**3GPP TSG-RAN WG4 Meeting #104-bis-e R4-22xxxxx**

Electronic Meeting, Oct 10 – 19, 2022

**Title:** WF on test burden reduction for multiple MSD in band combinations

**Source:** ZTE Corporation

**Agenda item:** 6.3.3

**Document for:** Approval

# 1. Background

In the objective of study item FS\_SimBC, how to reduce the test burden for band combinations is listed as below [1].

* Investigate the feasibility and optimize the specification structure and reduce the test burden
  + Study the methodology to simplify the test efforts for a UE supporting multiple features, e.g., NR-CA, EN-DC on the same band combination
    - Study of similarity and dependency of RF requirements for different features on the same band combination
  + Study the methodology to simplify RF requirement specifications for
    - MSD requirements in 38.101-1 and 38.101-3, e.g., reducing the test configurations with different bandwidth combinations
    - For Delta\_TIB and Delta\_RIB requirements, investigate and define the framework of the general principle or requirements with band-combination specific exceptions
    - For Delta\_TC,c, investigate whether it can be removed in low boundary formula for Pcmax

In RAN4#104-bis-e meeting, a discussion paper on how to reduce test burden in the aspect of multiple MSD values has been proposed [2]. To trace back the early stage when specifying the E-UTRA CA configurations with 2UL, there are agreements on how to meet the 2UL CA MSD requirements due to intermodulation exists. The baseline at that time in E-UTRA, only the worst case MSD is defined for each band, which means that even if there are multiple IMD’s, only the one resulting highest MSD will be specified [3]. In [2], the following proposal is proposed for reducing the test burden for NR CA and EN-DC combos.

* For each UL band combination, only the highest MSD with the lowest order IMD as the worst case will be specified.
  + Some exceptions should be accepted based on request of the proponent of the band combination.
  + The criterion for keeping the MSD other than the highest value should be clarified explicitly.
* Multiple IMDs for each NR CA and EN-DC band combos will be analyzed in the band combination TR for basket WI.
* For the multiple MSD requirements in TS 38.101, only highest MSD requirements shall be maintained, the other MSD will be moved into the related TRs unless there is a request to keep it.

# 2. Discussion

In RAN4#104-bis-e meeting, one sub-topic is set for test burden reduction for multiple MSD in thread [104-e][126] FS\_SimBC.

*Issue 3-2D: For the sake of test burden reduction for NR CA and EN-DC combos, can we reuse the previous agreements in E-UTRA for the 2UL MSD requirements having multiple IMDs with the following guidance?*

* Proposals
  + Option 1: Yes (Please provide further comments).
  + Option 2: No (Please provide further comments).
  + Option 3: Others (Please provide further comments).

During the online discussion, companies provide their considerations on this issue as follows.

