**3GPP TSG RAN WG1 #102-e R1-200xxxx**

e-Meeting, August 17th – 28th, 2020

Source: Moderator (NTT DOCOMO, INC.)

Title: Summary on [102-e-NR-TEI-02]

Agenda Item: 7.2.12

**Document for:** **Discussion and Decision**

# **Introduction**

This contribution summarizes the following email discussion/approval in AI 7.2.12.

[102-e-NR-TEIs-02] Email discussion/approval for potential CR(s) for aperiodic CSI-RS/TRS triggering with beam switching timing of 224 and 336 (17th-21st August) – Hiroki (DCM)

* TP in R1-2005453 for aperiodic CSI-RS triggering with beam switching timing of 224 and 336 is adopted for 38.214
* Whether TP in R1-2005453 for aperiodic TRS triggering with beam switching timing of 224 and 336 is adopted for 38.214 or not

# **Aperiodic CSI-RS triggering with beam switching timing of 224 and 336**

In [2], it is pointed that the endorsed TP for 38.214 in R1-2004831 was incorrectly captured in the editor CR for 38.214 in R1-2005162. Therefore, the TP based on R1-2004831 is provided.

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| In RAN1#101-e, based on the agreements mentioned in the Section 1, the following TP for TS 38.214 has been endorsed in R1-2004831 (also mentioned in the Chairman note [2]). But, unfortunately, this TP is incorrectly captured in the editor CR R1-2005162 and the corresponding specification TS 38.214.

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| -   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} and *enableBeamSwitchTiming-r16* is not provided, or is smaller than 48 when the reported value of *beamSwitchTiming-r16* is one of the values of {224,   336} and *enableBeamSwitchTiming-r16* is provided.     -   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} and *enableBeamSwitchTiming-r16* is not provided, aperiodic CSI-RS scheduled with offset larger than or equal to 48 when the reported value of *beamSwitchTiming-r16* is one of the values {224, 336} and *enableBeamSwitchTiming-r16* is provided, periodic CSI-RS, semi-persistent CSI-RS;    -   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.-   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* when the reported value is one of the values of {14,28,48} and *enableBeamSwitchTiming-r16* is not provided, or is equal to or greater than 48 when the reported value of *beamSwitchTiming-r16* is one of the values of {224, 336} and *enableBeamSwitchTiming-r16* is provided, 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. |

Consequently, we have the following text proposals according to the endorsed TP in R1-2004831.***TP 1: {****38.214: 5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have the same numerology}*

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| - 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} and *enableBeamSwitchTiming-r16* is not provided, or is smaller than 48 when the reported value of *beamSwitchTiming-r16* is one of the values of {224, 336} and *enableBeamSwitchTiming-r16* is provided.- 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} and *enableBeamSwitchTiming-r16* is not provided, aperiodic CSI-RS scheduled with offset larger than or equal to 48 when the reported value of *beamSwitchTiming-r16* is one of the values {224, 336} and *enableBeamSwitchTiming-r16* is provided, 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 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 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.- 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* when the reported value is one of the values of {14,28,48} and *enableBeamSwitchTiming-r16* is not provided, or is equal to or greater than 48 when the reported value of *beamSwitchTiming-r16* is one of the values of {224, 336} and *enableBeamSwitchTiming-r16* is provided, 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. |

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Based on the above contributions, it is agreed to discuss following point in the email discussion [9].

**Discussion point**

* **TP in R1-2005453 for aperiodic CSI-RS triggering with beam switching timing of 224 and 336 is adopted for 38.214**

Companies provided following views during the preparation phase discussion [9].

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Essential. |
| Intel | Agree to discuss. |
| Nokia | Agree to discuss |
| ZTE | Agree to discuss |
| vivo | Agree to discuss. |
| OPPO | Agree to discuss |
| Huawei, HiSilicon | Perhaps it would suffice to simply remind the editor about the mismatch, instead of dedicating one thread to discuss this.  |

## 2.1 Proposal and discussion

Based on contribution and above inputs during preparation phase discussion, following proposal is made.

