3GPP TSG-RAN WG4 Meeting # 107 R4-2310274

Incheon, KR, May 22 – May 26, 2023

**Source: Nokia, Nokia Shanghai Bell, Skyworks Solutions, Inc.**

**Title: TP** **to TR 38.846 to add guidance on Co-existence studies for Uplink Intra-Band Non-Contiguous CA**

**Agenda item: 8.1.2**

**Document for: Approval**

1. Introduction

In RAN4#106 proposal 1, 2 and 3 in [1] were agreed, this TP implements the agreed proposal to the relevant TR.

At RAN4#106bis a WF [2] were agreed that the TP submitted for RAN4#106bis [3] according to the RAN4#106 agreement should be revised to include additional information. This is the resulting TP.

Originally this TP was submitted as R4-2308066 and revised during RAN4#107 to the current version.

1. TP to TR 38.846

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of TP to TR 38.486 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

6.5 Guidelines on Co-Existence analysis

6.5.x Uplink Intra-Band CA with two UL CC transmissions

When adding a band combination including two uplink transmission in one UL Intra-Band Carrier Aggregation this study is needed for both non-contiguous and contiguous intra-band uplink CA.

There are 5 cases to consider where IMDs of the two CCs of an intra-band UL CA may cause MSD issues:

* FDD band with DL and UL contiguous intra-band CA (CA\_nXXB/ C UL and DL) => IMDs of intra band CA can cause MSD up to 7th order, only odd orders should be an issue
* FDD band with DL and UL non-contiguous intra-band CA CA\_nXX(2A) UL and DL) => IMDs of intra band CA can cause MSD up to 7th order, only odd orders should be an issue
* Two band simultaneous Rx/Tx combinations with 1 band UL with contiguous intra-band CA => IMDs of intra band CA can cause MSD up to 9th order, only odd order should be an issue as 2nd and 4th order are limited to 400MHz and higher even orders are typically low.
* Two band simultaneous Rx/Tx combinations with 1 band UL with non-contiguous intra-band CA => IMDs of intra band CA can cause MSD up to 7th order, 2nd order can be up to 600MHz and should not be an issue while 4th order can be an issue for low bands as it can reach up to 1200Mhz and higher even orders are typically low.
* Two band simultaneous Rx/Tx combinations with 2 band UL with contiguous intra-band CA in one of the bands => IMDs of intra band CA can cause MSD up to 7th order, 2nd order can be up to 600MHz and should not be an issue while 4th order can be an issue for low bands as it can reach up to 1200Mhz and higher even orders are typically low.
* The assumption that out of even order IMDs, only 4th order IMD is an issue, is based on the fact that in R18:
  + Maximum UL aggregated BW for contiguous intra-band is 200MHz
  + Maximum bandwidth separation class is 600MHz
* Two band simultaneous Rx/Tx combinations with 2 band UL with non-contiguous intra-band CA in one of the bands is not considered because it would require 3 non-contiguous UL clusters which is not allowed in R18.

Based on the above, an IMD calculation table can be made generic for all above cases as shown in Table 6.5.x-1.

Table 6.5.x-1: Co-existence studies for uplink configurations including intra-band UL CA

