3GPP TSG-RAN WG4 Meeting #116 R4-2510887

Bengaluru, India, August 25th – 29th, 2025

**Title:** Draft TP introduction of comparison of spatial channel models for SU-MIMO cases

**Source:** Huawei, HiSilicon

**Agenda item:** 7.12.2

**Document for:** Approval

# Background

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

1. Draft TP

6. Comparison of spatial channel Models

## **6.1 PDSCH performance under SU-MIMO scenario**

This section provides comparison for different spatial channel models with common simulation assumptions captured in Table 6.1-1.

**Table 6.1-1: Common Simulation assumptions**

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | | Value |
| Duplex mode | | | TDD |
| TDD Slot Configuration Pattern | | | 7D1S2U (PDSCH is not scheduled in S slot for Rank8) |
| Channel Bandwidth/SCS | | | 40MHz/30kHz |
| Rank | | | 4, 8 |
| Antenna configuration | | | Rank4: 4T4R  Rank8: 8T8R |
| MCS | | | 13 (64 QAM table) |
| Channel model | | | rCDL-C1  xTDL-C1  TDLC300-Low  TDLC300-ULA Med  TDLC300-ULA High  TDLC300-XP Med  TDLC300-XP High |
| Codebook configuration for PDSCH and DMRS | | CodebookType | Single Panel Type I; Randomized precoder selection for every REG bundle and updated per slot with equal probability of each applicable i1/i2 combination or codebook. |
| Codebook configuration | (N1,N2,O1,O2) = (4,1,4,1) |
| PDSCH configuration | Mapping type | | Type A |
| k0 | | 0 |
| Starting symbol (S) | | 2 |
| Length (L) | | 12 |
| PDSCH aggregation factor | | 1 |
| Resource allocation type | | Type 0 |
| VRB-to-PRB mapping type | | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | | N/A |
| PDSCH DMRS configuration | DMRS Type | | Type 1 |
| Number of additional DMRS | | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS | | 2 |
| Number of HARQ Processes | | | 8 |
| Maximum HARQ transmissions | | | 4 |
| UE receiver type | | | MMSE-IRC |
| Test metric | | | Rank 4: SNR@70% of maximum throughput  Rank8: SNR(dB) @ 30% and 70% of max throughput for each codeword |

Simulation assumptions for rCDL-C1 channel specifically are captured in Table 6.1-2:

Table 6.1-2: Simulation assumptions for rCDL-C1 channel

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Value | |
| Rank8 | |
| FR / Carrier frequency | | FR1, 3.5GHz | |
| UE speed and movement direction | | 3km/h, () | |
| AAV assumptions | | (M,N,P,Ms,Ns) = (1,2,2,1,1) | (M,N,P,Ms,Ns) = (1,4,2,1,1) |
| 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 following comparison test cases are included

* FR1 SU-MIMO PMI 4Tx 4Rx 4 layers
* FR1 SU-MIMO PMI 8Tx 8Rx 8 layers

**Table 6.2-3: Simulation result summary of SNR@70% of maximum throughput for FR1 SU-MIMO PMI 4Tx 4Rx with 4 layers**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel model | UE speed/Doppler | Source #1 | Source #2 | Source #3 | Source #4 | Source #5 | Source #6 | Source #7 | Source #8 | Source #9 |
| rCDL-C1 | 3 kph | 15.5 | 14.3 | 16.48 | 15.6 | 15.9 | 16.6 | 14.7 | 15.6 |  |
| xTDL-C1 | 10 Hz |  |  |  | 13.5 | 15.9 |  | 14 | 15.4 | 15.8 |
| TDLC300-Low | 10 Hz | 14 |  | 13.21 |  | 14.7 | 14.3 | 13 | 13.6 |  |
| TDLC300-ULA Med | 10 Hz | N/A |  |  |  | 49.2 | N/A |  | N/A |  |
| TDLC300-ULA High | 10 Hz |  |  |  |  |  |  |  | N/A |  |
| TDLC300-XP Med | 10 Hz | 15.3 |  | 14.95 |  | 16.3 |  |  | 15.5 |  |
| TDLC300-XP High | 10 Hz |  |  |  |  |  |  |  | 27.6 |  |
| rCDL-C1 | 30 kph | 16.3 | 15.34 | 17.17 |  |  | 17.9 | 15.2 | 17.5 |  |
| xTDL-C1 | 100 Hz |  |  |  |  |  |  | 14.5 |  |  |
| TDLC300-Low | 100 Hz | 14.5 |  | 14.05 |  | 15.6 |  | 13.3 |  |  |
| TDLC300-ULA Med | 100 Hz | N/A |  |  |  | N/A |  |  |  |  |
| TDLC300-ULA High | 100 Hz |  |  |  |  |  |  |  |  |  |
| TDLC300-XP Med | 100 Hz | 16.1 |  | 14.95 |  | 17.4 |  |  |  |  |
| TDLC300-XP High | 100 Hz |  |  |  |  | 15.9 | 16.6 | 14.7 | 15.6 |  |

