**3GPP TSG-RAN WG4 Meeting #111 R4-2408941**

**Fukuoka City, Fukuoka, Japan, 20th – 24th May, 2023**

**Agenda item: 10.9.4**

**Source:** Moderator (OPPO)

**Title:** Topic summary for [111][130] NR\_SL\_ intraB\_CA\_ITS\_part1

**Document for:** Information

# Introduction

This summary includes system parameters, TX requirements and RX requirements for intra-band non-contiguous CA in ITS band.

# Topic #1: System Parameter

## Companies’ contributions summary

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| --- | --- | --- |
| **TDoc** | **Company** | **Summary** |
| R4-2408834 | OPPO | **Proposal 1: To capture the intra-band contiguous and non-contiguous SL CA bands under the same sub-clause.****Proposal 2: For PC2 intra-band contiguous CA, reuse the same channel bandwidth of PC3 intra-band contiguous CA.****Proposal 3: No update for sidelink CA subclause is needed for intra-band non-contiguous CA.** |
| R4-2408952 | Xiaomi | **Proposal 1:** **All the requirements defined for PC2/PC3 sidelink intra-band non-contiguous CA shall apply under the assumption of the same subcarrier spacing for SL CA.** |

## Open issues summary

### Sub-topic 2-1 General

#### Issue 2-1-1: How to capture the operating band

* Proposals
	+ Proposal: To capture the intra-band contiguous and non-contiguous SL CA bands under the same sub-clause.
* Moderator Recommendation:
	+ Agree on the proposal

Agreement:

* To capture the intra-band contiguous and non-contiguous SL CA bands under the same sub-clause.

#### Issue 2-1-2: Update on sub-clause 5 of TS 38.101-1

* Proposals
	+ Proposal: No update for sidelink CA subclause is needed for intra-band non-contiguous CA

(Moderator note: This proposal limit to sub-clause 5 of TS 38.101-1 for intra-band non-contiguous CA besides the operating band).

* Moderator Recommendation:
	+ Agree on the proposal

Meta: the clause 5 needs be updated for channel bandwidth part. There is no specific channel band combination. We need add which band combination to be supported. We should follow the normal intra-band contiguous CA.

Moderator: we are quite aligned but we do not need agree on it now.

#### Issue 2-1-3: SCS

* Proposals
	+ Proposal: All the requirements defined for PC2/PC3 sidelink intra-band non-contiguous CA shall apply under the assumption of the same subcarrier spacing for SL CA.
* Moderator Recommendation:
	+ Further discuss

Agreement:

* All the requirements defined for PC2/PC3 sidelink intra-band non-contiguous CA shall apply under the assumption of the same subcarrier spacing for SL CA.

# Topic #2: UE TX RF requirement

## Companies’ contributions summary

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| **TDoc** | **Company** | **Summary** |
| R4-2407613 | Huawei, HiSilicon | ***Proposal 1: The work in Rel-19 NR sidelink intra-band non-contiguous CA with power class 3 and power class 2 would include at least**** ***Maximum output power***
* ***MPR for PC2 and PC3***
* ***Configured output power***
* ***Update output power dynamic, transmit signal quality, out of band emission, spurious emissions***

***Proposal 2: Arch#1-1 and Arch#1-2 are both with 1LO and shall be considered to specify requirements for intra-band sidelink non-contiguous CA with PC3/PC2.******Proposal 3: If there is any conclusion to update the definition PCmax for intra-band non-contiguous CA with 1LO in NR\_ENDC\_RF\_Ph4, we should update accordingly in NR\_SL\_ intraB\_CA\_ITS.******Proposal 4:*** ***Arch#2-2 with dualPA-Architecture (2x23dBm PA+ 2LO) shall be considered to specify requirements for intra-band sidelink non-contiguous CA with PC3/PC2 instead of Arch#2-1(2x26dBm PA+ 2LO).******Proposal 5: For the MPR evaluation of intra-band non-contiguous CA with PC2/PC3 1LO, the simulation assumptions as follows should be agreed***

|  |  |
| --- | --- |
| Center frequency | 5.9GHz |
| Bandwidth  | per CC: 10/20/30/40MHzAggregated CBW: Table 5.2.3-1 (up to 70MHz CBW) |
| Maximum output power for aggregated CBW | 23dBm and 26dBm |
| Numerology | 15 kHz/30kHz/60kHz |
| Modulation per CC | QPSK/16QAM/64QAM/256QAM |
| Waveform | CP-OFDM |
| Carrier leakage | 35dBc |
| IQ image | 40dBc |
| CIM3 | 60dBc |
| PA calibration | PA calibrated to deliver 30dBc ACLR for a fully allocated RBs in 20MHz QPSK DFT- S-OFDM waveform at 1 dB MPR.This is based to share PA between LTE V2X and NR V2X at 5.9GHz as worst case. |

