**3GPP TSG-RAN WG4 Meeting # 99-e R4-2108458**

**Electronic Meeting, 19th – 27th May, 2021**

**Agenda item:** 10.7

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [99-e][333] NR\_ATP

**Document for:** Information

# Introduction

The discussions in this thread includes study on 5G NR UE Application Layer Data Throughput performance requirements.

# Topic #1: TR Structure and Work Split

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2111255 | Qualcomm | Draft CR on RAN4 study on Application Layer Throughput Requirements |

## Open issues summary

### Sub-topic 1-1: TR Structure

**Issue 1-1: TR Structure**

* Proposals
  + Option 1 (QC):
  + 5.10 Feasibility of Defining Link Adaptation Absolute Physical Layer Requirements in RAN4
    - 5.10.1 General

The purpose of this clause is to analyse whether it is feasible to define absolute physical layer throughput requirements under link adaptation in RAN4 using link-level simulation results based on the agreed set of simulation assumptions. As part of feasibility study, this clause will also conclude on test methodology which includes:

Alignment criteria for aligning the simulation results across companies and

Methodology to define the final requirements, if it is found to be feasible to define such requirements in RAN4.

* + - 5.10.2 Test Methodology
      * 5.10.2.1 Simulation Alignment Criteria

TBA

* + - 5.10.3 Simulation Assumptions

TBA

* + - 5.10.4 Simulation Results

TBA

* + - 5.10.5 Summary

TBA

* Recommended WF
  + TBA
    - Discuss this issue first and then draft CR can be revised (if needed) based on the discussion.

### Sub-topic 1-2: CR Work Split

**Issue 1-2: CR Work Split**

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| --- | --- |
| **Topic** | **Company** |
| General | Qualcomm |
| Simulation Alignment Criteria | Ericsson |
| Simulation Assumptions | Huawei |
| Simulation Results (Same company will drive the effort for collection of simulation results) | Intel |
| Summary | Qualcomm |

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-1: TR Structure**  **Issue 1-2: CR Work Split** |
| Intel | **Issue 1-2: CR Work Split**  We can volunteer to work on Simulation Results part |
| Huawei | **Issue 1-3: CR Work Split**  Huawei would like to be the volunteer to work on simulation assumptions part |
| Ericsson | **Issue 1-2: CR Work Split**  Ericsson can be the volunteer to work on Simulation Alignment Criteria. |
| Qualcomm | **Issue 1-1: TR Structure**  Ok with Option 1.  **Issue 1-2: CR Work Split**  We can volunteer to work on General and Summary sections. |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1-1** | *Tentative agreements:*  Issue 1-1: No comments received on TR structure. So, it is considered agreeable and corresponding draft CR will be marked as agreeable.  *Recommendations for 2nd round:*  No further discussion is needed. |
| **Sub-topic #1-2** | *Tentative agreements:*  Issue 1-2: CR Work split is agreed and will be captured in the WF.  *Candidate options:*  *Recommendations for 2nd round:*  No further discussion is needed. |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2111255 | Agreeable |

## Discussion on 2nd round (if applicable)

# Topic #2: Simulation Results Alignment

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2109362 | Apple | Simulation results and below proposals:  Proposal #1: If determined to be feasible, define link adaptation throughout requirements for 2 SNRs – one in rank 1 and one in rank 2 operation SNR range.  Proposal #2: Define requirement for minimum absolute throughput at SNR points.  Proposal #3: The minimum absolute throughput is derived by multiplying the averaged throughput by Y (%), e.g., Y=95% or 90%. |
| R4-2109464 | Qualcomm | Simulation results and below proposals:  Proposal 1: Use 20dB SNR for FR1 and 16dB SNR for FR2 as baseline for studying the feasibility of defining NR link adaptation throughput requirements. |
| R4-2109996 | Ericsson | Proposal 1: RAN4 shall further discuss which simulation results alignment criteria is more suitable based on companies’ simulation results.  Proposal 2: The requirement definition for link adaptation (LA) physical layer throughput shall follow the same criteria in simulation results alignment. |
| R4-2109997 | Ericsson | Simulation results and below proposals:  Observation 1: UE reports relatively lower CQI/Rank to achieve lower BLER(10%).  Proposal 1: RAN4 not only to align the throughput results but also to consider the reasonable CQI, RI feedback and decoding rate. |
| R4-2110170 | Intel | Simulation results. |
| R4-2110525 | Huawei, HiSilicon | Observation 1: It seems impractical for BS to schedule PDSCH by following the reported CQI/PMI/RI completely in the actual scenario.  Proposal 1: RAN 4 should study and define one OLLA algorithm for BS/instrument for this test.  Proposal 2: RAN 4 should further study how to resolve the contradictions between achieving high throughput and feasible BLER (10%). |

