**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-210XXXX**

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 8.3.1, 8.3.2, 8.3.3

**Source:** Moderator (company name)

**Title:** Email discussion summary for [98-bis-e][130] NR\_RF\_FR2\_req\_enh2\_Part\_1

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary.*

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round: TBA
* 2nd round: TBA

# Topic #1: 8.3.2.1.1 Applicability of CBM/IBM for different CA configurations

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2104559**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104559.zip) | Add beam management type after particular band combination requirement | MediaTek Beijing Inc. | Approval:**Proposal: Add “\_IBM” or “\_CBM” after particular band combination requirement directly to show the requirement is for IBM or CBM.** |
| [**R4-2105095**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105095.zip) | Applicability of CBM/IBM for different CA configurations | Xiaomi | Approval:**Proposal 1: The UE capability signalling to indicate both of IBM and CBM are supported by UE per band combination should be introduced.** |
| [**R4-2106364**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106364.zip) | Discussion on CBM&IBM for FR2 Inter-band DL CA | ZTE Corporation | Approval:**Proposal 1. CBM and IBM should be explicitly indicated in the TP study and in the TS38.101-2 for FR2+FR2 band combination.** |

## Open issues summary

### Sub-topic 1-1

**Issue 1-1: Add beam management type after particular band combination requirement**

Proposals

* + Option 1: Yes
	+ Option 2: No
* Recommended WF
	+ TBA

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| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 1.As a proponent, our intention is very simple, just to make the particular requirement based on IBM/CBM be clearer, instead of use extra statement in TS to explain; because RAN4 would have different IBM/CBM requirements. Note that, The UEs still need to do signaling for IBM/CBM capability as agreed. |
| OPPO | Option 1. Ok to clarify the requirements are defined for CBM or IBM, maybe with a note in the band combination table is enough? |
| Qualcomm | Proposal is a possibility but is better revisited once we know UE RF requirements for CBM UE also. Until such time, it is not known which requirements need IBM qualification and which can be common for both |
| LG Electronics | Option 2. As agreed in last meeting, either IBM or CBM is applicable as UE capability. So, our preference is to note as UE capability. |
| Samsung | Option 1 makes requirements clearer. But it is also necessary to clarify the relationship with issue 1-2, i.e. in case a UE supports both IBM and CBM for the same band combo. |

**Issue 1-2: The UE capability signalling to indicate both of IBM and CBM are supported by UE per band combination should be introduced**

* Proposals
	+ Option 1: Yes
	+ Option 2: No
* Recommended WF
	+ TBA

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| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 1.If UE can meet both IBM and CBM requirements of the particular band combination, respectively, it makes sense to allow UE indicates both IBM and CBM are supported. How to simplify the signaling architecture/format can be FFS, we don’t have strong view on this currently. |
| OPPO | It has been supported by current signaling, i.e. beamManagementType-r16 -> ENUMERATED {ibm, cbm}. Not sure what is new here. |
| LG Electonics | It needs to be clarified. Does it mean either IBM or CBM, or both IBM and CBM ? As either IBM or CBM as UE capability, we support Option 1. For both IBM and CBM, we support Option 2. |
| Samsung | We also propose to discuss the case in our contribution R4-2105042, i.e. if a UE is allowed to support both IBM and CBM for a band combo. In our understanding, a UE can supports both, but current signaling can only indicating to support one of the two. To address this issue, we can accept option 1. To avoid signaling change, another manner can be also considered, i.e. define CBM as a fall back mode of IBM. (A UE indicating IBM capability implicitly indicates its support of CBM). |

**Issue 1-3: CBM and IBM should be explicitly indicated in the TP study and in the TS38.101-2 for FR2+FR2 band combination.**

Proposals

* + Option 1: Yes
	+ Option 2: No
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 1.Clear indication can make the CA band combination type demand be clearer. Note that, The UEs still need to do signaling for IBM/CBM capability as agreed. |
| OPPO | Option 1 |
| Qualcomm | Proposal may be a good method, but it is better to revisit if and when RAN4 decides that some band pair needs BM restrictions by specification (example: RAN4 may decide n2xx+n2yy may not be served by UEs with CBM). Until such time, it would appear both any band pair can be served with either IBM or CBM. |
| LG Electronics | Support option 1 as UE capability. |
| Samsung | Option 1 makes requirements clearer. But it is also necessary to clarify the relationship with issue 1-2, i.e. in case a UE supports both IBM and CBM for the same band combo. |

## Companies views’ collection for 1st round

### Open issues

Comment directly under each issue above.

### CRs/TPs comments collection

No CRs/TPs.

## 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 #1** | *Tentative agreements:**Candidate options:**Recommendations for 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.*

|  |  |
| --- | --- |
| **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)

# Topic #2: 8.3.2.1.2 UE requirements for CA configurations CA\_n258A-n260A and CA\_n257A-n259A based on IBM

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc**  | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2106287**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106287.zip) | Discussion on RF requirements for inter-band DL CA based on CBM and IBM | LG Electronics Polska | Discussion**Proposal 4: Define relaxation values considering frequency separation per band pair for FR2 inter-band CA with IBM in different frequency group.** |
| [**R4-2105095**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105095.zip) | Applicability of CBM/IBM for different CA configurations | Xiaomi | **Approval:****Proposal 3: Inter-band DL CA based on IBM need consider the relaxations of EIS and EIS spherical coverage:*** **No matter within the same frequency group or between different frequency groups, reuse the same framework established for n260+n261 and the same relaxation values 3.5dB.**
 |
| [**R4-2106364**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106364.zip) | Discussion on CBM&IBM for FR2 Inter-band DL CA | ZTE Corporation | Approval:**Proposal 2. No need to limit the maximum number of CCs** |
| [**R4-2104561**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104561.zip) | RIB proposal of CA\_n258A-n260A and CA\_n257A-n259A based on IBM | MediaTek Beijing Inc. | ***Proposal 1:*** *The relaxation values shall be further discussed based on per band pair case by case.****Proposal 2:*** *PC3 ΔRIB of CA\_n258A-n260A and CA\_n257A-n259A based on IBM shall be defined as:*For CA\_n258A-n260A:

|  |  |  |
| --- | --- | --- |
| **NR CA bands** | **NR band** | **ΔRIB,P,n (dB)** |
| CA\_n258-n260 | n258 | 4.1  |
| n260 | 4.0 |

|  |  |  |
| --- | --- | --- |
| **NR CA bands** | **NR band** | **ΔRIB,S,n (dB)** |
| CA\_n258-n260 | n258 | 4.2 |
| n260 | 3.2 |