 |
| R4-2407817 | Xiaomi | **Proposal 1：The MPR for PC2/PC3 intra-band non-contiguous SL CA should be specified for PSSCH/PSCCH, PSFCH and S-SSB.****Proposal 2: The MPR/A-MPR for PC2/PC3 intra-band non-contiguous SL CA can be defined based on the architectures of 1PA+1LO and 2PA+2LO, and doesn’t need to consider the architecture of 2PA+1LO.****Proposal 3: Using -34dBc carrier leakage as the starting point in MPR simulation.****Proposal 4: For the intra-band non-contiguous SL CA, using the frequency gap equal or smaller than the aggregated BW+5MHz as the baseline in the MPR simulation.****Proposal 5: PCMAX should be specified for PC2/PC3 intra-band non-contiguous SL CA.****Proposal 6: Other Tx requirements except MOR, MPR/A-MPR and configured transmitted power can reuse the requirements specified for PC2/PC3 single carrier V2X UE in 47.** |
| R4-2407983 | LG Electronics | **Proposal 1: Consider 3 architectures, 1x26dBm+1LO, 2x23dBm+2LO, and 2x23dBm+1LO for PC2 SL intra-band non-contiguous CA MPR evaluation.****Proposal 2: Consider all possible BW Gap size for PC2 SL intra-band non-contiguous CA MPR evaluation.****Proposal 3: Reuse the applicability of NR intra-band NC CA 2PA+1LO, i.e., BW Gap size＜CC1 +CC2 CBW.****Proposal 4:** **Indicate ‘dualPA-architecture’ like NR intra-band non-contiguous CA.** |
| R4-2408045 | Facebook Japan G.K. | **Proposal 1: *On top of above MPR simulation assumptions in Table in issue 2-2-2, RAN4 should consider the frequency gap between sub-block1 and sub-block2 to derive MPR/A-MPR requirements for NR SL intra-band non-contiguous CA UE in ITS spectrum*.** **Proposal 2: *The above MPR simulation assumptions in Table in issue 2-2-2 1, frequency gap with 20MHz in Euro regions and additional spectrum emission mask in Table 6.5E.2.3.1-1 in TS38.101-1 and additional spurious emission requirements in Table 6.5E.3.4.2-1 and Table 6.5E.3.4.2-2 in TS38.101-1 will be considered to derive A-MPR requirements to comply European regulation for NR SL intra-band non-contiguous CA for both power class 3 and power class 2 in ITS spectrum*.** **Proposal 3: *For US regulation requirements*, *RAN4 will study and specify the related A-MPR requirements with NS\_52 for NR SL intra-band non-contiguous CA UE after final FCC announcement for the additional emission limits in US.*****Proposal 4: *The above UE Tx/Rx requirements for NR SL intra-band non-contiguous CA shall be considered to specify the UE RF requirements in TS38.101-1.*** |
| R4-2408833 | OPPO | **Proposal 1: To consider both 1 PA and 2 PA architecture for intra-band non-contiguous sidelink CA MPR simulation for both PC3 and PC2.****Proposal 2: The 2PA+1LO architecture can be precluded for intra-band non-contiguous CA A-MPR simulation for both PC2 and PC3..****Proposal 3: To add new sub-clause to introduce UE TX requirement of intra-band non-contiguous CA.** |

## Open issues summary

### Sub-topic 2-1 MPR/A-MPR simulation

#### Issue 2-1-1: Architecture

* Proposals
	+ Proposal 1 (Huawei):
		- Arch#1-1 and Arch#1-2 are both with 1LO and shall be considered to specify requirements for intra-band sidelink non-contiguous CA with PC3/PC2.
		- Arch#2-2 with dualPA-Architecture (2x23dBm PA+ 2LO) shall be considered to specify requirements for intra-band sidelink non-contiguous CA with PC3/PC2 instead of Arch#2-1(2x26dBm PA+ 2LO)

|  |  |  |  |
| --- | --- | --- | --- |
| Arch | description | Remarks | Frequency Separation |
| #1-1 | 1x26dBm PA+ 1LO with 200MHz BW | Single–Tx | BW Gap size＜CC1 +CC2 CBW |
| #1-2 | 2x23dBm PA+ 1LO with 200MHz BW | dual-Tx or txDiversity | BW Gap size＜CC1 +CC2 CBW |
| #2-1 | 2x26dBm PA+ 2LO with 200MHz BW | dualPA-Architecture | can support any CC separation |
| #2-2 | 2x23dBm PA+ 2LO with 200MHz BW | dualPA-Architecture | can support any CC separation |

