**3GPP TSG-RAN WG4 Meeting #109 R4-2321735**

**Chicago, USA, November 13 – 17, 2023**

**Agenda item:** 8.3.1.4, 8.3.1.2

**Source:** Huawei, HiSilicon

**Title:** Ad hoc minutes for lower MSD and 4Tx

**Document for:** Information

# [124] FR1\_enh2\_part1 – Lower MSD

# Topic #1: Reply LS on power class indication in lower MSD capability

### Sub-topic 1-1: RAN4 answer for Q1 in LS R2-2311586

***Question 1) in RAN2 LS***

*It is not completely clear to RAN2 whether the power class that is supposed to signalled in the new MSD capability signalling is the power class of aggressor band(s) and/or victim band.*

* Proposals
  + Option 1: power class used in the new MSD capability signalling is the power class of the band combination consisting of the victim band and the aggressor band(s) with specific UL and DL configuration.
    - The aggressor can be the one UL band for MSD type of harmonic, harmonic mixing and cross-band isolation, or the 2 UL bands for MSD type of IMD for lower-MSD reporting in Rel-18 (Huawei).
    - the power class of the band combination with either 1 or 2 aggressor band(s) relies on UE itself to correctly report, along with other information included in lower MSD capability, and does not require the power class included in lower MSD capability to refer to the field indicated by *powerClass* and its variations in *BandCombination from signalling perspective* (Samsung).
  + Option 2: per band combination power class for CA configuration with aggressor band(s) and victim band(s)
    - The power class to be signalled is *powerClass-v1530* or *powerClass-v1610* for an associated CA configuration including aggressor band(s) and victim band. (Nokia)
  + Option 3: per band/per band per BC power class for MSD types with single aggressor band and per BC power class for two aggressor bands, refers to the power classes in the table of Q2.
    - The power class to be signalled in the new MSD capability signalling is only for aggressor UL band(s). (Apple, Xiaomi, vivo)
    - For harmonics, harmonic mixing, and cross band isolation, the power class is the aggressor band power class. For IMD, the power class is the band combination total power class. (OPPO, MTK, QC)
* Moderator’s observation

It was agreed by RAN2 that MSD combinations per MSD type are outside the *BandCombination* list, which means the power classes indicated in the *BandCombination* cannot be referred directly by the power class to be indicated in the BC in terms of MSD type. Now the MSD BC structure designed by RAN2 includes MSD type, victim band, aggressor band(s) and power class. That’s the reason RAN2 asked the question 1.

To the moderator’s understanding, all companies agree that MSD types can be categorized to two cases, i.e. one aggressor band for harmonics, harmonic mixing, cross band isolation, and two aggressor bands for IMD, in other words, power class(s) are relevant to the aggressor band(s). But regarding the question itself, it seems answer option 1 is more pertinent to the RAN2 question.

* Recommended WF
  + Check if option 1 can be considered as baseline for Q1.
* Discussion

AT&T: The last sub-bullet in Option 1 allows for a different power class to be reported than its highest power class. We don’t believe that the meaning should be different if power class is to be reported.

“… does not require the power class included in lower MSD capability to refer to the field indicated by powerClass and its variations in BandCombination.”

Samsung: the power class rely on UE itself to correctly report. From signaling perspective, UE does not need to refer the power class in BC list. Aggressor band(s) together with victim compose the MSD BC. Preference is option 1.

Nokia: proposal is similar to option 1. Power class included in the MSD capability, should not exceed to the PC of the BC in BC list.

OPPO: could decouple of the MSD power class with existing PC IEs.

Samsung: agree with Nokia the PC of MSD should not exceed the PC table defined. Must decouple the PC of lower MSD with existing PC IEs. Key point relies on UE reporting correctly.

MTK: views are not far away. Fine with first bullet of option 1, not quite sure of the second sub-bullet.

Skyworks: Originally agreed power class is UE supported highest PC.

Huawei: decouple Q1 and Q2. Q1 is related to band combination. In Q2, decide how to report the PC.

vivo: intention is not to refer to the power classes in the table of Q2

* Agreement

From signalling mechanism perspective, power class used in the new MSD capability signalling is the power class of the band combination consisting of the victim band and the aggressor band(s) with specific UL and DL configuration.

