3GPP RAN 5G-ACIA Evaluations Week 3

February 22nd – 26th 2021

Source: Moderator (Ericsson)

Title: Review of provided simulation results and needed updates

Document for: Discussion, Decision

# 1 Introduction

AT RAN#89, the following was agreed in [RP-202069](https://protect2.fireeye.com/v1/url?k=41a5db26-1f051960-41a59bbd-86fc6812c361-73f443258ff773bf&q=1&e=bc078f84-983d-45f3-ab31-19e60d911036&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FTSG_RAN%2FTSGR_89e%2FDocs%2FRP-202069.zip) on providing evaluations for 5G-ACIA:

* Start an offline email-based activity to provide evaluation results for 5G-ACIA
* One company volunteers as moderator
  + Proposes a work plan to follow
  + Ericsson is willing do this
* Discussions are on the RAN1\_NR reflector
  + Email activity only during short periods (< week) distributed across the time allocated to the activity
  + No email activity in weeks before/during/after RAN1 meetings or RAN defined inactive periods
  + All companies should strive to limit email activity as much as possible
  + Outcome of the offline discussion will directly go to RAN without need for discussion in RAN1 nor need for LS from RAN1 to RAN
* Target completion by RAN#91
* At RAN#91, RAN will decide on a response LS to 5G-ACIA

The moderator made the following proposal on a timeline:

1. 12-16 October 2020
   * Discussion on which URLLC features to include in the evaluations and simulation assumptions
2. 14-18 December 2020
   * First round of simulation results
3. 22-26 February 2021
   * Second round of simulation results
4. 8-12 March 2021
   * Finalization of the report to RAN#91

During week 1, the simulation assumptions were agreed as captures in the document below:

[https://www.3gpp.org/ftp/tsg\_ran/TSG\_RAN/TSGR\_90e/Inbox/Drafts/5G-ACIA October/Agreements/Agreements week 1 5G-ACIA.docx](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_90e/Inbox/Drafts/5G-ACIA%20October/Agreements/Agreements%20week%201%205G-ACIA.docx)

For week 2, companies provided the first round of simulation results. The summary is provided here:

[https://www.3gpp.org/ftp/tsg\_ran/TSG\_RAN/TSGR\_91e/Inbox/Drafts/5G-ACIA%20December/Final Summary/5G-ACIA Week 2 - Final summary.docx](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20December/Final%20Summary/5G-ACIA%20Week%202%20-%20Final%20summary.docx)

For the third week, companies provided the second round of simulation results:

[https://www.3gpp.org/ftp/tsg\_ran/TSG\_RAN/TSGR\_91e/Inbox/Drafts/5G-ACIA February/Company Inputs/](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20December/Company%20Inputs)

The input contributions are also listed in the reference section.

In this contribution, review comments from other companies are collected for each input document.

# 2 Company Inputs

## 2.1 Ericsson

[Contribution link](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/Ericsson%205G-ACIA%20Simulation%20Results%20Round2.zip).

Other companies can provide questions and comments in the table below:

|  |  |
| --- | --- |
| Company | Questions and comments |
| ZTE | 1. Whether cell coordination is assumed in your evaluation? 2. Regarding ‘ Since packet arrival is known by gNB, allocation in time and periodicity is optimized so that the alignment delay is minimized.’ in section 2.1, do you main the packet arrival is assumed in a predefined manner, e.g., data arrival is try to be aligned with the beginning of a transmission occasion? If so, it seems not aligned with your assumptions in appendix, where it is ‘DL traffic arrival with option-1’ (i.e., the packet arrival is assumed as uniformly random distributed in a transfer interval). 3. For Figure 3, why the delay of DL and UL are the same considering the DL and UL scheduling may be different due to different channel conditions and transmitting power etc. 4. Is a correct understanding that the target PER is assumed as 10^-3? |
| Nokia, NSB | For FR1, performance seems worse than e.g. ours and vivo’s. Any reasoning behind this performance difference? For example, could it be due to the assumed SPS/CG scheme (instead of the random PRB allocation assumed in our study)?  Besides, also for FR1, the PER statistics in Figure 4 doesn’t seem to match the CSA statistics in Figure 1. In the PER statistics, 99% of the UEs have a PER of 0%, but the CSA says that only 84.05% of the UEs reach the CSA target. Could this be clarified?  For FR2, have you assumed some limitations related to the beamforming operation? |

## 2.2 Huawei/HiSilicon

[Contribution link](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/HwHiSi%20-%20Simulation%20results%20for%205G-ACIA%20in%20the%20second%20round.docx).

