3GPP TSG-RAN WG2 Meeting#112-e Draft\_R2-200xxxx

Online, 2nd - 13th November 2020

Agenda Item: x.x.x.x

Source: Huawei

Title: [Draft] Summary of email discussion 914 on UE identification and access restrictions (Huawei)

Document for: Discussion and Decision

# Introduction

Rel-17 SI on RedCap was started in RAN2#111-e. One of the objective in the SID is to study UE identification and access restrictions for RedCap UEs [1]:

* Study functionality that will allow devices with reduced capabilities to be explicitly identifiable to networks and network operators, and allow operators to restrict their access, if desired [RAN2, RAN1].

In RAN2#111-e, the following agreements were made for UE identification and access restrictions [2]:

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| 1. An indication in system information is needed to indicate whether a REDCAP UE can camp on the cell. FFS whether the indication is explicit or implicit. 2. UAC mechanism also apply to REDCAP UEs. 3. System information indicates whether REDCAP operation is allowed/barred on a frequency. FFS reuse the legacy intraFreqReselection or introduce separate flag 4. Further discuss enhancement of UAC for REDCAP UEs, including e.g.:    1. define new Access Identity for REDCAP UEs    2. define new Access Categories for REDCAP UEs   (for any final decision we need to check with SA1 and/or CT1) |

UE identification for RedCap UEs was also discussed in RAN1#102-e, the following agreements were made [3]:

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| Agreements:   * Further study the options for identification of RedCap UEs, including ~~at least~~ the following indication methods:   + Opt. 1: During Msg1 transmission, e.g., via separate initial UL BWP, separate PRACH resource, or PRACH preamble partitioning.   + Opt. 2: During Msg3 transmission.   + Opt. 3: Post Msg4 acknowledgment.     - E.g., during Msg5 transmission or part of UE capability reporting.   + Opt. 4: During MsgA transmission (subject to support of if 2-step RACH)   + Other options are not precluded.   + Note: This study intends to establish feasibility of, and pros and cons for the identified options from RAN1 perspective, without any intention of down-selection without guidance from RAN2.   Conclusion:   * RAN1 to wait for further progress in RAN2 on the issues of temporary access barring and congestion control. |

The following email discussion was agreed in RAN2#111-e to further discuss UE identification and access restrictions for RedCap UEs:

* [Post111-e][914][REDCAP] UE identification and access restrictions (Huawei)

Scope: Discuss UE identification and access restrictions, addressing open issues from the meeting, taking into account possible RAN1 agreements and identifying possible solutions

Intended outcome: email discussion summary

Deadline: Thursday OCT 15 0700 UTC (please respect this deadline)

# Discussion

## UE identification

In RAN2#111-e, when to identify RedCap UEs was discussed in offline discussion 110. The following options were discussed:

- Option 1: Msg1 (Separate initial UL BWP or PRACH partitioning)

- Option 2: Msg3

- Option 3: Msg5

- Option 4: MsgA for 2 step RA

Companies’ view were split and several companies did not provide any preference but suggested to wait for RAN1 input.

The same options were discussed in RAN1 also. There was no conclusion in RAN1 but according to RAN1 agreement, guidance from RAN2 is needed before down-selection:

* + Note: This study intends to establish feasibility of, and pros and cons for the identified options from RAN1 perspective, without any intention of down-selection without guidance from RAN2.

Considering that UE identification is a RAN2 led topic, we think it is useful to discuss the consequences of not having the indication at this stage for each option from RAN2 perspective and then identify RAN2 preference based on the discussion. Based on RAN2 preference, a LS can be sent to RAN1 to check the feasibility.

**Option 1: Msg1 (Separate initial UL BWP or PRACH partitioning)**

In the offline discussion 110 in last meeting, the following arguments were provided to identify the RedCap UEs during Msg1:

* For the network to schedule Msg2/3 properly, e.g. to decide whether to schedule repetition.
* If a REDCAP UE is allowed to camp on the cell with larger initial UL/DL BWP than supported by the UE, the network needs to identify the UE via Msg1 to schedule Msg3 with the BW restriction of RedCap UE.

**Question 1.** Do you think it is needed **from RAN2 perspective** to identify RedCap UEs during Msg1? What is the consequence if not?