* The aggressor can be the one UL band for MSD type of harmonic, harmonic mixing and cross-band isolation, or the 2 UL bands for MSD type of IMD for lower-MSD reporting in Rel-18
* The power class in MSD capability does not refer to the existing PC IEs
* [The power class for lower MSD capability shall not exceed the power classes indicted by the existing PC IEs for the band combination or single band in the BC list which is guaranteed by the UE]

### Sub-topic 1-2: RAN4 answer for Q2 in LS R2-2311586

***Question 2) in RAN2 LS***

*RAN2 would like to point out that under the current UE capability signalling, the UE reports a power class per frequency band, per band combination and per band per band combination respectively (see the table below).*

|  |  |
| --- | --- |
| ***UE capability parameter*** | ***Applicability*** |
| *ue-PowerClass*  *ue-PowerClass-v1610*  *ue-PowerClass-v1700* | *per frequency band* |
| *powerClass*  *powerClass-v1610* | *Per band combination* |
| *ue-PowerClassPerBandPerBC-r17* | *Per band per band combination* |

*It was not clear to RAN2 which of the above power class types is relevant in the MSD capability signalling, and whether the choice of power class type can be dependent on the MSD type (e.g. whether the aggressor is a single band or two bands).*

* Proposals
  + Option 1: It relies on UE itself to correctly report the power class as mentioned in option 1 for Answer 1 (Samsung, Huawei)
    - For MSD type of harmonic, harmonic mixing and cross-band isolation, the power class is that for the following DL/UL component(s):
      * DL\_bandA(victim)-bandB, UL\_bandB(aggressor).
    - For MSD type of IMD, the power class is for the following DL/UL components:
      * DL\_bandA(victim)-bandB, UL\_bandA(aggressor)-bandB(aggressor) or
      * DL\_bandA(victim)-bandB-bandC, UL\_bandB(aggressor)-bandC(aggressor).
  + Option 2: the relevant Power Class capability is *powerClass-v1530* or *powerClass-v1610*. (Nokia)
  + Option 3: All the listed power class types could be relevant in the MSD capability signalling, and the choice of power class type is dependent on the MSD type, such as whether the aggressor is a single band or two bands (vivo, OPPO, MTK, Xiaomi, QC, [Apple])
    - Example (not all similar proposals are listed):

|  |  |  |
| --- | --- | --- |
| * MSD type | Number of Aggressor bands for one victim band | UE capability signalling refer to |
| 2 bands combination:  UL harmonic, harmonic mixing and crossband isolation MSD | 1 | If per band combination power class is higher than per band power class  ue-PowerClass; ue-PowerClass-v1610; ue-PowerClass-v1700  If per band combination power class is not higher than per band power class  powerClass; powerClass-v1610  If ue-PowerClassPerBandPerBC-r17 is not absent.  ue-PowerClassPerBandPerBC-r17 |
| 2 bands combination:  IMD with order=2/3/4/5 | 2 | powerClass  powerClass-v1610 |
| 3 bands combination:  IMD with order=2/3/4/5 | 2 | powerClass  powerClass-v1610 |

* Moderator’s observation

From above discussion for Q1, the lower MSD capability reporting for a combination is composed with MSD type, victim band, aggressor band(s) and power class. The power class, e.g. powerClass or ue-PowerClassPerBandPerBC-r17 indicated in *BandCombination* cannot be referred directly. Also, the power class for single aggressor band could be different from that indicated by *ue-PowerClass*. For instance, the indicated power class (by *ue-PowerClass*) for the aggressor band is PC2, and the PC indicated by powerClass for the combination with victim band and aggressor band in *BandCombination* is PC2, but for the lower MSD capability reporting, the PC for the aggressor band could be PC3. Thus, the power class of the band combination consisting of the victim band and the aggressor band(s) with specific UL and DL configuration would be determined by the UE itself rather than by the so called relevant power class(es).

* Recommended WF
  + Check whether option 1 is agreeable.
* Discussion

AT&T: Based on our response to Sub-topic 1-1, we support Option 2 if power class is to be reported.

