3GPP TSG-RAN WG1#80 R1-150562

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TITLE: COVERAGE ANALYSIS OF LARGE 2D ANTENNA ARRAYS

AGENDA ITEM: 7.2.4.3.1

DOCUMENT FOR: DISCUSSION AND DECISION

INTRODUCTION

- Coverage for 2DAA needs to be considered
  - Previously 10 degree vertical beamwidth, now with sub-element based precoding, 65 degree vertical beamwidth → Only 8 dBi gain for a CSI-RS antenna port
    - This will have an impact on CSI-RS coverage and feedback measurement quality

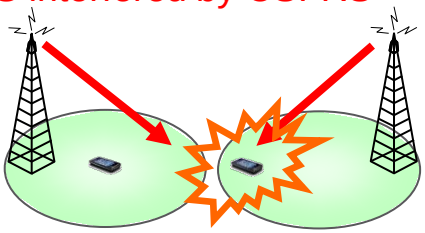
- This contribution analyses the coverage aspect of 2DAA

TWO CSI-RS TRANSMISSION ALTERNATIVES

- Antenna element specific CSI-RS
  - Codebook based feedback (1Dx1D codebook)
- Beam or sector specific CSI-RS
  - Beamforming the CSI-RS using M>1 antenna elements
  - Gives enhanced CSI-RS coverage but lower mobility as frequent RRC signaling may be needed to reconfigure the UE to measure on another beam/CSI-RS

SYSTEM SIMULATION RESULTS

CSI-RS interfered by CSI-RS



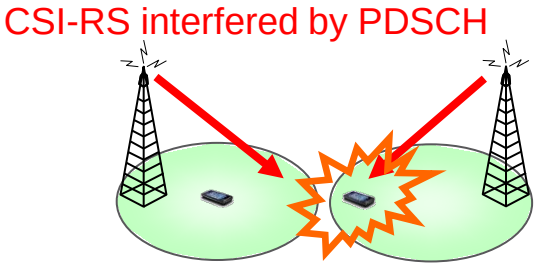
5th percentile CDF values for SINR measured on CSI-RS [dB]

	M=1 Antenna element CSI-RS	M=4 antenna Beamformed CSI-RS	M=8 antenna Beamformed CSI-RS	M=16 antenna Beamformed CSI-RS
3.5 GHz UMa	-4.71	-4.43	-3.36	-3.07
2.0 GHz UMa	-4.62	-3.54	-3.15	-2.98
3.5 GHz UMi	-4.03	-4.11	-3.79	-3.70
2.0 GHz UMi	-4.10	-3.86	-3.79	-3.64

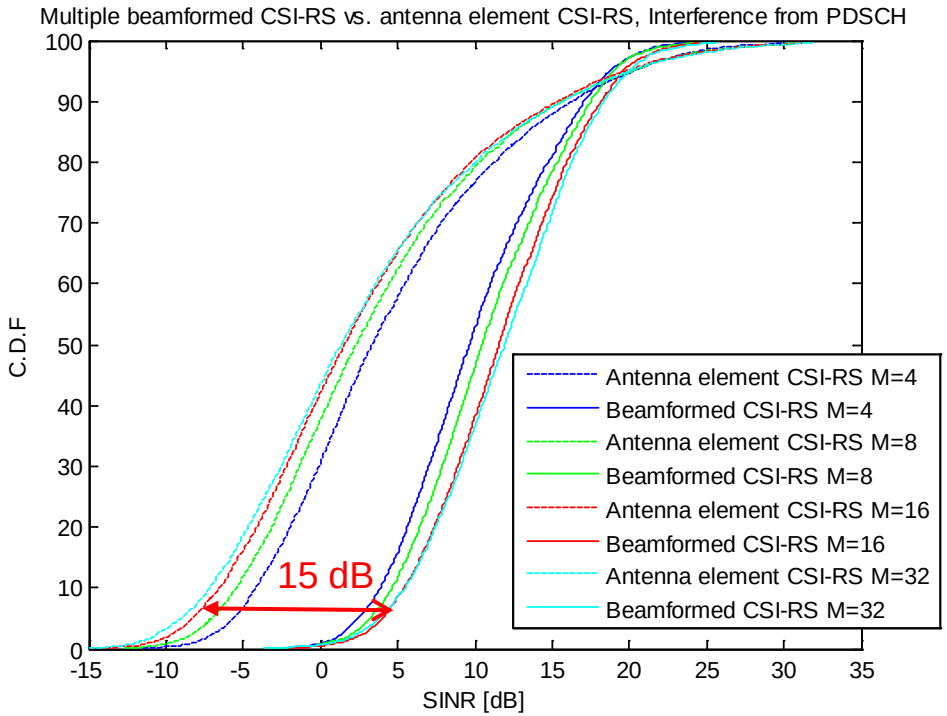
When CSI-RS is **colliding with CSI-RS from adjacent cells,** beamformed CSI-RS could give **significant coverage increase** compared to antenna specific CSI-RS