### **FL proposal 1:**

* **TP in R1-2005453 for aperiodic CSI-RS triggering with beam switching timing of 224 and 336 is adopted for 38.214**

Companies are encouraged to check above FL proposal and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | We support FL proposal.  |
| Spreadtrum | Support |
| Moderator | Thanks for the inputs!It seems this FL proposal is acceptable to all. |

# **Aperiodic TRS triggering with beam switching timing of 224 and 336**

In [2], it is proposed to align the UE behavior for beam switching timing of 224 and 336 for aperiodic TRS with that for aperiodic CSI-RS, and the corresponding TP for 38.214 5.1.6.1.1 is provided.

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| In RAN1#101-e, the following agreements were reached for beam switching timing for aperiodic TRS in Rel-15. But, how to address this issue in Rel-16 is still FFS. **Agreement**The following text proposal is endorsed. Final CR is agreed in R1-2004910 (TS38.214, Rel-15, CR#0104, Cat. F).

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| Periodic CSI-RS resource in one set and aperiodic CSI-RS resources in a second set, with the aperiodic CSI-RS and periodic CSI-RS resource having the same bandwidth (with same RB location)and the aperiodic CSI-RS being 'QCL-Type-A' and 'QCL-TypeD', where applicable, with the periodic CSI-RS resources. For frequency range 2, the UE does not expect that 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 smaller than the UE reported*~~ThresholdSched-Offset~~beamSwitchTiming*. The UE shall expect that the periodic CSI-RS resource set and aperiodic CSI-RS resource set are configured with the same number of CSI-RS resources and with the same number of CSI-RS resources in a slot. For the aperiodic CSI-RS resource set if triggered, and if the associated periodic CSI-RS resource set is configured with four periodic CSI-RS resources with two consecutive slots with two periodic CSI-RS resources in each slot, the higher layer parameter *aperiodicTriggeringOffset* indicates the triggering offset for the first slot for the first two CSI-RS resources in the set. |

* FFS: How to address this issue in Rel-16

The UE behavior for beam switching timing of 224 and 336 for aperiodic TRS should be aligned with that for aperiodic CSI-RS straightforwardly. Consequently, we have the following TP.***TP 2: {****38.214: 5.1.6.1.1 CSI-RS for tracking}*

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| - Periodic CSI-RS resource in one set and aperiodic CSI-RS resources in a second set, with the aperiodic CSI-RS and periodic CSI-RS resource having the same bandwidth (with same RB location) and the aperiodic CSI-RS being 'QCL-Type-A' and 'QCL-TypeD', where applicable, with the periodic CSI-RS resources. For frequency range 2, the UE does not expect that 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 smaller than the UE reported *beamSwitchTiming,* as defined in [13, TS 38.306], when the reported value is one of the values of {14, 28, 48} and *enableBeamSwitchTiming-r16* is not provided, or is smaller than 48 when the reported value of *beamSwitchTiming-r16* is one of the values of {224, 336} and *enableBeamSwitchTiming-r16* is provided. The UE shall expect that the periodic CSI-RS resource set and aperiodic CSI-RS resource set are configured with the same number of CSI-RS resources and with the same number of CSI-RS resources in a slot. For the aperiodic CSI-RS resource set if triggered, and if the associated periodic CSI-RS resource set is configured with four periodic CSI-RS resources with two consecutive slots with two periodic CSI-RS resources in each slot, the higher layer parameter *aperiodicTriggeringOffset* indicates the triggering offset for the first slot for the first two CSI-RS resources in the set. |

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Based on the above contributions, it is agreed to discuss following point in the email discussion [9].

**Discussion point**

* **Whether TP in R1-2005453 for aperiodic TRS triggering with beam switching timing of 224 and 336 is adopted for 38.214 or not**

Companies provided following views during the preparation phase discussion [9].

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Necessary to discuss. |
| Intel | Agree to discuss. |
| Nokia | Agree to discuss |
| ZTE | Agree to discuss |
| vivo | Agree to discuss. |
| OPPO | Agree to discuss |
| Huawei, HiSilicon | OK to discuss |

## 3.1 Proposal and discussion

Based on contribution and above inputs during preparation phase discussion, following proposal is made.

