**3GPP TSG RAN WG1 Meeting #105-e R1-** **210xxxx**

**e-Meeting, 10th – 27th May 2021**

**Title: Summary of NR UE Power Saving**

**Agenda item: 7.2.7**

**Source: CATT**

**Document for: Discussion**

# Final Summary of Email Discussions and Agreements

# Email Discussion [105-e-NR\_UE\_Pow\_Sav-01]

* **Issue 1: The proposed CR for applicable K2min in TS 38.214 when SUL is configured [1]**

If SUL is configured, both UL and SUL belongs to the same serving cell with separate BWP configurations. K2min is also configured separately for UL and SUL. , K2min needs to be clarified when DCI schedules a PUSCH on either UL or SUL.

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| 6.1.2.1 Resource allocation in time domain======skipped part=======When the UE is configured with *minimumSchedulingOffsetK2* in an active UL BWP it applies a minimum scheduling offset restriction indicated by the '*Minimum applicable scheduling offset indicator*' field in DCI format 0\_1 or DCI format 1\_1 if the same field is available. When the UE configured with *minimumSchedulingOffsetK2* in an active UL BWP and it has not received '*Minimum applicable scheduling offset indicator*' field in DCI format 0\_1 or 1\_1, the UE shall apply a minimum scheduling offset restriction indicated based on '*Minimum applicable scheduling offset indicator*' value '0'. When the minimum scheduling offset restriction is applied the UE is not expected to be scheduled with a DCI in slot *n* to transmit a PUSCH scheduled with C-RNTI, CS-RNTI, MCS-C-RNTI or SP-CSI-RNTI with *K*2 smaller than$\left⌈K\_{2min}⋅\frac{2^{μ^{'}}}{2^{μ}}\right⌉$, where *K*2min and $μ$ are the applied minimum scheduling offset restriction and the numerology of the active UL BWP of the scheduled cell when receiving the DCI in slot *n*, respectively, and $μ^{'}$ is the numerology of the new active UL BWP in case of active UL BWP change in the scheduled cell and is equal to $μ$, otherwise. If the UE is configured with *supplementaryUplink* in *ServingCellConfig* in the cell, *K*2min and $μ$ are the applied minimum scheduling offset restriction and the numerology of the active UL BWP of the scheduled UL or the scheduled SUL carrier for the PUSCH transmission when receiving the DCI in slot *n*, respectively, and $μ^{'}$ is the numerology of the new active UL BWP in case of active UL BWP change in the scheduled UL or SUL carrier of the scheduled cell and is equal to $μ$, otherwise. The minimum scheduling offset restriction is not applied when PUSCH transmission is scheduled by RAR UL grant or fallbackRAR UL grant for RACH procedure, or when PUSCH is scheduled with TC-RNTI. The application delay of the change of the minimum scheduling offset restriction is determined in Clause 5.3.1.======skipped part======= |

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| **Company** | **Support or not** | **Comments** |
| Qualcomm | Not support | In our view, the overall description on the PUSCH procedures in Clause 6 in TS 38.214 is based on the *PUSCH-config*, which can either (or both) be configured on UL or SUL. Thus, throughout the entire Clause, it is tacitly assumed, without any ambiguity, that the same procedure can be applied to UL and SUL, based on their corresponding *PUSCH-config* in the active BWPs.Hence, although we symphatize the intention of the proposal, we don’t think it is quite necessary. If such clarification/distinction between UL and SUL was really necessary, it should be applied to the entire Clause 6, not just Clause 6.1.2.1. |
| Nokia | Not support | We have a similar understanding as Qualcomm that the current text is sufficient. |
| Huawei, HiSilicon | Support | The overall description on the PUSCH procedures in Clause 6 in TS 38.214 may be based on the *PUSCH-config* . However, we think the issue is the current specication uses “scheduled cell” when describing scheduling restriction of PUSCH. So, it is not clear which SCS should be used considering SUL and UL are both configured in the scheduled cell. Some clarification is needed. The current specicatio is not clear. |
| MediaTek | Support  | We are fine to have clear clarification in spec. |
| Apple | Not support | Similar understanding as Qualcomm and Nokia.  |
| Ericsson | Not support | We think the current text is sufficient. |
| ZTE, Sanechips | Not support | We also believe the current spec is clear. |

