3GPP TSG RAN WG1 #101 DRAFT R1-2004640

e-Meeting, May 25th – June 5th, 2020

**Agenda item: 7.2.10.4**

**Source: Moderator (Nokia)**

**Title: FL summary on aperiodic CSI-RS triggering with different numerology between CSI-RS and triggering PDCCH**

**Document for: Discussion and Decision**

# 1 Introduction

This contribution is the RAN1#101 meeting discussion summary for the AI7.2.10.4 on aperiodic CSI-RS triggering with different numerology between CSI-RS and triggering PDCCH.

# 2 Discussion on identified issues

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| **Issue #** | **Description** | **Source** |
| #1 | For cross-carrier A-CSI-RS triggering with different SCS, RRC parameter [enableDefaultBeamForCCS] is used to enable the default QCL assumption. | Vivo |
| #2 | **Proposal 2 (vivo):** Capture the default QCL assumption for cross-carrier A-CSI-RS triggering with same SCS when the scheduling offset is smaller than the threshold and no CORESET is configured on A-CSI-RS carrier.  **Proposal 2 (Qualcomm):** In case of same numerology A-CSI RS triggering, when the offset between A-CSI RS and triggering DCI is less than *beamSwitchTiming,* capture the default QCL agreement in specification.   * If no CORESET configured on the carrier for receiving the A-CSI RS, UE receives the A-CSI RS by applying the QCL parameters of the activated PDSCH TCI state with lowest ID. | Vivo, Qualcomm |
| #4 | RRC parameter name alignment   * ~~CORESET ID~~ 🡺 controlResourceSetID * minimumSchedulingOffset 🡺 minimumSchedulingOffsetK0-r16 | Oppo |
| #5 | Correct the indentation level for three bullets for default QCL assumption determination. | Huawei, Qualcomm |
| #6 | Introduction of a missing RRC parameter in three places   * aperiodicTriggeringOffset or aperiodicTriggeringOffsetExt-r16 | Ericsson |
| #7 | A case of missing +d in one *timeDurationForQCL+*  Note: this was not in the original FL summary as it got dropped between the lines. I am proposing to look at this anyway, as it got lost due to FL mistake | Oppo |

## 2.1 Issue #1

* For cross-carrier A-CSI-RS triggering with different SCS, RRC parameter [enableDefaultBeamForCCS] is used to enable the default QCL assumption.

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| **TS 38.214**  **5.2.1.5.1a Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies**  < Unchanged parts are omitted >  Beam switch timing:  - If the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources in a *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* is smaller than the UE reported threshold *beamSwitchTiming* +  in CSI-RS symbols*,* as defined in [13, TS 38.306], when the reported value is one of the values of {14, 28, 48}, or is smaller than 48+ in CSI-RS symbolswhen the reported value of *beamSwitchTiming* is one of the values of {224, 336} and where if the µPDCCH < µCSIRS, the beam switching timing delay *d* is defined in Table 5.2.1.5.1a-1, else *d* is zero  - if one of the associated trigger states has the higher layer parameter *qcl-Type* set to 'QCL-TypeD',  - if there is any other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies the QCL assumption of the other DL signal also when receiving the aperiodic CSI-RS. The other DL signal refers to PDSCH scheduled with offset larger than or equal to the threshold *timeDurationForQCL,* as defined in [13, TS 38.306], aperiodic CSI-RS scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming* + in CSI-RS symbols when the reported value is one of the values {14,28,48}, aperiodic CSI-RS scheduled with offset larger than or equal to 48+ in CSI-RS symbols when the reported value of *beamSwitchTiming* is one of the values {224, 336}, periodic CSI-RS, semi-persistent CSI-RS;  - else,  - if at least one CORESET is configured for the BWP in which the aperiodic CSI-RS is to be received, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption used for the CORESET associated with a monitored search space with the lowest *CORESET-ID* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored.  - else if the UE is configured with *[enableDefaultBeamForCCS]*, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption of the lowest-ID activated TCI state applicable to the PDSCH within the active BWP of the cell in which the CSI-RS is to be received.  < Unchanged parts are omitted > |

