3GPP TSG-RAN WG3 Meeting #109-e R3-205663

E-meeting, 17 – 27 August, 2020

**Agenda item: 10.2.1.7**

**Source: Nokia (moderator)**

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

**Document for: Approval**

# 1 Introduction

This paper provides summary of discussions at RAN#109-e on:

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

**- Topics to discuss:**

 **- RACH conflict detection**

 **- RACH conflict resolution**

 **- Xn, F1 impacts**

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

**- LS to RAN2?**

**- If there are agreements, can proceed to CRs and LS**

(Nok - moderator)

Companies are kindly requested to provide input to the first stage of this discussion by EOB of Thursday, August 20, so we can take it into account during the online session on Friday.

# 2 For the Chairman’s Notes (round 2)

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

Proposal: **PRACH coordination in spectrum shared between LTE and NR may be solved based on Rel-15 XnAP signalling for DSS (E-UTRA - NR cell level resource coordination) aiming at avoiding colliding resources for EUTRA PRACH and NR PRACH.**

Issues 2, 3, 4 and 5 may be continued at next meeting based on options already captured in chairman's notes.

# 3 Round 2 discussion

It is proposed to see if convergence can be achieved on issue 1. The other issues (2, 3, 4, 5) may be continued at next meeting.

## 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)

3. (OAM): NR PRACH and EUTRA PRACH configured to use separate resources

Based on input to round 1, multi-vendor operation is required which excludes option 3. However option 2, based on Xn signalling, should work.

Proposal: **PRACH coordination in spectrum shared between LTE and NR may be solved based on Rel-15 XnAP signalling for DSS (E-UTRA - NR cell level resource coordination) aiming at avoiding colliding resources for EUTRA PRACH and NR PRACH.**

Please provide your company's view:

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| Company | Comment |
| China Telecom | 1. In SA scenario, there is no direct interface between LTE eNB and NR gNB. Solution 2 need to introduce an additional X2/Xn interface for LTE. From the perspective of operators, additional X2/Xn interface for LTE/NR SA mode cell will make the network configuration/management more complicated.
2. From the perspective of new-built NR gNB, the interference from the adjacent LTE cell and NR cell can be seen as whole. The Solution 1 use a single message to coordinate the interference between newly-built NR cell and LTE/NR DSS site. However, Rel-15 signalling for DSS only resolves the interference coordination between NR cell and LTE cell.

1. Solution 1 is a simple and straightforward solution: Only need to add LTE RACH configuration defined in 36.423 and ECGI of the paired NR cell in ***Neighbour Information E-UTRA*** IE
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| Ericsson | We agree with the proposal. Two cells that perform DSS will need to be coordinated in terms of resources to be used. RACH resources are only a small portion of resources the cells will need to coordinate in order not to result into collisions |
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## 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

## 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

## 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.

# 4 Round 1 discussion

Agreements from round 1:

Issue 6 - inter-en-gNB RACH coordination:

**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.**

Issue 7 - RACH report for SgNBs:

LS R3-205115 rev. in R3-205647 rev. in R3-205662 **final agreed unseen**

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

The issue is raised in [1]. Company input is requested on: **The PRACH Coordination between LTE cell in upgraded site and newly-built NR site should be considered in Rel-17.** The proposal targets XnAP enhancement as follows: Addition of (E-UTRA) *PRACH Configuration* IE to XnAP *Neighbour Information E-UTRA* IE [2].