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | Channel  BW | Minimum  Channel  separation | Maximum  Instantaneous UL BW | Minimum  frequency | Maximum  frequency |  |
| Data |  |  |  |  |  | - |
| CC location | fU1L | fU2L | fU3L | fU1H | fU2H | fU3H |
| Frequency |  |  |  |  |  |  |
| 2nd | I fU1L-fU2L I | I fU1L-fU3L I | fU1L + fU2L | fU1H+fU2H | - | - |
| Interference ranges |  |  |  |  | - | - |
| 3rd | 2\*fU1L-fU3L | 2\*fU1H-fU3H | 2\*fU1L + fU2L | 2\*fU1H + fU2H | - | - |
| Interference ranges |  |  |  |  | - | - |
| 4th | I 2\*fU1L - 2\*fU2L I | I 2\*fU1H - 2\*fU3H I | 3\*fU1L - fU3L | 3\*fU1H - fU3H | 3\*fU1L + fU2L | 3\*fU1H + fU2H |
| Interference ranges |  |  |  |  |  |  |
| 5th | I 3\*fU1L-2\*fU3L I | I 3\*fU1H-2\*fU3H I | 4\*fU1L-fU3L | 4\*fU1H-fU3H | 4\*fU1L+fU2L | 4\*fU1H+fU2H |
| Interference ranges |  |  |  |  |  |  |
| 6th | I 3\*fU1L-3\*fU2L I | I 3\*fU1H-3\*fU3H I | 4\*fU1L-2\*fU3L | 4\*fU1H-2\*fU3H | 5\*fU1L-fU3L | 5\*fUH1-fU3H |
| Interference ranges |  |  |  |  |  |  |
| 7th | I 4\*fU1L-3\*fU3L I | I 4\*fU1H-3\*fU3H I | 5\*fU1L-2\*fU3L | 5\*fU1H-2\*fU3H | 6\*fU1L-fU3L | 6\*fU1H-fU3H |
| Interference ranges |  |  |  |  |  |  |
| 9th | I 5\*fU1L-4\*fU3L I | I 5\*fU1H-4\*fU3H I | 6\*fU1L-3\*fU3L | 6\*fU1H-3\*fU3H | 7\*fU1L-2\*fU3L | 7\*fU1H-2\*fU3H |
| Interference ranges |  |  |  |  |  |  |

If any issues are identified via the calculations presented in Table 6.5.x-1 additional REFSENS requirements may be needed.

In the Table 6.5.x-1 the following abbreviations is used:

fU1L = minimum frequency of TX aggressor band of ULCC1 lower band range (i.e. Minimum frequency edge of the band)

fU2L = minimum frequency of TX aggressor band of ULCC2 lower band range (i.e. Minimum frequency edge of the band)

fU3L = maximum frequency of TX aggressor band of ULCC2 lower band range (i.e. Minimum frequency edge of the band + Maximum Instantaneous UL BW)

fU1H = maximum frequency of TX aggressor band of ULCC1 higher band range (i.e. Maximum frequency edge of the band)

fU2H = minimum frequency of TX aggressor band of ULCC2 higher band range

fU3H = maximum frequency of TX aggressor band of ULCC2 higher band range (i.e. Minimum frequency edge of the band - Maximum Instantaneous UL BW)

fD1L = minimum frequency of RX victim band of DLCC placed on the lower frequency side of the TX aggressor band

fD1H = maximum frequency of RX victim band of DLCC placed on the lower frequency side of the TX aggressor band

fD2L = minimum frequency of RX victim band of DLCC placed on the higher frequency side of the TX aggressor band

fD2H = maximum frequency of RX victim band of DLCC placed on the higher frequency side of the TX aggressor band

Channel BW = Channel bandwidth of the component carrier.  
 - Equal to minimum UL CBW for non-contiguous UL CA  
 - Equal to the maximum UL CBW combination that fits the minimum between the maximum aggregated CBW for the BCS and the band bandwidth for contiguous UL CA

Minimum channel separation = Minimum frequency separation between the two component carriers or the inter CC GB  
 - Equal to 0 for contiguous intra-band UL CA  
 - Equal to minimum CBW for non-contiguous ULCA

Maximum channel separation = Maximum frequency separation between the two component carriers or aggregated uplink BW  
 - For contiguous intra-band UL CA it is equal to either the aggregated bandwidth or total bandwidth of the band, whatever is the smallest.  
 - For non-contiguous intra-band UL CA it is equal to either the bandwidth separation class bandwidth or total bandwidth of the band, whatever is the smallest.



Figure 6.5.x-1: Co-existence studies for Uplink Intra-Band Non-Contiguous CA

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References

[1] R4-2300413, IMD analysis of NC intra-band CA in uplink, Nokia

[2] R4-2306480, WF on Templates and guidelines on coexistence studies for UL configurations with intra-band ULCA, Nokia

[3] R4-2304944, TP to TR 38.846 to add guidance on Co-existence studies for Uplink Intra-Band Non-Contiguous CA, Nokia