3GPP TSG-RAN WG3 Meeting #107-e R3-201133

E-meeting, 24 February – 6 March, 2020

**Agenda item: 10.2.3.2**

**Source: Nokia, Nokia Shanghai Bell**

**Title: Summary of offline discussion for CB: # 30\_Email030-Config\_conflicts\_RACHopt**

**Document for: Discussion**

# 1 Introduction

This document lists proposals relative to configuration conflict detection and resolution submitted to RAN3#107-e. The proposals are submitted mainly under AI 10.2.3.2 and some under AI 10.2.3.1. This document captures outcome of associated discussions.

**CB: # 30\_Email030-Config\_conflicts\_RACHopt**

**- should focus on a) UE RACH report between two neighbor nodes and b) related/assistant information transfer between CU and DU; may consider proposals from papers in 10.2.3.1**

**- note LS (0080); take into account RAN1 agreements**

**- RACH failure rate is calculated at gNB-DU, based on UE RACH Reports sent from the gNB-CU to the gNB-DU? (Nok)**

**- Procedure to use to exchange PRACH parameters over Xn? Xn setup req/resp. / NG-RAN node config update? Further details? (HW, CMCC)**

**- Procedure to use to exchange PRACH parameters over F1? F1 setup resp. / gNB-CU config update? (CU->DU)? Further details? (HW, CMCC)**

**- perform RACH configuration conflict resolution at gNB-DU, by providing a limited and filtered set of assistance information from gNB-CU, if required, and allowing the gNB-DU to request for further assistance information, if needed? (E///)**

**- common subset of proposals**

**- split work; revise/merge if needed; check details**

(Nok)

Hopefully the outcome would be to find an agreeable working solution. TPs (stage 2, stage 3) to be determined during the discussion.

For reference agreements from RAN3#106:

1. **RACH configuration conflict detection and resolution function is located at the gNB-DU; details on assistance info exchanged between CU and DU are FFS**
2. **gNB-DU needs to know the PRACH configuration of some or all cells neighbors to a cell subject to RACH configuration conflict, in order to effectively chose a new PRACH configuration for the cell in conflict**
3. **Signaling of UE RACH Reports to the gNB-DU is needed**

# 2 Transfer of UE RACH report between two neighbour nodes

**- Procedure to use to exchange PRACH parameters over Xn? Xn setup req/resp. / NG-RAN node config update? Further details? (HW, CMCC)**

**Comments / preferences:**

Company 1

Company 2

**- Procedure to use to exchange PRACH parameters over F1? F1 setup resp. / gNB-CU config update? (CU->DU)? Further details? (HW, CMCC)**

**Comments / preferences:**

Ericsson:

**- should focus on a) UE RACH report between two neighbor nodes and b) related/assistant information transfer between CU and DU; may consider proposals from papers in 10.2.3.1**

**- note LS (0080); take into account RAN1 agreements**

The above points refer to the mechanisms to transfer a RACH Report. In R3-200958 a mechanism to transfer RACH Reports from CU to DU is proposed. While this can be a good starting point, the mechanism does not fulfil the requirements from the LS from RAN2 in R3-200097, which quotes:

3 The UE can store more than one RACH procedure related RACH report.

4 The UE shall store upto 8 RACH reports.

5 UE shall store the RACH report entry if these RACH report entries can’t be retrieved by the network immediately and then report the stored RACH report entries upon receiving the UEInformationRequest message with rach-ReportReq set to “true”.

Namely, RAN2 has agreed that a UE will store up to 8 RACH report possibly collected at RACH access in different nodes/cells and the UE may report them all at once to a serving NG-RAN node. With this agreement RAN3 would also need to define non UE associated procedures over F1 and Xn to transfer RACH report to the appropriate nodes.

**Proposal: It is proposed to take an initial step in the direction of the RAN2 agreements with agreeing to** **R3-200958**

Nokia: We agree with Ericsson that we need to provide the appropriate procedures over F1 and Xn interfaces to transfer UE RACH Reports to the appropriate nodes. In our view, procedures over F1 interface can be both UE Associated and Non-UE Associated procedures while over the Xn interface we must have non-UE associated procedures in place. Even though we agree in principle with the proposal above we believe that we need to think carefully which will be the exact messages that will carry this information over the interfaces.

