3GPP TSG-RAN WG2 Meeting #109e [R2-200xxx](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-200xxxx.zip)x

Elbonia, Online, 24 February – 6 March 2020

**Agenda item: 4.5**

**Source: Nokia (offline email discussion rapporteur)**

**Title: Report of [AT109e][203][LTE15] LTE pre-Rel-15 CRs on CA (Nokia)**

**Document for: Report**

# 1 Scope of the offline email discussion

This document contains the summary of the offline email discussion “**[AT109e][203][LTE15] LTE pre-Rel-15 CRs on CA (Nokia)**”, as indicated below:

* [AT109e][203][LTE15] LTE pre-Rel-15 CRs on CA (Nokia)

Scope:

* + - Discuss the topics identified in [R2-2001134](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001134.zip)
    - Discuss which (if any) of the CRs [R2-2001135](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001135.zip), [R2-2001136](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001136.zip), [R2-2001137](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001137.zip), [R2-2001138](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001138.zip) are needed.
    - Discuss the CRs [R2-2001140](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001140.zip), [R2-2001141](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001141.zip), [R2-2001142](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001142.zip) to determine whether the proposed interpretation is correct and how should a correction (if needed) be captured

Intended outcome:

* + - Set of proposals with consensus (aim to agree to those over email), including the correct interpretation to both sets of CRs (by email rappporteur)

Deadline for providing comments and for rapporteur inputs:

* + - Companies input: Wednesday, Feb. 26th 17:00 CET
    - Rapporteur proposals: Thursday, Feb. 27th 17:00 CET (one day for rapporteur to make conclusions)
    - Updated CRs from each CR proponent: Friday Feb 28th 17:00 CET
    - Comments on the CR wording: Monday, March 2nd by 17:00 CET (i.e. one day to provide comments to the updated CR)

# 2 Interpretation of UE capabilities for non-contiguous intra-band CA

This section addresses topics identified in the input document to RAN2#109e in [R2-2001134](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001134.zip) [1] on UE capabilities for non-contiguous intra-band CA interpretation.

The following list of discussion points aim at clarifying the interpretation of associated UE capabilities.

## 2.1 Observations on differences of UE capabilities for intra-band contiguous and non-contiguous CA

While inter-band CA always consists of two or more disparate frequency blocks, Intra-band CA comes in two flavors: Intra-band contiguous CA (with at least two carriers aggregated together without frequency gaps) and intra-band non-contiguous CA (with at least two carriers aggregated together so that there is a frequency gap between the aggregated carriers). In [R2-2001134](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001134.zip) [1] we identified several issues that led to the following observations:

**Observation 1:** 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.

**Observation 2:** For intra-band contiguous carriers, UE band combination capabilities specify that UE supports any ordering of the capabilities.

**Observation 3:** UE band combination capabilities do not clearly specify whether capabilities applicable for different carriers in case of intra-band non-contiguous behave similarly as with intra-band contiguous CA.

**Observation 4** (Based on TS36.306): If the MIMO capabilities are not agnostic to the order in which they are indicated for intra-band non-contigous band combinations, network may under-utilize the UE capabilities or require additional reconfigurations to utilize them fully

**Observation 5** (Based on TS36.101): The ordering of intra-band non-contiguous entries is relevant for the support of BCS.

**Observation 6** (Based on TS36.101): The ordering of BCS is not directly related to the MIMO capabilities.

**Question 1:** Do companies agree with the Observation 1-6?

|  |  |  |
| --- | --- | --- |
| **Company** | **Do you agree with the Observation 1 to 6?** | **Detailed comments** |
| HW | **We agree with O1, O2, O5 and O6** | As for O3, the question seems not so clear, do you mean it is not clear specified that for intra-band non-contiguous CA, the UE shall support the setting indicated in each entry of the list regardless of the order of entries in the list?  As for O4, we think it is observed based on the assumption that from the NW’s perspective, the MIMO capability is not agnostic to the order but from the UE’s perspective, it is agnostic, then there is under-utilization concern. If the understanding is aligned between the NW and UE, no matter whether the capability is agnostic to the order or not, there is no issue. |
| Nokia, Nokia Shanghai Bell | **yes** | According to rationale in [R2-2001134](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001134.zip) |

Conclusion: Two companies agreed to the following:

**Observation:** 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.

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

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

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

Proposal: Capture in the Chairman’s minutes the following:

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.

