**3GPP TSG-RAN WG4 Meeting #111 R4-2408908
Fukuoka City, Fukuoka, Japan, 20th – 24th May, 2024**

**Title: LS on Rel-18 NR MIMO OTA progress**

**Response to:**

**Release: Rel-18**

**Work Item: NR\_MIMO\_OTA\_enh**

**Source: 3GPP RAN4**

**To: 3GPP RAN5, CTIA MOSG, CCSA TC9 WG1**

**Cc: 3GPP RAN Plenary**

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**Attachments:**

# 1 Overall description

This LS is to provide information on technical progress of Rel-18 NR\_MIMO\_OTA\_enh WI in 3GPP RAN4.

Based on the agreed scope and objectives in the WID [1], the Rel-18 NR\_MIMO\_OTA\_enh WI further enhanced NR MIMO OTA test methodologies based on the outcome of Rel-17 NR\_MIMO\_OTA WI in TS 38.151, and specified more MIMO OTA performance requirements for FR1 bands and FR2 bands as well as the recommended test tolerance (TT). The outcome of this WI impacted TS 38.151, and the measurements of MIMO OTA were captured in a new internal technical report TR 38.761.

The core part WI has been completed in RAN#102, Dec. 2023. As described in the WI summary [2], main outcomes of the core part WI are summarized as below:

* FR1 MIMO OTA test methodology enhancement:

- Specified necessary enhancements of the FR1 MIMO OTA test methodology for tablet device types in free space, with the 20-cm quiet zone and the 16-probe MPAC system unchanged

- Decided Test time reduction method for FR1 MIMO OTA

* For bands < 1GHz, the test parameter Minimum Number of Slots per Stream can be reduced to 10k for FR1 MIMO OTA measurement campaign and conformance testing for 15kHz SCS

- Refined FR1 channel model validation pass/fail limits

* Pass/fail criteria of power validation is defined as ± 1.5 dB
* FR2 MIMO OTA test methodology enhancement:

- Defined the framework for FR2 MIMO OTA requirement development

* Pure measurement approach was adopted for FR2 requirement definition

- Refined FR2 channel model validation pass/fail limits based on practical measurement results

* Pass/fail criteria of power validation is defined as ± 1.5 dB

For performance part WI, RAN4 has finalized MIMO OTA performance requirements work for FR1 bands and FR2 bands based on the approved framework and time plan in [3] and [4]. Key working procedures and outcomes in Rel-18 are summarized as below:

* FR1 MIMO OTA performance requirements work:

- RAN4 performed a successful FR1 MIMO OTA lab alignment at band n28, all the participated 6 labs are well aligned based on the measurement results of 3 performance alignment devices (PADs)

* The reference value of each PAD is derived from the linear average approach (in dBm) based on measurement results from all labs (no outliers identified)
* The pass/fail limit (the max deviation between individual results and the reference value) is defined as 0.75\*MU, i.e., +/- 1.96 dB for band n28

- RAN4 conducted a performance measurement campaign to collected TRMS measurement data from aligned labs

* A “partial anonymous” approach is adopted in Rel-18 to collect UE model information those for the measurement campaign, which is to check the representative of 3GPP MIMO OTA data pool. The disclosure of exact device model is done only between each test lab to the Neutral Party, by using the same template [5].

- RAN4 defined FR1 MIMO OTA performance requirements based on per-band data driven approach with CDF analysis of all the valid measurement results from Rel-18 performance measurement campaign.