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| ***Company name*** | ***Opinion*** | ***Comments*** |
| Huawei, HiSilicon | TBD | If RedCap UEs cannot be identify during Msg1:   * If the network indicates the support of RedCap UEs, the Msg3 of all UEs have to be scheduled with the BW restriction of RedCap UE (e.g. make sure that initial UL/DL BWP is equal to or smaller than 20Mhz or schedule Msg3 for all UEs within 20Mhz) * Other special handling of Msg2/3 for RedCap UEs is not possible   Above issues need to be confirmed by RAN1. |
| Qualcomm | Depends | We think the answer would depend on if RAN1 introduce repetition for msg2 and/or msg3 for RedCap UEs. If RAN1 do, then RedCap UEs have to identify themselves during msg1 transmission. Otherwise, we do not see the need for RedCap UEs to identify themselves during msg1 transmission.  We are neutral on the issue of smaller bandwidth, because in our view network can handle it by scheduling msg2/3 within the maximum bandwidth that RedCap UEs can support. If network does not like such a restriction, network can partitions PRACH between regular UEs and RedCap UEs so that msg2/3 for RedCap UEs can be scheduled differently. Network has full control in deciding which configuration to apply. Nothing seems broken. |
| Samsung | Depends | We share the view with Qualcomm that it depends on the RAN1 decision as RedCap UE with reduced antennas may suffer from coverage issue and scheduling restriction compared to normal UEs. Also note that to identify a RedCap UE can be achieved by having a separate PRACH configuration (or different BWP), and no additional indication would be needed. |
| Intel | Depends | It depends on whether the reception of RAR will be impacted or not, RAN1 inputs are needed. |
| Apple | Depends on RAN1 |  |
| Futurewei | Pending RAN1 progress |  |
| vivo | Depends on RAN1 decision | Actually, we cannot see a strong need for RAN to identify RedCap UEs in msg.1 by now. We agree with Qualcomm that it depends on if RAN1 will introduce repetition or scheduling restriction for msg.2/msg.3 for Redcap UEs.  As far as I know, discussion on msg.2/msg.3 repetition is being discussed in coverage enhancement WI. In their discussion, if msg.3 needs repetition, there may be indication in msg.1. Thus, we can also wait for more progress on this. |
| Ericsson | No from pure RAN2 perspective | From pure RAN2 perspective there doesn’t seem to be need. As pointed out in other replies, there may be reasons an early indication is needed e.g. if Msg2/Msg3 requires scheduling with coverage enhancement or if other special handling would be required.  The need for Msg1 indication may depend on other configuration such as system bandwidth etc, thus one possible way is to use Msg1 indication only when such is needed, that is, it would be up to NW configuration e.g. using PRACH partitions as mentioned by QC. |
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**Option 2: Msg3**

In the offline discussion 110 in last meeting, the following arguments were provided to identify the RedCap UEs during Msg3:

* If a RedCap UE is allowed to camp on the cell with larger initial UL/DL BWP than supported by the UE, the network needs to identify the UE at least in Msg3 to schedule Msg4/5 with the BW restriction of RedCap UE.
* If a RedCap UE is identified at least in Msg3, network can reject the RedCap UE based on the load and its strategy.

**Question 2.** Do you think it is needed **from RAN2 perspective** to identify RedCap UEs during Msg3? What is the consequence if not?

