3GPP TSG-RAN WG3 Meeting #112-e R3-212819

E-meeting, 17 – 27 May, 2021

**Agenda item: 10.2.1.7**

**Source: Nokia (moderator)**

**Title: CB: # 1207\_SONMDT\_RACH - Summary of email discussion**

**Document for: Approval**

# 1 Introduction

**CB: # 1207\_SONMDT\_RACH**

**- Topics to discuss:**

**- How gNB-DU resolves the RACH conflict**

**- Neighbor PRACH Configuration in F1AP**

**- Trigger from gNB-DU to gNB-CU for retrieval of a UE RACH Report?**

**- RACH failure rate calculation and transfer in F1AP and XnAP**

**- DU indicates to the CU the occurrence of RACH for cases when the RACH procedure is not known to the gNB-CU?**

**- gNB-DU/en-gNB to report upon every event of “MSG1 without consecutive MSG3”?**

**- Any other topic based on contributions submitted**

**- Start with summary of offline, proceed to TPs if there are agreements**

(Nok - moderator)

Summary of offline disc [R3-212663](file:///D:\\3gpp会议\\RAN3\\RAN3%23112\\offline\\CB%20%23%201207_SONMDT_RACH\\Inbox\\R3-212663.zip)

The discussion is structured in two phases, one before the online sessions and one after. The deadline for the first phase is Thursday 16:00 UTC.

# 2 For the Chairman’s Notes

Need to reply to chairman's question:  **- How gNB-DU resolves the RACH conflict**

List of discussed options:

* **Option a:** Large number of PRACH configurations from CU without further CU assistance to DU (*DU resolves PRACH configuration conflicts locally*)
* **Option b:** Large number of PRACH configurations from CU with CU assistance (RACH failure rate in neighbour cells) to DU (*DU resolves PRACH configuration conflicts locally*)
* **Option c:** Small number of PRACH configurations from CU to DU (*DU resolves PRACH configuration conflicts after requesting further CU assistance through more PRACH configurations*)
* **Option d:** Large number of PRACH configurations from CU to DU *(DU resolves PRACH configuration conflicts after requesting further CU assistance through more PRACH configurations*)
* **Option e:** gNB-CU signals up to 32 neighbour PRACH configurations to gNB-DU, together with the Cell ID of the cell potentially in conflict (*DU resolves PRACH configuration conflicts locally*)

Comments raised by several companies on assistance information from DU to CU (cell ID vs RACH failure information).

Supporting companies (a company may support more than one option):

Option a: 3 (as primary choice) 4 (as primary choice or acceptable choice)

Option b: 1 (as primary choice) 3 (as primary choice or acceptable choice)

Option c: 1 (as primary choice) 1 (as primary choice or acceptable choice)

Option d: 1 (as primary choice) 2 (as primary choice or acceptable choice)

Option e: 1 (as primary choice) 1 (as primary choice or acceptable choice)

**Proposal: For second round - continue discussion on the role of cell ID vs RACH failure rate as assistance information.**

**RACH Report retrieval:**

3 companies see the need that there is a trigger from DU to CU for RACH Report retrieval, 3 companies think that no trigger is needed, 1 company is ok to follow majority and 1 company suggests postponing this discussion to Rel. 17 (probably meant as Rel.18).

**Proposal: Postpone RACH Report retrieval to Rel.18**

**F1 SETUP RESPONSE**

4 companies prefer to include PRACH Configuration in F1 SETUP RESPONSE, 1 company is against and 1 company suggests that it can be included as an optional IE (included when available).

**Proposal: Introduce Neighbour PRACH Configuration in F1 SETUP RESPONSE as an optional IE (when available).**

# 3 Background

For RACH Optimization Enhancements we have the following agreements:

Support of inter-en-gNB RACH coordination in Rel-17 is beneficial, feasibility to be further evaluated in light of the NG-RAN solution to be defined.

Include neighbor PRACH Configuration in GNB-CU CONFIGURATION UPDATE, GNB-DU CONFIGURATION UPDATE ACKNOWLEDGE messages

FFS whether to include neighbor PRACH Configuration in F1 SETUP RESPONSE message

DU resolves PRACH configuration conflicts locally

Send a high number of Neighbour PRACH Configurations from CU to DU. Maximum value is FFS. The request from DU to CU is FFS.

