**3GPP TSG-RAN WG4 Meeting #116 R4-2512524**

**Bangalore, India, 25th – 29th August 2025**

**Title: TP for 38.753 introduction of spatial channel models for SU-MIMO PMI cases**

**Source: ZTE Corporation, Sanechips**

**Agenda item: 7.12.3**

**Document for: Approval**

**1 Background**

This draft TP captures comparison of PMI performance under SU-MIMO scenario for different spatial channel model parts.

**2 Draft TP**

6 Comparison of Spatial Channel Models

**6.2 SU-MIMO (PMI Aspects)**

This section provides comparison results for different spatial channel modes with simulation assumptions captured in Table 6.2-1.

**Table 6.2-1: Common simulation assumptions for PMI**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| Bandwidth | | | MHz | 40 |
| Subcarrier spacing | | | kHz | 30 |
| Duplex Mode | | |  | TDD |
| TDD DL-UL configurations | | |  | 7D1S2U S=6D+4G+4U |
| Antenna configuration | | |  | 8 x 4  (M, N, P, Ms, Ns) = (1, 4, 2, 1, 1) |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic |
| Number of CSI-RS ports (*X*) | |  | 8 |
| CDM Type | |  | CDM4 (FD2, TD2) |
| Density (ρ) | |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1, k2, k3) | |  | Row 8, (4,6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | Row 8, (5) |
| CSI-RS  interval and offset | | slot | 10, 1 |
|  | |  |  |
| cqi-FormatIndicator | | |  | Wideband |
| pmi-FormatIndicator | | |  | Not configured for eType II  Wideband for Type I |
| Sub-band Size | | | RB | 8 |
| csi-ReportingBand | | |  | 11111111111111 |
| Codebook configuration | Codebook Type | |  | 1. typeII-r16 2. typeI-SP |
| eType II CB config | *paramCombination-r16* |  | 6  (L =4, *pν* =1/2, β=1/2 ) |
| R*(numberOfPMISubbandsPerCQISubband-r16)* |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) | |  | (4,1) |
| (CodebookConfig-O1,CodebookConfig-O2) | |  | (4,1) |
| CodebookSubsetRestriction | |  | 0x FFFF |
| RI Restriction (typeII-RI-Restriction-r16) | |  | Rank 2: 0010  Rank 4: 1000 |
| Physical channel for CSI report | | |  | PUSCH |
| CQI/RI/PMI delay | | | ms | 7 |
| Maximum number of HARQ transmission | | |  | 4 |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding | | |  | Type I: Random and Follow PMI.  eType II: Folow PMI |
| Note: Use DM-RS based FOE and compensation. | | | | |

Table 6.2-2: Simulation assumptions for CDL channel

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| FR / Carrier frequency | | FR1,3.5GHz |
| UE speed and movement direction | | 3km/h, () |
| Channel Geometry | LCS UE | α = 180°, β=0°, γ = 0° |
| LCS gNodeB | α = 0°, β=10°, γ = 0° |
| GCS UE | Height = 1.5 m; Azimuth = 0; X Coordinate = 100 m |
| GCS gNodeB | Height = 25 m; Azimuth = 0; X Coordinate = 0 m |
| BS Antenna Polarisation | Cross Polarized antenna elements with +/-45 degrees polarization slant angles |
| BS Radiation Pattern | Defined Table 7.3-1 in TS 38.901 |
| UE Antenna Polarisation | cross-polarized antenna elements with +90/0 degrees polarization slant angles |
| UE Antenna Radiation Pattern | Omnidirectional |
| Antenna Panel Placement | YZ Plane |

The BS antenna configuration for CDL comparison is one antenna element per subarray.

* 8Tx : (M, N, P, Ms, Ns) = (1, 4, 2, 1, 1).

