3GPP TSG-RAN WG3 Meeting #111-e R3-210994

E-meeting, 25 January – 4 February, 2021

**Agenda item: 10.2.1.7**

**Source: Nokia (moderator)**

**Title: CB: # 1006\_SONMDT\_RACH - Summary of email discussion**

**Document for: Approval**

# 1 Introduction

This paper provides summary of discussions at RAN#111-e on:

**CB: # 1006\_SONMDT\_RACH**

**- SN indicates the availability of RACH report of a set of UEs?**

**- Xn: Access and Mobility Indication is enhanced to deliver RACH reports for specific UEs identified by SN?**

**- RACH failure rate in Xn**

**- “NR Cell PRACH Configuration” IE is added to “NR Neighbour Information” for TS 36.423 with information about the location and bandwidth of carriers, the TDD pattern and the number of SSB?**

**- Assistance information from gNB-CU for conflict resolution?**

**- F1 signaling indication about conflicting cells?**

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

**- Neighbor PRACH Configuration in F1 SETUP RESPONSE?**

**- Maximum 512 neighbor PRACH Configurations sent from gNB-CU to gNB-DU?**

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

**- RACH failure rate in F1**

**- May also discuss other issues based on papers submitted**

**- Try to reach high-level agreements in the first phase, proceed to TPs in the second phase of the email discussion**

(Nok - moderator)

Where possible we have kept the discussion structure and identified issues from previous meetings and tried to map the submitted proposals to this structure. Note that, Issue 1 on “PRACH Coordination in Shared Spectrum between LTE and NR” is not anymore in the scope of this WI. Note also, that a new aspect is brought up during this meeting, namely MR-DC aspects in RACH Optimization.

**Companies are kindly requested to provide input to the first stage of this discussion by** **8:00 UTC on Friday, January 29, so that we can take it into account during the online session the same day.**

# 2 For the Chairman’s Notes

[To be completed]

# 3 Discussion

## 3.1 Phase 1: High-Level Agreements

### 3.1.1 MR-DC aspects in RACH Optimization

**Related proposals in submitted papers:**

0678 discusses RACH access in MR-DC scenario. A RACH Report logged by a UE will contain RACH procedures over both MN and SN but the MN is not aware of the RACH procedures that took place at SN. A mechanism is proposed where SN indicates availability of RACH Reports from a set of UEs to make MN aware of RACH procedures that took place at SN.

**Please provide your views on whether SN should indicate the availability of RACH Reports from a set of UEs to MN.**

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| Company | Comment |
| Huawei | We noticed that this may relate to the discussion on UE rach reporting in MR-DC in RAN2 and ran2 does not make the decision yet. Since the RAN2 agreement will impact on RAN3 solution to be chosen, we prefer to wait for RAN2 progress for now. |
| Ericsson | We believe that the proposal to indicate availability of RACH reports from SN to MN is independent of RAN2 discussions (RAN2 is not discussing UE based solutions to flag the presence of a RACH report). The MN has no means to know that the UE has performed RACH over the SN, hence it does not know whether there is a RACH report to pull. We suggest that RAN3 studies the feasibility of a solution for this problem and has it ready for a possible agreement when we confirm that the solution does not interfere with RAN2 progress |
| ZTE | We see the benefit to take this into account. |
| CATT | We share the similar view with Huawei. We already send LS to RAN2 on RACH report for MR-DC case and it is better for RAN3 to wait the response from RAN2 before make any decision on network signalling impact. |
| Nokia | We agree with Huawei that currently RAN2 is discussing RACH Report retrieval options in MR-DC (e.g., by SN or by MN). For instance, there are proposals whether UE reports both MN and SN RACH Reports to the current MN. So there is a link with the ongoing RAN2 discussions and we therefore suggest to wait to see their progress before we determine the need to specify RAN3 signaling. |
| Samsung | We share the view of Nokia. |
| Qualcomm | OK to wait for RAN2 progress |

**If SN should indicate the availability of RACH Reports from a set of UEs to MN, please provide your views on whether** **Access and Mobility Indication procedure over Xn should be enhanced with NG-RAN node UE XnAP ID to allow RACH Report delivery from the indicated UEs.**

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| Company | Comment |
| Huawei | Agree, the Access and Mobility Indication procedure could be reused. |
| Ericsson | Yes, Access and Mobility Indication procedure is a procedure made for exactly this type of signalling. |
| ZTE | Agree to use Access and Mobility Indication procedure. |
| CATT | It could be decided after the LS from RAN2 is received. |
| Nokia | We should wait RAN2 decision before we decide this. |
| Samsung | Agree CATT and Nokia. |
| Qualcomm | Agree, but can wait for RAN2 decision |

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

**Main options submitted to this meeting:**

1. a) "High" number (512, 1024) of configurations sent from CU to DU versus b) "Low" number (e.g. 16) of configurations sent from CU to DU with assistance information from DU to CU.

