**3GPP TSG-RAN WG4 Meeting # 100-e R4-2115018**

**Electronic Meeting, 16th – 28th August, 2021**

**Agenda item:** 8.28 and 8.29

**Source:** Moderator (Huawei)

**Title:** Email discussion summary for [100-e][118] NR\_BCS4\_MSD\_Inter\_Band\_ENDC

**Document for:** Information

# Introduction

This email discussion handles the contributions submitted to agenda item 8.28 and 8.29 for NR\_BCS4 and MSD\_Inter\_Band\_ENDC. The scope of this email discussion covers some clarification and discussion for BCS4/5, the improvements to MSD table and introduction of MSD requirements for inter-band ENDC combinations. There are three topics listed as below in this email discussion and multiple sub-topics within each of them.

#1 General discussion for BCS4/5

#2 Improvements to MSD table

#3 Introduction of MSD requirements for inter-band ENDC combinations

# Topic #1: General discussion for BCS4/5

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2111765 | Nokia, Nokia Shanghai Bell | Proposal: RAN4 should confirm that BCS4/5 applies to SUL, NR CA, NR DC and SUL and/or NR CA part of inter band MR-DC while it does not apply to intra band MR DC. |
| R4-2112246 | Qualcomm Incorporated | Proposal 1: If BCS4 is requested for a band combination then it is equivalent to get BCS5 requested, and vice versa.  Proposal 2: RAN4 to represent BCS4 and BCS5 with the same manner as Table 1.  Proposal 3: RAN4 to use Table 2 and Table 3 to represent intra-band contiguous NR CA and intra-band non-contiguous NR CA respectively. |
| R4-2112914 | ZTE Corporation | **Proposal 1. For intra-band contiguous NR CA, a new single row for BCS4 or BCS5 are shown in tables 1.**  **Proposal 2. For inter-band contiguous NR CA, updating for BCS5 are shown in tables 2.** |
| R4-2113095 | Xiaomi | **Observation: FR2 intra-band CA doesn’t need BCS4 to indicate all possible channel bandwidth combinations.**  **Proposal 1: BCS 4 for SUL band combinations could reuse the same indication format with inter-band CA.**  **Proposal 2: BCS4 for FR1 intra-band CA can be indicated by adding suitable maximum aggregated bandwidth information, and following tables list the example cases, where n is the number of aggregated CCs:**  **min{n\*max channel bandwidth, CA bandwidth class, frequency range} for intra-band contiguous CA** |
| R4-2113422 | Huawei, HiSilicon | **Observation 1: Even if we introduce traditional BCS for these intra-band CA combinations, the workloads for delegates are limited. On the contrary, if we decide to introduce BCS4 for intra-band CA combinations, the unnecessary workloads for AMPR/REFSENS can be observed due to the uncertainties of bandwidth combinations.**  **Proposal 1: To introduce traditional BCS for intra-band CA combinations instead of BCS4.** |
| R4-2114243 | T-Mobile USA | Adds text for BCS4 and BCS5 and adds BCS4 and BCS5 for CA\_n41A-n66A as an example combination. |
| R4-2114245 | T-Mobile USA | Adding BCS4 and BCS5 to 38.101-1 |
| R4-2114246 | T-Mobile USA | Adds a note to NR-CA, NR-DC and SUL tables to indicate that BCSs other than BCS5 are release independent to Rel-15 and BCS5 is release independent to Rel-17. |
| R4-2114247 | T-Mobile USA | **Proposal 1: From now on BCS4 and BCS5 can be requested together in regular NR-CA, NR-DC and SUL basket requests.**  **Proposal 2: Existing band combination that requested traditional BCSs can be changed to BCS5/BCS5 upon request.**  **Proposal 3: RAN4 to discuss the applicability of BCS4 and BCS5 to intra-band combinations. This is important since many combinations have intra-band components** |

## Open issues summary

### Sub-topic 1-1

*Sub-topic description:*

*Based on the WF R4-2107821, RAN4 needs to continue discussions for how to represent BCS4 for intra-band NR-CA in this meeting*

**Issue 1-1-1: To discuss the applicability of BCS4 and BCS5 to intra-band combinations**

* Proposals
  + Option 1: To introduce traditional BCS for intra-band CA combinations instead of BCS4
  + Option 2: To introduce BCS4/BCS5 for intra-band NR CA
    - Option 2a both FR1 and FR2.
    - Option 2b: only for FR1
* Recommended WF
  + TBA

**Issue 1-1-2: If RAN4 agrees to introduce BCS4/BCS5 for intra-band NR CA, how can BCS4 for intra-band NR CA be indicated?**

* Proposals
  + Option 1: Proposed in R4-2112246 as below

Table 2: NR CA configurations and bandwidth combination sets defined for intra-band contiguous CA

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set** | | | | | | | | |
| **NR CA configuration** | **Uplink CA configurations** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Maximum aggregated  bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_nXC | CA\_nXC | 50 | 60, 80, 100 |  |  |  | 200 | 0 |
| 60 | 60, 80, 100 |  |  |  |
| 80 | 80, 100 |  |  |  |
| 100 | 100 |  |  |  |
| see nX channel bandwidths in Table 5.3.5-1 for each carrier | |  |  |  | 200 | 4/5 |
| NOTE 1: 5 MHz is not applicable for 30/60 kHz SCS. | | | | | | | | |

Table 3: NR CA configurations and bandwidth combination sets defined for intra-band non-contiguous CA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set** | | | | | | | |
| **NR CA configuration** | **Uplink CA configurations** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Maximum aggregated  bandwidth (MHz)** |
| CA\_nX(2A) | CA\_nX(2A) | 10, 20, 40, 50, 60, 80, 90, 100 | 10, 20, 40, 50, 60, 80, 90, 100 |  |  | 200 | 0 |
|  |  | 10, 20, 25, 30, 40, 50, 60, 80, 90, 100 | 10, 20, 25, 30, 40, 50, 60, 80, 90, 100 |  |  | 200 | 1 |
|  |  | see nX channel bandwidths in Table 5.3.5-1 for each carrier | |  |  | 200 | 4/5 |
| NOTE 1: Void.  NOTE 2: Parameter value accounts for both, the maximum frequency range of band n48 (150 MHz), and the minimum frequency gaps in between NR non-contiguous component carriers. | | | | | | | |

* + Option 2: Proposed in R4-2112914 as below.

Table 1. A new single row for BCS4 or BCS5 for intra-band contiguous NR CA

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA configuration / Bandwidth combination set | | | | | | | | |
| NR CA configuration | Uplink CA configurations | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Maximum aggregated  bandwidth (MHz) | Bandwidth combination set |
| CA\_nXC | CA\_nXC | 50, 60, 80,100 | 60, 80, 100 |  |  |  | 200 | 0 |
| See nX channel bandwidths for each carrier in Table 5.3.5-1, where sum of the supported channel bandwidth of each carrier are compliance to [lower value, upper value] x | | | | | upper value | 4 or 5 |
| Note x: Lower value is the lower limit of the Aggregated channel bandwidth for the corresponding NR CA bandwidth class in table 5.3A.5-1. Upper value shall be less than or equal to the upper limit of the Aggregated channel bandwidth for the corresponding NR CA bandwidth class in table 5.3A.5-1. | | | | | | | | |

* + Option 3: Proposed in R4-2113095 as below
* **min{n\*max channel bandwidth, CA bandwidth class, frequency range} for intra-band contiguous CA**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA configuration / Bandwidth combination set | | | | | | | | |
| NR CA configuration | Uplink CA configurations | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Maximum aggregated  bandwidth (MHz) | Bandwidth combination set |
| CA\_nXB | - | See nX and channel bandwidths in Table 5.3.5-1 | |  |  |  | min{2\*max channel bandwidth, CA bandwidth class, frequency range} | 4 |
| CA\_nXD | - | See nX and channel bandwidths in Table 5.3.5-1 | | |  |  | min{3\*max channel bandwidth, CA bandwidth class, frequency range} | 4 |

* **min{n\*max channel bandwidth, frequency range- min frequency gaps} for intra-band non-contiguous CA**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Uplink Configurations | Channel bandwidths for carrier  (MHz) | Channel bandwidths for carrier  (MHz) | Channel bandwidths for carrier  (MHz) | Channel bandwidths for carrier  (MHz) | Maximum  Aggregated bandwidth  (MHz) | Bandwidth combination set |
| CA\_nX(2A) | - | See nX channel bandwidths in Table 5.3.5-1 | |  |  | min{2\*max channel bandwidth, frequency range- min frequency gap} | 4 |
| CA\_nX(3A) | - | See nX channel bandwidths in Table 5.3.5-1 | | |  | min{3\*max channel bandwidth, frequency range- min frequency gaps} | 4 |

* + Option 4: other solutions
* Recommended WF
  + TBA

### Sub-topic 1-2

*Sub-topic description RAN4 agreed that BCS4 is optional for a given combination, allocated as requested. This sub-topic focus on when and how to request.*

*Open issues and candidate options before e-meeting:*

**Issue 1-2-1: When can companies request BCS4/5?**

* Proposals
  + Option 1: From now on BCS4 and BCS5 can be requested together in regular NR-CA, NR-DC and SUL basket requests.
  + Option 2: Others
* Recommended WF
  + Option 1

**Issue 1-2-2: Is it agreed that existing band combination that requested traditional BCSs can be changed to BCS5/BCS5 upon request?**

* Proposals
  + Option 1: Yes.
  + Option 2: Others.
* Recommended WF
  + Option 1

**Issue 1-2-3: If BCS4 is requested for a band combination, does it mean that it is equivalent to get BCS5 requested, and vice versa.?**

* Proposals
  + Option 1: Yes.
  + Option 2: No, BCS4 and BCS5 should be requested and indicated separately.
* Recommended WF
  + TBA

### Sub-topic 1-3

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-3-1: Should BCS4 for SUL band combinations reuse the same indication format with inter-band CA.?**

* Proposals
  + Option 1: Yes.
  + Option 2: Others
* Recommended WF
  + Option 1

**Issue 1-3-2: Clarify the scope**

* Proposals
  + Option 1: RAN4 should confirm that BCS4/5 applies to SUL, NR CA, NR DC and SUL and/or NR CA part of inter band MR-DC while it does not apply to intra band MR DC.
  + Option 2: Others.
* Recommended WF
  + Option 1