Huawei: we have similar views with Nokia. The F1 procedure needs to take into account the procedure used on Xn. Please see the following papers for details. Where we propose to use a non-ue assicated UE report transfer procedure on F1 which is aligned with Xn.

R3-200492 (TP for SON BL CR for TS 38.473): UE RACH Report for RACH Optimization (Huawei)

R3-200493 (TP for SON BL CR for TS 38.423): UE RACH Report for RACH Optimization (Huawei)

Nokia: There are several proposals proposing to use either existing or new messages over F1AP for RACH Report Exchange. We need to evaluate them before deciding.

# 3 Assistance information for conflict detection

Proposal to handle assistance information discussion here, copying from #29 and #30:

**- how to detect the conflict; may consider proposals from papers in 10.2.3.2**

**- RACH failure rate is calculated at gNB-DU, based on UE RACH Reports sent from the gNB-CU to the gNB-DU? (Nok)**

**- perform RACH configuration conflict resolution at gNB-DU, by providing a limited and filtered set of assistance information from gNB-CU, if required, and allowing the gNB-DU to request for further assistance information, if needed? (E///)**

***Proposals/observations copied from tdocs:***

**0492 (HW):** Proposal 6: It is proposed RAN3 to discuss whether a RACH event notification from DU to CU is needed to trigger the UE RACH report acquisition procedure over Uu interface.

**Comments:**

**ZTE, RACH event notification is needed**

**As we propose in our contribution [R3-200625]**

**Proposal 1: RACH OPTIMIZATION mechanism in split architecture include:**

**When a new DU setup , during F1 setup procedure, gNB-DU provides RO configuration to its gNB-CU. gNB-CU may provide neighbour RACH configuration per cell to gNB-DU.**

**When a cell in one DU set to active, gNB-DU sends *GNB-DU CONFIGURATION UPDATE* message to gNB-CU, includes RACH configuration of the cell in *Served Cells To Add List* IE. gNB-CU may provide neighbour RACH configuration of the cell to gNB-DU in *GNB-DU CONFIGURATION UPDATE* *ACKNOWLEDGE* message.**

**When RACH conflict happen or resource utilization degraded is identified, the gNB-CU sends *GNB-DU CONFIGURATION UPDATE* message, includes RACH configuration as an indication in *Served Cells To Modify List* IE. The gNB-CU shall, if available, provides RO assistant information including UE REPORT and RACH configuration of neighbor.**

**Nokia: We just want to clarify the understanding of your R3-200625. There, you define a mechanism to exchange RACH Configuration parameters from a gNB-CU to a gNB-DU. This in our view is not an event from gNB-DU to gNB-CU but rather a mechanism to initiate the transfer of RACH Configuration parameters from gNB-CU to gNB-DU. The RACH event notification in your contribution is from gNB-CU to gNB-DU and not from gNB-DU to gNB-CU, right?**

QC: We agree to include a RACH event notification from DU to CU to trigger collection of RACH Report to handle scenarios in which CU is unaware of RACH occurrence. This will enable CUs to have a full picture of all the RACH occurrences on the cells belonging to its own DUs.

Proposal #3 in 0492 to transfer RACH report over Xn to the CUs belonging to the source gNB in case of handovers might not work always, say in case there is no Xn interface between 2 NG-RANs. Therefore, we agree with Proposal #6 to add RACH event notification

Ericsson: We do not see the need for a RACH access notification from DU to CU. When the UE has performed RACH Access and has a RACH Report available, the UE will flag the availability of such report to the gNB-CU and gNB-CU will pull the report if possible. This mechanism seems to remove the need of a RACH access notification.

Nokia: In our view the gNB-CU will receive the RACH failure events from the UE RACH Reports. The gNB-DU cannot always detect a RACH failure since those may be visible to RRC (gNB-CU) but not to lower layers (gNB-DU). Thus, triggering the collection of UE RACH Reports from gNB-DU is not a reliable method. But more importantly, if a gNB-CU has received UE RACH Reports from its UEs (or from other neighboring gNBs) then it would immediately forward the information to its gNB-DU(s). Thus, a trigger from gNB-DU to gNB-CU to trigger collection of UE RACH Reports is pointless; if gNB-CU hasn’t sent UE RACH Reports to its gNB-DU(s) it is because it does not have any RACH information.