* Agreement

Use option 1 as baseline for answer of Q2

### Sub-topic 1-3: RAN4 answer for Q3 in LS R2-2311586

***Question 3) in RAN2 LS***

*RAN2 would also like to point out that under the current UE capability signalling, the UE reports only a single power class per frequency band, per band combination and per band per band combination respectively. RAN2 therefore needs a clarification from RAN4 regarding the RAN4 text, what the “highest supported power class” and “other power classes” refer to.*

#### **Issue 1-3-1: “highest supported power class”**

* Proposals
  + Option 1: The highest power class UE supported and indicated for the band combination in terms of MSD type (Nokia, Apple, Xiaomi, vivo, Samsung, QC, OPPO, Huawei)
    - the highest power class is the highest msdPowerClass-r18 in R2-2310735 among lower MSD capabilities (if multiple lower MSD with different msdPowerClass-r18 is supported by a UE) for the same per MSD type per aggressor(s) per victim (Nokia).
    - Based on the MSD type the highest per band or per band combination power class is reported. (QC).
  + Option 2: The “highest supported power class” is the power class a UE is capable to support in a CA/DC configuration in the lower MSD discussion (MTK)
* Moderator’s observation

From the proposals it’s not clear whether all companies share the same view that the highest power class is PC indicated for the band combination consisting of the victim band and the aggressor band(s) with specific UL and DL configuration, i.e. the band combination in terms of MSD type, rather than referring the combination listed by *BandCombination.* If the answer is yes that the understanding is the same, then there would be no difference for option 1 and option 2.

* Recommended WF
  + check whether option 1 is agreeable
* Discussion

Not fully discussed in the AH. To be checked in the draft reply LS.

It is suggested to revise the reply LS based on [**R4-2320675**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320675.zip)

#### **Issue 1-3-2: “other power classes”**

* Proposals
  + Option 1: Relative to the “highest supported power class”, “other power classes” are intended for the lower power class(es) (Samsung, Huawei, OPPO, QC, MTK, Xiaomi)
    - For example, if UE supports PC2 (the highest power class) for a band combination, “other power classes” means PC3. Additionally, more information RAN4 would like to share is that in current RAN4 specs, MSD is captured in different tables for different power classes in terms of each MSD mechanism, which makes it possible for UE to report different lower MSD capability classes according to different power classes. (Samsung)
    - The UE may fall back to. For example, if a UE supports PC2 for a band combination, “other power classes” means PC3. (Huawei).
    - the regulatory body may only allow a power class which is lower than the highest supported power class one UE can support, and power class criteria of conformance test was set accordingly, the “other power classes” applies in this case. (MTK)
  + Option 2: The “other power classes” are for the case when certain PEMAX (e.g. 23dBm which is same to PC3 nominal maximum output power) and/or non-zero ΔPPowerClass (e.g. 3 or 6dB) applied (vivo)
  + Option 3: The “other power classes” would be requested by network in consideration that the UE maximum output power could be limited by P-max (PEMAX) which is lower than the PCMAX of the “highest supported power class”. (Apple)
* Recommended WF
  + The options are not mutually exclusive. Check whether option 1 can be considered as baseline, and add some clarification and example for the lower power class(es).
* Discussion

AT&T: This item should be discussed together with the generic power class related issue. It is not specific to lower MSD.

Not fully discussed in the AH. To be checked in the draft reply LS.

It is suggested to revise the reply LS based on [**R4-2320675**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320675.zip)

# Topic #2: Information & approaches for lower MSD signalling design

### Sub-topic 2-1: Clarificatrion for ”ALL” MSD type

**Background**

*Agreement in RAN4#108:*

|  |
| --- |
| *“ALL” is defined per victim band per BC*  *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.* |

*Agreement in RAN4#108bis:*

|  |
| --- |
| **Issue 1-2-3: MSD type “ALL”**  *Keep previous agreement for “ALL” type*   * *“ALL” should not introduce additional test cases compared to UE not declaring lower MSD or relax MSD*   *If UE reports ALL, it does not mean UE always suffer from all MSD types* |

#### **Issue 2-1-1: The definition of MSD type ”ALL”**

* Proposals
  + Option 1: The Maximum allowed actual MSD of the reported MSD class for type ALL shall be smaller than the smallest non-zero MSD among the minimum requirements of the harmonic/harmonic mixing/cross band isolation/IMD2,3,4,5 if any.
  + Option 2: Consider a smaller maximum allowed actual MSD threshold for the “ALL” type, only MSD class I, II is allowed.
  + Option 3: It is allowed to signal a lower MSD class higher than one or more specified MSDs. In that case these MSDs are tested with the specified values and the remaining MSDs use the type all declared lower MSD class
    - It is allowed to signal a lower MSD class for one specific MSD type and order on top of the MSD type all
* Recommended WF
  + Given the agreement in RAN4#108, check whether option 1 is the common understanding by companies
* Discussion

Samsung: Huawei provide the better wording. Option 1 is aligned with our understanding.

