**3GPP TSG-RAN WG4 Meeting # 97e R4-2016957**

**Electronic Meeting, 2 – 13 Nov., 2020**

**Agenda item: 7.12.1**

**Source:** Moderator (Nokia)

**Title: Draft** Email discussion summary for [97e][113] NR\_RF\_FR2\_req\_enh\_Part\_4

**Document for:** Information

# Introduction

REL16 FR2 maintenance stream.

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

* 1st round: None
* 2nd round:
  + [97e][113] WF for Beam Correspondence based on configured DL RS (SSB or CSI-RS)
  + [97e][113] WF for addition of new frequency separation classes

# Topic #1: Beam Correspondence based on configured DL RS (SSB or CSI-RS)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014320 | LG Electronics | Enhanced beam correspondence test applicability rules in rel-16  APPROVAL  Observation 1: In RRM measurement accuracy requirements, they specified same measurement accuracy requirements as 6.5 dB for each SSB based or CSI-RS based beam management with same side conditions.  Observation 2: In RF session, RAN4 decide the X = 3~6dB, then the SSB signalling quality is still useful to choose fine CSI-RS beam detection.  **Proposal 1: RAN4 specify X=3~6dB back off of SSB’ PSD for CSI-RS based eBC requirements.**  **Proposal 2: Based on Proposal 1, RAN4 allow test applicability rule with option1.**  • **Option1: If a UE meets beam correspondence requirements based on SSB, it is considered to have met the beam correspondence requirements based on CSI-RS.** |
| R4-2014512 | Nokia, Nokia Shanghai Bell | REL16 eBC capability alingment with 38.306  **CAT F CR**  **- REL-16 BC capability names are corrected to align with the RAN2 specifications.**  **- TBD for additional applicability rules is removed as additional applicability rules are not necessary. Separate UE capabilities are defined for BC based on SSB and BC based on CSI-RS. Both UE requirements have their own conditions and UEs should be verified against the Rel-16 eBC requirements that it indicate support for. Therefore, no further applicability rules are needed.** |
| R4-2014584 | Intel Corporation | On CSI-RS based beam correspondence  Approval  **Proposal: SSB’s PSD is backed-off by 6 dB from CSI-RS in CSI-RS based beam correspondence test.** |
| R4-2014722 | Samsung | Discussion on Rel-16 beam correspondence remaining issues  Discussion  **Proposal 1: For Rel-16 CSI-RS based beam correspondence, the X value is preferred as 3dB, and should be no more than 6dB at the worst case.**  **Proposal 2: Decide additional applicability rule between Alt 1-2-1-2 and Alt 1-2-1-3; and Alt 1-2-1-3 is preferred, i.e., if a UE meets beam correspondence requirements based on SSB, it is considered to have met the beam correspondence requirements based on CSI-RS.** |
| R4-2014923 | Apple Inc. | Remaining issues with beam correspondence enhancements  Discussion  **Proposal 1: Select X = 3 dB for the BC based on CSI-RS side conditions.**  **Proposal 2: For UEs which support both eBC based on SSB and eBC based on CSI-RS, the UE RF core requirements for both side conditions shall apply.**  **Proposal 3: For UEs which support both eBC based on SSB and eBC based on CSI-RS, beam correspondence performance is verified based on SSB only side conditions for all applicable TX RF requirements, and, additionally, for N EIRP points with EIRP ≥ 50%-tile minimum requirement are verified using the CSI-RS side condition.**  **Proposal 4: An LS informing RAN5 of the eBC applicability rule is needed, so that the information can be taken into account during their work on defining the conformance test specification.** |
| R4-2014924 | Apple Inc. | CR to **TR 38.831** on beam correspondence corrections  **CAT F CR**   1. **Define an applicability rule for UEs which support both eBC based on SSB and eBC based on CSI-RS** 2. **Define X = 3 dB in the CSI-RS side condition** |
| R4-2015344 | OPPO | Discussion on Rel-16 BC  Approval  **Applicability rules for UE support both SSB based and CSI-RS based BC**  ***Observation 1: L1-RSRP measurement accuracy is same for different reference signals if the reference signal density and side conditions (SINR/power levels) are same.***  ***Observation 2: Side conditions are same for SSB based and CSI-RS based BC, the difference is the density of reference signals for BC tests.***  ***Observation 3: RSRP measurement resources for CSI-RS based (without considering the SSB) is much smaller than the SSB based measurement which makes CSI-RS based is more stringent than the SSB based beam correspondence***  ***Observation 4: Proper choose the SSB power back off value comparing to CSI-RS can make the impact of SSB in CSI-RS based beam correspondence be neglected.***  ***Proposal 1: It is proposed to only test CSI-RS based beam correspondence for UEs that support both SSB based and CSI-RS based beam correspondence.***  ***SSB power back off value in CSI-RS based BC tests***  ***Proposal 2: It is proposed to adopt 7-9dB as the initial value and sent to RAN5 for further testability evaluation and the largest value will be adopted with the consideration of proposal 1 above.*** |
| R4-2015808 | Sony, Ericsson | Remaining issues in beam correspondence  Approval  Observation 1: Backing off the SSB PSD with X dB from CSI-RS PSD can emulate the real-life scenario.  Observation 2: Based on real field measurements, a minimum 7 dB RSRP difference can be observed between SSB and CSI -RS beam under LOS propagation conditions.  Observation 3: The SNR of SSB will be >= -1.0 dB for all grid points that satisfy spherical coverage requirement if it is backed off by 7 dB PSD from Rel-15 DL reference signals side condition. The SNR level is feasible for BC test.  Observation 4: According to the agreed applicable rules, a Rel-16 UE can pass the RF test without supporting the use of SSB for beam correspondence. Future enhancements are needed to guarantee the UE can support BC with SSB as SSB is the only always-on reference signal in the field.  Observation 5: The BC based on SSB may partially verify the BC based on CSI-RS, considering the BC performance is mainly affected by the SNR and number of RE.  **Proposal 1: For Rel-16 BC based on CSI-RS, SSB and CSI-RS are present, but SSB's PSD is backed-off by 7 dB from CSI-RS.** |
| R4-2016518 | Huawei, HiSilicon | CR on beam correspondence side condition  **CAT F CR**  **Define the SNR for CSI-RS signal as 3dB, and the corresponding Minimum CSI-RS\_RP values are provided with 3dB SNR**. |

