as allowed in neighboring cells on the same frequency channel (see Note1).  |
| *notBarred* | *barred* | *allowed* | (see Note2)2Rx UEs are barred on the current cell and 1Rx UEs are not barred in the current cell.Both 1Rx and 2Rx UEs are allowed in neighboring cells on the same frequency channel (see Note1).  |

Note1: When reselecting a neighboring cell, the UE checks with SIB1 of the new cell for the exact cellBarring status of that cell.Note2: Although we don’t think the last two scenarios are likely, we enlist them here for completeness.  |
| Xiaomi | Common | IFRI is used to indicate whether UEs are allowed to camp on other cells than the strongest cell.For Redcap UEs (no matter 1RX or 2RXs), camp on the cell based on the strongest signalling strength is good for the coverage enhancement, we think the operator would have similar policy for both types of Redcap UEs. |
| Intel | Common | Share the same view as Ericsson.  |
| Sequans | Separate | Though not a strong preference, can agree with majority |
| ZTE | Separate IFRI | We see no reason to disallow operator/network to configure the different cell barring parameters (for 1Rx or 2Rx) for neighbour cells of same frequency. Cell barring may be set due to overload reason, so the configuration can be different even for intra-frequency neighbour cells.So we prefer to have separate IFRIs for 1Rx and 2Rx UEs, to be compatible with the separate cell barring parameters for 1Rx and 2Rx. |
| NEC | Common | Having IFRI separately for 1Rx and 2Rx sounds overspecification. |
| NTTDOCOMO | Common  | Common IFRI is easier for network deployment. |
| MediaTek | Common | Having separate IFRI for 1Rx and 2Rx UEs is overkill for this feature. The UE only needs to know if neighbour cells allow RedCap UE access or not. |
| Spreadtrum | Common | Agree with Xiaomi. |
| OPPO | no strong view | But we can accept common indication. |
| CMCC | Common | Agree with Ericsson. |
| ChinaTelecom | Common | We do not see the need to differentiate IFRI for 1Rx and 2Rx.  |

**Question 4:** If RedCap specific IFRI is not broadcasted, should the UE follow existing IFRI in MIB (if not, please explain why / alternative action)?

|  |  |  |
| --- | --- | --- |
| **Company** | **Q4: Yes / No** | **Comments**  |
| Qualcomm | See comment | We prefer that if a cell supports RedCap, then it always signals RedCap-specific IFRI (either yes or no). It is simpler for UE implementation.  |
| Ericsson | Yes | In such case the UE should follow the MIB bit. |
| Apple | Yes, but agree with Qualcomm as well. |  |
| Huawei, HiSilicon | No, see comment | We don’t believe the “RedCap specific IFRI” is optional, if the gNB supports RedCap. In legacy Uu, IFRI is mandatory configuration with two values. Also, optional IE will cause 1 more bit in ASN.1.If the RedCap specific IFRI is absent, it should be interpreted as the cell does not support RedCap.Not sure we need to define IFRI for non-RedCap capable gNB. |
| vivo | No | In our understanding, there would two cases for a cell not broadcasting RedCap specific IFRI.Case 1: Cellbar for RedCap is broadcasted, but IFRI for RedCap is not. We share the same view with QC and think this case is not a reasonable configuration, i.e. if a cell supports RedCap, then it should always signal RedCap-specific IFRI. Case 2: Both Cellbar and IFRI for RedCap are not broadcasted, e.g. gNB has not been upgraded to support RedCap.If the existing IFRI could also be used to indicates whether CapRed UE is allowed to perform intra-frequency re-selection, the operator is required to reconfigure a gNB for RedCap even the gNB doesn’t support RedCap. We prefer to avoid such dependence of parameters, which is easy to cause mistakes in the field.Given RedCap UEs usually prioritize stored frequencies during cell selection, there is no big chance for RedCap UEs to select a non-RedCap frequency, this optimization seems not very necessary.  |
| Nokia | No | Since the UE anyway needs to read the SIB1, it seems feasible for the NW to set the RedCap specific IFRI(s) correspondingly. |
| Sharp | comments | Agree with Qualcomm. |
| Fujitsu | No | We agree with other companies that the NW should always broadcast the RedCap specific IFRI.  |
| Thales | No | If cell support REDCAP, then RDCAP IFRI should be signaled. |
| Futurewei | No | In a cell supporting RedCap, as long as some RedCap UEs are barred, the corresponding RedCap-specific IFRI shall be broadcasted. As a potential optimization (if RAN2 wish to pursue), the only valid case that no RedCap-specific IFRI needs to be broadcasted is when cellBarring indications for both 1Rx and 2Rx are set to *notBarred.* On the other hand, if we answer Yes to the question, we may have a problem with the following scenario:The operator wishes to bar 1Rx or all RedCap UEs on a frequency channel throughout an area. One cell within the area on the frequency channel is undergoing maintenance (so, the cellBarring in MIB is set to *barred*). Meanwhile, the IFRI in MIB is set to *allowed* because the neighboring cells on the frequency channel are operational for non-RedCap UEs. In this case, If no RedCap-specific IFRI is broadcasted (in SIB1) and the barred RedCap UEs follow the IFRI in MIB, they may attempt to reselect a neighboring cell on the frequency channel, wasting their battery. |
| Xiaomi | Yes | It is preferred that gNB gives Redcap IFRI. If not, following the legacy IFRI seems not a big issue. |
| Intel | Yes |  |
| Sequans | No | Agree with QC, Nokia |
| ZTE | No  | Agree with QC. If a cell supports RedCap, it shall always broadcast RedCap specific IFRI.  |
| NEC | No | Agree with Qualcomm. |
| NTTDOCOMO | Yes |  |
| MediaTek | No | Agree with Qualcomm |
| Spreadtrum | No | Considering for simplification of UE implementation.  |
| OPPO | No | Agree with Qualcomm. |
| CMCC | No | Agree with Qualcomm. |
| ChinaTelecom | No | Agree with QC,HW. |