Coverage can be extended with up to 1.6 dB for 32 TXRU in UMa with 500m ISD

SYSTEM SIMULATION RESULTS



- When CSI-RS is **colliding with PDSCH from adjacent cells**, the use of beamformed CSI-RS compared to antenna specific CSI-RS has **a very large impact** on the coverage
  - CSI-RS Coverage can be extended with up to ***10-15 dB*** *using beamformed CSI-RS*

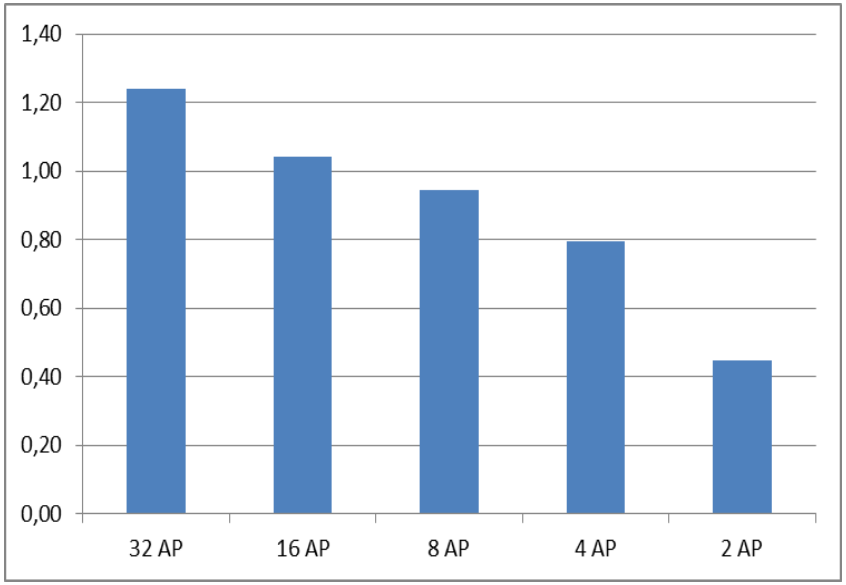


Beamformed CSI-RS is crucial to extend FD-MIMO coverage

LINK SIMULATION RESULTS

- Increased number of antenna specific CSI-RS ports (AP) increase channel estimation errors
  - Larger probability of precoder selection error
  - Selecting wrong beam/precoder impacts more severely with more ports

Coverage loss in SNR [dB] at 4 Mbit/s UE throughput due to real channel estimation compared to ideal channel estimation



The CE losses increases with the number of antenna ports

CONCLUSION

- There is a coverage loss associated with increasing the number of CSI-RS antenna ports.
- This will reduce the attractiveness of 2DAA, particularly for large antenna arrays, unless it is taken care of in the upcoming design.

- Investigations of coverage are needed and should be a prioritized part of the study item.

- **Proposal:** Capture in the TR:
  - A coverage analysis section with an analysis of the proposed schemes
  - That both the antenna specific (codebook based) and beamformed CSI-RS approaches are useful for 2DAA

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