**3GPP TSG-RAN WG2 Meeting #116bis electronic R2-22x**

**Online, January 17-25, 2022**

Agenda Item: 8.12.2.2

Source: Huawei, HiSilicon

**Title:** Summary of [AT116bis-e][103][RedCap] Identification and access restriction (Huawei)

Document for: Discussion and Decision

# Introduction

This paper aims at capturing the summary of email discussion.

* [AT116bis-e][103][RedCap] Identification and access restriction (Huawei)

Initial scope: Discuss identification and access restriction aspects based on submitted contributions

Initial 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): Wednesday 2022-01-19 1300 UTC

Initial deadline (for rapporteur's summary in R2-2201734): Wednesday 2022-01-19 1500 UTC

Proposals marked "for agreement" in R2-2201734 not challenged until Thursday 2022-01-20 0300 UTC will be declared as agreed via email by the session chair (for the rest the discussion will continue in the GTW session).

**Contact Table**

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1. Discussion
   1. Msg3 early identification

We have the following FFS from last meeting:

In MAC perspective, RedCap UE uses the dedicated LCID for Msg3 early identification, when the Msg3 includes the CCCH data. FFS on whether it requires no other precondition, or precondition as “when Msg1 early identification is not configured”, or precondition as “when Msg3 early identification is enabled by NW.

In addition, some contributions from operators are listed below for your consideration:

R2-2200861 Discussion on access restrictions and early identification CMCC

R2-2201623 Support and network behaviour for RedCap early indication messages BT Plc, Deutsche Telekom AG, Telecom Italia S.p.A., TurkCell, CMCC, NTT DOCOMO INC., Orange, Vodafone, KDDI

**In MAC perspective, RedCap UE uses the dedicated LCID for Msg3 early identification, when the Msg3 includes the CCCH data.**

**Option 1: it requires no other precondition;**

**Option 2: it requires precondition as “when Msg1 early identification is not configured”**

**Option 3: it requires precondition as “when Msg3 early identification is enabled by NW”**

**Question 1: Which option do you prefer?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Option?** | **Comments** |
| Samsung | Option 1 | We do not see any reason to add (unnecessary) precondition. |
| BT | Option 3 | It seems reasonable that a RedCap UE only includes Msg3 early indication if the network asks for that.  Important to note that Msg3 enable/disabled option is not agreed as highlighted in R2-2201623. |
| Nokia | Option 1 | Precondition would only increase the complexity without real benefit. |
| MediaTek | Option 1 (Open to Option 3) | While option 1 makes the most sense as it doesn’t come with any additional overhead, if operators see it as useful to have msg3 early identification as configurable to aid their deployments, we are open to Option 3 to enable this. |
| ZTE | Option 3 |  |
| Sierra Wireless | Option 3 |  |
| Apple | Option 3 |  |
| Sequans | Option 1 | No need for the restrictions. Can go with 3 as well. |
| Spreadtrum | Option 3 | It can be controlled by the network. |
| CATT | Option 2 | We think Msg3 early identification should not always be used, at least when the Msg1 early identification is configured. But for simplification, we prefer early identification is always be used, i.e. either Msg1 based or Msg3 based identification is used. It is one specific example of Option 3, i.e. if Msg 1 early identification is not configured, it implicitly indicates the Msg 3 early identification is enabled by the NW, otherwise, if the Msg 1 early identification is configured, it implicitly indicates the msg early identification is disenabled by the NW. |
| Futurewei | Option 1 (open to option 3) | BTW, we should extend the final decision to be made here to LCID based MsgA early identification as well. |
| LGE | Option 1 |  |
| NEC | Option 2 | Considering operators’ inputs, we tend to think the Option 2 or 3 is fine than Option 1. And given that Msg1 early identification can be enabled/disabled by the NW, explicit configuration for Msg3 based identification (i.e. Option 3) is not really necessary.  On the other hand, Option 1 is also acceptable if it is the majority view, as we guess the most important thing is to conclude this issue in this meeting. |
| Google | Option 1 |  |
| vivo | Option 2 (option 3 acceptable) | There is no additional gain using Msg3 early identification when Msg1 early identification is applied for RedCap UE (if Msg3 is only used for RedCap identification). Of course, using the dedicated LCID won’t bring extra overhead. However, the dedicated LCID doesn’t have to be used for early identification especially when Msg1 early identification is enabled, we think using it to indicate additional UE information is more efficient. |
| T-Mobile USA | Option 3 | All early indication features must be under network control. |
| Interdigital | Option 1 | We don’t see much point with the configurability and so option 1 looks better from UE implementation point of view. |
| Intel | Option 2 or 3 | Do not see the need to make Msg early identification mandatory. |
| Nordic | Option 1 | For implementation simplicity avoiding (unnecessary) precondition makes sense. Furthermore, then there is no need to signal enable/disable from the network. |
| CMCC | Option 3 | Early identification should be under network control. |
| Sharp | Option 1 |  |
| Qualcomm | Option 1 | Simpler to implement |
| Fujitsu | Option 1 | If Msg1 early identification is not configured, RedCap UE can use dedicated LCID for Msg3. But that is not mandatory.  While Msg1 early identification is configured, we think it’s still RedCap UE’s implementation to use the dedicated LCID or not for Msg3.  Msg3 early identification from NW side should always be enabled. gNB should consider a UE as RedCap UE if there is identification by Msg1 **or** Msg3. |
| KDDI | Option 3 |  |
| OPPO | Option 1 | As the use of dedicated LCID for Msg3 early identification does not add extra bit to the Msg3 size, it can be always indicated by RedCap UEs. |
| Orange | Option 3 | Msg3 early identification should be configurable by the NW. |
| DENSO | Option 1 | Agree with Samsung and Nokia. Similar to Cat.0 UE in LTE, there is no problem for RedCap UEs to use dedicated LCID in Msg.3. It is totally up to NW implementation how to deal with the dedicated LCID. Instead, precondition also requires additional implementation and configuration effort, which would result in increasing complexity as commented by Nokia. |
| Ericsson | Option 1 | There seems to be a misunderstanding regarding what options described above would actually mean. First of all the intention is to use the dedicated LCID regardless of whether early identification for Msg1 is configured. Note that RAN2 has already agreed that UE shall use Msg1 early identification if configured, so there will be no changes with respect to that. However, the proposal here is that the RedCap UE would still use the dedicated LCID since this has no impact on any other mechanism and would make the implementation easier. From MAC specification standpoint, the LCID is already reserved for RedCap UEs.  For the case where Msg1 early identification is not configured and the cell is not barred for RedCap UEs, the UE shall use the dedicated LCID as intended.  Regarding the discussion on whether there is any means for the network to control access from RedCap UEs if there is no explicit configuration for Msg3 early indication. We think this can already be achieved using the RedCap specific barring bits if the intention is to prevent access to the network. Considering that it should not be possible for a RedCap to access the network without early indication (Msg1 or Msg3) there is no need to address the case where the cell is not barred for RedCap UEs, but both Msg1 and Msg3 early indications are disabled implicitly or explicitly. |

