**3GPP TSG-RAN WG4 Meeting #108-bis R4-23xxxxx**

**Xiamen, China, October 09 – 13, 2023**

**Agenda item:** 5.3.1.4

**Source:** Huawei, HiSilicon

**Title:** Ad-hoc minutes for lower MSD

**Document for:** Information

# Topic #1: Information & approaches for lower MSD signalling design

### Sub-topic 1-2: MSD types and orders

#### **Issue 1-2-2: MSD type (new types)**

* Proposals
  + Option 1: MSD types can remain limited to the previously agreed ones of IMD 2, 3, 4, 5, harmonics, harmonic mixing and cross band isolation (QC, Xiaomi, MTK, Samsung)
    - The above MSD types are considered for Rel-18 (MTK)
    - It is suggested not to further differentiate the MSD mechanisms for IMD to intra-band contiguous ULCA, intra-band non-contiguous ULCA, inter-band 2CC ULCA and intra+inter ULCA. And as long as the order is within 5, the IMD mechanism could be considered in Rel-18 regardless of the IMD mechanism in terms of lower MSD capability reporting (Samsung)
  + Option 2: New MSD types in forward release if identified by RAN4 can be included: 1UL2CCIMD2, 1UL2CCIMD3, 1UL2CCIMD4, 1UL2CCIMD5, 3beat (MTK)
  + Option 2a: In future release, RAN4 can support high order IMD reporting such as IMD 6/7/8/9, then RAN4 can define the small granularity of MSD reporting capability signalling (Meta)
* Recommended WF
  + Focus on the scope of Rel-18 and adopt option 1. Meanwhile, consider the proposal from Samsung as supplementary conditions for previously agreed MSD types
* Discussion

AT&T: agree with the moderator proposal

Samsung: discuss together with next issue, main bullet of option 1 should be kept. Whether we need to introduce triple beat and UL intra CA in Rel-18, drop UL configuration or inform RAN2

Meta: Support option 1. In future release consider other schemes

MTK: Fine with option 1 first main bullet. Open to new mechanism in future release

Skyworks: support option1. RAN2 only consider DL configuration may be problematic

QC: also support option 1. Triple beat for future release

Nokia: Ok with option 1. Share some info with RAN2 with configuration, etc.

* Agreement

MSD types can remain limited to the previously agreed ones of IMD 2, 3, 4, 5, harmonics, harmonic mixing and cross band isolation in Rel-18

#### **Issue 1-2-2: MSD type (UL configuration)**

* Proposals
  + Option 1: it’s suggested to report MSD types per victim band per band combination rather than per UL configuration per victim band per band combinations. (CMCC, Samsung)
  + Option 1a: If RAN4 can keep the existing UL/DL configuration for the MSD test, then RAN4 don’t need to report the detail UL/DL configuration information (# of CC, # of bands of each UL/DL) (Meta)
  + Option 2: Apart from introduction of lower MSD capabilities for 1 band with two CCs like CA\_n5B and/or triple beat into Rel-18, RAN4 should share all the possible MSD types with side conditions like UL configuration with RAN2 to enable RAN2 to develop scalable signalling design to accommodate new MSD types in future releases. (Nokia)
  + Option 2a: IMD MSD type for different UL configuration type might be needed when UE report the lower MSD capability (ZTE)
* Moderator’s observation
  + The distinctive difference between option 1 and option 2 is whether to report UL configuration info for a band combination. If we agree that no need to differentiate the MSD mechanisms for IMD to intra-band contiguous ULCA, intra-band non-contiguous ULCA, inter-band 2CC ULCA and intra+inter ULCA, then there is no need to report the UL configurations.
* Recommended WF
  + Check whether option 1 is agreeable, i.e. no need to report UL configurations.
* Discussion

Samsung: whether to introduce triple beat and UL intra CA MSD in Rel-18.

AT&T: In Rel-18 may not need to introduce the complexity. Not against to inform RAN2 for the additional info.

Skyworks: fine not to introduce new mechanism in Rel-18.

MTK: don’t need to report UL configuration.

Nokia: similar view as Skyworks and Samsung.

