**3GPP TSG-RAN WG4 Meeting # 111 R4-2410641**

**Fukuoka, Japan, May 20 – May 24, 2024**

**Source:** Huawei, HiSilicon

**Title:** Discussion and TP for TR 38.718-02-01 to introduce CA\_n3A-n39A

**Agenda item:** 6.1.1.2

**Document for:** Approval

# 1 Background

This contribution provides the technical text proposal on the NR CA band combination CA\_n3A-n39A, which has been captured in the latest basket WI [1].

# 2 Discussion

In last meeting, CA\_n3-n39 contribution was noted as companies need more time to check the cross band isolation from band n3 UL to band n39 DL due to fly back effect inside n39. In this paper, we just analyse the MSD issue due to cross band isolation. The RF reference architecture is shown below for CA\_n3-n39.

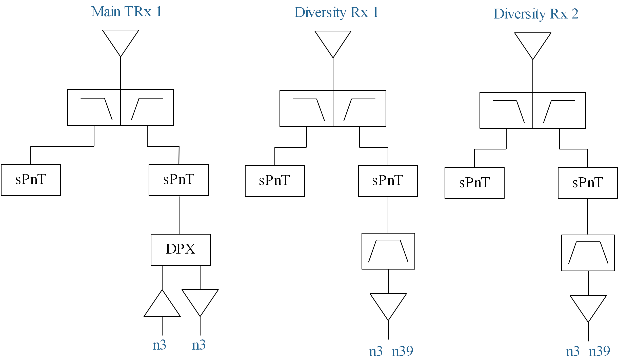


Figure 1 RF reference architecture for CA\_n3-n39

It’s noted that the following filter performance is assumed.

Table 1 The performance for some key components

|  |  |
| --- | --- |
| **Parameters** | **Value** |
| Antenna isolation | 10dB |
| Tx attenuation at 1880~1920MHz for band n3 duplexer | 30dB |
| Rx attenuation at 1710~1785MHz for band n3+n39 Rx filter | 40dB |

The MSD calculation for CA\_n3-n39 is shown below.

Table 2 The MSD calculation for CA\_n3-n39 due to cross band isolation

|  |  |  |  |
| --- | --- | --- | --- |
|  | parameters | n39 main path | n39 diversity path |
| transmit power for n3, dBm |  | 23 | 23 |
| Tx band n3 BW(MHz, Lcrb@15kHz) | 30 |  |  |
| RFFE loss, dB | **4** |  |  |
| Diplexer isolation at n3 uplink freq，dB | **0** |  |  |
| antenna isolation, dB | 10 |  |  |
| n39 receival singal at ANT port, dBm |  | 13 | 13 |
|  |  |  |  |
| n39 filter rejection at 1710~1785MHz, dB | **40** |  |  |
| signal After n39 filter, dBm |  | -31 | -31 |
| Typical receiver IIP2, dB | 50 |  |  |
| TX IM2 noise level refer to RX LNA input, dBm |  | -112 | -112 |
| front-end loss | 4 |  |  |
| TX IM2 noise level at ANT port, dBm |  | -108 | -108 |
|  |  |  |  |
| noise figure dB | 9 |  |  |
| Thermal noise at RX ant port(dBm/Hz) | -165 |  |  |
| Rx band n39 BW(MHz, NRB) | 4.5 |  |  |
| Thermal noise, dBm |  | -98.47 | -98.47 |
|  |  |  |  |
| n3 PA noise PSD at PA output port, dBm/Hz | **-130** |  |  |
| n3 PA noise PSD at PA output port, dBm/RxBW |  | -63.47 |  |
| n3 Tx filter rejection at 1880~1920MHz, dB | **30** |  |  |
| n3 PA noise power at Rx n104 ant port at 6425~7125MHz, dBm |  | -103.47 | -103.47 |
|  |  |  |  |
| Total noise level at ANT port |  | -96.92 | -96.92 |
| SNR requirement for QPSK | -1 |  |  |
| REFSENSE (referred to antenna)(20MHz BW) |  | -97.92 | -97.92 |
| Implementation Margin, dB | 2.5 |  |  |
| combined REFSENS(5MHz BW), dBm | -98.43 |  |  |
| MSD | 1.57 |  |  |

Thus, the following MSD test configuration can be considered.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) |
| n3 | n39 | 1770 | 30 | 15 | 160 (RBstart=0) | 1882.5 | 5 | 1.5 dB | >ACLR2 |