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Issue 1-1-1: None of the options Technically it is possible to apply BCS4/5 to intra band CA. At least we don’t need to apply it FR2.  Issue 1-1-2: Option 1 We need to understand the intent of texts from option 2. We don’t agree with the option 3. It is too complicated compared to the existing mechanism while the number of intra band CA is even less than that of inter band CA so that we don’t think the gain of the option 3 is not worth much. |
| OPPO | **Issue 1-1-1: To discuss the applicability of BCS4 and BCS5 to intra-band combinations**  Option 1(prefer) or 2b. Intra band CA has more limitation in supporting BW combinations due to shared hardware limitations like PA. There is possibility of supporting BCS4/5 with the limitation of total aggregated CBW or separation class. And it needs more attention in introducing BCS. Therefore, more prefer option 1, i.e. using traditional BCS for intra-band contiguous/non-contiguous CA.  **Issue 1-1-2: If RAN4 agrees to introduce BCS4/BCS5 for intra-band NR CA, how can BCS4 for intra-band NR CA be indicated?**  Option 1 but there are typos in the table for non-contiguous where BCS column is missing. |
| T-Mobile USA | **Issue 1-1-1:** Option 2a. A large number of higher-order band combinations include both inter-band and intra-band aspects, and UE capabilities indicate the highest order combinations, and not all of the fallbacks. So, if BCS4 and BCS5 can only be used for inter-band combination, then it will greatly limit their usefulness. We think that BCS4 and BCS5 need to be allowed for intra-band combinations and higher order combinations with intra-band aspects.  **Issue 1-1-2:** Option 2. Option 2 seems more consistent with the current intra-band contiguous rows (for n41C and n77C, for instance) where it is not assumed that the reader knows that only combinations of bandwidths that are greater than 100 MHz for FR2 class C are valid. |
| ZTE | **Issue 1-1-1: To discuss the applicability of BCS4 and BCS5 to intra-band combinations**  Option 2 with slightly perfer to Option 2a both FR1 and FR2.  The WID scope includes the intra-band combs, so Option 2 is compliance to the scope.  For FR2 combs, although there are no BCS problems like FR1 so far since all the CBWs are supported for each band, we think if there are new CBWs introduced in future, then the similar problem as FR1 will happen. Therefore, the BCS4/5 method can be used as palceholder for FR2 combs, but the urgency situations are mainly for FR1 combs at this time.  **Issue 1-1-2: If RAN4 agrees to introduce BCS4/BCS5 for intra-band NR CA, how can BCS4 for intra-band NR CA be indicated?**  Option 2.  To Nokia: The texts aims to indicate that the sum of the supported channel bandwidth of each carrier is restricted not only by the aggregated channel bandwidth range, but also by the Maximum aggregated bandwidth, this is different with inter-band NR CA. When proponent request intra-band NR CA combs, the Maximum aggregated bandwidth should be added, and Maximum aggregated bandwidth maynot equal to the upper value of bandwidth class, for example CA\_n41C.  For option 1, it gives high flexibility that sum of some of CBWs combination may exceed Maximum aggregated bandwidth, we think such CBWs combination are not allowed. |
| Xiaomi | **Issue 1-1-1:**  Option 2 and prefer to option 2b, we can find in current spec, the BCS of FR1 intra-band CA are requested by the method of enumeration, a new BCS will be needed if some case was missed, it will cause more BCS request if we still use the traditional BCS for FR1 intra-band CA. for FR2 the CA bandwidth classes have restricted the possible channel bandwidth combinations, unless RAN 4 change the rule for CA bandwidth class, so RAN4 don’t apply BCS4/5 to FR2 tentatively.  **Issue 1-1-2:**  Option 3  Actually, Option3 and Option 2 are similar, Option 2 proposed the max aggregated channel bandwidth are limited by upper value, I want to know how to decide the upper value. Option 1 proposed the max aggregated channel bandwidth is 200MHz which is the upper value of CA bandwidth class, but some cases can’t get it, for example, CA\_n41C, CA bandwidth class C could support 200Mhz max aggregated bandwidth and band n41 can support 100MHz max channel bandwidth, but the frequency range of n41 is only 194MHz; band n46 supports 80MHz max channel bandwidth, so CA\_n46C can only support 160MHz max aggregated bandwidth not 200MHz, in this cases how could we decide the upper value of max aggregated bandwidth. I think Option 3 just gives the method how to define the upper value. |
| Huawei | **Issue 1-1-1: To discuss the applicability of BCS4 and BCS5 to intra-band combinations**  We can wait for the specific demands and have no restriction on intra-band combinations for BCS4/5 at this stage. For the proponent of BCS4 for intra-band combinations, the potential AMPR issue should be considered.  **Issue 1-1-2: If RAN4 agrees to introduce BCS4/BCS5 for intra-band NR CA, how can BCS4 for intra-band NR CA be indicated?**  Option 1 is OK.  For option 2, there is no need to merge five cells into one cell for bandwidth class C. If it’s necessary to clarify lower value in the specification, it can be stated in the general core part instead of a note.  For option 3, we hare same view with Nokia. We can specify the max aggregated bandwidth directly instead of implication. |
| Skyworks | **Issue 1-1-1: To discuss the applicability of BCS4 and BCS5 to intra-band combinations**  **Option 2:**  Applying the BCS4 concept to intra-band NR-CA combination should be handled with great care because any new CBW for intra-band leads to complex MSD and A-MPR studies that are time consuming. Example of complex A-MPR is that of CA\_n41C. Example of complex MSD and A-MPR studies is CA\_n7B.  So, in our view, the BCS4 concept should not be applicable to intra-band UL CA combinations. It may be acceptable to adopt BCS 4 for DL only intra-band NR-CA combinations.  **Issue 1-1-2: If RAN4 agrees to introduce BCS4/BCS5 for intra-band NR CA, how can BCS4 for intra-band NR CA be indicated?**  Option 1 looks the simplest, but key concern here is to avoid work overload that will result from applying BCS4 to intra-band UL CA combinations, ie we should restrict BCS4 for DL only intra-band combinations. |
| Verizon | **Issue 1-1-1:** Option 2 is more for onward new CBW intra-band CA in future!  **Issue 1-1-2:** Option 1 is more clear and straight forward! |
| Qualcomm | **Issue 1-1-1: Option 2b.**  **From specification perspective, there is no issue to apply BCS4/5 to intra-band NR CA. We believe this WI is focusing on FR1 so we should not extend it to FR2.**  **Issue 1-1-2: Option 1.**  **Thanks OPPO for pointing out the typo in option 1. We revised the table as following.**   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **NR CA configuration / Bandwidth combination set** | | | | | | | | **Uplink CA configurations** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Channel bandwidths for carrier (MHz)** | **Maximum aggregated  bandwidth (MHz)** | **BCS** | | CA\_nX(2A) | 10, 20, 40, 50, 60, 80, 90, 100 | 10, 20, 40, 50, 60, 80, 90, 100 |  |  | 200 | 0 | |  | 10, 20, 25, 30, 40, 50, 60, 80, 90, 100 | 10, 20, 25, 30, 40, 50, 60, 80, 90, 100 |  |  | 200 | 1 | |  | see nX channel bandwidths in Table 5.3.5-1 for each carrier | |  |  | 200 | 4/5 | | NOTE 1: Void.  NOTE 2: Parameter value accounts for both, the maximum frequency range of band n48 (150 MHz), and the minimum frequency gaps in between NR non-contiguous component carriers. | | | | | | |   **We are fine to capture the Maximum aggregated bandwidth in the table per the companies’ request (upper value). But there might be no need to have the lower value since the channel bandwidth configuration for each class should follow 5.3A.5-1.** |
| ZTE | **Issue 1-1-2:**  To QC, since here we say sum of the channel bandwidth of each carrier, so the range of [lower value, upper value] aims to restrict it to the range of the corresponding bandwidth class. For example, the minimum aggregated channel bandwidth for class C is 40MHz, so for the CA\_nXC, the bandwidths configuration of 15M+15MHz may not apply since sum of the CBWs is only 30MHz which is out of the range of Class C.  BTW, what does ‘4/5’mean? ‘4 or 5’ or ‘4 and 5’? which one? |
| Qualcomm3 | To ZTE,  Thanks for clarifications. So you mean the lower value should be requested by companies, right? For example, the operator request the lower value is 60MHz and the upper value is 200MHz. Then all the possible CBW configurations between 60MHz and 200MHz should be supported. It is workable per my understanding. But I have a question, on what’s difference between CA BW class B and C in this case? How to differentiate B and C with BCS4 and BCS5?  To your question on “4/5”, it should be “4 and 5”. |
| ZTE4 | To QC  As mentioned in the note: Lower value is the lower limit of the Aggregated channel bandwidth for the corresponding NR CA bandwidth class in table 5.3A.5-1. So it would be ok that the lower value is same as the minimum Aggregated channel bandwidth, for example, lower values is 20MHz for class B and 100MHz for class C, that’s means Lower value is not need to be requested.  Since each bandwidth class has different lower value, so here we use a general way rather than using a specific value to avoid confusion.  For your example, Class B and Class C have already been separated with BWChannel\_CA. If proponent request nXC or nXB with lower value is 60MHz and the upper value is 200MHz, that’s invalid combs since it exceed either class B or class C range, i think this is also the case by using traditional BCS, i.e. it would not correct to use 40+20MHz for class C or 60+80M for class B.   |  |  |  |  | | --- | --- | --- | --- | | NR CA bandwidth class | Aggregated channel bandwidth | Number of contiguous CC | Fallback group | | A | BWChannel ≤ BWChannel,max | 1 | 1, 2, 3 | | B | 20 MHz ≤ BWChannel\_CA ≤ 100 MHz | 2 | 2, 3 | | C | 100 MHz < BWChannel\_CA ≤ 2 x BWChannel,max | 2 | 1, 3 |   For example, company request n41C\_BCS4/5, then it should be upper value = 190MHz, lower value = 100MHz, that’s as long as the sum of the channel bandwidths are in the scope of [100, 190]MHz, any channel bandwidths configurations in Table 5.3.5-1 can be supported in each carrier. |
| Apple | **Issue 1-1-1:** Option 2. It doesn’t make sense not to introduce BCS4/5 for those combinations where we have most of the BCSs specified, so option 1 is not helpful. For FR2 only combinations we currently do not have any BCS specified, therefore it may be helpful to not introduce any more BCS and just remove the BCS column. We could have a note saying that there is only BCS0. If we cannot agree on not introducing new BCSs, we should also specify BCS4/5 for FR2.  **Issue 1-1-2:** Option 1, maybe it is possible to even shorten the sentence to “see single carrier CBW“. If we could agree to use BCS4/5 for each combination, we may even not need to add a BCS4/5 line but just add a note at the bottom of the tables. Options 2 and 3 are too complicated, option 2 would blow up the table, option 3 replaces the simple number of the aggregated CBW by a complicated formula, which is not preferred. |