Another issue is whether RedCap should always support this Msg3 early identification. In case this is optionally supported, and there is no UE capability signaling, it means some RedCap UE may not indicate its type in Msg3, even if NW side configures/enables Msg3 early identification. Namely that an UE, not using dedicated LCID in Msg3, may still be one RedCap UE.

**Question 2: Do you think Msg3 early identification is optionally supported by RedCap UE?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes or No?** | **Comments** |
| Samsung | No | Since RAN2 assumes a dedicated gNB for RedCap UEs, both network and UE should support this identification. |
| BT | No | Both, RedCap cells and RedCap Ues must support early identification, other case the solution is incomplete. As it is mention in R2-2201623, operators do not want to face cases where NW and RedCap Ues implement different early indication messages.  Same issue applies to Msg1 and to MsgA if supported. Consequently, both also need to be mandatory supported.  The issue captured by the rappateur is a real thread. |
| Nokia | No | Since this is IDLE/INACTIVE mode indication, this shall be mandatorily supported, otherwise, NW cannot identify RedCap Ues during connection establishment when Msg1 early identification is not configured. |
| MediaTek | No | Agree with BT that unless this is mandatory for RedCap Ues, this feature is rather pointless as NWs will be unable to identify all RedCap Ues in their cell during initial access. |
| ZTE | No | It should be mandatory for RedCap Ues. Otherwise, NW has to always configure both Msg1 and Msg3 early identification to identify all RedCap Ues, this is highly inefficient. |
| Sierra Wireless | No |  |
| Apple | No |  |
| Sequans | No | NW needs to be able to identify RedCap UE even when Msg1 early identification is not configured |
| Spreadtrum | No |  |
| CATT | No | The Redcap UE should always support Msg3 early identification, but can be enabled under the control of the network. |
| Futurewei | No |  |
| LGE | No |  |
| NEC | No | As the network does not have any UE capability information for an accessing RedCap UE at Msg3 reception, it cannot be optional unless the following scenario is acceptable: The network does not enable the Msg1-based identification and the Msg3-based identification is expected somehow (pending Q1). If the RedCap UE does not support Msg3-based identification, then such UEs consider the cell is barred. |
| Google | No |  |
| vivo | Yes | RAN1 has agreed that Msg1 early identification is one of the mandatory features to define RedCap type. That is, RedCap UE mandatorily supports Msg1 early identification. In our view, only supporting one kind of early identification is enough for RedCap UEs. Supporting duplicated functionalities for the same purpose is not needed. Hence, we don’t think RedCap UE should mandatorily support Msg3 early identification. |
| T-Mobile USA | Yes | We don’t see the need for MSG3 early indication when there is MSG1 and UAC available |
| Interdigital | No | The support of Msg3 EI doesn’t deserve any optionality as it’s simple. |
| Intel | Yes | RAN1 has agreed that MSG1 based early identification is mandatory for RedCap UE. Not sure whether it is worth to specify two mandatory features in Rel-17. |
| Nordic | No | For simplicity avoid optional features whenever possible. |
| CMCC | No |  |
| Sharp | No |  |
| Qualcomm | No | It should not be optional because configuration of Msg1/A identification is optional by network |
| Fujitsu | Yes | It should not be mandatory for RedCap UE. The RedCap UE can determine whether to deliver early identification through Msg1, Msg3 or neither. |
| KDDI | No |  |
| OPPO | No | Msg3 early identification should be always supported by RedCap UE. |
| Orange | No | Both network and UE should support this identification. |
| DENSO | No | As commented to Q1, RedCap UE should always use the dedicated LCID in Msg.3. In other words, Msg.3 early indication should be mandatory for RedCap UEs. |
| Ericsson | No | It is optional for the network to support Msg1 and/or Msg3 early indication, but mandatory for the UE to support both. RAN1 has included the Msg1 early indication to the definition of the RedCap UE type (see feature group 28-1 in [R1-2112902](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107-e/Docs/R1-2112902.zip)) and RAN2 should do the same for Msg3 (and MsgA) early indication from RAN2 standpoint to be consistent and compliant with the WID. |

* 1. MsgA early identification

We have several straight forward proposals from R2-2200797, which use the similar principle as Msg1 early identification.

* Proposal 2 In MAC perspective, a RedCap UE uses MsgA PRACH early identification when it transmits preamble for CBRA if MsgA PRACH early identification is configured for RedCap by NW.
* Proposal 3 For MsgA PRACH early identification, RAN2 confirms both dedicated ROs and dedicated PRACH preamble can be supported from signalling point of view.
* Proposal 4 For RedCap, MsgA PRACH early identification is enabled/disabled implicitly by the presence of dedicated RACH configuration for MsgA PRACH early identification.