## Open issues summary and views’ collection for 1st round

**Issue 1-1: SSB’s PSD is backed-off by X dB compared to CSI-RS in CSI-RS** **based eBC requirements**

* Proposals
  + Option 1: 3 dB
  + Option 2: 6 dB
  + Option 3: > 6 dB
* Recommended WF
  + TBA

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| **Company** | **Comments** |
| LGE | Prefer option 1 to set SSB’s PSD. RAN4 shall not consider option3 to guarantee to find best CSI-RS beam. |
| OPPO | Option 1, with the understanding that this PSD back-off will be set from P1 procedure, if too low PSD is set then the rough beam selection will be incorrect which makes the P3 procedure will be impossible. |
| Nokia | Can accept option 2 or option 3. |
| Ericsson | We propose X = 7 dB as shown by measurements reported in R4-2015808. The offset experienced in the field obviously varies, X = 7 dB represents the scenario with a weak SSB in the background of a CSI-RS beam that the test should verify.  We can also accept Option 2 in the interest of finding a compromise. Option 1 would effectively mean a repeat of the existing Rel-15 test case, not a meaningful enhancement. |
| Sony | Option 3 is our preference; 7 dB is already a minimized value based on our field measurement, which is reported in the R4-2015808, where even larger differences can also be observed. We think the test should be designed such that the real field operation can be revived. However, we also could compromise to option 2 (6 dB) if this is value can be acceptable by the majority.  With 6 dB power back off, the SNR of the SSB can still remain at least 0 dB within the spherical coverage. Therefore, it should be enough for SSB detection. 0 dB SNR is well above the SNR (-3 dB) which is used for SSB RSRP measurement accuracy requirement. We would also like to point out that for each measurement point, the DL RS (SSB and CSI-RS) always comes from a single AoA during the test, so the SNR of SSB does not affect the beam selection on the TE side.  3 dB PSD (option 1) difference may too small to make the Rel-16 BC based on CSI-RS differs from the Rel-15 BC test, and the meaning of such a test could be questionable. |
| Qualcomm | Option 2 or 3 |
| Intel | Option 2 |
| Huawei | In TS 38.133, the SSB SNR side condition is -3dB for a ±6.5dB L1-RSRP relative accuracy for FR2, with option 3, it actually requires UE reach RF requirement under the worst case for L1-RSRP measurement.  It means, even UE reach the RSRP accuracy defined TS 38.133, UE cannot reach CSI-RS based BC requirement. Because with ±6.5dB variation, UE is highly possible to select the wrong DL rough beam. Then P3 procedure could not compensated by 6dB CSI-RS SNR configuration. However, in the real network, such RSRP measurement variation could remedy by BFR procedure. While for UE test in the chamber, we only have 2 choices, make higher MU, or reconnection on each test grid which makes test time unbelievable.  It actually make RRM requirement more stringent, not RF. We think whether RRM requirement can be enhanced should discuss in RRM session.  On the other hand, we observed in the real network, generally SSB and CSI-RS difference is less than 3dB for DL coverage, 6-9dB difference on SSB and CSI-RS just make BS transmitting requirement looser. It is unfair to compensate gNB DL power with UE enhanced DL RSRP accuracy.  So we prefer Option 1, we can just focus on RF requirement verification. |
| Samsung | We prefer Option 1. Option 3 is too much PSD back off which leads to worse L1-RSRP measurement accuracy so that P1 procedure could not be guaranteed. |
| Apple | Option 1 |