For CA\_n257A-n259A:

|  |  |  |
| --- | --- | --- |
| **NR CA bands** | **NR band** | **ΔRIB,P,n (dB)** |
| CA\_n257-n259 | n257 | 4.2 |
| n259 | 4.0 |

|  |  |  |
| --- | --- | --- |
| **NR CA bands** | **NR band** | **ΔRIB,S,n (dB)** |
| CA\_n257-n259 | n257 | 4.2 |
| n259 | 3.2 |

 |
| [**R4-2104698**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104698.zip) | UE requirements for CA based on IBM | Sony, Ericsson | Approval:**Proposal 1: Reuse the IBM inter-CA requirement framework established for n260+n261 for any requested CA band pair from the same frequency group****Proposal 2: The same relaxation value as the ones for CA\_n260-n261, i.e., 3.5 dB, can be used for all these band pairs from different frequency groups for IBM.****Proposal 3: Band combinations specified in Rel-17 can be implemented in a release-independent manner as long as no new signaling must be used by a UE of an earlier release.** |
| [**R4-2104715**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104715.zip) | FR2 inter-band CA for different frequency band groups with IBM | Nokia, Nokia Shanghai Bell | Approval:**Proposal 1: The relaxation values for CA\_n260-n261 are reused as the ones for CA\_n258-n260 and CA\_n257-n259. For other band pairs, it should be further discussed based on per band pair case by case.****Proposal 2:** **The release independence of inter-band FR2 CA based on IBM for the different frequency groups is applied from Rel-16 as far as the number of bands is two and CA bandwidths class already defined in Rel-16.****Proposal 3: TP to TR 38.851 is approved as attached in Annex for CA\_n257A\_n259A.** |
| [**R4-2105096**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105096.zip) | Rx requirements for CA\_n258A-n260A and CA\_n257A-n259A based on IBM | Xiaomi | Approval:**Proposal 1: The maximum number of CCs for inter-band CA including intra-band contiguous CA:*** **Option1: there is no need to limit the maximum number of CCs.**
* **Option2: it should keep align with the maximum number of CCs of intra-band contiguous CA.**

**Proposal 2: ΔRIB,P,n and ΔRIB,S,n should be defined as 3.5dB for all CA combination between the low band group (n257, n258 or n261) and high band group (n259 and n260) for IBM** |
| [**R4-2106346**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106346.zip) | Band specific requirements for DL CA\_n257-n259 including TP for TR 38.851 | NTT DOCOMO INC. | Approval:**Proposal 1: For ΔRIB,P,n and ΔRIB,S,n, the same relaxation values with n260+n261 should be applied to n257+n259.****Observation 1: We need to discuss based on per band pair case by case, but we can reuse the relaxation values for CA\_n260-n261 as the ones for CA\_n258-n260 and CA\_n257-n259.****Proposal 2: We should not limit the maximum number of CCs for FR2 DL inter band CA for future expansion.** |
| [**R4-2106365**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106365.zip) | Discussion on UE requirements for CA configurations of CA\_n258-n260 and CA\_n257-n259 based on IBM | ZTE Corporation | Approval:**Proposal. The relaxation values for CA\_n260-n261 are reused as the ones for CA\_n258-n260 and CA\_n257-n259. For other band pairs, it should be further discussed based on per band pair case by case.** |
| [**R4-2106565**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106565.zip) | R17 FR2 Inter-band DL CA with IBM | OPPO | Approval:***Proposal 1: It is proposed to clarify whether the 3.5dB relaxation defined in Rel-16 is for UE that only support n260 and n261 or it also consider UEs that support other FR2 bands.******Proposal 2: If the conclusion for Proposal 1 is YES (3.5dB relaxation in Rel-16 only considered UEs support n260 and n261), then it is proposed to add 0.5dB multi-band relaxation difference to the total relaxations, i.e. in total 4dB relaxation.*** ***Otherwise, it is proposed to keep the 3.5dB total relaxation for n258+n260, and n257+n259.*** |
| [**R4-2107108**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107108.zip) | Discussion on FR2 inter-band DL CA with CBM and IBM | Google Inc. | Approval:**Proposal 4: The REFSENS and EIS spherical coverage requirement for FR2 inter-band DL CA within the different frequency group based on IBM should be further discussed case by case for every band pair.** |
| [**R4-2107265**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107265.zip) | inter-band CA DL CA with IBM | Huawei, HiSilicon | Approval:***Proposal 4: Define 4dB relaxation for CA\_n257+n259.*** ***Proposal 5: for inter-band CA, single polarization for each band is assumed to define the Rx requirement.******Proposal 6: 3dB EIS requirement difference is required between single polarization and dual polarization architecture for each Band.*** |

## Open issues summary

### Sub-topic 2-1

**Issue 2-1: Inter-band DL CA based on IBM relaxations of EIS and EIS spherical coverage**

* Proposals
	+ Option 1: No matter within the same frequency group or between different frequency groups, reuse the same framework established for n260+n261 and the same relaxation values 3.5dB.
	+ Option 2: The same relaxation value as the ones for CA\_n260-n261, i.e., 3.5 dB, can be used for all band pairs from different frequency groups for IBM.
	+ Option 3: The relaxation values for CA\_n260-n261 are reused as the ones for CA\_n258-n260 and CA\_n257-n259. For other band pairs, it should be further discussed based on per band pair case by case.
	+ Option 4: Relaxations as in [R4-2104561](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104561.zip)
	+ Option 5: Define relaxation values considering frequency separation per band pair for FR2 inter-band CA with IBM in different frequency group
	+ Option 6: define relaxation as 4dB for CA\_ n257+n259
* Recommended WF
	+ TBA

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| * **Company**
 | **Comments** |
| MediaTek | We are open for Option 4/5/6. Basically, we think the relaxation value shall be defined per band pair, and the exact value can be further discussed. About Option1/2/3, we think reuse CA\_n260-n261 relaxation value directly is not made sense from technical perspective, because the relaxation value including MBR etc, which is heavily related to band components.Hence, as Option4 proponent, we calculate the value after considering both relaxation value of CA\_n260-n261and also MBR difference of exact band components.About Option 5, consider frequency separation as one of factors is fine, but we still need to consider exact bandwidth etc.About Option 6, a clarification question to Huawei (proponent), does the proposal is as below?

|  |  |  |
| --- | --- | --- |
| **NR CA bands** | **NR band** | **ΔRIB,P,n (dB)** |
| CA\_n257-n259 | n257 | 4.0 |
| n259 | 4.0 |
| **NR CA bands** | **NR band** | **ΔRIB,S,n (dB)** |
| CA\_n257-n259 | n257 | 4.0 |
| n259 | 4.0 |

 |
| OPPO | Others, the framework can be reused, however, the values need to be clarified.It is unclear whether the 3.5dB relaxation defined in Rel-16 is for UE that only support n260 and n261 or it also consider UEs that support other FR2 bands. If Rel-16 only consider UE supports n260 and n261, then the Multi-Band relaxation difference for n258+n260, and n257+n259 comparing to n260+n261 would achieve at least 0.5dB for these bands.Therefore:* If the conclusion for is 3.5dB relaxation in Rel-16 only considered UEs support n260 and n261 then add 0.5dB multi-band relaxation difference to the total relaxations, i.e. in total 4dB relaxation.
* Otherwise, keep the 3.5dB total relaxation for n258+n260, and n257+n259.
 |
| Qualcomm | Option 3 or option 3 modified by option 6 |
| LG Electronics | Support Option 5. Because, the frequency separation for CA\_n258-n260 and CA\_n257-n259 is larger than CA\_n260-n261.  |
| Samsung | To be compatible with more bands (47GHz, etc), for relaxation value, it seems that option 1 and option 2 can be precluded. Agree with companies comments that the relaxation values absorb MBR which is band combination dependent. The simultaneous operation of two bands further deteriorate the performance. |