* In Rel-18, FR1 TRMS minimum performance requirements for NR handheld UEs operating on SA mode in free space are defined for bands n1, n5, n28 as below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NR bands | Bandwidth (MHz) | MIMO layer | Channel model | Reference channel | TRMSaverage,70 |
| n1 | 40 | 4x4 | FR1 UMa CDL-C | R.PDSCH.1-2.4 FDD | TBA dBm/30kHz |
| n5 | 10 | 2x2 | FR1 UMi CDL-C | R.PDSCH.1-3.1 FDD | TBA dBm/15kHz |
| n28 | 10 | 2x2 | FR1 UMi CDL-C | R.PDSCH.1-3.1 FDD | TBA dBm/15kHz |

- RAN4 recommended TT for FR1 MIMO OTA as 0.6\*MU based on the Rel-17 RAN4 agreement

* FR2 MIMO OTA performance requirements work:

- RAN4 performed a successful FR2 MIMO OTA lab alignment at 28-GHz band, 4 volunteer labs are well aligned with the measurement results of 4 PADs

* The reference value of each PAD is derived from the linear average approach (in dBm) based on measurement results from all labs (no outliers identified)
* The pass/fail limit (the max deviation between individual results and the reference value) is defined as 0.75\*preliminary MU, i.e., +/- 3.79 dB for 28-GHz band

- RAN4 conducted a performance measurement campaign to collected MASC measurement data from aligned labs

* To increase the amount of data points, the averaged PADs measurement results were included into the data pool
* A total of 13 data points were collected for FR2 MIMO OTA data pool, with 6 devices provided by volunteer companies

- RAN4 defined FR2 MIMO OTA performance requirements based on per-band data driven approach with CDF analysis of all the valid measurement results from Rel-18 performance measurement campaign

* In Rel-18, FR2 MASC minimum performance requirements for NR handheld UEs operating on NSA mode in free space are defined for band n261 as below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NR bands | Bandwidth (MHz) | MIMO layer | Channel model | Reference channel | MASC70 [dBm/120kHz] |
| n261 | 100 | 2x2 | FR2 UMi CDL-C | R.PDSCH.5-2.2 TDD | TBA |

- RAN4 recommended the TT for FR2 MIMO OTA as 0.5\*preliminary MU budget

* Considering the deep relation between minimum requirements and TT for FR2 MIMO OTA, RAN4 suggests not to further change the TT value if MU values are further modified in RAN5

Meanwhile, 3GPP also approved a new Rel-19 Work Item as TRP\_TRS\_MIMO\_OTA\_Ph3 in RAN#103 meeting, March 2024 [6], targets enhanced OTA test methodologies and more requirements for NR OTA. Based on the agreed Rel-19 WID, dynamic MIMO OTA test methodology will be studied and the outcome will be captured in a new technical report. In addition, new MIMO OTA performance requirements are targeted to be defined for more bands based on the static MIMO OTA test methodology, which will impact TS 38.151.

# 2 Actions

**To** **3GPP RAN5, CTIA MOSG, CCSA TC9 WG1:**

**ACTION:** 3GPP RAN4 respectfully asks 3GPP RAN5, CTIA MOSG, and CCSA TC9 WG1 to take the above information into account.

# 3 Dates of next TSG-RAN WG4 meetings

TSG-RAN WG4 Meeting #112 19-23 August, 2024 Maastricht, NL

TSG-RAN WG4 Meeting #112bis 14-18 Oct, 2024 China

# 4 References

1. RP-240736, Revised WID: Enhancement of Multiple Input Multiple Output (MIMO) Over-the-Air (OTA) test methodology and requirements for NR UEs, CAICT, RAN#103, Mar. 2024.
2. RP-233743, Summary for WI: Enhancement of Multiple Input Multiple Output (MIMO) Over-the-Air (OTA) test methodology and requirements for NR UEs, CAICT, RAN#102, Dec. 2023.
3. R4-2405468, Updated Framework and time plan for FR1 MIMO OTA performance requirements development (Apr 2024), CAICT, 3GPP RAN4#110bis, Apr. 2024.
4. R4-2407662, Updated Framework and time plan for FR2 MIMO OTA performance requirements development (May 2024), CAICT, 3GPP RAN4#111, May 2024.
5. R4-2321191, Template for TRP TRS and MIMO OTA Device Information Collection, Apple, Telecom Italia, RAN4 #109, Nov. 2023.
6. RP-240841, New WID: WI on TRP (Total Radiated Power), TRS (Total Radiated Sensitivity) and MIMO OTA (Over the Air) testing enhancement Phase 3, vivo, CAICT, RAN#103, Mar. 2024.