Huawei:

To Nokia: As per our comment on the RACH failure rate, relying on Xn is not real time and will degrade the RACH algorithm performance.

To E///: there is no such RACH report available indication in the RRC message.

CMCC:

Different from RLF report, there is no indication by UE in msg5 to inform gNB that RACH report is available, so as QC commented, if we would like to have all the RACH report for optimization, this indication from DU to CU is needed.

Nokia:

To Huawei: The RACH Failure Rate is a metric calculated internally at a gNB-DU and transferred to the neighbours to provide “non-real time statistical” information on the RACH performance and to assist the network determine conflicts of RACH Configurations. It is assistance information and therefore does not degrade the performance -it can only “assist” if taken into account. We give an example later on how it could be used.

To CMCC: To our understanding there must necessarily be some availability indication for the RACH Report, it is hard to understand how the solution will work if there is not.

**0385 (Nokia):** Observation 1: Even though RACH report information at the gNB-DU is useful, mere forwarding of RACH reports from gNB-CU to gNB-DU may not always contain useful information unless they involve cells hosted by the receiving gNB-DU. Observation 2: RACH failure rate information involving neighboring gNB-DUs, sent from gNB-CU to gNB-DU provides statistical information on the outcome of RACH accesses on cells not managed by the receiving gNB-DU. + proposals 1-6 + F1AP TP in 0386 + XnAP TP in 0387.

**Comments:**

Huawei: we are not sure how RACH failure rate is calculated by the DU? Considering that some RACH failure may not be detected by the DU. And the failure RACH report from the UE is reported later when UE is in RRC connected which seems far from the time when the failure should be counted at the DU.

And how would RACH failure rate used in RACH optimisation?

ZTE: share the same concern with Huawei. RACH failure rate in one gNB may not directly relate to only one neighbor. Provide the information may need further clarification.

Samsung: RACH failure rate seems important for RACH optimisation. However, the benefits to exchange this information among nodes is not clear to us.

QC: We understand and agree that exchanging RACH configuration of cells served by neighbouring DUs can help in RACH conflict detection or resolution, but we are seeking clarification on how knowing the RACH failure rate statistic of other DUs can help in RACH conflict detection for the serving DU. If sufficient information can be gathered from the RACH report and RACH statistics computed internally at DU, we propose to exclude sending of RACH Failure Rate” metric over Xn and F1

Ericsson: As explained in the papers submitted to RAN3-106, the RACH optimisation solution should be simple because a RACH conflict is rather seldom. For that we would propose a solution where analysis of RACH reports and detection of RACH conflict is done at the gNB-DU by means of “raw” information (i.e. RACH reports, DU measurements, PRACH configuration of neighbour nodes). We do not see the need of forwarding to the DU RACH failure rates. In any case a RACH failure event would not be reported in a RACH Report but in a Connection Establishment Failure, which Ericsson proposes to signal between RAN nodes in R3-200945

Nokia: The metric of RACH Failure Rate is a simple metric that is calculated at the gNB-DU by using indeed “raw” information and DU measurements. Specifically, the RACH Failure rate will be calculated at a gNB-DU after receiving UE RACH Report information from its gNB-CU. UE RACH Report information contain information on the RACH failures that happened at the cells of the gNB-DU. This information may be collected by the gNB-CU itself (from UE RACH Reports it has collected) or it may be forwarded through the Xn interface (if some UEs finally succeeded their RACH procedure at a neighbour cell). The gNB-DU has internal information on the successful RACH procedures on its cells. So by combining information from RACH report and info on successful RACH procedures, the gNB-DU can calculate the RACH failure rate as the ratio of Failed RACH accesses per SSB Index per cell/ (Failed RACH accesses per SSB Index per cell + Successful RACH accesses per SSB Index per cell). Obviously, the gNB-DU will need to receive enough UE RACH Reports to calculate a meaningful statistical RACH Failure Rate.