Sub topic 1-2

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| --- | --- |
| **Company** | **Comments** |
| Nokia | Issue 1-2-1: Option 2  Request must be possible from this meeting, but reflection of it in the WID shall depend on if the work item is completed or not in the RAN#92e.  Issue 1-2-2: Option 2  We’d like to understand the intention of this proposal better.  In our understanding, it must not be changed. It is true that RAN4 agreed that BCS4/5 can be added to the existing band configurations based on request. In addition, RAN4 agreed that “Conventional BCS” request for a given band configuration that has already BCS4/5 is still possible. If we went with the option 1, conventional BCS request should not be allowed anymore if the replacement comes from the fact that BCS4/5 can indicate existing BCSs. In addition, it would not be possible to trace for what kind of BCS to be reported in the real network if we went with option 1.  Issue 1-2-3: Option 1 |
| OPPO | **Issue 1-2-1: When can companies request BCS4/5?**  Option 1: From now on BCS4 and BCS5 can be requested together in regular NR-CA, NR-DC and SUL basket requests.  **Issue 1-2-2: Is it agreed that existing band combination that requested traditional BCSs can be changed to BCS5/BCS5 upon request?**  Option 2, no. BCS4/5 should be applied to new band combinations. If apply to the existing band combinations whether there are NBC issues needs to be clarified in UE and BS. This may need RAN2 be involved.  **Issue 1-2-3: If BCS4 is requested for a band combination, does it mean that it is equivalent to get BCS5 requested, and vice versa.?**  Option 1, YES. |
| T-Mobile USA | **Issue 1-2-1:** Option 1.  **Issue 1-2-2:** Option 1. The thinking here is that once CRs are approved, requests for traditional BCSs could be changed by the requesting party so that TPs/draft CRs at the next RAN4 meeting can reflect the availability of BCS4/5. If this is not allowed, then there will be a delay of a quarter before BCS4 and BCS5 can be requested. The idea is to save work in RAN4. The WIDs could be updated next quarter to request the changes from traditional BCSs to BCS4/5.  **Issue 1-2-3:** Option 1. We see no need to request BCS4 and BCS5 separately. |
| ZTE | **Issue 1-2-1: When can companies request BCS4/5?**  Option 2, others.  Before we request BCS4/5, we’d like to ask some questions:  1: Whether BCS4 and BCS5 can be requested for the same band configuration by different companies? (related to issue 1-2-3)  2: How to treat BCS4 or BCS5 with traditional BCS for the same configuration? For example, if two companies request BCS4 and BCS3 for the same configuration, how to treat the TPs if they provide TPs for both BCS4 and BCS3? or only BCS4 TP is enough? Or if only BCS4 TP is provided and approved, then how to treat BCS3 configurations?  We think some priciples/guidelines should be approved before we using BCS4/5 to request the combs, also it seems how to implement BCS4/5 for intra-band combs are still open.  **Issue 1-2-2: Is it agreed that existing band combination that requested traditional BCSs can be changed to BCS5/BCS5 upon request?**  A question for clarfication: Does it mean for the incompleted combs with traditional BCSs in the WID?  If it is yes, then we can agree with Option 1 since we see no problem to change the information for the exisitng incompleted combs in the WID via ‘Modified’ indication in the proponent’s request sheet.  Moreover, we would like to underline that the current approach should be strictly obey, i.e. all the modified combs (in the revised WID) must be approved at the RAN plenary first, then the concrete work can be started.  **Issue 1-2-3: If BCS4 is requested for a band combination, does it mean that it is equivalent to get BCS5 requested, and vice versa.?**  Option 2. We think release independent for BCS4 and BCS5 are different, this should be indicated in TS38.307, also lagacy BS cannot understand the UE with BCS5, Also, we think BCS4 and BCS5 cannot apply to the same configurations, otherwise, it may cause conflication on the release independent. |
| Samsung | Issue 1-2-1: Option 2, better from this meeting considering operators always want all available bandwidths, although requests from companies for RAN#93e have already been shared via reflector, we can allow the request for BCS4/5 before the rapporteurs prepare the revised WID. Agree with ZTE that guidelines and principles should be approved in advance.  Issue 1-2-2: Option 1, keep traditional BCS or change to BCS4/5 shall be requested before the rapporteurs share the revised WID, and more time needed before the post-meeting email approval of the revised WID.  Issue 1-2-3: Option 1 |
| Xiaomi | **Issue 1-2-1: When can companies request BCS4/5?**  Option 2, Agree with ZTE that guidelines and principles should be approved in advance.  **Issue 1-2-2: Is it agreed that existing band combination that requested traditional BCSs can be changed to BCS5/BCS5 upon request?**   * + Option 1: Yes. But need resolve the MSD issue.   **Issue 1-2-3: If BCS4 is requested for a band combination, does it mean that it is equivalent to get BCS5 requested, and vice versa.?**  Option 1: Yes. BCS5 and BCS4 are agreed as a package, BCS5 just to resolve the issue of signalling can’t release independent, so if BCS4 is requested, it means BCS5 is also request, vice versa. |
| Huawei | Issue 1-2-1: No strong views. Based on operators’ demand, it’s better as soon as possible.  Issue 1-2-2: Following current procedure, contact companies should request to change the WID firstly if BCS4 is allowed to request in this meeting. I suppose BCS4’s request should be based on the real deployment plan. We should avoid to introduce something which is not the real demand. It may indicate a wrong signal to the industry. In addition, we still allow companies to introduce conventional BCS into spec. We should distinguish two cases.  Issue 1-2-3: Option 2. As the approved WF R4-2107821, BCS4 is optional for a given combination, allocated as requested since the industry need to identify the real demands. The reason why we introduce BCS5 is the so-called IODT efforts. I don’t think all kinds of CA band combinations will consume much the so-called IODT efforts, e.g. CA\_n1-n8. Following the current RAN4’s procedure, all the new BCS should be requested by companies, so that the technical issue can be identified when introducing them into specification.  Besides, some NBC and compatibility issues for BCS5 are identified by RAN2. Thus, RAN4 can be careful to introduce BCS5 before RAN2 make final decision. |
| Verizon | **Issue 1-2-1:** Option 2  **Issue 1-2-2:** Option 1  **Issue 1-2-3:** Option 1 |
| CHTTL | **Issue 1-2-1:** Option 2  **Issue 1-2-2:**  Maybe the two issues are together to propose to change conventional BCS for the combos in the existing WID to BCS4/5 in this meeting? Is it also targeting on new combos which had not requested before? maybe not? |
| Ericsson | **Issue 1-2-2:** Option 1  **Issue 1-2-3:** Option 2, since we agree with the ZTE view that release independence for BCS4 and BCS5 are different |
| Qualcomm | **Issue 1-2-1:** Partially agree with Option 1.  Companies can request BCS4/5 from now on but the precondition is RAN4 could agree how to introduce BCS4/5 in the spec, for example, the scope, the statements regarding BCS4/5, and the table format, etc.  **Issue 1-2-2:** Option 2  We have concerns on option 1. RAN4 has agreed that for the legacy band combinations, BCS4/5 can be added by companies per request. But changing the traditional BCSs to BCS4/5 would have NBC issues from UE and Network perspective.  **Issue 1-2-3:** Option 1.  In the WF from last meeting, it agreed that BCS4 and BCS5 are equivalent. So there is no need to request BCS4 and BCS5 separately. |
| ZTE | **Issue 1-2-3:** Option 1.  To QC, to our understanding, we think ‘equivalent’ for BCS4 and BCS5 means all the possible can be supported for BCS4 or BCS5, from this aspect, there are no difference. However, we need to consider the release independent for band combination, RAN4 have already agreed BCS4 is release independent from Rel-15 but BCS5 can only release independent from Rel-17. |
| Huawei | **Issue 1-2-1:**  To Qualcomm, I think this issue is independent. Request doesn’t mean new BCS has been introduced into spec.  **Issue 1-2-3:**  To Qualcomm,  Based on the approved WF in last meeting, we have no agreement to introduce BCS4 and BCS5 together into specification. RAN4 need to introduce the BCS which operators are interested in. As you know, developing one more BCS which is not used in the industry will cause the wasted effort. |
| Qualcomm3 | **To ZTE, Ericsson**  Even though BCS5 will be only introduced in Rel-17, BCS4 and BCS5 could be requested as a package. Anyway, the new band combos will be introduced in Rel-17 specification. Which release will be implemented for BCS4 and BCS5 shall be captured in TS38.307.  To Huawei:  As agreed in R4-2107821, BCS5 is the same as BCS4 except that there is new signaling for BCS5. We believe BCS4 and BCS5 are requested by a package is a compromise from last meeting. From the above comments, it is the common understanding from many companies. Technically, there is no issue if BCS4 and BCS5 are requested together since BCS4 has covered all the possible BW configuration and MSD, etc. In addition, request BCS4 and BCS5 separately will lead to more workload. |
| ZTE4 | To QC:  After some discussion with QC and thanks QC for further clarification, we agree with BCS4 and BCS5 could be requested by package. The release independent issue should be reflected/solved in 38.307. |
| vivo | Issue 1-2-1: Option 2.  Issue 1-2-2: Option 2  Issue 1-2-3: Option 1 |
| Apple | **Issue 1-2-1: When can companies request BCS4/5?**  Option 1. Besides requesting BCS4/5 starting now we should think about adding BCS4 or 5 also to all legacy combinations as an optional BCS  **Issue 1-2-2: Is it agreed that existing band combination that requested traditional BCSs can be changed to BCS4/BCS5 upon request?**  It is unclear what is meant with this question. Existing BCSs should not be changed (replaced), but BCS4 or 5 should be added instead. In that respect BCS4/5 can be added to any combination.  **Issue 1-2-3: If BCS4 is requested for a band combination, does it mean that it is equivalent to get BCS5 requested, and vice versa.?**  Option 1. Yes, both should come together. |