Huawei: if companies agree not to introduce UL intra CA, may not need UL configuration

Samsung: not suggesting RAN2 to consider UL configuration in signaling design, but the possible mechanism considered by RAN4

Nokia: not to force RAN2 to introduce UL configuration. But MSD comes from different mechanism and configurations

Skyworks: from scalability perspective, better to inform the possible mechanism for future proof

* Agreement
* MSD of triple beat and UL intra-CA as well as UL configurations are not considered by RAN4 for lower MSD reporting in Rel-18
  + MSD caused by different UL configurations may be considered in future release
* Share some information to RAN2 of MSD mechanisms even not considered for lower MSD, could be in the form of examples in the LS to RAN2

#### **Issue 1-2-3: MSD order**

* Proposals
  + Option 1: Do not introduce index to indicate IMD order (Nokia).
  + Option 2: Maximum IMD order should be limited to 5 regardless of IMD mechanism which can include intra-band, intra-band + inter-band and inter-band cases (QC, Meta, Samsung).
    - as long as the order is within 5, the IMD mechanism could be considered in Rel-18 regardless of the IMD mechanism in terms of lower MSD capability reporting (Samsung)
  + Option 3: In future release, RAN4 can support high order IMD reporting such as IMD 6/7/8/9, then RAN4 can define the small granularity of MSD reporting capability signalling (Meta)
* Recommended WF
  + check whether option 1 and option 2 are agreeable
* Discussion

Samsung: Option 1 for the agreement, option 2 may be contradict to previous agreement

Skyworks: Option 1 is ok, but may not be an efficient way

Huawei: wording of option 1 is confusing

Nokia:

* Agreement

No need to have further discussion of this issue in Rel-18

#### **Issue 1-2-3: MSD type “ALL”**

* Proposals
  + Option 1: Agreement in last meeting, i.e. Type “ALL” denotes the actual MSD values for harmonic/harmonic mixing/cross band isolation/IMD2,3,4,5 if any are all under the reported lower MSD capability threshold for a victim band with a band combination
  + Option 2: RAN4 further discuss on the rules to verify the requirements of special MSD type “All”. Specifically, propose not to introduce such type in current release (MTK)
* Recommended WF
  + If no consensus, follow the previous agreement as RAN2 is considering the signalling design upon RAN4 inputs, in which “ALL” is included.
* Discussion

Samsung: for conformance test, reuse the traditional test points

MTK: if UE reports ALL, all MSD types should be tested. Concern is though ALL could reduce singling overhead, but create test burden.

Meta: Have concern for ALL in last meeting.

Apple: concern for the testing too complicated. ALL is only meaningful for the selected threshold is lower than the specified MSD

Skyworks: Basic principle is no more test for lower MSD. ALL anyhow is an optional capability

* Agreement

Keep previous agreement for “ALL” type

* + “ALL” should not introduce additional test cases compared to UE not declaring lower MSD or relaxed MSD
  + If UE reports ALL, it does not mean UE always suffer from all MSD types

### Sub-topic 1-4: Conformance test for lower MSD

**Issue 1-4-1: Rule of Test points for lower MSD**

* Proposal in R4-2315451 (Samsung)
  + For a given MSD mechanism,
    - In case UE only supports one specified test point, it is used for lower MSD verification
    - In case UE supports more than one specified test point, the worst case configuration test point which corresponds to the largest MSD is used for lower MSD verification
* Recommended WF
  + Agree with the proposal
* Discussion
* Agreement

### Sub-topic 1-5: Signaling overhead reduction

*Sub-topic description*

*Open issues and candidate options before meeting:*

* Proposals
  + Option 1: Leave further detailed discussion on signalling overhead reduction and its necessity to RAN2. (Nokia, Samsung)
  + Option 2: Allow gNB to query UE capabilities and enable UE to report only to the queried information (QC, CMCC, Xiaomi, LGE, vivo, Meta, OPPO)
    - Query information could include following information, e.g. band combinations, power class, Tx power, aggressor and victim CBW, victim operation band (CMCC)
    - the query information shall align with the information of the UE capability, i.e. band combination, victim band, MSD types and orders (Xiaomi)
    - Add the lower MSD class as a filter coefficient, for network to indicate UE a preferred class. For UE with lower MSD class larger than preferred by network, the corresponding signalling of lower MSD support would not be reported by UE to reduce signalling overhead (vivo)
    - RAN4 can allow gNB query UE capability signalling and UE only reported the filtered capability signalling to reduce the signalling overhead. Also can merge MSD types with the same MSD values (Meta)
    - RAN4 shall make sure the low MSD reporting will not become a big burden for UE and NW, and some simplification approaches shall be defined together with the low MSD reporting scheme rather than leave it for further optimization in the future (OPPO)
  + Option 3: (MTK)
    - To reduce signalling overhead during connection and save UE maximum memory size for storing low-MSD information, an adaptive signalling approach that network can require UE only to report the top K largest MSD values together with its mechanism indexing and improved MSD values is proposed as option 5.
    - UE is also allowed to report top K’ largest low-MSD information where K’<K. For the low-MSD terms that are not responded, the MSD in existing specs applies.
* Moderator’s observation
  + Option 1 and option 2 are not mutually exclusive. Capability query is a usual mechanism supported by RAN2, and the issue is how to extend the existing mechanism to the lower MSD case. In moderator’s view, this belongs to the details for the signalling design. Check whether option 1 is acceptable.
* Recommended WF
  + Check whether option 1 is acceptable.
* Discussion
* Agreement

