**3GPP TSG RAN WG1 Meeting #114 R1-230xxxx**

**Toulouse, France, August 21st – 25th, 2023**

**Agenda item: 9.17**

**Source: Nokia, Nokia Shanghai Bell**

**Title: Summary of email discussion on NR\_MIMO enhancements on CSI**

**Document for: Discussion and Decision**

# 1 Introduction

This thread will discuss the draft CR to 38.214 for NR MIMO CSI.

First checkpoint for this discussion: **September 5, 6:00am UTC!**

# 2 Discussion – first round

The comments in this section are based on version 0 of the the draft CR available in the **Post RAN1#114 discussion.**

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| Company | Comments | Editor reply/Notes |
| CATT | **Comment 1(TypeII Doppler):**  For the following new added text, it’s better to clarify the value of.   |  | | --- | | For a *CSI-ReportConfig* configured with *codebookType* set to 'typeII-Doppler-r18' or 'typeII-Doppler-PortSelection-r18', the UE reports a CSI report only if receiving at least one aperiodic or periodic or semipersistent consecutive CSI-RS transmission occasions for each CSI-RS resource in the corresponding CSI-RS Resource Set for channel measurement and/or one CSI-IM occasion for interference measurement no later than the CSI reference resource and within the same DRX Active Time, when DRX is configured, and drops the report otherwise. The value of is indicated by UE capability. |   **Comment 2(CJT):**  There is no agreement to restrict the value of restrictedCMR-Selection when NTRP=1, so we suggest to add related text according to the following agreement.  **Agreement**  For the Rel-18 Type-II codebook refinement for CJT mTRP, support  ……   * if NTRP =1, that the NTRP-bit bitmap (for dynamic TRP selection) is not reported   **Proposed change:**   |  | | --- | | The UE may be configured with higher layer parameter *restrictedCMR-Selection*. If *restrictedCMR-Selection* is configured, the number of selected CSI-RS resources is . Otherwise, the UE is expected to select CSI-RS resources, with , and the selection is reported with an -bit bitmap, , where the CSI-RS resources are mapped from bit to bit by their ordering in the resource set and the first of the selected CSI-RS resources corresponds to the nonzero bit with lowest index. If NTRP=1, the -bit bitmap is not reported. |   **Comment 3(TypeII Doppler):**  According to the following agreement, only *N4*=1 is supported for the refinement of the Rel-17 FeType-II port seletion codebook. Therefore, relevant text of the Rel-17 FeType-II port seletion codebook with *N4*>1 should be removed.   |  | | --- | | Agreement  The Rel-18 Type-II codebook refinement for high/medium velocities comprises refinement of the following codebooks:   * Refinement of the Rel-16 eType-II regular codebook, with N4>=1 * Refinement of the Rel-17 FeType-II port selection (PS) codebook, based on the common design with the Refinement of the Rel-16 eType-II regular codebook, except for the supported set of parameter combinations, with N4=1   + Time-/Doppler-domain reciprocity is not assumed |   **Proposed change:**   |  | | --- | | - For Enhanced Type II for predicted PMI with (see Clause 5.2.2.2.10), Part 1 contains RI (if reported), the CQI (if the higher layer parameter *TDCQI* is set to '1-1' or '1-2') or the first CQI (if the higher layer parameter *TDCQI* is set to '2') and the total number of reported non-zero amplitude coefficients across layers. The fields of Part 1 – RI (if reported), CQI, and the total number of reported non-zero amplitude coefficients across layers – are separately encoded. Part 2 contains the second CQI (if the higher layer parameter *TDCQI* is set to '2') and the PMI of the Enhanced Type II for predicted PMI ~~or Further Enhanced Type II Port Selection for predicted PMI~~. Part 1 and 2 are separately encoded. |   **Comment 4(TypeII Doppler):**  According to the following agreement, the support of *l = (n – nCSI,ref )* is UE optional. Therefore, the relevant description should be added to 5.2.1.4.2 in 38.214.   |  | | --- | | **Agreement**  On the CSI reporting and measurement for the Rel-18 Type-II codebook refinement for high/medium velocities, when UE-side prediction is assumed, support UE “predicting” channel/CSI after slot *l* where the location of slot *l* is configured (from multiple candidate values) by gNB via higher-layer signalling   * Candidates of slot *l* location include the legacy CSI reference resource location (*n* – *nCSI,ref* ) and slot (*n*+*δ*) where *δ* ≥ 0 * FFS: Possible value(s) of *δ* and possible value(s) of WCSI   Note: Per legacy behavior, the legacy CSI reference resource, i.e., (*n* – *nCSI,ref* ), is reused for locating the last CSI-RS occasion used for a CSI report  For a UE that supports UE-side prediction, the support of *l* = (*n* – *nCSI,ref* ) is UE optional |   **Proposed change:**   |  | | --- | | Subject to UE capability, a UE configured with a *CSI-ReportConfig* with the higher layer parameter *N4* and *reportQuantity* set to 'cri-RI-PMI-CQI' is assumed to support UE-side CSI prediction. The reported PMI indicates predicted precoder matrices associated with consecutive slot intervals, each with duration of slots, where the value of is configured by *N4*. If the UE is configured with an aperiodic CSI-RS resource set for channel measurement, the value, in number of slots, of the time unit is configured by higher layer parameter *d*, where is defined in Clause 5.2.1.4.1. If the UE is configured with a periodic or semi-persistent CSI-RS resource set for channel measurement, the value of is equal to the periodicity of the CSI-RS resource. The earliest of the slot intervals starts at slot , where is the uplink slot in which the CSI is reported and the slot offset is configured by higher layer parameter *delta* and with defined in Clause 5.2.2.5. The value can be configured subject to UE capability.  - For , the UE is expected to report a predicted PMI for slot interval , ~~where the initial slot is configured by the slot offset and~~ the value can be configured only for . A UE can be configured with if the higher layer parameter *codebookType* is set to 'typeII-Doppler-r18', or 'typeII-Doppler-PortSelection-r18'.  - The reported CQI is associated with slot and the reported PMI.  - For , the UE is expected to report a PMI which indicates predicted precoder matrices associated with slot intervals , for ~~, where the initial slot is configured by the slot offset , with defined in Clause 5.2.2.5~~. A UE can be configured with if the higher layer parameter *codebookType* is set to 'typeII-Doppler-r18'. |   **Comment 5(TypeII Doppler):**  For *N4*=1, both *d*=1 and *d*>1 are supported with . Hence, the text of ‘the value can be configured only for ’ is not inaccurate. According to the following conclusion, if and *d*=1, there is no enhancement to UE measurement and CSI calculation. Therefore, the relevant description in 5.2.1.4.2 of 38.214 should be revised.   |  | | --- | | **Conclusion**  On the usage of CSI reporting and measurement for the Rel-18 Type-II codebook refinement for high/medium velocities, there is no consensus in *supporting any specification enhancement* for the following assumptions:   * Legacy UE procedure for CSI measurement/calculation (equivalent to the combination of *l* = (*n* – *nCSI,ref* ) and WCSI=1) * gNB-side prediction   + Note: This doesn’t preclude any gNB implementation |   **Proposed change:**   |  | | --- | | Subject to UE capability, a UE configured with a *CSI-ReportConfig* with the higher layer parameter *N4* and *reportQuantity* set to 'cri-RI-PMI-CQI' is assumed to support UE-side CSI prediction. The reported PMI indicates predicted precoder matrices associated with consecutive slot intervals, each with duration of slots, where the value of is configured by *N4*. If the UE is configured with an aperiodic CSI-RS resource set for channel measurement, the value, in number of slots, of the time unit is configured by higher layer parameter *d*, where is defined in Clause 5.2.1.4.1. If the UE is configured with a periodic or semi-persistent CSI-RS resource set for channel measurement, the value of is equal to the periodicity of the CSI-RS resource. The earliest of the slot intervals starts at slot , where is the uplink slot in which the CSI is reported and the slot offset is configured by higher layer parameter *delta*.  - For , the UE is expected to report a predicted PMI for slot interval , where the initial slot is configured by the slot offset ~~and the value can be configured only for .