**3GPP TSG-RAN WG4 Meeting #** **98 R4-2103469**

**Electronic Meeting, Jan.25 - Feb.5, 2020**

**Agenda item:** 11.3.5

**Source:** Moderator (Nokia, Nokia Shanghai Bell)

**Title:** Email discussion summary for [98e][230] [NR\_RF\_FR2\_req\_enh2\_RRM](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98_e/Inbox/Drafts/%5B98e%5D%5B230%5D%20NR_RF_FR2_req_enh2_RRM)

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion 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

The WID on NR RF Enhancements for FR2 RP-202107 has been approved in RAN#89e meeting. The purpose of this work item is to specify the following FR2 UE features and associated requirements including RF and RRM requirements.

* Inter-band DL CA enhancements [RAN4 RF/RRM]
  + Agree a method how applicable CBM/IBM information is captured into specification for a particular CA configuration. Agree how it is decided whether a certain CA configuration is assuming CBM or IBM based requirements (for-example is applicability based on operator request or some general rule or are all CA configurations applicable for both CBM and IBM).
  + Study and if feasible define UE requirements for CBM between different freq. groups (e.g. 28GHz + 37GHz).
  + Define requirements for CA\_n258A-n260A and CA\_n257A-n259A based on IBM (Note these CA configurations will be moved to Basket WI in RAN#90 and more combinations may be added to Basket WI later).
  + Define UE requirements for inter-band CA within the same freq. group (e.g. 28GHz + 28GHz) for common beam management (CBM) based on requested band combinations. Evaluate performance impact based on deployment conditions and design constraints, including outcome of MRTD requirement if any.
  + Study and if feasible define UE RF requirements for inter-band CA within the same freq. group (e.g. 28GHz + 28GHz) for (IBM) based on explicitly requested band combinations.
  + Both RF and RRM requirement aspects are in scope for DL interband CA.
* Inter-band UL CA [RAN4 RF/RRM]
  + Specify requirements for inter-band UL CA for two bands.
  + Define requirements for CA\_n257A-n259A based on IBM (Note this CA configuration will be moved to Basket WI in RAN#90 and more combinations may be added to Basket WI later).
  + Study and if feasible define UE requirements for CBM between different freq. groups (e.g. 28GHz + 37GHz).
  + Study and if feasible define UE requirements for CBM and/or IBM CA within the same freq. group (e.g. 28GHz + 28GHz), on hold until there is operator request.
  + Both RF and RRM requirement aspects are in scope for UL interband CA.
* UL gaps for self-calibration and monitoring. [RAN4 RF/RRM, RAN2] Study and, if feasible, introduce UE specific and NW configured gap for general self-calibration and monitoring purposes including
  + - PA efficiency and power consumption
    - Transceiver calibration due to temperature variation
    - UE Tx power management
    - Others self-calibration and monitoring are not precluded
  + **Phase 1:** Study and clearly identify the performance gain over the current baseline (Rel.16 requirements) Study of RF performance evaluation/testability related to UE self-calibration and monitoring. Study network impact of UE emissions during UL gap, if any.
  + **Phase 2:** Specify the UL gap configuration(s), related UE capability and interruptions, if needed, based on the identified performance gain in Phase 1 and UE fall back behaviour i.e. if gaps are not available for UE requesting gaps.

In RAN4#97-e meeting, the work plan R4-2014514 was approved where the initial discussion on RRM aspects are expected:

* 98e
  + Interband DL CA
    - Continue discussions on applicability of CBM/IBM on individual CA configuration
    - Continue discussion on aspects of CBM between different freq. groups
    - Continue discussions on requirements for CA\_n258A-n260A and CA\_n257A-n259A based on IBM
    - Continue discussion on aspects of IBM within same freq. groups
    - Initial discussions of RRM aspects of DL interband CA
  + Interband UL CA
    - Continue discussion on aspects of CBM between different freq. groups
    - Continue discussions on requirements for CA\_n257A-n259A based on IBM
    - Initial discussions of RRM aspects of UL interband CA
  + UL gaps for self-calibration and monitoring, phase 1.
    - Continue discussion on identification of areas that can be improved with UL gaps
    - Initial discussion RF performance evaluation/testability aspects related to UE self-calibration and monitoring.
    - Initial discussion network impact of UE emissions during UL gap

