**3GPP T****SG-RAN WG4 Meeting#110 R4-2403794**

**Athens, 26th Feb – 1st March, 2024**

**Agenda item:** 7.1

**Source:** Skyworks Solution Inc., Huawei, Murata, Qualcomm

**Title:** draftR4-240xxxx WF on CA\_n78-n104 Architecture and MSD

**Document for:** Information

# Introduction

In RAN4#109, CA\_n78-n104 UL was discussed and a way forward [5] was agreed to have more companies evaluating the architecture aspects and its impact on the band combination specification. In This meeting four companies provided complete or partial input in [1, 2, 3, 4]. The numbers and assumptions are quite different, so a further way forward is proposed to find more convergence and consensus at next meeting

# Issue #1: Band combination within 3.3-7.125GHz range

## Background

All companies proposed to analyze the band combination based on SimRx/Tx assumption.

## Way Forward

**Way Forward: Simultaneous Rx Tx is supported for CA\_n78-n104 2DL/2UL**

# Issue #2: Antenna and front-end architcture

## Background

Companies had different assumptions in terms of number of antennas, band diplexing and band filters.

For antennas sharing there was 3 main cases:

* Case 1: 4 separate n78/n104 for main+diversity (+4 separate for 4Rx in n78 and n104)? 8 total
* Case 2: 3 separate n78/n104 UL for main+diversity (+2 shared for 4Rx in n78 and n104)? 5 total
* Case 3: 2 shared n78/n104 UL/DL for main+diversity (+2 shared for 4Rx in n78 and n104)? 4 total

Two companies discussed the 3 cases while the other two assumed Casse 2 or Case 3 only.

It is important that the requirements are based on a reasonable assumptions that enables multiple implementations. It is clear that the fully optimized 8 antenna solution for mandatory 4Rx support in both bands cannot be considered as the baseline architecture.

Similarly there was different assumptions on bands supported, dedicated filter and diplexing:

* n77 filter + dedicated n104 filter + n77/n104 diplexer
* n77 filter + 5.1-7.125GHz filter  + n77/>n77 diplexing
* n77 filter + n104 or 5.925-7.125GHz or 5.1-7.125GHz + n77/>n77 diplexing
* n77 filter + 5.1-7.125GHz filter with direct diplexing and room for n79 add-on

This obviously result in different performance on the two band isolation on to of the antenna sharing assumptions. Also this combination is currently only valid for deployment in regions where n79 is also used. Finally, support for unlicensed bands >5.15GHz is needed in the phone and this further impacts the complexity of

## Way Forward

**Way Forward: The DeltaT/R and MSD requirements should enable implementions where:**

* **Use of 4 antennas to support mandatory 4Rx in both bands is not precluded**
	+ **FFS the duplexer/diplexer isolation between band n78 and n104 in main path.**
* **Support of the addition of n79 is is not precluded**
* **Support for the addition of unlicensed bands >5.15GHz is not precluded**
	+ **FFS the trade-off of the potential insertion loss between the addition and non-addition of unlicensed bands >5.15GHz**
	+ **NOTE: it doesn’t mean licensed band n104 need to share the same filter with unlicensed band n46/n96.**

# Issue #3: Cross band MSD

## Background

All companies identified MSD due to cross and isolation for a fully allocated 100MHz CBW UL into the DL of both n78 and n104. There was still some discrepancies in the details of frequencies and RB start. Test points should be aligned for further evaluation.

## Way Forward

**Way Forward: The following test points are further evaluated considering architecture aspect listed in topic 2:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL FC** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL FC** | **DL BW** | **MSD** | **Cross-band interference source** |
| **(MHz)** | **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(MHz)** | **(dB)** |
| n104 | n78 | 6475 | 100 | 30 | 270 (RBstart=0) | 3795 | 10 | FFS | >ACLR2 |
| n78 | n104 | 3750 | 100 | 30 | 270 (RBstart=3) | 6435 | 20 | FFS | >ACLR2 |

# Issue #4: UL harmonic MSD

## Background

All companies identified MSD due to UL harmonic 2 of n78 into n104, it is anticipated that this MSD will be very significant as already evaluated by one contributor. Some contributor suggested to exclude REFSENS measurement like it is done for unlicensed bands above 5.15GHz.

It is better to first analyze the MSD value and based on the concensus on the value decide if it is worth to be tested and anyhow capture the test point in the usual UL harmonic test point format.

Ther is also some differences on the UL configuration and it should be aligned to the minimum channel bandwidth and full allocation (in any case the 2nd harmonic can fully be captured into the 20MHz n104 DL channel.

Also one company proposed a near miss test point, here also, further evaluation is needed and based on it, it can be decided if such additional test point is needed

## Way Forward

**Way Forward: The following test points are further evaluated and enabling architecture aspect listed in topic 2 and based on the consensus on the MSD value companies can further discuss if it is worth testing and specifying for both the direct hit and near miss cases.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL BW** | **MSD** | **UL/DL fc condition** | **UL/DL harmonic order** |
| **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(dB)** |
| n78 | n104 | 10 | [15] | 50 (RBstart=0) | 20 | FFS | NOTE 2 | UL2/DL1direct-hit |
| n78 | n104 | 10 | [15] | 50 (RBstart=0) | 20 | FFS | NOTE 6 | UL2/DL1Near-miss |

# Issue #5: Harmonic mixing MSD

## Background

All companies identified MSD due to UL1/DL2 harmonic mixing MSD of n78 due to n104 UL, it is anticipated that this MSD will be significant as already evaluated by one contributor.

One company proposed two test points but one cannot be implemented with the supported CBW in n104.

## Way Forward

**Way Forward: The following test is further evaluated considering architecture aspect listed in topic 2 :**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | UL BW | SCS of UL band | UL RB Allocation | DL BW | MSD | UL/DL fc condition | UL/DL harmonic order |
| (MHz) | (kHz) | LCRB | (MHz) | (dB) |
| n104 | n78 | 20 | [15] | 50 (RBstart=0) | 10 | FFS | NOTE 7 | UL1/DL2 |

# Issue #6: DeltaT/R

## Background

Two companies provided values for DeltaT/R but based on different architcture and overall band support. The delta T/R values should enable any reasonable implementation of CA\_n78-n104 with other bands in the 3.3-7.125GHz range and according to architecture assumptions in Topic 2.

## Way Forward

**Way Forward: Delta T/R values shall enable reasonable implementations of CA\_n78-n104 with other bands in the 3.3-7.125GHz range and considering architecture aspect listedin Topic 2.**

# References

[1] R4-2401764 Discussion on MSD for CA\_n78A-n104A Huawei, HiSilicon, RAN4#110

[2] R4-2400724 CA\_n78-n104 and associated 3.3-7.1GHz architecture and challenges, Skyworks Solutions Inc., RAN4#110

[3] R4-2400716 CA\_n78-n104 Simultaneous RX/TX Analysis Murata Manufacturing Co Ltd., RAN4#110

[4] R4-2400643 Requirements for CA\_n78A-n104A, Qualcomm France, RAN4#110

[5] R4-2321930 WF on CA\_n78A-n104A, Qualcomm, RAN4#109