**3GPP TSG-RAN WG4 Meeting #100-e R4-2114966**

**Online Meeting, 16 August – 27 August, 2021**

**Source:** Orange

**Title:** WF on Tx diversity system aspects

**Agenda item:** 9.7.2

**Document for:** Approval

# Introduction

This WF captures the outcome of the first round of discussion on Tx diversity system aspects. In particular, the proposals from [1] have been discussed, which advocate the need for RAN4 to investigate proper TxD performance requirements.

# Background

In [1], an issue already identified in [2], [3] has been raised for a UE implementing TxD on the actual UE power capability seen at the gNB receiver. In [2], [3], it is demonstrated that the maximum output power of a UE may be lower than the advertised one, depending on the implementation of TxD, which is transparent to the specifications. Hence, it is claimed that a bad implementation of TxD may lead to severe performance degradation, in particular, it may lead to an unacceptable coverage reduction. Additionally, in [2] it is shown through simulations that transparent TxD implementing CDD scheme with two half power PAs can have even worse BLER performance than a single Tx with a full-power rated PA (for PUSCH transmissions) if the cyclic delay shift is not chosen appropriately. Fig. 1 [2] shows the comparison for cases of low (on the left) and high (on the right) correlation between the channels (with low RMS delay spread), for two different values of the cyclic delay shift. It is demonstrated that:

1. In the low correlation case, the loss of TxD (due to a too small Cyclic Delay) could amount to 1.1 dB compared to single Tx at 10% BLER.
2. In the high correlation case, the loss of TxD (due to a too small Cyclic Delay) could amount to 4.8 dB compared to single Tx at 10% BLER.

 

Figure 1: Single Antenna and TxD Performance for PUSCH, with low correlation (left) and high correlation (right).

In [1], it is stated that up to now the test requirements discussed in RAN4, tackling EVM and power per antenna connector, are not sufficient to prevent bad UE implementation of TxD that may appear in the future. Hence, the need for carefully designed TxD PUSCH performance requirements is stressed in order to ensure that TxD implementation is correct and that the advertised Power Class of the UE is meaningful.

Prior to RAN4#100-e meeting, the following issues have been identified by the moderator:

**Issue 1-1:** Are there any actionable requirement changes for UE or BS requirements based on proposals?

* Proposals
  + Option 1: Yes for UE, please comment what
  + Option 2: Yes for BS, please comment what
  + Option 3: Neither, proposals are for studies only
* Recommended WF
  + TBA

**Issue 1-2: Should RAN4 investigate advanced (dual) receivers for UE conformance testing?**

* Proposals
  + Option 1: Yes
  + Option 2: No
  + Option 3: Other comments
* Recommended WF
  + TBA

# Way Forward

At the end of the first round of the e-mail discussion the moderator has formulated the following status summary:

*Tentative agreements: No actionable requirement changes seems to be majority view but based on issue 1-2 responses, maybe RAN4 can investigate UE Tx EVM requirement to cover the concerns.*

*Candidate options:*

1. *Study further TxD UE in networks*
2. *Study EVM requirements*

*Recommendations for 2nd round: Continue discussion and gather comments on how the concerns can be accommodated in UE requirements*

After carefully studying the inputs from all the companies and since the holistic BLER performance conformance test is deemed too complex or too disruptive for RAN4, we propose to narrow down candidate option 1):

*Candidate options:*

1. *Define a range of S-CDD cyclic delay per bandwidth size as proposed by Skyworks*

*[Orange comment: Due to the large impact of the S-CDD delay on BLER performance, it seems not reasonable to have no RAN4 requirements on this parameter. Note that small bandwidth size is the priority for coverage.]*

1. *Investigate the BLER performance verification by using the EVM test as proposed by Rohde&Schwarz and Ericsson*

# Reference

[1] R4-2114003, “Discussion on requirements for Tx Diversity”, Orange

[2] R4-2109974, “More on transparent TxD and a Draft Reply LS to RAN2”, Ericsson

[3] R4-2105082, “Requirements for transparent TxD”, Ericsson