As this is the first meeting to discuss the RRM requirements for FR2 inter-band CA, the intention is to identify the potential RRM aspects and reach some agreements on the assumptions for defining the RRM requirements if possible. The tentative target of email discussion for 1st round ad 2nd round is indicated below:

* 1st round: Companies are expected to provide views and/or comments on the listed open issues.
* 2nd round: Identify the potential RRM aspects to be defined in FR2 inter-band CA and converge on the assumptions if possible for defining the RRM requirements.

# Topic #1: Inter-band DL CA enhancements

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

## Companies’ contributions summary

Moderator comments: All the contributions discussing or partially discussing the RRM requirements for FR2 inter-band CA enhancements are listed here. According to the meeting guideline, all CRs will be postponed so the CR relevant to this topic is marked with ”~~strikethrough~~”.

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100241 | Apple | Observation 1: For FR2 intra-band CA, symbol level alignment within CP length is essential to guarantee the same downlink spatial domain transmission filter on one OFDM symbol.  Observation 2: FR2 SCell activation requirements for intra-band CA suggests that when common beam management is assumed, fine timing and spatial information from one CC can be directly re-used by the other CC. This again makes it important that symbol level alignment should be with CP length.  Observation 3: For CBM based FR2 intra-band CA, L1 and L3 measurements on one CC can be reused for all the other CC. That implies the same Tx and Rx beams used across all CCs per OFDM symbol.  Proposal 1: In case of common beam management, it is assumed that gNB for all CC are collocated.  Proposal 2: It is proposed to reuse FR2 intra-band CA MRTD, i.e. 260ns for the MRTD of FR2 inter-band CA in case of common beam management. |
| [R4-2100640](file:///C:\\DuLei2019\\RAN4\\RAN4%2398e\\Docs\\R4-2100640.zip) | LG Electronics | Proposal 1: Assumption of deployment and band pair for IBM UE and CBM UE should follow the RF session conclusions.  For MRTD  Proposal 2: Define MRTD requirements with assumption of co-located deployment for CBM UE and with assumption of non-co-located deployment for IBM UE.  Proposal 3: Demodulation performance degradation due to Rx beam switch should be noted in MRTD requirements for CBM UE if MRTD is larger than CP.  For MTTD  Proposal 4: Define MTTD requirements with assumption of co-located deployment for CBM UE and with assumption of non-co-located deployment for IBM UE.  Proposal 5: For CBM on inter-band UL CA, RAN4 needs to study how to handle impact on performance due to Tx beam switching. |
| R4-2101077 | NEC | Proposal 1: RAN4 should agree on the deployment scenario for CA configurations before deciding on the applicability of IBM or CBM to certain CA configuration.  Proposal 2: RAN4 to introduce new MRTD of 3us for an UE which is capable of CBM.  Proposal 3: RAN4 to agree that worst case performance degradation of upto 1 OFDM symbol is allowed for UE operating in CBM during RX beam switch.  Proposal 4: RAN4 should further study in Rel-17 to reduce the worst case (1 OFDM symbol) performance degradation. |
| R4-2101266 | Intel Corporation | Proposal 1: For the UEs with common beam management in FR2 inter-band CA the existing interruption requirements of intra-band CA can be applied.  Proposal 2: RAN4 to apply an agreement from RAN4 #94-bis-e which says:   * “The scheduling availability requirements for FR2 inter-band CA scenario shall be introduced to clarify there is scheduling restriction on one FR2 band due to RLM/BFD/CBD/L1-RSRP measurements being performed on another FR2 band if UE uses common beam. * The existing scheduling restriction requirements on FR2 shall be extended to serving cells in different bands.”   Proposal 3: RAN4 to apply an agreement from RAN4 #95-e which says:  “For CBM UEs in FR2 inter-band CA, the existing measurement restriction requirements for FR2 is applied for the RLM/BFD/CBD/L1-RSRP measurements being performed on different FR2 bands.”  Proposal 4: For CBM UEs the measurement restriction applies when the SSB for RLM, BFD, CBD or L1- RSRP measurement on one band is in the same OFDM symbol as the CSI-RS for RLM, BFD, CBD or L1- RSRP measurement on another band  Proposal 5: RAN4 to apply the agreements from RAN4 #94-bis-e and #95-e which say:  “SCell activation requirement for case 1: SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band   * The existing SCell activation delay requirements in case of “SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band” can be reused for FR2 inter-band CA.   SCell activation requirement for case 2: SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2   * For CBM UEs in the Case 2, if the target SCell is known, the existing known SCell requirement in the case of“SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR1” shall be applied.”   Proposal 6: In the case when SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2 and the target SCell is unknown the existing SCell activation delay requirements for FR1+FR2 CA without L1-RSRP measurement delay can be reused.  Proposal 7: In case of common beam management in FR2 inter-band CA, for MRTD we propose to reuse FR2 intra-band CA requirements, i.e. MRTD = 260ns. |