## 2.3 Other topics

This section summarizes additional topics which are not explicitly part of the WID but with more than two companies proposing enhancements. Similar proposals have been discussed briefly during earlier meetings, but these topics have not been prioritized.

Number of companies, e.g. THALES [3], QC [5], Apple [10], Fujitsu [12], Intel [13], ZTE [15], Samsung [16], CMCC [25], CATT [27] discuss possible provision of indications on whether neighboring cells support or bar RedCap UEs. The following options are discussed:

* **Provide such information on neighboring cell support/barring:** Fujitsu [12], Samsung [16], CMCC [25], CATT [27]

The main argument is that such indications may reduce the UE power consumption as UE would not need to measure cells which do not support RedCap.

* **Provide such information and also differentiate 1 Rx / 2 Rx**: QC [5], Apple [10], ZTE [15], THALES [3]

The same main argument on power consumption applies for this option. Additionally, it is mentioned cell barring may be more dynamic thus it is not enough to rely on UEs’ previous understanding of cell support.

* **Do not introduce such indications in SI**: Intel [13]

Arguments: Dedicated frequency priority seems sufficient assuming frequencies are upgraded at the same time (Intel)

*Rapporteur comment*: There is some support for introducing neighboring cell information, but based on earlier discussion there is also some opposition. If such enhancement is introduced, the technical details should be discussed further, such as how often such information is expected to change (and e.g. impact on SI updates), higher layer (RAN3) impact, and whether the indication is for cell support or barring in neighboring cells or whether lists of allowed cells are provided as suggested by some companies.

1. [To discuss] Whether information on neighboring cell acceptance of RedCap UE access is provided in system information.

[Rapporteur]: P11 was not discussed online so far.

Question 5: Should system information provide information whether neighboring cells accept RedCap UE access?