**Issue 1-2: Additional applicability rules**

* Proposals
  + Option 1: None, remove current TBD
  + Option 2: Replace TBD with if a UE meets beam correspondence requirements based on SSB, it is considered to have met the beam correspondence requirements based on CSI-RS.
  + Option 3: Replace TBD with For UEs which support both eBC based on SSB and eBC based on CSI-RS, the UE RF core requirements for both side conditions shall apply.
* Recommended WF
  + TBA

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| **Company** | **Comments** |
| LGE | We prefer option2. Maybe based on OPPO proposal, we can add option 4 as follow  Option 4: Replace TBD with if UE meet the CSI-RS based beam correspondence, it is considered to have met the beam correspondence requirements based on SSB. |
| OPPO | Prefer “Option 4: Replace TBD with if UE meet the CSI-RS based beam correspondence, it is considered to have met the beam correspondence requirements based on SSB.”  According to calculation, the REs used for SSB based BC (16256 every 20ms) is much more than the CSI-RS based BC (2304 REs every 20ms), which makes the CSI-RS based BC is more stringent than the SSB based BC. |
| Nokia | Option 1 |
| Ericsson | We are a bit lost in this discussion. SSB-based BC is fundamental for FR2 operation and should have been mandatory and verified accordingly. |
| Sony | We think at least the BC based on SSB is essential, and it should not be skipped. |
| Qualcomm | Option 1 (seems equivalent to option 3 but more compact). Ok to accept option 2 if majority. |
| Intel | Option 2 |
| Huawei | We prefer Option 3, however we accept option 4: “Replace TBD with if UE meet the CSI-RS based beam correspondence, it is considered to have met the beam correspondence requirements based on SSB.” |
| MediaTek | After Nov 4th GTW, we prefer “Option 4: Replace TBD with if UE meet the CSI-RS based beam correspondence, it is considered to have met the beam correspondence requirements based on SSB.” |
| Samsung | We support Option 2. Agree with Qualcomm comment that Option 1 and Option 3 are equivalent. Both option 1 and option 3 are not acceptable. When discussing the feasibility of SSB based BC, there is agreement that an applicability rule is needed in R4-2005735:   * **Whether BC based on SSB-only requirement is feasible:**   + Yes, but need an applicability rule to minimize increase in test cases and test time compared with Rel-15   Based on that, it can be considered that SSB based BC and additional applicability rule is a package. |
| NTT DOCOMO, INC | After Nov 4th GTW session, we are OK with Option 2 as a compromise. But we have an objection on option 4 (and also option 5) discussed in GTW.  SSB only BC should not be skipped because there are network(s) that do not use CSI-RS for BC while SSB is used in all networks.  In addition, we have a concern about how to guarantee the performance of SSB only BC if we take option 4.  As described in TS 38.101-2, CSI-RS is not provided in SSB only testing, therefore we can surely guarantee the performance of SSB only BC by testing it. However, in option 4, SSB only BC will be skipped and thus it is difficult to guarantee the performance of BC based on SSB only since UE supporting CSI-RS only BC would use CSI-RS as reference signals in testing. |
| Apple | Option 3 from the core requirement perspective; and we should explore reducing the test burden |

**Issue 1-3: Testing aspects**

* Proposals
  + Option 1: For UEs which support both eBC based on SSB and eBC based on CSI-RS, beam correspondence performance is verified based on SSB only side conditions for all applicable TX RF requirements, and, additionally, for N EIRP points with EIRP ≥ 50%-tile minimum requirement are verified using the CSI-RS side condition.
  + Option 2: Only test CSI-RS based beam correspondence for UEs that support both SSB based and CSI-RS based beam correspondence.
  + Option 3: Other
* Recommended WF
  + TBA