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| Company | Comment |
| Huawei | OK. |
| CATT | Agree. |
| China Telecom | Agree☺1. The existing E-UTRA – NR Cell Resource Coordination need configure X2/Xn interface between LTE and NR. However, in SA scenario, there is no direct interface between LTE and NR SA cell.
2. The OAM based solution cannot solve all the issue, especially in multiple-vendors scenarios, e.g., the newly built NR sites deployed by another vendors
 |
| ZTE | Agree |
| Ericsson | The scenario seems to be already covered by other features. Two cells, E-UTRAN and NR, that are sharing resources, e.g. via DSS, can already coordinate resource utilization via the E-UTRA – NR Cell Resource Coordination, available over X2, Xn and F1. Two ells that share the same frequency resources need anyhow to undergo proper resource coordination so that resource utilisation collisions do not occur. Based on that, RACH resources are also coordinated in advance for two cells sharing resources, i.e. RACH resources are not shared. With this in mind, the resource sharing scenario is equivalent to other scenarios of coexistence between LTE and NR cells China Telecom replies:1. In our scenario, there is no directly interface between NR and LTE. We don’t think SA NR cell could be configured X2 interface with LTE cell.
2. Regardless of the RAT used by adjacent cells, the resource/interference coordination in co-channel interference scenario is needed. And NR cell can eliminate the interference from LTE PRACH to NR PUSCH based on LTE PRACH configuration information.
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| Nokia | We understand the described deployment to be co-channel LTE capacity booster layer) and NR coverage layer (without DSS). For the LTE capacity booster layer, NR is enabled in some resources based on DSS. For the NR coverage layer no DSS is used. We assume that LTE PRACH and NR PRACH are not intended to use the same frequency/time resources in this deployment, and hence "traditional" RACH optimization, e.g. based on avoidance of RSI conflict, is therefore not the target? We suggest to investigate use of OAM and/or signaling mechanism for DSS in this case, which could also enable protection of other critical LTE resources (not only PRACH), both in UL and DL if needed. |

## 4.2 Issue 2 – Max Number of neighbour cells’ PRACH configuration from CU to DU

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| Company | Comment |
| Huawei | 1024.As we explained in our discussion paper, there is no message oversize issue with 1024 neighbour cells’ PRACH configuration transferring from CU to DU in F1 setup response and gNB-CU configuration update message.As the size of PRACH configuration is much small than the served cell info.And we support 512 of cells on F1AP in F1 SETUP, which means there are 512 served cell info IEs. |
| Ericsson | 16.There are up to 32 PRACH configurations that can be signaled for one cell, 16 PRACH Configurations per cell per NUL + 16 PRACH Configurations per cell per SUL. Having a high number of neighbour cells for which PRACH configuration Info is signalled implies to signal a huge number of PRACH configurations. Take the example of 1024 neighbour PRACH Configuration Info: that means 1024 x 32 PRACH Configurations == 32.768 PRACH configurations to be signalled. This is not only excessive but also not needed. In fact, how many neighbouring cells may be in RACH conflict with one cell? At worst one could have a number from 1 to 5 neighbouring cells in RACH conflict with one cell, so why signalling 1024 neighbour RACH information to the gNB-DU? The vast majority of those PRACH configurations will simply be discarded.By allowing signalling of 16 neighbour cell’s PRACH Configuraiton Info it is already possible to signal 16 x 32 == 512 PRACH Configurations to the DU, which is more than enough to resolve possible RACH conflicts. Note that as per 38.401, “*The gNB-CU may forward a limited set of neighbour cell’s PRACH configurations received from neighbour gNB-CU to the gNB-DU to resolve the configuration conflict*”, hence a number of 16 neighbour cell’s PRACH Configuration Information is in line with this requirement. |
| Samsung | A bigger value can be defined in standard. Then it is the gNB-CU implementation issue how many neighbour cells’ PRACH configuration will be sent to the DU. |
| CATT | 512, or maybe 1024.A message sent from the gNB-DU toward the gNB-CU can include up to 512 “Served Cell Information”, each of which contains a “NR PRACH Configuration”.So on the other direction, a message sent from the gNB-CU toward the gNB-DU should also be possible to include up to 512 “NR PRACH Configuration”. This is natural.Of course, a gNB-CU can have many methods to deliver as few “NR PRACH Configuration” toward the gNB-DU as possible, and usually this number should never be larger than the number provided by the gNB-DU. But since the latter number is already defines as 512, why should we limit the former number far below 512? |
| China Telecom | Agree with CATT and Huawei. The bigger value is needed ,such as 512/1024  |
| Nokia | The proposal in 4759 provides a certain number of PRACH configurations for cells selected by the CU based on neighbor relations with cells served by the DU. The DU will not know which of these configurations that will potentially conflict with a given served cell, and anyway PRACH configuration information can just be an indication of potential conflicts. The number 1024 is relatively high in terms of message size, but relatively low from a functional point of view considering that each of the 512 cells served in the DU may have many co-channel neighbours. So we think a different approach is needed. |

## 4.3 Issue 3 - PRACH configuration conflict detection - transmission of NR PRACH configuration info for neighbour cells

Which enhancements are needed in Rel-17 in terms of transmission of NR PRACH configuration info for neighbour cells? Is a signalling procedure from DU to CU needed to trigger/filter PRACH configuration delivery?

(Please focus on NG-RAN including F1. X2 transfer of NR PRACH configuration information is covered under issue 5).

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| Company | Comment |
| Huawei | No, as we explained in our discussion paper, there is no message oversize issue with 1024 neighbour cells’ PRACH configuration transferring from CU to DU in F1 setup response and gNB-CU configuration update message.So, we don’t see the need to have an additional procedure from DU to CU for further PRACH configuration.This will introduce a lot of unnecessary signaling. |
| CATT | No need of any trigger. The gNB-CU can always perform filtering on its own and thus the PRACH list delivered toward the gNB-DU will never be much longer than the one which it receives from this very gNB-DU. Hence this should not be a considerable load to the gNB-DU. |
| China Telecom | No. agree with Huawei |
| ZTE | Not necessary. |
| Ericsson | Yes. There are two reasons for this.TS38.401 says:*In case of split gNB architecture, RACH configuration conflict detection and resolution function is located at the gNB-DU*1. If there is no RACH Configuration Conflict there is no need to signal any neighbour PRACH configuration to the gNB-DU. As the gNB-DU is the node detecting the RACH conflict, gNB-DU also needs a way to indicate to the gNB-CU that the conflict has been detected and that neighbour’s PRACH configuration information is needed.
2. If we maintain a healthy limit on the number of PRACH Configuration Information the gNB-CU can signal to the gNB-DU, then it might occur that the PRACH Configuration Information provided by the gNB-CU to the gNB-DU does not help resolving the PRACH conflict. In this case the gNB-DU needs to indicate to the gNB-CU that the conflict persists and that new PRACH Configuration Information is needed.
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| Samsung | The CU knows the serving cells in the DU. The CU also knows the neighbor relation based on ANR function and the UE’s measurement report. So the CU can do some filtering based on those information. |
| Nokia | Providing a limited and filtered set of assistance information (e.g. neighbor PRACH configuration) from the gNB-CU seems beneficial to enable RACH configuration conflict resolution at the gNB-DU. But probably the DU should not need to explicitly request such assistance information, but we think for this purpose the CU would need some information from the DU in terms of e.g. the rate of failed RACH attempts. |

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

Is a signalling procedure from DU to CU needed to request the CU to fetch UE RACH Reports from the UE (or from several UEs)?

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| Company | Comment |
| Huawei | Yes. We see some benefits to have such procedure, as there are many cases that RACH procedure may occur between the DU and the UE, but the CU are not aware of this. Therefore, without those RACH reports, the RACH channel load estimation, like access probability and access delay may be not accurate, and hence may impact on the optimisation step negatively. |
| ZTE | Yes, CU does not cover all RACH failure /sub-optimal states.  |
| Ericson | Yes, gNB-CU is not aware of all RACH events, hence this procedure would flag availability of RACH reports and timely retrieval of the reports. |
| Samsung | The DU doesn’t know whether the UE has RACH report or not. The DU may request this blinding. Considering there are several DUs connected to one CU. Each DU sends such request frequtanly may burden the CU unnecessarily. The CU can know whether there is such report available in the UE and pull it and just forward the information to the DU. |
| Nokia | No, it would break F1 design principles to make the CU aware of RACH attempts (for L2 purpose) in the DU. |

## 5.5 Issue 5 - PRACH configuration conflict resolution

Can a PRACH configuration conflict be solved locally in the DU that detects the conflict, or is any signalling needed in conflict resolution phase?