**Issue 2-2: What is the maximum number of CCs in 2-band DL CA combination that is release independent from REL-16.**

* Proposals
	+ Option 1: No need to limit the maximum number of CCs
	+ Option 2: Band combinations specified in Rel-17 can be implemented in a release-independent manner as long as no new signalling must be used by a UE of an earlier release.
	+ Option 3: The release independence of inter-band FR2 CA based on IBM for the different frequency groups is applied from Rel-16 as far as the number of bands is two and CA bandwidths class already defined in Rel-16.
* Recommended WF
	+ TBA

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| * **Company**
 | **Comments** |
| MediaTek | In our understanding, the 3 options are not exclusive. Hence, we share our view on each option:For Option 1: different maximum CC number demand would lead to quite different UE hardware capability, we prefer to define exact maximum number of CCs.For Option 2 & 3, Rel-16 only defines “inter-band DL CA based on IBM of different frequency group type (i.e. DL CA\_n261+n260, IBM)”. We think at least OTHER inter-band DL/UL CA types shall NOT be considered to be release independent from Rel-16. For the “inter-band DL CA based on IBM of different frequency group” type, release independent manner for other band pairs is FFS, at least clear other band pairs demand shall be clarified firstly. Note that, “DL CA configurations CA\_n258A-n260A and CA\_n257A-n259A are release independent from REL-16” was agreed. |
| OPPO | Option 3 is ok.For the option 2, signaling can supports both CBM and IBM in Rel-16, however, there is no CBM requirements for inter-band FR2 CA which means this inter-band CBM feature is not supported in RAN4 Rel-16. The CBM requirement itself needs to be introduced before discussing whether the CBM band combinations can be release independent to Rel-16. |
| Qualcomm | All the options seem to point in a similar direction. Perhaps a WF can be constructed around option 3 |
| LG Electronics | Support Option 3. |
| Samsung | Option 3 is okay |

**Issue 2-3: Polarization number for each Band of inter-band CA IBM.**

* Proposals
	+ Single polarization for each band is assumed to define the Rx requirement.
* Recommended WF
	+ TBA

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| --- | --- |
| * **Company**
 | **Comments** |
| MediaTek | We prefer to leverage single-band (non-CA) Rx assumption, in our understanding, it is average of two polarizations for REFSENS, for example. |
| OPPO | If single polarization is assumed for each band in Rx, does this also apply to Tx?Our understanding on the UE topology is both polarization is supported by UE, however, there is issues caused by the polarization mismatch in FR2 test enhancement WI and the problem is that UE cannot transmit dual polarization due to only 1 polarization at once in TE but diversity gain was calculated in requirement definition. So calculate requirements with single polarization for inter-band CA probably can avoid this issue. |
| Qualcomm | The impact on UE demodulation performance when it has only a single receiver is not clear if the gNB uses frequency diversity schemes in addition to dual pol transmit. We are not keen on revisiting demod assumptions just for this feature. This problem exists in the UL direction also – for this reason it is agreed elsewhere that TE should have dual pol Rx for OTA demod of UL. Moreover, it will result in further dilution of requirements. |
| LG Electronics | Need further discussion on impact by single polarization per band for inter-band CA considering RF architecture. In addition, we think the single polarization for each band is applicable to Tx side in aspect of implementation. So we needs to consider impact on Tx requirement of inter-band UL CA with the single polarization for each band. |
| Samsung | For Tx, it is not mandatory to support dual transmission. For Rx, it is mandatory to support dual RX. For single-CC Rx, it is assumed dual polarization receiving. But for inter-band CA, it is not clear in the group if dual polarization receiving should also be assumed since “polarization per band” is also one feasible implementation for IBM. |

## Companies views’ collection for 1st round

### Open issues

Comment directly under each issue above.

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| --- | --- | --- | --- |
| **CR/TP number** | **TDoc** | **company** | **Comments collection** |
| [**R4-2104715**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104715.zip) | TP: FR2 inter-band CA for different frequency band groups with IBM | Nokia, Nokia Shanghai Bell | Company ACompany B |
| [**R4-2106346**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106346.zip) | TP: Band specific requirements for DL CA\_n257-n259 including TP for TR 38.851 | NTT DOCOMO INC. | Company ACompany 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#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### 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”.*

# Topic #3: 8.3.2.1.3 UE requirements for CA configurations within the same frequency group based on CBM

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2104491**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104491.zip) | Requirement framework for Inter-band CA with CBM | Qualcomm Incorporated | Approval:1. **Adopt ‘unified requirement framework’, see table below**
2. **Requirements apply in both conditions to verify that beam squint related degradation is not excessive:**
	1. **Beam management reference signal in tested band**
	2. **Beam management reference signal in non-tested ‘other’ band**

**See draft CR [4] for spec. language proposal** |
| [**R4-2105095**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105095.zip) | Applicability of CBM/IBM for different CA configurations | Xiaomi | **Approval:****Proposal 2: Inter-band DL CA based on CBM need only consider the EIS relaxation:****• Between overlapping or touching bands, reused the same framework established for intra-band non-contiguous CA.****• Between different frequency groups, reuse the same framework established for n260+n261 based on IBM.** |
| [**R4-2106364**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106364.zip) | Discussion on CBM&IBM for FR2 Inter-band DL CA | ZTE Corporation | Approval:**Proposal 3. Prefer not to introduce Fs\_inter\_CBM as capability. Instead, The related RF requirements should be defined for all different frequency configurations.** |
| [**R4-2107108**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107108.zip) | Discussion on FR2 inter-band DL CA with CBM and IBM | Google Inc. | Approval:**Proposal 1: The REFSENS relaxations framework for FR2 inter-band DL CA within the same frequency group based on CBM shall follow intra-band DL CA scenario for every band pair.****Proposal 2: The EIS spherical coverage requirements for FR2 inter-band DL CA within the same frequency group based on CBM shall not be specified.****Proposal 3: The Fs\_inter\_CBM should be introduced as UE capability.**  |
| [**R4-2106287**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106287.zip) | Discussion on RF requirements for inter-band DL CA based on CBM and IBM | LG Electronics Polska | Discussion:**Proposal 1: Introduce ‘Fs\_inter\_CBM’ as UE capability to indicate the maximum frequency span between lower edge of lowest CC and upper edge of highest CC in FR2 inter-band DL CA based on CBM which UE can support.****Proposal 2: Define REFSENS relaxation similar to Rel-16 intra-band non-contiguous CA considering an extended frequency separation in FR2 inter-band DL CA based on CBM.****Proposal 3: Not define EIS relaxation in FR2 inter-band DL CA based on CBM.** |
| [**R4-2104401**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104401.zip) | UE RF CBM requirements for CA configurations within same frequency group | Nokia, Nokia Shanghai Bell | Discussion:**Observation 1: RAN4 needs to clarify in specification that current inter-band CA maximum input level, ACS and in-band blocking apply only for IBM UE****Observation 2: RAN4 needs to clarify whether it is contiguous or non-contiguous intraband CA requirements or both that apply for inter-band CA within same frequency group when UE is using CBM .****Observation 3: REFSENS relaxation value which depends on CC separations in frequency would seem to be good choise.****Observation 4: EIS spherical coverage requirement may not bring additional value for CBM UE testing.****Observation 5: Fs\_inter\_CBM capability fragments UE ecosystem and makes NW operation more difficult thus it should not be introduced.**  |
| [**R4-2104524**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104524.zip) | Discussion on EIS spherical coverage and Fs,inter for CBM | vivo | Approval:**Proposal 1: CBM also needs to specify the EIS spherical coverage, which can ensure a more reasonable implementation.** **Proposal 2: The relaxation of EIS spherical coverage for CBM only need apply to the SCC and related to the span between CCs, which can be as follows:** **Proposal 3: Introduce Fs, inter\_cbm, which is similar to Fs from intra-band CA, to inter-band CA with the same frequency group, and more frequency separation class is needed.** |
| [**R4-2104562**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104562.zip) | Introduce Fs\_inter\_CBM as UE capability for inter-band DL CA based on CBM | MediaTek Beijing Inc. | Approval:**Proposal: Introduce ‘Fs\_inter\_CBM’ as UE capability to indicate the maximum frequency span between lower edge of lowest CC and upper edge of highest CC in FR2 inter-band CA based on CBM which UE can support** |
| [**R4-2104699**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104699.zip) | UE requirements for CA based on CBM | Sony, Ericsson | Approval:**Observation 1: Different RF architectures are possible for CBM UEs, and it is important to align the assumption to create the framework of RF requirements.** **Observation 2: For the purpose of setting minimum requirements for CBM-capable UEs, the definition of CBM with measurement “the only CC configured with RS” for RX beam management is fine, while RS measurements on different bands (serving cells) are likely to be configured since the beams can be different.****Observation 3: The following EIS spherical coverage degradation on secondary CC is obtained:**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency separation (Fs) | Fs < 1400 MHz | 1400 MHz < Fs < 2400 MHz | 2400 MHz < Fs < 5200 MHz |
| Primary CC at 24 GHz | 0 dB - 0.2 dB | 0.2 dB - 1 dB | 1 dB -1.5 dB |
| Frequency separation (Fs) | Fs < 1400 MHz | 1400 MHz < Fs < 2400 MHz | 2400 MHz < Fs < 6400 MHz |
| Primary CC at 37 GHz | 0 dB - 0.2 dB | 0.2 dB – 0.8 dB | 0.8 dB -2.1 dB |