| R4-2101540 | OPPO | Proposal 1: MRTD, interruption, and SCell activation requirements of CBM UE for 2 CBM UE can be investigated in Rel-17 FR2 inter-band DL CA enhancements.  Proposal 2: For MRTD of FR2 inter-band CA with CBM, reuse FR2 intra-band CA MRTD, i.e. 0.26us.  Proposal 3: For a FR2 inter-band CA with CBM, the existing interruption requirements of intra-band CA can be applied.  Proposal 4: Scell actication delay would be reduced for the case if the PCell/PSCell and the target SCell are in a FR2 band pair with CBM, and the target SCell is unknown. |
| R4-2101686 | Huawei, HiSilicon | Observation 1: The existing requirements on scaling factor CSSFoutside\_gap in Rel-16 are not applied for FR2 inter-band CA with more than two bands.  Proposal 1: The requirements on scaling factor CSSFoutside\_gap need to be revised if FR2 inter-band CA with more than two bands will be introduced in Rel-17.  Proposal 2: The interruption requirements applied for CBM based FR2 inter-band CA need to be introduced in Rel-17, which need RF inputs on the RF architecture of CBM type UE.  Proposal 3: The SCell activation requirements in Case 2 applied for CBM type UE need to be defined.   * Case 2: SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2.   Observation 2: How to define the SCell activation requirements for CBM type UE depends on the RF architecture and MRTD requirements for CBM type UE.  Observation 3: The existing BFD/CBD requirements in Rel-16 can be applied for CBM type UE.  Proposal 4: In Rel-17, the existing scheduling/measurement restriction requirements applied for FR2 intra-band CA need to be extended to FR2 inter-band CA with CBM type UE.  Proposal 5: RAN4 need to investigate the MRTD requirements for FR2 inter-band CA with CBM type UE, which rely on the BS TAE requirements and the network deployment for CBM type UE. |
| R4-2101867 | Ericsson | Observation-1: There are many options before scheduling restrictions are needed, like available time in UL and DL (if carriers not full) and UL to DL switch, where UE could safely switch beams.  Observation-2: A beam switch change during TDL-UL guard period would not impact reception of another 3 µs late DL carrier.  Given these observations, we propose the following:  Proposal-1: Any change in MRTD should not impact already defined BS TAE of 3 µs for FR2 inter-band CA; i.e. keep Rel-15 values for BS TAE unchanged.  Proposal-2:   * The beam management is implementation dependent, thus not applicable to all UEs and to all band combinations. * The relevant UEs should be identified and distinguished (e.g. via capability indication, etc.) and the restrictions shall not be applied (e.g. deployment restrictions, etc.) for all UEs and all band combinations for the future of NR. * An agreed and approved UE capability indication, as in the bullet above, is a precondition for proposals in this document.   Proposal-3: Define MRTD for inter-band FR2 NR CA with common beam management as 3 µs.  Proposal-4: Corresponding MTTD for inter-band FR2 NR CA with common beam management as 3.5 µs. |
| ~~R4-2101868~~ | ~~Ericsson~~ | ~~Support up to 3 us MRTD~~ |
| R4-2102267 | Nokia, Nokia Shanghai Bell | 1. Rel-15 baseline UE assumption is similar to what is discussed as a CMB capable UE. 2. Rel-16 UE RRM requirements include requirements for an IBM capable UE.   And propose:   1. Capture that it is baseline UE requirement for an IBM capable UE, with more than 1 panel, to be able to have multiple panels active simultaneously. 2. Agree that the Rel-16 IBM UE requirements for an IBM capable UE already cover the illustrated scenarios. 3. The MRTD and MTTD requirements for inter-band CA in FR2 under IBM in Rel-16 are applicable for Rel-17. 4. The MRTD requirements for inter-band CA in FR2 under CBM could be 3us. |
| R4-2101687 | Huawei, HiSilicon | Observation 1: The existing MTTD requirement for FR2 inter-band CA can be applied for all the IBM based CA configurations, including CA\_n257A-n259A based on IBM.  Proposal 1: If CBM based FR2 inter-band UL CA would be introduced in Rel-17, then RAN4 needs to study the MTTD requirement applicable for CBM based FR2 inter-band CA.  Observation 2: The existing interruption and delay requirements for UL carrier RRC reconfiguration can be applied when new inter-band UL CA configurations are introduced.  Observation 3: The existing interruption requirements for UE switching between two uplink carriers are not applicable for FR2 inter-band UL CA.  Proposal 2: RAN4 investigates the interruption requirements for NR SRS carrier based switching applicable for inter-band SRS carrier switching in FR2. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