* + Proposal 2 (Xiaomi, OPPO)
		- The MPR/A-MPR for PC2/PC3 intra-band non-contiguous SL CA can be defined based on the architectures of 1PA+1LO and 2PA+2LO, and doesn’t need to consider the architecture of 2PA+1LO.
	+ Proposal 3 (LG Electronics)
		- Consider 3 architectures, 1x26dBm+1LO, 2x23dBm+2LO, and 2x23dBm+1LO for PC2 SL intra-band non-contiguous CA MPR evaluation
* Recommendation:
	+ Further discuss the architecture considering the number of LO and the power class of the PA.

Moderator: check whether proposal 3 is OK.

Meta: we can follow intra-band NC CA HPUE case. 2 LO should be considered for HPUE. We can follow the same principle. #2-1 and #2-2 are sufficient.

Xiaomi: we should keep aligned with intra-band NC CA. We should keep 2 PA + 2 LO and 1PA+1 LO.

LGE: Current NR intra-band CA. #1-1 and #1-2 use 1LO. Considering MPR requirement aspect, #2-1 is with lower MPR requirement. We proposal #1-1, #1-2 and #2-2 to be considered. SL CA the total bandwidth is 70MHz.

Huawei: We share the similar view as LGE. Proposal 1 and proposal 3 are similar. One set of requirements for #1-1 and #1-2.

LGE: to Huawei, I have different view that 1-1 and 1-2 are different.

OPPO: Companies try to refer to NR uplink CA HPUE. But HPUE is PC1.5 that one PA cannot cover. The case is different from SL case. We can refer to legacy NR PC2. We are trying to use a number of cases above table. The channel bandwidth and frequency gap are different. Be careful to refer to table.

Huawei: can we remove #2-1?

Meta: we can define one baseline architecture following NR CA HPUE case. #2-2 is baseline, and #1-1/1-2 can be considered for evaluation.

LGE: regarding baseline, we wonder if we will define multiple requirements.

Meta: if there is different MPR requirements based on #1-1 and 1-2, then we can consider the additional requirement.

Huawei: we disagree with #2-2 as baseline. Considering SL is with only 70MHz, the large frequency separation is not very common. One PA would be enough.

LGE: considering the current NR CA requirement, the multiple MPR requirements can be applied based on UE capability. UE cannot indicate dual PA architecture but UE can indicate TxD. If UE cannot indicate TxD, then the requirements are based on #1-1.

Meta: we can consider both 1LO and 2 LO RF architecture to derive the requirement.

Moderator: Meta compromise is good. We can do the simulation results with 1LO and 2LO

Vivo: for 2LO and 2PA, how to model 2 PA case. For 2 PA, we should consider reverse IMD. For CA, we use measurement rather than simulation.

Agreement

* Do evaluations based on assumptions of 1LO and 2LO
* Consider the following architecture for evaluation

|  |  |  |
| --- | --- | --- |
| Arch | description | Remarks |
| #1-1 | 1x26dBm PA+ 1LO | Single–Tx |
| #1-2 | 2x23dBm PA+ 1LO | dual-Tx or txDiversity |
| #2-2 | 2x23dBm PA+ 2LO | dualPA-Architecture |

#### Issue 2-1-2: Frequency gap

* Proposals
	+ Proposal 1: The MPR for PC2/PC3 intra-band non-contiguous SL CA should be specified for PSSCH/PSCCH, PSFCH and S-SSB. (Huawei)
		- Observation 1: The Frequency Separation, Gap between the CCs ≤ the overall channel bandwidth summed between two CC, may not be met for some of configuration for intra-band sidelink CA in Arch#1 without dualPA-architecture.
		- Observation 2: The RB allocation imbalance on the two CC of intra-band sidelink CA should be considered for PCmax in dualPA-Architecture according to the conclusion (if there to be) in NR\_ENDC\_RF\_Ph4.
	+ Proposal 2: For the intra-band non-contiguous SL CA, using the frequency gap equal or smaller than the aggregated BW+5MHz as the baseline in the MPR simulation. (Xiaomi)
	+ Proposal 3: (LG Electronics)
		- Consider all possible BW Gap size for PC2 SL intra-band non-contiguous CA MPR evaluation.
		- Reuse the applicability of NR intra-band NC CA 2PA+1LO, i.e., BW Gap size＜CC1 +CC2 CBW
	+ Proposal 4: (Facebook)
		- On top of above MPR simulation assumptions in Table in issue 2-2-2, RAN4 should consider the frequency gap between sub-block1 and sub-block2 to derive MPR/A-MPR requirements for NR SL intra-band non-contiguous CA UE in ITS spectrum.
		- The above MPR simulation assumptions in Table in issue 2-2-2 1, frequency gap with 20MHz in Euro regions and additional spectrum emission mask in Table 6.5E.2.3.1-1 in TS38.101-1 and additional spurious emission requirements in Table 6.5E.3.4.2-1 and Table 6.5E.3.4.2-2 in TS38.101-1 will be considered to derive A-MPR requirements to comply European regulation for NR SL intra-band non-contiguous CA for both power class 3 and power class 2 in ITS spectrum.
* Moderator Recommendation:
	+ Depend on the architecture discussion.
	+ Further to discuss
		- BW Gap Size
			* the BW Gap size<CC1+CC2 CBW rule of NR intra-band non-contiguous CA apply to SL.
			* frequency gap equal or smaller than the aggregated BW+5MHz.
			* Consider all possible BW Gap size for PC2 SL intra-band non-contiguous CA MPR evaluation.
		- The RB allocation imbalance