Sub topic 1-3

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| **Company** | **Comments** |
| Nokia | Issue 1-3-1: Option 1  Issue 1-3-2: Option 1 but regarding “NR CA” part needs to be modified according to the outcome of handling of intra band CA. |
| OPPO | **Issue 1-3-2: Clarify the scope**  Option 1: RAN4 should confirm that BCS4/5 applies to SUL, NR CA, NR DC and SUL and/or NR CA part of inter band MR-DC while it does not apply to intra band MR DC. |
| T-Mobile USA | **Issue 1-3-2:** Option 1. |
| ZTE | **Issue 1-3-1: Should BCS4 for SUL band combinations reuse the same indication format with inter-band CA.?**  Option 1, Yes  **Issue 1-3-2: Clarify the scope**  What does ‘intra band MR DC’ means? Intra-band ENDC? Or intra-band NR DC? It seems ENDC is not in the scope of the WID. |
| Samsung | Issue 1-3-1：Option 1, and for SUL band combination with inter-band CA, maybe could also take into account the optimization for Table 5.5C-4 in R4-2112723 (ZTE) |
| Xiaomi | **Issue 1-3-1: Should BCS4 for SUL band combinations reuse the same indication format with inter-band CA.?**  Option 1: Yes.  **Issue 1-3-2: Clarify the scope**  Option 1 |
| Huawei | Issue 1-3-1: Option 1  Issue 1-3-2: If necessary, WID revision is needed. |
| Verizon | **Issue 1-3-2:** Option 1 |
| Qualcomm | **Issue 1-3-2: Option 1 and to include the conclusion on Issue 1-1-1** |
| vivo | Issue 1-3-1: Option 1  Issue 1-3-2: Option 1. |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| R4-2114243 | ZTE: can we use “Bandwidth Combination Set 4 ~~and~~ or 5....”?  In addition, is it better to add some words to describe BCS4 and BCS5 are different release independent?  No sure why we need the last sentence. “The bandwidths the UE supports for each band and the maximum bandwidth for the band in the band combination are indicated in the UE capabilities.” |
| Huawei: This statement should be added for SUL as well based on the scope of this WID. |
| Qualcomm: “The bandwidths the UE supports for each band and the maximum bandwidth for the band in the band combination are indicated in the UE capabilities.” This sentence is not applied for BCS5. We can remove this sentence. |
| R4-2114245 | ZTE: Same as above. |
| Samsung: “Reason for change” and “Summary of change” need to be corrected |
| Huawei: Change reason is not correct.  Qualcomm: Did we have agreement to extend BCS4/5 from FR1 to FR1+FR2 band combos as well? |
| T-Mobile USA: To Qualcomm, I don’t think we ever decided that BCS4/5 would not apply to FR1+FR2 band combinations. Since the capability signaling reports the higher order combinations and then the supported fallbacks and BCSs are implicit, then BCS4/5 will have limited value if many of the higher order combinations supported by a UE have FR2, in which case we would require traditional BCSs. This is would be wasted effort because many if not all of the traditional BCSs that we avoided in FR1 we would have to define for FR1+FR2. . |
| Qualcomm3: To TMO, applying BCS4/5 to FR1+FR2 also means it will apply FR2 intra-band CA. Not sure if I remember correctly, it was discussed in RAN4/RAN-P, but it was not agreed. In addition, we will have to check if there is signalling issue from RAN2 perspective. Note that we are not against to use BCS4/5 to FR1+FR2. But what we focused on before is for FR1, so we’d better to be careful about FR2 related band combinations. |
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| R4-2114246 | ZTE: To our understanding, the release independent is for configuration itself, not for BCS. So on top of yours, i made some modifications below:  NOTE:   Configurations with BCSs other than BCS5 are release independent from Rel-15. Configurations with BCS5 are ~~is~~ Release independent from Rel-17. Where the BCSs for inter-band NR CA configuration are defined in TS38.101-1[2] and TS38.101-3[4]. |
| Huawei: To ZTE, it isn’t enough to only consider inter-band NR CA. The last sentence is not needed.  ZTE: To Huawei, different wordings should be used for different configurations table, ok to consider SUL. Or a common wording is :  NOTE:   Configurations with BCSs other than BCS5 are release independent from Rel-15. Configurations with BCS5 are ~~is~~ Release independent from Rel-17. Where the BCSs for configurations are defined in TS38.101-1[2] and TS38.101-3[4].  Qualcomm: From our RAN2 colleague’s feedback, RAN2 is still discussing the release independent for BCS4 and BCS5. We’d better wait for the RNA2 conclusion. |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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| --- | --- |
|  | **Status summary** |
| **Sub-topic 1-1** | **Issue 1-1-1: To discuss the applicability of BCS4 and BCS5 to intra-band combinations**  All the companies agreed to introduce BCS4/BCS5 for intra-band NR CA. At least 4~5 companies prefer to introduce BCS4/BCS5 only for FR1 intra-band NR CA. One company proposed to introduce BCS4/BCS5 only for FR1 intra-band DL CA.  *Tentative agreements:*  *1)* To introduce BCS4/BCS5 for FR1 intra-band DL CA  2) FFS whether BCS4/BCS5 can be used for FR1 intra-band UL CA  3) FFS whether BCS4/BCS5 can be used for FR2 intra-band CA or current BCS0 is enough for FR2 intra-band CA  *Candidate options:*  *Recommendations for 2nd round:*  To further discuss the open issues.  **Issue 1-1-2: If RAN4 agrees to introduce BCS4/BCS5 for intra-band NR CA, how can BCS4 for intra-band NR CA be indicated?**  Option 1 is the majority views, but some errors are observed. Two companies support option 2 and one company support option 3.  Tentative agreements:  The basic principle is not to change current core requirements especially for legacy BCSs and to limit specification changes for this WI. Any improvements or optimizations can be done in the dedicated WI.  *Candidate options:*  *Recommendations for 2nd round:*  Companies can take option 1 as starting point and further discuss the wordings and details. |
| **Sub-topic 1-2** | **Issue 1-2-1: When can companies request BCS4/5?**  Most companies think BCS4/BCS5 can be requested from this meeting. Three companies think the precondition should be done or comments should be addressed firstly.  *Tentative agreements:*  *None*  *Candidate options:*  *Recommendations for 2nd round:*  Companies can try to address companies’ comments in the 2nd round so that RAN4 can agree to request BCS4/BCS5 from this meeting.  **Issue 1-2-2: Is it agreed that existing band combination that requested traditional BCSs can be changed to BCS5/BCS5 upon request?**  The proponent clarified that this proposal is for the requested band combinations whose state is still ongoing in the current WID. However, companies expressed that current approved procedure should be followed. Some companies comments that the conventional BCSs are still allowed to be requested.  Moderator suggests that contact person can request to change the basket WID once RAN4 agree to request BCS4/BCS5. And the revised WID can be approved in the upcoming RAN plenary meeting. RAN4 can do something based on the latest approved WID in next RAN4 meeting.  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:*  Try to agree on when companies can request BCS4/BCS5 firstly.  **Issue 1-2-3: If BCS4 is requested for a band combination, does it mean that it is equivalent to get BCS5 requested, and vice versa.?**  Two companies think BCS4 and BCS5 should be requested and indicated separately. The others think the proposal can be accepted.  *Tentative agreements:*  *No agreement.*  *Candidate options:*  *Recommendations for* *2nd round:*  Moderator suggest to further discuss this issue in 2nd round. |
| **Sub-topic 1-3** | **Issue 1-3-1: Should BCS4 for SUL band combinations reuse the same indication format with inter-band CA?**  All the companies agreed this proposal  *Tentative agreements:*  RAN4 agreed this proposal  *Candidate options:*  *Recommendations for 2nd round:*  It can be captured in WF  **Issue 1-3-2: Clarify the scope**  Generally, companies are OK with this proposal, but NR CA and intra-band MR DC should be modified in the second round.  *Tentative agreements:*  This proposal is OK, but some modification is needed.  *Candidate options:*  *Recommendations for 2nd round:*  Further discuss the modification in the 2nd round. |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

### comments collection

*It’s recommended that companies provide comments on WF and revised CR directly. (It’s noted that R4-2114244 is not available. After 1st round discussion, a CR for 38.101-2 is not needed. )*