|  |  |  |
| --- | --- | --- |
| **Company** | **Q5: Yes / No** | **Comments**  |
| Qualcomm | Yes | First, having this information helps UE avoid unnecessary neighbor cell measurements;Second, this information is readily available to gNBs, as we agreed at the last meeting that gNBs should exchange such information with neighbor cells. So there is no extra implementation complexity to do so. |
| Ericsson | No | General approach is that NW does not advertise which features different nodes support. Also, in practice, it is expected that the network, or at least considerable parts of network (e.g. RAN area), implement support at the same time, thus such info would be redundant. Also, upon cell reselections/HOs, the UE can store information on which cells allow RedCap, which helps when visiting the same cells/area. Thus, we don’t seed need for such information to be broadcast in neighboring cells. If the barring configuration is expected to be dynamical, it is not acceptable that all neighboring cells need to trigger SI updates based on changing the barring bit(s) in a cell.  |
| Apple | Yes | We do not consider provision of NCell info as advertising NW features. Not only does this help the UEs in not wasting time/power in re-selection, but considering that NWs can ‘filter’ RedCap UEs (1Rx or 2Rx etc), it is useful to provide NCell info based on these filters as well. |
| Huawei, HiSilicon | No | Share the view from Ericsson.This depends on the R3 discussion on whether/how gNB knows the neighbor cell capability. Maybe we should postpone this. |
| vivo | Yes | We think RedCap specific black/white cell list can be considered. |
| Nokia | No | We agree with Ericsson. This would introduce considerable broadcast overhead which is not desirable.If something would be required, we could consider indicating the frequencies that support RedCap. |
| Sharp | No | Agree with Ericsson |
| Fujitsu | Yes | This can reduce the RedCap UE’s power consumption on measurement and cell reselection evaluation.  |
| BT | No | Agree with Ericsson.We don’t see the need to broadcast neighbor cells RedCap capabilities. It is a waste of radio resources. RAN3 can solve this with Xn messages. |
| Thales | Yes | This would avoid for the UE doing unnecessary measurements and decoding of neighbor cells which don’t accept REDCAP devices. Hence, for UE power saving respective information needs to be conveyed to the UE, i.e. which cells/frequencies to be measured and which can be ignored. Information to be differentiated for UEs supporting 1Rx/2RX. |
| Futurewei | No | We agree with Ericsson. In addition, two out of the three key UE categories for RedCap (industrial sensors, wearables, and surveillance cameras) tend to be stationary. Rel-17 RRM relaxation (stationarity criterion based) can be configured to save the UE from performing unnecessary RRM measurements. Therefore, we do not see the need/justification for broadcasting the information as proposed.  |
| Xiaomi | No | Agree with Ericsson.Also, as Futurewei mentions that RRM relaxation can be used. |
| Intel | No | Our understanding is that normally the operator will upgrade their network on the same frequency simultaneously, and therefore dedicated frequency priority should be sufficient to resolve the problem. |
| Sequans | No | Agree with Ericsson, this seems to be of relatively little use with a possibly large overhead and complications (e.g. for SI update).If there is a “yes” majority, at least more details need to be made clear before this can be agreed.We are also fine to postpone until RAN3 discussions are done on the RedCap support sharing issue.  |
| ZTE | Yes | Agree with QC. It is beneficial in power saving for RRC\_IDLE and RRC\_INACTIVE UEs.In addition, we think RAN3 anyway will support per-cell RedCap capability exchange (e.g. to assist handover decision). So we don’t see the need to wait for RAN3.  |
| NEC | No | similar view as Ericsson  |
| NTTDOCOMO | Yes | With this, we see benefits for reducing unnecessary neighbor cell measurement for IDLE RedCap UEs. For unnecessary HO, RAN3 is working on it over Xn interface. |
| MediaTek | Yes | We see benefits with this approach for IDLE RedCap UEs to:a) avoid unnecessary cell measurementsb) avoid unnecessary cell reselections |
| Spreadtrum | No |  |
| OPPO | Yes | Agree with vivo that RedCap specific black/white cell list can be considered. This can help RedCap UEs to save power. |
| CMCC | Yes | It helps for UE to avoid unnecessary measurement to the cells not supporting RedCap and reduce the latency for cell reselection. |

Introduction of RedCap-specific cell selection parameters, separate Qrxlevmin and Qualmin and separate cell (re)selection priorities are discussed and proposed in [4], [5], [12], [13], [15], [16], [18], [25] and [27] as follows (Note the following are not necessarily mutually exclusive):

* **Introduce RedCap specific cell (re)selection parameters:** HW [4], Intel [13], CMCC [25], CATT [27]

The main arguments for introducing such is that UE may experience reduced antenna efficiency and bad UL coverage (different performance in general) or that RedCap UEs could be directed towards certain frequencies supporting RedCap.