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| **Company** | **Comments** |
| Samsung | Issue 3-2D:  Generally We are supportive to the proposal. From our observation it is true that only lowest order IMD is maintained for LTE combos in 36.101 following the WF R4-1702446, and current procedure of introducing EN-DC and NR-CA combos is that the lowest order IMD is mandatorily defined in spec while the higher orders could be omitted with the note “*This band is subject to IMD X also which MSD is not specified*”. In addition, UE should be capable of supporting the full frequency range, and the lowest order IMD in our view is enough for architecture performance verification purpose.  However, there are two questions for clarification.  1) “The criterion for keeping the MSD other than the highest value should be clarified explicitly” → Does it mean RAN4 is supposed to develop the explicit criterion to allow higher order IMDs exceptions? Maybe the reginal specific combos could be considered as exceptions? We think it would be good if there is unified criterion for the proponent of band combinations reference.  2) Regarding the last bullet, does it mean all higher order IMDs except the lowest order and the exceptions would be removed in Rel-18 specs? |
| Huawei | Issue 3-2D: For the sake of test burden reduction for NR CA and EN-DC combos, can we reuse the previous agreements in E-UTRA for the 2UL MSD requirements having multiple IMDs with the following guidance?  Huawei: Option 3. We can consider to test the highest MSD mandatorily and test other cases with smaller MSD optionally. Probably, it isn’t good to remove the corresponding requirements directly in this study item. |
| ZTE | Issue 3-2D: Option 1. If the previous agreements in E-UTRA can be applied to NR CA and EN-DC combos, the test burden can be reduced.  To Samsung: (1) Regarding to question to “The criterion for keeping the MSD other than the highest value should be clarified explicitly”, we think the exceptional cases for considering higher order IMDs could be further discussed. An explicit criterion may be helpful.  (2) Regarding the last bullet – “only highest MSD requirements shall be maintained”, we prefer to apply the rules to newly introduced combos from Rel-18 on. And to reduce the impact on the already introduced combos, our preference is to keep them unchanged.  To Huawei: Here we just try to reduce test burden not to change the requirements. |
| Nokia | Issue 3-2D: We are in principal fine to choose the “strictest” requirement, here meaning the IMD with largest impact which normally is the lowest order. However, the source of the IMD may impact the design differently. It is not necessarily the worst (toughest) MSD that is the strictest requirement, and it doesn't exclude the other orders. As mentioned multiple times, it is the responsibility of RAN5 to design the testcases and they may choose to skip some. |
| AT&T | Issue 3-2D: Option 3. We are generally OK with this approach. However, we would not want to see the additional lower order test points removed from 38.101-X without discussion on each case given that they were added by proponents originally. For example, many of the combinations containing n77 in the USA may not be able to test the highest order case due to frequency range restriction and, as such, an additional lower order case may have been added.  We also agree with Nokia that the worst IMD case may not result in the worst-case performance for a particular UE implementation. |
| Skyworks | Issue 3-2D: We would like to suggest using the approach agreed for new MSD template in WF for R17 NR-CA: when multiple IMD occurs for a given band combination, a maximum of 2 test points may be specified: 1) it is mandatory to specify the lowest order IMD test point (highest MSD), 2) To address proponent’s concerns, one additional test point may be optionally specified on a case-by-case basis. |
| CHTTL | Issue 3-2D: No.  First of all, “The criterion for keeping the MSD other than the highest value should be clarified explicitly” is not from the previous agreement, which needs to be removed, otherwise the proposal seems misleading. Second, from operator’s point of view, since higher order IMDs cover more frequency range, which might be higher chance to be occurred in the real deployment, we think it shall be treated case-by-case, and can be requested by operators. Otherwise with the MSD for the lowest order IMD we only show how bad the performance is, which is also not meaningful.  Actually there was an previous agreement from R4-1710724 that up to 5th IMD needs to be defined. Proposal 2: For IMD problems, RAN4 should define MSD level for NR bands and LTE bands up to 5th IMD order to support NSA DC operation. And corresponding test configuration and MSD level will be considered to specify the NSA UE DC sensitivity level. |
| Apple | Issue 3-2D: Option 1 |
| Qualcomm | Issue 3-2D: Option 1 |

From the discussion, it can be seen that most of the companies raised their support of removal the higher order IMD to reduce test burden. However, some companies also raised their concern on the criterion for keeping the MSD other than the highest value being clarified explicitly. With the point that TS 38.101 only maintain the highest MSD requirements and the other MSD will be moved into the related TRs unless there is a request to keep it, some companies raised that it is not appropriate to remove the additional lower order test points without discussion since the case was originally added by proponents.

# 3. WF

It is proposed that for the test points for reference sensitivity exceptions due to intermodulation interference with 2UL CA, the limitation to higher order IMD source could be a solution to reduce test burden.

* IMD issues for NR CA and EN-DC/NE-DC band combinations shall be analyzed in each basket WI TR.
* The existing IMD MSD requirements in Rel-17 specifications are kept unchanged.
* For Rel-18 new introduced band combination, for a certain band:
  + If only one IMD order occurs, the MSD value if any shall be defined in the specifications.
  + If multiple IMD orders occur, the MSD values if any for up to two IMD orders as follow shall be defined in the specifications:
* The lowest order IMD.
* One additional IMD order may be optionally specified on a case-by-case basis.

*Recommendations for 2nd round (Please provide your comments below)*

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| **Company** | **Comments on** ***WF on test burden reduction for multiple MSD in band combinations*** |
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References

1. RP-222216, Revised SID: Study on simplification of band combination specification for NR and LTE, ZTE, vivo
2. R4-2216619, On test burden reduction for multiple MSD in band combinations, ZTE
3. R4-1702446, WF: MSD requirements for 2UL Inter-band CA combinations, LG Electronics