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| **WF/CR** | **Comments collection** |
| R4-2114919  WF on BCS4 for general part | Samsung:  **Issue 1-2-1:**  Some principles are proposed to discuss below   1. When requesting and preparing contributions for new BCS on exiting combos, in case all carriers in this configuration support all available bandwidth of the corresponding single band, use BCS4/5 instead of traditional BCS. 2. Request for BCS4/5 should be based on real deployment plan   **Question 1**: **Whether traditional BCS request and contribution could be allowed if BCS4/5 already defined in TS. If not allowed, I have below suggestions:**   1. Traditional BCS request could be allowed only if no BCS4/5 configuration specified in the spec 2. If contributions for traditional BCS and BCS4/5 on existing combos from different companies are submitted in the same meeting, approve BCS4/5 contribution if it is ok with all the MSD issues resolved, but if there is some unresolved issues for BCS4/5, approve traditional BCS, i.e. contribution for traditional BCS shall be approved only if no specification in TS or no approved contribution of BCS4/5 in the same meeting   **Question 2: How to treat already defined traditional BCS in current spec which already support all available bandwidth of the single band, should them be changed to BCS4/5?**   1. Suggest to leave them unchanged, and no request of BCS4/5 for them if no new bandwidth supported.   **Question 3: For new band combination, should BCS0 be defined in advance before BCS4/5, or BCS4/5 can be directly defined?**   1. XXXX   T-Mobile USA: These are interesting comments, but I’m not sure how to handle these. Is the suggestion to add these to the WF? Maybe it would be best to bring a contribution with these suggestions to RAN#101e? If the proposal is to update the WF, it would be helpful if Samsung could provide a proposed revision.  **Issue 1-2-2:**  1) Traditional BCSs can be changed to BCS4/5 with “Modified” change mark in column A if the status of this band combo is still ongoing in RAN92e approved revised WID and no approved contribution in RAN4#100e.  T-Mobile USA: We agree, but the change in the WID doesn’t have to happen before draft CRs and TPs include BCS4. From the WID:  Guideline 4: Until BCS4 CR(s) are agreed, TPs and Draft CRs should include the BCSs that were requested for already requested band combinations. After BCS4 CR(s) are agreed, it should be up to the proponents whether TPs and draft CRs include the BCS(s) that were requested and recorded in the WID, or if the TPs and draft CRs only include BCS4. If BCS4 is preferred, the exceptional case of inconsistent information between the basket WID and the TPs/draft CRs is acceptable until the WID is fixed accordingly.2) New request of traditional BCSs on existing are still allowed, but in case all carriers in this traditional BCS support all available bandwidth of the single band, then use BCS4/5 instead of traditional BCS  T=Mobile USA: Initially there may still be a desire for BCS0 even if it includes all channel BWs.  3) For new band combinations, could BCS4/5 be directly requested and defined? Or BCS0 should be specified in advance?  T-Mobile USA: Once all gNBs support BCS4 and BCS5, then there is no reason to define BCS0. But for compatibility with legacy gNBs it may be desirable to include BCS0. That decision is up to the implementer. |
| Nokia  Maybe we need to clarify or share the common view on what BCS4/5 means if we take a look at Samsung’s below comment.   1. When requesting and preparing contributions for new BCS on exiting combos, in case all carriers in this configuration support all available bandwidth of the corresponding single band, use BCS4/5 instead of traditional BCS. 2. Request for BCS4/5 should be based on real deployment plan   Our understanding is BCS4/5 is not like “all carriers in this configuration support all available bandwidth of the corresponding single band, use BCS4/5 instead of traditional BCS” as Sumsung proposed. But rather BCS4/5 can indicate some or all of the actually supported channel bandwidths per band configuration. Hence, in some cases, a UE may not support all available bandwidth of the corresponding single band. |
| Nokia(additional comments)  **Issue 1-2-3**  From procedure perspective, handling BCS4/5 together from Rel17 is the more suitable selection due to the following reasons.  In the past discussion, some UE/chipset vendors were against the introduction of BCS4 itself, but as a compromise, they accepted it under the condition that RAN4 address the IoDT issue raised by introducing some signalling mechanism like min channel bandwidth.  After that BCS5 was just proposed because of concern on the introduction of min channel bandwidth from Rel15.  Thus, not handling 4/5 together now would violate our past compromised agreement. |
| ZTE: We have some questions:  **1: Issue 1-1-1: (Page 2)**  How to distinguish the UL and DL for intra-band NR CA supporting BCS4 and BCS5 in the spec?  T-Mobile USA: If BCSs are declared per band combination and not per UL or DL, why do we need to distinguish between UL and DL BCSs in the spec?  **2: Issue 1-1-2 (Page 3)**  If we go with option 1, we propose to correct the Note x as follow:  •Note x: The aggregated bandwidth must be greater than or equal to the minimum for the bandwidth class defined in table 5.3A.5-1, and smaller than or equal to the maximum aggregated bandwidth.  Since to our understanding, the original note x may not include the case like CA\_n41C, where the maximum aggregated channel bandwidth is 190MHz, so 100+100MHz cannot be supported.  Moreover, in last meeting, RAN4 already agreed the templates for inter-band NR CA, however, only BCS4 was included, so can we update it to include BCS5 in this WF? To our understanding, just extent ‘BCS4’ to ‘BCS4 and BCS5’ would be enough.  T-Mobile USA: Done in r2 of the CR, so we can update the WF.  **3: Issue 1-2-1, 1-2-2 (Page 4)**  As commented in 1st round, some principles/guidelines should be discussed. Otherwise, it may cause problem at the stage of flagging.  Also, as announced by Chairman before, all the combs requested should be sent before the meeting. So we think it is too late to update the request sheet, especially after this meeting, although we understand the urgent intention. Time should be strictly observed. For those combs requested after the meeting, it would be seen as illegal combs and would not be included in the revised WID. This is not related to the technical, just the rule. We need to avoid this situation happen.  If companies think it would be ok for the exceptions, then we’d like to ask Chairman for “new” guidelines/rules.  T-Mobile USA: We think this exception has already been authorized by RAN in the WID. From the WID: *Guideline 4: Until BCS4 CR(s) are agreed, TPs and Draft CRs should include the BCSs that were requested for already requested band combinations. After BCS4 CR(s) are agreed, it should be up to the proponents whether TPs and draft CRs include the BCS(s) that were requested and recorded in the WID, or if the TPs and draft CRs only include BCS4. If BCS4 is preferred, the exceptional case of inconsistent information between the basket WID and the TPs/draft CRs is acceptable until the WID is fixed accordingly.*  **Issue 1-2-3:** It looks ok  **4: Issue 1-3-1 (Page 5)**  As mentioned above, the agreed templates for inter-band CA/SUL should be updated to include BCS5. |
| **Xiaomi**  **1. Issue 1-1-1: (Page 2)**  Same question with ZTE how to distinguish the UL only apply traditional BCS and DL can support BCS4 and BCS5 for intra-band NR CA in the spec?  T-Mobile USA: As we said above, since BCSs are only declared per combination and not per UL and DL, we don’t understand the need to distinguish between UL and DL BCSs in the specs.  **2. Issue 1-1-2 (Page 3)**  Although ZTE’s correction for the note x can give some indication that the aggregated channel bandwidth must be smaller or equal to the max the maximum aggregated bandwidth, but there is no any indication how small it should be.  T-Mobile USA: The note says it has to be greater than or equal to the minimum.  So I’m not sure how it can preclude the invalid bandwidth combination when the max aggregated bandwidth defined as 200MHz for class C and 100MHz for class B. For example, for class B, the min aggregated bandwidth is 20MHz, the max aggregated bandwidth is 100MHz, Band n1 can support 5,10,15,20,25,30,40, 50MHz channel bandwidth, so for CA\_n1B it can support the aggregated bandwidths from 5+15, 10+15,…. to 50+50. The max frequency range of band n1 is only 60MHz, how it can preclude the invalid bandwidth combinations 15+50, 20+50, 25+40, 25+50, 30+40, 30+50 and 40+50 from below definition of the BCS4/5 for CA\_n1B if it doesn’t indicate how small the max aggregated bandwidth should be.    CA\_n1B is not a special case, in FR1 the frequency range of most bands are less than 100MHz, the max aggregated bandwidth put in the table just repeats class B<= 100MHz, class C <= 200MHz, class D<=300MHz and so on, actually the definition of CA classes have already contained this meaning. Therefore, such max aggregated bandwidth is meaningless and useless and it can not be used to preclude the invalid bandwidth combination.  T-Mobile USA: Isn’t between the minimum and maximum sufficient? If not, what is the suggestion?  **3. Issue 1-3-1(Page5)**  Proposal: BCS4 for SUL band combinations reuse the same indication format with inter-band CA should be modified as  Proposal: BCS4 and BCS5 for SUL band combinations reuse the same indication format with inter-band CA  T-Mobile USA: Done. Thanks.  At same time, the templates for inter-band NR CA agreed in last meeting should be extended to BCS4 and BCS5 from BCS4.  T-Mobile USA: Agreed  Qualcomm2:  Issue 1-1-2:  Regarding ZTE and Xiaomi’s comments on the maximum aggregated CBW, per our understanding, the maximum aggregated CBW in the table could be smaller than the maximum CBW for band combo class which would depend on the request.  Issues 1-2-2: add some edits on the proposal  Proposal: As suggested by the moderator, the contact person can request to change the not completed band combinations in basket WID once RAN4 agree to request BCS4/BCS5. And the revised WID can be approved in the upcoming RAN plenary meeting. RAN4 can do something based on the latest approved WID in next RAN4 meeting.  Issue 1-2-3: we think the proposal of recommending requesting BCS4 and BCS5 is not clear. It might lead to additional work. Technically, there is no difference to complete BCS4 and BCS5 in the basket. Could not understand why CA\_n3A-n28A is listed as one example which could only be requested as BCS4? We suggest making the following change on the proposal:  **Proposal: ~~It’s recommended~~ RAN4 to request BCS4 and BCS5 together~~, but it doesn’t exclude that only BCS4 is requested by companies for some band combinations with few bandwidth combinations, e.g. CA\_n3A-n28A~~.**  Huawei: To Qualcomm, I think BCS4 and BCS5 are two optional solutions. RAN4 can’t ask companies to request which solution mandatorily. Why we introduced BCS5 is the IODT efforts. For some band combinations, e.g. CA\_n3A-n28A, the IODT efforts are limited. Whether to request BCS5 solution depends on companies’ demand.  T-Mobile USA: To Huawei: If it doesn not make sense to implement BCS5 for a given combination, then it will not be implemented. But since there is no difference in the specs in terms of MSD anslys between BCS4 and BCS5 we agree with Qualcomm that they should be both included. We don’t want to have the gNB police if BCS5 is allowed for a given combination or not. We think that should be left up to the implementers. Therefor we would like to have:  Proposal 7: BCS4 and BCS5 shall be requested together because there is no difference in the MSD analysis  OPPO: For issue 1-2-3, our understanding is that the BCS4 and BCS5 shall be requested at same time, and it is up to UE decide which BCS is supported.  T-Mobile USA: We agree with OPPO.  **Xiaomi2:**  **1. Issue 1-1-1: (Page 2)** Whether BCS4/BCS5 can be used for FR1 intra-band UL CA  The signaling *supportedBandwidthCombinationSet* is reported per band combination, can’t be reported for UL and DL separately.  To-Mobile USA: Good point:  Whether BCS4/BCS5 can be used for FR1 intra-band UL CA  Comment: BCSs are not defined or reported separately for UL and DL for traditional BCSs, so there should be no reason to differentiate between BCS4 and BCS5 for UL and DL  Proposal 2: BCS4 and BCS5 can be used for FR1 intra-band UL CA  **2. Issue 1-1-2 (Page 3)**  Thanks for QC’s clarification, that the maximum aggregated CBW in the table could be smaller than the maximum CBW for band combo class which would depend on the request.  I agree the proposal with the clarification of the maximum aggregated CBW could depend on the request.  **3. Issue 1-2-3:**  The BCS4 and BCS5 should be requested as a package without any exception. firstly, BCS5 is functionally equivalent to BCS4 except the signaling, therefore, there is no any additional workload for BCS5 introduced with BCS4. The purpose introducing BCS4 and BCS5 is to reduce RAN4’s workload and simplify the Spec due to a blood of BCSs are requested, the exception for some band combs only requesting BCS4 will cause additional workload to introduce BCS5 in future.  T-Mobile USA. Agreed:  Proposal 7: BCS4 and BCS5 shall be requested together because there is no difference in the MSD analysis |
| R4-2114922 Revised CR for 38.101-1: Introduction of BCS4 and BCS5 | Nokia  As commented in the above R4-2114919, it may be necessary to clarify the below texts.  The configuration tables for CA describe Bandwidth Combination Sets. Bandwidth Combination Set 4 and 5 contains all possible defined channel bandwidths for each band in the combination. The fact that BCS4 and BCS5 contains all channel bandwidths for each band does not alter if a bandwidth is mandatory or optional for a given band. Bandwidths that are identified as optional in Table 5.3.5-1 for a given release are still optional for UEs that support BCS4 or BCS5. The bandwidths the UE supports for each band and the maximum bandwidth for the band in the band combination are indicated in the UE capabilities.  BCS4/5 can contain or indicate all possible defined channel bandwidths for each band in the configuration but not all ways contain them.  If contains, the last text is contradicting since it says that some restriction can be made. And in case min channel bandwidth is introduced, that is also needed to be incorporated in the below text together with maximum bandwidth.  The bandwidths the UE supports for each band and the maximum bandwidth for the band in the band combination are indicated in the UE capabilities. |
| ZTE: For the sentence, “*Bandwidth Combination Set 4 and 5 contains all possible defined channel bandwidths* ***for each band*** *in the combination. ”,*  it seems exclude the configurations include intra-band contiguous/non-contiguous CA, since the channel bandwidth should be referred to the fallback intra-band contiguous/non-contiguous CA, rather than each band.  Not sure why we need the last sentence? The signalling design for BCS5 is still ongoing in RAN2.  Qualcomm2:  Agree with Nokia and ZTE. The last sentence could not reflect the BCS5’s new signalling which is still under discussion in RAN2. Suggest to removing the last sentence in this CR.  Regarding the examples added in the CR, I think we should remove it since it was not requested by formal procedure. For example, it should be requested in basket WID first. |
| T-Mobile USA: Thanks for the comments. The CR has been revised. |
| R4-2114924 Revised CR for 38.101-3: Introduction of BCS4 and BCS5 | Qualcomm2: Regarding the examples added in the CR, I think we should remove it since it was not requested by formal procedure. For example, it should be requested in basket WID first. |
| T-Mobile USA: Thanks for the comment. As discussed offline we think it is important to have example combinations. RAN4 WIDs usually have example combinations. |
|  |
| R4-2114925 Revised CR for 38.307: Release independence of BCS4 and BCS5 | Qualcomm2: the release independence issues are still discussing in RAN2. We suggested to postponing the CR for TS38.307. |
| T-Mobile USA: Thanks for the comment. As discussed offline we think it is important to have example combinations. RAN4 WIDs usually have example combinations. |
|  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configurations | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Maximum aggregated  bandwidth (MHz) | Bandwidth combination set |
| CA\_n1B | - | See nX and channel bandwidths in Table 5.3.5-1 | |  |  |  | 100 | 4 and 5 |
| Note x: The aggregated bandwidth must be greater than or equal to the minimum for the bandwidth class defined in table 5.3A.5-1, and smaller than or equal to the maximum aggregated bandwidth. | | | | | | | | |