* **Optionally configure separate Qrxlevmin and Qualmin**: QC [5], Fujitsu [12], Samsung [16], DENSO [18]

The main arguments are that different parameters should be configured in case NW schedules RedCap UEs differently compared to non-RedCap, prioritization of certain cells for RedCap and that 1 Rx UEs may require higher minimum signal strength to access the cell.

* **RedCap UEs can be configured with separate cell (re)selection priorities:** QC [5], Fujitsu [12], ZTE [15], Samsung [16], CMCC [25]

The main arguments are the possible need to direct RedCap UEs e.g. towards lower frequencies for better coverage and to avoid interference.

*Rapporteur comment:* The support for various options seems to be similar as it was during the last meeting and offline discussion ([ATT114-e][106]). The solutions seem to address different problems, as one example need for coverage enhancement and as another example possibility for operator to steer RedCap UEs towards specific frequencies. RAN2 should discuss further if there are particular issues which should be resolved, and if there are, which would be good solutions.

1. [To discuss] Whether to support RedCap specific cell (re)selection parameters and/or priorities (e.g. Qrxlevmin, Qualmin, offsets, cellReselectionPriorities, etc.)

[Rapporteur]: P12 was not discussed online so far.

**Question 6:** Should any of the following be introduced for RedCap in Rel-17 (please include motivation):

1. RedCap specific cell (re)selection parameters?
2. RedCap specific Qrxlevmin, Qualmin? (Or other parameters in detail)
3. Separate cell (re)selection priorities?

|  |  |  |
| --- | --- | --- |
| **Company** | **Q6: Support for 1/2/3?** | **Comments / motivation** |
| Qualcomm | 2, 3 | Agree with the motivations captured by the rapporteur |
| Ericsson | None | We consider these enhancements to be out of scope of the WID, and such would need strong motivation from the proponents and support to be implemented. For 1) and 2): There is no agreed coverage loss which would require enhancement for cell reselection. There is no request from RAN1/4 to RAN2 to work on this. For 3): Is there additional need for something on top of the redirect and dedicated priorities which can be provided in RRCRelease? |
| Apple | Neutral to this |  |
| Huawei, HiSilicon | 1, 2, but only for cell selection. | The motivation is to consider the coverage of RedCap UE. As long as RedCap UE can treat specially to consider one cell as suitable, the coverage issue is address. This will be considered in both UE cell selection and re-selection. But, we only need to define the RedCap specific parameters so that UE can select proper cell. |
| vivo | 2,3  | For 2, we think another motivation is to allow 1Rx UEs to apply lower minimum signal strength to access the cell. In the case, network can compensate the reduced Rx capabilities via implementation (e.g. different scheduling policy). |
| Nokia | None | We agree with Ericsson. |
| Fujitsu | 2,3 | These can enable the RedCap UE to prioritize a cell that allows/prefers the RedCap operation without impacting the normal UE.  |
| BT | None | There is no need for this from an operator point of view. It only adds extra complexity in the network design. |
| Thales | 2,3 | Slight preference, different parameters would allow for prioritization of certain cells for RedCap UEs. However this is seen as an addition, other aspects may need to be treated/agreed with higher priority.  |
| Xiaomi | Neutral to 3 | 1,2 are not needed as there is no agreed CE requirement. |
| Intel | 2 | We do not see the need to have cell specific reselection priority since frequency priority should be sufficient. However we see the benefits to have Rx specific threshold for cell (re)selection considering the coverage is different for 1Rx and 2Rx UEs. |
| Sequans | Neutral | No strong preference. This does not seem to be high priority in any case. |
| ZTE | 2,3 | We think separate minimum cell access thresholds are needed for 1Rx UEs. For 3), besides the motivation captured by rapporteur, it is beneficial to prevent RedCap UE from re-selecting to RedCap incapable frequencies.  |
| NEC | Neutral  | need further discussion how much this (or these) are really useful in which use case. We would like to postpone.. |
| NTTDOCOMO | Neutral | For 2, RAN4 input is preferable.  |
| MediaTek | None | Agree with Ericsson  |
| Spreadtrum | None |  |
| OPPO | None | Agree with Ericssion. |
| CMCC | 1,2,3 | Considering the shrunk coverage RedCap UE may experience, especially 1RX UE, and improving the flexibility of network deployment, we think RedCap specific parameters and priorities for cell (re)selection could be considered. |

# 4 Conclusion

**TBD**

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