**3GPP TSG-RAN WG4 Meeting # 109** **R4-2318121**

**Chicago, US, November 13 – 17, 2023**

**Agenda item:** 7.30.4

**Source:** Moderator (CATT)

**Title:** Topic summary for [109][115] NR\_700800900\_combo\_enh

**Document for:** Information

# Introduction

This contribution is the summary for the contributions on WI NR\_700800900\_combo\_enh in AI 7.30.

# Topic #1: CA\_n26(2A)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318434 | Apple | ***Observation 1****: Among all the RF impairments contributing to MSD, Tx noise generated from PA nonlinearity dominates.* ***Observation 2****: In the case of dual-PA implementation with one Tx for each UL carrier, the MSD would be dominated by the PA reversed IMD.****Observation 3****: For UL/DL CA\_n26(2A), the MSD caused by IMD3 is quite severe which may render the combination not being so useful.****Observation 4****: Though the dual-PA architecture can help improve MSD due to IMD5 substantially, the IMD3 MSD is still relatively high which may not justify the increased cost and RF front-end complexity for dual-PA implementation.****Proposal 1****: RAN4 to reconsider whether there is sufficient technical justification to support UL CA\_n26(2A) as its DL carriers are susceptible to relatively high MSD.****Proposal 2****: If RAN4 would proceed to specify UL/DL CA\_n26(2A), take the MSD values in the table below into consideration.*

|  |  |  |  |
| --- | --- | --- | --- |
| CA Combination | UE Architecture | PCC MSD (IMD3) | SCC MSD (IMD5) |
| UL/DL CA\_n26(2A) | Single-PA | 48.9 dB | 32.3 dB |
| Dual-PA | 35.2 dB | 1.0 dB |

 |
| R4-2319885 | Huawei, HiSilicon | **Proposal 1: To specify 60dB AMPR for UL CA\_n26(2A) to meet additional requirements below.**Table 6.2A.3.1.2-1: Additional Maximum Power Reduction (A-MPR) for intra-band non-contiguous CA

|  |  |  |  |
| --- | --- | --- | --- |
| CA Network Signalling value | Requirements (clause) | Uplink CA Configuration | A-MPR for sub-blocks in order of increasing uplink carrier frequency |
| A-MPR [dB](clause) |
| CA\_NC\_NS\_01 | 6.5A.2.2.26.5A.3.2.2 | All applicaple NR CA configurations | N/A |
| CA\_NC\_NS\_04 | 6.5A.2.3.2.16.5A.3.3.2.1 | CA\_n41(2A) | 6.2A.3.1.2.1 |
| CA\_NC\_NS\_12 | 6.5A.3.3.2.2 | CA\_n26(2A) | 60 dB |
| CA\_NC\_NS\_13 | 6.5A.3.3.2.3 | CA\_n26(2A) | 60 dB |
| CA\_NC\_NS\_14 | 6.5A.3.3.2.4 | CA\_n26(2A) | 60 dB |
| CA\_NC\_NS\_15 | 6.5A.3.3.2.5 | CA\_n26(2A) | 60 dB |
| CA\_NC\_NS\_55,CA\_NC\_NS\_57  | SeeCA\_NC\_NS\_01 | CA\_n77(2A) | SeeCA\_NC\_NS\_01 |
| CA\_NC\_NS\_100 | 6.5A.2.4.2.2 | CA\_n26(2A) | 60 dB |

**Proposal 2: to specify the following MSD levels for UL CA\_n26(2A) and improve the MSD table format.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| CA configuration | PCC/SCC (SCS, BW) | PCC/SCC UL Fc (MHz) | UL PCC/SCC allocation(LCRB) | PCC/SCC DL Fc (MHz) | PCC ΔRIBNC (dB) | SCC ΔRIBNC (dB) | Duplex mode |
| CA\_n26(2A) | (15kHz, 5MHz) / (15kHz, 5MHz) | 816.5 / 839 | 12 (RBSTART = 0) / 12 (RBSTART = 3) | 861.5 / 884 | **27.9** | **5.4** | FDD |

