**3GPP TSG-****RAN4 #102-e *R4-220xxxx***

**Electronic Meeting, 21st February – 3rd March 2022**

**Title:** WF on FR1 UL coherent MIMO

**Source:** Anritsu Limited

**Agenda Item:** 4.1.1.1.

**Document for:** Approval

**1. Introduction**

This Way Forward is intended to facilitate the CR to 38.101-1[1] expected in the coming meetings and covers several points corresponding to the proposals introduced and discussed in the 1st round of RAN4 #102-e [2][3].

**2. Topics**

**2.1. Location of information: Alphabet letter of the Annex**

Candidate proposal:

* Proposal 1:Put details regarding UL coherent MIMO requirements in "Annex G (informative): Transmit signal quality".

[Possible] WF recommendation: Approve Proposal 1.

* The submitted CRs should cover details regarding UL coherent MIMO requirements in the currently blank and unnamed Annex G, naming it: "Annex G (informative): Transmit signal quality".

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| Company | Comments |
| Qualcomm | OK with WF |
| Huawei | OK |
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**2.2. Channel estimation**

The “relative phase error” and “relative amplitude” shall be calculated in frequency domain based on channel estimation.

Candidate proposal:

* Proposal 2: Channel estimation should be used for determining the relative phase and amplitude errors.

[Possible] WF recommendation: Approve Proposal 2.

* The principle of using channel estimation for determining the relative phase and amplitude errors is agreed but details need to be given in submitted CRs.

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| Company | Comments |
| Qualcomm | Please include reference to this agreement |
| Huawei | OK |
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**2.3. Symbols used for calculation**

Either DMRS only symbols (DMRS resource elements i.e. pairs **(**DMRS symbol, DMRS subcarrier)) or DMRS + Data symbols can be used as the channel estimation between the two options should be relatively similar.

Candidate proposal:

* Proposal 3: Use DMRS resource elements (DMRS symbol, DMRS subcarrier).

[Possible] WF recommendation**:** In the CRs submitted one of the two options below should be selected, details should be provided. Choice justification could be either explained in CR “reason of change” or in an accompanying discussion paper particularly if it is not aligned with the related decisions taken in NR\_cov\_enh [4] and NR\_RF\_FR2\_enh2\_Part\_2 [5] if any, where related discussions exist.

* Option 1: DMRS REs
* Option 2: DMRS + Data

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| Company | Comments |
| Qualcomm | Prefer option 1 |
| Huawei | Option 1 is more simple |
| R&S | We would like to futher check, can be discussed based on the CR in the next meeting. |
| Anritsu | We agree with R&S as discussed in 1st round. |

**2.4. Frequency or Time domain type of ~~time~~ measurement ~~(instantaneous, average)~~**

The “relative phase error” and “relative amplitude” shall be calculated in frequency domain for each slot. There should not be then mention of “instantaneous” or “average over a slot”.

Candidate proposal:

* Proposal 4: The “relative phase error” and “relative amplitude” shall be calculated in frequency domain. There should not be then mention of “instantaneous” or “average over a slot” for their calculations.

[Possible] WF recommendation: Approve proposal 4. How from the different values obtained for each slot is a single value per slot determined should be detailed in the CR in agreement with the choice made for “symbols used calculation” (section 2.3. above).

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| Company | Comments |
| Qualcomm | The recommended WF is not complete, cannot agree as proposed.  Need to include detail on what should be done in the frequency domain, and how to extract ‘slot phase’ from the 3 DMRS symbols (LSE? Time average? Other?) |
| R&S | Do not agree yet, we need to figure out how to get to one value for each slot. E.g. it would be possible to average over the phase difference for each subcarrier. |
| Anritsu | We think those details can be given in the CRs that will submitted in May in accordance with the option chosen for 2.3 detailed in the CRs in question. We have understood the intent of moving to “CR format” is to have a concrete Annex G and ease discussions, while having some points still open for discussion.  We can rephrase to:   * *Proposal 4: The “relative phase error” and “relative amplitude” shall be calculated in frequency domain. ~~There should not be then mention of “instantaneous” or “average over a slot” for their calculations.~~*   *[Possible] WF recommendation: Approve proposal 4. How from the different values obtained for each slot is a single value per slot determined should be detailed in the CR in agreement with the choice made for “symbols used calculation” (section 2.3. above).* |
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**2.5. RF impairment compensation enabled in TE - CFO**

The carrier frequency offset (CFO) correction should be enabled and corrected for each slot individually, as if uncorrected it would lead to phase rotation and so phase error.

Candidate proposal:

* Proposal 5: CFO should be corrected for each slot.

[Possible] WF recommendation: Approve Proposal 5. In CR “reason of change” or in an accompanying discussion paper, it should be demonstrated that CFO correction is needed as for JCE [4] even if UL coherent MIMO used 2 Tx chains.

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| Company | Comments |
| Qualcomm | Do not agree with proposed WF (yet)  For tracking phase, we expect any CFO correction will interfere with the result. We do not yet agree to proposed WF, perhaps analysis from TE vendors is required to understand the impact of uncertainty introduced by slot-wise CFO for coherent the UL MIMO test |
| Anritsu | We agree with Qualcomm, the need for CFO correction or not should be justified for the case of UL coherent MIMO, even though we think CFO correction is needed, it is necessary to bring convincing analysis for it. |
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**2.6. Equalization**

Equalization is not required as the values for amplitude and phase can be determined from the channel estimation and so prior the equalization block.

Candidate proposal:

* Proposal 6: Equalization should not be used by the TE for performing the test.

[Possible] WF recommendation: Approve Proposal 6.

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| Company | Comments |
| Qualcomm | Depends on outcome of 2.3.  This proposal only works if DMRS-only is chosen in 2.3. If data is used in 2.3, not sure how equalization can be skipped. |
| Huawei | Better to merge with issue 2.3? |
| Anritsu | We agree it is better to merge this issue with 2.3 and equalization is necessary in the case of DMRS+Data. |
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**2.7. Block diagram and measurement point**

A block diagram inspired of the "Figure F.1-1: EVM measurement points" should be used. It should show the location at which the errors need to be determined either directly or not.

Candidate proposal:

* Proposal 7: A block diagram such as shown in Figure 2 of [2] should be added in Annex G to indicate the reference point.

[Possible] WF recommendation: Approve Proposal 7.

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| Company | Comments |
| Qualcomm | Support. |
| Huawei | OK |
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**3. References**

[1] 38.101-1, “NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone”

[2] R4-2205610, ‘FR1 UL coherent MIMO’, Anritsu, RAN WG4 #102-e, Feb-Mar 2022

[3] R4-220xxxx, ‘Email discussion summary for [102-e][101] R15\_Maintenance’, RAN WG4 #102-e, Feb-Mar 2022

[4] R4-220xxxx, ‘Email discussion summary for [102-e][136] NR\_cov\_enh’, RAN WG4 #102-e, Feb-Mar 2022

[5] R4-220xxxx, ‘Email discussion summary for [102-e][126] NR\_RF\_FR2\_enh2\_Part\_2’, RAN WG4 #102-e, Feb-Mar 2022