**3GPP TSG-RAN WG1 Meeting #106-eR1-210xxxx**

**e-meeting, August 16th – 27th 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.214** | **CR** |  | **rev** | **-** | **Current version:** | **16.6.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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| ***Title:***  | Draft CR on MU-CSI enhancement  |
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| ***Source to WG:*** | Moderator (CATT) |
| ***Source to TSG:*** | RAN1 |
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| ***Work item code:*** | NR\_eMIMO-Core |  | ***Date:*** | 2021-08-06 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-16 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | In Rel-16, enhanced Type II codebook and enhanced Type II port selection codebook are included. For the enhanced Type II codebook, the indices $i\_{1,1}$ and $i\_{1,2} $are used to identify the L vectors, i.e., the L spatial beam. It is the same as Type II codebook in Rel-15. It has been stated that the index $i\_{1,2}$ is not reported for the following configurations in current specification.- When ,  and , and $i\_{1,2}$ is not reported. - When  and ,  and , and $i\_{1,2}$ is not reported.- When  and ,  and, and $i\_{1,2}$ is not reported.We can see that index $i\_{1,2}$ is not always reported.For the enhanced Type II port selection codebook, only index $i\_{1,1}$ is used to select the L antenna ports per polarization. Hence, the index $i\_{1,2}$ is not reported. In order to implement CSI omission, Part 2 CSI of enhanced Type II codebook and enhance Type II port selection codebook are divided into three groups. In current specification, Group 0 includes indices$ i\_{1,1}$, $i\_{1,2}$ and $i\_{1,8,l}$ ($l=1,…,υ$). According to above discussion, the index $i\_{1,2} $ is not always reported. Therefore, it should be clarified that Group 0 includes index $i\_{1,2}$ only when it is reported. |
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| ***Summary of change:*** | Clarified that Group 0 includes index $i\_{1,2}$ only when it is reported. |
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| ***Consequences if not approved:*** | UE’s behaviour of CSI reporting using PUSCH when omitting Part 2 CSI information for a particular priority level for enhanced Type II codebook or enhanced Type II port selection codebook is not clear. |
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| ***Clauses affected:*** | 5.2.3 |
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|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |
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| ***This CR's revision history:*** |  |

### 5.2.3 CSI reporting using PUSCH

A UE shall perform aperiodic CSI reporting using PUSCH on serving cell c upon successful decoding of a DCI format 0\_1 or DCI format 0\_2 which triggers an aperiodic CSI trigger state.

When a DCI format 0\_1 schedules two PUSCH allocations, the aperiodic CSI report is carried on the second scheduled PUSCH. When a DCI format 0\_1 schedules more than two PUSCH allocations, the aperiodic CSI report is carried on the penultimate scheduled PUSCH.

An aperiodic CSI report carried on the PUSCH supports wideband, and sub-band frequency granularities. An aperiodic CSI report carried on the PUSCH supports Type I, Type II and Enhanced Type II CSI.

A UE shall perform semi-persistent CSI reporting on the PUSCH upon successful decoding of a DCI format 0\_1 or DCI format 0\_2 which activates a semi-persistent CSI trigger state. DCI format 0\_1 and DCI format 0\_2 contains a CSI request field which indicates the semi-persistent CSI trigger state to activate or deactivate. Semi-persistent CSI reporting on the PUSCH supports Type I, Type II with wideband, and sub-band frequency granularities and Enhanced Type II CSI. The PUSCH resources and MCS shall be allocated semi-persistently by an uplink DCI.

CSI reporting on PUSCH can be multiplexed with uplink data on PUSCH except that semi-persistent CSI reporting on PUSCH activated by a DCI format is not expected to be multiplexed with uplink data on the PUSCH. CSI reporting on PUSCH can also be performed without any multiplexing with uplink data from the UE.

Type I CSI feedback is supported for CSI Reporting on PUSCH. Type I wideband and sub-band CSI is supported for CSI Reporting on the PUSCH. Type II CSI is supported for CSI Reporting on the PUSCH.

For Type I, Type II and Enhanced Type II CSI feedback on PUSCH, a CSI report comprises of two parts. Part 1 has a fixed payload size and is used to identify the number of information bits in Part 2. Part 1 shall be transmitted in its entirety before Part 2.

- For Type I CSI feedback, Part 1 contains RI (if reported), CRI (if reported), CQI for the first codeword (if reported). Part 2 contains PMI (if reported) and contains the CQI for the second codeword (if reported) when RI (if reported) is larger than 4.

- For Type II CSI feedback, Part 1 contains RI (if reported), CQI, and an indication of the number of non-zero wideband amplitude coefficients per layer for the Type II CSI (see Clause 5.2.2.2.3). The fields of Part 1 – RI (if reported), CQI, and the indication of the number of non-zero wideband amplitude coefficients for each layer – are separately encoded. Part 2 contains the PMI of the Type II CSI. Part 1 and 2 are separately encoded.

- For Enhanced Type II CSI feedback, Part 1 contains RI, CQI, and an indication of the overall number of non-zero amplitude coefficients across layers for the Enhanced Type II CSI (see Clause 5.2.2.2.5). The fields of Part 1 – RI, CQI, and the indication of the overall number of non-zero amplitude coefficients across layers – are separately encoded. Part 2 contains the PMI of the Enhanced Type II CSI. Part 1 and 2 are separately encoded.

A Type II CSI report that is carried on the PUSCH shall be computed independently from any Type II CSI report that is carried on the PUCCH formats 3 or 4 (see Clause 5.2.4 and 5.2.2).

When the higher layer parameter *reportQuantity* is configured with one of the values 'cri-RSRP', 'ssb-Index-RSRP', 'cri-SINR' or 'ssb-Index-SINR', the CSI feedback consists of a single part.

For both Type I and Type II reports configured for PUCCH but transmitted on PUSCH, the determination of the payload for CSI part 1 and CSI part 2 follows that of PUCCH as described in Clause 5.2.4.

When CSI reporting on PUSCH comprises two parts, the UE may omit a portion of the Part 2 CSI. Omission of Part 2 CSI is according to the priority order shown in Table 5.2.3-1, where  is the number of CSI reports configured to be carried on the PUSCH. Priority 0 is the highest priority and priority  is the lowest priority and the CSI report *n* corresponds to the CSI report with the *n*th smallest Prii,CSI(*y,k,c,s*) value among the  CSI reports as defined in Clause 5.2.5. The subbands for a given CSI report *n* indicated by the higher layer parameter *csi-ReportingBand* are numbered continuously in increasing order with the lowest subband of *csi-ReportingBand* as subband 0. When omitting Part 2 CSI information for a particular priority level, the UE shall omit all of the information at that priority level.

- For Enhanced Type II reports, for a given CSI report $n$, each reported element of indices $i\_{2,4,l}$ $i\_{2,5,l} $and $i\_{1,7,l}$, indexed by $l,i$ and $f$, is associated with a priority value $Pri\left(l,i,f\right)=2⋅L⋅υ⋅π\left(f\right)+υ⋅i+l$, with $π(f)=min⁡(2⋅n\_{3,l}^{\left(f\right)},2⋅\left(N\_{3}-n\_{3,l}^{(f)}\right)-1)$ with $l=1,2,…,υ$, $i=0,1,…,2L-1$, and $f=0,1,…,M\_{υ}-1$, and where $n\_{3,l}^{(f)}$ is defined in Clause 5.2.2.2.5. The element with the highest priority has the lowest associated value $Pri\left(l,i,f\right)$. Omission of Part 2 CSI is according to the priority order shown in Table 5.2.3-1, where

- Group 0 includes indices $i\_{1,1}$, $i\_{1,2}$(if reported) and $i\_{1,8,l}$ ($l=1,…,υ$).

- Group 1 includes indices $i\_{1,5}$ (if reported), $i\_{1,6,l}$ (if reported), the $υ2LM\_{υ}-\left⌊K^{NZ}/2\right⌋$ highest priority elements of $i\_{1,7,l}$, $i\_{2,3,l}$, the $\left⌈K^{NZ}/2\right⌉-υ$ highest priority elements of $i\_{2,4,l}$ and the $\left⌈K^{NZ}/2\right⌉-υ$ highest priority elements of $i\_{2,5,l}$ ($l=1,…,υ$).

- Group 2 includes the $\left⌊K^{NZ}/2\right⌋$ lowest priority elements of $i\_{1,7,l}$, the $\left⌊K^{NZ}/2\right⌋$ lowest priority elements of $i\_{2,4,l}$ and the $\left⌊K^{NZ}/2\right⌋$ lowest priority elements of $i\_{2,5,l}$ ($l=1,…,υ$).

Table 5.2.3-1: Priority reporting levels for Part 2 CSI

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| Priority 0:For CSI reports 1 to $N\_{Rep}$, Group 0 CSI for CSI reports configured as 'typeII-r16' or 'typeII-PortSelection-r16'; Part 2 wideband CSI for CSI reports configured otherwise |
| Priority 1:Group 1 CSI for CSI report 1, if configured as 'typeII-r16' or 'typeII-PortSelection-r16'; Part 2 subband CSI of even subbands for CSI report 1, if configured otherwise |
| Priority 2:Group 2 CSI for CSI report 1, if configured as 'typeII-r16' or 'typeII-PortSelection-r16'; Part 2 subband CSI of odd subbands for CSI report 1, if configured otherwise |
| Priority 3:Group 1 CSI for CSI report 2, if configured as 'typeII-r16' or 'typeII-PortSelection-r16'; Part 2 subband CSI of even subbands for CSI report 2, if configured otherwise |
| Priority 4:Group 2 CSI for CSI report 2, if configured as 'typeII-r16' or 'typeII-PortSelection-r16'. Part 2 subband CSI of odd subbands for CSI report 2, if configured otherwise |
| ⁞ |
| Priority $2N\_{Rep}-1$:Group 1 CSI for CSI report $N\_{Rep}$, if configured as 'typeII-r16' or 'typeII-PortSelection-r16'; Part 2 subband CSI of even subbands for CSI report $N\_{Rep}$, if configured otherwise |
| Priority $2N\_{Rep}$:Group 2 CSI for CSI report $N\_{Rep}$, if configured as 'typeII-r16' or 'typeII-PortSelection-r16'; Part 2 subband CSI of odd subbands for CSI report $N\_{Rep}$, if configured otherwise |

<unchanged part omitted>