**3GPP TSG-RAN WG4 Meeting #112 R4-2414285**

**Maastricht, Netherlands, August 19 – August 23, 2024**

**Title:** WF on 6Rx UE requirements

**Agenda Item:** 8.1.3

**Source:** AT&T

**Document for:** Approval

# Topic 1: REFSENS (delta RIB,6R)

## Sub-topic 1-1: General considerations for specifying ΔRIB,6R value

**Issue 1-1-1: Whether band n104 should be included in the high band (n77, n78 and n79) category for 6Rx case**

**Agreement**: Include n104 in the high band (n77, n78, n79) category.

**Issue 1-1-2: Whether to use same ΔRIB,6R value for handheld UE and FWA**

**Agreement**: Different value for handheld UE and FWA.

**Issue 1-1-3: Verification of 6Rx receiver requirements**

**Way Forward**: Companies encouraged to provide their views on the ZTE proposal in Proposal 5 in R4-2411883 and any further positions on verification of 6Rx receiver requirements at future meetings given that ΔRIB,6R values are now defined.

## Sub-topic 1-2: ΔRIB,6R values for handheld UE and FWA

**Issue 1-2-1: Proposed ΔRIB,6R values for handheld UE and FWA**

**Agreement**: Based on the outcome of Issue 1-1-2, RAN4 to specify ΔRIB,6R values for handheld UE and FWA as follows.

- Adopt the average value of ΔRIB,6R for handheld UE from company proposals (updated to include company proposals from RAN4#111) and specify it for handheld UE devices.

**Table: Averaged values for handheld UE based on proposals**

|  |  |  |
| --- | --- | --- |
| 　 | Operating Bands | ΔRIB,6R (dB) |
| MediaTek | Band n41 | -3.4 |
| Band n77, n78, n79, n104 | -3.1 |
| Xiaomi | Band n41 | -3.2 |
| Band n77, n78, n79, n104 | -3.0 |
| LGE | Band n41 | -3.5 |
| Band n77, n78, n79, n104 | -3.0 |
| Spreadtrum | Band n41 | -3.3 |
| Band n77, n78, n79, n104 | -3.0 |
| Meta | Band n41 | -3.5 |
| Band n77, n78, n79, n104 | -3.1 |
| vivo #1 | Band n41 | -3.0 |
| Band n77, n78, n79, n104 | -3.0 |
| vivo #2 | Band n41 | -3.2 |
| Band n77, n78, n79, n104 | -3.0 |
| ZTE  | Band n41 | -3.5 |
| Band n77, n78, n79, n104 | -3.0 |
| Ericsson | Band n41 | -3.6 |
| Band n77, n78, n79, n104 | -3.2 |
| Google | Band n41 | -3.4 |
| Band n77, n78, n79 | -3.0 |
| Huawei | Band n41 | -3.3 |
| Band n77, n78, n79, n104 | -3.0 |
| Qualcomm | Band n41 | -3.4 |
| Band n77, n78, n79, n104 | -3.0 |
| Apple (R4-2407071) | Band n41 | -3.3 |
| Band n77, n78, n79, n104 | -3.0 |
| OPPO (R4-2408759) | Band n41 | -3.6 |
| Band n77, n78, n79, n104 | -3.2 |
| **Average** | Band n41 | **-3.4** |
| Band n77, n78, n79, n104 | **-3.0** |

- Adopt the average value of ΔRIB,6R for FWA UE from company proposals indicating different FWA UE values from handheld UE values and specify it for FWA UE devices.

**Table: Averaged values for FWA UE based on proposals**

|  |  |  |
| --- | --- | --- |
| 　 | Operating Bands | ΔRIB,6R (dB) |
| LGE | Band n41 | -3.7 |
| Band n77, n78, n79, n104 | -3.4 |
| Spreadtrum | Band n41 | -3.6 |
| Band n77, n78, n79, n104 | -3.2 |
| vivo | Band n41 | -3.4 |
| Band n77, n78, n79, n104 | -3.2 |
| Google | Band n41 | -3.7 |
| Band n77, n78, n79 | -3.3 |
| Nokia | Band n41 | -4.0 |
| Band n77, n78, n79, n104 | -3.4 |
| **Average** | Band n41 | **-3.7** |
| Band n77, n78, n79, n104 | **-3.3** |

