3GPP TSG-RAN WG3 Meeting #115-e R3-222405

Online, 21th Feb – 3rd Mar 2022

**Agenda item: 31.2.4**

**Source: Huawei (moderator)**

**Title: Summary of offline: Support exchange of protocol support at target RAN node for S1/NG handover**

**Document for: Discussion and Decision**

# 1 Introduction

**CB: # 16\_ProtocolSupport**

**- Enhance signalling in N2/S1 mobility scenarios as follows? Qualcomm Incorporated, Vodafone**

* **Adopt a minimal signalling solution with a single IE in response message only, targeted at RACS only**
* **Adopt one or both criticality solutions for further future proofing of the N2/S1 mobility scenarios (beyond RACS); both solutions would allow the source to be aware of issues with IEs in both the container as well as the signalling from the AMF/MME (it can be discussed further if this has value).**

**-Suggested to take approach 2 as way forward: Add new RACS Usage Indicator IE with criticality to “reject” in the source-to-target container and the Criticality Diagnostics in the Target to Source node Failure Transparent Container? Huawei, China Unicom, China Telecom**

**- Agree a criticality-diagnostics-based mechanism which foresees providing criticality diagnostics information concerning the target side NG-C/S1-MME interface within a transparent container from the target RAN node to the source RAN node? E///**

(HW - moderator)

Summary of offline disc [R3-222405](file:///C:\Users\llopes\OneDrive%20-%20Qualcomm\Documents\3%20RAN3\RAN3%20115\Inbox\Drafts\CB%20%23%2016_ProtocolSupport\Inbox\R3-222405.zip)

# 2 For the Chair’s Notes

First-round summary but not treated online:

Proposal 1: Determine which scenarios to cover, i.e., only remote RAN support, or remote far-end (including CN and RAN) for RACS, Redcap, UPIP or other features so as to have a general protocol solution.

Proposal 2: Further discuss the following three approaches, and possibly down-select, and propose way forward for 2nd-round.

* Approach#1: Remote Criticality Diagnostics
* Approach#2: Container-based Diagnostics
* Approach#3: Indicator of remote end use of RACS

Observation:

* Approach#1 cannot address the remote far-end scenario, and may not work in scenarios in case the RAN node does not receive the IE with “reject” criticality from the CN
* Approach #2 can not address the remote far-end scenario.
* Approach #3 is not relying on the “ASN.1 level via setting the criticality “reject” for essential IEs” principle.

# 3 Discussion (Phase 1)

At the beginning of the discussion, the moderator copies the agreements of the previous meeting for reference.

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| **RAN3#113-e meeting minutes**  *Add an explicit TEI17 Agenda Item for next meeting, e.g., “Support exchange of protocol support at target RAN node for NG handover” with below subtext:*  *Two approaches have been discussed: (1) explicit capability exchange, (2) making use of (potentially aggregated) criticality diagnostics information at the target RAN node. Further solutions not precluded.*  **RAN3#114-e meeting minutes provided in R3-215841**  *Topic to be continued, taking the inputs and discussion in this meeting as a starting point. The following points are recommended to be considered:*  *Further analysis of the approaches (other approaches or refinements not precluded)*  *Determine which RACS scenarios to cover e.g. only remote RAN support, or remote far-end (including CN and RAN)*  *Continue to aim for a general solution, if possible, for RACS and other future use cases*  *The possibility of solution combinations should not be discarded*  *To be continued...* |

From the contributions to this meeting, there are three approaches which are the same as proposed at the previous RAN3-114 meeting. The moderator excerpts from the detailed contents from **R3-215841** for reference.