**Observation 4: the relaxation of single RF chain architecture CBM UE can be composed as wideband performance degradation + beam squint effect.****Observation 5: In case there is a limitation of the frequency separation of CCs in different bands supported by the UE for an advertised (supported) inter-band DL CA configuration, the capability of ’Fs\_inter\_CBM’ would be needed.****Proposal 1: Create the requirement framework based on the single RF chain architecture.****Proposal 2: The RF requirement should be agnostic to any implementation.****Proposal 3: The requirement relaxation of CBM UE needs to be limited to a reasonable level to ensure inter-band DL CA's network coverage.**  |
| [**R4-2105097**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105097.zip) | Rx requirements for inter-band DL CA within the same frequency groups based on CBM | Xiaomi | Approval:**Proposal 1: RAN4 should define the requirements based on the single beam formed by singe Rx chain architecture as shown in Figure 2-1 for inter-band DL CA within the same frequency groups based on CBM.****Proposal 2: the EIS relaxations for inter-band CA based on CBM between overlapping or touching bands should be defined as Table 2-1:**Table 2-1: EIS Relaxation for inter-band CA based on CBM between overlapping or touching bands

|  |  |
| --- | --- |
| Configured DL spectrum (MHz) |  (dB) |
| ≤ 800 | 0.0 |
| > 800 and ≤ 1400 | 0.5 |
| > 1400 and ≤ 2400 | 1.5 |
| > 2400 and ≤ 6400 | 2.5 |

**Proposal 3: EIS spherical coverage requirements shall not be specified.** |
| [**R4-2106564**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106564.zip) | R17 FR2 Inter-band DL CA within same frequency group based on CBM | OPPO | Approval:**UE architecture and behaviour*****Observation 1: For the shared RF chain and antenna panel architecture, the supported inter-band CA within same frequency group might be restricted by the maximum receive BW limitation.******Observation 2: For the separate RF chain and antenna panel architecture, no restriction on the frequency separation of the band combination, but most likely this UE can also support IBM.******Proposal 1: Use shared RF chain and antenna panel architecture as the baseline for inter-band combination within same freq group CBM to define requirements.******Proposal 2: Introduce frequency separation class for inter-band combination within same freq group CBM UE similar as the Fs in intra-band non-contiguous CA.*****REFSENS requirements*****Proposal 3: REFSENS relaxation structure of intra-band non-contiguous CA is applied to inter-band CA within same freq group.******Observation 3: There are two approaches to apply the REFSENS relaxation, one is apply same for both bands, and the other is apply different values for each band.******Observation 4: Current inter-band DL CA within same freq group is targeting 28GHz band groups with the FR2 bands defined up to now.******Observation 5: There is no REFSENS difference between bands in 28GHz group, and same relaxation can be applied.******Proposal 4: Same REFSENS relaxation is applied to both bands of a band combination within same freq group.******Proposal 5: Further study whether same REFSENS relaxation can be applied to all bands within same freq group no matter which combination belongs to.******Observation 6: The EIS spherical coverage for inter-band DL CA within same freq group based on CBM is same as the case of intra-band DL CA due to same UE architecture is used.******Proposal 6: No EIS spherical coverage requirement needs to be defined for inter-band DL CA within same freq group based on CBM.*** |
| [**R4-2107262**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107262.zip) | inter-band CA DL CA with CBM | Huawei, HiSilicon | Approval:***Proposal 1: Separation class extends to be indicated per band combination for inter-band CA within the same frequency group in CBM.******Observation 1: RAN4 already agrees to define Maximum Peak EIS requirement for inter-band CA within same Frequency group in CBM.******Proposal 2: Define Maximum spherical coverage EIS for inter-band CA within same frequency group in CBM.******Proposal 3: Define PSD difference between 2 Bands as 6dB within inter-band separation class capability, and XdB across inter-band separation classes, in which X dB is the difference between peak EIS on one band and spherical EIS on the other Band.******Observation 2: Without performance degradation allowance, “BCs within the same freq. group based on CBM” is not applicable.******Proposal 4: RAN4 introduce “BCs within the same freq. group based on CBM”, performance relaxation should be allowed:******Accept demodulation performance degradation for L+L/H+H band combinations with CBM type, and make clarification into RAN4 spec.*** |

## Open issues summary

Most important topic to be agreed is the Issue 3-1 requirement framework. Then 3-3 and 3-4 would loqically follow.

