**3GPP TSG-RAN WG4 Meeting # 102-bis-e R4-2207209**

**Electronic Meeting, 21th Feb– 3th March, 2022**

**Agenda item:** 10.19.4

**Source:** Samsung

**Title:** WF on CSI requirement for Rel-17 FeMIMO

**Document for:** Approval

# Background

* R4-2203090, “WF on general and CSI requirement for Rel-17 FeMIMO”, Samsung. RAN4#101-bis-e meeting
* R4-2203091, “WF on demodulation requirement for Enhancement on HST-SFN deployment”, Samsung, RAN4#101-bis-e meeting
* R4-2203092, “WF on demodulation requirement for Enhancement on Multi-TRP”, Huawei, HiSilicon, RAN4#101-bis-e meeting

# CSI reporting requirement for multi-TRP

**Issue 3-1-1: Test cases for CSI reporting enhancement for m-TRP transmission**

Tentative agreements:

* Define PMI reporting requirement for single-DCI based Multi-TRP scheme with full overlapped resource allocation (SDM) only in FR1
* FFS on additional CSI reporting requirement for single/multi-DCI based Multi-TRP scheme
  + Option 1
    - Option 1a(Samsung, Nokia): Define new CSI reporting requirement for CQI reporting for Multi-DCI based Multi TRP scheme
    - Option 1b (Nokia, Intel): Define RI, CQI reporting requirement for single-DCI based Multi-TRP, and define CQI reporting requirement for multi-DCI
  + Option 2(Apple, Huawei, Qualcomm, Ericsson, MTK): Not define RI, CQI reporting requirement for single-DCI, Not define CQI reporting requirement for multi-DCI
  + Option 3 (Nokia): it time allows define CQI reporting requirement for multi-DCI



**Issue 3-2-1: Common simulation assumption**

Tentative agreements:

* Channel and correlation models: TDLA30-10 with XP High with statistically independent for each TRP
* Pc setting: Same Pc ratios for each TRP in defining requirement
* SNR setting: The SNRs for TRP #1 and TRP #2 are assumed to be balanced with a scaling factor of 1/sqrt(2) for the transmitted signal from each TRP



**Issue 3-2-2: General test set-up for CSI reporting**

Tentative agreements:

* 2 TPs configured with fully overlapping resource allocation
* One CSI-RS resource with Ks = 2
  + TP1 associated with NZP-CSI-RS resource 1
  + TP2 associated with NZP CSI-RS resource 2
* CSI reporting: One CSI associated with multi-TRP measurement hypothesis and X=0 CSI associated with single-TRP measurement hypothesis (CSI reporting mode 1 with X=0)
  + CMR group 1 {CMR a} corresponding to NZP CSI-RS resource 1, K1=1
  + CMR group 2 {CMR b} corresponding to NZP CSI-RS resource 2, K2=1
  + CMR pair (N=1) : CMR {a,b} for M-TRP measurement hypothesis
* No time/frequency offset between two TPs
* WB PMI reporting for mode 1 with X=0
* RAN4 apply the above test setup as baseline for CSI reporting requirement definition



**Issue 3-2-3: CSI resource configuration**

Tentative agreements:

* Configure two resources in a resource pair in the same slot for CSI reporting requirements for mTRP.



**Issue 3-2-4: Number of CSI-RS Ports**

Candidate options:

* Option 1 (Qualcomm):
  + 8 for each TRP
* Option 2 (Samsung, Apple, Huawei, Qualcomm (compromise), Nokia, MTK):
  + 4 for each TRP

Recommended WF

* Companies are encouraged to provide the simulation result in the next meeting with both option 1 and option 2 base on agreed simulation assumption to check the performance gain with the test metric, i.e. throughput ratio with a given SNR test. Make the decision about number of CSI-RS ports in next meeting.



**Issue 3-2-5: Number of layers**

Tentative agreements:

* Number of layers: 2 (1MIMO layer per TRP)



**Issue 3-2-6: Test metric for PMI reporting**

Tentative agreements:

* Apply test metric of TP ratio follow PMI and random PMI with m-TRP reporting. The layer for random PMI per TRP should be orthogonal



**Issue 3-2-7: Performance evaluation**

* Interested companies can provide the performance evaluation of PMI reporting with enhanced CSI reporting against single PMI reporting for multi-TRP transmission. No impact on the PMI reporting requirement definition for single-DCI based Multi-TRP.