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| **Company** | **Comments** |
| LGE | I don’t understanding, what is reason to discuss the testing aspect? This is straightforward issues. Also it is not aligned with applicability rule.  Maybe RAN4 decide as option3 in Issue 1-2, then we can consider with option1 in Issue 1-3.  But ,when RAN4 decide option2 in issue 1-2, then option2 in testing aspect is not aligned with the applicability rule. We make option3 as follow  Option3: Only test SSB-based eBC for UEs that support both SSB based eBC and CSI-RS based eBC. |
| OPPO | Option 2, aligned with the issue 1-2. And for the testing of other Tx RF requirements should follow Rel-15 conditions. And not mix Rel-16 BC enhancement with other Tx RF requirements. |
| Nokia | Option 3: UEs should be tested for all the Rel-16 eBC requirements that the UE indicates support for. |
| Ericsson | Option 3. |
| Qualcomm | Option 3: We agree with the idea of an additional verification step with the second set of side conditions. Our view:   1. If the UE declares support for both types of eBC, it should be left up to RAN5 discretion which side condition set is ‘primary’ and which is ‘secondary’. Here, the primary set of side conditions would be those that are used to verify compliance with all applicable Tx RF requirements. 2. Also, better choices exist for the proposed additional test in option 1. The main problem with the proposed test is does not test a UE’s ability to refine its beams. It is also potentially lengthy.   Instead, we can choose a more precise and shorter additional test, which is to verify min peak EIRP with the secondary set of side conditions. Beam peak search can be performed with knowledge of beam peak location with primary side condition set. |
| Intel | If RAN4 defines the testability, then Option 1 can cover both SSB based and CSI-RS based beam correspondence tests and also reduce the test effort. |
| Huawei | Enhanced BC is UE capability. If UE do not support enchanced BC, all RF requirements should be verified based on Rel-15 side condition. If UE support one of the enhanced BC, then all RF test based this enhanced BC can replace Rel-15 test. If UE support both enhanced BC, we think we have 2 choices: 1. Align with 1-2 2. Up to UE’s declare, which side condition it prefer to use. However, it still depends on the decision on CSI-RS based side condition. |
| MediaTek | After Nov 4th GTW, we are fine to discuss testing aspect in new Issue 1-2. |
| Samsung | Agree with LG that this issue is correlated with issue 1-2.  Option 1 could be considered as a compromise for issue 1-2, and then we agree with the principle of Option 1 but the N value is better to be agreed as 1 in RAN4 that only peak direction verification is enough. |
| NTT DOCOMO, INC | Option 1 and 3.  We have an objection on option 2 as described in issue 1-2. |
| Apple | Option 1 |

### CRs/TPs comments collection

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| **CR/TP number** | **Type/Source** | **Comments collection** |
| R4-2014512 | CAT F  Nokia | REL16 eBC capability alingment with 38.306 |
| Company A |
| Samsung: agree with Qualcomm. |
| Qualcomm: CR ok pending resolution of 1-2 and 1-3 |
| R4-2014924 | CAT F  Apple Inc | CR to TR 38.831 on beam correspondence corrections |
| Samsung: agree with Intel and QC |
| Intel: wait for the determination of X and applicability rules |
| Qualcomm: CR needs revision pending resolution of issues |
| R4-2016518 | CAT F  Huawei, HiSilicon | CR for side condition of beam correspondence requirement |
| Apple: The CSI-RS side conditions should be the same as in Rel-15; the only difference should be the SNR level of SSB |
| Nokia: Rel-16 eBC should not relax BC requirements as proposed by this CR. Instead the side conditions for CSI-RS based eBC should use the same side conditions as in Table 6.6.4.3.1-2 ‘Conditions for CSI-RS based L1-RSRP measurements for beam correspondence’ used for the Rel-15 BC requirements. |
| Intel: wait for the determination of X |
| Qualcomm: CR ok pending resolution of 1-1 (X = 3 not yet agreed) |
| Samsung: CR ok as long as X is finally agreed as 3. |

## Summary for 1st round

GTW session was held on Tuesday 3.11.

**For Issue 1-1: SSB’s PSD is backed-off by X dB compared to CSI-RS in CSI-RS based eBC requirements**

Option 4 was added because option 1 and option 3 seemed to be too extreme for all to accept.

Option 1: 3 dB

Option 2: 6 dB

Option 3: > 6 dB

Option 4: 5dB

**For Issue 1-2: Additional applicability rules**

Options 1 and 3 were removed but following was seen acceptable

RAN4 agreement: For UEs which support both eBC based on SSB and eBC based on CSI-RS, the UE RF core requirements for both side conditions shall apply

Option 6 seems to be ok for most.

~~Option 1: None, remove current TBD~~

Option 2: Replace TBD with if a UE meets beam correspondence requirements based on SSB, it is considered to have met the beam correspondence requirements based on CSI-RS.

~~Option 3: Replace TBD with For UEs which support both eBC based on SSB and eBC based on CSI-RS, the UE RF core requirements for both side conditions shall apply. Avoidance of over-testing will be discussed separately.~~

Option 4: “Replace TBD with if UE meet the CSI-RS based beam correspondence, it is considered to have met the beam correspondence requirements based on SSB.”

Option 5: either option 2 or 4 is up to UE declaration.

Option 6: Add one representative test for the secondary side conditions set. The number of test points is up to RAN5.

**Issue 1-3: Testing aspects**

This issue was discussed together with issue 1-2 and option 6 reflects that.

* Proposals
  + Option 1: For UEs which support both eBC based on SSB and eBC based on CSI-RS, beam correspondence performance is verified based on SSB only side conditions for all applicable TX RF requirements, and, additionally, for N EIRP points with EIRP ≥ 50%-tile minimum requirement are verified using the CSI-RS side condition.
  + Option 2: Only test CSI-RS based beam correspondence for UEs that support both SSB based and CSI-RS based beam correspondence.
  + Option 3: Other

WF was assigned to Apple to solve amount of X and additional application rule(s) and testing aspects.