# Topic #2: Improvements to MSD table

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2111727 | Qualcomm Incorporated | **Proposal 1**: Further investigate equation-based MSD for harmonic interference to accommodate unequal interference levels on the 2 RX ports.  **Observation 1:** Full uplink RB configuration will result in higher MSD than the counter IM MSD with restricted uplink configuration  **Observation 2:** Case 1 MSD can be higher or lower than Case 2 MSD due to filter rejection variation between band combinations  **Observation 3:** MSD will vary as a function of frequency offset and is not constant when DL bandwidth over the region of TX ACLR1 and TX ACLR2.  **Proposal 2**: Specify MSD due to full RB allocation in the next meeting and remove MSD due to CIM interference. |
| R4-2113421 | Huawei, HiSilicon | **Proposal 1: It’s proposed to choose an appropriate DL Rx channel bandwidth which only overlaps with 1st or 2nd adjacent channel in Tx aggressor band for the MSD due to Tx non-linearity interference in 1st and 2nd adjacent channel of UL band.**  **Proposal 2: RAN4 can specify the MSD requriements by configuring both full RB allocations and edge RB allocations.** |
| R4-2113423 | Huawei, HiSilicon | In RAN4#99 meeting, WF R4-2107822 for improvements on MSD was approved. The impacts on the specifications are shown in this CR.   1. To impove the REFSENS exceptions due to UL harmonic interference. 2. To impove the REFSENS exceptions due to cross band isolation.   To impove the REFSENS exceptions for SUL band combinations.  3. To improve the REFSENS exceptions for SUL band combinations. |
| R4-2114581 | Skyworks Solutions Inc. | **Observation 1: There are more than 800 MSD test points specified to cover solely the case of MSD due to Tx harmonic and cross-band isolation. Considering these 800 points are specified to approximately 100 unique pairs of aggressor/victims, there is a huge opportunity to reduce the TS size, complexity and consequently conformance test time. An overall factor x8 reduction may be achieved.**  **Observation 2: UL RB allocations are often inconsistent from bands to bands and do not necessarily allow verification of the UE worst case MSD performance.**  **Observation 3: RF parameters such as UL test carrier frequencies and / or CBW are captured in footnotes in a manner which is difficult to read and inconsistent between each MSD table.**  **Proposal 1: To greatly simplify and eliminate the following MSD tables:**   * **Table 7.3A.4-1 and to eliminate Table 7.3A.4-2 (NR-CA Tx harmonic MSD tables);** * **Table 7.3A.4-4, Table 7.3A.4-4a and to eliminate Table 7.3A.4-5 (NR-CA PC3, PC2 Rx Harmonic MSD tables); and** * **Table 7.3C.2-2 and to eliminate Table 7.3C.2-3 (SUL Tx harmonic MSD tables).**   **Adopt the concept of** Table 2 **where:**   * **Only one MSD test point is specified per aggressor/victim pair of bands and per hit condition (complete harmonic overlap / near miss overlap). This MSD test point is that which leads to the worst-case/highest victim’s MSD level. This corresponds to the lowest victim’s CBW.** * **Specify the UL/DL test carrier frequencies and test channel bandwidth.** * **Specify the aggressor UL RB Allocation (Lcrb + RBstart) which must guarantee that the UL harmonic PSD is entirely integrated by the victyim’s Rx CBW.** * **Specify the harmonic order.**   Table 2: Proposed concept and format change to Table 7.3A.4-1 and elimination of Table 7.3A.4-2 to capture REFSENS exceptions due to UL harmonic for the example case of NR CA\_n5-n77   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **UL band** | **DL band** | **UL Fc** | **UL BW** | **UL RB Allocation** | **DL Fc** | **DL BW** | **MSD** | **Harmonic  order** | | **(MHz)** | **(MHz)** | **LCRB** | **(MHz)** | **(MHz)** | **(dB)** | | n5 | n774, 5 | [846.5] | [5] | [12 (RBstart=6)] | [3386] | 10 | **10.5** | **4** |   **Proposal 2: To greatly simplify and eliminate the following MSD tables:**   * **Table 7.3A.6-1 (PC3 table),** **Table 7.3A.6-1a (PC2 table) and to eliminate Table 7.3A.6.2 (NR-CA Cross-band isolation MSD tables); and** * **Table 7.3C.2-4 and to eliminate Table 7.3C.2-5 (SUL Cross-band MSD tables).**   **Adopt the concept of Table 3 where:**   * **Only one MSD test point is specified per aggressor/victim pair of bands. This MSD test point is that which leads to the worst-case/highest victim’s MSD level. This corresponds to the lowest victim’s CBW.** * **Specify the UL/DL test carrier frequencies and test channel bandwidth.** * **Specify the aggressor UL RB Allocation as fully allocated.**   **Table 3**: Proposed concept and format changes to Table 7.3A.6-1 and elimination of Table 7.3A.6.2 to capture REFSENS exceptions due to cross-band isolation for the example case of NR CA\_n1-n3.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **UL band** | **DL band** | **UL Fc** | **UL BW** | **UL RB Allocation** | **DL Fc** | **DL BW** | **MSD** | | **(MHz)** | **(MHz)** | **LCRB** | **(MHz)** | **(MHz)** | **(dB)** | | n1 | n3 | [1945] | [50] | [270 (RBstart=0)] | [1877.5] | 5 | [22.5] | |

## Open issues summary

### Sub-topic 2-1

*Sub-topic description: The improvement for MSD due to harmonic interference has been discussed in several meetings. The detailed improvements were proposed by companies in WF R4-2107822. RAN4 can further discuss how to improve the MSD due to harmonic interference and the table format.*

*Open issues and candidate options before e-meeting:*

**Issue 2-1-1: How can RAN4 improve the MSD due to harmonic interference?**

* Proposals
  + Option 1: Only one MSD test point is specified per aggressor/victim pair of bands and per hit condition (complete harmonic overlap / near miss overlap). This MSD test point is that which leads to the worst-case/highest victim’s MSD level. This corresponds to the lowest victim’s CBW.
  + Option 2: Further investigate equation-based MSD for harmonic interference to accommodate unequal interference levels on the 2 RX ports
* Recommended WF
  + Option 1

**Issue 2-1-2: If only one MSD test point is specified for harmonic interference, how can the table format be specified?**

* Proposals
  + Option 1: Proposed concept and format change to Table 7.3A.4-1 and elimination of Table 7.3A.4-2 to capture REFSENS exceptions due to UL harmonic for the example case of NR CA\_n5-n77.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL Fc** | **UL BW** | **UL RB Allocation** | **DL Fc** | **DL BW** | **MSD** | **Harmonic  order** |
| **(MHz)** | **(MHz)** | **LCRB** | **(MHz)** | **(MHz)** | **(dB)** |
| n5 | n774, 5 | [846.5] | [5] | [12 (RBstart=6)] | [3386] | 10 | **10.5** | **4** |

* + Option 2: Others
* Recommended WF
  + Option 1

### Sub-topic 2-2

*Sub-topic description: There are three cases to be considered for different UL Tx bandwidths, DL Rx bandwidths and frequency gap between UL and DL carrier frequencies, which are identified in WF R4-2107822 for full RB allocation. And RAN4 need to further discuss whether to introduce MSD due to CIM interference with UL fewer RB allocation*

*Open issues and candidate options before e-meeting:*

**Issue 2-2-1: How can RAN4 improve the MSD due to cross band isolation for the band combinations that only case 3 apply?**