**Question 3: Do you agree the above proposals 2/3/4 in R2-2200797?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes?** | **Comments** |
| Samsung | Yes | For the completeness, CCCH in MsgA should also contain dedicated LCID for RedCap UEs. |
| Nokia | Yes with comments | Agree with Samsung’s proposal |
| MediaTek | Yes with comments | Agree with Samsung’s proposal |
| ZTE | Yes | Agree with Samsung’s proposal. |
| Apple | Yes |  |
| Sequans | Yes | Agree with Samsung |
| Spreadtrum | Yes |  |
| CATT | Yes | And we don’t think the CCCH in MsgA needs contain the dedicated LCID for Redcap UEs if MsgA PRACH early identification is enabled, otherwise, it seems like both Msg1 early identification and Msg3 early identification in 4-step RACH are both used at the same time. |
| Futurewei | Yes | For Samsung’s comment, we should be consistent with the final answer to Q1 w.r.t. whether the NW controls over the use of the dedicated LCID. |
| LGE | Yes |  |
| NEC | Yes |  |
| Google | Yes | Agree with Samsung |
| vivo | Yes | We agree to follow the same principle as Msg1 early identification. |
| T-Mobile USA | No | The primary goal of REDCAP is to reduce UE complexity, this feature increases UE complexity and there is not needed. |
| Interdigital | Yes + Samsung’s comment | Agree with Samsung |
| Intel | Yes |  |
| Nordic | Yes | Agree with Samsung comment. |
| CMCC | Yes |  |
| Sharp | Yes |  |
| Qualcomm | Yes | Agree with Samsung |
| Fujitsu | Yes | MsgA early identification should be aligned with Msg1 and Msg3 early identification. |
| OPPO | Yes | Agree with Samsung |
| DENSO | Yes | Agree with Samsung |
| Ericsson | Yes | Agree with Samsung |

* 1. IFRI

We have the FFS points as below:

**In case the cell is barred due to not supporting RedCap, intra-frequency cell reselection is considered by RedCap UE as:**

**Option 1: “allowed”;**

**Option 2: “not allowed”;**

**Option 3: follow the IFRI in MIB;**

**Option 4: UE implementation.**

**Question 4: Which option do you prefer?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Option?** | **Comments** |
| Samsung | - | RAN2 should have a consensus on the deployment scenario to make a decision: if RAN2 assumes homogeneous deployment per frequency i.e. if network supports redcap on a frequency, Option 2 should be chosen. Option 1 should be used if RAN2 assumes that deployment can be non-homogeneous per frequency i.e. network can support redcap on some but not all cells of the frequency. |
| BT | Option 3 | It is not possible to guarantee that RedCap solution will be deployed in a single frequency therefore option 2 should not be considered.  Option 1 and option 4 can delay reselection time. In fact, both can work together as intra- or inter- measurements priorities can be left to UE implementation. Unfortunately, if that happens operators have no mechanisms to prioritize one or the other even they are the ones with the knowledge of how the network is engineered.  For option 1, it should beneficial to clarify the RedCap UE behavior. Does it prioritize intra-frequency measurements over inter-frequency? |
| Nokia | Option 3 | If NW does not intend intra-frequency re-selection, IFRI in MIB should be followed. |
| MediaTek | Option 4/1 | If a cell is barred for RedCap Ues, we cannot assume that all cells on that frequency are barred for RedCap Ues. This is ideally left to UE implementation, to determine which cell(s) to look for (regardless of what’s indicated for non-RedCap Ues) |
| ZTE | Option ¼ | Option 3 is not preferred because network configures legacy IFRI based on the deployment of non-RedCap cells, we cannot assume the deployments are the same for RedCap and non-RedCap. So RedCap Ues may be misled by the legacy IFRI. |
| Apple | Option ¼ | Agree with MediaTek and ZTE comments. |
| Sequans | Option 4 (1) | Legacy IFRI cannot be considered as valid information for a RedCap UE. Implementation seems best, though 4 and 1 are basically equivalent |
| Spreadtrum | Option 3 | RedCap UE shall not access the legacy and it shall follow the legacy IFRI indication in MIB as this cell is barred for it. |
| CATT | None | We don’t think any option listed can always reflect the actual situation of the network deployment. And we think we should not impose additional function on Redcap UE specific IFRI, for example, using the present/absent of this field to indicate the cell supporting Redcap UE or not.  For the cell before Release 17, Option 4 can be used.  But for the cell of or after Release 17, there are two optional understandings for cell not supporting Redcap UE:   * The cell can’t accept the Redcap UE access, and can’t broadcast Redcap UE specific IFRI too: in this case, we agree with the view of ZTE, Option 4 can be used. * The cell can’t accept the Redcap UE access, but can broadcast Redcap UE specific IFRI: in this case, we suggest the network always broadcasts Redcap UE specific IFRI if the network wants to give a clear indication, otherwise, option 1 or option 2 can be used as a default option for UE   We can discuss the two options firstly, and achieve a common understanding on cell not supporting Redcap UE.  For the cell supporting Redcap UE, we also suggest the network always broadcasts Redcap UE specific IFRI if the network wants to give a clear indication, otherwise, option 1 or option 2 can be used as a default option for UE. |
| Futurewei | Option 3 | Open to Option 1. Given that operators have indicated that the initial deployment of RedCap cells may be patchy, option 2 should not be considered. |
| LGE | Option 3 |  |
| NEC | Option 1 | One scenario which needs option 1 is to deploy a cell supporting RedCap for surveillance video/camera in a specific area. In this case, there may not be homogeneous deployment on a frequency. |
| Google | Option ¼ | We think the IFRI is for non-RedCap Ues and should not be used for RedCap Ues. |
| Vivo | Prefer option 4,  Not option 3 | If a cell doesn’t support RedCap UE, e.g. the gNB of this cell hasn’t been upgraded, the gNB can’t provide any hint on whether neighbour cells support RedCap UE, i.e. option3 is not advisable.  Besides, we prefer option 4. |
| T-Mobile USA | Option 1, 2 or 3 | As CATT points out it depends on the deployment scenario. If an operator wants to deploy REDCAP homogeneously then no additional signaling is needed, however if non-homogeneous deployments are needed then the network needs to support additional signaling. |
| Interdigital | Option 3 | Agree with Nokia |
| Intel | Option 3 |  |
| Nordic | Option 3 |  |
| CMCC | Option 3 |  |
| Sharp | Option 3 |  |
| Qualcomm | Option 1 or 4 | Agree with MediaTek |
| Fujitsu | Option 4 | In our understanding, for a cell not supporting RedCap operation, the legacy IFRI in MIB is set not taking the RedCap UE’s access restriction into account. So, the RedCap UEs should ignore the legacy IFRI in MIB. The RedCap UE’s behavior is up to UE implementation. |
| OPPO | Option 1 | Since the IFRI in MIB is mainly used to control eMBB UE’s intra-frequency cell reselection, it does not make sense for the RedCap UE to follow this indication when the current cell is barred.  To increase the chance for RedCap UEs to reselect to another intra-frequency RedCap-supporting cell, we prefer option 1. |
| DENSO | Option 3 | Option 3 enables operators to select if intra-frequency cell reselection is allowed or not, hinging on their deployment scenario where support of RedCap is homogeneous in terms of the frequency layer or not. |
| Ericsson | Option 1 or 3 | The most important thing is to specify the UE behaviour clearly, so we are open to Options 1, 2, and 3 with preference for options 1 and 3. |