CHTTL: Huawei offline wording needs further check. We propose Option 1 and Option 2. If companies think Option 1 is complicated, we can consider Option 2.

Qualcomm: Option 1 is OK.

* Agreement: Agree on Option 1 and further refine the wording.

#### **Issue 2-1-2: Condition for reporting ”ALL”**

* Proposals
  + The lower MSD report type “ALL” should not be used when there is only one MSD among the harmonic/harmonic mixing/cross band isolation/IMD2,3,4,5 for the victim band of a BC.
* Recommended WF
  + Check whether the issue can be left to RAN2, as now “ALL” is considered as a separate MSD type by RAN2 just like harmonic or IMD MSD for a MSD band combination.

CHTTL: the original intention is to check other companies’ view. There is no reason to apply type ALL. There is no signalling reduction by doing this. We are fine not to mention this proposal in CR or LS.

Mediatek: Type ALL is the general parameter. We do not see the need to have such constrain to use ALL.

Samsung: We prefer not to capture it.

Conclusion: no further discussion is needed for this issue.

#### **Issue 2-1-3: Lower MSD signalling for forward compatibility**

* Proposals
  + MSD types signalling should be tagged per release to resolve issues due to new MSD types, reduced specified MSD values or updated worst case MSD due to a new larger channel bandwidth.
* Recommended WF
  + TBA
* Discussion

Samsung: we cannot guarantee future release. Prefer not to have conclusion.

CHTTL: It is better for proponent to clarify it. We may need tag to version.

OPPO: We feel confusion about the proposal. We can discuss it in the future release.

Vivo: We also think we leave it for future release discussion.

Huawei: we feel confusion of proposal. This approach belongs to RAN2 domain.

### Sub-topic 2-2: Lower MSD report for different power classes

**Background**

*Agreements in RAN4#107*

* + *The UE reports the MSD class per MSD types for the highest supported power class for the band combination*
* *UE can additionally report lower MSD for other PCs if NW/regulator requested*
* *Conformance test is only performed for the highest supported power class*
  + *Lower MSD reported for lower power class does not need to be tested*

*Agreements in RAN4#108*

* + *Lower MSD conformance test reuses the RAN4 MSD test point parameters and only changes the MSD value by the upper bound of the declared lower MSD class. And, similar to the specified MSD, the highest supported power class or power class required by certification/regulation body per UL configuration is verified*

#### **Issue 2-2-1: Lower MSD report for different power classes**

* Proposals
  + For lower-MSD capability reporting, there is no need to report it for different power classes simultaneously. We propose to remove the word “additionally” and update in the LS to RAN2
    - MSD for different power classes

- UE reports the lower MSD capability class per MSD type for the highest supported power class for the band combination

- UE can additionally report lower MSD capability class per MSD type for other power classes if requested by the network/regulator

* Recommended WF

Check if the previous agreement needs to be changed. If yes, inform RAN2 about the changes.

* Discussion

AT&T: We do not see a need for RAN4 to reverse the previous agreements.

Mediatek: to AT&T, because the previous agreement is ambiguous, we want to further improve the agreement. If lower power class is requested by network/regulator, then UE can alternatively only report lower MSD type for the requested power class.

AT&T: we get two things mixed up. The request is only exception basis. In some other region, if network requests different power class, that is not rule. You should verify the higher power class. It is only for exception case not the rule.

OPPO: for additional MSD power class, what is the additional power class?

Samsung: it is exactly what RAN2 asks us.

Meta: we support AT&T and do not need further discuss the RAN4 agreement.

Mediatek: we want to reduce the signaling overhead.

Huawei: UE is allowed to report the different power class. Need further discussions.