2. Association of Neighbour PRACH Configuration with serving cell at recipient gNB.

3. Introduction of Neighbour PRACH Configuration in F1 SETUP RESPONSE.

**Related proposals in submitted papers:**

0309 proposes:

* For F1, a flat list of 512 neighbour PRACH configurations to be included in “Cell Information Notification List IE” in the following messages: F1 SETUP RESPONSE, GNB-DU CONFIGURATION UPDATE ACKNOWLEDGE and GNB-CU CONFIGURATION UPDATE. Maximum Length of the Cell Information Notification List is *maxCellingNBDU*. Each PRACH configuration is associated to a cell (NR CGI) to indicate which cell served by the DU is a neighbour to cell whose PRACH Configuration is included in the message. 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.

0442 proposes to:

* Introduce a high number of, up to 512, PRACH configurations sent from CU to DU.
* Associate neighbour PRACH Configuration with served cell in the DU in GNB-CU CONFIGURATION UPDATE message.

0665 proposes:

* For F1, a flat list of a high number (up to 512) of neighbour PRACH Configurations from CU to DU. CU can limit the neighbour PRACH Configurations it sends to a DU by utilizing RACH Failure Rate information
* To associate Neighbour PRACH Configuration with serving cell at recipient gNB in F1 SETUP RESPONSE, GNB-DU CONFIGURATION UPDATE ACKNOWLEDGE and GNB-CU CONFIGURATION UPDATE. Repetitions of neighbour PRACH Configuration over different cells can be avoided by factoring out the common parts, e.g., those related to frequency and time resource information.

0679 proposes:

* Use F1 SETUP RESPONSE to send a limited set (up to 16) of neighbour PRACH Configurations from CU to DU. To facilitate progress, they could support up to 64 neighbour PRACH Configurations.
* A DU can use dedicated signaling to additionally request PRACH Configuration on conflicting cells. This can be done using GNB-DU CONFIGURATION UPDATE procedure.

**Please provide your further views on whether a high number of** **Neighbour PRACH Configurations should be sent between CU and DU versus a low number of Neighbour PRACH Configurations with assistance information. Should a DU request PRACH Configuration on conflicting cells from its CU?**

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| Company | Comment |
| Huawei | The high number is a maximum value. It does not mean that the CU will always sends the Neighbour PRACH Configurations with the max value. It relies on the CU implementation.  We don't see any issue to define a high maximum number 512 here.  Since it is very likely that the CU may only send a few number of Neighbour PRACH Configurations even we define a high number for the maximum value, from this point of view, the request from DU seems needed in some cases. |
| Ericsson | The case of PRACH conflict will be very rare. We think it is sub-optimal to have signalling of neighbour cells PRACH configurations to the DU even when a PRACH conflict does not occur. We can be ok to a number of neighbour PRACH configurations higher than our proposed “16”, but we would like to have these neighbour PRACH configurations signalled upon a request from the DU.  Please note that even for the case of served cell information over Xn we assumed that in practice a small number of cells would be signalled. But we ended up with problems of large Xn messages for which we had to standardise a solution for failure avoidance. We do not want to end up in the same situation here, especially because in most cases the PRACH neighbour information will not be needed, some of the reasons for this are below:   * As mentioned already, RACH conflict happens rarely. When it happens it may not need adjustments. If needed, adjustments may be performed locally at the DU (e.g. beam sweep pattern change) * If 512 neighbour PRACH configurations are signalled to the DU, at best 10 of those may be useful to select a new PRACH configuration (direct neighbours), all remaining PRACH configurations would not be used.   For the reason above we suggest to have an indication from DU to CU of cell in PRACH conflict and a response from CU to DU with a possibly large number of neighbour PRACH configurations. |
| CATT | High number.  PRACH configuration won’t change frequently and thus a high max number won’t cause any significant load.  We are open on whether to include some assistance information provided from the gNB-DU toward the gNB-CU, as long as such assistance information is not exchanged frequently. |
| Nokia | We support that CU sends a maximum of 512 Neighbour PRACH Configurations to a DU, and it seems there is no show stopper for this from other companies. Of course, this does not mean that CU has to always send this maximum allowed number of neighbour PRACH Configurations. |
| Samsung | We prefer a high number. Then, how many PRACH configuration should be transmitted can depend on e.g. the implementation of CU. |
| Qualcomm | How about a compromise of 64 neighbor PRACH configurations? Although 512 is just a max number and CU can send a limited set, 512 seems to be a large set for just picking a new PRACH configuration.  From our comparison of the 2 options (listed below), it seems we can avoid new signaling (DU to signal PRACH conflict indication to CU) and additional delay by using Option 2  Here is a comparison of the two options:  **Option 1: Low number of Neighbour PRACH Configurations with assistance information**   1. CU sends a list of 16 PRACH configurations of immediate neighboring cells 2. DU detects PRACH issue and notices that its PRACH config conflicts with one of the 16 PRACH configuration signaled. DU can’t pick a new PRACH config among the 16 as they might still conflict with other neighbors 3. DU sends PRACH conflict indication to CU 4. CU then sends a new list of 16 neighbor PRACH config which are not its immediate neighboring cells. DU then picks a new PRACH config among the new set   **Option 2: High number of Neighbour PRACH Configurations**   1. CU sends a list of 64 PRACH config of neighboring cells (including immediate neighbors and far away cells) with list of DU’s serving cell for each neighbor PRACH config 2. DU detects PRACH issue. Assuming it is a PRACH config conflict issue, DU picks a new PRACH config among the 64 which are not its immediate neighbors |

