3GPP TSG-RAN WG3 #114-e R3-215860

Online, Nov 1st - Nov 11th, 2021

Agenda Item: 11.2

Source: CMCC (moderator)

Title: SoD of Support for RedCap Capability Exchange

Document for: Discussion and Decision

# Introduction

**CB: # RedCap1\_UECapability**

**- Solutions on the table:**

**Sol1) Relying on OAM setting: CATT**

**Sol1bis) target’s rejection of an incoming HO of the RedCap UE: NEC (with new cause value)**

**Sol2) New Signalling solution: informati explicitly a type of RedCap UE indicator, such as the RedCap scheduled SIB content in Served Cell Information NR over the Xn Setup and Configuration messages: RadiSys, Reliance JIO, Samsung, CMCC, HW for Xn HO, ZTE, Qualcomm**

**- Introduce a new IE with the criticality set to “Reject” in the Source NG-RAN Node to Target NG-RAN Node Transparent Container to inform the target gNB about the handover of RedCap Ues for NG based HO? HW**

**- Add a list of non-supporting Redcap cells in: Xn HO Failure, Xn HO Request acknowledge, NG Target NG-RAN to Source NG-RAN Failure container, NG Target NG-RAN to Source NG-RAN transparent container? Add a new redcap IE with criticality reject in the Xn Handover message and NG Source NG-RAN to Target NG-RAN Transparent container? Nok**

**- In general do NOT introduce signaling mean to exchange the node capability, close this AI and wait for LS reply from RAN2? NEC**

**- Capture agreements and open issues**

(CMCC - moderator)

Summary of offline disc [R3-215860](file:///C:\zhmq\会议\3GPP会议\R3-114e\agenda\Inbox\R3-215860.zip)

We plan to divide the email discussion into two phases:

Phase1: Hope to reach the agreements on solutions for handling Redcap UE mobility before Friday, 5th November at 11:00am UTC.

Phase2: Depend on phase1 progress.

# For the Chairman’s Notes

**Proposal 1：Consider the following mobility handling scenarios for RedCap UEs, in terms of target of mobility,**

1. **Legacy gNB (Pre Rel-17)**
2. **New gNB (Rel-17) does not support RedCap UE;**
3. **New gNB (Rel-17) where RedCap UEs are temporarily barred, e.g., for 1Rx or 2Rx RedCap UE;**
4. **New gNB (Rel-17) supports RedCap UE**

**More companies slightly prefer solution 2 for handling RedCap UE mobility, but no consensus could be achieved.**

**If solution 1 is selected, majority of views support that no enhancement is needed.**

**If solution 2 is selected, FFS on the following stage 3 details:**

1. **Via Xn Setup and Configuration Update messages, e.g., reflect the SIB content in the served cell information or include a redcap support indicator, and could additionally include sub-IEs indicating barring, e.g., 1RX redcap UEs.**
2. **Via Xn HO handover messages, e.g., add a list of non supporting Redcap cells in: Xn HO Failure, Xn HO Request acknowledge, NG Target NG-RAN to Source NG-RAN Failure container, Target NG-RAN to Source NG-RAN transparent container.**

**To be continued**

# Discussion

## RedCap UE mobility Scenarios

Firstly, we need to confirm the possible mobility handling scenarios for RedCap UEs. Based on the capability of target cell, potential scenarios are summarized as follows.

1. Legacy gNB;
2. New gNB does not support RedCap UE;
3. New gNB where RedCap UEs are temporarily barred, e.g., for 1Rx or 2Rx RedCap UE;
4. New gNB supports RedCap UE

**Question 1: Do you agree above scenarios are valid and should be taken into account for RedCap UE mobility handling?**

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| --- | --- |
| Company | Comment |
| Qualcomm | Yes, the definition of “support” could be discussed but these are fine as a start |
| Huawei | Yes, we have both static cases and temporal cases as listed above. |
| NEC | Just want to understand the meaning of “Legacy gNB” and “New gNB”. Can I understand that “New gNB” is the gNB that has at least one of Rel-17 function, “legacy gNB” means the gNB e.g. Rel-16 gNB?  Moderator’s response: We assume that “legacy gNB” means the gNB is before Rel-17, and “New gNB” is the gNB that has at least one of Rel-17 function. |
| Radisys | Yes, we should also consider Inter RAT mobility |
| Deutsche Telekom | We assume that the understanding of NEC is correct as this would fit with ours.  C seems to be only a sub-scenario of D. |
| ZTE | Yes |
| Ericsson | Agree with Deutsche Telekom. |
| CATT | Agree with Deutsche Telekom. |
| TMUS | Same comments as NEC |
| Nokia | Yes and NO. For the present discussion, we could even summarize in two scenarios: target does not support Redcap permanently, and target does not support Redcap temporarily (cell barring case). |
| Samsung | Yes but agree with Nokia’s summary. |
| CMCC | Yes, it is necessary to distinguish the different scenarios. Some companies propose that scenario C is a sub-scenario of D. In our view, scenario C represents that RedCap UEs are temporarily barred in target gNB, and scenario D means that RedCap UEs at that moment are supported in target gNB. |

**Moderator’s summary:**

With the clarification of “legacy gNB” and “new gNB”, although having slightly different categorization of the scenarios, companies seem generally ok with the scenarios summarized by moderator.