## Open issues summary

### Sub-topic 2-1: Ways to Align Simulation Results

Based on simulation results provided in the contributions:

* There are two sets of simulation results:
  + Qualcomm and Apple’s results align,
  + Intel and Ericsson’s results align
  + However, above two sets have a large difference in performance.
* Ericsson’s FR2 throughput results seem too high. Request Ericsson to double check.

In this subtopic, we discuss possible ways to improve the alignment.

**Issue 2-1-1: Accounting for slots not containing grants**

* Proposals
  + Encourage companies to further check and comment whether they accounted for not scheduling any grant on Special slots and slots containing CSI-RS/TRS when reporting throughput results.
* Recommended WF
  + TBA

**Issue 2-1-2: Accounting for aperiodic reporting processing delay**

* Proposals
  + Encourage companies to further check and comment whether they accounted for aperiodic CSI reporting processing delays (FR1 FDD: 6ms, FR1 TDD: 5.5ms, FR2 TDD: 1.375ms) when reporting throughput results.
* Recommended WF
  + TBA

**Issue 2-1-3: Whether to consider AWGN channel in addition to fading channel to improve alignment**

* Proposals
  + Option 1: Yes
  + Option 2: No
* Recommended WF
  + TBA

Note: Many carriers have application layer throughput tests for both AWGN and fading channels in LTE.

**Issue 2-1-4: Target BLER**

* Proposals
  + Option 1: 10%.
* Recommended WF
  + TBA

Note: Targeting higher BLER may result in increased throughput. However, it may cause UE to fail existing CQI reporting tests.

**Issue 2-1-5: Additional reported metrics**

* Proposals
  + Option 1: BLER with link adaptation for each SNR point.
  + Option 2: No additional reported metric.
* Recommended WF
  + TBA

**Issue 2-1-6: Simulation results alignment criteria**

* Proposals
  + Option 1: Absolute throughput span within X% of average throughput across companies at a given SNR.
    - Decide X based on simulation results. Possible values of X = [5]% or [10]%.
  + Option 2: SNR G±Gspan can be reached for the T% of maximum throughput
    - Maximum throughput is derived with TBS corresponding to CQI index 15 with rank 2 for 2Rx/4Rx UE.
    - Decide Gspan based on simulation results. Candidate option is Gspan = [2.5] dB.
* Recommended WF
  + TBA

### Sub-topic 2-2: Assumptions

**Issue 2-2-1: Whether to consider OLLA algorithm for BS/TE**

* Proposals
  + Option 1: Yes. (Huawei)
  + Option 2: No
* Recommended WF
  + TBA

### Sub-topic 2-3: Requirements Definition

If it is found to be feasible to define absolute throughput requirements, following issues will be considered for defining the requirements.

**Issue 2-3-1: How to set the requirements (if found feasible to define such requirements)**

* Proposals
  + Set the physical layer throughput requirements by
    - Option 1: Multiplying the averaged throughput by Y (%), e.g., Y=95% or 90%.
    - Option 2: Using methodology from PDSCH demodulation requirements with fixed RMC (i.e. average of impairments results + X dB margin).
* Recommended WF
  + If Option 1 in Issue 2-1-6 is agreed, use Option 1. If Option 2 in Issue 2-1-6 is agreed, use Option 2.