 |
| R4-2319886 | Huawei, HiSilicon | Draft CR for 38.101-1 to introduce UL CA\_n26(2A) |
| R4-2320244 | Qualcomm France | **Observation 1**: The MPR allowance for any RB configuration within CA\_n26(2A) is between 9….15dB as per existing specifications, meaning at least 9dB power back-off is applied to any RB allocation combination**Observation 2**: Existing MPR for Intra-band contiguous CA with Dual-PA capability cannot be assumed to always offer -30dBm/1MHz up to 799MHz or 803MHz without RF filter help**Observation 3**: It is a tedious task to evaluate the required RF filter attenuation and MPR to meet the UE Co-existence**Proposal 1**: MSD’s evaluated for PCC and SCC can be initially considered for CA\_n26(2A) MSD.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA configuration** | **PCC/SCC Bandwidth****(MHz)** | **PCC UL Fc (MHz)** | **SCC UL Fc (MHz)** | **UL PCC allocation****(LCRB)** | **UL SCC allocation****(LCRB)** | **PCC DL Fc (MHz)** | **SCC DL Fc (MHz)** | **PCC ΔRIBC (dB)** | **SCC ΔRIBC (dB)** | **Duplex mode** |
| CA\_n26(2A) | 5/5 | 816.5  | 839 | 12 (RBSTART = [0]) | 12(RBSTART = [3]) | 861.5  | 884 | [36.0] | [20.3] | FDD |

**Observation 4**: CA\_n26(2A) cannot be completed in RAN4#109 as more measurements are needed to verify the MSD and the UE Co-existence |
| R4-2320799 | Murata Manufacturing Co Ltd. |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA configuration** | **PCC/SCC Bandwidth****(MHz)** | **PCC UL Fc (MHz)** | **SCC UL Fc (MHz)** | **UL PCC allocation****(LCRB)** | **UL SCC allocation****(LCRB)** | **PCC DL Fc (MHz)** | **SCC DL Fc (MHz)** | **PCC ΔRIBC (dB)** | **SCC ΔRIBC (dB)** | **Duplex mode** |
| CA\_n26(2A) | 5/5 | 816.5  | 839 | 12 (RBSTART = [0]) | 12(RBSTART = [3]) | 861.5  | 884 | [37.4] | [7.5] | FDD |

**Table 2-3**: CA\_n26(2A) REFSENS**Proposal 1:** Use CA\_n26(2A) REFSENS as shown in Table 2-3.**Proposal 2:** Use MA = [13.8] dB; 0 < B < 1.44 to meet -42dBm/6.25KHz**Proposal 3:** Use MA = [18] dB; 0 < B < 1.44 to meet -53dBm/6.25KHz**Proposal 4:** No added coexistence requirement necessary for band n26 to protect band n28 for CA\_n26(2A) with sufficient ΔTIB and 27dB minimum n26 filter rejection between 799-803MHz.  |
| R4-2320997 | Skyworks Solutions Inc. | **Proposal: Consider adopting the following MSD test point for CA\_n26 (2A) PC3.**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA configuration** | **PCC/SCC Bandwidth****(MHz)** | **PCC UL Fc (MHz)** | **SCC UL Fc (MHz)** | **UL PCC allocation****(LCRB)** | **UL SCC allocation****(LCRB)** | **PCC DL Fc (MHz)** | **SCC DL Fc (MHz)** | **PCC ΔRIBC (dB)** | **SCC ΔRIBC (dB)** | **Duplex mode** |
| CA\_n26(2A) | 5/5 | 816.5  | 839 | 12 (RBSTART = [0]) | 12(RBSTART = [3]) | 861.5  | 884 | 36.8 | 12.9 | FDD |

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## Open issues summary

**Issue 1-1: AMPR requirement for NS\_12/ 13/ 14/ 15, NS\_100**

* Proposals
	+ **Option 1:** 60 dB for NS\_12/ 13/ 14/ 15, NS\_100 (Huawei, R4-2319885)
	+ **Option 2:** Proposal in R4-2320799 (Murata)
* Use MA = [13.8] dB; 0 < B < 1.44 to meet -42dBm/6.25KHz
* Use MA = [18] dB; 0 < B < 1.44 to meet -53dBm/6.25KHz
	+ **Observation 1 in R4-2320244:** 9….15dB, at least 9 dB
* Recommended WF
	+ For NS\_12/ 13/ 14/ 15, discuss if option 2 in brackets is agreeable
	+ For NS\_100, discuss if [60] dB is agreeable.

*Moderator has the following suggestions:*

* + *Agree tentative values and write them with brackets in RAN4 spec to avoid any test in RAN5.*
	+ *If real deployment request is raised, the requirements can be revisited and tested.*

**Issue 1-2: Coexistence requirements to protect n28**

* Proposals
	+ Option 1: No added coexistence requirement (Murata, R4-2320799)
* Recommended WF
	+ Discuss if the above proposal is agreeable.

