3GPP TSG RAN Meeting #94e
Electronic Meeting, December 6-17, 2021

RP-213016

Agenda item : 8A.1

Source : Samsung

Title : View on the scope of Rel-18 Advanced MIMO for NR

Document for : Discussion and Decision

SAMSUNG

Current draft WID objectives | After 10-2021 email discussion

1. Study, and if justified, specify CSI enhancement, and possibly CSI-RS enhancement in high/medium velocities for exploiting time-domain correlation/Doppler-domain information to assist codebook based CSI acquisition mechanisms for DL precoding
2. Specify extension of Rel-17 Unified TCI framework, e.g., for indication of multiple DL and UL TCI states (e.g., M>1 and/or N>1, and inter-band) for multi-TRP and/or single-TRP schemes
3. Specify larger number of orthogonal DMRS ports
4. Study, and if justified, specify enhancements of CSI acquistion for Coherent-JT for both FDD and TDD targeting FR1
5. Study, and if justified, specify overhead and/or Latency reduction for UE-initiated beam management/beam acquisition procedures
6. Study, and if justified, specify [at least] UL DMRS, SRS to enable 6 and 8 Tx UL operation to support more than 4 layers per UE in UL targeting CPE/ FWA/vehicle/Industrial devices
7. Study, and if needed, specify features to facilitate simultaneous multi-panel UL transmission for higher UL throughput/reliability
8. Study, and if justified, specify panel-specific timing/power control for UL multi-TRP/panel scenario
9. Study, and if justified, specify frequency-selective precoding targeting devices with >=4 Tx
10. Study, and if justified, specify 2 CW for >=2layers in uplink

General impression:

- Scope is larger than Rel-17
- Given 3-TU allocation, the current list needs ~30-40% reduction in scope

Possible strategy for scope reduction

- Remove a few from the 10 topics
- For the remaining, clarify the scope of each objective (limit scope, avoid ambiguity)

Observation on target use case of the current objectives:

- DL-only: 1, 4
- DL + UL: 2, 3, 5
- UL-only: 6, 7, 8, 9, 10

Analysis | Samsung's view & trend from email discussion

1. **Study, and if justified, specify CSI enhancement, and possibly CSI-RS enhancement in high/medium velocities for exploiting time-domain correlation/Doppler-domain information to assist codebook based CSI acquisition mechanisms for DL precoding**
2. **Specify extension of Rel-17 Unified TCI framework, e.g., for indication of multiple DL and UL TCI states (e.g., M>1 and/or N>1, and inter-band) for multi-TRP and/or single-TRP schemes**
3. **Specify larger number of orthogonal DMRS ports**
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6. **Study, and if justified, specify [at least] UL DMRS, SRS to enable 6 and 8 Tx UL operation to support more than 4 layers per UE in UL targeting CPE/ FWA/vehicle/Industrial devices**
7. **Study, and if needed, specify features to facilitate simultaneous multi-panel UL transmission for higher UL throughput/reliability**
8. **Study, and if justified, specify panel-specific timing/power control for UL multi-TRP/panel scenario**
9. **Study, and if justified, specify frequency-selective precoding targeting devices with >=4 Tx**
10. **Study, and if justified, specify 2 CW for >=2layers in uplink**

Possible way forward:

- Remove #5 and #9 from Rel-18 scope, postpone to Rel-19
- Further limit scope for #1, #4, #7, #8
- Include #10 in #6 and #7

- #1: Already included in AI/ML SI – possibly postpone to Rel-19
  - However, there is significant interest among companies
- #2: Overall fine, but wording needs refinement to clarify/limit scope:
  - Remove "e.g.", "inter-band", "s-TRP" (already supported in Rel-17)
  - Scope can be further limited by focusing on M-DCI
- #3: Overall fine, but wording needs refinement to clarify/limit scope:
  - Add "for DL and UL", focus on CP-OFDM, up to 24 orthogonal ports?
- #4: Overall fine, the scope has been excessively reduced, change to "Specify".
  - Further limit scope to address concern, e.g. Type-2 codebook, SRS for TDD CJT interference avoidance
- #5: Overall fine but can postpone to Rel-19 if needed (expected to build on #2)
- #6: Overall fine, but wording needs refinement to clarify/limit scope
  - Remove "at least", "UL DMRS" (already covered in #3)
  - Add TPMI codebook (CB based), SRI refinement (NCB)
- #7: Expected to build on #6/10 –important but can postpone to Rel-19
  - However, there is significant interest among companies
- #8: Expected to build on #6/10 –important but can postpone to Rel-19
  - However, there is significant interest among companies
- #9: Concerns on implementation impact – possibly postpone to Rel-19
- #10: Overall fine, can be treated together (merged) with #6