### Sub-topic 3-2: Applicability of more than 2Rx for lower MSD

* Proposals
  + Proposal 1: If the UE is equipped with four or eight Rx antenna ports for the victim band of the BC, the lower MSD capability is verified with four or eight Rx antenna ports.
  + Proposal 2: Discuss to include an additional description in the specifications for the aspects in proposal 1.
    - NOTE 2: If the UE is equipped with four or eight Rx antenna ports for the victim band of the BC, the lower MSD capability is verified with four or eight Rx antenna ports with the increased MSD values of the minimum requirement based on the description in 7.3A.1.
* Recommended WF
  + Check if the verification of lower-MSD introduces additional test conditions than the verification of the minimum MSD requirements
  + Check if the proposed NOTE is agreeable

Samsung: generally we think the proposal is OK. The proposal is to ensure the verification of lower MSD in the same way as for MSD.

OPPO: the wording can be added to general session.

CHTTL: should add it in the section of lower MSD.

AT&T: it follows the general approach. It needs be clear that MSD should be verified based on REFSENS with delta value.

Agreement: Add the following note in the lower MSD section

* NOTE 2: If the UE is equipped with four or eight Rx antenna ports for the victim band of the BC, the lower MSD capability is verified with four or eight Rx antenna ports with the increased MSD values of the minimum requirement based on the description in 7.3A.1.

# [125] FR1\_enh2\_part1 – 4Tx

### Sub-topic 1-1: Coherence UL MIMO

**Issue 1-1-1: UL-MIMO coherence wording proposal for 4Tx**

* Proposals
  + Option 1: (Nokia)
    - For coherent UL MIMO, Table 6.4D.4-1 lists the maximum allowable difference between the measured relative power and phase errors between any two ports **out of the** scheduled **ports** for UL transmission at their respective antenna connectors in any slot within the specified time window from the last transmitted SRS on the same antenna connectors, for the purpose of uplink transmission (codebook or non-codebook usage) and those measured at that last SRS.
    - Note: Intention is to only specify the cases between any two ports, rather than multiple ports at the same time.
  + Option 2: (Qualcomm, InterDigital)
    - For coherent UL MIMO, Table 6.4D.4-1 lists the maximum allowable difference between the measured relative power and phase errors between any two coherent ports out of the scheduled ports for UL transmission at their respective antenna connectors in any slot within the specified time window from the last transmitted SRS on the same antenna connectors,
    - Note: Based on option 1, additionally consider partially coherent condition by having one more restriction.
  + Option 3: Others
* Recommended WF
  + TBD
* Discussion
* Agreement

Option 2.

### Sub-topic 1-2 Pcmax Tolerance

*Sub-topic description*

*Open issues and candidate options before meeting:*

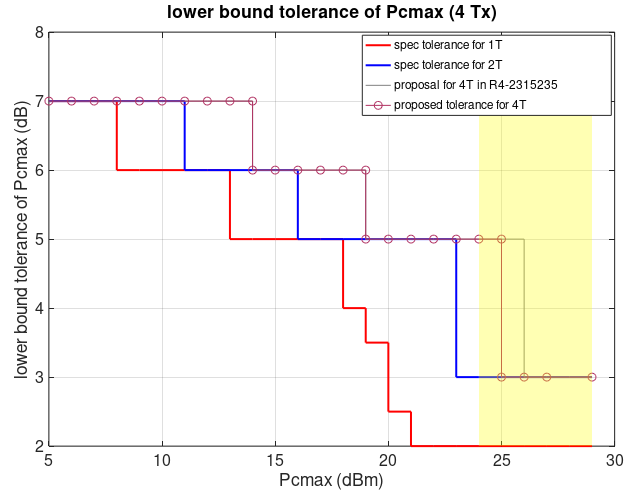
**Issue 1-2-1: PCMAX,c tolerance for 4Tx**

*WF in RAN4#108bis*

* + *In RAN4#108bis, adopting the following table which is based on shifting 2Tx curve by 3dB with certain power ranges in [] as baseline:*
  + *In RAN4#109, the ranges with [] will be revisited for possible reduction of shift values.*

|  |  |  |
| --- | --- | --- |
| *PCMAX,c (dBm)* | *Tolerance TLOW(PCMAX\_L,c) (dB)* | *Tolerance THIGH(PCMAX\_H,c) (dB)* |
| *[26] ≤ PCMAX,c ≤ 29* | *3.0* | *2.0* |
| *[25] ≤ PCMAX,c < [26]* | *5.0* | *2.0* |
| *[24] ≤ PCMAX,c < [25]* | *5.0* | *3.0* |
| *23 ≤ PCMAX,c < 24* | *6.0* | *4.0* |
| *19 ≤ PCMAX,c < 23* | *5.0* | |
| *14 ≤ PCMAX,c < 19* | *6.0* | |
| *-40 ≤ PCMAX,c < 14* | *7.0* | |

