3GPP TSG-RAN WG3 Meeting #110-e R3-206883

E-meeting, 2 – 12 November, 2020

**Agenda item: 10.2.1.7**

**Source: Nokia (moderator)**

**Title: CB: # 1007\_SONMDT\_RACH - Summary of email discussion**

**Document for: Approval**

# 1 Introduction

This paper provides summary of discussions at RAN#110-e on:

**CB: # 1007\_SONMDT\_RACH**

**- Topics to discuss:**

**- max number of neighbor cells for PRACH configuration transfer from CU to DU**

**-** **assistance information from gNB-DU to gNB-CU**

**- gNB-DU/en-gNB report of “potential PRACH conflict”**

**- gNB-DU resolves PRACH configuration conflicts?**

**- RACH Failure Rate calculation and signaling**

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

**- PRACH Coordination between LTE and NR in shared spectrum**

**- Details of Xn and F1 signaling**

**- May also discuss other topics based on contributions**

**- Propose to have the discussion in two phases; if there are agreements in the first phase, can proceed to discuss TPs in the second phase**

(Nok - moderator)

We have kept the discussion structure and issues from the second round of the discussion at RAN3#109-e, and tried to map the submitted proposals on that structure.

Companies are kindly requested to provide input to the first stage of this discussion by 8:00 UTC on Thursday, November 5, so that we can take it into account during the online session the same day.

# 2 For the Chairman’s Notes

The following is proposed for online discussion and agreement:

* **Send an LS to RAN1 and RAN4 to determine whether sufficient interference reduction can be achieved through PRACH Coordination between LTE cell in upgraded site and NR cell in newly-built NR site. If such coordination seems beneficial, RAN3 should further work on a solution for this problem in Rel-17.**
* **"High" number (512, 1024) of configurations sent from CU to DU, and no assistance information from DU to CU.**
* **Send an LS to RAN2 to ask whether UE-based methods for indicating availability of UE RACH Report to the gNB could be feasible for Rel-17.**
* **DU resolves PRACH configuration conflicts locally (Open issue: how to address the scenario where a DU is an aggressor to another DU.)**

# 3 Discussion

## 3.1 Issue 1 - PRACH Coordination in Spectrum Shared between LTE and NR

Options under discussion are:

1. (Xn signalling): Addition of (E-UTRA) *PRACH Configuration* IE to XnAP *Neighbour Information E-UTRA* IE

2. (Xn signalling): Rel-15 signalling for DSS (E-UTRA - NR cell level resource coordination)

**Related proposals in submitted papers:**

6372: Both Alternatives 1 and 2 raise questions of non collocated co-channel deployment of NR and LTE cells which would require analysis of RAN1 and RAN4 if pursued in Rel-17.

6554 proposes:

* Proposal 1: PRACH Coordination between LTE cell in upgraded site and newly-built NR site should be considered in Rel-17.
* Proposal 2: PRACH Configuration IE defined in TS36.423 should be added to the Neighbour Information E-UTRA IE in XnAP (TP in 6555).
* Proposal 3: For cell configuration information of each E-UTRA cell in Neighbour Information E-UTRA IE, ECGI of the paired NR cell shall be contained.