* **Issue 2:** **Restrict A-CSI-RS trigger by SRS request field for non-codebook based MIMO without cross-slot scheduling. [2]**

The issue of A-CSI-RS trigger for Non-codebook based UL MIMO and the cross slot scheduling with K > 0 was discussed in RAN1#104b-e with no consensus in change the specification. The proposal is to have additional text in UE assumption that UE does not expect to receive A-CSI-Rs resource triggered by SRS request field when UE is configured with cross-slot scheduling with K0,min >0

The text proposal for Clause 6.1.1.2 of TS38.214 is as follows,

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| 6.1.1.2  Non-Codebook based UL transmission======skipped text======If the UE configured with aperiodic SRS associated with aperiodic NZP CSI-RS resource, the presence of the associated CSI-RS is indicated by the SRS request field if the value of the SRS request field is not ‘00’ as in Table 7.3.1.1.2-24 of [5, TS 38.212] and if the scheduling DCI is not used for cross carrier or cross bandwidth part scheduling. The UE does not expect to receive the scheduling DCI with the SRS request field not being ‘00’ if UE is configured with *minimumSchedulingOffsetK0* inthe active DL BWP and the currently applicable minimum scheduling offset restriction K0min is larger than 0. The CSI-RS is located in the same slot as the SRS request field. If the UE configured with aperiodic SRS associated with aperiodic NZP CSI-RS resource, any of the TCI states configured in the scheduled CC shall not be configured with *qcl-Type* set to ‘typeD’. |

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| **Company** | **Support or not** | **Comments** |
| Qualcomm | Support with modificaiton | The text proposal requires the UE to check the conditions for the allowed SRS request values every time, in relation to the currently applicable K0min value. To avoid unnecessary complication of specification and UE implementation, we prefer to make it more static, i.e., prohibiting the configuration of aperiodic SRS associated with aperiodic NZP CSI-RS, when the minum scheduling offset restriction is configured. Note that, in Rel-16, we took the same approach for aperiodic CSI-RS triggering by CSI request (Section 5.2.1.5.1 in TS 38.214).Modified text proposal:If the UE configured with aperiodic SRS associated with aperiodic NZP CSI-RS resource, the presence of the associated CSI-RS is indicated by the SRS request field if the value of the SRS request field is not ‘00’ as in Table 7.3.1.1.2-24 of [5, TS 38.212] and if the scheduling DCI is not used for cross carrier or cross bandwidth part scheduling. If the UE is not configured with *minimumSchedulingOffsetK0* for any DL BWP and *minimumSchedulingOffsetK2* for any UL BWP, I CSI-RS is located in the same slot as the SRS request field. The UE does not expect to be configured with aperiodic SRS associated with aperiodic NAP CSI-RS resource if the UE is configured with *minimumSchedulingOffsetK0* for any DL BWP or *minimumSchedulingOffsetK2* for any UL BWP. If the UE configured with aperiodic SRS associated with aperiodic NZP CSI-RS resource, any of the TCI states configured in the scheduled CC shall not be configured with *qcl-Type* set to ‘typeD’. |
| Nokia | Tentative support | The proposal by Qualcomm falls bit back to the same discussion we had in last meeting. In last meeting we observed that was that there is no technical issue with the joint operation, and as acknowledged in the conclusion, the “only” power saving opportunities are restricted. The proposal from Qualcomm would prevent configuration of SRS associated with aperiodic NZP CSI-RS resource, if minimum scheduling slot offset is configured to any BWP. I’m not sure that we would like to see such restriction.Regarding the original CR, while I acknowledge that this CR not preferred by Qualcomm, we could change the wording to apply the condition first followed by the consequence: “If UE is configured with *minimumSchedulingOffsetK0* inthe active DL BWP and the currently applicable minimum scheduling offset restriction K0min is larger than 0, the UE does not expected to receive the scheduling DCI with the SRS request field value other than ‘00’” |
| Huawei, HiSilicon |  | We share similar view with Nokia that Qualcomm’s proposal seems restrict the configuration, which is different from the conclusion in the last meeting. |
| MediaTek | Support | We are fine with Nokia’s revisions. |
| Apple | Support | We support the text proposal, also OK with Nokia’s revision (move condition to the beginning of the sentence). It is important to clarify that UE does not expect to receive A-CSI-RS resource triggered by SRS request field when UE is configured with cross-slot scheduling with K0,min >0. Qualcomm’s proposal also work in this purpose to restrict configuration itself. To move forward, the original proposal may be a better way to converge as it put less restriction to NCB UL MIMO.   |
| Ericsson | Support | OK with Nokia revision.Regarding Qualcomm proposal, it is another option to have restriction on configuration, however our preference would be to avoid restricted configuration since cross-slot (or not) can be itself dynamically adapted via DCI. |
| ZTE, Sanechips | Not support | We think we had spent much time to discuss this issue in the last meeting with different options, but there is no consensus.We think this proposal CR is fundamentally the same with one of the option discussed in the last meeting. Hence, we prefer to not repeating the discussion. |