**Issue 1-3: MSD requirement for UL/DL CA\_n26(2A)**

* Proposals

|  |  |  |  |
| --- | --- | --- | --- |
| Company | UE Architecture | PCC MSD (IMD3) | SCC MSD (IMD5) |
| Apple | Single-PA | 48.9 dB | 32.3 dB |
| Dual-PA | 35.2 dB | 1.0 dB |
| Huawei | Dual-PA | 27.9 | 5.4 |
| Qualcomm | Dual-PA | [36.0] | [20.3] |
| Murata | Dual-PA | [37.4] | [7.5] |
| Skyworks | Dual-PA | 36.8 | 12.9 |

* Recommended WF
	+ According to last meeting’s agreement, only discuss requirements based on dual PA architecture.
	+ Discuss if the averaged MSD values are agreeable,

|  |  |
| --- | --- |
| PCC MSD (IMD3) | SCC MSD (IMD5) |
| 34.7 dB | 9.4 dB |

**Issue 1-4: How to handle CA\_n26(2A) considering the WI is planned to be completed in Dec.**

* Proposals
	+ **Proposal in R4-2318434:** RAN4 to reconsider whether there is sufficient technical justification to support UL CA\_n26 (2A) as its DL carriers are susceptible to relatively high MSD.
	+ **Observation in R4-2320244 (Qualcomm):** CA\_n26(2A) cannot be completed in RAN4#109 as more measurements are needed to verify the MSD and the UE Co-existence
* Recommended WF
	+ Try to complete the requirements in this meeting to close the WI in Dec.

# Topic #2: CA\_n5-n28-n105

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318419 | Apple | **Proposal: Adopt CA\_n5-n28-n105 MSD value due to IMD3 for n105 with CA\_n5A-n28A configured for UL as shown in the Table below.**

|  |  |
| --- | --- |
| *Band / Channel bandwidth / NRB / Duplex mode* | *Source of IMD* |
| *NR CA band combination* | *NR band* | *UL Fc (MHz)* | *UL/DL BW (MHz)* | *UL CLRB* | *DL Fc (MHz)* | *MSD (dB)* | *Duplex mode* |  |
| *CA\_n5-n28-n105* | *n5* | *845* | *5* | *25* | *890* | *N/A* | *FDD* | *N/A* |
|  | *n28* | *740* | *5* | *25* | *795* | *N/A* | *FDD* | *N/A* |
|  | *n105* | *686* | *5* | *25* | *635* | ***24.3*** | *FDD* | *IMD3* |

***Table 3-1:*** *Proposed MSD value for r CA\_n5-n28-n105 with CA\_n5A-n28A UL*  |
| R4-2319887 | Huawei, HiSilicon, Spark NZ | **Observation 1: there is no IMD interference which fall into Rx frequencies of third DL band n28 when CA\_n5-n105 is the UL configuration.****Observation 2:** **3rd order IMD may also fall into mobile receive frequencies of third DL band n105 when CA\_n5-n28 is the UL configuration.****Proposal 1: It’s proposed to capture band n105 MSD due to IMD3 of Tx band n5 + band n28 as below.**

|  |  |
| --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | Source of IMD |
| NR CA band combination | NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL CLRB | DL Fc (MHz) | MSD (dB) | Duplex mode |  |
| CA\_n5-n28-n105 | n5 | 845 | 5 | 25 | 890 | N/A | FDD | N/A |
|  | n28 | 740 | 5 | 25 | 795 | N/A | FDD | N/A |
|  | n105 | 686 | 5 | 25 | 635 | 22.9 | FDD | IMD3 |