**Please provide your view on the above proposals. Could an LS to RAN1/RAN4 be beneficial?**

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| Company | Comment |
| Nokia | Before deciding on network signalling for mitigation of interference in the described scenario of non collocated co-channel deployment of NR and LTE, it should first be confirmed by RAN1 and/or RAN4 whether proposal 2 would enable adequate interference reduction. We therefore propose to send an LS to RAN1/ RAN4. |
| CATT | For P1, it is OK for us.  For P2, in principle we are also OK with this, but we want to point out that maybe it is not needed to define it as a container—there is already an existing “9.2.2.25 E-UTRA PRACH Configuration” in TS 38.423. Reusing it directly seems much more suitable. |
| Ericsson | If E-UTRAN and NR cells are sharing the same frequency resources, resource coordination concerning the full range of cell resources is needed. It is of no use to exchange pRACH configuration information in this case because, even if PRACH resources between E-UTRAN and NR do not overlap, there will be overlapping and therefore interference between other resources e.g. PUSCH. In fact, without proper coordination, PUSCH resources of e.g. an NR cell may overlap with PRACH resources of an e.g. E-UTRAN cell, even if the respective PRACH resources are not overlapping. Therefore the proposals discussed here do not tackle the issue of cross cell interference.  However, the issue we create with Proposals involving the signalling of PRACH configuration for neighbour cells, is to increase the message size over X2. This is an issue as we have limited size messages a node can support, as well as limitation in the maximum message size the transport network can support.  We therefore would like to avoid signalling PRACH configurations of neighbour cells as in Proposal 2 and we would like to leave the topic of resource coordination in co-channel sharing between LTE and NR out of SON discussions. |
| China Telecom | Option 1   1. this is a SA scenario not NSA. Due to there is no direct interface between eNB and gNB, the existing E-UTRA – NR Cell Resource Coordination procedure cannot be reused in SA scenario.  1. reusing the existing “9.2.2.25 E-UTRA PRACH Configuration” in TS 38.423 is a simple and straightforward solution.   The mitigation of interference in downlink direction can be treated in TEI-17. |
| Huawei | We support operators reasonable requirements. Message size should not be used excessively as an excuse to object to introduce new functions. |
| ZTE | We support Operator ‘s requirement and support this to be consider in Rel-17. We also think consul on RAN1/RAN4 is benefit. |
| Samsung | We support option 1. We also feel LS to RAN1/RAN4 is beneficial. |

**Summary:**

No consensus. Several companies see benefit of sending LS to RAN1/RAN4 requesting feedback on the described interference scenario.

## 3.2 Issue 2 and 3 – PRACH configuration conflict detection: transmission of NR PRACH configuration info for neighbour cells

**Main options under discussion are:**

1. "High" number (512, 1024) of configurations sent from CU to DU, and no assistance information from DU to CU

2. "Low" number (e.g. 16) of configurations sent from CU to DU, with assistance information from DU to CU

**Related proposals in submitted papers:**

6104 proposes

* for F1 a flat list of 512 (or 1024) neighbour PRACH configurations to be included in the GNB-CU CONFIGURATION UPDATE message, not associated to any particular served cell in the gNB-DU, and no assistance information from DU to CU.

6134 proposes

* for F1 a flat list of 512 neighbour PRACH configurations to be included in the following messages: F1 SETUP RESPONSE, GNB-DU CONFIGURATION UPDATE ACKNOWLEDGE and GNB-CU CONFIGURATION UPDATE. Each PRACH configuration is associated to a cell (NR CGI) (served cell in the DU? neighbour cell?). No assistance information from DU to CU.
* for X2: add an optional *NR Cell PRACH Configuration* IE into the *NR Neighbour Information* IE, as well as some necessary IEs to deliver the location and bandwidth of carriers, the TDD pattern and the number of SSB.

6513 proposes for F1

* a flat list of 16 neighbour PRACH configurations to be included in the F1 SETUP RESPONSE message, not associated to any particular served cell in the gNB-DU;
* and a structured list of 512 \* 16 neighbour PRACH configurations to be included in a new gNB-DU triggered class 1 procedure providing assistance information from the DU to the CU. Each sub-list of 16 PRACH configurations is associated to a served cell in the gNB-DU.

6372 proposes

* for F1, a low number of neighbour PRACH configurations sent from gNB-CU to gNB-DU. Filtering is therefore needed in the gNB-CU, e.g. according to the cells that have the highest RACH Failure Rate;
* for Xn, assistance information (RACH failure rate) exchanged between neighbour nodes, which can also help the CU to filter the PRACH configurations to be sent on F1.

In summary, the number of transferred neighbour PRACH configurations are similar in all proposals. Companies are divided in two camps with regards to the need for assistance information.