**Question 5: Do you agree that, as in legacy, in case the cell is barred due to being unable to acquire the MIB, intra-frequency cell reselection is considered by RedCap UE as “allowed”?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes or No?** | **Comments** |
| Samsung | Yes | Same as in legacy. |
| BT | Yes |  |
| Nokia | Yes | Same as legacy |
| MediaTek | Yes |  |
| ZTE | Yes |  |
| Apple | Yes |  |
| Sequans | Yes |  |
| Spreadtrum | Yes |  |
| CATT | Yes |  |
| Futurewei | Yes |  |
| LGE | Yes |  |
| NEC | Yes |  |
| Google | Yes |  |
| vivo | Yes | Same as legacy. |
| T-Mobile USA | Yes |  |
| Interdigital | Yes | Same as legacy |
| Intel | Yes |  |
| Nordic | Yes |  |
| CMCC | Yes | Same as legacy |
| Sharp | Yes |  |
| Qualcomm | Yes |  |
| Fujitsu | Yes |  |
| KDDI | Yes |  |
| OPPO | Yes |  |
| DENSO | Yes |  |
| Ericsson | Yes |  |

**If the cellBarred field in MIB is set to barred, RedCap UE should:**

**Option 1: follow the legacy IFRI in MIB.**

**Option 2: continue to read SIB1 of the barred cell and follow the intraFreqReselectionRedCap indicated in SIB1.**

**Question 6: which option do you prefer?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Option?** | **Comments** |
| Samsung | Option 2 | Since RAN2 decided to introduce IFRI for RedCap Ues, UE should check the IFRIs in SIB1. |
| BT | Option 2 | RedCap UE is in a RedCap cell so IFRI in SIB1 is more accurate that IFRI in MIB that is for non-RedCap Ues. |
| Nokia | First Option 2, then Option 1 | If cell supports RedCap, follow RedCap IFRI; otherwise, follow MIB IFRI. |
| MediaTek | Option 2 |  |
| ZTE | Option 2 | The motivation of introducing RedCap specific IFRI is to provide different intra-frequency cell reselection control when the cell is barred. RedCap Ues should apply it if configured. |
| Apple | Option 2 |  |
| Sequans | Option 2 |  |
| Spreadtrum | Option 2 | If Redcap cell is supported, Redcap UE shall read the Redcap specific indication in SIB1 naturally. |
| CATT | Option 2 | That is the motivation of Redcap specification IFRI. |
| Futurewei | Option 2 then possibly Option 1 | Share the same view as Nokia. |
| LGE | Option 2 |  |
| NEC | Option 2 first, then Option 1 (if in legacy cell) | We originally assumed Option 1 is the consequence of agreement that the RedCap UE shall apply the cellBarred in MIB. This is because when RAN2 decided that, the reason was that there should be no need for RedCap UE to further check the cellBarred for RedCap in SIB1 e.g. for speed-up in cell reselection.  Considering the other views above, we are fine with Option 2. However, Option 2 itself is incomplete, as Nokia pointed out. If the cell does not support the RedCap, the RedCap UE shall follow legacy IFRI in MIB. |
| Google | Option 2 |  |
| vivo | Option 2 | If SIB1 has RedCap dedicated IFRI, then there is no doubt that RedCap UE should follow this IFRI. If SIB1 doesn’t have the RedCap dedicated IFRI, then it is same as Q5; or if RedCap UE can’t acquire the SIB1, it is same as Q7. |
| T-Mobile USA | First Option 2, then Option 1 | Agree with Nokia |
| Interdigital | Option 2 | It’s simpler that RedCap UE always follows IFRI in SIB1. |
| Intel | Option 1 | RAN2 already agreed  Agreements:   1. RedCap UE applies the existing cellBarred field in MIB   To our understanding, RAN2 agreements should also be applied for IFRI, i.e. legacy cell barred indication should still be applicable for any UEs (including RedCap) as RAN2 only agreed to an additional barring indication specific to RedCap on top of the legacy one. |
| Nordic | Option 2 | Redcap UE should read the RedCap specific indication in SIB1. |
| CMCC | Option 1 | Share similar view with Intel. |
| Sharp | Option 2 |  |
| Qualcomm | Option 2 | Agree with Samsung |
| Fujitsu | Option 2 | We think that RedCap UEs should ignore the legacy IFRI in MIB. |
| KDDI | First Option 2, then Option 1 | Agree with Nokia |
| OPPO | Option 2 |  |
| DENSO | Option 2 | At first, RedCap UE should try to follow the RedCap specific cell barring setting. If it is absent, RedCap UE should follow legacy IFRI in MIB. |
| Ericsson | Option 2, but | RedCap UEs should follow RedCap specific IFRI in SIB1 if available, but otherwise follow the IFRI in MIB considering that such configuration gives larger flexibility for network deployment, e.g., if desired by the network RedCap UEs can be directed differently using the IFRI in SIB1. |