# 3 Text Proposal

##### ---Start of changes TR 38.718-02-01 ---

## 5.x CA\_n3-n39

### 5.x.1 Common for 1 band UL and 2 bands UL CA

#### 5.x.1.1 Operating bands for CA

Table 5.x.1.1-1: CA band combination of band n3+n39

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n3 | 1710 | – | 1785 | 1805 | – | 1880 | FDD |
| n39 | 1880 | – | 1920 | 1880 | – | 1920 | TDD |
|  | | | | | | | |

#### 5.x.1.2 Channel bandwidths per operating band for CA

Table 5.x.1.2-1: Supported bandwidths per CA band combination of band n3+n39

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n39A | n3 | n3 | 5, 10, 15, 20, 25, 30 | 0 |
|  |  | n39 | 5, 10, 15, 20, 25, 30, 35, 40 |  |
|  | | | | |

#### 5.x.1.3 UE co-existence studies

Table 5.x.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n3-n39.

**Table 5.x.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | **DL Low Band Edge** | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3420 | 3570 | 5130 | 5355 | 6840 | 7140 | 8550 | 8925 |
| n39 | 1880 | 1920 | 1880 | 1920 | 3760 | 3840 | 5640 | 5760 | 7520 | 7680 | 9400 | 9600 |

**Table 5.x.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3610 | 3760 | 5415 | 5640 | 7220 | 7520 | 9025 | 9400 |
| n39 | 1880 | 1920 | 1880 | 1920 | 3760 | 3840 | 5640 | 5760 | 7520 | 7680 | 9400 | 9600 |

#### 5.x.1.4 ∆TIB,c and ∆RIB,c values

For CA\_n3-n39, the ΔTIB,c and ΔRIB,c values are given in the tables below, which refer to CA\_n3-n34/ CA\_n3-n38/ CA\_n3-n41.

Table 5.x.1.4-1: ΔTIB,c

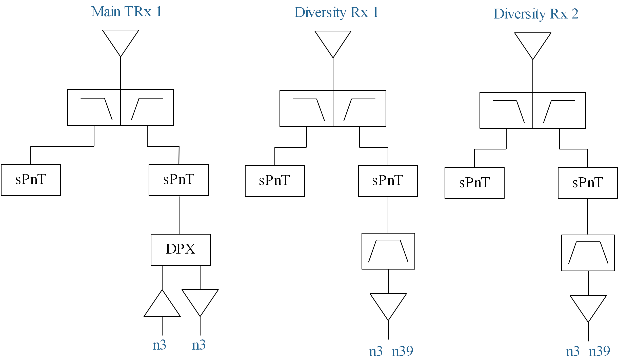
|  |  |  |
| --- | --- | --- |
| Inter-band CA combination | ΔTIB,c for NR bands (dB)\* | |
| Component band in order of bands in configuration\*\* | |
| CA\_n3-n39 | 0.5 | 0.5 |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3 the band order from left to right is n1 and n3. | | |

Table 5.x.1.4-2: ΔRIB,c

|  |  |  |
| --- | --- | --- |
| Inter-band CA combination | ΔRIB,c for NR bands (dB)\* | |
| Component band in order of bands in configuration\*\* | |
| CA\_n3-n39 | - | - |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n77 the band order from left to right is n1 and n77. | | |

#### 5.x.1.5 REFSENS requirements

There is no harmonic / harmonic mixing issue for CA\_n3-n39. For cross band isolation, since the band n3 Tx filter can provide 30~40dB attenuation at 1880~1920MHz and 10 dB above antenna isolation can be observed, the following MSD test configuration can be considered with the presented reference RF architecture.



**figure 5.x.1.5-1 reference RF architecture for CA\_n3-n39**

**Table 5.x.1.5-1: MSD test configuration due to cross band isolation for CA\_n3-n39**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) |
| n3 | n39 | 1770 | 30 | 15 | 50 (RBstart=110) | 1882.5 | 5 | 2.1 dB | >ACLR2 |

#### 5.x.1.6 OOB blocking exception requirements

There is no need to specify OOB blocking exception for CA\_n3-n39, but some clarification about how to apply FDL\_low and FDL\_high. Referring to CA\_20A-28A, the following note can be introduced into table 7.6.3-2 of TS 38.101-1.

“For a UE supporting CA\_n3A-n39A and higher order band combinations in which CA\_n3A-n39A is a subset, the requirements for Band n3 and Band n39 apply with FDL\_low given by the lower limit of the restricted operating frequency range in Band n3 and FDL\_high by Band n39.”

##### ---End of changes---

# Reference

[1] RP-232921, “Revised WID Rel-18 NR Inter-band Carrier Aggregation/Dual Connectivity for 2 bands DL with x bands UL (x=1,2)”, ZTE Corporation