3GPP TSG-RAN WG4 Meeting #110bis R4-2406578

Changsha, China, 15th – 19th April, 2024

**Title:** WF on MSD values for band combinations with simultaneous Rx-Tx

**Agenda Item:** 5.2

**Source:** Huawei

**Document for:** Approval

# Issue 1: Simultaneous Rx-Tx applied to CA\_n39A-n40A-n41A

In Murata paper R4-2404222, two different reference architecture options using triplexer are provided.

도표, 평면도, 기술 도면, 라인이(가) 표시된 사진

자동 생성된 설명

(a)

도표, 평면도, 기술 도면, 개략도이(가) 표시된 사진

자동 생성된 설명

(b)

Figure 1-1. Murata reference architecture options using shared antenna, (a) and (b)

* Option 1: To average the MSD values calculated with the two reference architectures.

Table 1-1. 3DL/2UL MSDs for CA\_n39A-n40A-n41A from Murata

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n39-n40-n41 | n39 | 1917.5 | 5 | 25 | 1917.5 | N/A | TDD | N/A |
|  | n40 | 2302.5 | 5 | 25 | 2302.5 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2685 | 31.6 | TDD | IMD3 |
|  | n39 | N/A | 5 | N/A | 1917.5 | 31.6 | TDD | IMD31 |
|  | n40 | 2302.5 | 5 | 25 | 2302.5 | N/A | TDD | N/A |
|  | n41 | 2685 | 10 | 50 | 2685 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

In Huawei paper R4-2404513, the architecture of n40 and n41 sharing antenna switch is provided.

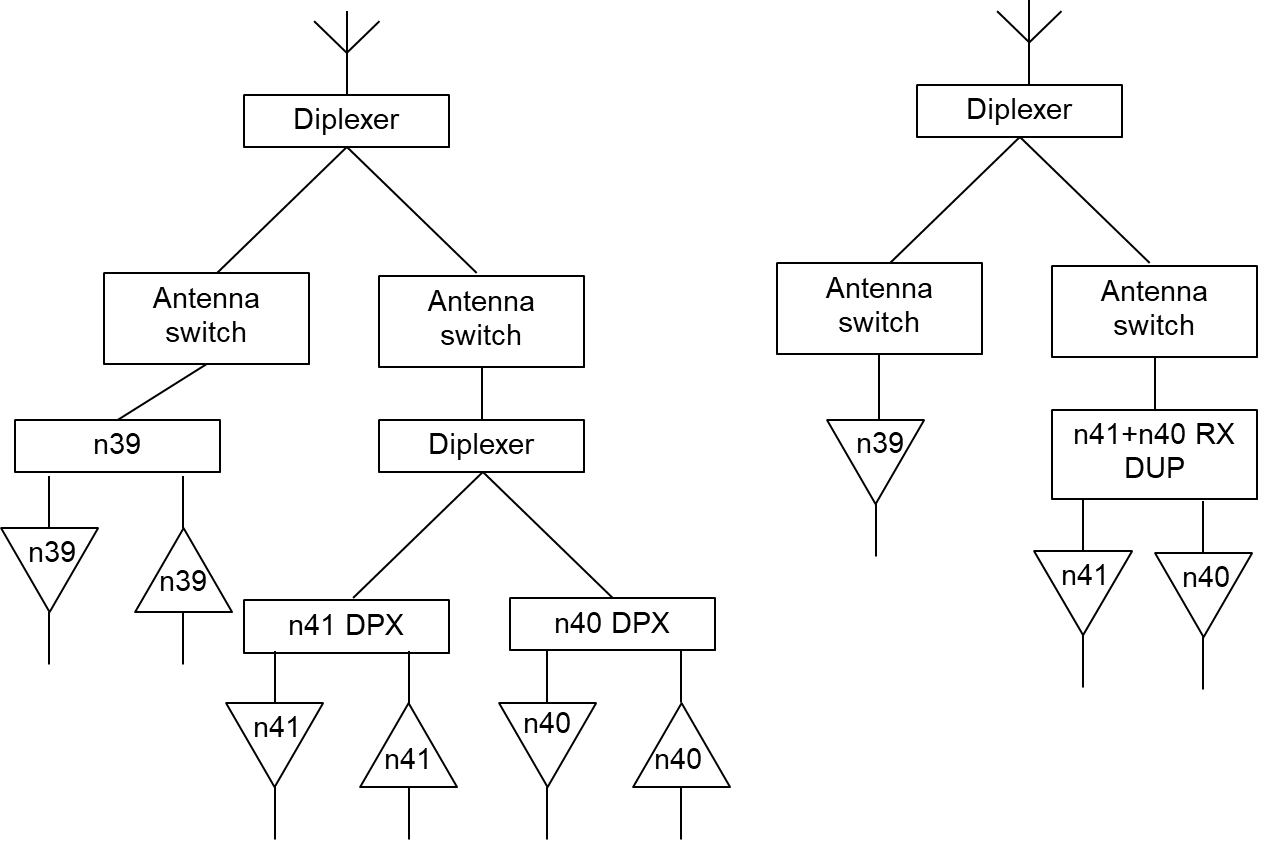


Figure 1-2. Reference UE architecture for CA\_n39-n40-n41

* Option 2:

Table 1-2. 3DL/2UL MSDs for CA\_n39A-n40A-n41A from Huawei

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n39-n40-n41 | n39 | 1917.5 | 5 | 25 | 1917.5 | N/A | TDD | N/A |
|  | n40 | 2302.5 | 5 | 25 | 2302.5 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2685 | 27.1 | TDD | IMD3 |
|  | n39 | N/A | 5 | N/A | 1915 | 16.3 | TDD | IMD31 |
|  | n40 | 2302.5 | 5 | 25 | 2302.5 | N/A | TDD | N/A |
|  | n41 | 2685 | 10 | 50 | 2685 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

In Qualcomm paper R4-2405452,

A diagram of a computer network

Description automatically generated

Figure 1-3. Reference UE architecture for simultaneous TX-RX 39-40, 40-41, 39-41

* Option 3:

Table 1-3. 3DL/2UL MSDs for CA\_n39A-n40A-n41A from Qualcomm

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n39-n40-n41 | n39 |  | 5 | 25 |  | N/A | TDD | N/A |
|  | n40 |  | 5 | 25 |  | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2685 | [29.8] | TDD | IMD3 |
|  | n39 | N/A | 5 | N/A | 1915 | [24.9] | TDD | IMD31 |
|  | n40 |  | 5 | 25 |  | N/A | TDD | N/A |
|  | n41 | 2685 | 10 | 50 |  | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

**<Way forward #1-1>**

* To average MSD values provided by companies and accommodate various RF front-end and antenna structures for simultaneous Rx-Tx requirements for higher order band combinations of CA\_n39A-n40A-41A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n39-n40-n41 | n39 | 1917.5 | 5 | 25 | 1917.5 | N/A | TDD | N/A |
|  | n40 | 2302.5 | 5 | 25 | 2302.5 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2685 | [29.5] | TDD | IMD3 |
|  | n39 | N/A | 5 | N/A | 1915 | [24.5] | TDD | IMD31 |
|  | n40 | 2302.5 | 5 | 25 | 2302.5 | N/A | TDD | N/A |
|  | n41 | 2685 | 10 | 50 | 2685 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

* Sufficient attenuation level between bands should be considered in ΔTIB,c and ΔRIB,c , given that increased insertion loss of the triplexer compared to single filter.

Table 1 ΔTIB,c due to CA\_n39-n40-n41

|  |  |  |  |
| --- | --- | --- | --- |
| Inter-band CA combination | ΔTIB,c for NR bands (dB)9 | | |
| Component band in order of bands in configuration10 | | |
| CA\_n39-n40-n41 | 0.3 | 0.6 | 0.6 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 2 ΔRIB,c due to CA\_n39-n40-n41

|  |  |  |  |
| --- | --- | --- | --- |
| Inter-band CA combination | ΔRIB,c for NR bands (dB)7 | | |
| Component band in order of bands in configuration8 | | |
| CA\_n39-n40-n41 | 0.3 | 0.6 | 0.6 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

Comment:

# Issue 2: MSD values for higher order band combinations of CA\_n39-n41 with simultaneous Rx-Tx

**<Way forward #2-1>: The MSD value for CA\_n28A-n39A-n41A with simultaneous Rx-Tx is**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** | **of IMD** |
| **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| CA\_n28-n39-n41 | n28 | 725 | 5 | 25 | 780 | N/A | FDD | N/A |
|  | n39 | N/A | 5 | N/A | 1895 | [32.6] | TDD | IMD2 |
|  | n41 | 2620 | 10 | 50 | 2620 | N/A | TDD | N/A |
|  | n28 | 725 | 5 | 25 | 780 | N/A | FDD | N/A |
|  | n39 | 1985 | 5 | 25 | 1895 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2620 | [32.6] | TDD | IMD2 |

**<Way forward #2-2>: The MSD value for CA\_n39A-n41A-n79A with simultaneous Rx-Tx is**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** | **of IMD** |
| **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| CA\_n39-n41-n79 | n39 | 1900 | 5 | 25 | 1900 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2650 | [26.0] | TDD | IMD21 |
|  | n79 | 4550 | 40 | 216 | 4550 | N/A | TDD | N/A |
|  | n39 | N/A | 5 | N/A | 1900 | [24.8] | TDD | IMD21 |
|  | n41 | 2650 | 10 | 50 | 2650 | N/A | TDD | N/A |
|  | n79 | 4550 | 40 | 216 | 4550 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

Comment:

# Issue 3: MSD values for higher order band combinations of CA\_n40-n41 with simultaneous Rx-Tx

* Issue 3-1: CA\_n40A-n41A-n79A with simultaneous Rx-Tx

Option 1(Murata R4-2400583):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** | **of IMD** |
| **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| CA\_n40-n41-n79 | n40 | 2330 | 5 | 25 | 2330 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2520 | 26.0 | TDD | IMD2 |
|  | n79 | 4850 | 40 | 216 | 4850 | N/A | TDD | N/A |
|  | n40 | 2350 | 5 | 25 | 2350 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2550 | 5.7 | TDD | IMD4 |
|  | n79 | 4500 | 40 | 216 | 4500 | N/A | TDD | N/A |
|  | n40 | 2350 | 5 | 25 | 2350 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2550 | 3.4 | TDD | IMD5 |
|  | n79 | 4800 | 40 | 216 | 4800 | N/A | TDD | N/A |
|  | n40 | N/A | 5 | N/A | 2330 | 23.7 | TDD | IMD2 |
|  | n41 | 2520 | 10 | 50 | 2520 | N/A | TDD | N/A |
|  | n79 | 4850 | 40 | 216 | 4850 | N/A | TDD | N/A |
|  | n40 | N/A | 5 | N/A | 2330 | 3.0 | TDD | IMD5 |
|  | n41 | 2530 | 10 | 50 | 2540 | N/A | TDD | N/A |
|  | n79 | 4960 | 40 | 216 | 4960 | N/A | TDD | N/A |

Option 2 (Huawei R4-2404515):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** | **of IMD** |
| **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| CA\_n40-n41-n79 | n40 | N/A | 5 | N/A | 2335 | [23.5] | TDD | IMD21 |
|  | n41 | 2545 | 10 | 50 | 2545 | N/A | TDD | N/A |
|  | n79 | 4880 | 40 | 216 | 4880 | N/A | TDD | N/A |
|  | n40 | 2340 | 5 | 25 | 2340 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2600 | [26.2] | TDD | IMD21 |
|  | n79 | 4880 | 40 | 216 | 4940 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

**<Way forward #3-1>: The MSD value for CA\_n40A-n41A-n79A with simultaneous Rx-Tx is**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source of IMD** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW (MHz)** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** |
| CA\_n40-n41-n79 | n40 | N/A | 5 | N/A | 2335 | [23.6] | TDD | IMD21 |
|  | n41 | 2545 | 10 | 50 | 2545 | N/A | TDD | N/A |
|  | n79 | 4880 | 40 | 216 | 4880 | N/A | TDD | N/A |
|  | n40 | 2340 | 5 | 25 | 2340 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2600 | [26.1] | TDD | IMD21 |
|  | n79 | 4880 | 40 | 216 | 4940 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

* Issue 3-2: CA\_n8A-n40A-n41A with simultaneous Rx-Tx

Option 1(Murata R4-2400583):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** | **of IMD** |
| **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| CA\_n8-n40-n41 | n8 | 900 | 5 | 25 | 945 | N/A | FDD | N/A |
|  | n40 | N/A | 5 | N/A | 2360 | 3.0 | TDD | IMD5 |
|  | n41 | 2530 | 10 | 50 | 2530 | N/A | TDD | N/A |

Option 2 (Huawei R4-2404516):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** | **of IMD** |
| **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| CA\_n8-n40-n41 | n8 | 895 | 5 | 25 | 940 | N/A | FDD | N/A |
|  | n40 | 2355 | 5 | 25 | 2355 | [3.58] | TDD | IMD5 |
|  | n41 | N/A | 10 | N/A | 2520 | N/A | TDD | N/A |

**<Way forward #3-2>: The MSD value for CA\_n8A-n40A-n41A with simultaneous Rx-Tx is**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source of IMD** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW (MHz)** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** |
| CA\_n8-n40-n41 | n8 | 895 | 5 | 25 | 940 | N/A | FDD | N/A |
|  | n40 | 2355 | 5 | 25 | 2355 | [3.29] | TDD | IMD5 |
|  | n41 | N/A | 10 | N/A | 2520 | N/A | TDD | N/A |

* Issue 3-3: CA\_n28A-n40A-n41A with simultaneous Rx-Tx

Option 1(Murata R4-2400583):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** | **of IMD** |
| **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| CA\_n28-n40-n41 | n28 | 725 | 5 | 25 | 780 | N/A | FDD | N/A |
|  | n40 | 2360 | 5 | 25 | 2360 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2545 | 3.3 | TDD | IMD5 |

Option 2 (Huawei R4-2404517):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** | **of IMD** |
| **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| CA\_n28-n40-n41 | n28 | 740 | 5 | 25 | 795 | N/A | TDD | N/A |
|  | n40 | 2380 | 5 | 25 | 2380 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2540 | [3.52] | TDD | IMD5 |

**<Way forward #3-3>: The MSD value for CA\_n28A-n40A-n41A with simultaneous Rx-Tx is**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source of IMD** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW (MHz)** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** |
| CA\_n28-n40-n41 | n28 | 740 | 5 | 25 | 795 | N/A | TDD | N/A |
|  | n40 | 2380 | 5 | 25 | 2380 | N/A | TDD | N/A |
|  | n41 | N/A | 10 | N/A | 2540 | [3.41] | TDD | IMD5 |