**FL proposal:** Adopt the text proposal above to TS 38214 subclause 5.2.1.5.1a

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| **Company** | **Comment** |
| Qualcomm | We are fine with this proposal. |
| Ericsson | Support |
| MTK | We agree on this proposal. |
| vivo | Support |

## 2.2 Issue #2

* Capture the default QCL assumption for cross-carrier A-CSI-RS triggering with same SCS when the scheduling offset is smaller than the threshold and no CORESET is configured on A-CSI-RS carrier.
* RRC parameter [enableDefaultBeamForCCS] is used to enable the default QCL assumption for cross-carrier A-CSI-RS triggering with same SCS.

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| **Vivo [1]** | **Qualcomm [5]** |
| **5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have the same numerology**  < Unchanged parts are omitted >  - If the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources in a *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* is smaller than the UE reported threshold *beamSwitchTiming,* as defined in [13, TS 38.306], when the reported value is one of the values of {14, 28, 48}, or is smaller than 48 when the reported value of *beamSwitchTiming* is one of the values of {224, 336}.  - if there is any other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies the QCL assumption of the other DL signal also when receiving the aperiodic CSI-RS. The other DL signal refers to PDSCH scheduled with offset larger than or equal to the threshold *timeDurationForQCL,* as defined in [13, TS 38.306], aperiodic CSI-RS scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming* when the reported value is one of the values {14,28,48}, aperiodic CSI-RS scheduled with offset larger than or equal to 48 when the reported value of *beamSwitchTiming* is one of the values {224, 336}, periodic CSI-RS, semi-persistent CSI-RS; | |
| - else if the UE is configured with *[enableDefaultBeamForCCS]*,  - if at least one CORESET is configured for the BWP in which the aperiodic CSI-RS is to be received, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption used for the CORESET associated with a monitored search space with the lowest *controlResourceSetId* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored;  - else, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption of the lowest-ID activated TCI state applicable to the PDSCH within the active BWP of the cell in which the CSI-RS is to be received.  - else, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption used for the CORESET associated with a monitored search space with the lowest controlResourceSetId in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored. | - else if the active BWP of the serving cell for receiving the aperiodic CSI-RS has configured ControlResourceSet, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption used for the CORESET associated with a monitored search space with the lowest controlResourceSetId in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored;  - else if the UE is configured with [*enableDefaultBeamForCCS*] and when receiving the aperiodic CSI-RS, the UE applies the QCL assumption of the lowest-ID activated TCI state applicable to the PDSCH within the active BWP of the cell in which the CSI-RS is to be received. |

**FL proposal:** Agree on the intent, and develop a TP to TS 38214 subclause 5.2.1.5.1

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| **Company** | **Comment** |
| Qualcomm | We are fine with both proposals. But the right side one is more compact by avoiding duplicate description for common behaviour between Rel-15 and Rel-16. Besides, the use of the flag [*enableDefaultBeamForCCS*] is consistent with proposal for Issue #1. Therefore, we prefer to adopt the right side proposal.  FYI, the related RAN1 agreement is attached below for reference.  Agreements  For cross carrier aperiodic CSI-RS with triggering time offset smaller the threshold**,** with A-CSI RS contains QCL-typeD information:   * If there is any other DL signal in the same symbols as the CSI-RS in the scheduled cell, the UE applies the QCL assumption of the other DL signal on the aperiodic CSI-RS.   + The definition of “other DL signal” is same as Rel-15 * Otherwise,   + if CORESET is configured in the A CSI-RS carrier, the UE follows existing spec text. I.e., A CSI-RS follows QCL assumption of the lowest ID CORESET in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored.   + If CORESET is not configured in the A-CSI-RS carrier, apply the QCL assumption in the activated TCI state with the lowest ID applicable to PDSCH in the active BWP of the serving cell with the A-CSI-RS transmission |
| Ericsson | Agree to the FL proposal. Note that we write CORESET and not ControlResourceSet in RAN1 specs. We do write *ControlResourceSetId* when we refer to the RRC field name, though. |
| MTK | We are fine with both proposals. But we slightly prefer the proposal from QC [5] since it seems to match the RAN1 agreement better from our view. |
| vivo | Support the FL proposal. |

