**3GPP TSG RAN WG1 Meeting #105-e R1-2106071**

**e-Meeting, May 10th – 27th, 2021**

**Agenda Item: 8.1.4**

**Source: Huawei, HiSilicon (Moderator)**

**Title: Summary of CSI enhancements for MTRP and FDD (Round 1)**

**Document for: Discussion and Decision**

# Introduction

# Summary of CSI enhancement for FDD

***Proposal 1:*** *For Rel-17 port selection codebook, the maximal value of CSI-RS port number P as Pmax is 32.*

* *Note:* *further reduction of the maximal value of CSI-RS port number for each possible parameter combination among codebook parameters of Rel-17 port selection codebook, e.g. {K1, Mv, Beta}, will be discussed jointly*
* *Note that total number of parameter combinations (for all # of CSI-RS ports) shall not exceed 8*

Yes (18): vivo, OPPO, ZTE, MTK, DOCOMO, LG, Nokia/NSB, Lenovo/Mot, [Samsung] (Suggest to discuss after conclusion 2), Intel, Fraunhofer IIS/Fraunhofer HHI, Apple, Spreadtrum, CATT, Sony

***Proposal 2:*** *At least for rank 1, values of K1 for port selection matrix W1 in N^(P\*K1) are {2, 4, 8, 12, 16, 24, 32}.*

* *Note that further reduction for possible parameter combinations among codebook parameters of Rel-17 port selection codebook, e.g. {K1, Mv, Beta}, will be discussed jointly once candidate values are determined.*
* *Note that total number of parameter combinations (for all # of CSI-RS ports) shall not exceed 8*

Yes (17): vivo, ZTE, QC (Need further restrictions), Ericsson (2 K1 values per port), MTK (small values of K1 not needed), Nokia/NSB, Lenovo/Mot, Samsung, Fraunhofer IIS/Fraunhofer HHI, Apple, OPPO, CATT, Intel, Sony

***Conclusion 1:*** *At least for rank 1, no further restriction or condition is applied for polarization-common based free-selection and combinatorial coefficient based port selection for W1.*

Yes(19): vivo, ZTE, Ericsson, MTK, CATT, LG, Nokia/NSB, Lenovo/Mot, Samsung, Intel, Fraunhofer IIS/Fraunhofer HHI, Apple, OPPO, DOCOMO, Spreadtrum, Sony

***Proposal 4:*** *At least for rank 1, FD bases used for Wf quantization are limited within a single window with size N configured to the UE whereas FD bases in the window must be consecutive from an orthogonal DFT matrix, i.e. Alt 1.*

* *FFS: whether further dependence/restriction, e.g. conditioned on N3 or the number of CSI-RS ports, can be applied to above design. If does, how to support a non-consecutive FD bases used for Wf quantization*

Yes (18): OPPO, ZTE, Ericsson, DOCOMO, CATT, Spreadtrum, Nokia/NSB, Lenovo/Mot, [Samsung] (Larger value of N3), Intel, Fraunhofer IIS/Fraunhofer HHI, Apple, MTK, vivo, Sony

No (1): LG (Alt 2). [Samsung](Smaller value of N3)

***Proposal 10:*** *For the compression coefficient Beta for non-zero coefficients of W2, values of Beta are {1/4, 1/2, 3/4, 1}*

* *Note that further reduction for possible parameter combinations among codebook parameters of Rel-17 port selection codebook, e.g. {K1, Mv, Beta}, will be discussed jointly once candidate values are determined.*
* *Note that total number of parameter combinations (for all # of CSI-RS ports) shall not exceed 8*

Yes(17):  vivo, ZTE, Ericsson (No small values), MTK (No 1/8), DOCOMO, CATT(without notes), Spreadtrum [Support larger values first and FFS smaller values], Nokia/NSB, Lenovo/Mot, Intel, Fraunhofer IIS/Fraunhofer HHI, Samsung, Apple, Sony

***Proposal 12:*** *A polarization-specific bitmap for indication non-zero coefficients should be supported for W2.*

Yes (18): vivo, OPPO, ZTE, Ericsson, MTK, LG, Spreadtrum, Nokia/NSB, Lenovo/Mot, Samsung, Intel, Fraunhofer IIS/Fraunhofer HHI, Apple, Spreadtrum, CATT

***Proposal 14:*** *For the quantization of W2 coefficient, reusing following Rel-16 quantization mechanism for Rank1 at least:*

* *Two polarization-specific reference amplitudes:*
  + *for the polarization associated with the strongest coefficient, the reference amplitude is not reported*
  + *for the other polarization, reference amplitude is quantized to 4 bits*
    - *The alphabet is{1, 1/2)^(1/4), (1/4)^(1/4), (1/8)^(1/4), …, (1/2^14)^(1/4), [Reserved]} (-1.5dB step size)*
* *For coefficients other than the strongest coefficient*
  + *differential amplitude is calculated relative to the associated polarization-specific reference amplitude and quantized to 3 bits*
    - *The alphabet is {1, 1/sqrt(2), 1/2, 1/(2\*sqrt(2)), 1/4, 1/(4\*sqrt(2)), 1/8, 1/(8\*sqrt(2))} (-3dB step size)*
  + *phase is quantized to 16PSK*
* *For the reserved state for reference amplitude, down-select one Alt* 
  + *Alt 1: it is kept to be reserved*
  + *Alt 2: it is replaced as (1/2)^(15/4),*
  + *Alt 3: it is replaced as (1/2)^(3/8)*

*Note: whether/how SCI is supported for R17 codebook will be discussed separately*

Alt1 (15): vivo, OPPO, Ericsson, MTK, CATT, LG, Spreadtrum, Nokia/NSB, Intel, Fraunhofer IIS/Fraunhofer HHI, Apple, QC

Alt 2 or Alt 3 (2): ZTE, Samsung

Lenovo/Mot (FFS differential amplitude values)

***Conclusion 2:*** *For PS codebook enhancements utilizing DL/UL reciprocity of angle and/or delay, there is no consensus of further enhancement for CSI-RS configurations associated with Rel-17 PS codebook.*

OK to make a conclusion as it is: QC, vivo, OPPO, MTK, DOCOMO, LG, Spreadtrum, Lenovo/Mot, Fraunhofer IIS/Fraunhofer HHI, Apple, Lenovo/Mot, Spreadtrum

Option 3: ZTE, Ericsson, CATT, Nokia/NSB, Samsung, Intel

Option 1: Nokia/NSB, Intel

# Summary of CSI enhancement for MTRP

***Proposal 18:*** *Whether a NZP CSI-RS resource can be referred by both a CMR pair configured for NCJT measurement hypothesis and a CMR configured for Single-TRP measurement hypothesis:*

* *It is feasible in both FR1 and FR2 but subject to UE capability for FR2. If a UE supports and the sharing is also enabled by gNB, two CMRs from a CMR pair configured for a NCJT measurement hypothesis can be used for Single-TRP measurement hypotheses, otherwise they cannot.*

***Proposal 20:*** *Whether to support interference measurement based on NZP CSI-RS outside the CMR pair configured for NCJT measurement hypothesis, in addition to CSI-IM*

*Alt 1: Yes, it is supported, subject to limitations, e.g. N=1 CMR pair and Ks=2 CMR resources*

*Alt 2: No, it is not supported*

Alt 1 (6): ZTE, Docomo, CMCC, InterDigital, Fraunhofer IIS, Fraunhofer HHI

Alt 2 (15): Vivo, QC, OPPO, MediaTek, Ericsson, Spreadtrum, LG, Nokia/NSB, Lenovo/Mot, NEC, Intel, Apple, Futurewei