**Question 7: Do you agree that, in case the cell is barred due to being unable to acquire the SIB1, intra-frequency cell reselection is considered by RedCap UE as “allowed”?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes or No?** | **Comments** |
| Samsung | Yes | In case of failure to acquire SIB1 from the cell, UE has no information about the IFRI bit in SIB1. Note that even if IFRI bit in MIB is set to not allowed, IFRI bit in SIB1 can be set to allowed. It is possible that UE can find another cell which supports redcap on the frequency. Hence, the RedCap UE should bar the cell only, if it fails to acquire SIB1. |
| BT | - | If RedCap UE is not capable to acquire SIB1 in a RedCap cell, how RedCap UE can distinguish from non-RedCap cell?  This situation looks to us like the one described in Q4. Therefore, for simplicity same solution should apply in this case. |
| Nokia | No | Should follow MIB IFRI in that case. Agree with BT. |
| MediaTek | Yes |  |
| ZTE | Yes | Agree with BT, the same solution should be applied for both Q4 and this case. |
| Apple | Yes |  |
| Sequans | Yes | Agree with BT, this is basically the same as Q4 |
| Spreadtrum | No | Agree with BT and Redcap UE shall follow the legacy IFRI in MIB. |
| CATT | Yes |  |
| Futurewei | - | Agree with BT. Prefer to follow legacy IFRI in MIB. However, also open to “allowed”, same as our answer to Q4. |
| LGE | Yes |  |
| NEC | Yes |  |
| Google | Yes |  |
| vivo | Yes | Per our understanding, this case is equivalent to the legacy case that Non-RedCap UE can’t acquire MIB, hence following the same principle as the legacy case is feasible, i.e. RedCap UE considers the IFRI as “allowed”. |
| Interdigital | Yes | UE should be able to try accessing another cell on the same frequency like MIB acquisition failure case. |
| Intel | Yes |  |
| Nordic | Yes | Agree with Samsung. |
| CMCC | - | Agree with BT. |
| Sharp | Yes |  |
| Qualcomm | Yes | Agree with Samsung |
| Fujitsu | Yes |  |
| OPPO | Yes |  |
| DENSO |  | Agree that it is the same as Q4. |
| Ericsson | No | We think that RedCap UE should follow the legacy IFRI in MIB. Note that this should eventually be consistent with the outcome of the related discussion above that RedCap UE should follow the RedCap specific IFRI in SIB1 if available. |

* 1. ASN.1 for cell barring in SIB1

Another leftover on the signalling design for cellBarredRedCap1Rx/2Rx is the decision between following options:

**Option 1: use two mandatory sub-Ies with {barred, notBarred} values included in one optional parent IE cellBarredRedCap-r17.**

cellBarredRedCap-r17        SEQUENCE {

cellBarredRedCap1Rx-r17        ENUMERATED {barred, notBarred},

cellBarredRedCap2Rx-r17        ENUMERATED {barred, notBarred}

}                         OPTIONAL,  -- Need R

**Option 2: use two optional Ies with {barred} values**

cellBarredRedCap1Rx-r17 ENUMERATED{barred} OPTIONAL, -- Need R

cellBarredRedCap2Rx-r17 ENUMERATED{barred} OPTIONAL, -- Need R

**Question 8: Which option do you prefer?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Option?** | **Comments** |
| Samsung | Option 1 | We slightly prefer Option 1, which is cleaner approach than Option 2. |
| BT | Option 2 | We slightly prefer Option 2. By default, RedCap cell can be considered as not barred hence, only when the RedCap cell is barred, cellBarredRedCap1Rx-r17 and/or cellBarredRedCap2Rx-r17IE will be broadcasted. |
| Nokia | Option 1 |  |
| MediaTek | Option 1 |  |
| ZTE | Option 1 |  |
| Sierra Wireless | Option 1 |  |
| Apple | Op 1 |  |
| Sequans | Option 2 | Prefer the human readability of option 2 over the slight bit saving of option 1, but fine to go with majority |
| Spreadtrum | Option 1 |  |
| CATT | Option 1 |  |
| Futurewei | No strong view. | Can go along with the majority. |
| LGE | Option 1 |  |
| Google | Option 1 |  |
| vivo | Option 1 | Option 1 is clearer. |
| T-Mobile USA | Option 2 | A UE is considered “allowed” by default if the IE is not present. The use of two values implies that the IE must be present for the UE to access the cell. |
| Interdigital | Option 1 | Option 1 is cleaner. |
| Intel | Option 1 | Agree with Samsung, option 1 is cleaner. |
| Nordic | Option 1 | Prefer option 1 but open for Option 2 as well. |
| CMCC | Option 1 |  |
| Sharp | No strong view | No big difference from the two options, we are fine to go with the majority. |
| Qualcomm | Option 1 |  |
| Fujitsu | No strong view. | Can follow the majority. |
| KDDI | Option1 |  |
| OPPO | Option 1 |  |
| DENSO | Option 1 | Same view as Samsung. |
| Ericsson |  | No strong view |

One issue on the presence of intraFreqReselectionRedCap for RedCap cell is discussed in below contributions.

