**3GPP TSG-RAN WG4 Meeting #111 R4-2408942**

**Fukuoka City, Fukuoka , Japan, 20th – 24th May, 2024**

**Agenda item:** 10.9.4

**Source:** Moderator (LG Electronics)

**Title:** Topic summary for [111][131] NR\_SL\_ intraB\_CA\_ITS\_part2

**Document for:** Information

# Introduction

*This topic summary is for Rel-18 NR Sidelink Evolution in Agenda 10.9.3 as follows.*

* *Topic#1: UE Tx RF requirements for SL intra-band contiguous CA*
* *Topic#2: UE Rx RF requirements for SL intra-band contiguous CA*
* *Topic#3: System parameters*
	+ *In Agenda 10.9.2.1, proposal 2 in R4-2408834 is treated.*

# Topic #1: Tx requirements for SL intra-band contiguous CA

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407612 | Huawei, HiSilicon | **Proposal 1: For PC2 intra-band contiguous SL CA, the following two aspects should be specified in Rel-19.*** Minimum requirements for Power Class 2 should be applicable for SL intra-band contiguous CA combination configuration, and update the maximum output power for sidelink CA
* MPR/A-MPR requirements for intra-band contiguous SL CA with PC2, including, PSSCH/PSCCH, PSFCH and S-SSB.

***Proposal 2: For the MPR evaluation of intra-band contiguous CA with PC2, 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 | 26dBm |
| Numerology | 15 kHz/30kHz/60kHz |
| Modulation per CC | QPSK/16QAM/64QAM/256QAM |
| Waveform | CP-OFDM |
| Carrier leakage | 25dBc |
| IQ image | 25dBc |
| 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 3: Intra-band contiguous SL CA with PC2 should be specified in Rel-19 referring to the methodology of that with PC3 in Rel-18.*** **For PSSCH/PSCCH: specify MPR for power class 2 contiguous CA with contiguous RB allocation, including inner and outer.**
* **For PSFCH: specify MPR for PC2 contiguous CA based on different range of R, R is the ratio of the gap bandwidth between the two PSFCH transmitted on the two intra-band carrier by the total bandwidth of the two carrier**
* **For S-SSB: specify MPR for PC2 contiguous CA by single S-SSB and two S-SSB, separately.**
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| R4-2407819 | Xiaomi | **Proposal 1：The MPR for PC2 intra-band contiguous SL CA should be specified for PSSCH/PSCCH, PSFCH and S-SSB.****Proposal 2: The MPR/A-MPR for PC2 intra-band 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: Introduce ΔPPowerClass, SL\_CA to modify PCMAX** **of PC3 SL intra-band contiguous CA to be feasible for PC2 SL intra-band contiguous CA.****Proposal 4: Other Tx requirements except MOR, MPR/A-MPR and configured transmitted power can reuse the requirements specified for PC3 intra-band contiguous SL CA.** |
| R4-2407984 | LG Electronics | **Proposal 1: Consider 3 architectures, 1x26dBm+1LO, 2x23dBm+2LO, and 2x23dBm+1LO for PC2 SL intra-band contiguous CA MPR evaluation.****Proposal 2: Indicate ‘dualPA-architecture’ like NR intra-band contiguous CA.** |
| R4-2408129 | vivo | **Observation 1: The reverse IMD introduced by two Tx is difficult to simulated if Option3 (2PA + 1LO) is adopted for SL contiguous CA. Observation 2: Measurements may be needed for deriving the MPR based on Option 3 (2PA + 1LO) for SL contiguous CA.****Proposal 1: To reuse the assumption of Carrier leakage 34dBc and IQ image 25dBc for PC2 SL intra-band contiguous CA.****Observation 3: there will be no SAR related issues for PC2 SL intra-band CA.****Proposal 2: For other Tx requirements than maximum output power and MPR requirements, they can be reused from PC3 SL intra-band contiguous CA.*** **Pcmax for SL CA can still be used**
* **Minimum output / transmit OFF power /ON/OFF time mask**
* **Power control**
* **Transmit signal quality**
* **SEM/ACLR**
* **Spurious emissions**
* **Transmit intermodulation**
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| R4-2408831 | OPPO | **Observation 1: There are two table for PC2 sidelink with 1TX and 2TX.****Observation 2: 2TX in PC2 sidelink MPR is defined as two PAs.****Observation 3: For NR intra-band contiguous CA, the *dualPA-Architecture* IE is used to differentiate the MPR requirements.****Observation 4: The *dualPA-Architecture* IE assumes dual PA and dual LO.****Proposal 1: To consider both 1 PA and 2 PA architecture for intra-band sidelink CA MPR simulation.****Observation 5: For A-MPR simulation, the MPR influence for 2 TX with 1 LO or 2 LO can be further analysed.****Proposal 2: To introduce ΔPPowerClass,CA in sidelink intra-band contiguous PC2 CA.****Proposal 3: For intra-band contiguous PC2 CA, it is proposed to reuse 31dB ACLR.****Proposal 4: No UE RX requirement for PC2 intra-band contiguous CA to be added based on Rel-18.** |
| R4-2408048 | Facebook Japan G.K. | **Proposal 1: The above MPR simulation assumptions in Table in issue 3-2-2 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 contiguous CA for 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 contiguous CA UE after final FCC announcement for the additional emission limits in US.** **Proposal 3: The below UE Tx/Rx requirements for NR SL intra-band contiguous CA shall be considered to specify the UE RF requirements in TS38.101-1.**