**Observation 3:** **Generally, there are some network deployment methods to avoid the IMD product hitting the DL carrier directly. For example, if the UL carrier in band n28 is configured in 703~718MHz, no matter which UL frequency carrier in band n5 is configured, the IMD3 products will not hit the DL carrier in band n105 directly. If the UL carrier in band n28 is configured above 718MHz, the REFSENS degradation in band n105 can be observed due to the IMD product. The RFSENS degradation will be quantified during the specification phase.** |
| R4-2319888 | Huawei, HiSilicon, Spark NZ | Draft CR for 38.101-1 to introduce CA\_n5-n28-n105 |
| R4-2320242 | Qualcomm France | **Proposal 1**: Use the following MSD when deciding MSD for n105 DL

|  |  |
| --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | Source of IMD |
| NR CA band combination | NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL CLRB | DL Fc (MHz) | MSD (dB) | Duplex mode |  |
| CA\_n5-n28-n105 | n5 | 845 | 5 | 25 | 890 | N/A | FDD | N/A |
|  | n28 | 740 | 5 | 25 | 795 | N/A | FDD | N/A |
|  | n105 | N/A | 5 | N/A | 635 | 26.4 | FDD | IMD3 |

 |

## Open issues summary

**Issue 2-1: MSD requirement**

* Proposals:

|  |  |
| --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | Source of IMD |
| NR CA band combination | NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL CLRB | DL Fc (MHz) | MSD (dB) | Duplex mode |  |
| CA\_n5-n28-n105 | n5 | 845 | 5 | 25 | 890 | N/A | FDD | N/A |
|  | n28 | 740 | 5 | 25 | 795 | N/A | FDD | N/A |
|  | n105 | N/A | 5 | 25 (Apple, Huawei)N/A (QC) | 635 | 24.3 (Apple)22.9 (Huawei)26.4 (QC) | FDD | IMD3 |

* Recommended WF
	+ Discuss if the average value can be agreed.

|  |  |
| --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | Source of IMD |
| NR CA band combination | NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL CLRB | DL Fc (MHz) | MSD (dB) | Duplex mode |  |
| CA\_n5-n28-n105 | n5 | 845 | 5 | 25 | 890 | N/A | FDD | N/A |
|  | n28 | 740 | 5 | 25 | 795 | N/A | FDD | N/A |
|  | n105 | N/A | 5 | 25 | 635 | 24.5 | FDD | IMD3 |

# Topic #3: DTV protection for CA\_n5-n28 and CA\_n26-n28

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318463 | NTT DOCOMO, INC., KDDI Corporation | **Observation 1: In Japan, n28 is available as a NR band in 700MHz, and n5/n18/n26 are available as NR bands in 800MHz.****Observation 2: Based on Japanese regulation, for the requirements of n28 single-CC, the emission requirements from n28 to DTV system are already specified in TS 38.101-1.****Observation 3: The emission requirements for DTV protection are needed for the requirements for CA\_n5-n28 and CA\_n26-n28 to be operated in Japan.****Proposal 1: The requirements for additional spurious emissions for NS\_17 is added in the requirements for CA\_n5-n28 and n26-n28, which protects DTV system based on Japanese regulation.**Table: Additional Requirements for uplink inter-band carrier aggregation (two-bands)(Table 6.2A.3.1.3-1 in TS 38.101-1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NR CA combination | Band | AppliedNS | Requirements (clause) | A-MPR (table/clause) | Note |
| [Omitted] |
| CA\_n5-n28 | n5 | 100 | 6.5.2.4.2 | Table 6.2.3.1-2 | 1,2 |
| n28 | 17 | 6.5.3.3.2 | N/A |
| [Omitted] |
| CA\_n26-n28 | n26 | 100 | 6.5.2.4.2 | Table 6.2.3.1-2 | 1,2 |
| n28 | 17 | 6.5.3.3.2 | N/A |
| [Omitted] |
| NOTE 1: NS\_05U, NS\_43U and NS\_100 can be signalled for NR bands that have UTRA services deployed and the requirements in clause 6.5.2.4.2 are only applicable to the signalling carrier.NOTE 2: Applicable when the assigned NR carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz. |

**Proposal 2: The requirements for spurious emissions for UE co-existence is added in the requirements for CA\_n5-n28 and n26-n28, which protects DTV system based on Japanese regulation.**Table: Requirements for uplink inter-band carrier aggregation (two bands)(Table 6.5A.3.2.3-1 in TS 38.101-1 with changes of R4-2317588)

|  |  |
| --- | --- |
| NR CA combination | Spurious emission |
|  | Protected Band | Frequency range (MHz) | Maximum Level (dBm) | MBW (MHz) | NOTE |
| [Omitted] |
| CA\_n5-n28 | Frequency range | 470 | - | 710 | -26.2 | 6 | 13 |
|  | Frequency range | 758 | - | 773 | -32 | 1 | 4 |
|  | Frequency range | 773 | - | 803 | -50 | 1 |  |
|  | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| [Omitted] |
| CA\_n26-n28 | Frequency range | 470 | - | 710 | -26.2 | 6 | 13 |
|  | Frequency range | 758 | - | 773 | -32 | 1 | 4 |
|  | Frequency range | 773 | - | 799X | -50 | 1 |  |
|  | Frequency range | 799X | - | 803 | -40 | 1 | 4 |
|  | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| [Omitted] |
| NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHzNOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.NOTE 13: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718 - 728 MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and Rbstart < 48.NOTE X: For 20MHz channel bandwidth in band n26 this value is changed to 794MHz |

 |
| R4-2318464 | NTT DOCOMO, INC., KDDI Corporation | Draft CR 38.101-1 to add DTV protection requirements for CA\_n5-n28 and CA\_n26-n28 |

## Open issues summary

**Issue 3-1: DTV protection requirement based on Japanese regulation**

* Proposal from DCM:

The following changes, marked in yellow, are newly proposed in this draft CR.

* + In Table 6.2A.3.1.3-1, the DTV protection requirements for additional spurious emissions for NS\_17 is added for CA\_n5-n28 and n26-n28.
	+ In Table 6.5A.3.2.3-1, the DTV protection requirements for spurious emissions for UE co-existence is added for CA\_n5-n28 and n26-n28.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CA\_n5-n28 | n5 | 100 | 6.5.2.4.2 | Table 6.2.3.1-2 | 1,2 |
| n28 | 17 | 6.5.3.3.2 | N/A |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CA\_n26-n28 | n26 | 100 | 6.5.2.4.2 | Table 6.2.3.1-2 | 1,2 |
| n28 | 17 | 6.5.3.3.2 | N/A |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_n5-n28 | Frequency range | 470 | - | 710 | -26.2 | 6 | 13 |
|  | Frequency range | 758 | - | 773 | -32 | 1 | 4 |
|  | Frequency range | 773 | - | 803 | -50 | 1 |  |
|  | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_n26-n28 | Frequency range | 470 | - | 710 | -26.2 | 6 | 13 |
|  | Frequency range | 758 | - | 773 | -32 | 1 | 4 |
|  | Frequency range | 773 | - | 799X | -50 | 1 |  |
|  | Frequency range | 799X | - | 803 | -40 | 1 | 4 |
|  | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |

* Recommended WF
	+ Discuss if the above proposal is agreeable.

# Topic #4: Release independent

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318313 | CATT | **Proposal 1: Remove the following note for *CA\_n26-n28.* If a UE supports this configuration is based on UE capability report.***NOTE y: For UEs only supporting DL CA\_n26-n28, uplink support in band n26 is optional in this release, if the UE supports CA\_n26-n28 UL configuration, it should also support UL in band n26 and n28.***Proposal 2: All of the band combinations in WI NR\_700800900\_combo\_enh are release independent from R15, which is following the current CA approach in TS 38.307.**  |
| R4-2318314 | CATT | Release independent CR for NR\_700800900\_combo\_enh |

## Open issues summary

**Issue 4-1: Release independent for CA\_n26-n28**

* Proposal from CATT
	+ Remove the following note for CA\_n26-n28. If a UE supports this configuration is based on UE capability report.

*NOTE y: For UEs only supporting DL CA\_n26-n28, uplink support in band n26 is optional in this release, if the UE supports CA\_n26-n28 UL configuration, it should also support UL in band n26 and n28.*

* Recommended WF
	+ Discuss if the above proposal is agreeable.

**Issue 4-2: Release independent for all of the band combinations in the WI**

* Proposal from CATT
	+ All of the band combinations in WI NR\_700800900\_combo\_enh are release independent from R15, which is following the current CA approach in TS 38.307.
* Recommended WF
	+ Discuss if the above proposal is agreeable.

# Topic #5: CA\_n5-n8 CR and draft CR resubmit

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318994 | vivo | CR for capturing the output for 2UL/2DL CA\_n5-n8*Moderator: Capture the agreements for 2UL/2DL CA\_n5-n8 to the TR.* |
| R4-2319889 | Huawei, HiSilicon | Draft CR for 38.101-1 to introduce CA\_n8-n20-n28*Moderator: Resubmission the endorsed CR R4-2308574 in RAN4#107.* |
| R4-2318402 | CATT | TS 38.101-1 big CR for NR\_700800900\_combo\_enh*Moderator: Resubmission the endorsed draft big CR in RAN4#108b.* |