**3GPP TSG-RAN5 Meeting #98 Draft\_R5-231891\_v2**

**Greece, Athens 27 February - 3 March 2023**

**Title: [DRAFT]** LS response on measurement of phase continuity requirements for DMRS bundling

**Response to:** R4-2210550: LS to RAN5 on measurement of phase continuity requirements for DMRS bundling from WG4

**Release:** Rel-17

**Work Item:** NR coverage enhancement (NR Cov\_enh)

**Source:** TSG RAN WG5

**To:** TSG RAN WG4

**Cc:**

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**Attachments:** R5-227959, R5-231835

**1. Overall Description:**

RAN5 thanks RAN4 for the information shared on the phase continuity requirement for DMRS bundling in both FR1 and FR2 in [1]. RAN5 has discussed the questions raised by RAN4 for FR2 and FR1 in [2] and [3], respectively. Please find below responses from RAN5 to the questions raised by the RAN4 LS.

**Questions on Common Frequency Offset and its handing (within one bundling time):**

Q1-1: What would be the impact of the residual frequency error after CFO correction by TE on the testability of the phase offset measurement for UE complying with +/- 0.1 ppm frequency error requirement, particularly for the upper range of FR2-1 and lowest allowed SCS?

The maximum test system uncertainty (MTSU) for frequency error results in an approximately 3 times larger phase error than the targeted RAN4 phase continuity (FDD) or for FR1 TDD, the MU is already 52% of the targeted RAN4 requirement [3]. This makes testing of the phase continuity not feasible.

Considering the MTSU for frequency error of ±0.01 ppm for FR2, the phase difference can be ±39 deg for band n259, which is the highest band introduced in TS 38.521-2. This value is larger than the targeted minimum conformance requirement of [25] deg and blocks the measurement [2]. For the upper frequency edge of FR2-1 the MTSU for frequency error has not been specified yet, but it is expected that its value is not smaller than ±0.01 ppm.

In order to enable phase continuity measurements, RAN5 agreed to propose to RAN4 to correct the mean phase for each slot and to apply the phase continuity requirement on the worst case phase difference between the two measured slots with respect to the sub carriers.

The mean phase error correction shall be defined as

$\tilde{φ'}\left(t,f\right)= \tilde{φ}\left(t,f\right)-\frac{1}{n}\sum\_{i=1}^{n}\tilde{φ}\left(t,f\_{i}\right)$,

where $\tilde{φ}\left(t,f\right)$ is the phase response of the TX chain and *f*i are the sub carriers.

After the mean phase error correction, the processing as described in Annex F.9.4 of TS 38.101-1 [4] and Annex F.8.4 of TS 38.101-2 [5] can be performed, where RAN5 suggests to apply absolute value as highlighted in yellow below in order to correct the metric:

$$∆\tilde{φ}\left(f\right)= \tilde{φ'}\left(t\_{m},f\right)-\tilde{φ'}(t\_{ref},f)$$

$$PhaseOffset=\max\_{f}(|∆\tilde{φ}\left(f\right)|)$$

Q1-2: Can Frequency error be corrected in such way that it has minimal or no impact on measurement uncertainty for phase discontinuity requirements? If answer is yes, in which options below could achieve this:

1. CFO correction in each slot should be applied taking into account a slot starting from a reference time slot (e.g. slot 0 or any slot p-1) to measured time slot (slot p) to enable a continuous correction to avoid any potential phase step introduced by CFO correction.
2. CFO in each slot is corrected with its individual frequency error

In order to minimize the impact of frequency error, RAN5 proposes to correct the mean phase in each slot and update subsequent processing as proposed for Q1-1. CFO option 2 in combination with mean phase correction results in no impact of frequency error on the phase continuity measurement.

Q1-3: Does RAN5 see any other testing issue apart from issues raised by RAN4 above?

It is also required to correct the timing of the signal.

**Questions on improving test accuracy by repeated testing**

Q2-1: The requirement of phase continuity requirement is applied within one DMRS bundling configuration, would the measurement uncertainty be improved as the result of repeating the test over several bundles and if so, what would be the recommended number of bundles and should it be dependent on the subcarrier spacing?

If the mean phase error is corrected per slot, repeated testing is not needed. RAN5 recommends to pursue the approach proposed for Q1-1.

Q2-2: In case multiple bundles will be tested, what is Ran5 view on how the test results in terms of phase offset from individual bundles be used to improve the test reliability and reduce measurement uncertainty (e.g., maximum over all bundles or RMS average over all bundles or others method)?

Since common frequency offset correction on its own is not sufficient to enable testing, a mean phase error correction per slot as proposed is preferred and repeated testing is not needed.

RAN5 kindly asks RAN4 to consider above answers in the definition of the phase offset measurement for DMRS bundling

**2. Actions:**

**To RAN4 group.**

**ACTION:** RAN5 kindly asks RAN4 to consider above answers in the definition of the phase offset measurement for DMRS bundling

**3. Date of Next TSG-RAN WG5 Meetings:**

TSG-RAN5 Meeting#99 22nd – 26th May 2023 Incheon, Korea

TSG-RAN5 Meeting#100 21st – 25th August 2023 EU

**4. References**

1. R5-223917, LS to RAN5 on measurement of phase continuity requirements for DMRS bundling, 3GPP TSG RAN WG4, WG5 Meeting #96-e, August 2022
2. R5-227959, On the measurements of phase continuity requirements, Rohde & Schwarz, 3GPP TSG RAN WG 5 Meeting #97, Toulouse, November 2022
3. R5-231835, On the measurements of phase continuity requirements for FR1, Rohde & Schwarz, 3GPP TSG RAN WG 5 Meeting #98, Athens, February 2022
4. TS 38.101-1, V17.8.0, 3GPP TSG RAN WG4, December 2022
5. TS 38.101-2, V17.8.0, 3GPP TSG RAN WG4, December 2022