|  |  |
| --- | --- |
| **Tx requirements for SL intra-band contiguous PC2 CA UE in ITS band** | **Comments for Requirements** |
| 6.2E.1A MOP | Define SL intra-band contiguous CA PC2 MOP as total transmitted power (Per UE) for PC2 SL CA UE |
| 6.2E.2A MPR | Need to MPR simulation campaign based on the agreed MPR simulation Table [1] |
| 6.2E.3A A-MPR | Need to A-MPR simulation campaign for Europe based on section 2.1 assumptions. FFS in the US until the FCC finally release the additional emission limits. |
| 6.2E.4A Configured Tx power  | Update the configured Tx power for SL CA PC2 UE based on the configured Tx power of intra-band contiguous SL CA PC3 UE.  |
| 6.3E.1A minimum output power | For intra-band contiguous SLCA PC2 UE, apply the same min power requirements per CC in Table 6.3E.1.1A-1 for intra-band contiguous SL CA PC3 UE. |
| 6.3E.2A Transmit OFF power | For intra-band contiguous SLCA PC2 UE, apply the same transmit off power requirements (-50dBm /measurement BW) in Table 6.3E.2.1A-1 will be applied to per CC |
| 6.3E.3A Transmit On/OFF time mask  | For intra-band contiguous SLCA PC2 UE, apply the same transit on/off time mask per CC in section 6.3E.3.1A of intra-band contiguous SL CA PC3 UE.  |
| 6.3E.4A. Power control | For intra-band contiguous SLCA PC2 UE, absolute power tolerance of NR SL for single carrier will be applied to per CC.  |
| 6.4E.1A Frequency error | ±0.1 PPM observed over a period of 1 ms will be applied for the primary CC for all SL synchronous reference sources. |
| 6.4E.2A Transmit modulation quality | For intra-band contiguous SL CA PC2 UE, apply the same transit modulation quality in section 6.4E.2.2A, 6.4E.2.3A and 6.4E.2.4A of intra-band contiguous SL CA PC3 UE. EVM requirements in section 6.4E.2.2A will be applied per CC.The carrier leakage requirement (6.4E.2.3A) is defined for each CC. Only one uplink carrier is activated in a time, the applicable LO leakage (6.4.2.2) in NR UE will be applied per the activated carrier.The In-band emission (6.4E.2.4A) of NR intra-band contiguous CA will be applied to the SL aggregated transmission bandwidth. |
| 6.5E.1A Occupied bandwidth | The occupied bandwidth requirement (6.5E.1.1A) is a measure of the bandwidth containing 99 % of the total integrated power of the transmitted spectrum. |
| 6.5E.2A.2 out-of-band emission: General SEM | Composite spectrum emission mask applies to frequencies up to ΔfOOB starting from the edges of the aggregated CBW. For PC2 intra-band contiguous SL CA UE, the spectrum emission mask in Table 6.5A.2.2.1-1 is measured as the sum from both UE transmit antenna connectors when UE indicates support for *dualPA-Architecture* IE. |
| 6.5E.2A.3 out-of-band emission: A-SEM | Need to consider the A-SEM with NS\_33 in Europe since the A-SEM in Table 6.5E.2.3.1-1 is applied for the 10MHz CBW in Europe.For the US, RAN4 can reuse NS\_52, the details of emission limits can be further discussed with the final A-SEM or A-SE requirements from FCC. |
| 6.5E.2A.4 ACLR  | The general PC2 NR intra-band contiguous CA ACLR requirements in Table 6.5A.2.4.1.1-2 shall be applied to the aggregated CBW with SL CA bandwidth class B. |
| 6.5E.3A.1 General SE | For intra-band contiguous SL CA, the spurious emissions are measured in the aggregated CBW with SL CA bandwidth class B as the sum from both UE transmit antenna connectors when UE indicates support for *dualPA-Architecture* IE.Composite spurious emission is applied to frequencies up to ΔfOOB starting from the edges of the aggregated CBW. |
| 6.5E.3A.2 UE coexistence | The protection operating band lists for n47 transmission was defined in Table 6.5.3.2-1 which will be reconsidered the UE coexistence requirements for intra-band contiguous PC2 SL CA UE. |
| 6.5E.3A.3 A-SE | The A-SE with NS\_33 in Table 6.5E.3.4.2-1 and CEN DSRC protection requirements in Table 6.5E.3.4.2-2 will be reconsidered for NR CA UE in Europe. |