The following comparison test cases are included this chapter:

* FR1 SU-MIMO PMI 8Tx 4Rx 4 layers with Type I.
* FR1 SU-MIMO PMI 8Tx 4Rx 4 layers with eType II.
* FR1 SU-MIMO PMI 8Tx 4Rx 2 layers with Type I.
* FR1 SU-MIMO PMI 8Tx 4Rx 2 layers with eType II.

Table 6.2-3: Simulation result summary for FR1 SU-MIMO Follow PMI 8Tx 4Rx with 4 layers

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel  Model | Doppler/Speed | PMI | Gamma at 90% Norm. Throughput | | | | | | | | |
| Source #1 | Source #2 | Source #3 | Source #4 | Source #5 | Source #6 | Source #7 | Source #8 | Source #9 |
| rCDL-C1 | 3km/h | Type I | 1.8 |  | 1.8 |  | 1.8 | 1.8 |  | 1.7 |  |
| eType II | 1.8 |  | 1.8 |  | 1.8 | 1.7 |  | 1.4 |  |
| xTDL-C1 | 10Hz | Type I |  |  |  |  | 1.6 |  |  | 1.4 |  |
| eType II |  |  |  |  | 1.3 |  |  | 1.3 |  |
| TDLC-300 low | 10Hz | Type I | 1.3 |  |  |  | 1.1 | 1.1 |  |  |  |
| eType II | 1.3 |  |  |  | 1.0 | 0.9 |  |  |  |
| TDLC-300 Med | 10Hz | Type I |  |  |  |  | N/A | N/A |  |  |  |
| eType II |  |  |  |  | N/A | N/A |  |  |  |
| TDLC-300 XP Med | 10Hz | Type I | 1.9 |  | 1.92 |  | 1.8 | 1.8 |  |  |  |
| eType II | 1.8 |  | 1.92 |  | 1.7 | 1.2 |  |  |  |
| TDLC-300 XP High | 10Hz | Type I | 2.0 |  |  |  |  |  |  | 2.1 |  |
| eType II | 2.0 |  |  |  |  |  |  | 2.0 |  |

Table 6.2-4: Simulation result summary for FR1 SU-MIMO Follow PMI 8Tx 4Rx with 4 layers

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel  Model | Doppler/Speed | PMI | SNR at 70% Norm. Throughput | | | | | | | | |
| Source #1 | Source #2 | Source #3 | Source #4 | Source #5 | Source #6 | Source #7 | Source #8 | Source #9 |
| rCDL-C1 | 3km/h | Type I | 12.4 | 11.0 | 9.7 | 10.3 | 10.2 | 9.7 | 9.5 | 10.2 | 9.8 |
| eType II | 14.0 | 14.3 | 8.4 | 11.6 | 10.1 | 10.8 | 8.2 | 13.8 | 10.8 |
| xTDL-C1 | 10Hz | Type I |  |  |  | 12.3 | 13.0 |  | 11.3 | 10.8 |  |
| eType II |  |  |  | 13.5 | 14.7 |  | 10.9 | 11.6 |  |
| TDLC-300 low | 10Hz | Type I | 12.6 |  |  |  | 14.4 | 13.2 |  |  |  |
| eType II | 12.8 |  |  |  | 15.0 | 15.7 |  |  |  |
| TDLC-300 Med | 10Hz | Type I |  |  |  |  | N/A | N/A | N/A |  |  |
| eType II |  |  |  |  | N/A | N/A | N/A |  |  |
| TDLC-300 XP Med | 10Hz | Type I | 12.7 |  | 13 |  | 15.2 | 18.9 |  |  |  |
| eType II | 12.8 |  | 12.66 |  | 15.3 | 24.5 |  |  |  |
| TDLC-300 XP High | 10Hz | Type I | 18.6 |  |  |  |  |  |  | 23.4 |  |
| eType II | 17.4 |  |  |  |  |  |  | 24.6 |  |

Table 6.2-5: Simulation result summary for FR1 SU-MIMO Follow PMI 8Tx 4Rx with 2 layers