~~ , except for and *d*=1, the UE is expected to report a non-predicted PMI as described in Clause 5.2.2.2.5 or Clause 5.2.2.2.6. A UE can be configured with if the higher layer parameter *codebookType* is set to 'typeII-Doppler-r18', or 'typeII-Doppler-PortSelection-r18'. |   **Comment 6(TypeII Doppler):**  For Rel-18 TypeII codebook, resources in one NZP CSI-RS Resource set are supported, but can’t be configured with two Resource Groups. Therefore, the following paragraph in 5.2.1.4.1 of 38.214 is not applicable to Rel-18 TypeII codebook.  **Proposed change:**   |  | | --- | | Except for a *CSI-ReportConfig* configured with *reportQuantity* set to 'cri-RI-PMI-CQI' and *codebookType* set to 'typeII-CJT-r18', 'typeII-CJT-PortSelection-r18', 'typeII-Doppler-r18', or 'typeII-Doppler-PortSelection-r18', An NZP CSI-RS Resource Set for channel measurement with resources can be configured with two Resource Groups, with resources in Group 1 and resources in Group 2, such that , and with Resource Pairs. Each Resource Pair consists of one resource from Group 1 and one resource from Group 2. The same resource can be associated with two Resource Pairs in frequency range 1 but not in frequency range 2. |   **Comment 7(TypeII Doppler):**  For Rel-18 CJT, the parameter *codebookType* is used to enable this feature. For Rel-18 predicting CSI, some texts in 38.214 use the parameter *codebookType* to enable this feature, and some texts use the parameter *N4* to identify this feature. We think it is better to use only one RRC parameter to identify one feature. Therefore, we suggest that the RRC parameter *codebookType* should be used to enable Rel-18 predicting CSI for all texts in 38.214.  **Proposed change:**   |  | | --- | | 5.2.1.4.1  Subject to UE capability, a UE configured with a *CSI-ReportConfig* with the higher layer parameter *~~N4~~**codebookType* set to 'typeII-Doppler-r18', or 'typeII-Doppler-PortSelection-r18' and *reportQuantity* set to 'cri-RI-PMI-CQI' is assumed to support UE-side CSI prediction. The reported PMI indicates predicted precoder matrices associated with consecutive slot intervals, each with duration of slots, where the value of is configured by *N4*. If the UE is configured with an aperiodic CSI-RS resource set for channel measurement, the value, in number of slots, of the time unit is configured by higher layer parameter *d*, where is defined in Clause 5.2.1.4.1. If the UE is configured with a periodic or semi-persistent CSI-RS resource set for channel measurement, the value of is equal to the periodicity of the CSI-RS resource. The earliest of the slot intervals starts at slot , where is the uplink slot in which the CSI is reported and the slot offset is configured by higher layer parameter *delta*.  5.2.1.4.2  Subject to UE capability, a UE configured with a *CSI-ReportConfig* with the higher layer parameter *~~N4~~* *codebookType* set to 'typeII-Doppler-r18', or 'typeII-Doppler-PortSelection-r18' and *reportQuantity* set to 'cri-RI-PMI-CQI' is assumed to support UE-side CSI prediction. The reported PMI indicates predicted precoder matrices associated with consecutive slot intervals, each with duration of slots, where the value of is configured by *N4*. If the UE is configured with an aperiodic CSI-RS resource set for channel measurement, the value, in number of slots, of the time unit is configured by higher layer parameter *d*, where is defined in Clause 5.2.1.4.1. If the UE is configured with a periodic or semi-persistent CSI-RS resource set for channel measurement, the value of is equal to the periodicity of the CSI-RS resource. The earliest of the slot intervals starts at slot , where is the uplink slot in which the CSI is reported and the slot offset is configured by higher layer parameter *delta*.  If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-PMI-CQI', ' cri-RI-i1', 'cri-RI-i1-CQI', 'cri-RI-CQI' or 'cri-RI-LI-PMI-CQI', then the UE is not expected to be configured with more than 8 CSI-RS resources in a CSI-RS resource set contained within a resource setting that is linked to the *CSI-ReportConfig*, except when the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *~~N4~~ codebookType* set to 'typeII-Doppler-r18', or 'typeII-Doppler-PortSelection-r18', *reportQuantity* set to 'cri-RI-PMI-CQI' and the corresponding CSI-RS resource set for channel measurement is aperiodic with resources. | |  |
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