**3GPP TSG-****RAN WG4 Meeting** **#104-e Rev. of R4-2212640
E-meeting,** **Aug. 15 – Aug. 26, 2022**

**Agenda item: 9.1.2.2**

**Source:** **CAICT**

**Title:** **Proposals on FR1 MIMO OTA performance requirements**

**Document for: Approval**

# 1 Introduction

The Rel-17 NR MIMO OTA Work Item is scheduled to conclude at the RAN #97 plenary in Sep. 2022 [1]. RAN4 #104-e is the last meeting to finalize the remaining open issues. One remarkable objective is to specify FR1 MIMO OTA performance requirements.

In the last meeting, the lab alignment activity and the test campaign for FR1 MIMO OTA requirements development have achieved good progress with the following agreements captured in the WF [2].

**Issue 2-1: FR1 MIMO OTA lab alignment results**

**Agreement:**

* 3GPP FR1 MIMO OTA lab alignment among the 5 labs, i.e., CAICT, CMCC&BUPT, Huawei, MediaTek, and Xiaomi, is confirmed.

**Issue 2-5-1: TRMS measurement data for defining FR1 MIMO OTA performance requirements**

**Agreement:**

* Include the measurement results in R4-2209330, R4-2209513, and R4-2210934 into FR1 MIMO OTA data pool for defining performance requirements.

In this meeting, more TRMS measurement results are submitted in [3]-[5]. Besides, the alignment among the 6 labs (CAICT, CMCC&BUPT, Huawei, MediaTek, Xiaomi, and Apple) is confirmed [9].

This contribution summarizes the TRMS measurement results from the aligned labs [3]-[8], and proposes MIMO OTA performance requirements for n41 and n78 bands.

# 2 Discussion

The TRMS measurement results from the aligned labs in [3]- [8] are included into FR1 MIMO OTA data pool for defining performance requirements, as summarized in Tables 1 and 2.

**Table 1. UE TRMS measurement data for n41 band**

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| **No.** | **Band** | **TRMSaverage,70** | **TRMSaverage,90** | **Test lab** |
| 1 | n41 | -101.45  | -100.83  | Lab1 |
| 2 | n41 | -101.23  | -99.68  | Lab2 |
| 3 | n41 | -100.54  | -98.70  | Lab2 |
| 4 | n41 | -99.99  | -98.43  | Lab2 |
| 5 | n41 | -99.69  | -98.15  | Lab2 |
| 6 | n41 | -99.31  | -97.16  | Lab3  |
| 7 | n41 | -99.04  | -97.07  | Lab1 |
| 8 | n41 | -99.00  | -97.51  | Lab2 |
| 9 | n41 | -98.14  | -95.95  | Lab3  |
| 10 | n41 | -97.42  | -95.28  | Lab3  |
| 11 | n41 | -97.06  | -94.95  | Lab4 |
| 12 | n41 | -97.05  | -94.94  | Lab3  |
| 13 | n41 | -96.98  | -95.05  | Lab2 |
| 14 | n41 | -96.90  | NA | Lab4 |
| 15 | n41 | -96.80  | -94.59  | Lab3 |
| 16 | n41 | -96.77  | NA | Lab4 |
| 17 | n41 | -95.87  | -93.73  | Lab3 |
| 18 | n41 | -95.06  | -92.90  | Lab3 |
| 19 | n41 | -95.00  | -92.92  | Lab3 |
| 20 | n41 | -94.64  | -93.00  | Lab5 |
| 21 | n41 | -94.37  | -92.79  | Lab5 |
| 22 | n41 | -93.92  | -92.29  | Lab5 |
| 23 | n41 | -93.91  | -92.32  | Lab5 |
| 24 | n41 | -93.85  | -92.17  | Lab5 |
| 25 | n41 | -93.74  | -92.12  | Lab5 |
| 26 | n41 | -93.68  | -92.07  | Lab5 |
| 27 | n41 | -93.27  | -91.64  | Lab5 |

**Table 2. UE TRMS measurement data for n78 band**

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| **No.** | **Band** | **TRMSaverage,70** | **TRMSaverage,90** | **Test lab** |
| 1 | n78 | -101.43  | -99.61  | Lab2 |
| 2 | n78 | -101.04  | -98.99  | Lab3 |
| 3 | n78 | -100.42  | -98.24  | Lab3 |
| 4 | n78 | -100.37  | -98.82  | Lab2 |
| 5 | n78 | -100.13  | -98.31  | Lab2 |
| 6 | n79 | -99.49  | NA | Lab4 |
| 7 | n78 | -99.11  | -98.16  | Lab1 |
| 8 | n78 | -98.93  | -96.85  | Lab3 |
| 9 | n78 | -98.77  | -96.62  | Lab3 |
| 10 | n78 | -98.67  | -97.87  | Lab1 |
| 11 | n78 | -98.34  | -96.18  | Lab3 |
| 12 | n78 | -98.04  | -95.60  | Lab2 |
| 13 | n78 | -97.05  | -94.88  | Lab3 |
| 14 | n78 | -96.86  | -94.79  | Lab3 |
| 15 | n78 | -96.79  | -95.14  | Lab2 |
| 16 | n78 | -96.47  | -94.76  | Lab5 |
| 17 | n78 | -96.29  | -94.74  | Lab5 |
| 18 | n78 | -96.26  | -94.69  | Lab5 |
| 19 | n78 | -96.10  | -94.50  | Lab5 |
| 20 | n78 | -95.78  | -94.19  | Lab5 |
| 21 | n78 | -95.67  | -94.06  | Lab5 |
| 22 | n78 | -95.50  | -93.91  | Lab5 |
| 23 | n78 | -95.10  | -93.45  | Lab5 |
| 24 | n78 | -94.79  | -92.70  | Lab3 |

The corresponding CDF curves of the TRMS measurement data for n41 and n78 bands are shown in Figures 1 and 2, respectively.