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## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1 : Tx UE RF requirements for PC2 SL intra-band contiguous CA

*Sub-topic description*

*Open issues and candidate options before meeting:*

#### **Issue 1-1: MOP**

* Proposals
	+ Option 1: For PC2 intra-band contiguous SL CA, the following two aspects should be specified in Rel-19 (Huawei)
	+ Minimum requirements for Power Class 2 should be applicable for SL intra-band contiguous CA combination configuration, and update the maximum output power for sidelink CA
	+ Option 2: Define SL intra-band contiguous CA PC2 MOP as total transmitted power (Per UE) for PC2 SL CA UE (Meta)
* Recommended WF
	+ Both Option 1 and Option 2 are agreeable.

Agreement:

* For PC2 intra-band contiguous SL CA, the following two aspects should be specified in Rel-19
	+ Minimum requirements for Power Class 2 should be applicable for SL intra-band contiguous CA combination configuration, and update the maximum output power for sidelink CA
* Define SL intra-band contiguous CA PC2 MOP as total transmitted power (Per UE) for PC2 SL CA UE

#### **Issue 1-2: MPR**

* Proposals
	+ Option 1: MPR/A-MPR requirements for intra-band contiguous SL CA with PC2 should be specified in Rel-19 referring to the methodology of that with PC3 in Rel-18 including, PSSCH/PSCCH, PSFCH and S-SSB (Huawei)
	+ For PSSCH/PSCCH: specify MPR for power class 2 contiguous CA with contiguous RB allocation, including inner and outer.
	+ For PSFCH: specify MPR for PC2 contiguous CA based on different range of R, R is the ratio of the gap bandwidth between the two PSFCH transmitted on the two intra-band carrier by the total bandwidth of the two carrier
	+ For S-SSB: specify MPR for PC2 contiguous CA by single S-SSB and two S-SSB, separately.
	+ Option 1a: The MPR for PC2 intra-band contiguous SL CA should be specified for PSSCH/PSCCH, PSFCH and S-SSB (Xiaomi)
* Recommended WF
	+ Option 1 is agreeable.
	+ Option1a can be covered by Option 1

OPPO: the NC RB allocation is precluded from Rel-19 WI?

LGE: Rel-18 considers the NC and contiguous RB allocation. Rel-19 also considers both.

Agreement:

* MPR/A-MPR requirements for intra-band contiguous SL CA with PC2 should be specified in Rel-19 referring to the methodology of that with PC3 in Rel-18 including, PSSCH/PSCCH, PSFCH and S-SSB
	+ For PSSCH/PSCCH: specify MPR for power class 2 contiguous CA with contiguous/non-contiguous RB allocation, including inner and outer.
	+ For PSFCH: specify MPR for PC2 contiguous CA based on different range of R, R is the ratio of the gap bandwidth between the two PSFCH transmitted on the two intra-band carrier by the total bandwidth of the two carrier
	+ For S-SSB: specify MPR for PC2 contiguous CA by single S-SSB and two S-SSB, separately.