**Please provide your further views on the need for assistance information, and on which interface(s).**

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| Company | Comment |
| Nokia | We support a small number of neighbour PRACH configurations to be sent from gNB-CU to gNB-DU. |
| CATT | We support a “high number”.  The current spec already allows a gNB-DU to provide up to 512 cells of PRACH config toward a gNB-CU, it is reasonable to allow a gNB-CU to provide up to 512 cells of PRACH config toward a gNB-DU for alignment.  Nevertheless, the gNB-CU should perform some filter, i.e. only deliver the PRACH config of the neighbour cells with overlapping band and with a cell size no smaller than the gNB-DU’s. As the result the length of neighbour cell list would seldom be large. For example, for a gNB-DU host 469 cells (a hexagon with 13 cells on each side), the number of its 2-fold neighbours would be only 162, and thus the gNB-CU only need to deliver the PRACH config of 162 cells toward the gNB-DU. |
| Ericsson | We support a small number of neighbour PRACH configurations to be sent from gNB-CU to gNB-DU, i.e. 16 neighbour PRACH configurations.  In response to CATT:  The fact that a gNB-DU can include up to 512 PRACH configurations does not mean that the gNB-DU can receive an extra 512 PRACH configuration from the gNB-CU. The gNB-DU implementation will choose how many cells to add in e.g. F1 Setup Request, so the gNB-DU has control (depending on its implementation) of how big e.g. the F1 Setup Request message is. Howver, the gNB-DU would have no control on the size of the message received from the gNB-CU. If DU capabilities are to decode messages of up to 256 served cells and DU receives from CU a message with 512 pRACH configurations, DU will be subject to failures.  Also, the filtering described by CATT is one possible (and not mandated) implementation option. A vendor may well decide to go for a simpler implementation and send an un-filtered full list of neighbour PRACH configurations to the gNB-DU, i.e. 512 PRACH configurations. Out of all these configurations the vast majority will be use-less to the DU. However, the DU might have to declare failure because the DU may not have the capabilities to decode such large message.  We therefore propose to have CU to signal a filtered list of up to 16 PRACH configurations, where such configurations are selected by the CU on the basis of the likely cells that 1) are neighbours and 2) are likely to be in RACH conflict based on their PRACH configuration parameters. This list could be sent independently by the CU or in response for a RACH conflict indication for a specific cell, signalled by the DU |
| China Telecom | It is reasonable to support “high number” for PRACH configuration. |
| Huawei | In order to make progress, a possible compromised solution together with issue 5 is given here.   1. The CU sends max 512 neighbour cell’s PRACH configurations to DU in F1 SETUP RESPONSE and gNB-CU configuration update. 2. Optionally, if needed, the DU may also request the CU to feedback more neighbour cell’s PRACH configurations if there is still PRACH configuration conflict not resolved by the information received in step1. 3. The assistance information from DU to CU in step 2 is FFS (e.g., cell ID, RACH failure rate, etc, whatever).   With this compromised approach, the CU still is able to only send 16 PRACH configurations to DU.  And it is also possible for the CU to send max 512 cell’s PRACH configurations to DU if the CU decides to do so.  Hope this compromise is acceptable for all companies. |
| Nokia | In the absence of a trigger from DU to CU (as discussed in issue 5), it would be preferable to allow a high number of configurations, with the option of filtering at the CU to a lower number. However, in order to make progress we are fine to support either a small or a high number of configurations. |
| Samsung | A bigger number is our preference. Then, it is the gNB-CU implementation issue on the number of transferred configurations. |

**Summary:**

A majority of companies agree that a high number of RACH Configurations should be sent from CU to DU and that CU could filter (based on implementation) how many such configurations it sends to a DU. 1 company supports that a small number of PRACH Configurations should be sent from CU to DU.

## 3.3 Issue 4 - PRACH configuration conflict detection - retrieval of UE RACH Reports

Options under discussion are:

1. DU requests the CU to upload UE RACH Report

2. CU autonomously uploads UE RACH Reports

**Related proposals in submitted papers:**

6372 proposes that the CU uploads UE RACH Reports from the UE without being triggered by the DU, considering that the DU has not full view of RACH failures experienced by the DU and that the CU may be guided for example by RLF Report availability information.

6513 proposes that the DU requests the CU to upload UE RACH Report each time the occurrence of the RACH procedure is not known to the gNB-CU.

6695 proposes that the DU requests the CU to upload one or more UE RACH Report (by providing a list of UE IDs), based on detection of sub-optimal RACH configuration by the DU. It is not necessary to always retrieve RACH report from all UEs.