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel  Model | Doppler/Speed | PMI | Gamma at 90% Norm. Throughput | | | | | | | | |
| Source #1 | Source #2 | Source #3 | Source #4 | Source #5 | Source #6 | Source #7 | Source #8 | Source #9 |
| rCDL-C1 | 3km/h | Type I | 2.0 |  | 2.4 |  | 2.3 | 2.3 |  | 1.7 |  |
| eType II | 1.9 |  | 2.9 |  | 2.4 | 2.4 |  | 1.6 |  |
| xTDL-C1 | 10Hz | Type I |  |  |  |  | 1.7 |  |  | 1.5 |  |
| eType II |  |  |  |  | 1.9 |  |  | 1.6 |  |
| TDLC-300 low | 10Hz | Type I | 1.5 |  |  |  | 1.3 |  |  |  |  |
| eType II | 1.8 |  |  |  | 1.8 |  |  |  |  |
| TDLC-300 Med | 10Hz | Type I |  |  | 2.21 |  | 2.1 | 1.05 |  |  |  |
| eType II |  |  | 2.3 |  | 2.1 | 1.4 |  |  |  |
| TDLC-300 XP Med | 10Hz | Type I | 2.8 |  | 3.1 |  | 2.5 | 2.1 |  |  |  |
| eType II | 2.6 |  | 3.16 |  | 2.5 | 2 |  |  |  |
| TDLC-300 XP High | 10Hz | Type I | 6.1 |  |  |  |  |  |  | 3.7 |  |
| eType II | 3.3 |  |  |  |  |  |  | 2.3 |  |

Table 6.2-6: Simulation result summary for FR1 SU-MIMO Follow PMI 8Tx 4Rx with 2 layers

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel  Model | Doppler/Speed | PMI | SNR at 70% Norm. Throughput | | | | | | | | |
| Source #1 | Source #2 | Source #3 | Source #4 | Source #5 | Source #6 | Source #7 | Source #8 | Source #9 |
| rCDL-C1 | 3km/h | Type I | 4.7 |  | 0.2 |  | 1.7 | 0.9 |  | 2.2 |  |
| eType II | 5.3 |  | -0.8 |  | 1.5 | 1.5 |  | 3.3 |  |
| xTDL-C1 | 10Hz | Type I |  |  |  |  | 4.1 |  |  | 4.3 |  |
| eType II |  |  |  |  | 2.8 |  |  | 3.5 |  |
| TDLC-300 low | 10Hz | Type I | 5.1 |  |  |  | 5.6 |  |  |  |  |
| eType II | 4.4 |  |  |  | 4.1 |  |  |  |  |
| TDLC-300 Med | 10Hz | Type I |  |  | 11.37 |  | 14.1 | 1.5 |  |  |  |
| eType II |  |  | 10.79 |  | 14.0 | 1.3 |  |  |  |
| TDLC-300 XP Med | 10Hz | Type I | 2.1 |  | 0.76 |  | 2.7 | 3.8 |  |  |  |
| eType II | 2.7 |  | 0.49 |  | 2.8 | 5.4 |  |  |  |
| TDLC-300 XP High | 10Hz | Type I | 2.1 |  |  |  |  |  |  | 1.1 |  |
| eType II | 2.9 |  |  |  |  |  |  | 4.5 |  |

For more results with full curves refer to [R4-2509413].

Regarding legacy TDL the following observations can be drawn:

* For TDL Low there is an overly optimistic channel matrix condition number
* For TDL Low no performance impact from the PMI choice
* For TDL nonLow a heuristic correlation tuning is required to show expected performance gain

Regarding rCDL-C1 the following observations can be drawn:

* For rCDL-C1 a spatial channel effect is observed

Regarding xTDL-C1 the following observations can be drawn:

* For xTDL-C1 a spatial channel effect is observed

**3 Conclusion**

This draft TP captures comparison of PMI performance under SU-MIMO scenario for different spatial channel model part.