### Sub-topic 3-1

**Issue 3-1:CBM requirement framework**

* Proposals
	+ Option 1: Create the requirement framework based on the shared RF chain and antenna panel architecture
	+ Option 2: Create the requirement framework based unified requirement framework as presented in R4-2104491.
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 1. “Shared RF chain and antenna panel architecture” is the basic understanding for CBM while RAN4 started to use the wording IBM/CBM in our understanding. |
| OPPO | Option 1. For the separate RF chain and antenna panel architecture, no restriction on the frequency separation of the band combination, but most likely this UE can also support IBM since the hardware already support that and there is no reason this multi-panel UE does not support IBM. |
| Qualcomm | Option 2, because option 1 is not fair to all implementations. Examples:1. single or shared RF chain requirements for REFSENS are unreasonable to impose on multi-beam or multi-chain implementations, because with single chain assumption REFSENS for both bands will be tested in a single direction. A multi-chain UE may not be able to guarantee same REFSENS directions in both bands and the network is no worse for it (IBM REFSENS is precedent, and allows for REFSENS in each band to have an independent direction)
2. skipping EIS spherical coverage is reasonable for single chain implementations, but not reasonable for multi-chain implementations. Multi-chain UEs need to demonstrate they have good inter-band’ beam mapping (due to BM ref. signal in only one band, the UE must set up 1:1 spatial association between beams in band with BMRS to beams in second band)

While this is true:*“Shared RF chain and antenna panel architecture” is the basic understanding for CBM while RAN4 started to use the wording IBM/CBM in our understanding.* , also implicit was L+L of H+H type of band combinations. Since there is no longer such restriction on the band pairing for CBM, we can no longer limit to *“Shared RF chain and antenna panel architecture”. We do not think a UE with single chain can support an L+M or L+H combination with acceptable network performance.* |
| LG Electronics | Support option 1. |
| Samsung | The requirement framework should address the single chain implementation which can be considred as typical implementation, but also should be inclusive to other implementations. If the consensus in group is CBM is also feasible for different frequency group, then option 2 seems a middle way. |

**Issue 3-2: Introduction of ‘Fs\_inter\_CBM’ as UE capability to indicate the maximum frequency span between lower edge of lowest CC and upper edge of highest CC in FR2 inter-band for band combinations within same frequency group**

* Proposals
	+ Option 1: Do not to introduce Fs\_inter\_CBM as a capability
	+ Option 2: Fs\_inter\_CBM as a capability is introduced
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 2. From UE hardware perspective, CBM is similar to NCCA; hence, Fs\_inter\_CBM shall be introduced to indicate clear UE capability. |
| OPPO | Option 2The Fs\_inter\_CBM is similar as the Fs in intra-band non-contiguous to indicate the freq span of CBM. Without the capability introduced UE might only choose to not support large freq separation bands. |
| Qualcomm | Option 1: It is important not to dilute the meaning of ‘inter-band’. The UE still retains the ability to signal frequency separation class in each band. Instead of creating a new capability, performance degradation due to wide frequency coverage can be captured.  |
| LG Electronics | Support option 2. With this capability, there can be more opportunities to support FR2 inter-band CA based on CBM with same frequency group.  |
| Samsung | A question is, if ‘Fs\_inter\_CBM’ is introduced for CBM within same frequency group, how to handle Fs\_inter\_CBM for CBM across different frequency group? |

**Issue 3-3: EIS spherical coverage for band combinations within same frequency group**

Proposals

* + Option 1: EIS spherical coverage requirements is not specified for CBM UE
	+ Option 2: EIS spherical coverage requirements is specified for CBM UE
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | We prefer to achieve consensus on REFSENS firstly. |
| OPPO | Option 1.The CBM UE cannot adjust the 2nd band beam direction with 1st band beamforming matrix, there is no meaning to define spherical requirements for this kind of UE. For example, if the spherical cannot be met what should this UE do? |
| Qualcomm | Option 2: The requirements must be inclusive of all reasonable implementations, which also means that the requirements must be set in a way to check for degradation mechanisms of all implementations. Skipping EIS spherical coverage is reasonable for single chain implementations, but not reasonable for multi-chain implementations. Multi-chain UEs need to demonstrate they have good inter-band ‘beam mapping’ (due to BM ref. signal in only one band, the UE must set up 1:1 spatial association between beams in band with BMRS to beams in second band)Without EIS spherical coverage requirement, a multi-beam UE can have extremely poor common coverage and be compliant which can severely impact co-located deployments. |
| LG Electronics | Support option 1. It is similar to Rel-16 intra-band non-contiguous CA based on CBM. |
| Samsung | Based on consensus up to now, we can firstly focus on REFSENS |

**Issue 3-4: REFSENS relaxation framework**

Proposals

* + Option 1: REFSENS relaxation structure of intra-band non-contiguous CA is applied to inter-band CA within same freq group and same REFSENS relaxation is applied to both bands of a band combination within same freq group.
	+ Option 2: REFSENS relaxation structure is based on IBM interband CA
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 1. Apply NCCA concept as starting point is made sense basically, and the exact relaxation value shall be FFS. |
| OPPO | Option 1.This inter-band within same freq group is more like intra-band non-contiguous CA, and the framework can be shared for them. |
| Qualcomm | Option 2: The requirements must be inclusive of all reasonable implementations, which also means that the requirements must be set in a way to check for degradation mechanisms of all implementations.Single or shared RF chain requirements for REFSENS are unreasonable to impose on multi-beam or multi-chain implementations, because with single chain assumption REFSENS for both bands will be tested in a single direction. A multi-chain UE may not be able to guarantee same REFSENS directions in both bands and the network is no worse for it (IBM REFSENS is precedent, and allows for REFSENS in each band to have an independent direction) |
| LG Electronics | Support option 1. Same REFSENS relaxation can be applied to both bands of a band combination within same freq group, however the REFSENS relaxation value needs to be specified per band pair considering the frequency separation per band pair. |
| Samsung | Firstly of all we need to align on understanding of CBM implementation. To address CBM across different frequency group, option 2 is more compatible. |

**Issue 3-5: RAN4 introduce “BCs within the same freq. group based on CBM”, performance relaxation should be allowed**

Proposals

* + Option 1: Accept demodulation performance degradation for L+L/H+H band combinations with CBM type, and make clarification into RAN4 spec.
	+ Option 2: No demodulation performance degradation
	+ Option 3: Other
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 1. While basic Rx requirement is relaxed (ex: REFSENS), it makes sense to have relaxation for demodulation. |
| OPPO | Option 1. |
| Qualcomm | Option 3: We prefer to confine ourselves to RF performance requirements. Demod performance and RRM impact can be separately studied and quantified by baseband sessions. We however agree that single chain implementations are likely to see unpredictable degradation in the real world. |
| LG Electronics | Support option 1. The performance degradation cannot be avoided if rx beam switch occurs in not CP duration but symbol duration.  |
| Samsung | Option 3Degradation is expected but shall be discussed in other thread |

## Companies views’ collection for 1st round

### Open issues

Comment directly under each issue above.

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |  |  |
| --- | --- | --- | --- |
| **CR/TP number** | **TDoc** | **Company** | **Comments collection** |
| [**R4-2104490**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104490.zip) | Draft CR to 38.101-2 on requirements for UEs that support inter-band CA with CBM | Qualcomm Incorporated | Company ACompany 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#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### 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”.*