# 4 Discussion - 1st round

## 4.1 PRACH conflict detection and resolution

It is agreed that the "DU resolves PRACH configuration conflicts locally". So far, the agreeable outcome goes in the direction of CU assistance based on sending of "a high number of Neighbour PRACH Configurations from CU to DU", listed as option a) below. Other options that can be deduced from the submitted papers are:

* **Option a:** Large number of PRACH configurations from CU without further CU assistance to DU (*DU resolves PRACH configuration conflicts locally*)
* **Option b:** Large number of PRACH configurations from CU with CU assistance (RACH failure rate in neighbour cells) to DU (*DU resolves PRACH configuration conflicts locally*)
* **Option c:** Small number of PRACH configurations from CU to DU (*DU resolves PRACH configuration conflicts after requesting further CU assistance through more PRACH configurations*)
* **Option d:** Large number of PRACH configurations from CU to DU *(DU resolves PRACH configuration conflicts after requesting further CU assistance through more PRACH configurations*)
* **Option e:** gNB-CU signals up to 32 neighbour PRACH configurations to gNB-DU, together with the Cell ID of the cell potentially in conflict (*DU resolves PRACH configuration conflicts locally*)

In your view, which of the options above would be sufficient to detect and resolve PRACH configuration conflicts? Are any options in the submitted proposals missing in your view?

|  |  |
| --- | --- |
| Company | Comment |
| Huawei | First of all, just to clarify that the small number amd the large number refer to the maximum number of neighbour cells PRACH configurations sending from the CU to the DU. Since a large number was agreed at last meeting, we prefer to set the maximum value to 512 which was proved by the F1 SETP from DU to CU that there is no any messge size issue.  Regarding the assistance information, we have two options, the RACH failure rate and the cell ID that is suffering from PRACH configuration conflict.  We think that the RACH failure rate doesn't help the CU much more than the cell ID. The DU may indicate the cell ID directly if the failure rate in that cell is beyond a threshold.  We can accept to send the cell ID as the assistance information as a compromise by using the gNB DU configuration update procedure. |
| CATT | We prefer Option a, while Option b and d are also acceptable for us.  We believe Option a won’t bring much signalling load as it is almost one-shot, thus technically not necessary to introduce any optimisation. Nevertheless if some company prefers to introduce some optimisation, we don’t oppose as it doesn’t harm anyway. |
| Nokia | We also support to send a large (maximum) number of PRACH Configurations from CU to DU according to the previous agreement, but there can't be any mandate that the CU always send the maximum number (if there is no need for such).  We support Option b. Sending RACH failure rate of neighbour cells on F1 can help a CU identify/filter PRACH configuration information to be sent to its served DUs. Other acceptable option is Option a.  Answering to HW: the benefit of RACH failure rate as opposed to just indicating the Cell ID suffering from PRACH Configuration conflict is that RACH failure rate gives additional information about “how much” conflict there exists in the cells of a DU. Any binary trigger would leave the decision to the DU; a greedy DU policy could define/trigger a conflict at a lower level as opposed to a more fair DU which would lead to non-comparable information at the CU. RACH Failure rate provides a common metric to determine conflict. Unlike usage of Cell ID, RACH Failure Rate could also be used to identify an aggressor cell since latter would typically have a particularly low RACH failure rate compared to its neighbours.  For a full solution we would need also to send the RACH failure rate on Xn, but maybe the intra-gNB scenario could be focus for Rel-17. Inter-gNB scenario can be further improved in later releases if needed. |
| China Telecom | We prefer Option a), and can also accept Option b). On the value of the Large number, since the DU can report 512 cells’ PRACH configuration to CU, we propose to set it to 512. |
| Ericsson | It is rather difficult to understand how the solutions listed map to the contributions. At least it is not possible to recognise the solution in R3-212260 from the list above. For this a new solution was added, Option e).  We are in favour of a moderate amount of neighbour cells PRACH configurations signalled from the gNB-CU to the gNB-DU upon the gNB-CU detects that a potential conflict occurs at a cell of a served gNB-DU. The gNB-CU would signal the potential cell in conflict to the gNB-DU. This is a step in a compromise direction with respect to our previous proposal to allow gNB-DU to signal gNB-CU of a RACH conflict detection.  We believe that RACH failures are not needed as they do not necessarily convey information about RAN conflicts (e.g. RACH failures may be simply due to UL/DL imbalance) |
| Qualcomm | Option c/d or Option a  Defining a large number of max configurations (e.g. 512) does not mandate that the CU always sends the maximum number. So, in our understanding, option c and option d can be the same except the difference in signalling overhead and an appropriate number can be chosen if a compromise is needed.  Now whether CU sends PRACH configurations autonomously (option a) or upon request from DU (option b, c/d) should be the main discussion.  Regarding Option b (RACH failure metric as assistance), it is not clear how simply signaling the “**Number** of RACH failures on NUL/SUL carrier per cell/SSB” would be uniform. A lightly loaded DU might have a smaller number of RACH attempts and hence smaller number of RACH failures. If percentage of RACH failures are instead considered, it needs to be then evaluated whether this is a fair comparison. Instead why not DU simply indicate the cell ID under RACH conflict and the trigger for this can be implementation specific like Huawei pointed out.  Option c/d (cell ID as assistance) is preferred. Option a is the simplest and can be accepted if there are no consensus on whether assistance information is needed. |
| Samsung | Option a. High number of Neighbour PRACH Configurations from CU to DU, and DU resolves PRACH configuration conflicts locally, were agreed in previous RAN3 meetings. We think it’s enough. |