**Issue 3-2-8: Codebook Structure**

* Reusing the existing Rel-15 PMI requirement setup: i.e, type I single panel for PMI reporting requirement for single-DCI based Multi-TRP



# PMI reporting requirement for Rel-17 enhanced ype II PS codebook

**Issue 4-1-1: Whether to define PMI requirement for Rel-17 FeTye II PS codebook**

Candidate options:

* Option 1 (Samsung, Nokia, Huawei, Intel): Yes
  + Option 1a(Huawei): Define PMI reporting requirement for Rel-17 FeTypeII port selection codebook based on evaluation on the performance gain over eTypeII codebook.
  + Option 1b(Ericsson, Nokia): Consider defining PMI requirement for Rel-17 eType II port selection only if RAN4 can reach an agreement on a simplified way of testing with SU-MIMO test set-up, otherwise not to define requirement**.**
* Option 2 (Apple, Qualcomm): No

Recommended WF

* Companies are encouraged to provide the detail test setup and test metric , also including gNB implementation model in the next meeting



**Issue 4-2-1: General Test seup of PMI reporting requirement**

Candidate options:

* Option 1 (Nokia): Both SU-MIMO and MU-MIMO
* Option 2 (Samsung, Huawei, Ericsson): SU-MIMO



**Issue 4-2-2: Modelling BF CSI-RS Port**

Candidate options:

* Option 1 (Samsung)
  + Option 1a: MIMO fading channel as Rel-13 LTE Class B K=1 PMI test cases
  + Option 1b: Power scaling method similar as Rel-13 LTE Class B K>1 CRI test case
* Option 2(Huawei)
  + Further discuss the modeling method if PMI reporting requirement for FeTypeII port selection is introduced.
* Option 3(Nokia)
  + Include feType II PS performance requirements utilizing CSI-RS transmission with a predetermined beam selection used in the transmission
* Other options are not precluded

Recommended WF

* Apply option 1 as a starting point for initial evaluation



# Other

**Issue 5-1-1: whether to define PMI reporting requirement for inter-cell interference scenario in Rel-17 FeMIMO**

Candidate Options

* Option 1(Huawei, Samsung, Qualcomm ): No
  + Option 1a (Huawei): Firstly focus on the RAN1 feature for FeMIMO demodulation requirements definition considering the limitation TU for RAN4 FeMIMO performance part.
  + Option 1b (Samsung): NO discussion/handling of the topic for PMI reporting under inter-cell interference in Rel-17 FeMIMO WI
    - This issue can be handled under either TEI-17 or Rel-18 specific WI pending on the consensus in RAN4
* Option 2(Ericsson, Verizon, AT&T): RAN4 to first evaluate the impact brought by false PMI reporting solution, then discuss a proper model to reveal this issue, and consider introducing the corresponding PMI reporting requirement to resolve this issue
* Option 3 (MTK, Ericsson, Verizon, AT&T ): RAN4 defines PMI reporting requirement for inter-cell interference scenario
* Option 4(Apple):
  + RAN4 further evaluates PMI reporting in ICI before deciding to introduce requirements.
  + The scope of PMI reporting in ICI is approved in FeMIMO WID or part TEI-17 for further discussion in RAN4.

Recommended WF

* FFS on PMI reporting requirement with inter-cell interference in Rel-17 FeMIMO WI
* FFS on where to handle the PMI reporting requirement with inter-cell interference
  + Option 1 (Apple, Samsung, MTK, Ericsson, AT&T, Intel): Rel-17 TEI
  + Option 2 (Qualcomm, Huawei, Samsung): Rel-18 timeframe
  + Option 3 (Ericsson, AT&T, MTK, Intel): Rel-17 FeMIMO WI



**Issue 5-1-2: PMI reporting with inter-cell interference evaluation assumption**

* Option 1(Apple, Ericsson, Verizon, AT&T): For further evaluation of PMI reporting in ICI use the following simulation assumptions as baseline
  + Antenna config: 8x2 XP High
  + Prop. Channel model: TDLA30-5; ensure that channel from target and interference cell are statistically independent and have different beam direction (to ensure PMI are different)
  + NZP CSI-RS for interference:
    - Overlapping with serving cell
    - Non-overlapping with serving cell
  + CSI-IM for interference: non overlapping with CSI-IM for serving cell
  + Loading for interference cell: PDSCH transmission is enabled in all slots for interference cell
  + Evaluate performance based on TP ratio with and with ICI for (1) overlapping NZP CSI-RS (2) non-overlapping NZP CSI-RS
* Other options are not precluded



**Issue 5-1-3: Test metric of PMI reporting with inter-cell interference**

* Option 1(MTK, Ericsson, Verizon, AT&T)
  + TP ratio with following PMI with inter-cell interference and follow PMI without interference
* Other options are not precluded



# Reference

* R4-2207160, Email discussion summary fo [102-e][320] NR\_HST\_FR2\_Demod, Samsung, RAN4#102-e meeting