#### **Issue 1-3: Simulation Assumption for MPR**

* Agreement in WF(R4-2406611)
	+ Agree on below table for simulation assumption
	+ The carrier leakage can be further discussed

|  |  |
| --- | --- |
| 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 | 26dBm |
| Numerology | 15 kHz/30kHz/60kHz |
| Modulation per CC | QPSK/16QAM/64QAM/256QAM |
| Waveform | CP-OFDM |
| ACLR | 31dBc |
| Carrier leakage | 25dBc |
| IQ image | 34dBc |
| 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. |

* Proposals
	+ Option 1: Carrier leakage = 25dBc, IQ image = 34dBc (WF(R4-2406611))
	+ Option 2: Carrier leakage = 25dBc, IQ image = 25dBc (Huawei)
	+ Option 3: Carrier leakage = 34dBc, IQ image = 25dBc (vivo)
* Recommended WF
	+ Keep IQ image of 34dBc based on the WF(R4-2406611)
	+ Consider carrier leakage of 25dBc

#### **Issue 1-4: UE RF architecture for MPR evaluation**

* Proposals
	+ Option 1: Consider 1PA+1LO and 2PA+2LO (Xiaomi)
	+ Option 2: Consider 1x26dBm+1LO, 2x23dBm+2LO, and 2x23dBm+1LO (LGE)
	+ Option 3: Consider 1PA and 2PA (OPPO).
* Recommended WF
	+ Moderator’s view : The PC2 UE RF architecture of NR intra-band contiguous CA for MPR can be found as below for information (1 PA, dual Tx(Tx diversity), and dualPA)
	+ 1 PA : 1x26dBm + 1LO
	+ Dual Tx : 2x23dBm + 1LO
	+ dualPA : 2x23dBm + 2LO, or 2x26dBm + 2LO
	+ Further discuss the architectures

OPPO: we can use the same agreements as contiguous case.

Meta: we can remove 2x26dBm + 2LO.

Huawei: Shall we prioritize 1LO case?

Agreement:

* The PC2 UE RF architecture of NR intra-band contiguous CA for MPR can be found as below for information (1 PA, dual Tx(Tx diversity), and dualPA)
	+ High priority for MPR evaluations
		- 1 PA : 1x26dBm + 1LO
		- Dual Tx : 2x23dBm + 1LO
	+ Second priority for MPR evaluations
		- dualPA : 2x23dBm + 2LO

#### **Issue 1-5: whether to indicate ‘dualPA-architecture’**

* Proposals
	+ Option 1: Indicate ‘dualPA-architecture’ like NR intra-band contiguous CA (LGE)
* Recommended WF
	+ Further discuss

#### **Issue 1-6: ACLR**

* Proposals
	+ Option 1: Reuse 31dB ACLR for intra-band contiguous PC2 CA (OPPO)
* Recommended WF
	+ Option 1 is agreeable

Agreement:

* Reuse 31dB ACLR for intra-band contiguous PC2 CA

#### **Issue 1-7: Whether to introduce ΔPPowerClass,SL CA**

* Proposals
	+ Option 1: Introduce ΔPPowerClass,SL CA for PC2 SL intra-band contiguous CA (OPPO, Xiaomi)
	+ Option 2 : Not introduce due to no SAR related issues (vivo)
* Recommended WF
	+ Further discuss 2 options and conclude in this meeting.

Meta: similar as LGE, the SAR issue should not be considered.

Xiaomi: same view. Delta\_P-power class is not needed.

OPPO: SAR has been discussed. We had no conclusion. Adding Delta\_P\_Powerclass has no harm.

Huawei: Share the similar view as Meta and Xiaomi. Option 2.

Vivo: To OPPO, Delta\_P-PowerClass is needed only if SAR is considered. Do not need consider SAR issue.

Agreement:

* Not to introduce ΔPPowerClass,SL CA due to no SAR related issues for sidelink CA on the ITS band

#### **Issue 1-8-1: A-MPR for EU regulation**

* Proposals
	+ Option 1: Consider A-MPR requirements using MPR simulation assumption and the regulation requirement of NS\_33 (Table 6.5E.2.3.1-1, Table 6.5E.3.4.2-1 and Table 6.5E.3.4.2-2 ) (Meta)
* Recommended WF
	+ Further discuss.

Moderator: we do not specify A-MPR requirement previously.

Meta: This is for intra-band contiguous CA. We agree with LGE.

Agreement:

* No A-MPR requirement based on EU regulation is needed for sidelink intra-band contiguous CA.

#### **Issue 1-8-2: A-MPR for US regulation**

* Proposals
	+ Option 1: Study and specify the related A-MPR requirements with NS\_52 after final FCC announcement for the additional emission limits in US (Meta)
* Recommended WF
	+ Option 1 is agreeable.