**Summary:**

A comment was raised on the list of options, adding bullet e). Also comments raised by several companies on assistance information from DU to CU (cell ID vs RACH failure information).

Preferences were expressed as follows:

Option a: 3 (as primary choice) 4 (as primary choice or acceptable choice)

Option b: 1 (as primary choice) 3 (as primary choice or acceptable choice)

Option c: 1 (as primary choice) 1 (as primary choice or acceptable choice)

Option d: 1 (as primary choice) 2 (as primary choice or acceptable choice)

Option e: 1 (as primary choice) 1 (as primary choice or acceptable choice)

**Proposal: For second round - continue discussion on the role of cell ID vs RACH failure rate as assistance information.**

## 4.2 Trigger of retrieval of UE RACH report

Options under discussion at RAN3#111-e were the following:

1. For RACH events that are visible to the DU but not to the CU, DU triggers the CU to retrieve UE RACH Reports from a UE.

2. No trigger from DU is needed - CU is triggered by the UE to retrieve UE RACH Reports.

No agreement was reached - can further discussion on these mechanisms be left to later release, which means no additional trigger for UE RACH report is provided to the CU?

|  |  |
| --- | --- |
| Company | Comment |
| Huawei | We see some benefits to have the trigger from DU to CU. But ok to follow the majority. |
| Nokia | We do not support a trigger from DU to CU, primarily since this would break the fundamental principle of functional split, where a CU should not need to be aware of e.g. intra-cell inter-beam (L2) mobility.  But also, such trigger would result in high signaling impact towards the UE. From UE perspective a RACH Report is complete and awaits network retrieval when 8 RACH procedures have been stored. This also reduces the signaling required for the retrieval of the report. Since the gNB-DU cannot know how many RACH procedures a UE has logged (a UE may store RACH procedures from another gNB), it would trigger retrieval every time a new procedure (visible to the DU) is logged. This introduces excessive signaling both over F1 and over Uu interfaces.  Thus, it seems more convenient to let the responsibility to retrieve UE RACH reports to the CU. Currently it is optional for a CU to retrieve a RACH Report from a UE; If the CU does not retrieve it within 48h then the UE will discard the RACH Report. It is unclear why this functionality needs to be changed.  In the lack of any agreement, we are fine also to postpone this mechanism to a later release. |
| China Telecom | Agree with Nokia. We also prefer Option2. The option 1 may lead to much signalling exchange between CU and DU. CU can decide whether to retrieve UE RACH report according to its local policy. |
| ZTE | For signalling overhead, DU only trigger the procedure on need, for example , RACH failure rate rise in a DU but the DU is short of enough RACH report. Therefore, signalling overhead would not be big issue.  If we let the CU only take the responsibility to retrieve RACH report, then how does CU know which DU really need RACH report? Then CU has to keep busy to retrieve all UE’s rach report and sends to DUs. Which will bring unnecessary signalling overhead.  Since the issue raised in Rel-16 and we think this can be postpone to next release ,which is Rel-17. |
| Ericsson | We are in favour of an indication from gNB-DU to gNB-CU.  The problem mentioned of excessive signalling does not need to exist. The gNB-CU can initially retrieve a RACH Report from the UE. While the UE is served by the gNB-CU, the gNB-CU is aware of RACH procedures visible at L3, while it becomes aware of RACH procedures only visible at the gNB-DU. When such amount of RACH procedures reaches 8 (i.e. the UE has 8 RACH Report stored), then the gNB-CU can trigger retrieval of the RACH report from the UE.  Note that for some critical services the gNB-CU might have an interest in retrieving the RACH report from the UE as soon as possible and to send it to the node responsible for fixing the issue, so that robustness for the critical service can be restored. |