**Please provide your further views on whether to associate** **Neighbour PRACH Configuration with serving cell at recipient gNB.**

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| Company | Comment |
| Huawei | Yes. In the message, totally 512 Neighbour PRACH Configurations are delivered. In each Neighbour PRACH Configuration, a list of DU’s serving cells could be attached to manage the message size. |
| Ericsson | If we follow our approach of having DU to flag the cell in PRACH conflict the CU should only signal configurations of cells neighbouring that cell. Hence, we would not need DU cell info as part of the PRACH configuration signalled by CU |
| CATT | Slightly different approach.  We prefer to relate a neighbour’s PRACH to a list of “served cells” of the recipient gNB-DU, rather than to only one “served cell”. |
| Nokia | Yes, we need to associate neighbour PRACH Configuration with serving cell at recipient gNB. Repetitions of neighbour PRACH Configurations from different cells can be avoided by factoring out the common parts, e.g., those related to frequency and time resource information. |
| Samsung | Yes. |
| Qualcomm | Yes |

**Please provide your further views on whether to introduce Neighbour PRACH Configuration in F1 SETUP RESPONSE.**

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| Company | Comment |
| Huawei | Yes. It may be needed in case that the DU is introduced to an operating network. |
| Ericsson | Although we included Neighbour PRACH Configuration in F1 Setup Response in our CR, we do not think there is a strong need for it. A DU that becomes operational will activate its cells only after F1 setup completion. Hence no L3 measurements would be available at the gNB-CU for the DU’s cells at the time of F1 setup. For this reason there is limited knowledge at CU of which cells are neighbouring the DU cells. |
| CATT | Yes.  There is cases that new gNB-DUs are deployed connected to an existing gNB-CU, which already has stored some PRACH configurations of neighbours. The gNB-CU can then include these PRACH configurations within the F1 SETUP RESPONSE message. |
| Nokia | Yes, this would be useful for the scenario of addition of a new DU. |
| Qualcomm | Seems useful for a new DU addition scenario as pointed above |

**Please provide your views if an optional NR Cell PRACH Configuration IE as well as IEs to provide location and bandwidth of carriers, TDD pattern and number of SSBs are needed in NR Neighbour Information IE over X2.**

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| Company | Comment |
| Huawei | Shouldn't this be discussed in TEI 17 as per the agreement of last meeting? |
| Ericsson | We do not believe this is needed |
| CATT | At least Yes for location and bandwidth which is necessary to deduce the frequency of PRACH resources. |
| Nokia | We think this is part of the work item, to support RACH optimisation between en-gNBs. At least X2 is mentioned in the WID. The mentioned parameters seem to be needed. |
| Samsung | Agree with Huawei |

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

Options under discussion have been:

1. 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.