**Proposal 1：Consider the following mobility handling scenarios for RedCap UEs, in terms of target of mobility,**

1. **Legacy gNB (Pre Rel-17)**
2. **New gNB (Rel-17) does not support RedCap UE;**
3. **New gNB (Rel-17) where RedCap UEs are temporarily barred, e.g., for 1Rx or 2Rx RedCap UE;**
4. **New gNB (Rel-17) supports RedCap UE**

## Solutions

In last RAN3 meeting, solutions for handling Redcap UE mobility are discussed. Based on progress of last meeting and the input reference papers, two main potential options and pros and cons of the respective solution are summarized as follows.

*Sol1) Relying on OAM setting*

*Sol1bis) target’s rejection of an incoming HO of the RedCap UE*

*Pros: Do not introduce new signalling over Xn. Noted that a RedCap indicator IE in the Xn HANDOVER REQUEST message with criticality of “reject” may be needed in some scenario, e.g., scenario A.*

*Cons: A single solution is not applicable to all scenarios.*

*Sol2) New Signalling solution: signalling explicitly a type of RedCap UE indicator, such as the RedCap scheduled SIB content in Served Cell Information NR over the Xn Setup and Configuration messages*

*Pros: Support all scenarios.*

*Cons: gNBs need to perform configuration updates every time the cell changes its access restriction info.*

**Question 2: Which solution do you prefer to handle RedCap UE mobility? Do you agree the pros and cons of two solutions mentioned above?**

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| Company | Comment |
| Qualcomm | Solution 2. We have a more detailed analysis in R3-214895, but bottom line is that solution 1 struggles to cover all scenarios, and then ends up in some proposals impacting signalling anyway. We see no justification to complexify when there is a very simple solution available. |
| Huawei | Solution 2. As also pointed out by Qualcomm, solution 2 supports the scenarios in one package. With new signaling via Xn, it shall work for all the cases where an Xn interface exist. |
| NEC | Sol 1 i.e. relying on OAM setting is by default, if only for the expectation of “support” capability i.e. capability exchange, as the capability is rather unchanged frequently (e.g. capability is supported only when the software of a gNB is upgraded), then we think there is no need to further introduce signalling mean. |
| Radisys | We prefer Solution 2. Solution 1 creates inter vendor operable issues. We have provided a detailed discussion in R3-215497. |
| Deutsche Telekom | Sol 1: From our perspective relying on OAM is sufficient as the support of RedCap UEs is a more or less static characteristic of a gNB. |
| ZTE | Solution2.  OAM solution (solution1) only works for static configuration, but we think cell may change its barring status for RedCap. In addition, As pointed out by Radisys, Solution 1 creates inter vendor operable issues.  Solution 1bis is not very efficient and will degrade the user experience. In addition, when the neighbour cell change its barring status, Solution 1bis may not be able to synchronize the barring status for redcap of neighbour cell. |
| Ericsson | How frequent the barring in the network will happen must be confirmed by RAN2. So, we prefer to wait for the RAN2 reply LS before agreeing on a solution. |
| CATT | Solution 1.  The redcap capability is static so OAM is enough.  Next question is about cell bar information, we think bar information is about the cell capability it cannot be changed frequently.  Furthermore, we already support exchange load information over XnAP. If my understanding is right, even though the bar information of target cell can be changed due to overload, the source redcap gNB also know the target cell is overload. Therefore, source redcap gNB may not trigger the handover. In general, source redcap gNB may not hand over a redcap UE to an overload target cell which the cell bar information may have been changed (if support). |
| TMUS | No strong view |
| Nokia | Solution 2 but disagree with the summary. Solution 2 involves signaling in general, sending Xn setup and Configuration update is just an example of solution 2: please note the “**such as**” in the sentence *such as the RedCap scheduled SIB content in Served Cell Information NR over the Xn Setup and Configuration messages*. Solution 2 is wider and could encompass other solutions such as in tdoc R3-214780 which involved less signaling because the information is piggybacked in HO Request/Request Acknowledge messages.  We therefore support solution 2 but need to compare between the different variants of solution 2 in a second step. |
| Samsung | Solution 2 |
| CMCC | Solution 2, this solution introduces a new IE indicating whether the bar information is broadcast in SIB1 content, and provides a dynamic adaptation process to fit in all scenarios. |

**Moderator’s summary:**

More companies slightly prefer solution 2 for handling RedCap UE mobility, but no consensus could be achieved. How frequent the temporary barring in the network will happen impacts the decision, some companies propose to wait for RAN2 reply.