* **Issue 3:** **The condition of default A-CSI-RS offset value 0 is “or” or “and” when the UE is not configured with minimumSchedulingOffsetK0 for any DL BWP or/and minimumSchedulingOffsetK2 for any UL BWP [3]**

**Proposal: Email discussion the condition is “or” or “and” for minimumSchedulingOffsetK0, minimumSchedulingOffsetK2**

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| **TP for Clause 5.2.1.5.1 of TS38.214**<omit unchanged text>When aperiodic CSI-RS is used with aperiodic reporting, the CSI-RS offset is configured per resource set by the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffset-r16*. The CSI-RS triggering offset has the values of {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} slots. If the UE is not configured with *minimumSchedulingOffsetK0* for any DL BWP ~~or~~ and *minimumSchedulingOffsetK2* for any UL BWP and if all the associated trigger states do not have the higher layer parameter *qcl-Type* set to ‘typeD’ in the corresponding TCI states, the CSI-RS triggering offset is fixed to zero.<omit unchanged text> |

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| **Company** | **Support or not** | **Comments** |
| Qualcomm | Support | According to the agreements in RAN1 #99, we believe the text proposal is the correct:Agreements:If all the associated trigger states do not have the higher layer parameter *qcl-Type* set to ‘QCL-TypeD’ in the corresponding TCI states and the PDCCH SCS is equal to the CSI-RS SCS, the aperiodic CSI-RS triggering offset can be set to a non-zero value when* Any BWP is configured with at least one minimum applicable K0/K2 value
 |
| Nokia | Support |  |
| Huawei, HiSilicon | OK | We are in general fine. However, if we want to clarify, why not to make it more clear as that in [3]:<omit unchanged text>When aperiodic CSI-RS is used with aperiodic reporting, the CSI-RS offset is configured per resource set by the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffset-r16*. The CSI-RS triggering offset has the values of {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} slots. If the UE is not configured with *minimumSchedulingOffsetK0* for any DL BWP ~~or~~ and if the UE is not configured with *minimumSchedulingOffsetK2* for any UL BWP and if all the associated trigger states do not have the higher layer parameter *qcl-Type* set to ‘typeD’ in the corresponding TCI states, the CSI-RS triggering offset is fixed to zero.<omit unchanged text> |
| MediaTek | Support |  |
| Apple | Support  |  |
| Ericsson | Support | Slight preference to take the TP from [3] directly for more clarity. |
| ZTE, Sanechips | Okay to support | Okay with the version provided by Ericsson or Huawei. |

# Email Discussion during Preparation[105-e-Prep\_NR\_UE\_Pow\_Sav]

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| **Company** | **Supporting Issues and draft CR** | **Comments** |
| ZTE, Sanechips | Issue 1, 3 | Okay to discuss issue 1, 3.Regarding issue 2, we share the same view with moderator that it’s not needed to re-open the discussion, the conclusion/discussion in the last meeting is clear. |
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# Summary of Open Issues

* **Issue 1: The proposed CR for applicable K2min in TS 38.214 when SUL is configured [1]**

If SUL is configured, both UL and SUL belongs to the same serving cell with separate BWP configurations. K2min is also configured separately for UL and SUL. , K2min needs to be clarified when DCI schedules a PUSCH on either UL or SUL.