## 2.2 Conclusion on interpretation of UE capabilities intra-band non-contiguous BCs

How should the UE indicate its capabilities if it supports order-agnostic MIMO with CA\_xA\_xA? Should it indicate:

1. Duplicate band combination entries, each with different MIMO layer ordering (i.e. one BC with (2,4) MIMO layers and one with (4,2) MIMO layers?  
   OR
2. Single band combination with e.g. (4,2) MIMO layers (assuming network comprehends this applies for either ordering)?

From network viewpoint, both capabilities are valid but either has its issues: For 1), it is clear that UE supports both orderings, but does it also mean that such a UE may NOT support all orderings in case it uses 2) for some intra-band non-contiguous BC? And similarly, for 2), is it clear that this UE only supports (4,2) and not (2,4), or does it always support both orderings if it never duplicates the BCs for any intra-band non-contiguous cases?

**Observation 7:** The example of UE capabilities for the intra-band non-contiguous BCs leads to two different interpretations.

**Question 2:** Do companies agree both interpretations are valid?

|  |  |  |
| --- | --- | --- |
| **Company** | **Do you agree with the Observation 7?** | **Detailed comments** |
| HW | **No** | It seems that the 1) is not order-agnostic as UE needs to indicate duplicated entries to indicate the support of both (2, 4) and (4, 2). For 2) we think this is to support order-agnostic UE capability as UE only indicates (4, 2) while the NW assumes either ordering is supported. So to me, it is confused that both are interpretations of how UE indicate its capabilities if it supports order-agnostic MIMO |
| Nokia, Nokia Shanghai Bell | **Yes** |  |

Conclusion: No conclusion could be reached on what the UE should indicate if it supports order-agnostic MIMO with CA\_xA\_xA.

Proposal: N.A.

## 2.3 Need for clarification on UE capabilities intra-band non-contiguous BCs

We have observed both types of UEs can be seen in the field. At least in some cases, both types of UEs still do support both orderings, but since this is not clear in specifications it should be clarified whether this applies also to all UEs. Therefore, we would like to clarify what the common understanding in RAN2 is with regard to this to minimize any IODT issues.

RAN2 need to establish common understanding on MIMO layer and CSI processing capabilities with intra-band non-contiguous CA: E.g. If UE supports (2, 4) MIMO layers with CA\_xA\_xA, will it also support (4, 2) MIMO layers with CA\_xA\_xA?

**Question 3:** Do companies agree RAN2 specification(s) need to reflect common understanding on MIMO layer and CSI processing capabilities with intra-band non-contiguous CA

|  |  |  |
| --- | --- | --- |
| **Company** | **Do you agree with the Question 3?** | **Detailed comments** |
| Qualcomm | **-** | Not sure what O8 refers to here, but it goes without saying that RAN2 specification(s) need to reflect common understanding on MIMO layer and CSI processing capabilities with intra-band non-contiguous CA. |
| HW | **-** | O8 seems to be missing here, but currently we can not easily agree that if UE supports (2, 4) MIMO layers with CA\_xA\_xA, it will also support (4, 2) MIMO layers with CA\_xA\_xA as we need more time to check if there is any backward compatible issue. |
| Nokia, Nokia Shanghai Bell | **Yes** |  |

Conclusion: Companies agree that RAN2 specification(s) need to reflect common understanding on MIMO layer and CSI processing capabilities with intra-band non-contiguous CA, but it remains to be clarified if once UE supports (2, 4) MIMO layers with CA\_xA\_xA, it will also support (4, 2) MIMO layers with CA\_xA\_xA

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

## 2.4 [R2-2001135](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001135.zip), “Clarification to UE capabilities for non-contiguous intra-band CA “

The CR in [R2-2001135](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001135.zip) [2] on UE capabilities for non-contiguous intra-band CA interpretation is addressing the issue and intends to clarify whether UE indicating support for a BC involving intra-band non-contiguous CA with certain capabilities (e.g. CA\_xA\_xA with MIMO layers set as 4 layers + 2 layers) also supports any ordering of the capabilities between the non-contiguous entries (e.g. also 2 layers + 4 layers in the example case).