# Topic #4: 8.3.2.2 Inter-band UL CA

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2104525**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104525.zip) | Discussion on per UE concept of FR2 UL CA | vivo | Discussion:**Observation 1:** The max EIRP limitation of 43 dBm is mainly due to the consideration of exposure, which is related to the power density in the free space.**Proposal1:** The max EIRP for FR2 UL CA should be defined as “per UE”.**Observation 2:** The EIRP is conceptually linked to a certain direction which is unclear for the multi-CC/multi-Beam simultaneous radiation scenario.**Proposal 2:** The “per UE” EIRP in multi-CC/Beam scenario can be clarified as the sum of the EIRP of all respective CCs/Beams in a certain direction, which can be express as:**Proposal 3:** The max EIRP can be described as the largest “per UE” EIRP among all the directions, as follows: *max EIRP = max (c-EIRP (θ1, φ1), c-EIRP (θ1, φ2), …, c-EIRP (θn, φn)) ≤ 43dBm***Proposal 4:** The max TRP for FR2 UL CA should be per band, and there is no conflict with max EIRP.  |
| [**R4-2106289**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106289.zip) | Discussion on RF requirements for inter-band UL CA based on IBM | LG Electronics Polska | Discussion:**Proposal 1: Specify max EIRP as per UE for inter-band CA based on IBM for n257A-n259A.****Proposal 2: Specify Min Peak EIRP as per band for inter-band CA based on IBM for n257A-n259A taking multiband relaxation (RMB) into account.****Proposal 3:** **Specify Spherical Coverage for inter-band CA based on IBM taking UE architecture into account.** |
| [**R4-2104560**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104560.zip) | Proposal on inter-band UL CA requirement framework | MediaTek Beijing Inc. | Approval:**Proposal 1: For inter-band UL CA, specify max EIRP as per band** **Proposal 2: For inter-band UL CA, specify min Peak EIRP as per band with 3dB relaxed requirement compared to single-CC**  |
| [**R4-2104706**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104706.zip) | UE UL CA requirements based on IBM | Sony, Ericsson | Approval**Observation 1: The PCMAX is defined in a different reference plane than EIRP, which may create issues especially when the beams point towards different directions for UL inter band CA operation.****Proposal 1: Specify max EIRP as per band with PC1: max EIRP of each band set to 55 dBm, and PC3/4: max EIRP of each band set to 43 dBm****Proposal 2: Specify min peak EIRP as per band with relaxed requirement compared to single-CC, i.e., n257=22.4-X dBm, n259=18.7-Y dBm. The value of relaxation (e.g., X, Y) can equal the MBR.****Proposal 3: Absorb the MBR into the total relaxation for inter-band UL CA in FR2 to align with the inter-band DL CA in FR2.** |
| [**R4-2104716**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104716.zip) | On FR2 inter-band UL CA for different frequency group based on IBM | Nokia, Nokia Shanghai Bell | Approval:**Observation 1: The regulatory coexistence requirement is specified per band in general.****Observation 2: Per UE power limitation of maximum EIRP does not help MPE requirement in FR2 unlike FR1 SAR requirement.****Proposal 1 Maximum EIRP and maximum TRP requirement are applied per band.****Proposal 2 Minimum peak EIRP and EIRP spherical coverage requirement is specified per band, while allowing the relaxation per CA band combination.** |
| [**R4-2104918**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104918.zip) | Definition of Max EIRP limit for FR2 ULCA | Qualcomm Incorporated | Approval:**Proposal 1: For non-overlapping bands specify the max EIRP limit as per band, with max EIRP limit of each band set to 43 dBm (PC3/PC4) and 55 dBm (PC1).** **Proposal 2: For overlapping bands where the UL of both bands are not in the overlapping region specify the max EIRP limit as per band, with max EIRP limit of each band set to 43 dBm (PC3/PC4) and 55 dBm (PC1).****Proposal 3: For overlapping bands where the UL of one band is not in the overlapping region and the UL of the other band is in the overlapping region specify the max EIRP limit as per band, with max EIRP limit of each band set to 43 dBm (PC3/PC4) and 55 dBm (PC1).****Proposal 4: The max EIRP limit for overlapping bands where the UL of both bands are in the over lapping region needs to be discussed further.** |
| [**R4-2105098**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105098.zip) | Tx requirements for inter-band UL CA for two bands between different frequency groups based on IBM | Xiaomi | Approval:**Proposal 1: The package requirements of MOP should be defined per band and reuse the requirements of single CC operation for inter-band UL CA between different frequency groups for IBM.** **Proposal 2: The relaxation requirements for min peak EIRP and min EIRP spherical coverage (i.e., ΔTIB,P,n and ΔTIB,S,n) should be introduced for inter-band UL CA between different frequency groups for IBM.****Proposal 3: ΔTIB,P,n and ΔTIB,S,n for CA\_n257-n259 could be defined as below framework:**Table 2-1 ΔTIB,P,n min peak EIRP relaxation

|  |  |  |
| --- | --- | --- |
| **NR CA bands** | **NR band** | **ΔTIB,P,n (dB)** |
| CA\_n257-n259 | n257 | 3 |
| n259 | 3 |

Table 2-2 ΔTIB,S,n min EIRP spherical coverage requirement relaxation

|  |  |  |
| --- | --- | --- |
| **NR CA bands** | **NR band** | **ΔTIB,S,n (dB)** |
| CA\_n257-n259 | n257 | 3 |
| n259 | 3 |

**Proposal 4: In additional, MPR, AMPR, Output RF spectrum emissions and beam correspondence could reuse the requirements of single CC operation for inter-band UL CA between different frequency groups for IBM.** |
| [**R4-2106402**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106402.zip) | UE requirements for FR2 UL Inter-band CA from the perspective of Japanese regulations | NTT DOCOMO, INC., SoftBank Corp., KDDI Corporation, Rakuten Mobile, Inc | Information:**Observation 1: There are no Japanese regulation for max EIRP of inter-band UL CA for 28GHz+40GHz at this time.****Observation 2: There are no Japanese regulation for MPE of inter-band UL CA for 28GHz+40GHz at this time.****Observation 3: When the PD requirement for 40GHz is introduced in the future, if the PD requirement is specified as sum of 28GHz and 40 GHz, it is necessary to control the P-MPR value appropriately in consideration of each transmission power.** |
| [**R4-2106563**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106563.zip) | R17 FR2 Inter-band UL CA | OPPO | Approval:***Observation 1: Max EIRP/TRP are regulation requirements that is not defined by 3GPP, what 3GPP can do is to follow the inter-band UL CA regulatory requirements if there is any.******Observation 2: If there is no such inter-band UL CA regulatory requirements, what can be relied on is the existing single band regulatory requirements.******Proposal 1: If there is no inter-band UL CA regulatory requirements, it is proposed to follow single band regulatory requirements, i.e. Max EIRP/TRP are per-band defined.******Observation 3: The factors like relaxation to meet common spherical coverage requirements, and multi-band relaxations also exist in inter-band UL CA.******Observation 4: 2dB relaxation is needed to meet the common spherical coverage requirements in DL, and similar in UL.******Observation 5: More than 0.5dB relaxation is needed according to the multi-band relaxation differences between n257+n259 and n260+n261.******Proposal 2: It is proposed to define 2.5dB relaxation for each band in n257+n259 compared with single band requirements.*** |