| Qualcomm | Option 1 (DU can indicate to CU with a RACH Indication). This indication can be useful at CU to be aware of RACH that are not visible to CU e.g beamFailureRecovery, lUnSynchronized, noPUCCHResourceAvailable, requestForOtherSI, sCellAdditionTAAdjestment etc.  Regarding Nokia’ comment “…*it would trigger retrieval every time a new procedure (visible to the DU) is logged. This introduces excessive signaling both over F1 and over Uu interfaces.*” 🡪 CU need not retrieve the RACH report every time DU indicates it over F1. CU can use this as assistance and retrieve RACH report from UE, say every 3 RACH indications over F1.  Also, another intention to introduce this assistance from DU is for CU to retrieve it on a timely fashion without needing to retrieve it from a neighbouring CU over XnAP and then forwarding the RACH report to DU. |
| Samsung | Agree with Nokia and CTC. |
| CMCC | We see some benefits of Option 1 (DU can indicate to CU with a RACH Indication) as Qualcomm commented. This indication can be useful at CU to be aware of RACH that are not visible to CU e.g beamFailureRecovery, lUnSynchronized, noPUCCHResourceAvailable, requestForOtherSI, sCellAdditionTAAdjestment etc. |

**Summary:**

3 companies see the need that there is a trigger from DU to CU for RACH Report retrieval, 3 companies think that no trigger is needed, 1 company is ok to follow majority and 1 company suggests postponing this discussion to Rel. 17 (probably meant as Rel.18).

**Proposal: Postpone RACH Report retrieval to Rel.18**

## 4.3 Inclusion of PRACH Configuration in F1 SETUP RESPONSE

This proposal was discussed at RAN3#111-e without agreement, and further proposed at this meeting in 1864 with additional clarifications. Please provide your further views:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei | If the CU can send the neighbour cells’ PRACH configurations in F1 SETUP response, it will enable the DU to do the first round detection on the PRCH configuration conflict.  There are many implementation specific ways to let the CU know where is the new deployed DU and which are its neighours roughly. |
| CATT | We prefer to include it, as shown in 1864. |
| Nokia | Even though we don’t have a strong preference in including neighbour PRACH Configuration information at F1 SETUP RESPONSE, we think that there can be some scenarios where this can be useful.  One example is when a DU reconnects to its CU after a failure. Another plausible example may be cell reparenting scenario (cells being reallocated between gNB-DUs) involving gNB-DU restart. These are 2 scenarios that could justify inclusion of PRACH Configuration in F1 SETUP RESPONSE. |
| Ericsson | NOT OK  The F1 Setup procedure is already loaded with a lot of information and including also a list of neighbour PRACH configuration may cause severe message size issues.  Besides, at F1 Setup there are no neighbour relations created. Namely, th gNB-CU may not even have knowledge of where the gNB-DU cells activated by the gNB-CU reside geographically. ANR has clearly not kicked in yet, so neighbour relations are at best limited if not inexistent. |
| Qualcomm | No strong view. If this is an OPTIONAL IE in F1 SETUP RESPONSE, neighbour cell PRACH configurations can be included if its available. |
| CMCC | We slightly prefer to include it since it will help DU to do some detection on the PRCH configuration conflict. |

**Summary:**

4 companies prefer to include PRACH Configuration in F1 SETUP RESPONSE, 1 company is against and 1 company suggests that it can be included as an optional IE (included when available).

