**3GPP TSG-RAN WG4 Meeting # 110 R4-2402093**

**Athens, Greece, February 26 – March 01, 2024**

**Title: TP to TR 37.718-03-01: Addition of CA\_n1-n28-n102 variants**

**Source: Nokia, BT**

**Agenda item: 7.11.2**

**Document for: Approval**

# 1 Introduction

This is a TP to TR 37.718-03-01 to add CA\_n1-n28-n102 including ULCA combinations of inter and intra-band configurations of n1A and n28A with n102B/C, which require analysis. All fallbacks have been analysed [1],[2]. Unchanged sections of the TR have been omitted.

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#### 5.54.1.2 Channel bandwidths per operating band for CA

Table 5.54.1.2-1: Supported bandwidths per CA band combination of band n1+n28+n102

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n28A-n102A | CA\_n1A-n28ACA\_n1A-n102ACA\_n28A-n102A | n1 | 5, 10, 15, 20, 25, 30, 40, 50  | 0 |
|  |  | n28 | 5, 10, 15, 20, 30  |  |
|  |  | n102 | 20, 40, 60, 80, 100  |  |
| CA\_n1A-n28A-n102B | CA\_n1A-n28ACA\_n1A-n102ACA\_n28A-n102ACA\_n1A-n102BCA\_n28A-n102B | n1 | 5, 10, 15, 20, 25, 30, 40, 50  | 0 |
|  |  | n28 | 5, 10, 15, 20, 30  |  |
|  |  | n102 | CA\_n102B\_BCS0 |  |
| CA\_n1A-n28A-n102C | CA\_n1A-n28ACA\_n1A-n102ACA\_n28A-n102ACA\_n1A-n102CCA\_n28A-n102C | n1 | 5, 10, 15, 20, 25, 30, 40, 50  | 0 |
|  |  | n28 | 5, 10, 15, 20, 30  |  |
|  |  | n102 | CA\_n102C\_BCS0 |  |
| CA\_n1A-n28A-n102D | CA\_n1A-n28ACA\_n1A-n102ACA\_n28A-n102A | n1 | 5, 10, 15, 20, 25, 30, 40, 50  | 0 |
|  |  | n28 | 5, 10, 15, 20, 30  |  |
|  |  | n102 | CA\_n102D\_BCS0 |  |
| CA\_n1A-n28A-n102E | CA\_n1A-n28ACA\_n1A-n102ACA\_n28A-n102A | n1 | 5, 10, 15, 20, 25, 30, 40, 50  | 0 |
|  |  | n28 | 5, 10, 15, 20, 30  |  |
|  |  | n102 | CA\_n102E\_BCS0 |  |
| CA\_n1A-n28A-n102(2A) | CA\_n1A-n28ACA\_n1A-n102ACA\_n28A-n102 | n1 | 5, 10, 15, 20, 25, 30, 40, 50  | 0 |
|  |  | n28 | 5, 10, 15, 20, 30  |  |
|  |  | n102 | CA\_n102(2A)\_BCS0 |  |

### 5.54.2 Specific for 2 bands UL CA

#### 5.54.2.1 UE co-existence studies

This is a 3-band combination, so uplink harmonic and harmonic mixing analysis is already done in the fallbacks. Only IMD for two uplink configurations is analysed.

Table 5.54.2.2-1 lists Band n1 + Band n28 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

Table 5.54.2.2-2 lists Band n1 + Band n102 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

Table 5.54.2.2-3 lists Band n28 + Band n102 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

**Table 5.54.2.1-1: Band n1 and Band n28 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL Frequency [MHz] | 1920 | 1980 | 703 | 748 |
| DL Frequency [MHz] | 2110 | 2170 | 758 | 803 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1277 | 1172 | 2623 | 2728 |
| 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 3092 | 3257 | 574 | 424 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 4543 | 4708 | 3326 | 3476 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 5012 | 5237 | 129 | 324 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 2344 | 2554 | 5246 | 5456 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 6463 | 6688 | 4029 | 4224 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 1072 | 832 | 7217 | 6932 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 1596 | 1851 | 4534 | 4264 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 4732 | 4972 | 8383 | 8668 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 5949 | 6204 | 7166 | 7436 |

**Table 5.54.2.1-2: Band n1 and Band n102 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL Frequency [MHz] | 1920 | 1980 | 5925 | 6425 |
| DL Frequency [MHz] | 2110 | 2170 | 5925 | 6425 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3945 | 4505 | 7845 | 8405 |
| 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 2585 | 1965 | 9870 | 10930 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 9765 | 10385 | 13770 | 14830 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 665 | 15 | 15795 | 17355 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 9010 | 7890 | 15690 | 16810 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 11685 | 12365 | 19695 | 21255 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 23780 | 21720 | 1995 | 1255 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 15435 | 13815 | 5910 | 7090 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 25620 | 27680 | 13605 | 14345 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 21615 | 23235 | 17610 | 18790 |