## Open issues summary

### Sub-topic 4-1

**Issue 4-1: The max EIRP for FR2 UL CA**

* Proposals
	+ Option 1: per UE
	+ Option 2: per band with max EIRP limit of each band set to 43 dBm (PC3/PC4) and 55 dBm (PC1).
	+ Option 3: per band but the max EIRP limit for overlapping bands where the UL of both bands are in the over lapping region needs to be discussed further.
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 1.Do alignment on min/max EIRP requirement. |
| OPPO | Option 2 or Option 3Our understanding is the max EIRP is regulation defined requirements not RAN4, and if there is no inter-band UL CA regulatory requirements, it is proposed to follow single band regulatory requirements, i.e. Max EIRP/TRP are per-band defined. And in this meeting, we notice that there is some feedback from FCC but no mention about the case of overlapping bands. It might be better to further get clarification from FCC, it is not an issue can be interpreted by companies here. |
|  Qualcomm | Option 3: per band but the max EIRP limit for overlapping bands where the UL of both bands are in the over lapping region needs to be discussed further.One possibility for when the UL of both bands falls in the overlapping region is a hard -3 dB split in max EIRP limit. |
| LG Electronics | Support option 1. The max EIRP needs to be limited per UE in order to meet regulatory requirement. For example, if the max EIRP is specified per band, total max EIRP is larger than the regulatory requirement regardless of overlapping band or non-overlapping band. |
| Samsung | Further study on option 1 or 3Similar understanding as OPPO that it is dependent on regulation. Option 2 seems not reasonable for frequency overlapping case. |

**Issue 4-2: Min Peak EIRP**

* Proposals
	+ Option 1: per band with relaxed requirement compared to single-CC, i.e., n257=22.4-X dBm, n259=18.7-Y dBm. The value of relaxation (e.g., X, Y) can equal the MBR.
	+ Option 2: per band with 3dB relaxed requirement compared to single-CC
	+ Option 3: Other
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 2. That keep total power concept, and still have good alignment between min and max EIRP requirements. |
| OPPO | Option 3, in our view 2.5dB should be defined.The factors like relaxation to meet common spherical coverage requirements, and multi-band relaxations also exist in inter-band UL CA as inter-band DL CA. 2dB relaxation is needed to meet the common spherical coverage requirements in DL, and similar in UL.More than 0.5dB relaxation is needed according to the multi-band relaxation differences between n257+n259 and n260+n261.Therefore, in total the relaxation could be 2.5dB. |
| Qualcomm | Option 3: Other. per band with relaxed requirement compared to single-CC, I.e., n257=22.4-X dBm, n259=18.7-Y dBm. X,Y not necessarily limited to MBR of table 6.2.1.3-4. FFS on impairments to be considered for X and Y |
| LG Electronics | Support option 3. We think that single polarization per band should not be excluded in UE implementation aspects. Therefore the single polarization per band should be considered for Tx requirements for FR2 inter-band UL CA. In addition, the single polarization can support multi band. Therefore, both 3dB relaxed requirement compared to single-CC and MBR needs to be considered.Option 3: Both per band with 3dB relaxed requirement compared to single-CC and MBR |
| Samsung | Option 3Note that min peak EIRP is the minimum requirement, considering power splitting and CA relaxation, the relaxation value may be higher than 3dB. |

**Issue 4-3: Spherical coverage**

* Proposals
	+ Option 1: EIRP spherical coverage requirement is specified per band, while allowing the relaxation per CA band combination.
	+ Option 2: EIRP spherical coverage requirement is specified per band, while allowing 3 dB relaxation per band.
	+ Option 3: Other
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 1. The basic requirement framework leveraged from “inter-band DL CA based on IBM” is made sense. The exact relaxation value shall be FFS, it may need to consider not only conductive power difference, but also common coverage definition impact, if it follows inter-band DL CA spherical coverage definition.  |
| OPPO | Option 3, same relaxation as min peak EIRP, i.e. 2.5dB in total. |
| Qualcomm | Option 3: We would like to try and align with DL inter-CA spherical coverage requirements that emphasizes common spherical coverage. It is not obvious if option 1 or 2 imply that requirement. |
| LG Electronics | As issue 4-2, we support option 3 as,Option 3 : EIRP spherical coverage requirement is specified per band, while allowing both 3 dB relaxation per band and MBR. |
| Samsung | Option 3: similar view as Qualcomm that the group should firstly align common spherical coverage |

## Companies views’ collection for 1st round

### Open issues

Comment directly under each issue above.

### CRs/TPs comments collection

No CRs or TPs.

## 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#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### 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”.*

# Topic #5: 8.3.3 Feasibility study

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2106287**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106287.zip) | Discussion on RF requirements for inter-band DL CA based on CBM and IBM | LG Electronics Polska | Discussion**Proposal 5: Consider frequency separation per band pair to define RF requirements for FR2 inter-band CA with IBM in same frequency group.** |
| [**R4-2107262**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107262.zip) | inter-band CA DL CA with CBM | Huawei, HiSilicon | Approval:***Proposal 5: For inter-band CA from different frequency group in CBM, the RF requirement framework can follow IBM requirement. Maximum Peak EIS requirement, spherical coverage EIS, relaxation requirements, and PSD difference should be defined. For relaxation requirements, it can be defined based on specific Band combination.******Proposal 6: Define 4dB relaxation for CA\_n257+n259 in CBM.*** ***Observation 3: if beam squinting effect is small, it seems BM RS is not mandatory to be configured in a CC with configured UL BWP.*** |
| [**R4-2104524**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104524.zip) | Discussion on EIS spherical coverage and Fs,inter for CBM | vivo | Approval:**Proposal 4: Fs,inter\_cbm, which is the max frequency span that UE can support under the influence by “beam squint” with different frequency group, should be specified in spec.**  |
| [**R4-2106290**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106290.zip) | Discussion on feasibility for inter-band DL CA | LG Electronics Polska | Discussion:**Feasibility study for CA configurations within same frequency group based on IBM****Proposal 1: For inter-band DL CA within same frequency group, either IBM or CBM is applicable as per UE capability.****Proposal 2: For inter-band DL CA within same frequency group based on IBM, whether or not to reuse Rel-16 reference sensitivity relaxation and EIS spherical coverage relaxation should be investigated for corresponding band combination.****Feasibility study for CA configurations within different frequency group based on CBM****Proposal 3: For CBM on inter-band DL CA, performance degradation due to Rx beam switch should be allowed if MRTD is defined that is larger than CP.****CBM/IBM vs *simultaneousRxTxInterBandCA*****Proposal 4: For inter-band CA within same frequency group, simultaneous Rx/Tx capability is not applicable.**  |
| [**R4-2104400**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104400.zip) | UE RF IBM requirements for CA configurations within same frequency group | Nokia, Nokia Shanghai Bell | Approval:**Proposal 1: Rel-16 reference sensitivity requirement including power imbalance aspect can be reused for the CA configurations within same frequency group in Rel-17. ΔRIB can be discussed case by case when new CA configurations are introduced which is a RAN4 custom.****Proposal 2: Rel-16 EIS spherical coverage requirement can be reused for the CA configurations within same frequency group in Rel-17. ΔRIB,S,n can be discussed case by case when new CA configurations are introduced which is a RAN4 custom.** |
| [**R4-2105099**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105099.zip) | The feasibility of inter-band CA within the same frequency group for IBM | Xiaomi | Approval:**Observation 1: Whether the inter-band CA within the same freq. group support IBM depends on UE implementation.****Proposal 1: The UE capability signalling to indicate both of IBM and CBM are supported by UE per band combination should be introduced for inter-band CA within the same frequency group.****Proposal 2: The separate relaxation requirements for the same band combination within the same freq. group should be defined according to IBM or CBM capability.****Proposal 3: ΔRIB,P,n and ΔRIB,S,n for all inter-band CA within the same freq. group for IBM could reuse the same framework established for n260+n261 and the same relaxation values 3.5dB.** |
| [**R4-2107265**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107265.zip) | inter-band CA DL CA with IBM | HiSilicon Technologies Co. Ltd | Approval:***Proposal 1: Reuse the RF requirement framework for any requested CA band pair from the same frequency group******Proposal 2: for Relaxation requirement, reuse 3.5dB for CA\_n257+n258. FFS for CA\_n259+n260.******Proposal 3: For FR2 inter-band DL CA, we prefer to have limitation on CC number in Rel-17.******Proposal 5: for inter-band CA, single polarization for each band is assumed to define the Rx requirement.******Proposal 6: 3dB EIS requirement difference is required between single polarization and dual polarization architecture for each Band.*** |
| [**R4-2105042**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105042.zip) | Discussion on CBM inter-band CA | Samsung | Discussion:**Observation 1: CBM UE does not have to receive two CCs with the same beam.****Observation 2: CBM UE does not have to be restricted to band combo within the same frequency group.****Proposal 1: RAN4 discuss if a UE is allowed to support both IBM and CBM for a band combo. If yes, RAN4 further discuss if CBM is considered as the fall back mode of IBM.****Proposal 2: different requirement framework shall be adopted for CBM than that of IBM. It is preferred to minimize the impact of PSD difference for CBM requirements. RAN4 further discuss the following alternatives for EIS requirements of CBM:** **Alt1: CC1 and CC2 achieve sensitivity status simultaneously** **Alt2: when testing EIS of CC1, make sure CC2 throughput is below a certain level, e.g. <100%TP** |
| [**R4-2105100**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105100.zip) | The feasibility of inter-band CA between different frequency groups for CBM | Xiaomi | Approval:**Proposal 1: All inter-band CA between different frequency groups can support both of IBM and CBM simultaneously.****Proposal 2: Just REFSENs relaxation requirements need define for inter-band CA between different frequency groups for CBM, the relaxation value:*** **Option1: ΔRIB,P,n need further study.**
* **Option2: ΔRIB,P,n could keep the same value (3.5dB) with IBM.**
 |