Sending RACH failure rate to the neighbouring gNB-DUs will provide statistics helping to detect RACH conflics. It will provide a neighbouring gNB-DU non-UE associated information on RACH performance at the cells of its neighbours. This can help a gNB-DU determine if it is an aggressor to one of its neighbours and assist it control its parameters, e.g. to use less aggressive RACH power ramping should be used in own cell.

**0960 (E///):** Observation 1: RACH Configuration conflict detection at gNB-CU by comparing cell’s RACH configuration and by determining cell’s neighbourhood, is subject to errors due to UL/DL coverage imbalance and lack of beams overlap from a time/space point of view. This may result in unnecessary conflict detections. Observation 2: If the gNB-CU has to decide independently about the PRACH configurations of neighbour cells to send to a gNB-DU, it is very likely that a high number of such configurations would be signalled to the gNB-DU. Observation 3: Assistance information from gNB-CU including PRACH configuration information needs to be filtered and limited due to the need to reduce amount of data signaled towards a gNB-DU. Proposal: It is proposed to perform RACH configuration conflict resolution at gNB-DU, by providing a limited and filtered set of assistance information from gNB-CU, if required, and allowing the gNB-DU to request for further assistance information, if needed. + TP in 0961.

**Comments:**

Huawei: firstly, we agree that the PRACH configuration conflict resolution should be at DU.

We are so sure how the CU will filter the neighbour cells’ pRACH configs? This method have two drawbacks :

1. Downgrade the RACH algorithm performance in the DU, because the DU has to wait at least a RTT F1 delay to get the neighbour cell’s PRACH cofing.
2. Deadlock on retrying to require more PRACH configurations from the CU. How many times that the DU will retry if the PRACH configurations received in previous request cannot solve the PRACH conflict in the DU?

Therefore, a safe way is to send all the neighbour cell’s PRACH config to the DU in one time.

ZTE: In general , we support the mechanism as Ericsson propose. Considering CU may server more than 10000 cells , the RO assistant solution in split architecture reduce the performance burden introduced by RO function.

**Samsung: The comparison analysis is needed e.g. whether there is issue to send all the neighbour cell’s RRACH config to the DU? how much message size reduction can be achieved if filtering in CU ? Is there any delay for RACH optimisation in DU if filtering ?**

QC: In general, we are also OK with E/// proposal of sending limited and filtered set of RACH assistance information from gNB-CU and if required allow the gNB-DU to request for further assistance information. Currently the TP mentions the filtered set is limited to 16 cells and additional assistance can be requested later. Seeking clarification on i) how is the initial set of 16 cells chosen for RACH assistance to the serving DU (based on neighbouring cells?), ii) Is 16 cells sufficient for initial RACH assistance? and iii) Will CU send PRACH config of all the remaining cells upon the 2nd step of additional RACH assistance?

Ericsson: It is of paramount importance that we limit the number of pRACH configurations sent to the DU. We already incurred in message size issues for the Xn Setup and EN-DC X2 Setup procedures, which RAN3 had to address by introducing a new and dedicated procedure (and we do not want to end up in the same mistake).

In the solution proposed in R3-200961 the gNB-CU performs an initial filtering of up to 16 PRACH Configurations to send to the gNB-DU based on

* Neighbour relations between cells and
* Likelyhood that the RACH configurations may clash with each other
* Note: the filtering mechanisms will be up to the CU implementation and the above are examples

Upon detection of a possible RACH configuration conflict the gNB-DU may attempt to solve the conflict by changing the RACH configuration of the problematic cell. Alternatively the gNB-DU may request for further assistance information from the gNB-CU in the form of a further list of up to 16 PRACH configurations of neighbouring cells.

The gNB-DU can signal a request for further additional assistance information multiple times, if needed.

Note: Detection of a RACH conflict at gNB-DU is a statistical process, i.e. it is not a single event based detection, and for this F1 RTT delays in retrieving additional assistance information from the gNB-CU are not an issue.