**Issue 2-3-2: Number of SNR points for defining requirements (if found feasible to define such requirements)**

* Proposals
  + Option 1: one in rank 1 and one in rank 2 operation SNR range.
  + Option 2: one in rank 2 operation SNR range.
* Recommended WF
  + TBA

**Issue 2-3-3: SNR point for defining requirements (if found feasible to define such requirements)**

* Proposals
  + Option 1: 20dB for FR1, 16dB for FR2. (QC)
  + Option 2: (14, 22) dB for FR1 2Rx, (4,20) dB for FR1 4Rx, (12,18) dB for FR2. (Apple)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Sub-topic 2-1: Ways to Align Simulation Results**  **Issue 2-1-1: Accounting for slots not containing grants**  **Issue 2-1-2: Accounting for aperiodic reporting processing delay**  **Issue 2-1-3: Whether to consider AWGN channel in addition to fading channel to improve alignment**  **Issue 2-1-4: Target BLER**  **Issue 2-1-5: Additional reported metrics**  **Issue 2-1-6: Simulation results alignment criteria**  **Sub-topic 2-2: Assumptions**  **Issue 2-2-1: Whether to consider OLLA algorithm for BS/TE**  **Sub-topic 2-3: Requirements Definition**  **Issue 2-3-1: How to set the requirements**  **Issue 2-3-2: Number of SNR points for defining requirements**  **Issue 2-3-3: SNR point for defining requirements** |
| Intel | **Sub-topic 2-1: Ways to Align Simulation Results**  **Issue 2-1-1: Accounting for slots not containing grants**  For our analysis we consider PDSCH mapping on all DL slot. We can check the results for scenarios without PDSCH mapping on slots with CSI-RS.  **Issue 2-1-2: Accounting for aperiodic reporting processing delay**  Processing delay is assumed for our analysis.  **Issue 2-1-3: Whether to consider AWGN channel in addition to fading channel to improve alignment**  Probably after resolving of Issues 2-1-1 and 2-1-2, is we still will have big misalignment then we can check whether we can reach alignment for AWGN conditions. If not, then probably we can consider fixing of some parameters PMI or RI.  **Issue 2-1-4: Target BLER**  Based on our understanding, we should not target certain BLER error for whole SNR region. Depending on implementation it can vary in certain range around 10% for CQI Tables 1 and 2. We probably can check that BLER is not too low (for example, not lower than 2%, like for CQI test with fading conditions).  **Issue 2-1-5: Additional reported metrics**  We think that first we can check whether we can reach alignment for CQI and RI reporting. After that, we can probably also check alignment for BLER.  **Issue 2-1-6: Simulation results alignment criteria**  Can be further decided based on collection of simulation results.  **Sub-topic 2-2: Assumptions**  **Issue 2-2-1: Whether to consider OLLA algorithm for BS/TE**  OLLA algorithm is rather implementation specific and it is not considered for any CSI reporting test. Based on our understanding, we should not specify any OLLA algorithm and test should be focused mainly on UE reporting. Therefore, we support Option 2.  **Sub-topic 2-3: Requirements Definition**  Suggest to come back to this sub-topic later after collection of simulation results and after conclusion on feasibility of such requirements. |
| China Telecom | **Issue 2-1-5: Additional reported metrics**  We tend to agree option 1 proposed by E///. Also as mentioned by Huawei, contradictions between achieving high throughput and feasible BLER (10%) can be observed, so we can set a BLER metric to avoid too low BLER.  **Issue 2-2-1: Whether to consider OLLA algorithm for BS/TE**  We agree in practical OLLA can be used, for the purpose of increasing the overall throughput and maintaining reasonable BLER. To our knowledge, different OLLA algorithms will have direct impact on the throughput performance. So the issue is whether RAN4 can come up with a unified OLLA algorithm, and whether it will impact the alignment of the simulation results.  **Sub-topic 2-3: Requirements Definition**  As usual, it is reasonable to follow the agreement in Issue 2-1-6: Simulation results alignment criteria as in the recommended WF, since the requirements will be derived based on simulation results. |