**For chairman notes:**

**More companies slightly prefer solution 2 for handling RedCap UE mobility, but no consensus could be achieved.**

If solution1 is chosen, some improvements are required to fulfill all scenarios, e.g., defining new cause values or using OAM to configure.

**Question 3: If solution1 is chosen, companies are invited to provide their views on if any signalling is needed to have a whole solution for all scenarios.**

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| Company | Comment |
| Qualcomm | OAM could for example cover whether a neighbour may be considered for handover or not (for RedCap UEs), for sure cause values will not work with legacy. Then for new nodes, you need at least 4 cause values to indicate different combinations of support or barring. But now this means the source must keep trying for all temporary barring cases. This is not a good design at all. |
| NEC | If talk about support capability set by OAM then the source will not try to handover RedCap UE to neigbour that does not support RedCap UE. |
| Deutsche Telekom | Same view as NEC. |
| Ericsson | Same view as DT and NEC if solution 1 is selected – no enhancement needed.  In our view, RedCap barring in a network is a deployment aspect. When a network is deployed it is done so that all the network components are upgraded to support the feature in a consistent way. If a RedCap-supporting gNB is deployed, the same support must be for all gNBs in the area. Therefore, the number of HO requests trials won’t be an issue in our view. Also, no need for additional cause values. |
| CATT | Agree with E///. |
| TMUS | Same as Ericsson |
| Nokia | Same view as DT and NEC if solution 1 is selected – no enhancement needed. |
| CMCC | Same view as Ericsson |

**Moderator’s summary:**

If solution 1 is selected, majority of views support that no enhancement is needed.

**For Chairman Notes:**

**If solution 1 is selected, majority of views support that no enhancement is needed.**

If solution2 is chosen, the procedures and some stage3 details exchanged between gNBs, e.g., capabilities broadcast in SIB1 for barring RedCap UEs, need to be specified.

**Question 4: If solution2 is chosen, companies are invited to provide theirs views on the impacted procedures and stage3 details.**

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| Company | Comment |
| Qualcomm | As shown in R3-214895, we should simply need to echo the broadcast parameters (functionally, not necessarily exactly same structure) in the *Served Cell Information NR* IE, with some suitable procedural text.  Note (since this seems to be a concern) that this is not capability exchange. |
| Huawei | All we need to do is exchanging the capability, e.g. a redcap support indicator, via Xn setup/configuration update procedures. Note that we can even exchange more detailed capabilities, i.e. the capability to support RedCap UEs with 1/2 Rx branches. A way suggested by Qualcomm to echo the broadcast parameters may also work. |
| NEC | If this is for capability exchange and that capability is assumed not to change frequently, then OAM setting is enough. But if it is not for the purpose of capability exchange, then can consider other ways to realize. |
| Radisys | For solution 2, we have Ng, F1 and Xn impacts. The F1 and Xn impacts on Serving Cell configuration, Paging, HO is provided in our CRs R3-215157 and R3-215159 |
| ZTE | For solution 2, As shown in our R3-215788, we would like to introduce the Broadcast RedCap Barring information of the cell (e.g, cell barred for RedCap1RX, cell barred for RedCap2Rx) into the Served Cell Information IE over XN and F1 interface. |
| Ericsson | First, we would like to re-iterate the RAN3 good principles that we do not advertise about gNB capabilities over network interfaces.  Then, if sol2 is selected (pending RAN2 LS reply), we should do it in a way that RedCap barring/activation in neighboring gNBs is not signaled as a capability. We can work on the examples given by QC/ZTE. Although F1 impacts are not needed, since the CU knows the cells for intra-gNB mobility. |
| CATT | If solution 2 is agreed, cell bar information can be exchanged in Xn |
| TMUS | Agree with Ericsson |
| Nokia | If solution 2 is agreed, cell bar information need to be exchanged over Xn, and also possibly NG. We need to compare solutions in Xn Conf Update (such as in 4895) and solutions in Xn HO handover messages (such as in 4780). One advantage of 4780 is that it involves less signaling and can easily be extended to NG. |
| Samsung | Agree with HW. |
| CMCC | We prefer to exchange the RedCap barring information of a cell between gNBs through the presence or absence of RedCap Broadcast Information. |

**Moderator’s summary:**

No consensus on the stage 3 signaling details for solution 2. Potential solutions include:

1. Via Xn Setup and Configuration Update messages, e.g., reflect the SIB content in the served cell information or include a redcap support indicator, and could additionally include sub-IEs indicating barring, e.g., 1RX redcap UEs.
2. Via Xn HO handover messages, e.g., add a list of non supporting Redcap cells in: Xn HO Failure, Xn HO Request acknowledge, NG Target NG-RAN to Source NG-RAN Failure container, Target NG-RAN to Source NG-RAN transparent container.