Agreement:

* Study and specify the related A-MPR requirements with NS\_52 after final FCC announcement for the additional emission limits in US

#### **Issue 1-9: Other Tx requirements than MOP, MPR and A-MPR**

* Proposals
	+ Option 1: Reuse the requirements of PC3 SL intra-band contiguous CA (vivo)
	+ Minimum output / transmit OFF power /transmit ON/OFF time mask
	+ Power control
	+ Transmit signal quality
	+ SEM/ACLR
	+ Spurious emissions
	+ Transmit intermodulation
* Recommended WF
	+ Further discuss

# Topic #2: Rx requirements for SL intra-band contiguous CA

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407820 | Xiaomi | **Proposal 1: The Rx requirements including REFSENS, ACS, maximum input power and blockings for intra-band contiguous SL CA with PC3 in current Spec shall apply to the intra-band contiguous SL CA with PC2 directly.** |
| R4-2408831 | OPPO | **Proposal 4: No UE RX requirement for PC2 intra-band contiguous CA to be added based on Rel-18.** |
| R4-2408048 | Facebook Japan G.K. | **Proposal 3: The below UE Tx/Rx requirements for NR SL intra-band contiguous CA shall be considered to specify the UE RF requirements in TS38.101-1.**

|  |  |
| --- | --- |
| **Rx requirements for SL intra-band contiguous PC2 CA UE in ITS band** | **Comments for Requirements** |
| 7.2E.2A REFSENS | For intra-band contiguous PC2 SL CA UE in n47, the reference sensitivity requirement specified in Table 7.3E.2-1 shall apply for each CC with all carriers active. The requirement is applied for each CC reception when 2 Carrier transmissions are activated at the same time. |
| 7.4E.1A Maximum input level | For intra-band contiguous PC2 SL CA UE, the same maximum input level requirements (Section 7.4E.1A) will be applied to aggregated CBW. The throughput (>= 95% T-put) shall meet or exceed the minimum requirements for the specified reference measurement channel in Annex 7.3 and 7.4. |
| 7.5E.1A ACS | For intra-band contiguous PC2 SL CA UE, the UE shall fulfil the minimum requirement specified in Table 7.5E.1A-1 to Table 7.5E.1A-3 either side of the aggregated downlink signal at a specified frequency offset where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.7.2 while all DL carriers are active. |
| 7.6E.2A In-band blocking  | For intra-band contiguous PC2 SL CA UE, the UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.7.2 with the test parameters defined in clause 7.6E.2.1A to Table 7.6E.2.1A-2 while all downlink carriers are active. |
| 7.6E.3A Out-of-band blocking | For intra-band contiguous PC2 SL CA UE, the UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.7.2 with test parameters defined in clause 7.6E.3.1A while all downlink carriers are active. |
| 7.7E.1A Spurious response | For intra-band contiguous PC2 SL CA UE, the UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.7.2 with test parameters defined in clause 7.7E.1A while all downlink carriers are active. |
| 7.8E.1A Wideband intermodulation  | For intra-band contiguous CA, the UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.7.2 with test parameters defined in clause 7.8E.2.2A while all downlink carriers are active. |

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## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1 : Rx UE RF requirements for PC2 SL intra-band contiguous CA

*Sub-topic description*

*Open issues and candidate options before meeting:*

#### **Issue 2-1: Rx UE RF requirements**

* Proposals
	+ Option 1: The Rx requirements including REFSENS, ACS, maximum input power and blockings for intra-band contiguous SL CA with PC3 in current Spec shall apply to the intra-band contiguous SL CA with PC2 directly (Xiaomi, [Meta])
	+ Option 1a: No UE RX requirement for PC2 intra-band contiguous CA to be added based on Rel-18 (OPPO)
* Recommended WF
	+ Option 1 can be agreed. (Option 1 is same as Option 1a)

Agreement:

* The Rx requirements including REFSENS, ACS, maximum input power and blockings for intra-band contiguous SL CA with PC3 in current Spec shall apply to the intra-band contiguous SL CA with PC2 directly

# Topic #3: System Parameter

## Companies’ contributions summary

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| --- | --- | --- |
| **TDoc** | **Company** | **Summary** |
| R4-2408834 | OPPO | **Proposal 2: For PC2 intra-band contiguous CA, reuse the same channel bandwidth of PC3 intra-band contiguous CA.** |

## Open issues summary

### Sub-topic 3-1 General

#### **Issue 3-1: Channel bandwidth**

* Proposals
	+ Proposal: For PC2 intra-band contiguous CA, reuse the same channel bandwidth of PC3 intra-band contiguous CA.
* Moderator Recommendation:
	+ Agree on the proposal

Agreement:

* For PC2 intra-band contiguous CA, reuse the same channel bandwidth of PC3 intra-band contiguous CA.