Other companies can provide questions and comments in the table below:

|  |  |
| --- | --- |
| Company | Questions and comments |
| ZTE | Why the CDF in Figure 4 is a step function? Take Figure 4(a) reliability of DL as an example, is it correct understanding that the PER of all packets of all UEs can only be one the following values: ~4\*10E-6, ~4\*10E-5, 2\*10E-4 or 1\*10E-1? |
| Nokia, NSB | In our view, scheme (1) with orthogonal frequency reuse actually falls better in the category of ‘with cell coordination’, since this assumes a static cell coordination.  For scheme (2), the extremely conservative allocation scheme seems to be generating large amount inter-cell interference and is not providing a clear picture of what can be achieved in a realistic uncoordinated scheme. It would be good to see the performance with more traditional link adaptation scheme. |

## 2.3 Intel

[Contribution link](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/INTEL%20-%205G-ACIA%20LS%20-%20Phase%203%20inputs%20v0.docx).

Other companies can provide questions and comments in the table below:

|  |  |
| --- | --- |
| Company | Questions and comments |
| ZTE | Whether cell coordination is assumed in your evaluation? |
| Nokia, NSB | We observe that the performance is generally poorer than other companies’ results. We wonder if the reason is the relatively high 1E-3 BLER target which may not be sufficient to achieve CSA of 6-nines? The low PRB utilization (<30%) suggests that it is possible to operate at lower BLER target. |

## 2.4 Nokia

[Contribution link](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/NOKIA%20-%205G-ACIA%20Final%20round%20of%20simulation%20results.docx).

Other companies can provide questions and comments in the table below:

|  |  |
| --- | --- |
| Company | Questions and comments |
| ZTE | 1. Whether cell coordination is assumed in your evaluation?   Nokia: No. A fully uncoordinated-scheme is considered where each BS independently allocates the RBs to its UEs.   1. Whether MU-MIMO is enabled in your evaluation?   Nokia: No. Each BS schedules at most 1 UE per RB. So only ‘inter-cell’ interference is experienced in the case the same RBs are scheduled for transmission/reception at neighboring BSs. |

## 2.5 Qualcomm

Contribution links for [FR1](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/QUALCOMM-5G-ACIA_URLLC_simulation_results_2nd_round_FR1.docx) and [FR2](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/Qualcomm5G-ACIA_URLLCsimulationResultsRound1_FR2_version1.docx).

Other companies can provide questions and comments in the table below:

|  |  |
| --- | --- |
| Company | Questions and comments |
| ZTE | For FR1 with HARQ re-transmission, it seems you assumed cell coordination among BSs, right? If so, gNB can coordinate each other to avoid any interference if the number of UEs per cell is not too much, e.g., up to 20 UEs in your evaluation. Thus, no matter the BLER is set to 10-2 or 10-4 or 10-6, the packet could be highly likely to be successfully transmitted even with the highest MCS index (no re-transmission is needed) for FR1. Thus, setting the initial or retransmission BLER lower than the 10-6 seems not able to save resources in most cases. Instead, it seems the reserved half of resources always for re-transmission would be wasted. |
| Nokia, NSB | For FR1, it seems that no UE/gNB processing times are assumed since the minimum latency is the same as the mini-slot duration. |

## 2.6 vivo

[Contribution link](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/vivo%20-%205G-ACIA%202nd%20round%20URLLC%20evaluation%20results.zip).

Other companies can provide questions and comments in the table below:

|  |  |
| --- | --- |
| Company | Questions and comments |
| ZTE | For the results without cell coordination, it seems the performance is also very good even when the number of UEs are very large. In our understanding, the interference cannot be avoided without cell coordination, and the severe interference in factory scenario would be very likely to cause packet error. Conservative resource allocation may not be helpful since it could also increase the interference. Could you clarify a bit more on the scheduling or other aspects about the performance without cell coordination? |
| Nokia, NSB | For FR2, have you assumed some limitations related to the beamforming operation? Would it be possible to clarify the following sentence: *For coordination transmission in FR2, since multi-beam transmission is adopted in FR2, and all UEs are uniformly distributed within per service area without considering uniformly distributed in each beam, some UEs may not be fully FDMed within a beam with the increasing of UEs per service area.* |

## 2.7 ZTE

[Contribution link](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/ZTE-5G-ACIA%20evaluations%20-%202nd%20round%20of%20simulation%20results.docx).