Nokia: We agree with the proposal of Ericsson that RACH Configuration Conflict Resolution should be performed at gNB-DU. We also agree that gNB-CU could provide gNB-DU a limited filtered set of assistance information. For example, we believe that a gNB-CU, before forwarding UE RACH Reports to a gNB-DU, may need to filter the UE RACH Reports to contain only RACH accesses on the cells of the receiving gNB-DU. Since a UE RACH Report can contain up to 8 RACH procedures it is possible that it contains attempts on cells of different gNB-DUs under the same or different gNB-CU. However, we disagree with Ericsson on the last part regarding the need of assistance information from the gNB-DU to the gNB-CU. In the above example, it is not obvious that there will be less signalling if each DU (selected from a possibly large number of gNB-DUs managed by a given gNB-CU) initiates a request/response procedure of assistance information comprising a set of PRACH configurations of its neighbours, one or multiple times. In fact, our idea of introducing the RACH Failure rate had this principle in mind; it was a method to allow a gNB-CU identify conflicting RACH Configurations by observing the statistics of RACH failures rates observed by different gNB-DUs. Huawei: Ok. We would be ok that gNB-CU could provide gNB-DU a limited filtered set of PRACH configurations of neighbour cells. However, the need of assistant information from DU to CU is not justified and needed.

CMCC: Fine with E///’s approach to have a limited set of PRACH configurations .

Nokia:

To Huawei: Responding to the earlier comment of on how RACH Failure rate can “assist” into the PRACH Configuration Conflict Resolution we present the following example. Different gNB-DUs calculate their RACH failure rates and send them to their gNB-CU (which further forwards it to neighbouring gNB-DUs). A gNB-CU that has received RACH Failure Rate information from different gNB-DUs (gNB-DUs it hosts and also other gNB-DUs hosted by neighbouring gNB-CUs) it can determine which PRACH Configurations cause conflicts to each other. It can use this information to filter PRACH Configuration information; it doesn’t need to forward all the PRACH Configurations but only the conflicting ones. Having said this, one important aspect we must take into account is the amount of PRACH Configuration information and the exact parameters per PRACH Configuration in order to avoid an explosion of signalling through the interfaces.

**0591 (CMCC, Huawei):** TP to TS 38.300 on RACH optimization.

**Comments:**

QC: Also please add “Purpose of RACH” as part of the contents of the RACH information report in addition to the TP.

Ericsson:

Do we really need the bullets following the sentence “The setting of RACH parameters that can be optimized are:”? Wouldn’t it be up to implementation which parameters to optimise? Also this list might soon become obsolete if RACH configurations change.

The bullet “Indication of on which carrier (i.e., NUL/SUL) one RACH procedure performed.” Should be removed as the RACH report contains carrier information, which implicitly indicates whether RACH is on UL or SUL.

Huawei: prefer to reword the TP directly.

CMCC: seems companies are fine with most of the text, we can reword the TP directly.

**0590 (CMCC, Huawei):** TP to TS 38.401 on RACH optimization for split gNB: “In case of split gNB architecture, RACH configuration conflict detection and resolution function is located at the gNB-DU. To perform RACH optimisation at gNB-DU, gNB-CU sends the RACH report reported by the UE to gNB-DU via F1AP signalling. The gNB-DU signals the PRACH configuration per-cell to gNB-CU. The gNB-CU may forward the neighbour cell’s PRACH configurations receiving from neighbour gNB-CU to the gNB-DU to resolve the configuration conflict.”

**Comments:**

QC: Agree with the TP

Ericsson: The TP is ok, however we suggest to amend as follows “The gNB-CU may forward a limited set of neighbour cell’s PRACH configurations to the gNB-DU to resolve the configuration conflict.”

Nokia: In the view of our previous comment, we agree with Ericsson with the above correction, namely that a gNB-CU may forward to the gNB-DU a limited set of neighbour cell’s PRACH Configurations. We believe that those could be identified by the gNB-CU through observation of the RACH Failure Rate values calculated at the gNB-DUs it manages as well as the RACH Failure Rate values corresponding to its neighbouring gNB-DUs that it receives through the Xn interface.

Huawei: OK.

CMCC: OK with the proposed corrections

# 4 Conclusion

It seems that stage 2 TPs are agreeable with modifications as indicated in the discussion above.

* **0591 (CMCC, Huawei):** TP to TS 38.300 on RACH optimization – revised in R3-20xxxx
* **0590 (CMCC, Huawei):** TP to TS 38.401 on RACH optimization for split gNB – revised in R3-20xxxx

Other aspects to be continued at next meeting.