### 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** |
| **Issue 1-1**  **SSB’s PSD is backed-off by X dB compared to CSI-RS in CSI-RS based eBC requirements** | Tentative agreements: None  Candidate options:  Option 1: 3 dB  Option 2: 6 dB  Option 3: > 6 dB  Option 4: 5dB  Recommendations for 2nd round: Discuss in WF |
| **For Issue 1-2:**  **Additional applicability rules** | RAN4 agreement: For UEs which support both eBC based on SSB and eBC based on CSI-RS, the UE RF core requirements for both side conditions shall apply  Candidate options:  Option 2: Replace TBD with if a UE meets beam correspondence requirements based on SSB, it is considered to have met the beam correspondence requirements based on CSI-RS.  Option 4: “Replace TBD with if UE meet the CSI-RS based beam correspondence, it is considered to have met the beam correspondence requirements based on SSB.”  Option 5: either option 2 or 4 is up to UE declaration.  Option 6: Add one representative test for the secondary side conditions set. The number of test points is up to RAN5.  Recommendations for 2nd round: Discuss in WF |
| **Issue 1-3:**  **Testing aspects** | It can be covered in Issue 1-2.  Recommendations for 2nd round: Discuss in WF |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF for Beam Correspondence based on configured DL RS (SSB or CSI-RS) | Apple |

### CRs/TPs

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

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| **CR/TP number** | **Title** | **CRs/TPs Status update recommendation** |
| R4-2014512 | CAT F  REL16 eBC capability alingment with 38.306  Nokia | To be Revised |
| R4-2014924 | CAT F  CR to TR 38.831 on beam correspondence corrections  Apple Inc | To be Revised |
| R4-2016518 | CAT F  CR for side condition of beam correspondence requirement  Huawei, HiSilicon | To be Revised |

## Discussion on 2nd round (if applicable)

Concentrate on WF for Beam Correspondence based on configured DL RS (SSB or CSI-RS) and following CRs. Comments can be added in table below.

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| **CR/TP number** | **Type/Source** | **Comments collection** |
| **R4-2016820**  **Apple** | WF for Beam Correspondence based on configured DL RS (SSB or CSI-RS) | **Intel: For WF3, both option 1 and option 2 are ok** |
| **LGE:**  **1) WF1 (X dB back-off) : support option4 as compromised solution**  **2) WF2 (applicability rule): support option 2 and option 5**  **3) WF3 (Representative test) : it is depend on RAN4 decision when RAN4 choose option 6 in WF2. We can wait to decide this WF3** |
| **OPPO:**  WF1: X=5dB is ok  WF2:   * About Option 2/4, as we discussed in 1st round, the comparison of whether SSB based is more stringent than the CSI-RS based is rely on the reference signal resources that can be used during the test. However, there is no SSB configuration defined in 38.101-2 spec, and actually it reuses the common configuration in RAN5 38.508-1 whether the SSB is 1 per cell. This makes the reference signal resources in SSB based BC (254 REs) is much less than the CSI-RS based BC (2304 REs) without considering the SSBs that might potentially be used in some directions. With this understanding, the SSB based will be much more stringent than the CSI-RS based.   Therefore, Option 2 is reasonable, i.e. UE meet the SSB based will be considered met CSI-RS based.   * Regarding Option 6, some clarifications are needed:   + The meaning of “All RF requirements are verified using the SSB side condition” is unclear, does it mean all the UE RF Tx requirements or only beam correspondence requirements?   + In previous meetings, there are discussion on the relation of Rel-15 BC and Rel-16 BC. And the conclusion is if UE meets either SSB based or CSI-RS based then it is considered have met the SSB+CSI RS BC which is Rel-15 BC. However, since all other UE Tx RF requirements are based on BC in the OTA tests, there is no conclusion whether these requirements will based on Rel-15 or Rel-16 BC according to our understanding. Some companies think the BC enhancement discussion should focus on BC itself while others think all other RF requirements also changed. So here Option 6 needs to be clarified from this aspect.   WF3: Option 2 is preferred from test costs perspective. And here the peak EIRP is the only requirement that need to be further checked rather than all other RF requirements. |
| **DOCOMO: For WF2, support option 2 and option 6** |
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| **R4-2016821**  **Nokia** | CAT F  REL16 eBC capability alingment with 38.306 |  |
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| **R4-2016822**  **Apple** | CR to TR 38.831 on beam correspondence corrections |  |
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| **R4-2016823**  **Huawei, HiSilicon** | CAT F  CR for side condition of beam correspondence requirement |  |
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## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **Title** | **T-doc Status update recommendation** |
| **R4-2016820**  **Apple** | WF for Beam Correspondence based on configured DL RS (SSB or CSI-RS) |  |
| **R4-2016821**  **Nokia** | CAT F  REL16 eBC capability alingment with 38.306 |  |
| **R4-2016822**  **Apple** | CR to TR 38.831 on beam correspondence corrections |  |
| **R4-2016823**  **Huawei, HiSilicon** | CAT F  CR for side condition of beam correspondence requirement  Huawei, HiSilicon |  |