**Figure 1. CDF curve of the TRMS measurement data for n41 band**



**Figure 2. CDF curve of the TRMS measurement data for n78 band**

We calculated 80%, 85%, and 90% percentile values of the CDF curves, as listed in Table 3.

**Table 3. 80%, 85%, and 90%** **percentile values of the CDF curves for n41 and n78 bands**

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| **Band** | **Percentile** | **TRMSaverage,70**  |
| n41 | 80% | -94.10 |
| 85% | -93.92 |
| 90% | -93.82 |
| 95% | -93.70 |
| n78 | 80% | -96.04 |
| 85% | -95.74 |
| 90% | -95.57 |
| 95% | -95.18 |

3GPP adopted 85% percentile values in the CDF curves to define MIMO OTA TRMS requirements for E-UTRA[10]. CCSA adopted 80% percentile values in the CDF curves to define MIMO OTA TRMS requirements for E-UTRA. It is reasonable to follow the successful history to specifying MIMO OTA TRMS requirements for NR.

The main difference between LTE and NR FR1 MIMO OTA performance metrics in 3GPP are summarized as below:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Rx Antennas** | **Performance Metrics** | **Additional criterion** |
| **LTE** | 2Rx | TRMSaverage,70 [dBm/15kHz] | TRMSaverage,95 [dBm/15kHz] | 11 of 12 @ 70%TP | 10 of 12 @ 95%TP |
| **NR FR1 (n41&n78)** | 4Rx | TRMSaverage,70 [dBm/30kHz] | N/A | 11 of 12 @ 70%TP | [10] of 12 @ 90%TP |

Since NR FR1 has removed the TRMS performance metric at 95% throughput and relaxed the additional criterion of azimuthal orientations from 10 of 12 azimuthal orientation at 95%TP to -10- of 12 at 90%TP, it is more crucial for the group to define reasonable requirements at 70%TP in order to ensure good implementation of NR devices.

Considering it is the early stage of NR commercialization, the performance of NR UEs is expected to be further improved, we recommend to select 80% percentile values in the CDF curves to specify NR MIMO OTA TRMS requirements to provide a better guidance to the industry.

**Proposal 1: Adopt 80% percentile values in CDF curves to specify FR1 MIMO OTA TRMS requirements.**

The 80% percentile values in the CDF curves of TRMSaverage,70 are calculated as -94.10dBm/30kHz and -96.04dBm/30kHz for n41 and n78 bands, respectively.

**Proposal 2: Approve the values in the following table as FR1 MIMO OTA TRMS requirements for n41 and n78 bands.**

|  |  |  |
| --- | --- | --- |
| **Operating Band** |  | **TRMSaverage,70 [dBm/30kHz]** |
| n41 |  | -94 |
| n78 |  | -96 |

# 3 Conclusion

This contribution summarizes the TRMS measurement results from the aligned labs [3]-[8], and proposes MIMO OTA performance requirements for n41 and n78 bands.

**Proposal 1: Adopt 80% percentile values in CDF curves to specify FR1 MIMO OTA TRMS requirements.**

**Proposal 2: Approve the values in the following table as FR1 MIMO OTA TRMS requirements for n41 and n78 bands.**

|  |  |  |
| --- | --- | --- |
| **Operating Band** |  | **TRMSaverage,70 [dBm/30kHz]** |
| n41 |  | -94 |
| n78 |  | -96 |

# References

1. RP-213101, “Revised WID: Multiple Input Multiple Output (MIMO) Over-the-Air (OTA) requirements for NR UEs”, CAICT, OPPO, 3GPP RAN#94e, Dec. 2021.
2. R4-2210675, “WF on NR MIMO OTA”, vivo, CAICT, 3GPP RAN4#103-e, May 2022.
3. R4-2213204, “test result for FR1 performance requirement”, Xiaomi, RAN4#104-e, Aug. 2022.
4. R4-2211996, “FR1 MIMO OTA Performance Test Campaign Results from Huawei”, Huawei, RAN4#104-e, Aug. 2022.
5. R4-2212407, “MIMO OTA device measurement results and requirement”, Apple, RAN4#104-e, Aug. 2022.
6. R4-2209330, “TRMS measurement results for bands n41, n78”, CAICT, 3GPP RAN4#103-e, May 2022.
7. R4-2209513, “initial test result for FR1 performance requirement”, Xiaomi, 3GPP RAN4#103-e, May 2022.
8. R4-2210934, “Commercial terminal testing results of CMCC & BUPT joint lab”, CMCC, 3GPP RAN4#103-e, May 2022.
9. R4-2214360, “WF on NR MIMO OTA”, CAICT, vivo, 3GPP RAN4#104-e, Aug. 2022.
10. R4-1712791, “MIMO OTA TRMS requirements for B5 and B19”, CATR, 3GPP RAN4#85, Reno, USA, Nov. 2017.