**FL proposal 2:**

* **TP in R1-2005453 for aperiodic TRS triggering with beam switching timing of 224 and 336 is adopted for 38.214**

Companies are encouraged to check above FL proposal and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Regarding beamSwitchTimnig for TRS, we would like clarify whether the understanding is correct.In 38.214 section 5.2.1.5.1, following is captured, which means the description is applicable when trs-Info is not configured: 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], …And, following is captured in 38.306, which means sym224, sym336 are only valid for aperiodic CSI-RS configured with repetition ON, which is not applicable for TRS: *beamSwitchTiming* of value (*sym224* or *sym336*) indicates the minimum number of required OFDM symbols between the DCI triggering aperiodic CSI-RS and the corresponding aperiodic CSI-RS transmission in a CSI-RS resource set configured with repetition 'ON' |
| Huawei, HiSilicon | We share similar question as vivo, and wish to see more clarifications. So far, our understanding is similar to vivo that *sym224* and *sym336* are not valid for aperiodic TRS, with which the 2nd half of the TP should be removed as below. - Periodic CSI-RS resource in one set and aperiodic CSI-RS resources in a second set, with the aperiodic CSI-RS and periodic CSI-RS resource having the same bandwidth (with same RB location) and the aperiodic CSI-RS being 'QCL-Type-A' and 'QCL-TypeD', where applicable, with the periodic CSI-RS resources. For frequency range 2, the UE does not expect that 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 smaller than the UE reported *beamSwitchTiming,* as defined in [13, TS 38.306], when the reported value is one of the values of {14, 28, 48} ~~and~~ *~~enableBeamSwitchTiming-r16~~* ~~is not provided, or is smaller than 48 when the reported value of~~ *~~beamSwitchTiming-r16~~* ~~is one of the values of {224, 336} and~~ *~~enableBeamSwitchTiming-r16~~* ~~is provided~~. The UE shall expect that the periodic CSI-RS resource set and aperiodic CSI-RS resource set are configured with the same number of CSI-RS resources and with the same number of CSI-RS resources in a slot. For the aperiodic CSI-RS resource set if triggered, and if the associated periodic CSI-RS resource set is configured with four periodic CSI-RS resources with two consecutive slots with two periodic CSI-RS resources in each slot, the higher layer parameter *aperiodicTriggeringOffset* indicates the triggering offset for the first slot for the first two CSI-RS resources in the set. |
| Apple | We are fine with Huawei TP |
| ZTE | We support FL proposal. In our views, the *sym224* and *sym336* are both valid for aperiodic TRS, taking into account that frequency and time tracking is very useful for the subsequent data transmission for the newly activated panel. The motivation of AP-TRS is to handle this sudden event. |
| OPPO | Share the same view as vivo and Huawei. gNB doesn’t need to activate an inactive panel at UE side for the reception of A-TRS. We are fine with the revised TP from Huawei.  |
| Intel | Agree with TP from Huawei |
| Spreadtrum | Fine with TP from Huawei |
| ZTE2 | Firstly, for AP-TRS, there is no default QCL assumption (as vivo mentioned) due to the fact that the gNB should trigger AP-TRS more than or equal to the threshold for default beam. In other words, for FL proposal-2, it is not to ask UE of supporting AP-TRS transmission with triggering offset of 224 or 336 for panel switching, but instead it is to make sure that, for any cases (regardless of reporting R15 or R16 UE capability), the gNB should guarantee that the triggering offset of AP-TRS should NOT be less than the threshold for default QCL assumption for AP-CSI-RS.  But, on the other hand, if going with other TP from Huawei/Hisi, if R15 beamSwitchTiming < 48 and R16 beamSwitchTiming = 224 or 336 are both reported, it occurs that the triggering offset of AP-TRS is less than 48 (i.e., the threshold for default QCL assumption when this Rel-16 feature is enabled by RRC). It is against the basic motivation for this paragraphs for avoiding some ambiguities of UE behavior. Otherwise we still want to further specify the default QCL assumption for AP-TRS < threshold. |
| Moderator | Thanks for the inputs!FL proposal 2 is supported by only one company (ZTE) while all other companies providing inputs so far support another TP suggested by Huawei/HiSilicon.Based on the further discussion over emails, it seems the situation has not been changed.Therefore, FL proposal 2 is updated based on the majority view. |
| Samsung | Support FL’s original proposal (not updated one) and have the same view with ZTE’s second comment.For the case when beamSwitchTiming-r16 = {224 or 336}, if we follow updated FL proposal,* Case 1. AP-CSI-RS for Rx beam sweeping: min. scheduling offset = beamSwitchTiming-r16
* Case 2. AP-CSI-RS, not for Rx beam sweeping: min. scheduling offset = 48
* Case 3. AP-TRS: min. scheduling offset = beamSwitchTiming (Rel-15 capa.)