# Topic #2: DL interband CA

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014290 | Qualcomm Incorporated | Inter-band + intra-band CA FR2 frequency separation class  Approval  Observation 1: For combination of intra-band and inter-band CA, UE must support minimum of 1600 MHz BB bandwidth due to restrictions in available UE capabilities.  Observation 2: Without proper flexibility in the capabilities operators have to either accept UE with lower capabilities or then require over engineered devices for their needs.  **Proposal 1: Add 200, 400 and 600 MHz to the list of frequency separation classes in the Table 5.3A.4-2.** |
| R4-2014581 | Intel Corporation | CR to 38.101-2 (Rel-16) inter-band DL CA  **CAT F CR**  For inter-band DL CA, the current REFSENS and EIS spherical coverage requirements have brackets, remove the brackets |
| R4-2014585 | Intel Corporation | Rel-16 Inter-band DL CA requirements  Approval  **Proposal 1: Remove the brackets in the following sentence in the spec to keep PSD imbalance as specified:**  **[The requirement on each component carrier shall be met when the power in the component carrier in the other band is set to its EIS spherical coverage requirement for inter-band CA specified in sub-clause 7.3A.3.3].**  **Proposal 2: For ΔRIB,S,n in Table 7.3A.3.3-1, the brackets can be removed.**  **Proposal 3: For ΔRIB,P,n in Table 7.3A.2.3-1, the brackets can be removed.** |
| R4-2014597 | Qualcomm | Clarification of EIS spherical coverage for inter-band CA  **CAT F CR**  **Complete requirement specifications for EIS spherical coverage for inter-band CA for each power class by introducing passing criterion for common coverage area:**  **‘The common coverage requirement is determined as <100 - percentile rank> %, where ‘percentile rank’ is included in the specification of spherical coverage for that power class from section 7.3.4’**  **Note that ‘percentile rank’ is the number that goes before ‘%ile’.** |
| R4-2014932 | NTT DOCOMO, INC. | CR for PSD imbalance for FR2 DL inter-band CA  **CAT F CR**  **- Remove squeare bracket for the following sentence to apply PSD imbalance for FR2 DL inter-band CA**  **The requirement on each component carrier shall be met when the power in the component carrier in the other band is set to its EIS spherical coverage requirement for inter-band CA specified in sub-clause 7.3A.3.3.** |
| R4-2015088 | Nokia, Nokia Shanghai Bell | CR to TR 38.831 to include DL CA agreement  Approval  This TP propose to include the agreement on FR2 DL CA into TR 38.831 |
| R4-2015343 | OPPO | Discussion on Rel-16 FR2 inter-band DL CA  Approval  Observation 1: ΔRIB,P,n was introduced covering multi-band relaxation and large PSD imbalance relaxation where 2.5dB for multi-band relaxation seems agreeable.  Observation 2: During the peak EIS testing the other band will still transmit and the power is much higher than the band under testing which makes the other band is a blocking signal and performance degradation will happen.  **Proposal 1: It is proposed to agree on the 3.5dB total relaxation for inter-band DL CA and remove the [ ] from spec.** |
| R4-2016519 | Huawei, HiSilicon | CR for inter-band NC DL CA Rrefsens  **CAT F CR**  **Adding sentence: For a UE supporting a inter-band CA configuration, the ΔRIB applies for both SC and CA operation.** |
| R4-2016053 | Ericsson | Frequency separation class alignment  **CAT F CR**  Remove frequency separation class tables from RAN4 specs |
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## Open issues summary and views’ collection for 1st round

**Issue 2-1: Add 200, 400 and 600 MHz to the list of frequency separation classes in the Table 5.3A.4-2.**

* Proposals
  + Option 1: Add 200, 400 and 600 MHz
  + Option 2: Add nothing
  + Option 3: Add something
* Recommended WF
  + TBA