R2-2200797: Proposal 8 Revert the agreement “If RedCap-specific IFRI is absent from broadcast SI, the UE considers the cell does not support RedCap.”

R2-2200861: Proposal 1: Both RedCap-specific cellbarred and RedCap specific IFRI should be taken into consideration for a UE to decide whether RedCap is supported or not in the cell, for example, if one of the two IEs is absent means RedCap is not supported.

This is somehow depends on the ASN.1 design above for cellBarredRedCap1Rx/2RX (i.e. whether somehow the presence cellBarredRedCap1Rx/2Rx can aleady indicate the supporting of RedCap ).

**Question 9: Do you agree that the cell supporting RedCap should always present the intraFreqReselectionRedCap in SIB1? (i.e. the previous agreement is still valid)**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes or No?** | **Comments** |
| Samsung | Yes | - |
| BT | Yes | The agreement “If RedCap-specific IFRI is absent from broadcast SI, the UE considers the cell does not support RedCap.” was reached in August and should be kept. As we have expressed many times, RedCap cells only is not part of the WI so there is no need at all to reopen this discussion. |
| Nokia | Yes |  |
| MediaTek | Yes |  |
| ZTE | Yes |  |
| Apple | Yes |  |
| Sequans | Yes | See no good reason to revert the agreement |
| Spreadtrum | Yes |  |
| CATT | See comments | Please refer to our description in Question 4. we are ok on keeping the previous agreement valid, but we are also think that, if the Redcap UE can identify the Redcap UE supporting cell by other indication, e.g. the cell bar information in Question 8, the cell supporting Redcap UE need not always present Redcap UE specific IFRI in SIB1.  And just for clarification, whether the previous agreement has excluded the following case: a cell not supporting Redcap UE can also broadcast Redcap UE specific IFRI. |
| Futurewei | Yes |  |
| LGE | Yes |  |
| NEC | Yes | It would be good to stick to the agreement |
| Google | Yes |  |
| vivo | Yes | We agree that when a cell supports RedCap UEs, the IFRI won’t be used. Hence, it seems the IFRI is not necessarily present in this case. However, as we have reached the agreement and the IFRI in MIB is always present also, we think there is no extra impact even if the RedCap IFRI is always present in SIB1. |
| T-Mobile USA | No | REDCAP is missing an important simple use case. If all an operator wants to do is to support a wearable with a single antenna in a particular band with 20 MHz maximum channel bandwidth. This requirement mandates that mandates that the wearable UE support all of the overhead/complexity of REDCAP when all that is needed is for the UE to follow MBB procedures. |
| InterDigital | Yes | No strong motivation to reverse the agreement of RedCap IFRI.  But we should revist the agreement “RedCap UE applies the existing cellBarred field in MIB”. |
| Intel | Yes |  |
| Nordic | Yes | Agree with BT comment. |
| CMCC | Yes |  |
| Sharp | Yes |  |
| Qualcomm | See comment | We agree with the comment by T-Mobile. But at this stage of the study, maybe we should keep the agreement |
| Fujitsu | Yes |  |
| KDDI | Yes |  |
| OPPO | Yes |  |
| Orange | Yes |  |
| DENSO | Yes | We have a sympathy with proposal in R2-2200797 that it is a bit strange for NW to provide all RedCap parameters except the IFRI in SIB1. On the other hand, so far there are three fields that relates to RedCap in SIB1, according to the current running CR in R2-2201564. These are cellBarredRedCap1Rx, cellBarredRedCap2Rx and intraFreqRselecitonRedCap. So, if the RedCap specific IFRI is absent, the other two fields do not have to be present in SIB1. The scenario where RedCap parameters except the IFRI are present in SIB does not happen. |
| Ericsson | Yes |  |

* 1. Cell (re)selection parameters

Another leftover is on the need of configuring some RedCap specific parameters/priority for cell (re)selection. The below question is to achive the high-level intention first.

