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

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

**Agenda item:** 7.2.6

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

**Title:** [107-e-NR-eMIMO-03] Email discussions on K\_NZ to codepoint mapping

**Document for:** Discussion/Decision

# Introduction

Enhanced Type II codebook and Enhanced port-selection Type II codebook are introduced Rel-16. In CSI feedback based on these two codebooks, the actual number of coefficients, i.e., $K^{NZ}$, is reported by UE. However, the spec is unclear about how the codepoints of $K^{NZ}$ reporting are mapped to the candidate values. This tdoc is used to collect companies’ views for email thread [107-e-NR-eMIMO-03].

# Discussion

In current 214 spec, section 5.2.2.2.5 and section 5.2.2.2.6, $K^{NZ}$ is defined as following: “$K\_{l}^{NZ}=\sum\_{i=0}^{2L-1}\sum\_{f=0}^{M\_{υ}-1}k\_{l,i,f}^{(3)}\leq K\_{0}$ is the number of nonzero coefficients for layer $l=1,…,υ$ and $K^{NZ}=\sum\_{l=1}^{υ}K\_{l}^{NZ}\leq 2K\_{0}$ is the total number of nonzero coefficients”. Given this definition, it is clear that $K^{NZ}$ takes the value between 1 and $2K\_{0}$. In current 212 spec, it further specified that the bitwidth to report $K^{NZ}$ is $\left⌈log\_{2}K\_{0}\right⌉$ if maximum configured rank is rank-1 or $\left⌈log\_{2}2K\_{0}\right⌉$ otherwise. However, in R1-2112195 and R1-2112412, it is pointed out that the spec is unclear of whether UE should encode $K^{NZ}$ values starting from codepoint “0” or codepoint “1”.

* For instance, if $2K\_{0}=6$, UE will use 3-bit to encode $K^{NZ}$, but only 6 out of 8 codepoints are valid. The first option is mapping the $K^{NZ}$ candidate values to codepoint {000, 001, 010, 011, 100, 101}, the second option is mapping $K^{NZ}$ values directly to binary bits meaning that the $K^{NZ}$ candidate values are mapped to codepoint {001, 010, 011, 100, 101, 110}.

In R1-2112195, it is stated that this encoding procedure is similar to RI, thus it is more straightforward to reuse the scheme as RI encoding, where smallest allowable value is mapped to codepoint “0”. In R1-2112412, it is also mentioned that the value of $K^{NZ}=1$ is mapped to ‘0’, and the rest are mapped in increasing order.

Moreover, since Rel-17 FeType II port-selection codebook has same structure of Rel-16 eType II CSI, ZTE and Qualcomm also point out this issue during the email discussion [Post-106bis-e-NR-NR\_feMIMO-Core-38.212]. Based on above observation, following is proposed

**Moderator proposal: In Rel-16 enhanced Type II and enhanced Type II port-selection codebook, clarify that the codepoints of** $K^{NZ}$ **indicator field are mapped to** $K^{NZ}$ **indicator in increasing order where codepoint “0” is mapped to the smallest allowed** $K^{NZ}$ **indicator value.**

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

### 6.3.2 Uplink control information non PUCSH

### 6.3.2.1.2 CSI only

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Table 6.3.2.1.2-8: RI and CQI of *codebookType=typeII-r16 or typeII-PortSelection-r16*

|  |  |
| --- | --- |
| Field | Bitwidth |
| Rank Indicator | $$min\left(2,\left⌈log\_{2}n\_{RI}\right⌉\right)$$ |
| Wide-band CQI | 4 |
| Subband differential CQI | 2 |
| Indicator of the total number of non-zero coefficients summed across all layers $K^{NZ}$ | $\left⌈log\_{2}(K\_{0})\right⌉$ if max allowed rank is 1;$\left⌈log\_{2}(2K\_{0})\right⌉$ otherwise |

where $n\_{RI}$ is the number of allowed rank indicator values according to Clauses 5.2.2.2.5 and 5.2.2.2.6 [6, TS 38.214],$ K\_{0}=\left⌈2L\left⌈p\_{1}×\frac{N\_{3}}{R}\right⌉β\right⌉$, where $p\_{1}$, $N\_{3}$, $R$, and $β$ are given by Clause 5.2.2.2.5 and 5.2.2.2.6 in [6, TS 38.214]. 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. The values of the $^{}$ indicator field are mapped to the allowed values of $K^{NZ}$ values according to Clauses 5.2.2.2.5 and 5.2.2.2.6 [6, TS 38.214] with increasing order, where ‘0’ is mapped to the smallest allowed $K^{NZ}$ indicator value.

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**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 | We are okay to clarify this. But isn’t it clearer to say something like this? Do we have anything like “allowed values of K\_NZ” in the current spec?*The* $K^{NZ}$ *indicator field values are mapped to* $K^{NZ}$ *values with* $K^{NZ}$ *equal to* $K^{NZ}$ *indicator field value plus one.* |

# Conclusion

TBD