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| --- | --- |
| **Company** | **Comments** |
| Nokia | Support Option 3.  A question to the proponent: Are 200/400/600 MHz used only for UE supporting the combination of intra and inter-band CA? Or are they also allowed in a single band capable UE? |
| Ericsson | A good question by Nokia. For which configurations do these classes apply? |
| Qualcomm | The new FS classes are intended for UEs supporting inter-band CA.  To Huawei:   1. It is written in our paper that the limitation is in BB and IF interfaces. 2. What is and is not reasonable for an implementation is the point of our paper that combined processing requirement of 1600 MHz without any spectrum that needs it is not reasonable. Could Huawei indicate where this is needed. And a tip, the envelope of simultaneous processing capability drives the UE design and a large chunk of continuous spectrum can be precessed in smaller part. The block diagram is for reference only. How this is done in real implementation is irrelevant. Only the envelope. |
| Huawei | We have some clarification questions on the contribution:   1. In the contribution, from the architecture figure, it seems the separation limitation is brought from IF part, i.e. the MUX, however, in our knowledge, it would not be the limitation from implementation perspective. For L+H band combination, there are already 2 RF chains which can separately indicate separation class, so the limitation do not come from RF part. So what is separation upper limitation coming from for L+H combination? 2. In the contribution, from the architecture figure, why one receiving chain could only handle 400 or 800MHz when the other receiving chain could handle 800MHz date? Why the asymmetrical ability for each processing chain? Seems not reasonable. |
| Samsung | If added, a notification to address Nokia’s comment is necessary. |
| Apple | Option 3. We think that 200 MHz is not necessary, and therefore we support to add 400 MHz and 600 MHz only. |

**Issue 2-2: Brackets removal from rel-16 Inter-band DL CA requirements**

* Proposals
  + Option 1: Remove all brackets (R4-2014585)
  + Option 2: Do not remove brackets
  + Option 3: Remove some of the brackets
* Recommended WF
  + TBA

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| **Company** | **Comments** |
| Nokia | Option 1 |
| Intel | Option 1 |
| Huawei | Option 1 |
| MediaTek | Option 1 |
| Samsung | Option 1 |
| NTT DOCOMO, INC | Option 1 |
| Apple | Option 1 |

**Issue 2-3: Remove frequency separation class tables from RAN4 specs (R4-2016053)**

* Proposals
  + Option 1: Remove the tables
  + Option 2: Keep the tables
* Recommended WF
  + TBA

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| **Company** | **Comments** |
| XXX |  |
| OPPO | Option 2, Not clear why the FS table is removed even RAN2 has defined signalling, this table gives necessary information for the CA. |
| Nokia | Option 2, we think that RAN4 specifications needs also to list frequency separation classes. |
| Qualcomm | Option 2: We agree with the principle of not duplicating information, and spec consistency. The parameters proposed to be removed are however extremely RF centric, and RAN2 spec is not the appropriate location for this information. Alignment is better achieved by RAN2 referencing RAN4 tables. |
| Intel | Option 2: Keeping the table is better. RAN4 defines RF capability, RAN2 implements corresponding capability signalling. Removal of these tables reduces the RAN4 spec readability. RAN4 may lose the track of record of RAN4 spec changes. |
| Huawei | Option 2, because RAN2 spec TS 38.306 says: the separation class definition is referred to TS 38.101-2. |
| Samsung | Option 2. It is not duplicated. RAN4 spec also needs this information. |
| Apple | Option 2, we require these Tables in the TS 38.101-2 since it is RF related. |

### 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** | **Type/Source** | **Comments collection** |
| R4-2014581 | CAT F CR  Intel | CR to 38.101-2 (Rel-16) inter-band DL CA |
| Moderator: Cover sheet error as rev field is missing “-“, old CR template. |
| Nokia: we support this CR |
| Samsung: we support this CR |
| NTT DOCOMO, INC: We support this CR. |
| R4-2014597 | CAT F CR  Qualcomm | Clarification of EIS spherical coverage for inter-band CA |
| Moderator: Cover sheet error as rev says 1, old CR template. |
| Samsung: it is fine to extend the applicable power classes. Just a question, is clause 7.3A.3.1 and 7.3A.3.2 reserved for PC1 and PC2 respectively? If so, it seems we still have last chance to make use of “void” section. |
| Nokia: Editorial comment: Section 7.3.4 -> clause 7.3.4 |
| Intel:The addition of the following sentence is redundant, original wording is clear enough. What is new information brought by the sentence **‘The common coverage requirement is determined as <100 - percentile rank> %, where ‘percentile rank’ is included in the specification of spherical coverage for that power class from section 7.3.4’?** |
| Qualcomm; To intel, it adds the agreed 50 % of the common coverage area in to the TS. It is not written anywhere even it was agreed in WF’s. |
| R4-2014932 | CAT F CR  CAT F CR  NTT DOCOMO, INC. | CR for PSD imbalance for FR2 DL inter-band CA |
| Nokia: prefer Intel CR R4-2014581 as it also removes brackets inΔRIB and ΔRIB,S,n tables. |
| NTT DOCOMO, INC: We are also OK to remove bracket in ΔRIB and ΔRIB,S,n and focus on Intel CR. |
|  |
| R4-2015088 | Nokia, Nokia Shanghai Bell | CR to TR 38.831 to include DL CA agreement |
| Moderator: TR is under change control; real CR is required. |
| Company A |
| Company B |
| R4-2016519 | CAT F CR  Huawei, HiSilicon | CR for inter-band NC DL CA Rrefsens |
| Nokia: if CR is agreeable then “SC” needs to be spelled out as it is not defined in 3.3 abbreviations |
| Huawei: to Nokia, yes we can spell out. To QC, generally, delta RIB is also valid for single carrier case if the UE indicates it supports inter-band CA. we wants to address for this scenario. |
| Qualcomm: Some clarification requested from proponent. Delta(R\_IB) applies per CC. Would you explain what specific scenario the addition is meant to address? |
| NTT DOCOMO, INC: We wonder if ΔRIB should apply to SC operation. In our understanding, one of the main factors ofΔRIB for FR2 inter-band CA is supporting common spherical coverage in CA operation. This is different from FR1 ΔRIB which is caused by insertion loss of additional filter to support CA. |
| R4-2016053 | CAT F CR  Ericsson | Frequency separation class alignment CR |
| Apple: We cannot agree with this CR. |
| Nokia: not agreeable we want to keep frequency separation classes in RAN4 specs |
| Qualcomm: We agree with the principle of not duplicating information, and spec consistency. The parameters proposed to be removed are however extremely RF centric, and RAN2 spec is not the appropriate location for this information. Alignment is better achieved by RAN2 referencing RAN4 tables. |
| Intel: Prefer to keep the table for better readability. See the comments to Issue 2-3 |
| Huawei: we would like provide the information that, in TS 38.306, it is described for separation class: “the values mhzX correspond to the values defined in TS 38.101-2”, with such RAN2 reference, it seems RAN4 cannot remove the table?  C:\Users\z00405189\AppData\Roaming\eSpace_Desktop\UserData\z00405189\imagefiles\9DAF604A-E106-474D-B53C-C294F19753F0.png  Let me know if there is misunderstanding on RAN2 spec. |