**Please provide your further views on option 2 vs option 1, and in case of option 1, whether it is needed to always retrieve RACH report from all UEs.**

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| Company | Comment |
| Nokia | Option 2. We support that CU autonomously requests RACH Reports from the UEs without being triggered by the DU. Even though currently there exists no availability indicator for the UE RACH Report, there exists an availability indicator for RLF Report. This can give CU an indication of the existence of a RACH Report available at the UE. RACH procedure is a very frequent procedure in the network. Having DU signaling CU every time there is a RACH event would mean a lot of signaling through the network interface that we don’t see as necessary, and which also breaks the principle of functional split between CU and DU. |
| Ericsson | We prefer Option 1. The UE has generated a RACH report and for that it seems unreasonable not to upload it to the RAN. Why otherwise has the UE compiled such report? We therefore think that a simple solution is for DU to notify CU of RACH access from the UE that CU may not have visibility for. |
| Huawei | We prefer option 1 to enable a robust RACH optimisation function. |
| Nokia | RACH Report is optional and therefore completion of a RACH procedure does not imply the existence of a RACH Report at the UE. A simple solution to trigger the CU for a RACH Report retrieval could be acceptable but signaling of a RACH event from DU to CU is not simple both in terms of the required signaling and because it breaks the functional split. Besides, it won’t solve the problem due to reason mentioned above. Therefore, we think that an LS to RAN2 is needed to determine whether UE-based methods of such indication could be feasible in Rel-17. |
| ZTE | Prefer Option 1.  In LTE, eNB is allowed to retrieve RACH report when necessary (E.g RACH access performance degradated aware by eNB). While if option 2 used, CU will exhausted to retrieve RACH report for all UE server by all connected DU autonomously. Which is misaligned with the behavior of LTE.  Fine to send LS to RAN2 . |
| Samsung | Option 2.  If the RACH retrieving relies on the DU triggering, we may face the situation that DU will trigger this frequently as long as there is RACH event, which increases the signalling burden over F1. |

**Summary:**

Companies could not reach an agreement on whether DU requests the CU to upload UE RACH Reports or whether CU autonomously uploads UE RACH Reports from the UEs. Some companies think a trigger from DU to CU could notify CU when to retrieve a RACH Report which would be beneficial for the RACH optimization function. 2 companies think that a trigger from DU to CU every time there is a RACH event is heavy on signaling and should be avoided. One company pointed out that this solution may not be feasible since RACH Report is an optional feature and the existence of a RACH event does not imply the existence of a RACH Report at the UE. For this reason, it was proposed to send an LS to RAN2 regarding the feasibility of UE-based methods for the retrieval of a RACH Report.

## 3.4 Issue 5 - PRACH configuration conflict resolution

Options under discussion are:

1. DU resolves PRACH configuration conflicts locally

2. DU resolves PRACH configuration conflicts locally, but may flag the presence of a conflict to the gNB-CU so that gNB-CU can send assistance information

3. DU resolves PRACH configuration locally whenever possible, and informs about RACH failure rate for mitigation of interference scenarios.

**Related proposals in submitted papers:**

6104 and 6134: option 1, with neighbour RACH configuration information filtered autonomously by the CU (and eNB for 6134).

6372: option 3, with assistance information proposed on F1 and Xn.

6513: option 2, with assistance information proposed on F1.

**Please provide your further views on options 1/2/3, e.g. the capability of each option to solve PRACH configuration conflicts.**