 **Prospoal for email discussion with the draft CR.**

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| 6.1.2.1 Resource allocation in time domain======skipped part=======When the UE is configured with *minimumSchedulingOffsetK2* in an active UL BWP it applies a minimum scheduling offset restriction indicated by the '*Minimum applicable scheduling offset indicator*' field in DCI format 0\_1 or DCI format 1\_1 if the same field is available. When the UE configured with *minimumSchedulingOffsetK2* in an active UL BWP and it has not received '*Minimum applicable scheduling offset indicator*' field in DCI format 0\_1 or 1\_1, the UE shall apply a minimum scheduling offset restriction indicated based on '*Minimum applicable scheduling offset indicator*' value '0'. When the minimum scheduling offset restriction is applied the UE is not expected to be scheduled with a DCI in slot *n* to transmit a PUSCH scheduled with C-RNTI, CS-RNTI, MCS-C-RNTI or SP-CSI-RNTI with *K*2 smaller than$\left⌈K\_{2min}⋅\frac{2^{μ^{'}}}{2^{μ}}\right⌉$, where *K*2min and $μ$ are the applied minimum scheduling offset restriction and the numerology of the active UL BWP of the scheduled cell when receiving the DCI in slot *n*, respectively, and $μ^{'}$ is the numerology of the new active UL BWP in case of active UL BWP change in the scheduled cell and is equal to $μ$, otherwise. If the UE is configured with *supplementaryUplink* in *ServingCellConfig* in the cell, *K*2min and $μ$ are the applied minimum scheduling offset restriction and the numerology of the active UL BWP of the scheduled UL or the scheduled SUL carrier for the PUSCH transmission when receiving the DCI in slot *n*, respectively, and $μ^{'}$ is the numerology of the new active UL BWP in case of active UL BWP change in the scheduled UL or SUL carrier of the scheduled cell and is equal to $μ$, otherwise. The minimum scheduling offset restriction is not applied when PUSCH transmission is scheduled by RAR UL grant or fallbackRAR UL grant for RACH procedure, or when PUSCH is scheduled with TC-RNTI. The application delay of the change of the minimum scheduling offset restriction is determined in Clause 5.3.1.======skipped part======= |

* **Issue 2:** **Restrict A-CSI-RS trigger by SRS request field for non-codebook based MIMO without cross-slot scheduling. [2]**

The issue of A-CSI-RS trigger for Non-codebook based UL MIMO and the cross slot scheduling with K > 0 was discussed in RAN1#104b-e with no consensus in change the specification.

**Proposal: No further discussion in RAN1#105e**

* **Issue 3:** **The condition of default A-CSI-RS offset value 0 is “or” or “and” when the UE is not configured with minimumSchedulingOffsetK0 for any DL BWP or/and** **minimumSchedulingOffsetK2 for any UL BWP [3]**

**Proposal: Email discussion the condition is “or” or “and” for minimumSchedulingOffsetK0, minimumSchedulingOffsetK2**

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| **TP for Clause 5.2.1.5.1 of TS38.214**<omit unchanged text>When aperiodic CSI-RS is used with aperiodic reporting, the CSI-RS offset is configured per resource set by the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffset-r16*. The CSI-RS triggering offset has the values of {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} slots. If the UE is not configured with *minimumSchedulingOffsetK0* for any DL BWP ~~or~~ and *minimumSchedulingOffsetK2* for any UL BWP and if all the associated trigger states do not have the higher layer parameter *qcl-Type* set to 'typeD' in the corresponding TCI states, the CSI-RS triggering offset is fixed to zero.<omit unchanged text> |

# Contributions summary and proposals

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| Huawei, HiSilicon [1] | * Proposal 1: The proposed CR for applicable K2min in TS 38.214 when SUL is configured.
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| Apple [2] | * Proposal 1: Explicitly specify that A-CSI-RS is located in the same slot as the SRS request field to the case where cross-slot scheduling is not configured, or when current applicable K0min = 0.
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| Ericsson[3] | * Proposal : Adopt below TP for 38.214-g50, subclause 5.2.1.5.1 when A-CSI-RS for non-codebook-based MIMO and cross-slot scheduling is configured
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# Reference

1. R1-2104254 Remaining issues for Rel-16 UE power saving Huawei, HiSilicon
2. R1-2105086 Maintenace of UE power saving for NR Apple
3. R1-2105788 Maintenance for Rel-16 UE power savings Ericsson