* Proposals
  + Proposal 1: Based on 3dB relaxation of the power ranges compared to 2Tx, and 1dB tightening for the higher range.



|  |  |  |
| --- | --- | --- |
| PCMAX,*c*(dBm) | Tolerance TLOW(PCMAX\_L,*c*) (dB) | Tolerance THIGH(PCMAX\_H,*c*) (dB) |
| 25 ≤ PCMAX,*c* ≤ 29 | 3.0 | 2.0 |
| 24 ≤ PCMAX,*c* < 25 | 5.0 | 2.0 |
| 23 ≤ PCMAX,*c* < 24 | 5.0 | 3.0 |
| 22 ≤ PCMAX,*c* < 23 | 5.0 | 4.0 |
| 19 ≤ PCMAX,*c* < 22 | 5.0 | |
| 14 ≤ PCMAX,*c* < 19 | 6.0 | |
| -40 ≤ PCMAX,*c* < 14 | 7.0 | |

* + Proposal 2: 0.5dB relaxation of the power ranges compared to 2Tx.

|  |  |  |
| --- | --- | --- |
| PCMAX,*c*(dBm) | Tolerance TLOW(PCMAX\_L,*c*) (dB) | Tolerance THIGH(PCMAX\_H,*c*) (dB) |
| 23.5 ≤ PCMAX,*c* ≤ 29 | 3.0 | 2.0 |
| 22.5≤ PCMAX,*c* < 23.5 | 5.0 | 2.0 |
| 21.5≤ PCMAX,*c* < 22.5 | 5.0 | 3.0 |
| 20.5≤ PCMAX,*c* < 21.5 | 6.0 | 4.0 |
| 16.5 ≤ PCMAX,*c* < 20.5 | 5.0 | |
| 11.5 ≤ PCMAX,*c* < 16.5 | 6.0 | |
| -40 ≤ PCMAX,*c* < 11.5 | 7.0 | |

* + Proposal 3: Based on 3dB relaxation of the power ranges compared to 2Tx, and 0.5dB more relaxation for ceratin tolerance value. (Late)

|  |  |  |
| --- | --- | --- |
| PCMAX,*c*(dBm) | Tolerance TLOW(PCMAX\_L,*c*) (dB) | Tolerance THIGH(PCMAX\_H,*c*) (dB) |
| PCMAX,*c*=29 | 3.0 | 2.0 |
| 26 ≤ PCMAX,*c* ＜29 | 3.5 | 2.0 |
| 25≤ PCMAX,*c* < 26 | 5.0 | 2.0 |
| 24 ≤ PCMAX,*c* < 25 | 5.0 | 3.0 |
| 23 ≤ PCMAX,*c* < 24 | 6.0 | 4.0 |
| 19 ≤ PCMAX,*c* < 23 | 5.0 | |
| 14 ≤ PCMAX,*c* < 19 | 6.0 | |
| -40 ≤ PCMAX,*c* < 14 | 7.0 | |

* Recommended WF
  + TBD
* Discussion

OPPO: according to input from this meeting, the tolerance is 3dB.

Qualcomm: We need study. 1dB is more general.

Moderator: 1dB can be accepted by most companies.

Vivo: need clarification whether it is applied for all the power range or higher power range.

Moderator: based on the WF last meeting, we just changed the high power limit and do not touch the level of output power. We do not need change the lower limits.

Qualcomm: According to our simulation, the relaxation applies to all the ranges.

Vivo: if we reserve the previous agreement and apply to all the ranges, we can accept 2dB. If applicable to high range, we can accept 1dB.

* Need further discuss: [1.5] dB relaxation compared to 2Tx is acceptable.