**Question 4:** Do companies agree with the intent of the CR [R2-2001135](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001135.zip)?

|  |  |  |
| --- | --- | --- |
| **Company** | **Do you agree with the intent of the CR?** | **Detailed comments** |
| Qualcomm | **TBD** | While we are still checking internally, let me provide my initial comments (conditional upon if we determine that the intent is ok and we need the CR):  Wondering if Impacted functionality: Intra-band non-contiguous CA should be Impacted functionality: Intra-band non-contiguous CA capability reporting.  In the actual change, it seems it is not clarified that the swap-ability of the indicated capability is only possible if the bandwidth class is also the same. Current CR text only says same band (intra-band) but the example (correctly) shows same bandwidth class. Additionally, the first sentence can end with ‘.’ instead of ‘:’ (before “For example”). |
| HW | **No** | See our comments above. |
| Nokia, Nokia Shanghai Bell | **Yes** | RAN2 specification(s) need to reflect common understanding on MIMO layer and CSI processing capabilities with intra-band non-contiguous CA. |

Conclusion: More time has been asked to allow detailed checking of the topics identified in [R2-2001134](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001134.zip) and the CRs in [R2-2001135](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001135.zip), [R2-2001136](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001136.zip), [R2-2001137](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001137.zip), [R2-2001138](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001138.zip). Proposal: RAN2 postpones the CRs in [R2-2001135](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001135.zip), [R2-2001136](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001136.zip), [R2-2001137](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001137.zip), [R2-2001138](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001138.zip).

## 2.5 Which release to start with to incorporate the clarification?

The CR in [R2-2001135](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001135.zip) [2] introduce the clarification for Rel-12 version of the TS36.331. The clarification ensures all UE and network implementations comprehend it in the same way. Mirror corrections towards Rel-13, Rel-14 and Rel-15 are proposed in [3],[4],[5].

**Question 5:** Do companies agree the clarification should be introduced from Rel-12?

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| --- | --- | --- |
| **Company** | **Do you agree with the first release of the clarification to be Rel-12?** | **Detailed comments** |
| HW | **Not sure** | Actually according to our reply above, firstly we need to double check whether any changes are needed at all. Secondly we also have concern why the clarification is introduced from Rel-12 since we already have intra-band non-continuous CA from Rel-10. |
| Nokia, Nokia Shanghai Bell | **Yes** | If the clarification start from Rel-12 version of the TS36.331 , we ensure clarification implies to all UE and network implementations comprehend it in the same way |

Conclusion: FFS: common understanding on MIMO layer and CSI processing capabilities with intra-band non-contiguous CA.

Proposal: N.A.

# 3 Mandatory aspect of the HARQ ACK codebook capabilities

This section addresses an issue identified in the input document to RAN2#109e in [R2-2001140](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001140.zip) [6]. The CR intends to clarify UE’s *codebook-HARQ-ACK-r13* capability meaning.

The field is used to indicate a method which UE supports to determine HARQ-ACK codebook size. According to TS36.331, the UE signals the capability: codebook-HARQ-ACK-r13 as follows:

PhyLayerParameters-v1310 ::= SEQUENCE {

codebook-HARQ-ACK-r13 BIT STRING (SIZE (2)) OPTIONAL,

where:

* first bit of the capability set to "1" implies the UE supports the DAI-based codebook size determination
* second bit is set to "1" if the UE supports the codebook determination based on the number of configured CCs.

The requirement added on codebook-HARQ-ACK-r13 in Rel-13 (in the capability description in TS36.306), that was supposed to support Rel-13 CA aggregation enhancements was as follows:

“For both solutions, it is mandatory for UEs of this release of the specification if carrier aggregation with more than 5 DL component carriers is supported. “

This statement intended to follow the recommendation agreed by RAN1 on Rel-13 CA aggregation enhancements support:

|  |
| --- |
| RAN1#82bis agreed (see: [report](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_82b/Report/)):   * eNodeB can configure by RRC signaling an eCA UE to determine HARQ-ACK codebook size according to either (a) or (b) as follows:   a) DAI based solution (…)  b) Number of configured CCs based solution (…)   * Both solution (a) and solution (b) are mandatory feature as UE capability from RAN1 recommendation point of views for UEs supporting more than 5 CCs |

**Observation 8:** Both solution (a)DAI based) and solution (b)CC based) are mandatory feature as UE capability from RAN1 point of views for UEs supporting more than 5 CCs

**Question 6:** Do companies agree with the Observation 8?

|  |  |  |
| --- | --- | --- |
| **Company** | **Do companies agree with the Observation 8?** | **Detailed comments** |
| Qualcomm | **-** | Both solutions are conditionally mandatory (when supporting more than 5 DL CC) with capability indication (IOT bits) for each solution separately. |
| HW | **Yes** | According to RAN1 agreement, both solutions are mandatory if UE supports more than 5 CCs. |
| Nokia, Nokia Shanghai Bell | **Yes** |  |

Conclusion: Companies agreed that for *codebook-HARQ-ACK-r13* capability, both solutions:

(a)DAI based, and

(b)CC based,

are mandatory features (when supporting more than 5 DL CC).

