3GPP TSG-RAN WG2 Meeting #110-e [R2-2005744](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005744.zip)

Elbonia, 20 – 30 April 2020

**Agenda item: 4.5.1**

**Source: Nokia**

**Title: Summary and discussion on [AT110e-][202][LTE15] LTE non-contiguous CA capabilities (Nokia)**

**Document for: Discussion and Decision**

# 1 Introduction

This document is to collect companies views on LTE non-contiguous CA capabilities, and the need to clarify their interpretation in TS36.331, based on the two set of CRs:

Scope:

* + - Determine what can be agreed based on the Nokia CRs in [R2-2005186](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005186.zip), [R2-2005187](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005187.zip), [R2-2005188](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005188.zip), [R2-2005189](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005189.zip) and [R2-2005190](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005190.zip) and Huawei CRs in [R2-2005481](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005481.zip), [R2-2005482](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005482.zip), [R2-2005483](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005483.zip), [R2-2005484](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005484.zip), [R2-2005485](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005485.zip), [R2-2005486](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005486.zip) and [R2-2005487](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005487.zip)
    - Determine from which release onwards a correction should be provided

# 2 Discussion

## 2.1 LTE non-contiguous CA capabilities interpretation

The documents in 1) and 2) concern pre-Rel-15 UE CA capabilities as shown below:

|  |  |
| --- | --- |
| **Tdoc(s), Title, Company** | **Proposal(s)** |
| 1) [R2-2005186](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005186.zip), [R2-2005187](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005187.zip), [R2-2005188](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005188.zip), [R2-2005189](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005189.zip), [R2-2005190](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005190.zip), “Clarification to UE capabilities for non-contiguous intra-band CA“ Nokia, Nokia Shanghai Bell, Qualcomm | **Discussed already in RAN2#109-e**  CRs from Rel-12 to clarify intra-band non-contiguous is handled as intra-band contiguous are agnostic to the order in which they are indicated in the band entries, for the CA of the same bandwidth class. |
| 2) [R2-2005481](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005481.zip), [R2-2005482](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005482.zip), [R2-2005483](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005483.zip), [R2-2005484](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005484.zip), [R2-2005485](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005485.zip), [R2-2005486](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005486.zip), [R2-2005487](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005487.zip) “Clarification on UE capability for intra-band non-continuous CA”, Huawei, Hisilicon | **Discussed already in RAN2#109bis-e**  CRs from Rel-12 to clarify intra-band non-contiguous UE capabilities for carriers sharing the same uplink capability within intra-band non-contiguous CA are agnostic to the order in which they are indicated in the band entries. |

The set of CRs 1) was already discussed in RAN2#109-e, with the following conclusions (from RAN2#109-e email discussion [203]):

**RAN2 note the following observations on differences of UE capabilities for intra-band contiguous and non-contiguous CA:**

**- Intra-band contiguous CA capabilities are all contained within a single band entry of a band combination, while intra-band non-contiguous CA capabilities require at least two band entries.**

**- For intra-band contiguous carriers, UE band combination capabilities specify that UE supports any ordering of the capabilities.**

**- (Based on TS36.101): The ordering of intra-band non-contiguous entries is relevant for the support of BCS.**

**- (Based on TS36.101): The ordering of BCS is not directly related to the MIMO capabilities.**

**FFS: if UE supports (2, 4) MIMO layers with CA\_xA\_xA, it will also support (4, 2) MIMO layers with CA\_xA\_xA.**

**The CRs in** [**R2-2001135**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001135.zip)**,** [**R2-2001136**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001136.zip)**,** [**R2-2001137**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001137.zip)**,** [**R2-2001138**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001138.zip) **are postponed.**

**The CRs in** [**R2-2001140**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001140.zip)**,** [**R2-2001141**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001141.zip)**,** [**R2-2001142**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001142.zip) **are postponed to next meeting.**

The two set of CRs 1) and 2) were jointly discussed in RAN2#109bis-e, with the following conclusions (from RAN2#109bis-e email discussion [202]):

**Outcome of offline discussion [202]**

* There are (still) several interpretations by different companies on the issue raised by Nokia in [R2-2003147](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003147.zip), [R2-2003148](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003148.zip), [R2-2003149](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003149.zip), [R2-2003150](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003150.zip), [R2-2003151](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003151.zip), and Huawei in [R2-2003549](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003549.zip), [R2-2003550](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003550.zip), [R2-2003551](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003551.zip), [R2-2003552](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003552.zip), [R2-2003553](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003553.zip), [R2-2003554](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003554.zip) all of which seem slightly different but which should be taken into account. The topic is postponed to next meeting – companies are requested to provide contributions that take all of the above aspects into account.

Based on the last meeting’s conclusion, the interpretation issue still exists but the set of documents in 1) clarified further, following a few companies converged views, that order in which UE capabilities are indicated in the band entries can be agnostic, for the CA of the same bandwidth class.