1. **Approach#1**: Remote Criticality Diagnostics

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| * A new *Remote Criticality Diagnostics* IE is introduced (based on the existing *Criticality Diagnostics* IE), which can be used in both successful and failure transparent containers (in both NG and S1APs) - in S1AP there is also a need to define the failure container * The IE carries criticality information related to the **“remote” interface** i.e. target side message in NGAP/S1AP (HANDOVER REQUEST) * The source can request this information so e.g. even in successful handovers, the target may provide information from previous handovers (which could have come from different source nodes) |

1. **Approach#2**: Container-based Diagnostics

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| * An IE is added to the source-to-target container e.g. “RACS Usage Indicator”, with a criticality of “reject”. * The *Criticality Diagnostics* IE is added to the failure transparent containers (in both NG and S1APs) – in S1AP there is also a need to define the failure container * The IE carries criticality information related to the contents of the incoming transparent container |

1. **Approach#3**: Indicator of remote end use of RACS

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| * The target RAN node includes a new IE (*RACS Indication*) in the target to source transparent container to indicate that “it is able to acquire the UE capabilities through reception of the UE Radio Capability ID” * This indicates also that the target is receiving the UE Radio Capability ID from the target CN |

## 3.1 Determine which scenarios to cover, i.e., only remote RAN support, or remote far-end (including CN and RAN)

Last RAN3#114e meeting left two aspects to further discuss.

* *Determine which RACS scenarios to cover e.g. only remote RAN support, or remote far-end (including CN and RAN)*
* *Continue to aim for a general solution, if possible, for RACS and other future use cases*

On these two issues, overview of the RAN3 papers:

* Huawei [R3-221954]: It was proposed that: **The discussion should be mainly focusing on the RAN node support of the capabilities for CN-based handover, i.e. instead of the capability detection of the remote far-end.** 
  + *The reason is that at least three use cases as follows.* 
    - *RACS*
    - *Redcap*
    - *Possibly EPS User plane integrity protection (UPIP) depending on the SA3 reply LS (see the LS in R3-221473)*
  + *When looking at the above use cases, for EPS UPIP, when the MME does not support it while the eNB supports, it is already specified in TS 33.401 that when the eNB does not receive the UPIP policy from the MME for the UPIP capable UE, it shall use the locally configured UPIP policy (“preferred”) to enable the UPIP. Then at least for the EPS UPIP, there is no need to detect the* ***remote far-end support****.*
  + *For Redcap, there is no new indicator in the HO request message. Hence at least the approach 1 (the Remote Criticality Diagnostics) can not address this use case. And there is no need to detect the remote far-end support.*
* Qualcomm [R3-221738]: provides a summary of whether the source can detect non-support of RACS at the target system in various scenarios for approach#1 and approach#2.

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| **RAN support for RACS** | **CN support for RACS** | **V1 (based on NGAP IEs)** | **V2 (based on Transparent Container IEs)** |
| NO | NO | No detection possible | Detection possible only if both CN and RAN support failure container (i.e. not in case of pre-rel17 MMEs, or pre-rel17 E-UTRAN, or inter-system handover to E-UTRAN) |
| NO | YES | Detection possible in some scenarios; for failure same as V2; else relies on memory and sending criticality diagnostics for previous procedure. | Detection possible only if both CN and RAN support failure container (as above) |
| YES | NO | No detection possible | No detection possible |

* Ericsson [R3-222058 revised in 2493] did not discuss whether/how the scenario covers, but with the following observation.
  + *Discussions at RAN3#113/4-e have shown that it is possible to introduce a mechanism that rather builds on exchanging of criticality diagnostics information between the target and the source RAN node concerning NG-C/S1-MME protocol support, than exchanging explicit information of node-level support information on a per-feature basis.*

At the beginning, the moderator tries to collect views on the following particular issue so as to have a general protocol solution:

**Determine which scenarios to cover, i.e., only remote RAN support, or remote far-end (including CN and RAN) for RACS, Redcap, UPIP or other features so as to have a general protocol solution?**

For example, the answer could be that the general solution should cover mainly RAN support, while the remote far-end support detection can be treated with the at best effort, or case by case etc.