# Topic 2: SRS antenna switching and ΔTRxSRS

## Sub-topic 2-1: General considerations for SRS antenna switching and ΔTRxSRS

**Issue 2-1-1: Whether to consider an additional breakpoint for bands whose FUL\_high is higher than the FUL\_low of n104**

**Way forward**: Further discuss the following options.

Option 1: Do not consider an additional breakpoint for bands whose FUL\_high is higher than the FUL\_low of n104

Option 2: Consider additional breakpoint for bands whose FUL\_high is higher than the FUL\_low of n104

**Issue 2-1-2: Whether to consider separate ∆TRxSRS values when the device is power class 2 in the band and ΔPPowerClass = 0dB and not indicating Tx diversity capability**

**Agreement**: Have additional 3dB for power class 2 when ΔPPowerClass = 0dB and not indicating Tx diversity capability.

## Sub-topic 2-2: ΔTRxSRS values

**Issue 2-2-1: Proposed ∆TRxSRS values**

**Way Forward**: RAN4 agrees to adopt the average values for Bands n41, n77, and n78. For Band n79 and n104, further analysis is needed. Take Option 10 and option 11 as the starting point, not precluding any other numbers.

- Adopt the average values from companies (updated to include company proposals from RAN4#111) as summarized below and specify the values for ΔTRxSRS for bands whose FUL\_high is lower than the FUL\_low of n79.

**Table: Averaged values based on proposals**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 　 | Operating Bands | ΔTRxSRS t1r6 (dB) | ΔTRxSRS t2r6 (dB) | ΔTRxSRS t1r6-t2r6 (dB) |
| **Average** | Band n41, n77, n78 | **4.0** | **3.5** | **4.5** |

- Option 10: Adopt the average values from companies (updated to include company proposals from RAN4#111) as summarized below and specify the values for ΔTRxSRS without considering an additional breakpoint for bands whose FUL\_high is lower than the FUL\_low of n104.

**Table: Averaged values based on proposals**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 　 | Operating Bands | ΔTRxSRS t1r6 (dB) | ΔTRxSRS t2r6 (dB) | ΔTRxSRS t1r6-t2r6 (dB) |
| **Average** | Band n79, n104 | **5.4** | **4.7** | **5.9** |

- Option 11: Adopt the average values from companies (updated to include company proposals from RAN4#111) as summarized below and specify the values for ΔTRxSRS considering an additional breakpoint for bands whose FUL\_high is lower than the FUL\_low of n104.

**Table: Averaged values based on proposals**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 　 | Operating Bands | ΔTRxSRS t1r6 (dB) | ΔTRxSRS t2r6 (dB) | ΔTRxSRS t1r6-t2r6 (dB) |
| **Average** | Band n79 | **5.4** | **4.7** | **5.9** |
| Band n104 | **5.7** | **5.0** | **6.3** |

# Topic 3: MIMO layer evaluation for 6Rx UE

## Sub-topic 3-1: General considerations for MIMO layer evaluation for 6Rx UE

**Issue 3-1-1: Tightening BS EVM requirement**

**Agreement**:

- Do not tighten the minimum requirements of BS Tx EVM

- Further discuss the assumption of Tx EVM for 6-layer performance evaluation.

**Issue 3-1-2: 6-Layer Performance Evaluation Assumptions**

**Way Forward**: RAN4 to further discuss and align the 6-Layer MIMO performance evaluation assumptions considering realistic antenna correlation assumptions and deployment scenarios.

**Issue 3-1-4: Performance requirements for 6Rx**

**Agreement**: RAN4 to defer decision after evaluation of 6 MIMO layer performance for handheld and FWA devices.

## Sub-topic 3-2: 6-layer Support

**Issue 3-2-1: 6-layer Support**

**Way Forward**: RAN4 to further discuss the following options.

- Option 1: 6-layer support is feasible for handheld and FWA based on some company evaluations considering realistic antenna correlation assumptions and deployment scenarios.

- Option 2: 6-layer support is feasible for FWA devices.

- Option 3: Companies to align on the feasibility criteria and simulation assumptions to evaluate 6-Layer feasibility using the following as a starting point.