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| ***Company name*** | ***Opinion*** | ***Comments*** |
| Huawei, HiSilicon | Needed from RAN2 perspective | If RedCap UEs cannot be identify during Msg3:   * It is not possible for the gNB to reject RRC connection request from RedCap UEs only. * Considering that RedCap UEs have different minimum capability set compared with legacy eMBB UEs, the gNB may not configure RedCap UEs properly in Msg4. * The gNB need to schedule Msg5 for all UEs within 20Mhz * Other special handling of Msg4/5 for RedCap UEs is not possible   At least the first two bullets are RAN2 related thus we think UE identification no later than Msg3 is needed from RAN2 perspective. |
| Qualcomm | Needed from higher-layer perspective | Identification of RedCap UE during msg1 **transmission** is mainly for RAN to use. RedCap UEs also need to identify themselves to core network for procedures such as subscription validation (i.e. to ensure RedCap is only used for its intended use cases). This identification hence should be singalled in msg3 **payload**.  However, we do not see a strong need for RAN to identify RedCap UEs in msg3. How to handle bandwidth restriction of RedCap UEs for msg4/5 transmission can be up to network implementation. |
| Samsung | Needed from RAN2 perspective | As a RedCap UE may have limited processing capability and bandwidth, such UE has to be identified in Msg3 at the latest to complete the Random Access procedure and be properly configured. |
| Intel | Depends | The network may reject the UE if the requested service (based on cause value) is not allowed for RedCap UE.  The network may configure UE properly if the minimum capability for RedCap UE is different from normal UE. (RAN1 confirmation is needed on what capabilities will be reduced, and what impact will be for MSG4/5 configuration).  Therefore if the special handling is needed for MSG4/5, the network needs to identify RedCap UE before sending MSG4.  But there is size limitation in MSG3, only 1 bit left. Therefore, the indication may be contained via MSG1 (if anyway it is needed from RAN1 perspective).  Before RAN2 make decision, we need to understand whether special handling is needed for MSG4/5. |
| Apple | Depends, but we can also prevent the scenario of NW needing to know at MSG3, with access restriction | We are wondering on why the NW needs to know and then correspondingly reject, if it is possible to prevent the UEs from camping on the cell where the UE cannot support the minimum BWs the NW wants to the UE to support. This also depends on the set of access restriction filters which can be broadcasted to allow UEs to decide if they want to camp. Then MSG3 based differentiation is not that critical. We also agree that NAS level gating might be needed, but that doesn’t need to be at MSG3. |
| Futurewei | Yes | Indication in MSG3 should be used if Redcap specific handling needs to be introduced only from MSG4/5. |
| vivo | Depends | Actually, we also cannot see a strong need for RAN to identify RedCap UEs in msg3, which is similar as the above question. Regarding the arguments provided by rapporteur,   1. *if a RedCap UE is allowed to camp on the cell with larger initial UL/DL BWP than supported by the UE,*   We think if the network allows such UE (supports lower BW than the cell) camping on this cell, it should be up to network implementation to to schedule Msg4/5 with the BW restriction of RedCap UE.   1. *If a RedCap UE is identified at least in Msg3, network can reject the RedCap UE based on the load and its strategy.*   We would like to first understand what the intention for this behaviour is or why network needs to reject the RedCap UEs at this stage.  Regarding to the objective “to ensure RedCap is only used for its intended use cases”, we think RedCap UEs need to be identified to core network for subscription validation, which is being discussed in another email discussion [Post111-e][913]. |
| Ericsson | Yes | We think the UEs should identify as RedCap UEs in Msg3 in all cases.  It is beneficial for the NW to understand UE is RedCap for proper configuration and e.g. possibility to reject RRC connection as brought up in HW reply.  Regarding need for the NW to reject RedCap UEs during RRC establishment phase, the need depends partly on how the access triggering conditions are specified, but also additionally, network might need to temporarily reject some attempts e.g. if the intention is not to change SI to disallow RedCap operation in the cell or there is a temporary reason to reject specifically RedCap access. |
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**Option 3: Msg5**

In the offline discussion 110 in last meeting, there were company view that identifying Redcap UE in Msg5 is enough if a REDCAP UE is not allowed to camp on the cell with larger initial UL/DL BWP than supported by the UE.

**Question 3.** Do you think it is needed **from RAN2 perspective** to identify RedCap UEs during Msg5? What is the consequence if not?