**Question 1: Your views about the above question?**

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| **Company** | **Comments** |
| Huawei | Our thinking is that the discussion should be mainly focusing on the RAN node support of the capabilities for CN-based handover. There is no need to specifically consider the remote far-end (including CN).  This is especially true for the UPIP and Redcap. Typically, the UPIP can work if the target CN does not support it, and for Redcap, there is no requirement of the CN capability detection of the RedCap. |
| CATT | Generally, we are fine to consider remote RAN capabilities only.  But for RACS, “**remote far-end”** support seems needed. The target RAN node should only indicate support of RACS when both RAN node and core network support RACS. Which means if only consider the RAN capability, the source RAN node may understand the target RAN node support RACS and not provide necessary UE capability in RRC Container, but in case of CN does not support RACS, the UE capability ID is also not provided to the target RAN, this may bring new issue for handover.  For Redcap and UPIO, **remote RAN** support should be ok. |
| Qualcomm | Indeed RACs is a little different from the other use cases. Of course we can argue about deployment scenarios (and keep in mind RAN sharing too), but ultimately it is not a question of RAN support, but of RACS system support at the far end.  Each of the use cases is slightly different. Of course some tools may be generally applicable but the premise of the question is incorrect (i.e. that by defining the scenario narrowly, we may achieve a unified protocol solution). Let’s focus on RACS and then apply the learnings. |
| Ericsson | agree with Huawei, protocol support features should concentrate on RAN support, not on CN support. |
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## 3.2 Further analysis for respective solution

Though it is pretty clear how the respective approach works for the RACS, it is not clear from the contributions that how each approach could work for other use cases, e.g., Redcap, and UPIP (possibly other features). Note that for Redcap, this CB focuses only on the static node capability, i.e., not consider the temporarily barring case.

The moderator intends to collect companies’ views for each approach, e.g., how/whether it could work, pros vs. cons etc.

**Approach#1: Remote Criticality Diagnostics**

Overview of submitted papers

* Qualcomm [R3-221738]: there are potential issues for this approach
  + *Both versions rely partly or wholly on handover failure, and also signalling using the target-to-source failure container. Since such container does not exist in S1, these will not work either with pre-rel17 MMEs, or pre-rel17 E-UTRAN, or inter-system handover to E-UTRAN.*
  + *The first version applies to the scenario where the target CN node supports RACS, but not the RAN, but in any case, will not work if the target CN does not support RACS. If the CN has identified already that the RAN does not support RACS, and therefore will not use RACS towards it, it relies on usage of memory to send diagnostics for a previous procedure instance (on demand).*
* Huawei [R3-221954]: issues for this approach
  + *For Redcap, there is no new indicator in the HO request message. Hence at least the approach 1 (the Remote Criticality Diagnostics) can not address this use case.*
* Ericsson [R3-222058]: further explains how this solution could work.

**Question: your views on this approach#1, and how to in addition support RedCap, UPIP or other features.**

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| **Company** | **Comments** |
| Huawei | We think this solution cannot be used to address the following cases.  For RACS, if the CN detects the target node does not support the RACS, and then it will not include the UE radio capability IE to the target node. The same is true for UPIP.  For Redcap, the CN will not send any new indicator to the target node. |
| CATT | To avoid big impact to the whole system, direct way between RAN nodes seems better. |
| Qualcomm | As per table above, requires for sure CN support for the new criticality handling functionality; and by definition cannot detect if CN does not operate RACS.  Then even with CN support, it relies on storage of criticality diagnostics per interface, and its reuse in other non-related messages. Overall this quite a major impact, while not trapping all use cases. |
| Ericsson | it is true, that this addition cannot work pre-Rel-17. Nevertheless we agreed to spend work on it. better now than never.  and, if we wish support of a new feature to work with the “remote-criticality” mechanism, we should of course think twice regarding the criticality to be applied (but we assume that importance of applying “reject” to new procedures/IEs coincides well with the ability to apply the remote-criticality mechanism). |
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**Approach#2: Container-based Diagnostics**