## Summary for 1st round

In GTW session **Issue 2-1: Add 200, 400 and 600 MHz to the list of frequency separation classes in the Table 5.3A.4-2 w**as discussed without conclusion, WF was assigned to Qualcomm.

Following topics were not discussed as time run out. But these companies seem to have uniform opinion.

**Issue 2-2: Brackets removal from rel-16 Inter-band DL CA requirements 🡪 Agreeable**

**Issue 2-3: Remove frequency separation class tables from RAN4 specs (R4-2016053) 🡪 Not pursuit**

### Open issues

*Recommendations on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF for addition of new frequency separation classes | Qualcomm |

### CRs/TPs

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

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2014581 | agreeable but to be revised, cover sheet error rev field is missing “-“, |
| R4-2014597 | to be revised, cover sheet error, fix void clause headers if necessary, Section 7.3.4 -> clause 7.3.4 |
| R4-2014932 | To be noted, is included in R4-2014581 |
| R4-2015088 | to be revised, Real CR is needed as TR is under change control |
| R4-2016519 | to be revised |
| R4-2016053 | To be noted not agreeable |

## Discussion on 2nd round (if applicable)

Concentrate on

the WF for addition of new frequency separation classes

and following CRs

R4-2016825 agreeable but to be revised, cover sheet error rev field is missing “-“,

R4-2016826 to be revised, cover sheet error, fix void clause headers if necessary, Section 7.3.4 -> clause 7.3.4

R4-2016827 to be revised, Real CR is needed as TR is under change control

R4-2016828 to be revised

Comments can be added in table below.

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| **CR/TP/LS/WF number** | **Title** | **Comments** |
| **R4-2016824**  **Qualcomm** | WF on addition of new frequency separation classes | Intel: Option 2a and 2b. Question: what is difference between option 2a and 2b? |
| LGE: For the applicability, prefer option1 in slide3 |
| OPPO: Option 2a or 2b is ok from UE design flexibility perspective. But if the BB design challenge is mainly coming from intra+inter band CA, then Option 1 is also an acceptable choice. |
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| **R4-2016825**  **Intel** | CR to 38.101-2 (Rel-16) inter-band DL CA |  |
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| **R4-2016826**  **Qualcomm** | Clarification of EIS spherical coverage for inter-band CA |  |
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| **R4-2016827**  **Nokia** | CR to TR 38.831 to include DL CA agreement |  |
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| **R4-2016828**  **Huawei, HiSilicon** | CR for inter-band NC DL CA Rrefsens |  |
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## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| --- | --- | --- |
| **CR/TP/LS/WF number** | **Title** | **T-doc Status update recommendation** |
| **R4-2016824**  **Qualcomm** | WF on addition of new frequency separation classes |  |
| **R4-2016825**  **Intel** | CR to 38.101-2 (Rel-16) inter-band DL CA |  |
| **R4-2016826**  **Qualcomm** | Clarification of EIS spherical coverage for inter-band CA |  |
| **R4-2016827**  **Nokia** | CR to TR 38.831 to include DL CA agreement |  |
| **R4-2016828**  **Huawei, HiSilicon** | CR for inter-band NC DL CA Rrefsens |  |