## 2.3 Void

## 2.4 Issue #4

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| 5.2.1.5.1a Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies  When the triggering PDCCH and the triggered aperiodic CSI-RS are of different numerologies, the behavior defined in 5.2.1.5.1 for the case where the numerologies are the same applies with the following exceptions:  Beam switch timing:  *(omitted part)*  - else,  - if at least one CORESET is configured for the BWP in which the aperiodic CSI-RS is to be received, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption used for the CORESET associated with a monitored search space with the lowest *controlResourceSetId*  in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored.  *(omitted part)*  Aperiodic CSI-RS timing:  - When the aperiodic CSI-RS is used with aperiodic CSI reporting, the CSI-RS triggering offset *X* is configured per resource set by the higher layer parameter *aperiodicTriggeringOffset,* including the case that the UE is not configured with *minimumSchedulingOffsetK0-r16* for any DL or UL BWP and all the associated trigger states do not have the higher layer parameter *qcl-Type* set to 'QCL-TypeD' in the corresponding TCI states.. The CSI-RS triggering offset has the values of {0, 1,…,31} slots when the µPDCCH < µCSIRS and {0, 1, 2, 3, 4, 16, 24} when the µPDCCH > µCSIRS.. The aperiodic CSI-RS is transmitted in a slot , if UE is configured with ca-SlotOffset for at least one of the triggered and triggering cell, and *Ks* = , otherwise, and where  *(omitted part)* |

**FL proposal:** Agree on the TP above to TS 38214 subclause 5.2.1.5.1a fixing two RRC parameter names

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| **Company** | **Comment** |
| Qualcomm | We are fine with the proposal. |
| Ericsson | Support |
| MTK | We agree on this proposal. |
| vivo | Fine |

## 2.5 Issue #5

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| **5.2.1.5.1a Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies**  When the triggering PDCCH and the triggered aperiodic CSI-RS are of different numerologies, the behavior defined in 5.2.1.5.1 for the case where the numerologies are the same applies with the following exceptions:  Beam switch timing:  - If the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources in a *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* is smaller than the UE reported threshold *beamSwitchTiming* + in CSI-RS symbols*,* as defined in [13, TS 38.306], when the reported value is one of the values of {14, 28, 48}, or is smaller than 48+ in CSI-RS symbolswhen the reported value of *beamSwitchTiming* is one of the values of {224, 336} and where if the µPDCCH < µCSIRS, the beam switching timing delay *d* is defined in Table 5.2.1.5.1a-1, else *d* is zero  - if one of the associated trigger states has the higher layer parameter *qcl-Type* set to 'QCL-TypeD',  - if there is any other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies the QCL assumption of the other DL signal also when receiving the aperiodic CSI-RS. The other DL signal refers to PDSCH scheduled with offset larger than or equal to the threshold *timeDurationForQCL,* as defined in [13, TS 38.306], aperiodic CSI-RS scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming* + in CSI-RS symbols when the reported value is one of the values {14,28,48}, aperiodic CSI-RS scheduled with offset larger than or equal to 48+ in CSI-RS symbols when the reported value of *beamSwitchTiming* is one of the values {224, 336}, periodic CSI-RS, semi-persistent CSI-RS;  - else,  - if at least one CORESET is configured for the BWP in which the aperiodic CSI-RS is to be received, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption used for the CORESET associated with a monitored search space with the lowest *CORESET-ID* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored.  - else, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption of the lowest-ID activated TCI state applicable to the PDSCH within the active BWP of the cell in which the CSI-RS is to be received.  - If the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources is equal to or greater than the UE reported threshold *beamSwitchTiming* + in CSI-RS symbols, when the reported value is one of the values of {14,28,48}, or is equal to or greater than 48+ in CSI-RS symbols when the reported value of *beamSwitchTiming* is one of the values of {224, 336}, the UE is expected to apply the QCL assumptions in the indicated TCI states for the aperiodic CSI-RS resources in the CSI triggering state indicated by the CSI trigger field in DCI.  <Unchanged parts omitted> |