| Huawei | **Sub-topic 2-1: Ways to Align Simulation Results**  **Issue 2-1-1: Accounting for slots not containing grants**  We can assume all slots are accounted in during the simulation  **Issue 2-1-2: Accounting for aperiodic reporting processing delay**  The aperiodic reporting processing delay should be considered during simulation, it may affect the simulation results under the fading condition.  **Issue 2-1-3: Whether to consider AWGN channel in addition to fading channel to improve alignment**  As Intel suggested, we can firstly target to align the results under fading channel, if not, then maybe we can consider simulation under AWGN for alignment  **Issue 2-1-4: Target BLER**  **Issue 2-1-5: Additional reported metrics**  Whether consider BLER as metric or not, a reasonable BLER should be considered during the alignment. Finally if RAN4 agrees to define the related performance requirements, it should not conflict with the existing CQI reporting test. And also no duplicated testing as the existing CQI test is needed.  **Issue 2-1-6: Simulation results alignment criteria**  **Further alignment among companies is needed.**  **Sub-topic 2-2: Assumptions**  **Issue 2-2-1: Whether to consider OLLA algorithm for BS/TE**  The performance requirement will be designed to test the real UE, the throughput that one UE can achieve is closely related to the OLLA algorithm implemented by BS in the real network, without common OLLA algorithm at the TE side, UE may have different CQI to MCS mapping algorithm, it is the reason that the existing CQI test never test the exactly reported CQI index and just a median CQI and related BLER. Without such OLLA algorithm, what is meaning that we define this test? It can be really used for verification of the UE max throughput capability?  **Sub-topic 2-3: Requirements Definition**  Discuss this after RAN4 conclude the feasibility to define requirements |
| Ericsson | **Sub-topic 2-1: Ways to Align Simulation Results**  **Issue 2-1-1: Accounting for slots not containing grants**  For our analysis, we also consider PDSCH mapping on all DL slots. We also have the results for scenarios without PDSCH mapping on slots with CSI-RS and Special slots for alignment purposes.  To moderator,  Is it possible to create a new excel to collect each company’s simulation results? Then we can update our latest results.  **Issue 2-1-2: Accounting for aperiodic reporting processing delay**  In the simulations Ericsson has accounted for the reporting delay. We can update our results once the simulation results excel is created.  **Issue 2-1-3: Whether to consider AWGN channel in addition to fading channel to improve alignment**  We have the same view with Intel. The misalignment is probably a question of where PDSCH have been submitted, and firstly the issue 2-1-1 and 2-1-2 shall be solved. If the results still cannot be aligned, we can further consider AWGN channel.  **Issue 2-1-4:**  It’s better to guarantee BLER in a reasonable range, i.e., not too low and too high, but don’t need to target on 10%.  **Issue 2-1-5:**  We suggest to consider additional metrics to control the BLER in a reasonable range.  **Issue 2-1-6:**  We think option 1 is fine, but it’s better to further check it after aligning the simulation results.  **Issue 2-2-1:**  We don’t need to consider OLLA in BS/TE. The test is targeted to test UE’s performance following the CQI reporting. Otherwise, the requirements will be defined highly dependent on a typical BS/TE implementation. Then once UE fails the test in a real network, how to judge it, UE’s issue or network’s issue? Thus, we should decouple the test with any BS/TE implementation and hence we support option 2  Also the existing HSPA/LTE application layer throughput requirements (e.g. TS37.901 B.2.1.1, B.2.2.1) do not assume OLLA in SS.  **Issue 2-3-1:**  We’re fine with recommended WF.  **Issue 2-3-2:**  It should be discussed in WI (not SI).  **Issue 2-3-3:**  It should be discussed in WI (not SI). |