**Related proposals in submitted papers:**

Option 1:

* 0566 proposes that DU sends indication to CU to trigger retrieval of one or more UE RACH reports by the CU over Uu interface. A list of UE IDs can be provided from DU to CU to retrieve multiple UE Reports without requesting RACH Reports from all UEs.
* 0679 proposes that DU triggers CU to retrieve UE RACH Reports by indicating a RACH occurrence in case the RACH procedure is not known to the CU.

Option 2:

* 0665 proposes that the trigger for RACH Report retrieval by the network should be UE-based (and no trigger is needed from DU to CU).

**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 |
| Huawei | If we rely on the UE to trigger the UE RACH report retrieval, the UE may discard the UE RACH report if the list is full of 8 reports. |
| Ericsson | RAN2 agreed that the UE will not flag the availability of a RACH Report and we should take that as the reference design. RAN2 is not discussing this topic in Rel17. We therefore see it as beneficial to have a notification from DU to CU, so that RACH reports can be pulled if needed and so that RACH reports can be pulled (if wanted) while the UE is still served in the serving gNB (hence the RACH report can be associated to an existing UE context) |
| ZTE | We also see the benefit to have a notification from DU to CU. |
| Nokia | If we rely on the gNB-DU to trigger UE RACH Report retrieval, the UE impacts from the signaling will be high. 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, and we should leave it this way. If the CU does not retrieve it within 48h then the UE will discard the RACH Report.  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.  If we rely on the UE to trigger UE RACH Report retrieval, the UE will keep the RACH Report for 48h after the last RACH procedure is logged. Similarly, the UE could indicate availability of the report before all 8 RACH procedures are logged to avoid losing RACH procedures because it is full.  Initiating the RACH report retrieval by the UE would also facilitate the process in MR-DC scenarios where it is otherwise more complicated in our view to forward RACH Reports between SN and MN.  Indicating when a RACH event happens from DU to CU is not in line with the fundamental principle of functional split, where a CU should not be aware of DU’s actions. |
| Samsung | Option 2. . |
| Qualcomm | Option 1.  If RAN2 doesn’t introduce a RACH availability indication in Rel-17, there is benefit in introducing a RACH Indication from DU to CU for RACH not visible to CU.  Regarding Nokia’s 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*. ”, this need not be true necessarily for Uu signaling and can be based on CU implementation. An example is CU retrieves RACH report from UE only upon receiving 5 RACH indications from DU. Even today, CU has the freedom on how frequent it requests RACH report from UE using UEInformationRequest; this RACH Indication just informs CU that there are many RACH procedures whose report is waiting to be retrieved. |

### 3.1.4 Issue 5 - PRACH configuration conflict resolution

The following options further build on "*DU resolves PRACH configuration conflicts locally*" (option 1, agreed at RAN3#110-e):

* Option 2: DU resolves PRACH configuration conflicts locally, but may flag the presence of a conflict to the CU so that CU can send assistance information.
* Option 3: DU resolves PRACH configuration locally whenever possible, and informs about RACH failure rate for mitigation of interference scenarios.

**Related proposals in submitted papers:**

0309 proposes that:

* There is no need for DU/en-gNB to report upon every event of “MSG1 without consecutive MSG3”.

0679 proposes two alternatives:

* In the absence of assistance information from CU to DU, then DU detects and resolves RACH conflicts locally.
* If assistance information from CU to DU is allowed, then CU provides DU a limited and filtered set of assistance information. This information can be sent in F1 Setup Response.

0665 proposes that:

* DU resolves PRACH Configuration conflicts locally whenever possible.
* DU may further receive RACH Failure Rate information from other DUs through Xn and F1 interfaces. RACH Failure Rate is calculated locally at a DU using internal information on RACH successes and the received RACH Reports and helps DU determine whether it is an aggressor to other DUs.