**Proposal: Introduce Neighbour PRACH Configuration in F1 SETUP RESPONSE as an optional IE (when available).**

# 5 Discussion - 2nd round

## 5.1 Role of cell ID vs RACH failure rate for PRACH conflict detection and resolution

Outcome of 1st round discussion was captured as follows in chairman's notes:

**For second round - continue discussion on the role of cell ID vs RACH failure rate as assistance information.**

**To be continued in 2nd round...**

It was also clarified during the online discussion that different roles of the cell ID may be considered:

* as part of request sent from gNB-DU to gNB-CU, in order to request additional PRACH configuration info as per options c and d discussed in the first round
* as part of information sent from gNB-CU to gNB-DU, in complement to the PRACH configurations as per option e

The moderator assumes that the cell ID in both cases refers to a cell controlled by the gNB-DU that is involved in the signalling procedure (companies are invited to further clarify, if needed).

Please provide your view:

|  |  |
| --- | --- |
| Company | Comment |
| Nokia | When sent from the gNB-DU to the gNB-CU as in option b, the RACH failure rate is sent together with the cell ID for which the RACH failure rate applies. This is to enable the gNB-CU to distinguish different PRACH conflict scenarios which will require different actions in the gNB-CU in terms of sending PRACH configurations to its served gNB-DUs:   1. The gNB-CU may in a first step assume that gNB-DUs may solve PRACH conflicts by change of some resource allocation in the victim cell, typically update of the Root Sequence Index (RSI), because there may not be much latitude to change time/frequency allocation due to cell capacity reasons. For this purpose the gNB-CU will typically send PRACH configurations of intra-frequency neighbour cells back to the gNB-DU that provided RACH failure rate/cell ID in conflict. 2. This first step will not solve scenarios where some cells use too high power settings for PRACH, hence interfering other cells. Some interference is unavoidable (and RACH failure rate may therefore not become 0), but if the gNB-CU observes too high RACH failure rate in some cells while some neighbouring cells have a very low RACH failure rate (or don’t provide RACH failure rate information), the gNB-CU may in a second step deduce that cells with low RACH failure rate and high power settings provide unnecessary PRACH interference towards its victims. In that case the gNB-CU may send PRACH configuration info towards gNB-DUs controlling such potential aggressor cells. The PRACH configuration info will in this case be info of cells that are neighbours to the potential aggressor cell, and the cell ID will be cell ID of the potential aggressor cell.   In order to support these different scenarios, we therefore believe that both option b and the principle proposed in option e (send cell ID from gNB-CU to gNB-DU) should be supported. If only sending of cell ID (in both directions) is supported, the cell ID sent from gNB-DU to gNB-CU could be interpreted as a binary indication of “high RACH failure rate”.  A first drawback of this approach is that the operator would get the burden of configuring this “high RACH failure rate” threshold. But more importantly, we don’t think such binary indication can work due to scenarios with relatively high but different RACH failure rates observed in different gNB-DUs. These gNB-DUs would all send cell ID (“high RACH failure rate” indication), but the gNB-CU would not be able to distinguish which of these gNB-DUs that experience the lowest RACH failure rate which would typically be the aggressor. |
| Ericsson | We do appreciate the effort and analysis from Nokia. However, we believe that RACH conflict is a very rare event. It is even rarer the cases when this event requires a correction. Hence, we should find the least impacting and simplest mechanism to resolve the issue.  In our view these two options can work:   1. gNB-DU signals to gNB-CU one or more CGIs where RACH conflicts are detected (how they are detected is implementation specific). gNB-CU in reply signals to the gNB-DU PRACH configurations of cells neighbouring the CGIs with problems. gNB-DU resolves the conflict locally. 2. gNB-CU compares PRACH configurations of neighbour cells and identifies potential PRACH conflicts. gNB-CU signals to gNB-DU the CGI(s) in potential conflict together with their neighbour PRACH configurations to the gNB-DU. gNB-DU resolves the conflict locally.   Note that in both the options above the gNB-CU does not need to signal to gNB-DU a large number of PRACH configurations, but only the PRACH configurations of the cells neighbouring the cells in conflict |
| Huawei | Thanks the analysis from Nokia above.  First of all , the message size issue has been already proved not a really problem. So I am really confused that why we down select solutions based on a not even existing limitation requirement?  Regarding the concern that the DU does not need to save too much neighbor cells’ PRACH configurations, please note that the RACH optimization function is totally placed at DU. It is very likely that the DU may allocate new PRACH resources to a certain cell which has higher RACH load. The DU should first check whether the new PRRACH resources is conflict with its neighbors before allocating it to the cell…..  The request procedure from DU to CU can work only after the conflict has already happened. This is not the best way to achieve a high performance RACH optimization algorighm. |
| CATT | Acceptable for both, although not preferred.  In our understanding, the mere use of PRACH coordination is to resolve any potential PRACH collision between cells.  Thus the most simple and robust implementation in our opinion is that, the gNB-CU inform the gNB-DU about the PRACH configuration of its every neighbour cell, and then the gNB-DU changes the PRACH configuration of its served cell so that none of them is theoretically possible to conflict with any of its neighbour’s.  This method is surely radical to some extent as it treats every pair of neighbour cell as subject of “potential PRACH conflict”, which may indeed unnecessarily change some cell’s PRACH configuration. However, this is the same method as PCI conflict resolution, which is already proven to be feasible. Considering the space of PRACH configuration is far larger than PCI configuration, applying this method in PRACH coordination is also feasible as well. Therefore we believe this approach should be supported at least.  In order to make some progress over this long-debated topic, we are open to agree with any optimisation (we acknowledge their potential benefits) whose introduction doesn’t preclude our preferred solution as described above. That is to say, we are open to the method of exchanging between gNB-CUs and gNB-DUs the CGIs of cells whose PRACH performance are concerned, as long as it is an optional feature and the max number of neighbour cells delivered from the gNB-CU toward gNB-DU is defined as 512. |
| Samsung | Nothing. As our viewpoint in round 1, we prefer option a. It’s not necessary to add some assistant information from DU to CU. |