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| ***Company name*** | ***Opinion*** | ***Comments*** |
| Huawei, HiSilicon | Not needed from RAN2 perspective | If UE identification of RedCap UEs during Msg1, Msg3 or MsgA are not agreed, we do not see the need to identify the UE during Msg5. Identifying RedCap UEs via UE capability should be enough. |
| Qualcomm | Not needed | We share the same view with Huawei |
| Samsung | Not needed from RAN2 perspective | We agree with Huawei. |
| Intel |  | If the indication is used by the network to check whether the RedCap UE is allowed to access the particular service, and if we do not need special handling on MSG4/5, etc, then MSG5 could be a good way compared to capability based solution since it can reduce signalling overhead and also can let the network handle it faster. |
| Apple | Not needed from RAN2 | Ideally we would like to gate the UE at access time and then NAS level gating (accept/reject service) should be enough. The rest of Redcap UE capability handling can be using legacy capability exchange. |
| Futurewei | No | There seems not to be much benefits of having Redcap indication in MSG5 over using UE capability signalling from RAN2 perspective. |
| vivo | No needed | We agree with Huawei, as there is no additional benefit to indicate RedCap UEs in msg.5, comparing to current capability reporting.  Besides, if the identification of Redcap UEs was agreed in msg.1 or msg.3, there is also no need to identify RedCap UEs during msg.5.  Thus, msg.5 based early indication has no use case, anyway. In this way, we could exclude this solution in SI phase. |
| Ericsson | No, unless optimization is needed | Agree with above comments – early indication is another question but at this point the UE capabilities should be available to gNB.  However, as pointed out by Intel there could be possibility to optimize – this discussion would anyways depend on whether Msg1/Msg3 indications would be specified, thus we propose to capture the alternative in TR but no need to decide right now. |
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**Option 4: MsgA**

This option only applies to 2-step RA. Arguments similar to Option 1 and Option 2 in 4-step RA were provided in the last RAN2 meeting.

**Question 4.** For 2-step RA, do you think it is needed **from RAN2 perspective** to identify RedCap UEs during MsgA? What is the consequence if not?

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| ***Company name*** | ***Opinion*** | ***Comments*** |
| Huawei, HiSilicon | Needed from RAN2 perspective | Please see our reply to Question 2, i.e. the need of UE identification during Msg3 in 4-step RACH. |
| Qualcomm | Needed from both RAN and higher-layer perspective | Please see our reply to Q1 and Q2. |
| Samsung | Needed from RAN2 perspective | This is similar to the answer for Question 2. |
| Intel | Not sure | It depends on whether the reception of MSGB will be impacted or not, RAN1 inputs are needed. |
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| Apple | Depends on the outcome of Q2 and from RAN1 output. | Our view is the same as response to Q2. |
| Futurewei | Yes | Indication in MSGA should be used if Redcap specific handling needs to be introduced for MSGB. |
| vivo | Depends | It should be similar to the decision for Q1 and Q2. |
| Ericsson | Yes | Please see our reply to Q2 |
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**Question 5.** Based on reply to Questions 1-4, please indicate your preference **from RAN2 perspective**:

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| ***Company name*** | ***Preference*** | ***Comments*** |
| Huawei, HiSilicon | Msg3/A are needed from RAN2 perspective | According to our reply to Question 2 and 4, the RedCap UEs need to be identified at least during Msg3/A due to the following **RAN2 reasons**:   * It should be possible for the gNB to reject RRC connection establishment request from RedCap UEs. * The gNB needs to configure RedCap UE according to its restricted capability in Msg4. |
| Qualcomm | See comment | * Identification in msg1/A **transmission** is needed by RAN; * Identification in msg3/A **payload** is needed by higher layer. * Therefore, both identifications should be studied. |
| Samsung | Msg3/A at the latest from RAN2 perspective | As commented earlier, the indication should be done in Msg3/A at the latest from RAN2 perspective, but it can also be done in Msg1 based on RAN1 input. |
| Intel |  | If anyway, MSG1/MSGA are needed from RAN1 perspective. Then we do not need MSG3/5.  If special handling is needed for MSG4/5, and if MSG1 is not needed from RAN1 perspective, then MSG3 is needed;  Otherwise MSG 5 or capability based solution should be enough.  Before RAN2 make decision, we need to understand whether special handling is needed for MSG4/5. |
| Apple | Wait for RAN1 to conclude. | Before we proceed further. |
| Futurewei | MSG3/A | From RAN2 perspective, Redcap indication should be included in MSG3/A, if there is no Redcap indication introduced in MSG1 and there is need of Redcap specific handling for MSG4/MSGB. |
| vivo | Depends | See above comments. Before making any decision, we need to first agree the intended use case or motivation for this early indication considering RAN1 inputs (by now, it is being discussed) and RAN2 requirements (by now, it is not clear for us). |
| Ericsson | Msg3/A | We should capture the options and analysis in the TR analysis. The final decision can be taken either for potential WI scope or during WI. |
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Based on reply to Questions 1-5, please comment whether a LS to RAN1 is needed, e.g.:

* To inform RAN2 conclusion
* To check the feasibility of the RAN2 preferred option (if there is RAN1 impact)
* To ask RAN1 whether they have identified the need for earlier identification from RAN1 perspective

**Question 6.** Do you agree to send LS to RAN1 including above information/question?

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| ***Company name*** | ***Yes/No*** | ***Comment*** |
| Huawei, HiSilicon | Yes | We think a LS to RAN1 is needed, including:   * Indicate to RAN1 that from RAN2 perspective, RedCap UEs need to be identified by the network during which step (according to conclusion of Question 1-5)   Ask RAN1 whether they have identified the need for earlier identification from RAN1 perspective |
| Qualcomm | No | * Our understanding is that RAN1 are already discussing identification in msg1/A transmission. So we don’t have to inform them this issue. * Identification in msg3/A payload has no impact on RAN1. So we don’t need inform RAN1 about it. |
| Samsung | No | The LS would not be needed at the moment, as whether to indicate it in Msg1 (e.g. using a different PRACH resource/BWP) purely depends on the RAN1 issue (e.g. coverage). We think RAN2 can wait for RAN1 progress. |
| Intel | No | Since the two actionable items for RAN1 are anyway going to be discussed in upcoming RAN1 meeting based on decision from last meeting. |
| Apple | No | RAN1 is already discussing. |
| Futurewei | Yes | To indicate that RAN2 may introduce Redcap indication in MSG3 if it is not needed for MSG2 reception and MSG3 transmission. |
| vivo | No | As far as I know, RAN1 has already initialized the corresponding discussion. RAN2 could just wait for more progress on coverage issue, scheduling restriction, and separate initial BWP for RedCap UEs from RAN1. |
| Ericsson | No | RAN2 can start to draft text to TR from RAN2 viewpoint e.g. by listing the different options and listing pros and cons and impact of each of the alternatives.  In our understanding RAN1 is already analysing the options from RAN1 perspective, especially whether indication in Msg1 is required for RedCap UEs for proper operation. |
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## Access restrictions

### UAC

In the last meeting, RAN2 has confirmed that UAC also applies to RedCap UEs and agreed to further discuss enhancement of UAC for REDCAP UEs, including e.g.:

* 1. define new Access Identity for REDCAP UEs
  2. define new Access Categories for REDCAP UEs

Considering that UAC is SA1 scope, LS to SA1 is needed.

**Question 7.** Do you agree to send LS to SA1 (cc CT1?) about UAC enhancement for RedCap UEs? If yes, what should be included in the LS?

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| ***Company name*** | ***Yes/No?*** | ***Comments*** |
| Huawei, HiSilicon | Yes | If both legacy eMBB UEs and Redcap UEs are served by the same cell, we can see the motivation to control the access of RedCap UEs separately. But we think UAC is a pure SA1 issue. Thus, we support to send a LS to SA1 (maybe cc CT1), including:   * Indicate SA1 the motivation to have UAC enhancement from RAN2 perspective * Ask SA1 opinion regarding UAC enhancements for RedCap UEs |
| Qualcomm | Yes | The LS should include the motivations for UAC enhancements for RedCap and what RAN2 expect from the enhancements.  But this LS is better be sent after RAN1/2 have agreed on the number of RedCap UE types. |
| Samsung | Yes but | Similar view to Qualcomm: in principle, we should inform SA1/CT1 of the corresponding update (if agreed), but RAN2 should make further progress to ask them for certain actions to SA1/CT1. |
| Intel | Y | Ask them whether current access identifies/access categories can be reused for RedCap UEs. If yes, then CT1 does not need to introduce new access identifies and access categories. |
| Apple | Yes to send LS and then take this up based on their response. |  |
| Futurewei | Yes | We are fine with sending an LS either now to inform them the intention of using access identity/access category for Redcap access control or later after more progress are made on the possible types of Redcap UE. |
| vivo | Yes | We should inform SA1/CT1 the motivation for UAC enhancement from RAN2 perspective, and the above potential enhancements, either now or after making more progress. |
| Ericsson | Yes but | Agree with Samsung view.  Initially we can focus to capture analysis of solutions(s) in TR from RAN2 point of view, including the impact in other WGs (in this case at least SA1 and CT1). We don’t think there is a hurry to send LS right now until e.g. the UE type discussion is progressed. Also, a response from SA1/CT1 should not be needed for RAN2 to conclude the SI.  We can inform SA1 that RAN2 is working on RedCap and use of UAC to control the access and whether they see any issues. Depending on timing of the LS, if RAN2 has agreed to pursue a specific solution or if as a result of an analysis there is a clear recommended solution from RAN2 perspective, we can ask SA1 to consider specifying such solution. |
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### Indication in system information