Other companies can provide questions and comments in the table below:

|  |  |
| --- | --- |
| Company | Questions and comments |
| Nokia, NSB | The case of ‘no coordination’ seems a bit misleading. Actually, this seems like a ‘static’ coordination scheme where orthogonal PRBs are statically assigned to each BS.  Can you clarify the following in Observation 2: “*If the number of UEs per service area is 40, the CSA is 100% for both DL and UL, while the percentage of UEs satisfying the requirements is 68.75% and 78.33% for DL and UL respectively”*? In our understanding the requirement is that each UE should have a CSA of 99.9999%, so it’s unclear which requirement is referred to when reporting the “Percentage of UEs satisfying requirements”. |

## 2.8 ITRI

[Contribution link](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/ITRI_5G-ACIA%20Simulation%20Results_2nd%20round.docx).

Other companies can provide questions and comments in the table below:

|  |  |
| --- | --- |
| Company | Questions and comments |
| Nokia, NSB | The performance seems slightly lower than what is reported by other companies. One reason seems to be the fact that the resource allocation size (i.e. number of PRBs per TB) is exactly the same for all UEs (16, 8 or 4 PRBs) which is probably suboptimal since the MCS is not adjusted as per each UE’s specific SINR conditions.  Also, it is unclear what are exactly the main differences between the first and second round of simulation results. Could this part be clarified? *However packet arrival is available to gNB in connection setup phase. The configuration of DL SPS and UL CG could be adjusted appropriately for the packet arrival pattern. For example, the resource allocation in time domain and the resource periodicity may be configured to minimize the gap of the DL/UL frame alignment delay.* |

## 2.9 CATT

[Contribution link](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/CATT%205G-ACIA%20evaluation%20results%20Round2.docx).

Other companies can provide questions and comments in the table below:

|  |  |
| --- | --- |
| Company | Questions and comments |
| Nokia, NSB | For BLER target 1E-3, it would be good to include results with larger number of UEs (e.g. 30, 40, 50) to see at which load point the CSA gets below 100%.  For BLER target 1E-5, it’s unclear why the achieved CSA is lower than the one achieved with 1E-3. |

# 3 Conclusions

# References

1. [RP-202069](https://protect2.fireeye.com/v1/url?k=41a5db26-1f051960-41a59bbd-86fc6812c361-73f443258ff773bf&q=1&e=bc078f84-983d-45f3-ab31-19e60d911036&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FTSG_RAN%2FTSGR_89e%2FDocs%2FRP-202069.zip), “Way forward on RAN work for 5G ACIA requested simulations“, Ericsson
2. “[Simulation Results for 5G-ACIA (Second round)](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/Ericsson%205G-ACIA%20Simulation%20Results%20Round2.zip)”, Ericsson
3. “[Simulation results for 5G-ACIA in the second round](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/HwHiSi%20-%20Simulation%20results%20for%205G-ACIA%20in%20the%20second%20round.docx) Huawei, HiSilicon
4. “[5G-ACIA LS – Phase 3 input](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/INTEL%20-%205G-ACIA%20LS%20-%20Phase%203%20inputs%20v0.docx)”, Intel Corporation
5. “[Final round of simulation results for 5G-ACIA evaluation](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/NOKIA%20-%205G-ACIA%20Final%20round%20of%20simulation%20results.docx)”, Nokia, Nokia Shanghai Bell
6. “[Second round of FR1 simulation results for 5G ACIA URLLC LS response](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/QUALCOMM-5G-ACIA_URLLC_simulation_results_2nd_round_FR1.docx)”, Qualcomm CDMA Technologies
7. “[Simulation Assumptions and URLLC Performance Evaluations for 5G-ACIA Performance Evaluation Round 1](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/Qualcomm5G-ACIA_URLLCsimulationResultsRound1_FR2_version1.docx)(FR2)”, Qualcomm CDMA Technologies
8. “[5G-ACIA 2nd round URLLC evaluation results](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/vivo%20-%205G-ACIA%202nd%20round%20URLLC%20evaluation%20results.zip)”, vivo
9. “[5G-ACIA evaluations - 2nd round of simulation results](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Inbox/Drafts/5G-ACIA%20February/Company%20Inputs/ZTE-5G-ACIA%20evaluations%20-%202nd%20round%20of%20simulation%20results.docx)”, ZTE