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| Company | Comment |
| Nokia | Option 3. In our view, DU cannot always resolve PRACH Configuration conflicts locally by itself and may need assistance information. Binary flagging of a presence of a RACH configuration conflict from a DU to a CU may not be sufficient since it is unclear how to determine the existence of a conflict in a consistent way. A more “selfish” DU may flag conflict more often than a more moderate DU. Such a binary flag would also make it difficult to determine conflicts under a multivendor setting if different DUs determine conflicts in different ways. In that sense, we support the existence of a metric that could capture a rate of RACH failures at the cells of a DU in a consistent way. Other metrics could be defined. RACH configuration conflicts may occur between DUs under the same or different CU. Providing assistance information through F1 would be useful to assist a DU determine RACH configuration conflicts that occur with other DUs under the same CU but is not sufficient in case a RACH configuration conflict exists between DUs under different CUs. That is why in addition to F1 we support to provide assistance information through Xn interface. |
| CATT | Option 1. Option 1 only cost a few messages upon cell setup and then the gNB-DU can deactivate the PRACH collision resolution module, while Option 2 and 3 both needs the gNB-DU to monitor for a long period of time, and prone to false alarms due to suboptimal MAC-layer RACH parameter settings. |
| Ericsson | We prefer Option 2. We may also accept a variant of Option 1.  We need to start with the understanding that PRACH conflict, in NR, is a very seldom event. The only fact that two cells may have exactly the same PRACH configuration but different beam sweep, implies that there is no RACH conflict. Overengineering a solution that will enter in action only a few times during the lifecycle of a node is not good.  We also need to understand that the function that monitors PRACH performance at the DU will never switch off. DU will receive RACH reports from the CU and it will continuously check if RACH performance can be optimised. Conflict detection/resolution can be part of RACH performance optimisation  We therefore think that, in the seldom case of RACH conflict, DU (responsible for RACH conflict detection, as per RAN3 agreements) can signal to CU the cell in conflict, so that CU generates in response a tailored list of neighbour PRACH configurations that can help the DU to select a new PRACH configuration.  The alternative to Option 1 we can accept is where the gNB-DU detects RACH conflict by itself, but gNB-DU does not signal indication of a conflict to the gNB-CU.  The gNB-CU can send a filtered list of 16 PRACH configurations to the DU, e.g. in F1 Setup Response or gNB-CU Configuration Update, where the list includes cels that 1) are neighbours and 2) are likely to be in RACH conflict based on their PRACH configuration parameters.  gNB-CU may send in future gNB-Configuration Updates new lists of up to 16 PRACH configurations, filtered as explained above. This gives to the gNB-DU more neighbour PRACH configuration information, helping the gNB-DU to solve the RACH conflict. |
| China Telecom | Option 1. Agree with CATT |
| Huawei | Option 1. Or the compromised solution if feasible. |
| Nokia | Given the preference to Option 1, and in order to make progress, we are fine to accept Option 1 where CU filters neighbour RACH configuration information autonomously, modified according to Ericsson’s suggestion, i.e., without trigger of assistance information from DU to CU. |
| Nokia | A comment on **the capability of each option to solve PRACH configuration conflicts:**  With the current proposal we address how a CU can filter PRACH configurations to send to a DU to inform DU about PRACH Configurations of neighbour cells. However, one aspect that has slid away from this discussion is how enable a DU recover from wrong or aggressive PRACH Configuration settings. DU could be an aggressor to another DU. DU could also be suffering interference from other DUs. This information cannot be deducted at a DU just by receiving PRACH Configurations from its CU and is in our view needed to enable DU recover from RACH Configuration conflicts.  Thus, in our view how to handle a scenario where a DU is an aggressor to another DU remains still an open issue. |
| Samsung | Option 1  DU has the fully capability to resolve the conflicts locally. |

**Summary:**

There seems to be a consensus by companies that DU resolves RACH Configurations locally, and the scenario where a DU is an aggressor to another DU is proposed to be kept as open issue.

# 4 Conclusion, Recommendations [if needed]

If needed

# 5 References

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| [R3-206104](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206104.zip) | (TP for SON BL CR for TS 38.473): PRACH configuration conflict (Huawei) | other |
| [R3-206134](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206134.zip) | Discussion on Rel-16 leftover issues for PRACH coordination (CATT) | discussion |
| [R3-206135](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206135.zip) | (TP on SON for 38.473)TP on PRACH coordination for F1AP (CATT) | other |
| [R3-206136](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206136.zip) | (TP on SON for 38.423)TP on PRACH coordination for X2AP (CATT) | other |
| [R3-206372](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206372.zip) | RACH Remaining Aspects (Nokia, Nokia Shanghai Bell) | discussion |
| [R3-206373](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206373.zip) | (TP for SON BL CR to TS 38.423) Enhancement of RACH Conflict Resolution (Nokia, Nokia Shanghai Bell) | other |
| [R3-206374](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206374.zip) | (TP for SON BL CR to TS 38.473) Enhancement of RACH Conflict Resolution (Nokia, Nokia Shanghai Bell) | other |
| [R3-206513](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206513.zip) | (TP for SON BL CR for TS38.473): RACH conflict resolution and RACH report (Ericsson) | other |
| [R3-206554](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206554.zip) | Discussion on the PRACH Coordination between LTE and NR (China Telecom, ZTE, Huawei) | discussion |
| [R3-206555](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206555.zip) | (TP for [NR\_SON\_MDT] BL CR for TS 38.423) Addition of LTE PRACH Coordination in XnAP (China Telecommunications) | other |
| [R3-206695](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_110-e/Inbox/Drafts/CB%20%23%201007_SONMDT_RACH/Docs/R3-206695.zip) | Left issue for Rel-16 RACH Optimization (ZTE) | discussion |