**FL proposal:** Agree on the TP above correcting the indentation on the three bullets to TS 38214 subclause 5.2.1.5.1a

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| **Company** | **Comment** |
| Qualcomm | The proposal is needed so that spec follows RAN1 agreement.  The related RAN1 agreement is attached below for reference.  Agreements  For cross carrier aperiodic CSI-RS with triggering time offset smaller the threshold**,** with A-CSI RS contains QCL-typeD information:   * If there is any other DL signal in the same symbols as the CSI-RS in the scheduled cell, the UE applies the QCL assumption of the other DL signal on the aperiodic CSI-RS.   + The definition of “other DL signal” is same as Rel-15 * Otherwise,   + if CORESET is configured in the A CSI-RS carrier, the UE follows existing spec text. I.e., A CSI-RS follows QCL assumption of the lowest ID CORESET in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored.   + If CORESET is not configured in the A-CSI-RS carrier, apply the QCL assumption in the activated TCI state with the lowest ID applicable to PDSCH in the active BWP of the serving cell with the A-CSI-RS transmission |
| Ericsson | Support |
| MTK | We agree on this proposal |
| vivo | OK |

## 2.6 Issue #6

Introduction of a missing RRC parameter in three places

* aperiodicTriggeringOffset or aperiodicTriggeringOffsetExt-r16

Shown below with the cyan highlight on top of the April-agreed CR revision marks

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| 5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have the same numerology <omitted 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 *aperiodicTriggeringOffsetExt-r16*. The CSI-RS triggering offset has the values of {0, 1, 2, 3, 4, 16, 24} slots. If the UE is not configured with [*minimumSchedulingOffset*] for any DL or UL BWP and if all the associated trigger states do not have the higher layer parameter *qcl-Type* set to 'QCL-TypeD' in the corresponding TCI states , the CSI-RS triggering offset is fixed to zero. The aperiodic triggering offset of the CSI-IM follows offset of the associated NZP CSI-RS for channel measurement.  <omitted text> 5.2.1.5.1a Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies <omitted text>  Aperiodic CSI-RS timing:  - When the aperiodic CSI-RS is used with aperiodic CSI reporting, the CSI-RS triggering offset *X* is configured per resource set by the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffsetExt-r16,* including the case that the UE is not configured with [*minimumSchedulingOffset*] for any DL or UL BWP and all the associated trigger states do not have the higher layer parameter *qcl-Type* set to 'QCL-TypeD' in the corresponding TCI states.. The CSI-RS triggering offset has the values of {0, 1,…,31} slots when the µPDCCH < µCSIRS and {0, 1, 2, 3, 4, 16, 24} when the µPDCCH > µCSIRS.. The aperiodic CSI-RS is transmitted in a slot , if UE is configured with ca-SlotOffset for at least one of the triggered and triggering cell, and *Ks* = , otherwise, and where  *- n* is the slot containing the triggering DCI, *X* is the CSI-RS triggering offset in the numerology of CSI-RS according to the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffsetExt-r16*,  - and are the subcarrier spacing configurations for CSI-RS and PDCCH, respectively,  <omitted text> |

**FL proposal:** Agree on the TP above adding or aperiodicTriggeringOffsetExt-r16 in three different places in TS 38.214 subclauses 5.2.1.5.1 and 5.2.1.5.1a