Proposal: For *codebook-HARQ-ACK-r13* capability, RAN2 confirms both solution (a)DAI based) and solution (b)CC based are conditionally mandatory features (i.e.when supporting more than 5 DL CC) with capability indication (IOT bits) for each solution separately.

## 3.2 [R2-2001140](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001140.zip), “Clarification on codebook-HARQ-ACK-r13 capability for CA with more than 5CCs

The CR in [R2-2001140](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001140.zip) [6] on UE capabilities for non-contiguous intra-band CA interpretation is addressing the issue that added statement to the concerned UE capability (i.e. “For both solutions, it is mandatory for UEs of this release of the specification if carrier aggregation with more than 5 DL component carriers is supported. “ ) does not explicitly reflect the RAN1 agreement.

The CR intent is to clarify the requirement added on codebook-HARQ-ACK-r13 in the TS36.306 should reflect the RAN1 agreement:

* Both solution (a) and solution (b) are mandatory feature as UE capability from RAN1 recommendation point of views for UEs supporting more than 5 CCs

**Question 7:** Do companies agree with the intent of the CR [R2-2001140](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001140.zip)?

|  |  |  |
| --- | --- | --- |
| **Company** | **Do you agree with the intent of the CR?** | **Detailed comments** |
| Ericsson | **No** | We think the change is not needed since it is clear from the spec that it is mandatory to support both solutions if the UE supports carrier aggregation with more than 5 DL. |
| Qualcomm | **Yes** | While the original intent is clear, we do realize there is potential for confusion in current text. There are two separate IOT bits, and it should be possible to set one IOT bit while not setting other (otherwise it would have been a single bit). Current spec text is somewhat confusing: “For both solutions, it is mandatory…” not clear what “it” refers to here – B5C or sol 1 and sol 2 of codebook size determination? The confusion further comes from the word “and/or” in the first sentence.  In the end, the field in question consists of two bits in a bitmap where each bit is separate and independent of other. Unfortunately, the proposed text in CR can still be confused due to “and/or” in first sentence. So, while sacrificing on the verbosity, I think field description update as following is preferable for clarity: 4.3.4.42          *codebook-HARQ-ACK-r13* The first bit of this bitmap defines whether HARQ ACK codebook size determination based on the DAI-based solution as specified in TS 36.213 [22] is supported by the UE. If the UE supports carrier aggregation with more than 5 DL component carriers, it is mandatory to support HARQ ACK codebook size determination based on the DAI-based solution.  The second bit of this bitmap defines whether HARQ ACK codebook size determination based on the number of configured CCs as specified in TS 36.213 [22] is supported by the UE. If the UE supports carrier aggregation with more than 5 DL component carriers, it is mandatory to support HARQ ACK codebook size determination based on the number of configured CCs. |
| HW | **No** | Actually I think the current specification already reflects the RAN1 agreement, not sure what is the real problem, why the current description does not explicitly reflect the RAN1 agreement? |
| Nokia, Nokia Shanghai Bell | **Yes** | We conform Qualcomm understanding that the current\t spec text is confusing: “For both solutions, it is mandatory…” It makes unclear what “it” refers to here – B5C or sol 1 and sol 2 of codebook size determination? The confusion further comes from the word “and/or” in the first sentence. |

Conclusion: No conclusion could be reached on the CRs need.

Proposal: RAN2 postpones the CRs in [R2-2001140](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001140.zip), [R2-2001141](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001141.zip), [R2-2001142](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001142.zip).

## 3.3 Which release to start with to incorporate the clarification?

The CR in [R2-2001140](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001140.zip) [6] introduce the clarification starting from TS36.306 v13.12.0. The clarification ensures all UE and network implementations comprehend it in the same way. Mirror corrections towards Rel-14, and Rel-15 are proposed in [7],[8], respectively.