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| Company | Comment |
| Huawei | Yes, with a max number of 1024 neighbour cells’ PRACH configurations, we think that the DU has enough information to solve the PRACH configuration conflict issue locally. |
| CATT | Solving it locally in the gNB-DU is the most efficient method. The gNB-DU knows better the radio circumstances anyhow. |
| China Telecom | Yes.  |
| ZTE | Solving the conflict in the gNB-DU locally. |
| Ericsson | The gNB-DU can solve the conflict locally, but it needs to retrieve assistance information from the gNB-CU, i.e. it needs neighbor PRACH Configuration Information. For this reason, gNB-DU needs to flag the presence of a conflict to the gNB-CU, so that gNB-.CU can send assistance information. If the information signaled by the gNB-CU do not help solving the conflict, gNB-DU needs to request more assistance information. |
| Samsung | Yes.  |
| Nokia | Local solution of RACH conflict could work in some cases, e.g. in case of conflicting RSI while other parameters (power ramping) are well configured. But a cell will in most cases not be able to detect whether e.g. its power parameters are too aggressive and it therefore acts as an interference aggressor towards other cells. Its own RACH success rate will in this case be good. So we think signaling for the conflict resolution phase is needed. |

## 5.6 Issue 6 - inter-en-gNB RACH coordination

RAN3#108-e agreed to postpone inter-en-gNB RACH coordination to Rel-17:

* + X2AP signalling of PRACH configurations of neighbour cells is postponed to Rel-17

Proposals can be found in [7], [8]. Please provide your company's view.

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| Company | Comment |
| Huawei | Good to have. |
| CATT | This issue should be solved with a similar approach as the issue over F1AP. |
| China Telecom | Agree with the proposals in [7][8]  |
| ZTE | Support to have. |
| Ericsson | It is very important to limit the number of PRACH configuration signaled to an eNB as this node may be supported by a legacy platform, which is less suited to handle huge message size. For this reason [7] proposes to signal a maximum of 16 neighbour cell’s PRACH Configuration Information, which can provide up to 16x32 PRACH configurations. This should be sufficient to identify and correct any RACH conflict |
| Samsung | Ok to have. |
| Nokia | Good to have. |

## 5.7 Issue 7 - RACH report for SgNBs

The issue is raised in [11], and an LS proposed sent to RAN2 [12]. Please provide your company's view.

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| Company | Comment |
| Huawei | No strong view. |
| CATT | Similar with MRO for SN change failure case, RACH report for SgNB should also be considered. |
| China Telecom | It is beneficial to introduce RACH report for SgNB |
| Ericsson | Ok to send an LS to RAN2. However, we should not place an action that mandates RAN2 to find solutions, we should let RAN2 analyse the case and if needed provide solutions |
| Samsung | No strong view. But since RAN3 have no clear information to request the UE report. It’s also possible to directly discuss this in RAN2 send their conclusion to RAN3. |
| Nokia | OK to send an LS to RAN2. |

# 6 Conclusion, Recommendations [if needed]

If needed

# 7 References

 [1] R3-204633 Discussion on the PRACH Coordination in Spectrum Shared between LTE and NR, China Telecom, ZTE, Huawei discussion

[2] R3-204634 (TP for [NR\_SON\_MDT] BL CR for TS 38.423) Addition of LTE PRACH Coordination in XnAP China Telecommunications other 38.423

[3] R3-204758 PRACH configuration conflict detection Huawei discussion

[4] R3-204759 PRACH configuration conflict detection Huawei CR 38.473

[5] R3-205011 TP for RACH report availability indication on F1 interface Ericsson discussion

[6] R3-205012 Solution for RACH Conflict Detection and Resolution at gNB-DU Ericsson discussion

[7] R3-205013 PRACH Configuration of neighbouring cells for EN DC scenario Ericsson CR 36.423

[8] R3-205111 Discussion on Rel-16 leftover issues for PRACH coordination CATT discussion

[9] R3-205112 CR on PRACH coordination for F1AP CATT CR 38.473

[10] R3-205113 CR on PRACH coordination for X2AP CATT CR 36.423

[11] R3-205114 Discussion on RACH report for SgNB CATT discussion

[12] R3-205115 LS to RAN2 on RACH report for SgNB CATT LS out

[13] R3-205204 2-step RACH Configuration Exchange Nokia, Nokia Shanghai Bell discussion

[14] R3-205205 RACH Conflict Resolution Nokia, Nokia Shanghai Bell discussion

[15] R3-205206 Enhancement of RACH Conflict Resolution Nokia, Nokia Shanghai Bell CR 38.423

[16] R3-205207 Enhancement of RACH Conflict Resolution Nokia, Nokia Shanghai Bell CR 38.473

[17] R3-205323 Left issue for Rel-16 RACH Optimization ZTE, China Telecom, China Unicom discussion