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| **Company** | **Comment** |
| Qualcomm | We agree new parameters for Rel-16 should be captured in spec, but it is unclear why this parameter should be discussed in current cross-carrier A-CSIRS agenda.  It would be necessary if the proponent can clarify the background about the proposal. In particular, could you please provide the RAN1 agreement information related to *aperiodicTriggeringOffsetExt-r16* and was the discussion for this parameter made in current agenda?  If our understanding is correct, the paper for Issue #6 proposal has referred to R1-2003138 for this new RRC parameter. However, we foud R1-2003138 did not mention *aperiodicTriggeringOffsetExt-r16*. |
| Ericsson | The new RRC parameter was introduced in this topic (see RRC parameter list [R1-2003190](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2003190.zip), row 12 in NRDCCA tab) and hence the alignment proposal is made here. The extended values are also in 3138, but since the parameter belongs to this WI, the alignment is proposed here. |
| MTK | We are fine with the proposal |
| vivo | OK |

## 2.7 Issue #7

The following was not present in the feature lead summary:

* a case of missing *timeDurationForQCL+*

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| 5.2.1.5.1a Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies  When the triggering PDCCH and the triggered aperiodic CSI-RS are of different numerologies, the behavior defined in 5.2.1.5.1 for the case where the numerologies are the same applies with the following exceptions:  Beam switch timing:  - If the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources in a *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* is smaller than the UE reported threshold *beamSwitchTiming* +  in CSI-RS symbols*,* as defined in [13, TS 38.306], when the reported value is one of the values of {14, 28, 48}, or is smaller than 48+ in CSI-RS symbolswhen the reported value of *beamSwitchTiming* is one of the values of {224, 336} and where if the µPDCCH < µCSIRS, the beam switching timing delay *d* is defined in Table 5.2.1.5.1a-1, else *d* is zero  - if one of the associated trigger states has the higher layer parameter *qcl-Type* set to 'QCL-TypeD',  - if there is any other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies the QCL assumption of the other DL signal also when receiving the aperiodic CSI-RS. The other DL signal refers to PDSCH scheduled with offset larger than or equal to the threshold *timeDurationForQCL+,* as defined in [13, TS 38.306], aperiodic CSI-RS scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming* +  in CSI-RS symbols when the reported value is one of the values {14,28,48}, aperiodic CSI-RS scheduled with offset larger than or equal to 48+ in CSI-RS symbols when the reported value of *beamSwitchTiming* is one of the values {224, 336}, periodic CSI-RS, semi-persistent CSI-RS;  *(omitted part)* |

**FL proposal:** Agree on the TP above to TS 38214 subclause 5.2.1.5.1a

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| **Company** | **Comment** |
| Qualcomm | We agree with the intension of the TP, but it is better to clarify a few points first.  We noticed the following text in TS 38.214 where is added to *timeDurationForQCL.* It seems with this text, *timeDurationForQCL* now has inlucded whenever applicable.  If the TP is accepted, it means that *timeDurationForQCL* in the TP is the original value, i.e., no double additional of .   * The *timeDurationForQCL* is determined based on the subcarrier spacing of the scheduled PDSCH. If μPDCCH < μPDSCH an additional timing delay is added to the *timeDurationForQCL*, where *d* is defined in 5.2.1.5.1a-1;   There are also several other places in TS 38.214 with wording like   * and the time offset between the reception of the DL DCI and the corresponding PDSCH is equal to or greater than *timeDurationForQCL* if applicable,   If we adopt the TP, should we change all the other places with *timeDurationForQCL* in the spec? |
| Ericsson | We agree with Qualcomm. Since timeDurationForQCL is a capability, it would seem inappropriate to add anything to it – it is constant. We support a review of the specification to include the offset explicitly in the appropriate places. |
| MTK | Same view as QC and Ericsson. |
| vivo | Not fine. |

# References

1. R1-2003412 Remaining issues on aperiodic CSI-RS triggering, vivo
2. R1-2004058 Text proposals for aperiodic CSI-RS triggering with different numerologies, OPPO
3. R1-2004150 Remaining issues on the A-CSI RS triggering with different numerology, Huawei, HiSilicon
4. R1-2004204 Maintenance for cross-carrier CSI-RS triggering, Ericsson
5. R1-2004475 Remaining issues for aperiodic CSI-RS triggering with different numerology, Qualcomm Inc.
6. R1-2004638 FL summary on aperiodic CSI-RS triggering with different numerology between CSI-RS and triggering PDCCH, Moderator (Nokia)