We think defining different behaviors for Case 2 and 3 just makes the spec. more fragmented without clear reason. Also, Case 3 does not restrict the case of beamSwitchTiming = {224, 336} which is different from vivo/HW/OPPO’s claim that those values are invalid for AP-TRS. Rather, original FL proposal which makes UE behavior for Case 3 to be the same as Case 2, successfully avoiding {224, 336} from being used for AP-TRS which seems more aligned with vivo/HW/OPPO’s claim. |

### **Updated FL proposal 2:**

* **Following TP is adopted for 38.214**

- Periodic CSI-RS resource in one set and aperiodic CSI-RS resources in a second set, with the aperiodic CSI-RS and periodic CSI-RS resource having the same bandwidth (with same RB location) and the aperiodic CSI-RS being 'QCL-Type-A' and 'QCL-TypeD', where applicable, with the periodic CSI-RS resources. For frequency range 2, the UE does not expect that 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 smaller than the UE reported *beamSwitchTiming,* as defined in [13, TS 38.306], when the reported value is one of the values of {14, 28, 48}. The UE shall expect that the periodic CSI-RS resource set and aperiodic CSI-RS resource set are configured with the same number of CSI-RS resources and with the same number of CSI-RS resources in a slot. For the aperiodic CSI-RS resource set if triggered, and if the associated periodic CSI-RS resource set is configured with four periodic CSI-RS resources with two consecutive slots with two periodic CSI-RS resources in each slot, the higher layer parameter *aperiodicTriggeringOffset* indicates the triggering offset for the first slot for the first two CSI-RS resources in the set.

# **Conclusion**

**FL proposal 1:**

* **TP in R1-2005453 for aperiodic CSI-RS triggering with beam switching timing of 224 and 336 is adopted for 38.214**

**Updated FL proposal 2:**

* **Following TP is adopted for 38.214**

- Periodic CSI-RS resource in one set and aperiodic CSI-RS resources in a second set, with the aperiodic CSI-RS and periodic CSI-RS resource having the same bandwidth (with same RB location) and the aperiodic CSI-RS being 'QCL-Type-A' and 'QCL-TypeD', where applicable, with the periodic CSI-RS resources. For frequency range 2, the UE does not expect that 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 smaller than the UE reported *beamSwitchTiming,* as defined in [13, TS 38.306], when the reported value is one of the values of {14, 28, 48}. The UE shall expect that the periodic CSI-RS resource set and aperiodic CSI-RS resource set are configured with the same number of CSI-RS resources and with the same number of CSI-RS resources in a slot. For the aperiodic CSI-RS resource set if triggered, and if the associated periodic CSI-RS resource set is configured with four periodic CSI-RS resources with two consecutive slots with two periodic CSI-RS resources in each slot, the higher layer parameter *aperiodicTriggeringOffset* indicates the triggering offset for the first slot for the first two CSI-RS resources in the set.

# **References**

[1] R1-2005362 Discussion on flexible NR bandwidth vivo

[2] R1-2005453 Maintenance of Rel-16 NR TEIs ZTE

[3] R1-2005982 Discussion on the introduction of new bandwidths of CSI-RS for tracking OPPO

[4] R1-2006408 Flexible TRS bandwidth configuration for 10 MHz in Rel-16 Huawei, HiSilicon

[5] R1-2006431 On remaining NR TEI issues Nokia, Nokia Shanghai Bell

[6] R1-2006585 Discussion on UCI bit sequence generation ASUSTeK

[7] R1-2006837 Discussion of flexible NR UE bandwidth TEI and UL skipping Qualcomm Incorporated

[8] R1-2006906 Introduction of Flexible TRS bandwidth for BWP of 52 RBs Vodafone

[9] R1-2006716 Summary on Rel-16 NR TEI related discussion Moderator (NTT DOCOMO, INC.)