In the last meeting, RAN2 has confirmed that an indication in system information is needed to indicate whether a REDCAP UE can camp on the cell. Whether the indication is explicit or implicit is FFS.

According to online comments in the last meeting, whether an explicit indication is needed depends on other design aspects on initial access, e.g. if separate initial BWP or RACH partitioning is supported, explicit indication is not needed.

**Question 8.** Please companies provide your view on the indication in system information?

* Option 1: Explicit
* Option 2: Implicit and how?
* Option 3: Too early to decide

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| ***Company name*** | ***Option?*** | ***Comments*** |
| Huawei, HiSilicon | Option 3 | Whether to have an explicit or implicit indication depends on whether there is any RedCap-specific configuration in system information, e.g. separate initial UL/DL BWP or RACH resource for RedCap UEs.  There is no conclusion on this aspect yet. Thus we propose to discuss this FFS in WI phase. |
| Qualcomm | Option 3 | This question seems to be more of a stage-3 issue and hence may be discussed during WI phase. |
| Samsung | Option 3 | As indicated in our previous response, this can be achieved in many ways, so it is difficult to conclude it at the moment. |
| Intel | Option 3 | Can be discussed in normative phase. |
| Apple | Option -1 | We think some sort of SI needs to be broadcast to let the RedCap UE know if it can camp. We do agree that details need to be ironed out. We wonder if it’s a good approach to allow all RedCap UEs to RACH and then decide to allow or not (waste of resources/power)…some level of filtering should be done even before the RedCap decides to RACH. |
| Futurewei | Option 3 | Some indication will likely be present in system information. Whether it’d be explicit or implicit can be left to WI phase when more details become available. |
| vivo | Option 3 | This is related to the discussion on whether the configuration for RedCap UEs is different from non-RedCap UEs, e.g. seperate initial BWP.  Current conclusion that “*an indication in system information is needed to indicate whether a REDCAP UE can camp on the cell”* is enough for study item. Further decision on explicit or implicit indication can be discussed in work item phase. |
| Ericsson | Option 3 | We agree in principle with Apple, but in our understanding an implicit indication can achieve similar outcome.  Let’s capture analysis of alternatives in the TR, specific details can be discussed and agreed to in the normative phase. |
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There is also a FFS regarding whether to reuse the legacy intraFreqReselection or introduce a separate flag.

**Question 9.** Please companies provide your view on intraFreqReselection?

* Option 1: reuse the legacy intraFreqReselection
* Option 2: introduce separate flag
* Option 3: Too early to decide

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| ***Company name*** | ***Option?*** | ***Comments*** |
| Huawei, HiSilicon | Option 3 | We need to know the details of the enabling/disabling indication first. Thus we propose to discuss this FFS in WI phase. |
| Qualcomm | Option 2 | We prefer a separate flag. But we agree this issue can be discussed later during WI phase. |
| Samsung | Option 3 | This can be discussed in the WI phase. |
| Intel | Option 3 | It is unclear why option 2 is needed. But would be ok to discuss it during WI phase. |
| Apple | Option 3, but | We also wonder on the availability of bits in MIB. SIB1 can take in more fields. |
| Futurewei | Option 3 | More considerations would be needed. |
| vivo | Option 3 | We agree to discuss it in WI phase. |
| Ericsson | Option 3 |  |
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# Conclusion

This offline discussion focused on UE identification and access restrictions for RedCap UEs:

**TBD**

# References

1. RP-201677, “Revised SID on Study on support of reduced capability NR devices”, Ericsson, RAN#89-e, Online, September 14 - 18, 2020
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