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.



(a)



(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,



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 |