- Feasibility criteria

- Consider 4-layer vs 6-layer throughput performance.

- Simulation assumptions

- Only consider link-level simulation for performance evaluations.

- Simulation assumptions provided in Annex A as a starting point. Companies to clarify the settings used in the simulation assumptions for BS correlation matrix and Tx EVM.

**Issue 3-2-2: 6-layer Support as optional feature**

**Way Forward**: RAN4 to further discuss if 6-Layer support should be considered an optional feature.

- Option 1: Introduce 6 MIMO layers support as an optional feature.

# Topic 4: SRS IL imbalance issue

## Sub-topic 4-1: General considerations for SRS IL imbalance issue

**Issue 4-1-1: Whether to solve SRS IL imbalance issue in Rel-19**

**Way Forward**: RAN4 to further discuss the following options.

- Option 1: RAN4 should not continue the discussion on how to solve the SRS IL imbalance issue.

- Option 2: Continue to pursue a solution to the SRS IL imbalance issue dependent on the outcome of Issue 4-1-2 in the approved WF in R4-2410751.

**Issue 4-1-2: Initial Considerations for SRS IL imbalance issue**

**Way forward**: Given the different views amongst companies, RAN4 to further discuss the set of initial considerations which will allow companies to have a common understanding for the study including existing UE behavior for SRS transmissions in case of SRS IL.

- Companies are encouraged to bring analysis on the existing UE behavior and achievable power imbalance for SRS transmissions based on current specification and UE implementations in case of SRS IL.

- Companies are encouraged to analyse the impact of SRS IL imbalance on NW performance degradation.

## Sub-topic 4-2: SRS IL imbalance issue solutions

**Issue 4-2-1: Candidate solutions for the SRS IL imbalance issue**

**Way forward**: Companies encouraged to provide compromised solutions for consideration with minimal impact to the specification and to indicate the specific impacts to RAN1, RAN2, and RAN4 specifications and performance gain.

Annex A:
Feasibility Study Link-Level Simulation Assumptions

Table: Feasibility Study Link-Level Simulation Assumptions

|  |  |
| --- | --- |
| Parameter | Value |
| Duplex mode | TDD |
| Bandwidth | 40MHz or 100MHz |
| SCS | 30 |
| Antenna configuration  | Option 1: 16Tx, 6RxOption 2: 8Tx, 6Rx |
| Propagation channel | Option 1: TDLA30-5Option 2: TDLA30-10(Interested companies can bring results with TDLC300-100) |
| Rank | Fixed rank [4,5,6] |
| MCS | Option 1: Adaptive MCS (target BLER 10%)Option 2: MCS13, MCS17 from Table 1Other MCS options are not precluded |
| PDSCH configuration | Mapping type | Type A |
|  | Starting symbol  | 2 |
|  | Length | 12 |
|  | PRB bundling size | 2 |
|  | VRB-to-PRB mapping type | Non-interleaved |
|  | Precoding | Rel-15 Type I |
| PDSCH DMRS configuration | DMRS Type | Type 1 |
|  | DMRS Configurations |  Option 1: [1+1(4L), 2+0(6L)]Option 2: [2+2(4L), 2+2(6L)]Option 3: [1+1 (4L), 2+2 (6L)] |
|  | Precoding | Random |
| UE Correlation matrix | Option 1: A graph of numbers and letters  Description automatically generated with medium confidenceOption 2:$$\left[\begin{array}{c}\begin{matrix}1.00&0.10\\0.10&1.00\\0.30&0.10\end{matrix} \begin{matrix}0.30&0.15\\0.10&0.14\\1.00&0.12\end{matrix} \begin{matrix}0.13&0.12\\0.30&0.20\\0.20&0.12\end{matrix}\\\begin{matrix}0.15&0.14\\0.13&0.30\\0.12&0.20\end{matrix} \begin{matrix}0.12&1.00\\0.20&0.11\\0.12&0.30\end{matrix} \begin{matrix}0.11&0.30\\1.00&0.10\\0.10&1.00\end{matrix}\end{array}\right]$$Option 3: Interpolation of options 1 and 2 with a weight of 0.5 i.e., average across these two matrices. Other weights are not precluded.Option 4: Other options are not precluded. |