For this meeting, the remaining open point is whether and how the uplink capability should be taken into account by the UE when setting capabilities for non-contiguous intra-band CA (which is raised in documents set 2)).

Companies are requested to provide comments in the tables 1 and 2 below to get a common RAN2 understanding on the UE capabilities interpretation and a need to clarify them:

**Q1: Is it necessary for the UE take into account uplink capability when signalling capabilities for non-contiguous intra-band CA?**

|  |  |
| --- | --- |
| **Company** | **Is it necessary for the UE take into account uplink capability when signalling capabilities for non-contiguous intra-band CA?** |
| OPPO | No.  We have not understood the reason to consider uplink capability here. |
| Qualcomm | We have not understood the reason to limit the NOTE to “sharing the same UL capability”.  We think the “agnostic to the order in which they are indicated in the band entries” applies when both DL+UL capabilities are (considered to have been) swapped together. I.e., if the UE signals support for {DL1/UL1, DL2}, that would mean UE supports {DL2, DL1/UL1}, but not necessarily {DL2/UL1, DL1}. For example, if UE supports 4 layers 256QAM in one CC, 2 layers 1024QAM in the other, that doesn’t by itself mean that UE supports 4 layers 1KQAM, 2 layers 256QAM.  So, if needed, the NOTE in Nokia’s CRs may be further refined to make it clearer. |
| Nokia | We also have not understood the reason well. If this is clarified, we are open to make the NOTE even more precise. |
| HW | **In the example proposed by Qualcomm, {DL1/UL1, DL2}, if the reported MIMO layer capability is (4,2), then the NW must interpret DL1 supports 4 layers while DL2 supports 2 layers which means only the carrier supports 4 layers can be utilized as PCC while the carrier supports 2 layers can only be utilized as SCC in order to avoid exceed what the UE actually support which may lead to a drop of the link in the worst case. That’s why we think the UE capability for intra-band non-continuous CA can be “partial” agnostic to the order. For carriers sharing different capability, the UE capability cannot be agnostic to the order. My original interpretation on this note is to allow DL2 to support 4 layers and DL1 to support 2 layers. But based on the feedback from other companies, this note seems to allow the support of {DL2, DL1/UL1}, if so, what is the motivation, as there is no difference DL2 is on the left side or right side and from the NW’s perspective, it can only be utilized as SCC. If there is any misunderstanding, please correct me.** |

**Table 1. Dependency on uplink capability**

**Conclusion 1:** 3 companies agreed the order in which UE capabilities are indicated for the band entries can be agnostic, for the CA of the same bandwidth class, but without considering dependencies on paired band entries in UL. 1 company raised concerns on the dependency. There is still no clarity on the necessity to reflect dependency on UL band entries supported by the UE, when signalling capabilities for non-contiguous intra-band CA.

**Proposal 1:** RAN2 discuss if intra-band non-contiguous UE capabilities for downlink carriers can be interpreted as order agnostic only for carriers which are paired with the same uplink carrier(s).

**Q2: In case it is necessary to reflect the dependency on uplink capabilities, how the clarification should be formulated? (E.g. as in CRs in 2, any other alternative)**

|  |  |
| --- | --- |
| **Company** | **In case it is necessary to reflect the dependency on uplink capabilities, how the clarification should be formulated? (E.g. as in CRs in 2, any other alternative)** |
|  |  |
|  |  |
|  |  |
|  |  |

**Table 2. Wording for dependency on uplink capability**

**Conclusion:** N/A

**Proposal: N/A**

## 2.2 Which release clarification for LTE non-contiguous CA capabilities?

Based on the last meeting’s conclusion, the issue exists but how a correction should be worded and from which release onwards should a correction be made was not decided.

Companies are requested to provide comments in the table 3 below to decide which release onwards the correction is needed:

|  |  |
| --- | --- |
| **Company** | **From which release onwards should something be captured and why?** |
| Qualcomm | Rel-12 is ok |
| Nokia | The problem can occur from Rel-12 onwards, thus starting from Rel-12 is our preference. |
| HW | **We think changes should be started from Rel-10 in which intra-band non-continuous CA was started to be supported.** |

**Table 3. Starting release for the correction CRs**

**Conclusion 2:** 2 companies agree to Rel-12 to be starting release for the correction, 1 company proposes Rel-10 to be starting release for the correction.

**Proposal 2:** RAN2 to confirm if CRs can be agreed from Rel-12.

# 3 Conclusion

**Conclusion 1:** 3 companies agreed the order in which UE capabilities are indicated for the band entries can be agnostic, for the CA of the same bandwidth class, but without considering dependencies on paired band entries in UL. 1 company raised concerns on the dependency. There is still no clarity on the necessity to reflect dependency on UL band entries supported by the UE, when signalling capabilities for non-contiguous intra-band CA.

**Proposal 1:** RAN2 discuss if intra-band non-contiguous UE capabilities for downlink carriers can be interpreted as order agnostic only for carriers which are paired with the same uplink carrier(s).

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