Meta: for intra-band NC CA, RAN4 should consider frequency gap between sub-block 1 and 2. Option 4 is preferred.

OPPO: we are trying to agree on BW gap size. Meta is talking about different regulation, which can go for A-MPR.

LGE: The 2nd block is different from the existing CA. Why to consider +5MHz?

Meta: To moderator, for MPR evaluation, we need consider the worst sub-block gap. MPR should be general requirement to be applied to global region. We should consider the worst gap. A-MPR should be considered specific.

LGE: For evaluation we can consider all the gap size.

Agreement:

* Consider the worst case for BW gap size between sub-block #1 and #2 for the MPR requirement.
* For evaluations, consider all the gap size.

#### Issue 2-1-3: MPR/A-MPR evaluation parameters

* Proposals
	+ Proposal 1 (Huawei):
		- Proposal: For the MPR evaluation of intra-band non-contiguous CA with non-dualPA architecture, the simulation assumptions as follows should be agreed

|  |  |
| --- | --- |
| Center frequency | 5.9GHz |
| Bandwidth  | per CC: 10/20/30/40MHzAggregated CBW: Table 5.2.3-1 (up to 70MHz CBW) |
| Maximum output power for aggregated CBW | 23dBm and 26dBm |
| Numerology | 15 kHz/30kHz/60kHz |
| Modulation per CC | QPSK/16QAM/64QAM/256QAM |
| Waveform | CP-OFDM |
| Carrier leakage | 35dBc |
| IQ image | 40dBc |
| CIM3 | 60dBc |
| PA calibration | PA calibrated to deliver 30dBc ACLR for a fully allocated RBs in 20MHz QPSK DFT- S-OFDM waveform at 1 dB MPR.This is based to share PA between LTE V2X and NR V2X at 5.9GHz as worst case. |

* + Proposal 2 (Xiaomi)
		- Using -34dBc carrier leakage as the starting point in MPR simulation.
* Recommendation:
	+ Further discuss proposal 1
	+ Proposal 2 in-line with agreement in the last meeting

LGE: regarding the WF last meeting, we agree with the table except for carrier leakage. Why should we change the IQ image? Last meeting carrier leakage is 25.

Huawei: In Rel-17 intra-band NC measurement, with large I/Q image, we can get normal MPR. The requirement could be even worse. The assumption can be used for 1 LO case. We suggest to check it.

Qualcomm: we feel whatever values we should keep the consistent assumption between contiguous and non-contiguous due to the same hardware.

Moderator: based on Huawei statement, they did some simulation to find the performance is bad. We can keep the original leakage and ask companies to check the performance.

Huawei: Rel-17 NC CA, MPR is based on the assumption with higher carrier leakage and IQ image. Otherwise, the performance is bad.

LGE: for dual PA, we have to consider different PSD. Currently we can only consider equal PSD for dual PA architecture. We should consider different PSD for dual-PA.

#### Issue 2-1-4: Requirement for simulation

* Proposal 1: The above MPR simulation assumptions in Table in issue 2-2-2 1, frequency gap with 20MHz in Euro regions and additional spectrum emission mask in Table 6.5E.2.3.1-1 in TS38.101-1 and additional spurious emission requirements in Table 6.5E.3.4.2-1 and Table 6.5E.3.4.2-2 in TS38.101-1 will be considered to derive A-MPR requirements to comply European regulation for NR SL intra-band non-contiguous CA for both power class 3 and power class 2 in ITS spectrum.
* Proposal 2: For US regulation requirements, RAN4 will study and specify the related A-MPR requirements with NS\_52 for NR SL intra-band non-contiguous CA UE after final FCC announcement for the additional emission limits in US.
* Recommendation:
	+ The EU regulation is more stable and can be agreed
	+ For FCC regulation, can work based on current NS\_52 first and wait for FCC update.