## Open issues summary

### Sub-topic 5-1 IBM UE for band combinations within same frequency group

**Issue 5-1-1: whether IBM inter-CA requirement framework established for n260+n261 shall be applied to any requested CA band pair from the same frequency group (parameter values discussed separately)**

* Proposals
	+ Option 1: Yes
	+ Option 2: No
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 1.We think “IBM type” can have similar discussing framework no matter same frequency group or different frequency group, and the exact value shall be discussed per band pair; moreover, potential additional loss factor shall not be excluded. Besides, we’d like to clarify the exact demand of this type, we think discuss requirement based on exact band pair is more efficient. |
| OPPO | Option 1. But to clarify the answer is “IBM inter-CA requirement framework established for n260+n261 shall be applied to any requested CA band pair from the same frequency group (parameter values discussed separately) with IBM” |
| Qualcomm | Option 1 (for DLCA, FFS for ULCA) |
| LG Electronics | Support Option 1. In Rel-16, CA\_n260-n261 was specified to only Rx requirements. And, frequency separation per CA band pair from same frequency group is different from that of n260-n261. |
| Samsung | If there is no PSD difference issue for IBM inter-band CA within same frequency group, option 1 is fine. |

**Issue 5-2-1: how to define the relaxation values of FR2 inter-band CA within same frequency group for IBM**

* Proposals
	+ Option 1: reuse 3.5dB for all band combinations
	+ Option 2: reuse 3.5dB for CA\_n257+n258. FFS for CA\_n259+n260.
	+ Option 3: other
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 3. We shall clarify exact demand on this type, and then discuss the relaxation value by band pair. |
| OPPO | Option 2, and to clarify this is for DL. |
| Qualcomm | Option 2 (not sure if there is market demand for n259+n260) |
| LG Electronics | Support option 3. For relaxation, it needs to be taken the smaller frequency separation within same frequency group than n260-n216 into account. |
| Samsung | Option 3Similar view as MediaTek. |

### Sub-topic 5-2 CBM UE for band combinations between frequency groups

**Issue 5-2-1: CBM inter-CA requirement framework for band combinations between the frequency groups**

* Proposals
	+ Option 1: RF requirement framework can follow IBM requirement. Maximum Peak EIS requirement, spherical coverage EIS, relaxation requirements, and PSD difference should be defined. For relaxation requirements, it can be defined based on specific Band combination.
	+ Option 2: different requirement framework shall be adopted for CBM than that of IBM. It is preferred to minimize the impact of PSD difference for CBM requirements. RAN4 further discuss the following alternatives for EIS requirements of CBM:
		- Alt1: CC1 and CC2 achieve sensitivity status simultaneously
		- Alt2: when testing EIS of CC1, make sure CC2 throughput is below a certain level, e.g. <100%TP
	+ Option 3: Just REFSENs relaxation requirements need define for inter-band CA between different frequency groups for CBM, the relaxation value:
		- Option1: ΔRIB,P,n need further study.
		- Option2: ΔRIB,P,n could keep the same value (3.5dB) with IBM.
	+ Option 4: Other
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | We are open for Option2/3/4. However, we’d like to clarify the exact demand on this type “CBM UE for band combinations between frequency groups” firstly.About Option1. We think IBM and CBM are quite different. |
| OPPO | Option 2 with alt-1.For UE with CBM to support inter-band between freq groups, this UE is not a capable UE as IBM and people should not expect this UE can support as high PSD difference as IBM. Meanwhile, for the inter-band between freq groups, the PSD is less likely to be equal. Note that current REFSENS for different freq group already have several dB difference which can reflect the PSD different at certain level. Then with these two factors considered, alt-1 might be a better choice. |
| Qualcomm | Option 1Any other option can compromise network performance. See R4-2104491 for detail. |
| LG Electronics | At first, we need to decide whether CBM UE is feasible for inter-band CA within different frequency group or not. After that, we can discuss for related RF requirements.  |
| Samsung | Option 2 with alt-1It is important to minimize PSD difference for CBM. Moreover, Option 2 is not contradict with the unified framework in R4-2104491 on PSD difference. |

## Companies views’ collection for 1st round

### Open issues

Comment directly under each issue above.

### CRs/TPs comments collection

No CRs or TPs.

## 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** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### 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”.*

# Topic #6: LS on introduction of new frequency separation classes (R4-2104402)

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| R4-2104402 | LS on introduction of new frequency separation classes | Nokia | **1. Overall Description:**RAN4 has introduced two new frequency separation classes into Table 5.3A.4-2 in TS 38.101-2. Values in that table correspond to IE *FreqSeparationClass.* New values are 400 and 600 MHz.**2. Actions:****To RAN2:****ACTION:** RAN4 respectfully asks RAN2 to update the signalling. |

## Open issues summary

### Sub-topic 6-1: Approval of LS on introduction of new frequency separation classes

**Issue 6-1: Is the LS agreeable on** **R4-2104402**

* Proposals
	+ Option 1: Yes
	+ Option 2: Yes, but with modifications
	+ Option 3: Not needed
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | Option 1. It’s good to sync-up with RAN2. |
| OPPO | Option 1. |
| Qualcomm | Option 1 |
| Samsung | Option 1 |

## Companies views’ collection for 1st round

### Open issues

Comment directly under each issue above.

### CRs/TPs comments collection

No CRs or TPs.

## 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#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### 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 |
|  |  |  |

**Existing tdocs**

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

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