* Proposals
  + Option 1: Only one MSD test point is specified per aggressor/victim pair of bands. This MSD test point is that which leads to the worst-case/highest victim’s MSD level. This corresponds to the lowest victim’s CBW. The table format can be used as below.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL Fc** | **UL BW** | **UL RB Allocation** | **DL Fc** | **DL BW** | **MSD** |
| **(MHz)** | **(MHz)** | **LCRB** | **(MHz)** | **(MHz)** | **(dB)** |
|  |  |  |  |  |  |  |  |

* + Option 2: others
* Recommended WF
  + Option 1

**Issue 2-2-2: How can RAN4 specify the MSD for the band combinations that case 1 and/or case 2 also apply except for case 3, e.g. CA\_n1-n3 and CA\_n1-n40?**

* Proposals
  + Option 1: RAN4 can specify the MSD requirements by configuring both full RB allocations and edge RB allocations for case 1 and/or case 2.
  + Option 2: RAN4 can specify the MSD requirements by only configuring full RB allocations for case 1 and/or case 2. (That means not to consider MSD due to CIM interference)
  + Option 3: Others
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Issue 2-1-1:  Apart from the option 1 or 2, MSD for the other Rx channel bandwidths should be captured in TR. Otherwise, people may think that some band combinations are useless by just taking a look at the worst case.  Issue 2-1-2: Option 1 |
| T-Mobile USA | Issue 2-1-1: We agree with Nokia that it would be best if there was some way to differentiate so that worst case MSD doesn’t always apply.  Issue 2-1-2: Option 1 |
| ZTE | Issue 2-1-1:  We disagree that MSD captured in the TR and TS are different, i.e. MSD in TS only include the worse case while MSD in TR for the other Rx channel bandwidths, also they are in different table format. It will cause trouble when implementing the big CR since rapporteur may judge by himself which one is the worst case among all the values defined in the TR, which may cause technical issue.  **Issue 2-1-2: If only one MSD test point is specified for harmonic interference, how can the table format be specified?**  Not sure why we need ‘**RBstart’** in the table, since in original table, no such information included. Also how to derive the RBstart? |
| Huawei | Issue 2-1-1:  Option 1. To Nokia, currently the TR has captured the MSD for the other Rx channel bandwidths. In the future, if RAN4 agree to do additional analysis for other Rx channel bandwidths, I’m OK with it. However, as we discussed in my paper, we can’t enumerate all the combinations with different UL channel bandwidth and DL channel bandwidth. In addition, REFSENS is the key factor to consider the network deployment instead of MSD. For example, CA\_n3-n78 with DL 10MHz in n78 may have 23dB MSD, but all the REFSENS are -71.7dBm for all the different DL channel bandwidth in n78. MSD is just used to specify the requirements conveniently.  Issue 2-1-2: Option 1 |
| Skyworks | **Issue 2-1-1: Option 1.**  To address Nokia’s concerns and ZTE’s concerns, how about capturing in the TR the MSD that will be removed from TS by using equation-based representation? This approach has proven sufficiently accurate to represent how the MSD due to harmonic relation decays vs CBW. It would be rather simple to capture in TR, and would also address operator’s concerns.  **Issue 2-1-2: Option 1 as this enables great simplification of TS complexity.** |
| Verizon | Issue 2-1-1:Option 1  Issue 2-1-2: Option 2 agree with ZTE |
| CHTTL | Issue 2-1-1:  We also have concern on the option 1.  First, we still prefer the existing table in the TS, which is already very clear. Also some of the requirements are already there for several years and several releases, not sure it is proper to take them out. And we think people in this area are much more focus on the TS spec.  Second, if only one MSD test point can be chosed, larger bandwidth is prefered since small bandwidth is usually not used in commercial network. And since REFSENS is also degrade with the larger channel BW as Huawei pointed out, for example, the REFSENS for CA\_n3-n78 with DL 10MHz is -96.1+23.9 = -72.2 dBm, but the the REFSENS for CA\_n3-n78 with DL 100MHz is -85.6+13.8 = -71.8, with this aspect, the lowest victim’s CBW seems not the worst case.  Third, we are wondering why the specific test point is needed to be defined, we think the UE shall fulfull the requirement under the condition descibed in the spec ex: under some order of harmonic overlapping, so the test point which is randomly picked must be ok.  Issue 2-1-2: Option 2 (see comment above) BTW the length of the TS spec is not reduced. |
| ZTE | Issue 2-1-1:  To SKW, not sure equation-based representation is sufficiently accurate, since we see different MSD values proposed for the same band configuration by different companies by using traditional methods and equation-based methods. Also we see companies still have concerns on equation-based methods (i.e. Option 2).  In addition, since one of the BCS4 work is to define the missing MSD value for the new channel bandwidth supported in constitute band for the combination which is not request to support these CBWs but to compliance BCS4. However, please bear in mind the BCS4 is optional, and traditional BCSs are also applicable pending on the proponent request. If only worst case MSD is defined, is that mean no MSD work needed for these configuration requested with traditional BCSs? If it is the case, people may ignore to further check especially the BW for the worse case is not used in reality.  Moreover, we share the same view as CHTTL that it may not proper to rule out the existing values, also we see there are some problems pointed out by CHTTL. So currently we also prefer the existing table in the TS. |
| Qualcomm | Issue 2-1-1:  The problem with option1 is that it assumes no difference between 1RX and 2RX and ASSUMES that equal interference on both ports gives the worst-case condition over all BWs and the analysis we presented clearly shows this is not the case as the higher interference on one antenna will reflect higher MSD at the larger BW. How do you take this condition into account in the future? Arguments will then be made to raise the MSD at the lower BW for equal interference on 2RX to account for higher MSD at the larger BW for unequal interference.  Issue 2-1-2:  Need to explain how to account for the worst-case MSD over DLBW. |
| Huawei | To QC, you may misunderstand the current proposal. Current MSD values specified in spec are reused and We just take one test configuration instead of using equation-based method.  To CHTTL, we have explained the reason why we do this improvement in our contributions R4-2110405.  Firstly, As the channel bandwidths are increasing, it’s necessary to simplify the MSD exception tables in 7.3A.4 from TS 38.101-1, e.g. 35MHz, 45MHz and irregular channel bandwidth.  Secondly, RAN4 use the minimum channel bandwidth of victim bands to evaluate the MSD value and derive values of other channel bandwidth when specifying MSD. That’s why the minimum channel bandwidth is chosen. As you said CA\_n3-n78, 100MHz DL case is just based on the derivation instead of technical evaluation.  Thirdly, as channel bandwidth is increasing, we never increase the UL RB allocation. If we consider the combination (aggressor UL BW, victim DL BW), RAN4 need to enumerate more test cases. The specific test case can make the MSD more accurate.  In the end, the purpose of MSD improvement is not to shorten the specification. The test efforts for so many different DL BW test configurations have been analyzed in Skyworks’ contribution. |
| Apple | Issue 1-2-1  We support to define only one test point for each interference mechanism for each band combination, like what we have done for 2UL IMD test configuration. The DL victim carrier channel BW can be specified as the minimum channel BW supported by the band, and the UL aggressor channel BW/RB allocation can be chosen such that the victim carrier would observe the highest MSD.  In the case of BCS5, where the UE is allowed to signal its supported minimum CBW, a single MSD test point defined at minimum channel BW may render not testable for some UEs. In our view, a compromise between mandating BCS4 and defining only one MSD test point can be a good WF.  If defining BCS4 and still allowing UE to skip certain channel BWs as defined in the specifications (all CBW defined in Table 5.3.5-1 are supposed to be mandatorily supported by UE), and yet exhausting the MSD configurations for all channel BW, it might defeat the purpose of BCS4. With that said, we think BCS5 might not be so useful if UE is mandated to support all CBW as specified in Table 5.3.5-1. |

Sub topic 2-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Issue 2-2-1: Option 2  Option 1 + other cases to be captured in TR is recommended. It makes readers think that some band combination useless.  Issue 2-2-2: Option 1  Edge RB allocations are necessary otherwise the impact of CIM on system cannot not be visible. |
| T-Mobile USA | Issue 2-2-1: Option 2  Issue 2-2-2: Option 1 |
| ZTE | Issue 2-2-1: Option 2  Similar with issue 2-1-1. |
| Huawei | Issue 2-2-1: Option 1  Issue 2-2-2: Option 1 |
| Skyworks | Issue 2-2-1: Option 1  To TMO-USA: could option 2 be further explained? In our view, it is essential that test points in TS are reduced to a single pair of aggressor/victim’s CBW to make the TS future-proof in the case new CBW are added and to serve BCS4 concept.  To Nokia: Option 1 + missing MSD in TR: In principle this is a good idea. In practice, contrary to the MSD due to harmonic, equation based can not be simply ported to the case of MSD due to cross-band isolation because the MSD vs CBW is a stair-case function which depends on which region of the aggressor noise emission is the victim band located. So, capturing the removed MSD test points in the TR is feasible, but additional work load should be considered.  Issue 2-2-2: Option 1 |
| Verizon | Issue 2-2-1: Option 1  Issue 2-2-2: Option 1 |
| CHTTL | Issue 2-2-1: Option 2. Same comment applied as in Issue 2-1-1, we prefer the existing table for the existing combinations, we are not sure the issue on the existing approach, and BCS4/5 seems to be request based. |
| Qualcomm | Issue 2-2-1: Option 1  Issue 2-2-2: Option 1 |

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2113423 | Skyworks: Thank you for bringing this CR. We suggest revisiting this CR once agreement has been reached on the MSD test point solutions discussed in this meeting. Then we could greatly simplify the number of MSD test points. |
| CHTTL: Thank you for the CR, it seems a huge change on the spec. Some requirements are removed, but the length of the paragraph is not reduced……? |
| Huawei: To CHTTL, the purpose is not to shorten the specification. As the channel bandwidths are increasing, it’s necessary to simplify the MSD exception tables. The test effort have been analyzed in Skyworks’ contribution. |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#2-1** | **Issue 2-1-1: How can RAN4 improve the MSD due to harmonic interference?**  4~5 companies agree the option 1. No one support Option 2. One company have concerns on the number of test cases and the minimum channel bandwidth.  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:*  RAN4 can further discuss in 2nd round.  **Issue 2-1-2: If only one MSD test point is specified for harmonic interference, how can the table format be specified?**  Four companies express concerns on the worst-case MSD over DLBW and RBstart.  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:*  Proponent can further address these comments raised by companies in the second round. Companies are encouraged to further discuss option 1 as a start point. |
| **Sub-topic#2-2** | **Issue 2-2-1: How can RAN4 improve the MSD due to cross band isolation for the band combinations that only case 3 apply?**  4~6 companies agree option 1. Two companies prefer the existing table. Two companies want to include current requirements into TR at least.  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:*  RAN4 can further discuss in 2nd round.  **Issue 2-2-2: How can RAN4 specify the MSD for the band combinations that case 1 and/or case 2 also apply except for case 3, e.g. CA\_n1-n3 and CA\_n1-n40?**  6 companies agree option 1  *Tentative agreements:*  RAN4 can specify the MSD requirements by configuring both full RB allocations and edge RB allocations for case 1 and/or case 2.  *Candidate options:*  *Recommendations for 2nd round:*  The agreement can be captured in WF. |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