**Question 8:** Do companies agree the clarification should be introduced from Rel-13?

|  |  |  |
| --- | --- | --- |
| **Company** | **Do you agree with the first release of the clarification to be Rel-13?** | **Detailed comments** |
| Ericsson | **No** | Please see the comments above. |
| Qualcomm | **Yes** |  |
| HW | **No** | See comments above |
| Nokia, Nokia Shanghai Bell | **Yes** |  |

Conclusion: No conclusion could be reached on the CRs need

Proposal: RAN2 postpones the CRs in [R2-2001140](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001140.zip), [R2-2001141](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001141.zip), [R2-2001142](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001142.zip).

# 4 Conclusions

**Conclusions:**

**Conclusion 1:** Two companies agreed to the following:

**Observation:** 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.

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

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

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

**Conclusion 2:** No conclusion could be reached on what the UE should indicate if it supports order-agnostic MIMO with CA\_xA\_xA.

**Conclusion 3:** Companies agree that RAN2 specification(s) need to reflect common understanding on MIMO layer and CSI processing capabilities with intra-band non-contiguous CA, but it remains to be clarified if once UE supports (2, 4) MIMO layers with CA\_xA\_xA, it will also support (4, 2) MIMO layers with CA\_xA\_xA

**Conclusion 4:** More time has been asked to allow detailed checking of the topics identified in [R2-2001134](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001134.zip) and the CRs in [R2-2001135](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001135.zip), [R2-2001136](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001136.zip), [R2-2001137](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001137.zip), [R2-2001138](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001138.zip).

**Conclusion 5**: FFS: common understanding on MIMO layer and CSI processing capabilities with intra-band non-contiguous CA.

**Conclusion 6:** Companies agreed that for *codebook-HARQ-ACK-r13* capability, both solutions:

(a)DAI based, and

(b)CC based,

are mandatory features (when supporting more than 5 DL CC).

**Proposal 1:** Capture in the Chairman’s minutes the following:

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.

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

**Proposal 3:** RAN2 postpones the CRs in [R2-2001135](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001135.zip), [R2-2001136](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001136.zip), [R2-2001137](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001137.zip), [R2-2001138](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001138.zip).

**Proposal 4:** For *codebook-HARQ-ACK-r13* capability, RAN2 confirms both solution (a)DAI based) and solution (b)CC based are conditionally mandatory features (i.e.when supporting more than 5 DL CC) with capability indication (IOT bits) for each solution separately.

**Proposal 5:** RAN2 postpones the CRs in [R2-2001140](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001140.zip), [R2-2001141](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001141.zip), [R2-2001142](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001142.zip).

**Agreed CRs:**

N.A.

# 5 List of referenced documents

[1] [R2-2001134](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001134.zip) Interpretation of UE capabilities for non-contiguous intra-band CA Nokia, Nokia Shanghai Bell discussion Rel-12 LTE\_CA-Core, TEI12

[2] [R2-2001135](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001135.zip) Clarification to UE capabilities for non-contiguous intra-band CA Nokia, Nokia Shanghai Bell CR Rel-12 36.331 12.18.0 4206 - F LTE\_CA-Core, TEI12

[3] [R2-2001136](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001136.zip) Clarification to UE capabilities for non-contiguous intra-band CA Nokia, Nokia Shanghai Bell CR Rel-13 36.331 13.15.0 4207 - A LTE\_CA-Core, TEI12

[4] [R2-2001137](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001137.zip) Clarification to UE capabilities for non-contiguous intra-band CA Nokia, Nokia Shanghai Bell CR Rel-14 36.331 14.13.0 4208 - A LTE\_CA-Core, TEI12

[5] [R2-2001138](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001138.zip) Clarification to UE capabilities for non-contiguous intra-band CA Nokia, Nokia Shanghai Bell CR Rel-15 36.331 15.8.0 4209 - A LTE\_CA-Core, TEI12

[6] [R2-2001140](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001140.zip) Clarification on codebook-HARQ-ACK-r13 capability for CA with more than 5CCs Nokia, Nokia Shanghai Bell CR Rel-13 36.306 13.12.0 1737 - F LTE\_CA\_enh\_b5C-Core

[7] [R2-2001141](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001141.zip) Clarification on codebook-HARQ-ACK-r13 capability for CA with more than 5CCs Nokia, Nokia Shanghai Bell CR Rel-14 36.306 14.11.0 1738 - A LTE\_CA\_enh\_b5C-Core

[8] [R2-2001142](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001142.zip) Clarification on codebook-HARQ-ACK-r13 capability for CA with more than 5CCs Nokia, Nokia Shanghai Bell CR Rel-15 36.306 15.7.0 1739 - A LTE\_CA\_enh\_b5C-Core