### Sub-topic 1-1 TxD capability Related

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 1-3-1: The applicability relationship of Legacy and newly introduced 2Tx capability**

* Proposals
  + Option 1: New Rel-18 2Tx TxD capability would be applied to both single band (non-CA) and for CA cases.
    - This means legacy per-band capability would be override / omitted from Rel-18, as long as new Rel-18 2Tx TxD capability exist.
    - This option can be further differentiated by whether legacy per-band capability is required or not. i.e.
      * 1a. legacy per-band capability is still required
      * 1b. legacy per-band capability is not required anymore.
  + Option 2: Legacy per-band capability is applied to non-CA only, and new Rel-18 2Tx TxD capability for CA band combination only.
    - This means the legacy and new capability would be used for non-CA and CA respectively.
    - This option can be further differentiated by whether legacy per-band capability is required or not. i.e.
      * 2a. legacy per-band capability is still required
      * 2b. legacy per-band capability is not required anymore.
  + Option 3: Others
* Recommended WF
  + TBA
* Discussion

Samsung: clarification between the rel-16 signaling and the newly introduced capability. For single band, UE does not need to signal twice

Ericsson: we are aware of sending LS to RAN2 asking for new capability. Further considering this in this meeting cycle, the capability is not needed. We can do with existing TxD indication. Network can do anything without the indication. TxD is transparent. The only thing that network will use is the power class and number of MIMO layers. That information is not useful. If it is test issue, everything is declared by RAN5. With that in mind, we should avoid defining the new capability.

Moderator: for usage of capability, we introduced the signaling from Rel-16 for test purpose. Rel-16 capability cannot be used.

Samsung: Such capability was introduced in Rel-16. We are not quite sure if such capability will be used in the future to differentiate MPR table. Otherwise, the single band has such capability then we need the new capability for CA.

Vivo: The Rel-16 signaling is results after 2-year discussion. Network may possible use the capability to know the clear UE behavior.

Ericsson: to Samsung, we do not need repeat the mistake if it is a mistake. If it is not used by network, we do not need specify the capability.

Huawei: the purpose of capability is for the network. In Rel-16 the TxD capability is introduced. The existing capability has already caused the confusion. We need further clarify the capability.

* Need further discussion:

New Rel-18 2Tx TxD capability would be applied to both single band (non-CA) and for CA cases

* [This means legacy per-band capability would be override / omitted from Rel-18, as long as new Rel-18 2Tx TxD capability exist.]
* [For 2Tx TxD, CA doesn’t inherit the single band capability, and if Rel-18 2Tx TxD is not signalled for band A within CA\_A-B, it means A within CA\_A-B does not support 2Tx TxD]

It is suggested to further check the above clarifications in [ ] and following issues in the draft LS led by Samsung.

**Issue 1-3-2: The inter-dependency of newly introduced Rel-18 2Tx-TxD capability and 4Tx-TxD capability**

* Proposals
  + Option 1: The presence of 4Tx-TxD signalling does not require the support of 2Tx-TxD signalling.
  + Option 2: A UE indicating fourTxDiversity-r18 for a given FS need not indicate twoTxDiversity-r18 for the same FS; and a network shall understand that a UE supports twoTxDiversity-r18 in a FS where fourTxDiversity-r18 is indicated.
  + Option 3: Others
* Recommended WF
  + TBA
* Discussion

Not discussed in AH.

OPPO: we do not need introduce 4Tx-TxD signaling and just reuse the existing TxD signaling.

Vivo: Regarding 4Tx, the use case is also for conformance testing. We also found some problem if we do not distinguish 2Tx and 4Tx TxD.

**Issue 1-3-3: Whether Rel-18 4Tx TxD capability should be limited to CA cases only.**

* Proposals
  + Option 1: No.
  + Option 2: Yes. This may means another 4Tx TxD capability for non-CA case is needed.
  + Option 3: Others
* Recommended WF
  + TBA
* Discussion

Not discussed in AH.

**Issue 1-3-4: Structure of the requirements.**

* Proposals
  + Proposal 1: Extend the general description of Tx diversity requirements to cover more capabilities.
  + Proposal 2: Discuss a general term instead of listing all the capabilities for most of the cases.
  + Proposal 3: Discuss case by case which part should use which use general capability wording or specific capability for 2Tx or 4Tx TxD.
* Recommended WF
  + TBA
* Discussion

Not discussed in AH.

**Issue 1-3-5: Discuss whether another LS is needed to RAN2.**

* Proposals
  + Option 1: Yes
  + Option 2: No.
  + Option 3: Others
* Recommended WF
  + TBA
* Discussion

See recommendation for Issue 1-3-1.