Proposed refinement | clarification on #2, #3, and #6

#2: Specify extension of Rel-17 Unified TCI framework~~, e.g.,~~ for indication of multiple DL and UL TCI states (e.g., M>1 and/or N>1, and inter-band) for multi-TRP and/or single-TRP schemes

#3: Study and, if justified, specify larger number of orthogonal DMRS ports for downlink and uplink MU-MIMO, only for CP-OFDM

- striving for a common design between DL and UL DMRS
- Up to 24 orthogonal DM-RS ports

#6: Study, and if justified, specify ~~[at least]~~ UL DMRS, SRS, TPMI, and SRI enhancements to enable 6 and 8 Tx UL operation to support more than 4 layers per UE in UL targeting CPE/ FWA/vehicle/Industrial devices

- #2: The first "e.g." is confusing and not needed. It should be removed to clarify the scope
- #3: The objective should target more immediate needs in real deployment, i.e. DL and UL MU-MIMO (where for UL, CP-OFDM is more relevant)
  - Just as it is customary, it is desirable to have a common design between DL and UL
  - Restricting the maximum number of orthogonal ports avoids lengthy arduous debate during the WI phase, proposing to simply double the number
- #4: To ensure the scope is clear, "at least" should be removed.
  - To support 6/8Tx transmission, TPMI and STI enhancements are needed for CB- and NCB-based transmission (added for completion)

Proposed refinement | scope restriction on #1 and #4

#1: Study, and if justified, specify CSI reporting enhancements for~~, and possibly CSI-RS enhancement in~~ high/medium UE velocities ~~for~~ by exploiting time-domain correlation/Doppler-domain information to assist ~~codebook based CSI acquisition mechanisms for~~ DL precoding, targeting FR1, as follows:

- Rel-16/17 Type-II codebook refinement, without modification to updating the spatial and frequency domain codebook basis of Rel-16/17 Type-II codebook
- Rel-15 Type-I codebook refinement, without modification to updating the spatial domain codebook basis of Rel-15 Type-I codebook

#4: Study, and if justified, specify enhancements of CSI acquisition for Coherent-JT for both FDD and TDD targeting FR1, as follows:

- Rel-16/17 Type-II codebook refinement for FDD CJT mTRP targeting FDD
- SRS enhancement to reduce inter-TRP interference targeting for TDD CJT mTRP via SRS capacity enhancement and/or interference randomization

- #1: In Rel-17, focus on CSI enhancement strictly based on extending Type-I and II codebooks (presented in previous releases) with Doppler/time-domain channel properties
  - More advanced schemes will be studied as a part of the Rel-18 ML/AI SI
- #4: Narrow down the scope, keeping in mind that both FDD and TDD need to be enhanced:
  - FDD: Type-II codebook refinement for geographically separated TRPs/RRHs
  - TDD: Reducing the effect of inter-TRP interference to enhance accuracy of SRS-based CSI acquisition with minimum spec impact on SRS. The scope can be limited to up to two classes of solution
    - Such SRS enhancement can also be beneficial for other use cases <u>including UL</u>

Proposed refinement | scope restriction on #7 and #8

#7: Study, and if needed, specify ~~features~~ the following items to facilitate simultaneous multi-panel UL transmission for higher UL throughput/reliability, targeting FR2 and multi-TRP

- UL beam indication for PUCCH/PUSCH based on the unified TCI state structure
- UL precoding indication for PUSCH where the total number of codewords is restricted to up to two

#8: Study, and if justified, specify ~~panel-specific timing/power control~~ multiple TAs and power control for UL multi-TRP~~/panel~~ scenario where unified TCI state structure is reused

- #7: The most relevant case would be FR2 and multi-TRP (e.g. panel-1 to TRP-A and pabel-2 to TRP-B)
  - The scope on UL beam indication and UL precoding should be clarified to avoid ambiguity
  - For Rel-18, up to two panel-TRP pairs to ensure manageable scope (hence the proposal to restrict the number of CWs to <=2)
  - Unified TCI framework is assumed to contain the scope for beam indication
- #8: Focus on UL components on timing (multiple TAs) and PC for UL mTRP based on unified TCI framework
  - Also open to further discuss how to reduce the number of combinations, e.g. M-DCI vs S-DCI

Proposed WID | After refinement

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