**Table 6.2-4: Simulation result summary of SNR@70% of maximum throughput for FR1 SU-MIMO PMI 8Tx 8Rx with 8 layers (sources #1-#5)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel model | UE speed/Doppler | Source #1 | | Source #2 | | Source #3 | | Source #4 | | Source #5 | |
| CW1 | CW2 | CW1 | CW2 | CW1 | CW2 | CW1 | CW2 | CW1 | CW2 |
| rCDL -C 1 | 3 kph |  |  | 16.9 | 23.7 | 14.2 | 26 | 16.5 | 24.4 | 16.7 | 24 |
| xTDL-C1 | 10 Hz |  |  |  |  |  |  | 14.5 | 21.2 | 11.1 | 19.7 |
| TDLC300-Low | 10 Hz |  |  |  |  |  |  |  |  | 15.7 | 15.8 |
| TDLC300-ULA Med | 10 Hz |  |  |  |  |  |  |  |  | N/A | N/A |
| TDLC300-ULA High | 10 Hz |  |  |  |  |  |  |  |  |  |  |
| TDLC300-XP Med | 10 Hz |  |  |  |  | N/A | N/A |  |  | N/A | 35.1 |
| TDLC300-XP High | 10 Hz |  |  |  |  |  |  |  |  |  |  |
| rCDL -C 1 | 30 kph |  |  | 18.13 | 23.91 | 15.32 | 28.54 |  |  |  |  |
| xTDL-C1 | 100 Hz |  |  |  |  |  |  |  |  |  |  |
| TDLC300-Low | 100 Hz |  |  |  |  |  |  |  |  | 16.4 | 16.4 |
| TDLC300-ULA Med | 100 Hz |  |  |  |  |  |  |  |  | N/A | N/A |
| TDLC300-ULA High | 100 Hz |  |  |  |  |  |  |  |  |  |  |
| TDLC300-XP Med | 100 Hz |  |  |  |  | N/A | N/A |  |  | N/A | 39.1 |
| TDLC300-XP High | 100 Hz |  |  |  |  |  |  |  |  |  |  |

**Table 6.2-5: Simulation result summary of SNR@70% of maximum throughput for FR1 SU-MIMO PMI 8Tx 8Rx with 8 layers (sources #6-#9)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel model | UE speed/Doppler | Source #6 | | Source #7 | | Source #8 | | Source #9 | |
| CW1 | CW2 | CW1 | CW2 | CW1 | CW2 | CW1 | CW2 |
| rCDL -C 1 | 3 kph | 17.5 | 24.7 | 17.2 | 23.4 | 18.5 | 24.4 |  |  |
| xTDL-C1 | 10 Hz |  |  | 15.4 | 16.6 | 14.8 | 20.4 |  |  |
| TDLC300-Low | 10 Hz | 15.9 | 15.9 | 15.5 | 15.7 | 14.4 | 14.3 |  |  |
| TDLC300-ULA Med | 10 Hz | N/A | N/A |  |  | N/A | N/A |  |  |
| TDLC300-ULA High | 10 Hz |  |  |  |  | N/A | N/A |  |  |
| TDLC300-XP Med | 10 Hz |  |  |  |  | 27.4 | N/A |  |  |
| TDLC300-XP High | 10 Hz |  |  |  |  | N/A | N/A |  |  |
| rCDL -C 1 | 30 kph | 18.6 | 25.5 | 17.4 | 23.8 | 21.1 | 26.4 |  |  |
| xTDL-C1 | 100 Hz |  |  | 16 | 17.4 |  |  |  |  |
| TDLC300-Low | 100 Hz |  |  | 16.4 | 16.6 |  |  |  |  |
| TDLC300-ULA Med | 100 Hz |  |  |  |  |  |  |  |  |
| TDLC300-ULA High | 100 Hz |  |  |  |  |  |  |  |  |
| TDLC300-XP Med | 100 Hz |  |  |  |  |  |  |  |  |
| TDLC300-XP High | 100 Hz |  |  |  |  |  |  |  |  |

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

Regarding legacy TDL the following observations can be drawn:

[See conclusion section]

Regarding rCDL-C1 the following observations can be drawn:

[See conclusion section]

Regarding xTDL-C1 the following observations can be drawn:

[See conclusion section]

1. Conclusion

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