LGE: for EU regulation, we need check more which combination will be used. FCC regulation is OK.

Meta: for A-MPR simulation, we should consider the existing EU regulation for requirement. We do not understand why to check EU regulation, which is quite fixed.

LGE: EU regulation considers different number of sub-blocks.

Agreement:

* For FCC regulation, work is based on current NS\_52 first and wait for FCC update.

### Sub-topic 2-2 TX Requirements

#### Issue 2-2-1: TX Requirement

* Proposals
	+ Proposal 1: The work in Rel-19 NR sidelink intra-band non-contiguous CA with power class 3 and power class 2 would include at least
		- Maximum output power
		- MPR for PC2 and PC3
		- Configured output power
		- Update output power dynamic, transmit signal quality, out of band emission, spurious emissions
	+ Proposal 2: (Xiaomi)
		- PCMAX should be specified for PC2/PC3 intra-band non-contiguous SL CA.
		- Other Tx requirements except MOR, MPR/A-MPR and configured transmitted power can reuse the requirements specified for PC2/PC3 single carrier V2X UE in 47
	+ Proposal 3: (Facebook)
		- The above UE Tx/Rx requirements for NR SL intra-band non-contiguous CA shall be considered to specify the UE RF requirements in TS38.101-1.Moderator Recommendation:
	+ Proposal 4: (OPPO)
		- To add new sub-clause to introduce UE TX requirement of intra-band non-contiguous CA.
* Recommendation:
	+ Further discuss

Huawei: proposal 1 and proposal 3 are aligned. Those requirements just need be updated simply.

LGE: proposal 1 can be considered as starting point.

Agreement:

* Use proposal 1 as the starting point.

#### Issue 2-2-2: Signalling

* Proposal: Indicate ‘dualPA-architecture’ like NR intra-band non-contiguous CA
* Recommendation:
	+ Further discuss after the simulation frame work is agreed.

# Topic #3: UE RX RF requirement

## Companies’ contributions summary

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| **TDoc** | **Company** | **Summary** |
| R4-2407614 | Huawei, HiSilicon | *Proposal 1: The description of the following Rx requirements in the specification should be updated from that only for contiguous intra-band SL CA to also accommodate the requirements for non-contiguous intra-band SL CA** ***REFSENS***
* ***Maximum input level,***
* ***ACS locking***
* ***In-band/ out-of-band blocking***
* ***Spurious response***
* ***Wide band Intermodulation***
 |
| R4-2407818 | Xiaomi | **Proposal 1: The REFSENS specified for single carrier operation in n47 shall apply to each component carrier of intra-band non-contiguous SL CA.****Proposal 2: For intra-band non-contiguous SL CA, the Rx requirements including maximum input power, ACS and blocking should be specified based on the sub-block. The requirements for single carrier shall apply to the sub-block including one component carrier only and the requirements for intra-band contiguous SL CA shall apply to the sub-block including multiple component carriers.** |
| R4-2408832 | OPPO | **Proposal 1: For intra-band non-contiguous SL CA, for all the RX requirements, the requirement for general and intra-band contiguous CA apply for one component carrier and two component carriers per sub-block, respectively.** |

### Sub-topic 3-1

#### Issue 3-1-1: RX requriements

* Proposals
	+ Proposal 1 (Huawei):
		- The description of the following Rx requirements in the specification should be updated from that only for contiguous intra-band SL CA to also accommodate the requirements for non-contiguous intra-band SL CA
			* REFSENS
			* Maximum input level,
			* ACS locking
			* In-band/ out-of-band blocking
			* Spurious response
			* Wide band IntermodulationProposal 2
	+ Proposal 2 (Xiaomi, OPPO)
		- The REFSENS specified for single carrier operation in n47 shall apply to each component carrier of intra-band non-contiguous SL CA.
		- For intra-band non-contiguous SL CA, the Rx requirements including maximum input power, ACS and blocking should be specified based on the sub-block. The requirements for single carrier shall apply to the sub-block including one component carrier only and the requirements for intra-band contiguous SL CA shall apply to the sub-block including multiple component carriers.
* Recommendation:
	+ Further discuss

Meta: we also proposed paper for Rx part. We are aligned with Huawei proposals.

Agreement:

* Use proposal 1 as the starting point.