**Table 5.54.2.1-3: Band n28 and Band n102 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL Frequency [MHz] | 703 | 748 | 5925 | 6425 |
| DL Frequency [MHz] | 758 | 803 | 5925 | 6425 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 5177 | 5722 | 6628 | 7173 |
| 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 5019 | 4429 | 11102 | 12147 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 7331 | 7921 | 12553 | 13598 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 4316 | 3681 | 17027 | 18572 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 11444 | 10354 | 13256 | 14346 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 8034 | 8669 | 18478 | 20023 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 24997 | 22952 | 2933 | 3613 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 17869 | 16279 | 9606 | 10741 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 24403 | 26448 | 8737 | 9417 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 19181 | 20771 | 13959 | 15094 |

Based on the tables above it can be seen that

n1 + n28 IMD5 may affect Rx frequencies of band n102

Table 5.54.2.1-4 lists Band n1 + Band n102C 2UL bands CA 1st order triple beat (IMD3) for the UE-to-UE coexistence analysis into the third receive band of Band n28, where Band n102C is the uplink band of the separated RB allocations and Band n1 is the contiguous single uplink carrier.

**Table 5.54.2.1-4: Band n1 and Band n102 triple beat IMD products**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CC location | fU1L | fU2L | fU3L | fU1H |  | CBW |
| Frequency | 5925 | 5965 | 6385 | 6425 |  | 20 |
| CC location | fSCCL | fSCCH | fU2H | fU3H |  | Min ch. separation |
| Frequency | 1920 | 1980 | 6405 | 6265 |  | 0 |
| 1st order TB | IfU3L -fU1L- fSCCL| | IfU2L -fU1L + fSCCL| | IfU2L -fU1L- fSCCH| | IfU3L -fU1L + fSCCH| |  | Max ch. separation |
| Ranges | 1760 | 1940 | 1960 | 2140 |  | 160 |
| 1st order TB | IfU2L+fU1L-fSCCH| | IfU1H+fU2H-fSCCL| | IfU2L +fU1L+fSCCL| | IfU1H +fU2H+fSCCH| |  |  |
| Ranges | 9890 | 10910 | 13790 | 14810 |  |  |

Based on Table 5.54.2.1-4, 1st order triple beat IMD has no occurrence in band n28. There is no change to the REFSENS requirements as there is no triple beat IMD.

Table 5.54.2.1-5 lists Band n28 + Band n102C 2UL bands CA 1st order triple beat (IMD3) for the UE-to-UE coexistence analysis into the third receive band of Band n1, where Band n102C is the uplink band of the separated RB allocations and Band n28 is the contiguous single uplink carrier.

**Table 5.54.2.1-5: Band n28 and Band n102 triple beat IMD products**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CC location | fU1L | fU2L | fU3L | fU1H |  | CBW |
| Frequency | 5925 | 5965 | 6385 | 6425 |  | 20 |
| CC location | fSCCL | fSCCH | fU2H | fU3H |  | Min ch. separation |
| Frequency | 703 | 748 | 6405 | 6265 |  | 0 |
| 1st order TB | IfU3L -fU1L- fSCCL| | IfU2L -fU1L + fSCCL| | IfU2L -fU1L- fSCCH| | IfU3L -fU1L + fSCCH| |  | Max ch. separation |
| Ranges | 543 | 723 | 728 | 908 |  | 160 |
| 1st order TB | IfU2L+fU1L-fSCCH| | IfU1H+fU2H-fSCCL| | IfU2L +fU1L+fSCCL| | IfU1H +fU2H+fSCCH| |  |  |
| Ranges | 11122 | 12127 | 12573 | 13578 |  |  |

Based on Table 5.54.2.1-5, 1st order triple beat IMD has no occurrence in band n1. There is no change to the REFSENS requirements as there is no triple beat IMD.

### 6.8.1 Configurations for DC\_n1-n28-n102

Table 6.8.1-1: Inter-band NR DC configurations

| NR DCconfiguration | Uplink NR DCconfiguration |
| --- | --- |
| DC\_n1A-n28A-n102ADC\_n1A-n28A-n102BDC\_n1A-n28A-n102CDC\_n1A-n28A-n102DDC\_n1A-n28A-n102E | DC\_n1A-n102ADC\_n1A-n102BDC\_n1A-n102CDC\_n28A-n102ADC\_n28A-n102BDC\_n28A-n102C |
| DC\_n1A-n28A-n102(2A) | DC\_n1A-n102ADC\_n28A-n102A |

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# References

[1] R4-2321853 TP to TR 38.718-02-01 Addition to CA\_n1-n102 and DC\_n1-n102, Nokia - RAN4#109

[2] R4-2321854 TP to TR 38.718-02-01 Addition to CA\_n28-n102 and DC\_n28-n102, Nokia - RAN4#109