### Sub-topic 1-6: lower MSD capability for higher order combination

*Sub-topic description*

*Thanks Nokia for pointing out the latest progress in RAN2. Given the RAN2 agreement in Aug meeting, the decision by RAN2 is not to override the previous RAN4 recommendation. Thus, we can leave the issue for further consideration by RAN2 during their signaling design.*

*Open issues and candidate options before meeting:*

* Proposals
  + Option 1: Since RAN2 has already concluded that lower MSD capability is reported outside BandCombinationList, no need to have further discussion in RAN4 unless receiving further clarification request from RAN2 (Nokia, QC, Meta, vivo)
  + Option 2: it’s suggested to reply RAN2 with the clarification for higher order combinations (CMCC)
* Recommended WF
  + No further discussion on lower MSD capability for higher order combination unless receiving further clarification request from RAN2
* Discussion
* Agreement

### Sub-topic 1-7: Others

*Sub-topic description*

*Open issues and candidate options before meeting:*

#### **Issue 1-7-1: other approaches for lower MSD reporting**

* Proposals
  + Option 1: No to consider different overlapping schemes, e.g. new lower MSD type/order definition, in this release (vivo)
  + Option 2: The approach that would create additional MSD test point(s) for lower MSD verification should not be pursued anymore at least within Rel-18 (Samsung)
  + Option 3: allow UE report under which Tx power all the MSD values would be negligible/acceptable. This information could help gNB to know which UE could be allocated to MSD-victim RB since the MSD is negligible for this UE when it is at cell center with less target Tx power (CMCC)
    - Option 2a: if reporting the Tx power that all the MSD values would be negligible/acceptable is considered, reporting the required corresponding power back off (e.g. MPRdesense) relevant to power class could be also a good candidate (Xiaomi)
  + Option 4: Single bit indication and 2-bits MSD reporting bitmap for the small MSD capability (MSD <= [3] dB) can be considered to apply the improved MSD level by the high order IMD/harmonic problems (Meta)

|  |  |  |
| --- | --- | --- |
| *Bit map* | *MSD range*  *(i.e. Thresholds)* | *Note* |
| 00 | - | Not supported the lower MSD capability. Only apply the existing MSD requirements in TS38.101-1 and TS38.101-3. |
| 01 | [1] dB | 0 ≤ Actual MSD ≤ [1] |
| 10 | [2] dB | 1 < Actual MSD ≤ [2] |
| 11 | [3] dB | 2 < Actual MSD ≤ [3] |

* + Option 5: To discuss the at least [x] dB MSD improved value (ZTE)
* Recommended WF
  + Check whether option 1 and option 2 can be considered at least for Rel-18
* Discussion
* Agreement

# Topic #2: Requirements for lower MSD capability

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **T-doc name** | **Company** | **Proposals / Observations** |
| [**R4-2315150**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_108bis/Docs/R4-2315150.zip) | The remaining open issues for lower MSD capability signalling | Meta Ireland | ***Add the Note in section 7.3A.4, 7.3A.5 and 7.3A.6 to support lower MSD capability requirements without the explicit additional MSD requirements in TS38.101-1 and TS38.101-3.***  **NOTE X: If the UE supports the lower MSD capability, then a reported MSD threshold shall be tested and verified as the REFSENS exception requirements with the appropriate test point in each reference sensitivity exceptions in section 7.3A.4, 7.3A.5 and 7.3A.6.** |
| [**R4-2316478**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_108bis/Docs/R4-2316478.zip) | DraftCR for introduction of lower-MSD requirements for inter-band CA | Huawei, HiSilicon | ***Include lower MSD capability classes as well as conditions of test points for lower MSD in the spec with a dedicated sub-clause*** |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1: Requirements for lower MSD capability

*Sub-topic description:*

*Open issues and candidate options before meeting:*

* Recommended WF
  + Discuss the possible spec impact based on the draft CR
* Discussion
* Agreement