| Qualcomm | **Sub-topic 2-1: Ways to Align Simulation Results**  **Issue 2-1-1: Accounting for slots not containing grants**  We accounted for skipping grant on slots containing SSB, CSI-RS and TRS in our results.  **Issue 2-1-2: Accounting for aperiodic reporting processing delay**  We accounted for processing delay in our simulations.  **Issue 2-1-3: Whether to consider AWGN channel in addition to fading channel to improve alignment**  We are also ok with Intel’s proposal. We can decide in the 2nd round whether we need to consider AWGN since we have limited time left for this SI.  **Issue 2-1-4: Target BLER**  We are ok with suggestion from Intel and Ericsson. We can probably target the BLER between 2-15%, for example so that it is not too low and not too high.  **Issue 2-1-5: Additional reported metrics**  We are ok with Intel’s suggestion. We can first check if we can reach alignment based on current results. If not, we can discuss about considering other metrics in the 2nd round.  **Issue 2-1-6: Simulation results alignment criteria**  It can be decided based on updated results from companies.  **Sub-topic 2-2: Assumptions**  **Issue 2-2-1: Whether to consider OLLA algorithm for BS/TE**  Prefer Option 2. Having OLLA algorithm can drastically change the performance depending on its implementation even if UE implementation is kept the same. Here, we are trying to evaluate UE performance rather than overall UE + gNB performance. It also unnecessarily adds complexity to test setup and TE implementation. So, we prefer not to consider OLLA similar to other CSI reporting tests.  **Sub-topic 2-3: Requirements Definition**  **Issue 2-3-1: How to set the requirements**  Ok with recommended WF.  **Issue 2-3-2: Number of SNR points for defining requirements**  Prefer to discuss after feasibility is evaluated.  **Issue 2-3-3: SNR point for defining requirements**  Prefer to discuss after feasibility is evaluated. |
| Apple | **Sub-topic 2-1: Ways to Align Simulation Results**  **Issue 2-1-1: Accounting for slots not containing grants**  We used the same assumption as Rel-15 RI tests – no PDSCH scheduling in CSI-RS and ‘S’ slots.  **Issue 2-1-2: Accounting for aperiodic reporting processing delay**  We used the same assumption as RI reporting test cases.  **Issue 2-1-3: Whether to consider AWGN channel in addition to fading channel to improve alignment**  After alignment on issues 2-1-1 and 2-1-2 if we still observe diverging results, we can consider first fixing RI and/or limiting PMI.  **Issue 2-1-4: Target BLER**  Range of 2-15/20% seems reasonable. Would this be an additional metric for alignment only or also requirement?  **Issue 2-1-5: Additional reported metrics**  Nothing in addition to BLER  **Issue 2-1-6: Simulation results alignment criteria**  It can be decided based on simulation results.  **Sub-topic 2-2: Assumptions**  **Issue 2-2-1: Whether to consider OLLA algorithm for BS/TE**  Option 2. We don’t think we should consider OLLA on the gNB side as this is for UE requirement. Although it might be used in actual network, we don’t typically have requirements for UE with OLLA enabled.  **Sub-topic 2-3: Requirements Definition**  **Issue 2-3-1: How to set the requirements**  We are fine with recommended WF.  **Issue 2-3-2: Number of SNR points for defining requirements**  Discuss after feasibility is determined.  **Issue 2-3-3: SNR point for defining requirements**  Discuss after feasibility is determined. |
|  |  |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#2-1** | *Tentative agreements:*  Based on updated simulation results, there are few SNR points with throughput span within 10% in all the scenarios considered. So, results are aligned and there is no need to further discuss Issues 2-1-1 to 2-1-5.  *Recommendations for 2nd round:*  Continue discussing Issue 2-1-6 and conclusion on feasibility. |
| **Sub-topic#2-2** | *Candidate Options*  Issue 2-2-1: Whether to consider OLLA algorithm for BS/TE  Option 1: Yes  Option 2: No  4 companies support Option 2, 1 company support Option 1, 1 company suggests more discussion.  *Recommendations for 2nd round:*  Continue discussing Issue 2-2-1. |
| **Sub-topic#2-3** | *Candidate Options*  *Recommendations for 2nd round:*  Since results are aligned, continue discussing in 2nd round. |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on 5G NR UE Application Layer Data Throughput Performance | Qualcomm Incorporated |  |
| Summary of simulation results for Application Layer Throughput | Qualcomm Incorporated |  |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2111255 | Draft CR on RAN4 study on Application Layer Throughput Requirements | Qualcomm Incorporated | Agreeable |  |
|  |  |  |  |  |
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|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents