**3GPP TSG RAN WG1 #107-e R1-211xxxx**

**e-Meeting, November 11th – November 19th, 2021**

**Agenda item:** 7.1

**Source:** Moderator **(**Qualcomm Incorporated)

**Title:** Summary of [107-e-NR-7.1CRs-12] discussion on UCI bitwidth and UCI mapping for non-PMI CSI feedback

**Document for:** Discussion/Decision

# Introduction

Non-PMI CSI feedback was introduced (with report quantity set to “cri-ri-cqi”) to NR since Rel-15. In non-PMI CSI feedback, CRI, RI, LI and CQI are reported, but their bit-width and mapping order are not clearly defined in 212 spec. This tdoc is used to collect companies’ views for email thread [107-e-NR-7.1CRs-19].

# Issue 1: bit-width of UCI components for non-PMI CSF

In current TS38.212 spec (sec 6.3.1.1.2 and 6.3.2.1.2), the bitwidth for UCI components are defined for each codebook, none of the table from 6.3.1.1.2-1 to 6.3.1.1.2-6 are defined for non-PMI based CSI feedback. In non-PMI based CSI feedback, UE should report CRI, RI, LI and CQI, and the maximum allowable rank could be upto 8. With that, one can see that the UCI components of non-PMI CSI is similar to that of Type I CSI part 1, and it is straightforward to reuse the bit-width defined in table 6.3.1.1.2-3.

For the bitwidth of RI, it is widely used in all codebook type that the bitwidth is dependent on the number of allowable rank, but this may not feasible for non-PMI based CSI because the allowable rank, provided by the higher layer parameter *PortIndexFor8Ranks*, is CSI-RS resource specific. To solve this issue, we think there are two ways

* Alt1: the bitwidth of RI is dependent on the total number of different allowable rank across all the resources associated to the non-PMI based CSI report config. And the codepoints are mapped to the allowable ranks across all resources in increasing order where codepoint 0 is mapped to the smallest allowable rank across all resources.
* Alt2: the bitwidth of RI is always 3-bit (regardless of the higher layer parameter *non-PMI-PortIndication*) assuming smallest rank is rank-1 and largest rank is rank-8. And the codepoints are mapped to the allowable rank in increasing order. UE only report the valid codepoints of the selected CSI-RS resource

A concrete example is provided in R1-2112190. Alt1 is proposed in R1-2112190.

**Moderator proposal 1: For Rel-15 non-PMI CSI feedback,**

* **Clarify the bitwidth of UCI components CRI, RI, LI and CQI using table 6.3.1.1.2.3 of TS38.212 by revising the table title to accommodate non-PMI CSI.**
* **For RI reporting, its bitwidth is dependent on the total number of different allowable rank across all the resources associated to the non-PMI based CSI report config. And the codepoints are mapped to the allowable rank in increasing order with 0 mapped to the smallest rank across all resources.**

**Following spec change can be considered for TS38.212 spec:**

### 6.3.1.1.2 CSI only

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

The bitwidth for RI/LI/CQI/CRI of *codebookType=typeI-SinglePanel* and *reportQuantity* set to 'cri-RI-CQI' is provided in Tables 6.3.1.1.2-3.

Table 6.3.1.1.2-3: RI, LI, CQI, and CRI of *codebookType=typeI-SinglePanel*, or *reportQuantity* set to 'cri-RI-CQI'

|  |  |
| --- | --- |
| **Field** | **Bitwidth** |
| **1 antenna port** | **2 antenna ports** | **4 antenna ports** | **>4 antenna ports** |
| **Rank1~4** | **Rank5~8** |
| Rank Indicator | 0 |  |  |  |  |
| Layer Indicator | 0 |  |  |  |  |
| Wide-band CQI for the first TB | 4 | 4 | 4 | 4 | 4 |
| Wideband CQI for the second TB | 0 | 0 | 0 | 0 | 4 |
| Subband differential CQI for the first TB | 2 | 2 | 2 | 2 | 2 |
| Subband differential CQI for the second TB | 0 | 0 | 0 | 0 | 2 |
| CRI |  |  |  |  |  |

For *codebookType=typeI-SinglePanel,*  in Table 6.3.1.1.2-3 is the number of allowed rank indicator values according to Clause 5.2.2.2.1 [6, TS 38.214]. For higher layer parameter *reportQuantity* set to 'cri-RI-CQI',  in Table 6.3.1.1.2-3 is the number of different allowable rank indicator values according to Clause 5.2.1.4.2 [6, TS 38.214] across all CSI-RS resources associated to the CSI reporting setting.  is the value of the rank. The value of  is the number of CSI-RS resources in the corresponding resource set. The values of the rank indicator field are mapped to allowed rank indicator values with increasing order, where '0' is mapped to the smallest allowed rank indicator value.

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

**Companies are invited to provide views on moderator proposal 1. Please comment on 1) whether the bitwith of UCI components can be clarified using the table of Type I SP or using a separate table, 2) whether Alt1 or Alt2 is preferred for RI bitwidth, and 3) any suggestion on the TP.**

|  |  |
| --- | --- |
| Company | Comments |
| Qualcomm | 1. Ok with using table 6.3.1.1.2-3 by revising the title. Otherwise, if a new table is defined, more changes are needed in solving issue 2.
2. For RI, both Alt1 and Alt2 are fine, can live with majority view.
 |
| ZTE | To revise the table tile is okay for us. For RI bit width, we have the following description in Section 5.2.1.4.2 of TS 38.214:“*The UE shall only report RI corresponding to the configured fields of PortIndexFor8Ranks*”Then combining with the description of 212 “ *in Table 6.3.1.1.2-3 is the number of allowed rank indicator values*”. It implies the bit width of RI for non-PMI feedback also follows this way. Perhaps one clarification is to add the citation of section number “5.2.1.4.2” in 212 as well. |
| vivo | For issue 1), support Moderator’s proposal;For issue 2), agree with ZTE’s analysis.  |
| Nokia/NSB | 1. either way is fine2. one concern with the proposed solution is that, when non-PMI-PortIndication is configured, there may be different numbers of allowed rank values for different resources in a set, i.e. is dependent on the selected resource. Hence, it’s not clear if the bitwidth should be dependent on the reported CRI (because RI and CQI are conditioned on CRI), or if the union of all allowed ranks should be taken. In the latter case we should clarify the mapping of codepoints to the rank values. Besides, when non-PMI-PortIndication is not configured, all P rank values are allowed, where P is the number of ports.A simpler solution is to define the bitwidth as log2(P) in all cases, by saying:For higher layer parameter *reportQuantity* set to 'cri-RI-CQI', , where is the number of ports. |
| Ericsson | On issue 1.1, we are fine to reuse the table by revising the title.On issue 1.2, our preference is Alt2. |
| Apple | OK with revising the title for table 6.3.1.1.2-3, as it is proposed. For RI, we have slight preference on Alt2 (so if majority agreed on Alt2, the proposed text needs to be revisisted). For the text change in 6.3.1.1.2, we propose to change “and reportQuantity set” to “, or ~~and~~ reportQuantity set” |
| Samsung | We support Moderator’s proposal to reuse the table for Type I SP CB. We prefer Alt2.  |
| OPPO | On issue 1, support the proposalWe prefer to Alt2. |
| CATT | 1. We are fine with revising the table title.
2. For the definition of , Alt 2 (the bitwidth of RI is always 3-bit) is preferred.
 |
| Huawei | 1. We prefer to have a new table to clarify this issue. No matter Alt 1 or Alt 2 is determined thereafter, the design principle of allowable ranks for non-PMI reporting is different from that of allowable ranks for other CSI reporting mechanism. Alt 1 needs to across all CSI-RS resources, aggregate allowed ranks, sort out all ranks, and remove redundancy etc. Therefore, we have concern re-interpreting n\_RI, which is clearly linked with 38.214 and associated with certain RRC signaling design. For Alt 2, we don’t need n\_RI.
2. We prefer Alt 2, which is much simpler than Alt 1. The payload of Alt 2 is more implementation-friendly. Saving reporting payload, e.g. just 1 bit as Mod’s example, is not critical during such late stage of maintenance. A new table is needed for Alt2.
 |

# Issue 2: UCI mapping order and PMI format

Apart from UCI bitwidth, UCI mapping order for non-PMI based CSI reporting is also missing in current TS38.212 spec. One issue with UCI mapping table Table 6.3.1.1.2-7, Table 6.3.1.1.2-9 to Table 6.3.1.1.2-11 and Table 6.3.2.1.2-3 to 6.3.2.1.2-5 is that they are related to pmi-FormatIndicator. However, this would cause ambiguity for non-PMI CSI reporting as there is no PMI components and the granularity is purely dependent on cqi-FormatIndicator. To solve this issue, following proposal is proposed by the moderator

**Moderator proposal 2: Clarify that UE is not expected to be configured with pmi-FormatIndicator for non-PMI based CSI feedback.**

**Following text proposal can be considered for TS38.214 spec:**

### 5.2.1.4 Reporting configurations

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

- wideband PMI or subband PMI reporting as configured by the higher layer parameter *pmi-FormatIndicator*. When wideband PMI reporting is configured, a wideband PMI is reported for the entire CSI reporting band. When subband PMI reporting is configured, except with 2 antenna ports, a single wideband indication (*i1* in Clause 5.2.2.2) is reported for the entire CSI reporting band and one subband indication (*i2* in clause 5.2.2.2) is reported for each subband in the CSI reporting band. When subband PMIs are configured with 2 antenna ports, a PMI is reported for each subband in the CSI reporting band.

- a UE is not expected to be configured with *pmi-FormatIndicator* if reportQuantity set to ‘cri-ri-cqi'.

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

**Companies are invited to provide views moderator proposal 2, whether the spec change is needed.**

|  |  |
| --- | --- |
| Company | Comments |
| Qualcomm | We prefer to change the spec or at least a conclusion, configuring pmi-FormatIndicator for non-PMI based CSI does not make sense.Besides, in some UCI mapping order tables, it is specified that PMI X1 or X2 is included if pmi-FormatIndicator=wideband or subband. This may cause ambiguity if pmi-FormatIndicator is configured for non-PMI based CSI reporting. |
| ZTE | We don’t see any issue to configure pmi-FormatIndicator for non-PMI feedback. UE can still follow the pmi-FormatIndicator configuration to determine which UCI mapping table is used for non-PMI feedback, which means the current spec works well without any issue. There is no need to have this configuration restriction and further revise the spec to solve the issue created by this configuration restriction. |
| vivo | It is also ok without any changes.  |
| Nokia/NSB | We also don’t see a need for this change. Sec 5.2.1.4 already says that the reporting is WB when CQI format is WB, which implies that pmi-FormatIndicator does not need to be configured for non-PMI reportingA CSI Reporting Setting is said to have a wideband frequency-granularity if- *reportQuantity* is set to 'cri-RI-PMI-CQI', or 'cri-RI-LI-PMI-CQI', *cqi-FormatIndicator* is set to 'widebandCQI'and *pmi-FormatIndicator* is set to 'widebandPMI', or- *reportQuantity* is set to 'cri-RI-i1' or- *reportQuantity* is set to 'cri-RI-CQI' or 'cri-RI-i1-CQI' and *cqi-FormatIndicator* is set to 'widebandCQI', or- *reportQuantity* is set to 'cri-RSRP' or 'ssb-Index-RSRP' or 'cri-SINR', or 'ssb-Index-SINR' |
| Ericsson | We don’t see the need for this change in the specs, but it is fine for us to make it as a conclusion. |
| Apple | OK with the proposed text change |
| Samsung | We are fine either way.  |
| OPPO | It may not be needed. |
| CATT | Agree with Nokia, we also don’t see the need to change the current specs. According to sec 5.2.1.4 for TS38.214, if *cqi-FormatIndicator* is set to 'widebandCQI' for non-PMI feedback, the CSI report is said to have a wideband frequency-granularity regardless of the higher layer parameter *pmi-FormatIndicator*. |
| Huawei | We have the same view with Nokia.  |

**Moderator proposal 3: For UCI mapping order of non-PMI feedback,**

* **For CSI on PUCCH and wideband CQI (single part UCI), UCI mapping Table 6.3.1.1.2.7 also applies to non-PMI based CSI feedback. Spec change is needed to revise the table title so as to accommodate non-PMI based CSI reporting.**
* **For CSI on PUCCH and subband CQI (two-part UCI), Table 6.3.1.1.2-9 to Table 6.3.1.1.2-11** **apply to non-PMI based CSI feedback. No spec change is needed.**
* **For CSI on PUSCH (two-part UCI), Table 6.3.2.1.2-3 to 6.3.2.1.2-5 apply to non-PMI based CSI feedback. No spec change is needed.**

**Following text proposal can be considered for TS38.212 spec**

### 6.3.1.1.2 CSI only

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

Table 6.3.1.1.2-7: Mapping order of CSI fields of one CSI report, *pmi-FormatIndicator=widebandPMI* and *cqi-FormatIndicator=widebandCQI, or reportQuantity* set to ‘cri-RI-CQI’ and *cqi-FormatIndicator=widebandCQI*

|  |  |
| --- | --- |
| CSI report number | CSI fields |
| CSI report #n | CRI as in Tables 6.3.1.1.2-3/4, if reported |
| Rank Indicator as in Tables 6.3.1.1.2-3/4, if reported |
| Layer Indicator as in Tables 6.3.1.1.2-3/4, if reported |
| Zero padding bits , if needed |
| PMI wideband information fields , from left to right as in Tables 6.3.1.1.2-1/2, if reported |
| PMI wideband information fields , from left to right as in Tables 6.3.1.1.2-1/2, or codebook index for 2 antenna ports according to Clause 5.2.2.2.1 in [6, TS38.214], if reported |
| Wideband CQI for the first TB as in Tables 6.3.1.1.2-3/4, if reported  |
| Wideband CQI for the second TB as in Tables 6.3.1.1.2-3/4, if reported |

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

**Companies are invited to provide views moderator proposal 3, whether the moderator assessment is correct and any suggestion of spec change.**

|  |  |
| --- | --- |
| Company | Comments |
| Qualcomm | We support the proposal. |
| ZTE | As we commented for the previous proposal, for non-PMI feedback, UE can still follow the configuration of pmi-FormatIndicator configuration to determine the used table, which does not require any change of the spec. However, we are okay to clarify the table title if the group thinks it is clearer.  |
| Vivo | It is also ok without any changes. |
| Nokia/NSB | In our understanding pmi-FormatIndicator does not need to be configured for non-PMI reporting, as quoted above from 5.2.1.4, hence we are ok with this clarificationIt seems we also need to address the case of cri-RI-CQI with wideband CQI. In this case the report on PUCCH is split in two parts and part 2 contains only the CQI (WB and SB) of the second codeword, if reported. It seems a new table is needed for reportQuantity set to ‘cri-RI-CQI’ and cqi-FormatIndicator=subbandCQI |
| Nokia/NSB 2 | Please disregard the second part of my previous comment because, as was pointed out to me offline, Tables 9-11 in 6.3.1.1.2 already apply to non-PMI subband reporting, as it says pmi-FormatIndicator= subbandPMI **OR** cqi-FormatIndicator=subbandCQI, rather than **AND** |
| Ericsson | We are fine with the proposal. |
| Apple | Ok with the proposal and with the proposed title for Table 6.3.1.1.2-7 |
| Samsung | We support Moderator’s proposal.  |
| OPPO | We are fine with the proposal. |
| CATT | We are fine with the proposal. |
| Huawei | We are fine with the proposal.  |

# Further discussion on issue 1 and 2 (Round 2)

Based in the discussion in the initial round, the topics can be further split into 4 aspects.

## UCI bitwidth table

The first topic is whether reusing the UCI bitwidth table 6.3.1.1.2-3 or creating a new one. Qualcomm mentioned that the benefit of reusing the table is to minimize spec impact, while Huawei has concern on reinterpreting RI. Based on the discussion, there is a clear majority view of reusing UCI bitwidth table 6.3.1.1.2-3 (9 vs. 2). Given the situation, following proposal is made

**Moderator proposal 1-1: For Rel-15 non-PMI CSI feedback, clarify the bitwidth of UCI components using table 6.3.1.1.2.3 of TS38.212 by revising the table title to accommodate non-PMI CSI (with the title and the table in issue 1).**

**Companies please comment if you are ok with the proposal or not.**

|  |  |
| --- | --- |
| Company | Comments |
| Moderator | @Huawei, hope it is also ok you. If not, it would be better if you could provide text for a new table, and elaborate more on the concern of reinterpreting n\_RI. @Apple, please specify which text your comment “we propose to change “and reportQuantity set” to “, or ~~and~~ reportQuantity set” is referring to. The title is already “or reportQuantity set to”. |
| Apple | Table title is OK. I was referring to the proposed text change in Sec. 6.3.1.1.2 (as mentioned in my earlier comment):The bitwidth for RI/LI/CQI/CRI of *codebookType=typeI-SinglePanel*, a~~nd~~ or *reportQuantity* set to 'cri-RI-CQI' is provided in Tables 6.3.1.1.2-3. |
| Samsung | Support Moderator’s proposal. We also support Apple’s modification of the text above Table 6.3.1.1.2-3 with very minor modification as below.The bitwidth for RI/LI/CQI/CRI of *codebookType=typeI-SinglePanel*, a~~nd~~ or *reportQuantity* set to 'cri-RI-CQI' is provided in Table~~s~~ 6.3.1.1.2-3. |
| ZTE | We are fine with the proposal. |
| vivo | OK |
| Huawei  | Looking at newly proposed specification text, we are fine to reuse legacy table to mitigate changes.  |
| Nokia/NSB | Ok with proposal and Apple’s corrections to the text above the table |

## RI bitwidth

The solution to clarify RI bitwidth is discussed. ZTE and vivo expressed that clarifying the section citation is enough, while the majority view is that RI bitwidth need be solved in a different way as the allowable rank is resource-specific. Among those companies, Qualcomm mentioned that Alt1 is an extension of the RI of other CSI reports and can save overhead compared to Alt2, and Nokia propose a simpler alternative of using log2(P) bits to report RI where P is the number of CSI-RS ports. Besides, a good number of companies, including Ericsson, Apple, Samsung, OPPO, CATT, Huawei prefer Alt2 for simplicity and cleaness.

* Alt1: the bitwidth of RI is dependent on the total number of different allowable rank across all the resources associated to the non-PMI based CSI report config. And the codepoints are mapped to the allowable ranks across all resources in increasing order where codepoint 0 is mapped to the smallest allowable rank across all resources.
	+ Qualcomm
* Alt2: the bitwidth of RI is always 3-bit (regardless of the higher layer parameter *non-PMI-PortIndication*) assuming smallest rank is rank-1 and largest rank is rank-8. And the codepoints are mapped to the allowable rank in increasing order. UE only report the valid codepoints of the selected CSI-RS resource
	+ Qualcomm, Ericsson, Apple, Samsung, OPPO, CATT, Huawei
* Alt3: the bitwidth of RI is defined as log2(P) in all cases, by saying: For higher layer parameter reportQuantity set to 'cri-RI-CQI', , where is the number of ports.
	+ Nokia, Qualcomm

Based on the situation, following is proposed based on Alt2

**Moderator proposal 1-2: For Rel-15 non-PMI CSI feedback, clarify that the RI is reported using 3-bit, and the codepoints are mapped to the rank in increasing order with 0 mapped to rank-1 with the following text proposal to TS38.212.**

For *codebookType=typeI-SinglePanel,*  in Table 6.3.1.1.2-3 is the number of allowed rank indicator values according to Clause 5.2.2.2.1 [6, TS 38.214].  is the value of the rank. The value of  is the number of CSI-RS resources in the corresponding resource set. The values of the rank indicator field are mapped to allowed rank indicator values with increasing order, where '0' is mapped to the smallest allowed rank indicator value. For higher layer parameter *reportQuantity* set to 'cri-RI-CQI', in Table 6.3.1.1.2-3. The values of the rank indicator field are mapped to rank indicator values with increasing order, where '0' is mapped to rank-1

**Companies please comment if you are ok with the proposal or not.**

|  |  |
| --- | --- |
| Company | Comments |
| Moderator | @Nokia, hope Alt2 is ok for you.@all, please feel free to comment if you prefer Alt3 from Nokia.@all, please also comment and polish the wording if you have a better one.  |
| Samsung | We support the TP. |
| ZTE | We are fine with the proposal and TP. If Alt 1 is not acceptable, we prefer Alt 2 rather than Alt 3.  |
| vivo | We can accept Alt2. |
| Huawei | We are fine with either Alt 2 or Alt 3 because they seem to be same to us, unless we misunderstanding something. If Alt 2 or Alt 3 have different suggestion of TPs, could we discuss TPs directly? Thanks. Looking at above proposed specification changes with n\_RI=8, , for 4 ports, will give rise to 2 bits so that it is the same with of log 2(P) as Alt 3. Therefore we are fine with TP of Proposal 1-2.  |
| Nokia/NSB | Our proposal was not really a new alternative, but a proposed wording for Alt 2. The reason we suggested n\_RI=P was because the formulation of Alt 2 “the bitwidth of RI is always 3-bit” seemed incorrect because the RI bitwidth for non-PMI reporting can be in {0,1,2,3} as pointed out by Huawei.So we support Alt 2, and agree with Huawei that n\_RI=8 or n\_RI=P gives the same bitwidth. We slightly prefer n\_RI=P because it keeps the meaning of n\_RI as the number of allowed rank when non-PMI-PortIndication is not configured, so we propose the following TP. Note that the two TPs produce the same bitwidth. in Table 6.3.1.1.2-3 is the number of allowed rank indicator values according to Clause 5.2.2.2.1 [6, TS 38.214].  is the value of the rank. The value of  is the number of CSI-RS resources in the corresponding resource set. The values of the rank indicator field are mapped to allowed rank indicator values with increasing order, where '0' is mapped to the smallest allowed rank indicator value. For higher layer parameter *reportQuantity* set to 'cri-RI-CQI', , where is the number of antenna ports, regardless of whether *non-PMI-PortIndication* is configured. The values of the rank indicator field are mapped to rank indicator values with increasing order, where '0' is mapped to rank 1 |

## PMI format indicator

Whether PMI format indicator can be configured is discussed in the initial round. ZTE and vivo think the pmi-FormatIndicator can be configured. Qualcomm mentioned that PMI format indicator is unnecessary and may cause ambiguity because in some UCI mapping order tables, it is specified that PMI X1 or X2 is included if pmi-FormatIndicator=wideband or subband. Nokia and CATT also think pmi-FormatIndicator is not configured in non-PMI mode because the CSI granularity is only determined by CQI. Despite of that, there is a good number of companies (including ZTE, vivo, Nokia, Ericsson (with conclusion), OPPO, CATT, Huawei) don’t see the need of spec change. Given the situation, following conclusion is proposed

**Possible conclusion: When report quantity is set to “cri-ri-cqi”, UE is not expected to be configured with pmi-FormatIndicator.**

**Companies please comment if you are ok with the conclusion or not.**

|  |  |
| --- | --- |
| Company | Comments |
| Moderator | @ZTE, vivo: the conclusion is based on majority and hope it is fine to you. There are different views on whether it can be configured, so it seems better to clarify this case. Otherwise, UE may have to follow different mapping table for pmi format set to wideband and subband, which seems unnecessary.  |
| Apple | Support moderator’s conclusion |
| Samsung | We are fine with the conclusion. We also agree that configuring *pmi-FormatIndicator* doesn’t make sense when a UE is configured with *reportQuantity* set to ‘cri-RI-CQI’. However, it is not clear to us which table in 38.212 a UE would confuse with Table 6.3.1.1.2-7, if the title of the latter is modified according to Moderator proposal 3-1. |
| ZTE | We are fine to have a conclusion.  |
| vivo | A conclusion would be ok |
| Huawei | We are fine to have a conclusion.  |
| Nokia/NSB | Support the conclusion |

## UCI mapping table

The UCI mapping order for non-PMI based CSI reporting is discussed. ZTE commented that UE can follow the PMI foramat to determine UCI mapping table, while Qualcomm shows concern because non PMI is reported. Based on the discussion, there seems a clear majority (9 vs. 1) view of changing the spec to clarify UE only need to follow cqi format indicator. Based on the discussion, following is proposed

**Moderator proposal 3-1: Clarify that UCI mapping Table 6.3.1.1.2.7 also applies to non-PMI based CSI feedback, with the following text proposal to TS38.212 spec**

### 6.3.1.1.2 CSI only

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

Table 6.3.1.1.2-7: Mapping order of CSI fields of one CSI report, *pmi-FormatIndicator=widebandPMI* and *cqi-FormatIndicator=widebandCQI, or reportQuantity* set to ‘cri-RI-CQI’ and *cqi-FormatIndicator=widebandCQI*

|  |  |
| --- | --- |
| CSI report number | CSI fields |
| CSI report #n | CRI as in Tables 6.3.1.1.2-3/4, if reported |
| Rank Indicator as in Tables 6.3.1.1.2-3/4, if reported |
| Layer Indicator as in Tables 6.3.1.1.2-3/4, if reported |
| Zero padding bits , if needed |
| PMI wideband information fields , from left to right as in Tables 6.3.1.1.2-1/2, if reported |
| PMI wideband information fields , from left to right as in Tables 6.3.1.1.2-1/2, or codebook index for 2 antenna ports according to Clause 5.2.2.2.1 in [6, TS38.214], if reported |
| Wideband CQI for the first TB as in Tables 6.3.1.1.2-3/4, if reported  |
| Wideband CQI for the second TB as in Tables 6.3.1.1.2-3/4, if reported |

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

**Companies please comment on whether you are fine this proposal.**

|  |  |
| --- | --- |
| Company | Comments |
| Moderator | @ZTE, hope you can be flexible to this proposal. |
| Apple | Support  |
| Samsung | Support |
| ZTE | We are fine if it is the majority view. |
| vivo | Fine. |
| Huawei | Support |
| Nokia/NSB | Support |

# Discussion in Round 3

Based on the comments made in round 2, it is clear that proposal 1-1, 3-1 and the conclusion proposed in section 4.3 receive no objection, while the controversial issue lies in proposal 1-2, i.e., the RI bitwidth.

As pointed out by Nokia and Huawei, the intention of Alt3 is having RI bitwidth dependent on number of CSI-RS ports. Since the number of rank hypothesis cannot be larger than the number of ports, there is no need to use some redundant bits to report RI (e.g., 0-bit is needed if there is single-port, however Alt2 still needs 3-bit). However, Alt2 is the majority view, but the text proposal raised in section 4.2 does not precisely capture Alt2. Instead, it is an alternative way of reinterpreting compared to Alt3. So, to avoid confusion and discuss more on the issue raised by Nokia and Huawei, following alternatives are proposed and voted by companies.

* Alt2-1: always using 3-bit. The spec is changed by adding a new row in table 6.3.1.1.2-3 together with a text explaining the codepoint mapping below the table.
	+ Samsung, Apple (1st), Ericsson (1st), Intel
* Alt2-2: the bitwidth depends on number of ports P. The spec is changed by reinterpreting together with a text explaining the codepoint mapping below the table (same text proposal in section 4.2).
	+ Apple (2nd), Huawei, ZTE
* Alt3: the bitwidth depends on number of ports P. The spec is changed by reinterpreting together with a text explaining the codepoint mapping below the table.
	+ Nokia, Huawei

During the discussion, to help reach consensus, Nokia proposed the following suggestion “adding a new dedicated row in the table as per Alt 2-1, but with values of 0,1,2,3,3 for the 5 columns, respectively”? This could address the question raised by Huawei and Nokia, and also avoid reinterpreting n\_RI. It receives support from ZTE, Apple, Ericsson, Intel, Huawei, so following text proposal is made (combining with proposal 1-1 and RI bitwidth discussion in round 3):

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

The bitwidth for RI/LI/CQI/CRI of *codebookType=typeI-SinglePanel* or *reportQuantity* set to 'cri-RI-CQI' is provided in Tables 6.3.1.1.2-3.

Table 6.3.1.1.2-3: RI, LI, CQI, and CRI of *codebookType=typeI-SinglePanel*, or *reportQuantity* set to 'cri-RI-CQI'

|  |  |
| --- | --- |
| **Field** | **Bitwidth** |
| **1 antenna port** | **2 antenna ports** | **4 antenna ports** | **>4 antenna ports** |
| **Rank1~4** | **Rank5~8** |
| Rank Indicator when *codebookType=typeI-SinglePanel* | 0 |  |  |  |  |
| Rank Indicator when *reportQuantity* set to 'cri-RI-CQI' | 0 | 1 | 2 | 3 | 3 |
| Layer Indicator | 0 |  |  |  |  |
| Wide-band CQI for the first TB | 4 | 4 | 4 | 4 | 4 |
| Wideband CQI for the second TB | 0 | 0 | 0 | 0 | 4 |
| Subband differential CQI for the first TB | 2 | 2 | 2 | 2 | 2 |
| Subband differential CQI for the second TB | 0 | 0 | 0 | 0 | 2 |
| CRI |  |  |  |  |  |

 in Table 6.3.1.1.2-3 is the number of allowed rank indicator values according to Clause 5.2.2.2.1 [6, TS 38.214].  is the value of the rank. The value of  is the number of CSI-RS resources in the corresponding resource set. The values of the rank indicator field are mapped to allowed rank indicator values with increasing order, where '0' is mapped to the smallest allowed rank indicator value. For higher layer parameter *reportQuantity* set to 'cri-RI-CQI', the values of the rank indicator field are mapped to rank indicator values with increasing order, where '0' is mapped to rank-1.

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

# Conclusion

The text proposal in section 5, and section 4.3 are endorsed. The conclusion in section 4.2 is agreed.