## 5.2 RACH Report retrieval

From first round, 3 companies see the need that there is a trigger from DU to CU for RACH Report retrieval, 3 companies think that no trigger is needed, 1 company is ok to follow majority and 1 company suggests postponing this discussion to Rel. 17 (probably meant as Rel.18).

**Proposal: Postpone [enhancements for] RACH Report retrieval to Rel.18**

There was no time for online discussion of this proposal, please provide your view below:

|  |  |
| --- | --- |
| Company | Comment |
| Nokia | Agree |
| Ericsson | Agree |
| Huawei | Agree |
| Samsung | Agree |
| ZTE | Agree |

## 5.3 F1 SETUP RESPONSE

From first round, 4 companies prefer to include PRACH Configuration in F1 SETUP RESPONSE, 1 company is against and 1 company suggests that it can be included as an optional IE (included when available).

**Proposal: Introduce Neighbour PRACH Configuration in F1 SETUP RESPONSE as an optional IE (when available).**

There was no time for online discussion of this proposal, please provide your view below:

|  |  |
| --- | --- |
| Company | Comment |
| Nokia | Agree |
| Ericsson | Disagree. As stated many times, there are no neighbour elations at the time of F1 setup and it is impossible for th egNb-CU to send to the gNB-DU a filtered list of cells that are neighbour of a cell in clonflict. All the gNB-DU can do is to send random cell’s PRACH configurations to the gNB-DU. It is unclear what the utility of such information is. A big drawback of this proposal is that the F1 Setup Request is already a very large message due to Served Cell Information included. It will become even bigger once this information of little to no use is added to it. |
| Huawei | Agree. As I explained above. There is no any harm but a lot of benefits to maintain enough neighbour cells’ PRACH configurations at the DU. |
| CATT | Agree, Similar view with Huawei |

# 6 Conclusion, Recommendations [if needed]

If needed