### comments collection

*It’s recommended that companies provide comments on WF and revised Draft CR directly.*

|  |  |
| --- | --- |
| **WF/CR** | **Comments collection** |
| R4-2114920  WF on MSD improvement | CHTTL: Thank you for the WF.  As we comment in the 1st round, the lowest victim’s CBW seems not the worst case from the REFSENS point of view, also there will be a problem when the minimum supported channel BW changes due to the introduction of new BCS (ex: BCS5), then the test point might not be testable if we apply the proposals in this WF, so we think further study is needed.  And regarding the testing effort, even with the current table, RAN5 already defined the test configuration with the test point based that not all of the DL/UL pairs are tested, only **one** of them is selected for the given configuration, so it seems that it is already solved in RAN5, so maybe we can just leave this to RAN5.  So for the harmonic and the cross-band isolation table, our thinking is to keep the existing table, but maybe some additional note can be considered that if the MSD value is not specified in the table for the supported channel BW, then it can be determined by the equation based method, with this we also don’t need to update all the MSD due to the introduction of the new BW.  We suggest to further consider the solution that can maintain the current table, so we are not ok with the WF. |
| Nokia: we support the comment from CHTTL(though we don’t think BCS5 is not related to this discussion).  For harmonics, we understand that we need to minimize the number of testing points. But in case some narrower channel bandwidths are introduced, these requirements should also be reflected in the spec.  For MSDs regardless of causes, we still think that capturing TRs is necessary. We are OK to capture a formula to derive MSD or specific values. Since we understand the burden to check every single combination, so that it would be good to discuss on how formula works. |
| ZTE: We support CHTTL’s comments.  Not sure why we need ‘**RBstart’** in the table, since in original table, no such information included. Also how to derive the RBstart?  Moreover, it seems companies tent to agree to use equation based method, it would be good to discuss on how it works. |
| Skyworks:  To CHTTL:  For MSD due to harmonic P1/p2: the rationale for picking the victim’s smallest CBW is justified because this is the CBW at which the highest MSD occurs. So the key is capture the worst case MSD not the worst case REFSENS. This can be clearly seen in the cited example of CA\_n3-n78: the MSD decays from 23.9dB at 10MHz to 13.8dB at 100MHz CBW. This is why the n78 10MHz CBW is the worst case, not the 100MHz CBW. For this example, only the 23.9dB needs to be specified.  We have not checked if RAN5 does what is reported here. In our opinion, it is sufficient to adopt the agreed dual IMD MSD approach where RAN4 already skips several lower MSD values than the agreed value. For example, there are several combinations for which only the highest IMD order MSD is specified and a footnote is used to inform that MSD due to, say, IM5 (a lower IMD order) is not specified. This is the root cause of a long discussion on an LS reply to RAN 5 in thread [149]. And contrary to MSD due to harmonic, when an MSD due to say IMD4 is missing, it is not trivial to derive the missing MSD value. However, for MSD due to harmonic, we think it is the right approach because due to the monotonic decay of an MSD due to harmonic relations, it is fairly straightforward to calculate the missing/removed MSD test point. The early proposals on equations-based representation seemed to provide relatively accurate approximation of the agreed MSD levels. So removing MSD test points should not be an issue, and if the values are needed, they can be easily calculated and/or captured in TR.  Note this comment also applies to MSD due to cross band isolation. See for example MSD plots vs victim CBW reproduced here. 5MHz victim’s channel BW is the BW at which the highest MSD is met (case of fully allocated n1 Tx aggressor in CA\_n1-n3).    To ZTE:  For MSD due to harmonic: the reason why we need to capture RBstart is that it enables not only retaining one MSD test point (P2) per agg/victim pair, but it also ensures the equation based delivers best accuracy. Explanation: in the previous WF, it was agreed that the aggressor harmonic PSD is entirely integrated by the victim’s CBWs. This means we need to align the center frequency of the aggressor harmonic with the victim DL Fc and we need to ensure that the victim’s CBW is greater than the aggressor harmonic bandwidth. This is why we need to adjust Lcrb and RBstart when UL Fc and DL Fc are specified. Once this aggressor / victim collision condition is met for the smallest victim’s Rx CBW, monotonic MSD decay is guaranteed since increasing the victim Rx CBW does not change the integrated harmonic total power. This is why it is an enabler to using equation-based formulae in TR.  To Nokia: it is correct that the assumption in our discussion paper is that today’s minimum CBW remains the lowest CBW. If say, a bandwidth lower than 5MHz is introduced for bands where this was the lowest value, we would have to decide on a case by case basis how to handle the MSD for this new lowest CBW. It would mean the single test point proposed here is no longer the absolute worst-case MSD. Would two points per aggressor/victim pair be acceptable (legacy smallest CBW & “new” smallest CBW)? This would still be a significant gain over the hundreds of redundant test points. |
| Qualcomm | We are okay with the single test point for harmonic MSD, however as we have shown in our contribution and discussed in the 1st round and the last meeting (#99-e), the MSD decay from the lowest DL BW to the highest DL BW will depend on the interference level difference on the 2 RX antenna ports using MRC combiner. This information must be added to the TR. |
| Huawei | To Qualcomm and Nokia, do you mean that some derived equation and analysis should be captured in Basket TR? Because BCS4 WI has no internal TR. |
| CHTTL | Since draft v2 also includes the option to investigate the solution for new channel BW while keeping the existing table, we are ok.  To Skyworks:  Thanks for the explanation. Regarding the worst case MSD/REFSENS discussion, we just want to point out the MSD values for larger channel BW is also important for us. The worst MSD is chosen based on the concept as “worst case scenario”. But the REFSENS values after the relaxation by the MSD is the actual performance requirement. And by removing the MSD for larger BW, we will not able to know the expected minimum performance for the larger BW, which is much more practical for the deployment. And we prefer to keep them in the TS spec, as the TS spec is much more representative, and the content of the TR is scattered in different releases. Also, consider the current tables are already there for three releases, we should keep the spec stability. And with option 1, the test point will be changed if the new lower ch BW is introduced, the stability is also questionable. So we think the solution should be based on the existing table. And the actual test points can be handled in RAN5, and they are already handled in RAN5. For IMD, the scenario is much more complicated so different approach is applied. |
| R4-2114921  Draft CR for 38.101-1 to simplify the MSD | CHTTL: same comment above. |
|  |
|  |

# Topic #3: Introduction of MSD requirements for inter-band ENDC combinations

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2113808  (R4-2113809 CAT A) | Huawei, HiSilicon | 1. Adding the MSD requirements of DC\_3\_n41 for PC2.  2. To remove brackets in clause 7.3B.2.3.1 and 7.3B.2.3.4. |
| R4-2113810 | Huawei, HiSilicon | 1. To specify harmonic MSD requirements of DC\_2\_n48/ DC\_8\_n41/ DC\_20\_n41/ DC\_26\_n41/ DC\_66\_n48/ and UL configurations of DC\_2\_n78.  To specify cross band isolation MSD requirements of DC\_1\_n41/ DC\_3\_n41/ DC\_1\_n3/ DC\_1\_n40/ DC\_7\_n40/ DC\_41\_n3. |

### CRs/TPs comments collection

*Companies can comment the CR directly.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2113808  (R4-2113809 CAT A) | Company A |
| Company B |
|  |
| R4-2113810 | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#3-1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:*  *No comment are received. All the CRs can be agreed.* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
| *WF on BCS4 for general part* | *T-Mobile USA* |  |
| *WF on MSD improvement* | *Huawei, HiSilicon* |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-2111727 | BCS4 MSD | Qualcomm Incorporated | Noted |  |
| R4-2111765 | Clarification of BCS4/5 scope | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2112246 | Proposals on BCS4 and BCS5 | Qualcomm Incorporated | Noted |  |
| R4-2112914 | Templates on BCS4/5 | ZTE Corporation | Noted |  |
| R4-2113095 | BCS4 for SUL and intra-band NR-CA | Xiaomi | Noted |  |
| R4-2113421 | Discussion on MSD due to Tx non-linearities interference in 1st and 2nd adjacent channel of UL band | Huawei, HiSilicon | Noted |  |
| R4-2113422 | General discussion on introduction of BCS4 | Huawei, HiSilicon | Noted |  |
| R4-2113423 | Draft CR for 38.101-1 to simplify the MSD | Huawei, HiSilicon | revised |  |
| R4-2114243 | CR for 38.101-1: Introduction of BCS4 and BCS5 | T-Mobile USA | revised |  |
| R4-2114244 | CR for 38.101-2: Introduction of BCS4 and BCS5 | T-Mobile USA | Not available |  |
| R4-2114245 | CR for 38.101-3: Introduction of BCS4 and BCS5 | T-Mobile USA | revised |  |
| R4-2114246 | CR for 38.307: Release independence of BCS4 and BCS5 | T-Mobile USA | revised |  |
| R4-2114247 | BCS4 and BCS5 Discussion | T-Mobile USA | Noted |  |
| R4-2114581 | BCS4 - Improvements to MSD Tables | Skyworks Solutions Inc. | Noted |  |
| R4-2113808 | CR for 38.101-3 to introduce the missing MSD requirements (Rel-16) | Huawei, HiSilicon | Agreeable |  |
| R4-2113809 | CR for 38.101-3 to introduce the missing MSD requirements mirrorCR | Huawei, HiSilicon | Agreeable |  |
| R4-2113810 | CR for 38.101-3 to specify the MSD requirements for ENDC combinations (Rel-17) | Huawei, HiSilicon | Agreeable |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)