Overview of submitted papers

* Qualcomm [R3-221738]: there are potential issues for this approach
  + *Both versions rely partly or wholly on handover failure, and also signalling using the target-to-source failure container. Since such container does not exist in S1, these will not work either with pre-rel17 MMEs, or pre-rel17 E-UTRAN, or inter-system handover to E-UTRAN.*
  + *The second version applies also to the scenario where the target RAN does not support RACS but does not apply to the case where the target RAN does support RACS, but the CN does not support or is not sending the information for any reason.*
* Huawei [R3-221954]: further explains this solution.
  + *this is not a new solution in terms of NG-RAN/AMF/SMF handlings, since the in the INITIAL CONTEXT SETUP RESPONSE message, the NG-RAN includes not only the Criticality Diagnostics to the AMF, but also the Criticality Diagnostics in the SMF container, for which the AMF can transparently forward to the SMF;*
  + *Another possible way is to introduce* ***a bitmap IE*** *or* ***a feature list IE****, where each bit or each feature IE represents a feature to be detected by the target RAN node*

**Question: your views on this approach#2, and how to in addition support RedCap, UPIP or other features.**

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| **Company** | **Comments** |
| Huawei | As the proponent company of this approach.  In order to support Redcap/UPIP, we are fine to introduce a bitmap IE or a feature list IE in the source to target container, where each bit or each feature IE represents a feature to be detected by the target RAN node. This could be a general solution, relying on the “criticality” set to “reject” characteristics to align with what we have agreed at the direct interface cases. |
| CATT | Source RAN node provide a feature list, and the target response support of each of them by setting of *Criticality Diagnostics* in Target to Source Container. It’s feasible, but this should not only in the failure message, may also be needed in successful response message, e.g. when target RAN node does not support RACS, the handover procedure could still be success.  Not sure how the bitmap way works, source RAN node provides a *bitmap* IE to indicate the capabilities of the features to be detected. Bur how the target response within the *Criticality Diagnostics* IE if some of the features in the bitmap are supported while some are not. |
| Qualcomm | As already stated, this does not work without both RAN and CN support of the failure container (and RAN support of the criticality feature), meaning that a number of scenarios are not covered since the failure container does not exist in E-UTRAN. In particular, it will miss most legacy scenarios. |
| Ericsson | we have been able to work with different feature support in source and target RAN nodes over decades now, and this wasn’t a real problem. Full support of a feature with all the advantages can for sure only be guaranteed in case of homogenously supporting parts of the network. we are very reluctant in starting to introduce node-capability feature bit maps, we have general protocol mechanisms and shouldn’t go far beyond that. What is new to RACS, RedCap and UPIP, to be honest, really? |
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**Approach#3:** Indicator of remote end use of RACS

* Qualcomm [R3-221738]: explains how this solution could work.
  + *A signalling-based solution (requiring a positive indication from the target) seems to work in all scenarios*
* Huawei [R3-221954]: has the following descriptions.
  + *how to support the EPS UPIP and Recap also need to be considered and clarified. And importantly, it is not aligned with the observation above that “The specification has allowed the node capability detection and report at the ASN.1 level via setting the criticality “reject” for essential IEs.”*

**Question: your views on this approach#3, and how to in addition support RedCap, UPIP or other features**

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| **Company** | **Comments** |
| Huawei | In order to support the Redcap/UPIP, it seems that new IEs are needed in the target to source successful container?  Basically our view is that this is not aligned with the “*The specification has allowed the node capability detection and report at the ASN.1 level via setting the criticality “reject” for essential IEs*” , for the direct interface cases. |
| CATT | This is the simplest and explicit way if we only focus on the RACS capability.  To be future proof, adding more and more new IEs is not an appropriate way.  To support different RAN capabilities, maybe we could just add a bitmap in target to source container to indicate the support of the features in the target RAN node. Perhaps this is the most efficient way with minimum specification impact. |
| Qualcomm | This seems to work in all scenarios.  Strictly it is not in scope of this CB to come up with a generic solution, in fact it is the other way round: other topics can learn taking into account the specifics. But to Huawei’s point, we think that new IE(s) in the target-to-source container are inevitable for UPIP as anyway criticality cannot work. For RedCap we are not convinced anything is absolutely needed, but can further discuss. |
| Ericsson | CATT well explains our deepest fears: that we end up with an large list of node capability indications. we have general mechanisms and now also found a way to apply this to CN based HO scenarios. and btw, we propose to not only apply exchange of remote-criticality in failure scenarios. |
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## 3.3 Potential way forward