**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 |
| Huawei | Option 2 seems already covered by issue 2 and 3?  Regarding the RACH failure rate information. It could be one of the metrics that can be used by the DU to evaluate the RACH performance. In LTE stage, I remember that we studied several other metrics, such as Access Probability, etc. However, which to use by the DU is up to implementation.  Another issue of the RACH failure rate is that it’s difficult to determine which cell is the aggressor cell which interferes to the victim cell having a high RACH failure rate. |
| Ericsson | Perhaps the part we could capture is that if the DU detects an issue with PRACH performance the DU can decide to take local measures to attempt to remove the issue. Namely, we should capture the possibility for a PRACH conflict detection and resolution that does not need communication between CU and DU |
| CATT | We slightly prefer Option 1.  It is already effective enough: If a gNB(-DU) find that its PRACH configuration may collide with a neighbour’s since they are entirely the same, it should randomly select another feasible PRACH configuration for itself. This is just like how PCI conflict is resolved in LTE E-UTRAN. No need to distinguish an “aggressor” from an “aggressed”. |
| Nokia | Comment to E///: OK for us to capture in the specification the possibility of local conflict detection and resolution as we agreed at last meeting. But it is only part of the needed solution.  Comment to CATT: As pointed out by other companies, e.g. E///, an analysis purely based on "colliding" PRACH configurations will create too many "false alarms", e.g. due to use of beams, and hence unnecessary configuration updates. Some observation of actual conflicts (RACH failures) is therefore needed.  Comment to HW: On how to determine the aggressor cells, we believe that the RACH failure rate could be quite efficient because such aggressor cell would typically have a particularly low RACH failure rate compared to its neighbours. |
| Samsung | The agreement at last meeting is enough. The DU detects an issue with PRACH performance and the DU can decide to take local measures to attempt to remove the issue. |
| Qualcomm | Prefer to stick with option 1 (DU to resolve PRACH config conflicts locally and no signaling to CU needed seeking or providing assistance) |

**Please provide your further views on whether you support to introduce a metric beyond a binary flag to determine RACH Configuration Conflicts among DUs.**

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| Company | Comment |
| Huawei | Need further study how it works. |
| Ericsson | We do not see a strong need for it |
| CATT | We are open on whether a gNB-DU can provide some assistance information (e.g. RACH failure rate maybe) toward its gNB-CU, but we don’t think any additional information is needed over the XnAP.  In LTE E-UTRAN, only the PRACH configurations of served cells are exchanged over X2AP, now in NG-RAN/NR we should follow the same approach for alignment. |
| Nokia | On Xn, the NR PRACH configuration is sent per served cell (same as LTE). So the first problem to solve would indeed need to focus on assistance information on F1. Sending RACH failure rate on F1 from DU to CU could help the CU to identify PRACH configuration info to be sent to its served DUs. Otherwise, a simple indicator would leave the decision to the DU, while the failure rate information makes it easier to compare information sent from different DUs. The CU should also further propagate the RACH failure rate to its other served DUs.  We still believe that 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 release if needed. |
| Ericsson | Seems no strong need. |
| Qualcomm | The solution to signal RACH failure rates from DU to CU, and in turn from CU to other DUs would need a lot of additional signaling over F1 and definition of RACH failure metrics.  Even is supported, this just helps in knowing a quantitative metric of RACH failures in all DUs for a quick comparison and identify the poorly performing DUs in terms of RACH. It still can’t resolve the RACH issue say by pair-wise identifying RACH config conflict or the root cause of the issue. We therefore don’t see a strong need as well. |

## 3.2 Phase 2: TP approval

[TBD]

# 4 Conclusion, Recommendations [if needed]

If needed

# 5 References

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| [R3-210309](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210309.zip) | Discussion on Rel-16 leftover issues for PRACH coordination (CATT) | discussion |
| [R3-210310](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210310.zip) | (TP on SON for 38.473) TP on PRACH coordination for F1AP (CATT) | other |
| [R3-210311](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210311.zip) | (TP on SON for 36.423) TP on PRACH coordination for X2AP (CATT) | other |
| [R3-210442](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210442.zip) | (TP for SON BL CR for TS 38.473): Left overs on RACH Optimization Enhancements (Huawei) | other |
| [R3-210443](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210443.zip) | (TP for SON BL CR for TS 38.401):Stage 2 update for RACH Optimization (Huawei) | other |
| [R3-210566](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210566.zip) | Left issue for Rel-16 RACH Optimization (ZTE) | discussion |
| [R3-210665](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210665.zip) | RACH Optimization Further Discussion (Nokia) | discussion |
| [R3-210666](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210666.zip) | (TP for SON BL CR to TS 38.423) Enhancement of RACH Conflict Resolution (Nokia) | other |
| [R3-210667](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210667.zip) | (TP for SON BL CR to TS 38.473) Enhancement of RACH Conflict Resolution (Nokia) | other |
| [R3-210678](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210678.zip) | (TP for SON BL CR for TS 38.423): On delivering SN related RACH reports to the SN (Ericsson) | other |
| [R3-210679](http://ftp.3gpp.org/tsg_ran/WG3_Iu/TSGR3_111-e/Docs/R3-210679.zip) | (TP for SON BL CR for TS 38.473): RACH conflict resolution and RACH report availability indication over F1 interface (Ericsson) | other |