**For Chairman Notes:**

**If solution 2 is selected, FFS on the following stage 3 details:**

1. **Via Xn Setup and Configuration Update messages, e.g., reflect the SIB content in the served cell information or include a redcap support indicator, and could additionally include sub-IEs indicating barring, e.g., 1RX redcap UEs.**
2. **Via Xn HO handover messages, e.g., add a list of non supporting Redcap cells in: Xn HO Failure, Xn HO Request acknowledge, NG Target NG-RAN to Source NG-RAN Failure container, Target NG-RAN to Source NG-RAN transparent container.**

## Mobility handling of legacy target cell

According to the contribution [1][2], a new RedCap IE with the criticality set as ‘Reject’ is introduced in the source-to-target container to prevent handover from the RedCap UE to a legacy NG-RAN node.

**Question 5: Companies are invited to provide their views on whether criticality set as ‘Reject’ is needed and on which interface is needed.**

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| Company | Comment |
| Qualcomm | This is about NGAP. This could be ok, but depends on the parallel discussion on handling of criticality during NGAP handover, so it is hard to reach a conclusion now.  Note that solution 2 in Xn automatically addresses some NGAP HO scenarios i.e. scenarios where NGAP is necessary even though Xn exists such as inter-AMF mobility. For other scenarios some form of trial-and-fail may be needed and can be discussed further.  We would recommend trying to reach a way forward on Xn and marking NGAP scenarios not covered by that as FFS for next meeting. |
| Huawei | Yes. In cases where Xn interface is not available, we believe such method works. The method is a complement to solution 2. Details can wait for the progress of on-going RACS discussion. |
| NEC | NGAP can be discussed later. |
| Radisys | Agree with Qualcomm |
| ZTE | FFS.  We are ok for this approach. But at last meeting, RAN3 has sent a LS to RAN2 to ask how access control will work for legacy gNBs. So we can wait the reply and discuss at next meeting. |
| Ericsson | No, does not look critical. |
| CATT | It seems reasonable but we would like to wait for RAN2’s feedback first |
| Nokia | We need to look at the full picture i.e. Xn and NG. Tdoc 4780 proposes for NG the criticality reject in the source to target direction but also to piggyback the list of non supporting cells in the target to source direction. The solution therefore covers both Xn and NG which is an advantage. |
| Samsung | Can be discussed later |
| CMCC | Postpone the discussion of NGAP after making decision of Xn. |

**Moderator’s summary:**

Majority of views support that NGAP can be discussed later.

## Others

The case of no Xn between the nodes seems forgotten in this summary. There is no point to introduce a partial solution which would not work in all scenarios i.e. work when there is an Xn and not work when there is no Xn. That would mean for example allowing incoming redcap UEs if there is no Xn and rejecting the if there is Xn! Therefore, any solution should would for any deployment case.

Companies are invited to say which solution they foresee for the scenario of “no Xn”.

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| --- | --- |
| Company | Comment |
| Nokia | Tdoc R3-214780 proposes the criticality reject in the source to target container of NG Handovers but also to piggyback the list of non supporting cells in the target to source container (in NG HO Request Acknowledge). The piggyback is done during normal handovers (not necessarily redcap UEs handover). Therefore, no additional signaling (message exchange) is added. |
|  |  |
|  |  |

# Conclusion, Recommendations [if needed]

If needed

# References

1. R3-214895, (TP for XnAP BL CR on RedCap) Xn mobility handling for RedCap UEs, Qualcomm
2. R3-215094, Coordination between gNBs on the supporting of RedCap UEs, HW
3. R3-214780, Coordination of Redcap Capability across gNBs, Nokia
4. R3-214940, RedCap Capability Exchange between nodes, NEC
5. R3-215018, Discussion on RedCap capability exchange, CATT
6. R3-215497, Discussion on Redcap UE Handover aspects and Capability exchange, Radisys, Reliance JIO
7. R3-215554, RedCap Capability Exchange, Samsung
8. R3-215679, Discussion on RedCap Capability Exchange, CMCC