Overview of the RAN3 papers

* Qualcomm [R3-221738]: *Enhance signalling in N2/S1 mobility scenarios as follows*
* *Adopt a minimal signalling solution with a single IE in response message only, targeted at RACS only*
* *Adopt one or both criticality solutions for further future proofing of the N2/S1 mobility scenarios (beyond RACS); both solutions would allow the source to be aware of issues with IEs in both the container as well as the signalling from the AMF/MME (it can be discussed further if this has value).*
* *Agree the CRs for approach3 that introduce a RACS related IE in the response message (if above is agreed, they can be merged with other CRs).*
* Huawei [R3-221954]:
* *it is suggested to take approach 2 as way forward*
* Ericsson [R3-222058]:
* *propose to endorse the text proposals for approach 1:*

**Question: what is your preference(s) of the three approaches, also your possible combinations? Please provide your suggested way forward (if any), in the 2nd round discussion.**

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| **Company** | **Comments** |
| Huawei | It is suggested to take approach2 as way forward. |
| CATT | Slightly prefer to go for approach#3 with some revision, i.e. extending the RACS indicator to a bitmap to indicate more RAN capabilities of the target RAN node in target to source container.  Approach 2 is also feasible, but it requires more changes to the spec, and the bitmap way should be further clarified. (see the comments above) |
| Qualcomm | Approach 3 seems to be the only one that works for RACS across all scenarios.  As stated, in order to move forward we are open to consider criticality handling approaches for future proofing and generic enhancements – but they are not needed (or work well) for RACS. Hence we prefer to agree approach 3 as a starter.  A response to CATT’s suggestion: this is possible but in RACS we are not actually defining capabilities as such, but whether the feature is operational including CN support. If we went in this way, each bit would have to be defined separately (see the procedural text in 1739/1740) – which is possible, but requires thought. |
| Ericsson | Approach 1 is the most general one. if you really die for having one of your capability bits set here and there, as a total exception, please do so, but for sure not for all features as a general rule. |
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## 3.4 Other aspects

**Question: Any issues that are not covered by above.**

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| **Company** | **Comments** |
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# 4 Discussion (Phase 2)

TBD

# 5 Conclusions, Recommendations

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# References

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| [R3-221738](file:///D:\会议硬盘\TSGR3_115-e\Docs\R3-221738.zip) | Further discussion on RACS Capability Detection for S1 and NG handover (Qualcomm Incorporated, Vodafone) | discussion |
| [R3-221739](file:///D:\会议硬盘\TSGR3_115-e\Docs\R3-221739.zip) | Detection of RACS support at target during N2/S1 handover (Qualcomm Incorporated, Vodafone) | CR1811r3, TS 36.413 v16.8.0, Rel-17, Cat. B |
| [R3-221740](file:///D:\会议硬盘\TSGR3_115-e\Docs\R3-221740.zip) | Detection of RACS support at target during N2/S1 handover (Qualcomm Incorporated, Vodafone) | CR0572r3, TS 38.413 v16.8.0, Rel-17, Cat. B |
| [R3-221954](file:///D:\会议硬盘\TSGR3_115-e\Docs\R3-221954.zip) | On node capability detection for non-direct-connected nodes (Huawei, China Unicom, China Telecom) | discussion |
| [R3-221955](file:///D:\会议硬盘\TSGR3_115-e\Docs\R3-221955.zip) | On node capability detection for non-direct-connected nodes [Node\_Cap\_Dect] (Huawei, China Unicom, China Telecom) | CR0690r1, TS 38.413 v16.8.0, Rel-17, Cat. B |
| [R3-221956](file:///D:\会议硬盘\TSGR3_115-e\Docs\R3-221956.zip) | On node capability detection for non-direct-connected nodes [Node\_Cap\_Dect] (Huawei, China Unicom, China Telecom) | CR1841r1, TS 36.413 v16.8.0, Rel-17, Cat. B |
| [R3-222058](file:///D:\会议硬盘\TSGR3_115-e\Docs\R3-222058.zip) | [TP for 38.413 and 36.413] On Remote Criticality (Ericsson) | other  revised in R3-222493 |