**Question 10: Do you agree to support the RedCap specific cell (re)selection parameter?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes or No?** | **Comments** |
| Samsung | Yes | A RedCap UE with 1 Rx branch would require higher ‘minimum required signal strength/quality level’ (i.e. Qrxlevmin/Qqualmin from the cell selection criterion S). So, the network should provide a separate ‘minimum required signal strength/quality level’ for a RedCap UE especially with 1 RX branch.  We also support the different priority for cell reselection in SIB2&4: Since most companies in RAN2 assume that RedCap UE can connect to a gNB that supports RedCap Ues, so the legacy priority for cell reselection would not be applicable in certain deployment scenario (which is not a corner case, we think). |
| BT | Yes | Agree with Samsung, especially for 1 Rx branch in higher FR1 bands. |
| Nokia | Yes | For cell selection criterion S modified Qrxlevmin/Qqualmin is needed for 1 Rx branch RedCap UE. We think that there is no need to signal new S criterion, but 1 Rx branch RedCap UE can modify the S criteria by itself by using e.g. offset value.  For cell re-selection we think that legacy re-selection functionality is sufficient. |
| MediaTek | No | This is unnecessary, as introduction of RedCap does not change the cell layout. The RedCap UE will compare the signal strengths of serving and neighbour cells to determine which cell to move to. If we add an offset to the S criteria of all cells, we change nothing in the resulting comparison of serving and neighbour cell strengths. |
| ZTE | Yes | It is beneficial to allow network to configure different cell (re)selection thresholds for 1Rx RedCap Ues.  Based on various deployment, it is also useful to allow network/operator to configure different cell reselection priorities for RedCap Ues and non-RedCap Ues. |
| Apple | No | Rather the thinking using Q11 below should be sufficient. |
| Sequans | Yes | Agree with Samsung |
| Spreadtrum | No | It is not necessary. The cell selection/reselection for Redcap UE is performed based on the signal strength. |
| CATT | Yes |  |
| LGE | No | Differentiated handling is unnecessary. |
| NEC | No | We think this can be considered with consulting RAN1/4 in later release, if needed. |
| Google | Yes | RedCap-specific cell selection parameters provide flexibility for network deployment. |
| Vivo | Yes |  |
| T-Mobile USA | No | The situation with 1RX is no different than UE’s with different receiver sensitivities. RAN4 specifies the minimum RX sensitivity per band that is often exceeded, by wide margins, in implementations. |
| Interdigital | Yes | Same view as Samsung |
| Intel | Yes | The single strength level of 1Rx would be different from 2Rx UE when they are in the same location and would be good to introduce separate threshold for cell (re)selection. |
| Nordic | Yes |  |
| CMCC | Yes |  |
| Sharp | No |  |
| Qualcomm | Yes | Agree with Samsung |
| Fujitsu | Yes | Agree with Samsung |
| OPPO | No | Same view as MediaTek. |
| DENSO | Yes for cell selection criterion | At least, the different cell selection criterion S should be supported for RedCap UEs with single Rx to compensate the coverage shrink compared to the legacy UEs. On RedCap specific reselection priority, agree with Apple that the same behavior can be supported by the neighbor cell information as discussed in Q11. |
| Ericsson | Yes | An optional offset is required for 1 Rx RedCap UEs to have the same cell-edge as other RedCap UEs. It would be better to specify the functionality in Rel-17 since it would be very difficult to add later (when/if it turns out to be a problem in the field) otherwise. |

* 1. Neighbour cell supporting

We see many contributions proposing to introduce the SI indication on whether neighbor cells supports/allows RedCap access.

**Question 11: Do you agree that system information should provide information on which cells/frequencies accept RedCap UE access (e.g. by considering whether supporting RedCap)?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes or No?** | **Comments** |
| Samsung | - | It depends on the conclusion from Question 4: if RAN2 assumes homogeneous deployment per frequency, then different priority in Question 10 would be sufficient. Otherwise, ‘allowed-cell-list’ for RedCap Ues would be beneficial. |
| BT | Neutral |  |
| Nokia | Yes for frequencies | Cell list will introduce too much overhead in terms of signaling and coordination between base stations/NW nodes. |
| MediaTek | Yes | This information is useful to reduce unnecessary reselection attempts to neighbour cells that do not support RedCap (which would result in increased Idle mode power consumption). |
| ZTE | Yes | This can help RedCap UE to avoid unnecessary measurement and reselection attempts, which saves UE’s power.  Regarding the support of RedCap indication, we think both per-freq and per-cell (or cell range) level are needed. But there is no need to indicate the “cell barred” information, because network does not expect to update the system information frequently just to change the barred information. |
| Apple | Yes |  |
| Sequans | Yes | Agree with Nokia that for frequencies seems more feasible |
| Spreadtrum | Neutral | Maybe some dedicated frequency priority can be configured for Redcap UE. No need to change SI. |
| CATT | Yes |  |
| Futurewei | OK with frequencies | considering that many RedCap Ues (such as industrial sensors and surveillance cameras) tend to be stationary and that a cell list may add too much overhead. |
| LGE | Neutral |  |
| NEC |  | No, for “cell” information, it could have a lot of overhead.  For “frequency” information, we are open for discussion but it will not work well unless the homogeneous support on a frequency is expected. |
| Google | Yes | Frequency information should be sufficient. There is no need to have cell information considering the overhead. |
| Vivo | Yes | It can help RedCap UE to avoid performing measurements on unsuitable cell/frequencies. |
| T-Mobile USA | No | MBB procedures are adequate. |
| Interdigital | Yes for frequency | RedCap frequency may be signalled in NCL but per cell info looks too much. |
| Intel | - | Same view as Samsung, depends on deployment. |
| Nordic | Yes | Tend to agree with Nokia. |
| CMCC | Yes | This may help to RedCap UE avoid unnecessary measurement on reselection attempts, and save UE’s power. |
| Sharp | No strong view |  |
| Qualcomm | Yes | Agree with MediaTek. If that’s not agreeable, frequency-based indication is also fine with us |
| Fujitsu | Yes | System information can indicate whether the RedCap operation is barred/not supported on a neighbor frequency or cell or indicates the frequency list or cell list barring/not supporting RedCap operation. |
| KDDI | Yes | This could save Redcap UE’s cell reselection time which have benefit on saving UE’s power |
| OPPO | Yes | For idle/inactive state RedCap UEs to do cell reselection, it would be beneficial if UEs can know beforehand which neighbor cells support RedCap UEs and which do not. This can help RedCap UEs to save power by, e.g. focusing the measurement and evaluation on those RedCap-supported neighbor cells and refraining from measuring those RedCap-not-supported neigbhor cells and accessing and rejecting, etc. |
| DENSO | Yes | The neighbour cell information can bring the UE power saving gain because this information helps RedCap UEs avoid unnecessary RRM measurements on barred cells. |
| Ericsson | No | We do not think this is essential functionality, i.e. an optimization, and gains are not clear given the increased SI overhead (also for legacy UEs) and complexity. Therefore, this should not be prioritized in Rel-17. |

* 1. UE capability for paging

This issue is discussed in below contributions:

R2-2200597, Proposal 9: Paging to RedCap UE should be only sent in cells allowing the target RedCap UE camping. To enable one gNB to determine whether a target UE is RedCap or not, UERadioPagingInformation is extended to include RedCap related radio capability (e.g. 1rx RedCap or 2rx RedCap).

R2-2200554, Proposal 8: The Rx branches capability should be included in the UERadioPagingInformation inter-node message.

Some motivations are cited below:

*In NR, there exists UERadioPagingInformation inter-node message, which includes UE’s capability like supported NR frequency bands. If received, the NG-RAN node may use it to apply specific paging schemes, e.g., performs paging only on UE supported NR frequency bands. UE’s Rx capability can also be utilized for specific paging scheme. It is agreed that SIB1 indicates cell barring for 1 Rx branch and 2 Rx branches separately for RedCap Ues. With cellBarredRedCap1Rx (or cellBarredRedCap2Rx) indicated in SIB1, RedCap Ues with 1 Rx branch (or 2 Rx branches) are not allowed to camp in the cell. Correspondingly, the gNB may not perform paging in the cell if paging messages for Ues with above Rx capability are received. Thus, as assistance information for specific paging scheme, the Rx branches of UE should be included in above UERadioPagingInformation message.*

Observation 1: Based on the RX branches capability, gNB can only send paging message to the specific Ues (e.g. if the paging message is for 1RX UE but the cell bars all 1RX RedCap Ues, gNB can choose not to send paging message.).

**Question 12: Do you agree the Rx branches capability should be included in the UERadioPagingInformation inter-node message?**

|  |  |  |
| --- | --- | --- |
| **Companies** | **Yes or No?** | **Comments** |
| Samsung | No | We think that it is not an essential feature, but an optimization which might be useful in certain scenarios (as provided in the example above). |
| BT | Neutral |  |
| Nokia | No |  |
| MediaTek | Open to this | We are open to introducing such information if NW vendors think that it adds value. |
| ZTE | No |  |
| Apple | Not essential | Anyway the paging succeeds only when UE responds, and UE responds only in the cells where the UE is allowed to camp… |
| Sequans | Yes | While not essential, reducing the paging load for power-sensitive RedCap Ues can be significant |
| Spreadtrum | No | It is not essential. |
| CATT | No | Agree with Samsung. |
| Futurewei | Yes | This may help NW to avoid sending paging message for a UE in the cells that the UE won’t camp in due to RedCap-specific barring. |
| LGE | No |  |
| NEC | No |  |
| Google | No |  |
| vivo | Open to discuss | We agree with the intention, and think it is not an essential issue. We are open to discuss it. |
| T-Mobile USA | No | Need to keep the complexity to a minimum |
| Interdigital | No | That’s not essential. |
| Intel |  | Agree with Samsung, it is not essential. |
| Nordic | Neutral | Tend to agree with MediaTek |
| CMCC | No |  |
| Sharp | No strong view | It depends on NW’s requirement, since the UE monitors paging no matter the cell is barred or not. |
| Qualcomm | No | Agree with Samsung |
| Fujitsu | No | Agree with Samsung |
| OPPO | No |  |
| DENSO | No |  |
| Ericsson | Yes | We agree that it would be beneficial to avoid paging in cells which do not support RedCap, 1 Rx or HD-FDD UEs from **network standpoint.** |

1. Conclusion and proposals

Based on the above summary, following proposals are given.

1. Reference
2. R2-2200287 Open issues on Early identification, camping restrictions and NCD-SSB Intel Corporation
3. R2-2200554 Identification and access restriction of RedCap UE, and NCD-SSB related issues Huawei, HiSilicon
4. R2-2200597 Remaining issues on NCD SSB, identification and access for RedCap vivo, Guangdong Genius
5. R2-2201113 RedCap UE power-saving aspects at cell re-selection Apple discussion NR\_redcap-Core
6. R2-2200208 Cell barring aspects Samsung Electronics Co., Ltd
7. R2-2200249 Discussion on RedCap UE's identification and camping restrictions OPPO
8. R2-2200332 Cell (re)selection details for RedCap UEs Samsung Electronics
9. R2-2200343 System Information and supporting for RedCap UEs KDDI Corporation
10. R2-2200468 Discussion on UE access restrictions for Redcap devices Beijing Xiaomi Mobile Softwar
11. R2-2200469 Discussion on early Identification for Redcap devices Beijing Xiaomi Mobile Softwar
12. R2-2200568 Camping restrictions of RedCap UE Fujitsu
13. R2-2200609 On Access and Camping Restrictions ZTE Corporation, Sanechips
14. R2-2200616 Further considerations on access restrictions NEC
15. R2-2200639 Discussion on the open issues of identification and access restrictions for RedCap UE Spreadtrum Communications
16. R2-2200686 Discussion on the remaining issues of early identification and IFRI CATT discussion
17. R2-2200725 Corrections for cellBarred in MIB handling for RedCap UE InterDigital, Europe, Ltd.
18. R2-2200797 Early indication & access restriction for RedCap UEs Ericsson
19. R2-2200836 NR-REDCAP access restriction/allowance indication to ease mobility THALES
20. R2-2200861 Discussion on access restrictions and early identification CMCC
21. R2-2201207 Discussion on identification and access restrictions for RedCap UEs LG Electronics UK
22. R2-2201232 Early identification and camping restrictions for RedCap UE Sierra Wireless. S.A.
23. R2-2201237 Neighbour cell information and cell (re)selection for RedCap UE DENSO CORPORATION
24. R2-2201587 Further details of identification, access, and camping restrictions Nokia, Nokia Shanghai Bell
25. R2-2201623 Support and network behaviour for RedCap early indication messages BT Plc, Deutsche Telekom AG, Telecom Italia S.p.A., TurkCell, CMCC, NTT DOCOMO INC., Orange, Vodafone, KDDI