Moderator comments: This is the first RAN4 meeting where the RRM core requirements for FR2 inter-band CA will be discussed. From last meeting, some agreements and way forward were reached in RF session. Following were cited from the way forward R4-2016915 and R4-2017813.

* IBM UE capability is applicable for all CA configurations
* FFS if IBM should be the baseline (i.e., if CBM can be considered as an incapability signaling for the UE to use for certain allowed band combinations)
* FFS if the same IBM requirements apply to all CA configurations
* On “frequency group”
* “frequency group” term shall not be defined in specification
* On applicability of CBM/IBM requirements
* If either CBM or IBM is concluded as infeasible for certain band combinations, it is reasonable to clearly state in the spec that only the requirements of feasible BM apply to these band combinations. If both CBM and IBM are concluded as feasible for certain band combinations, IBM/CBM is up to UE’s capability.
* On applicability of CBM/IBM capability
* Detailed approach to justify applicability of CBM capability is TBD. Further discuss approaches including Fs,inter parameter in next meeting.
* Further study whether and/or how frequency separation class is introduced for inter-band CA based on CBM and IBM
* Typical inter-band CA deployment between bands in the same frequency group cannot be limited to co-located deployments
* IBM UEs are implementable
* Feasibility to support is left to UE vendor choice
* Companies are encouraged to evaluate requirements based on non-co-located test cases

### Sub-topic 1-1: General

*Sub-topic description:* This sub-topic discusses the general issues relevant to defining the RRM requirements for FR2 inter-band DL CA e.g. the deployment and UE assumptions for IBM and CBM UEs.

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

**Issue 1-1-1: Deployment scenarios assumption for CBM**

* Proposals
  + Option 1: In case of common beam management, it is assumed that gNB for all CC are collocated (Apple, LG, NEC)
  + Option 2: Assumption of deployment and band pair for IBM UE and CBM UE should follow the RF session conclusions (LG)
  + Option 4: The deployment of co-located or non co-located is up to network configuration. (Nokia)
  + Option 5: RAN4 should agree on the deployment scenario for CA configurations before deciding on the applicability of IBM or CBM to certain CA configuration (NEC)
  + Option 6: A UE which is only capable of common beam management for a band combination where common beam management is possible, may, assume collocated site, in this case. (CR R4-2101868 and R4-2101868)
* Recommended WF
  + TBA

**Issue 1-1-2: UE assumptions for CBM**

* Proposals
  + Option 1: Similar to Rel-15 baseline UE assumption i.e. UE can receive with one panel and beam at a time. (Nokia)
  + Option 2: The relevant UEs should be identified and distinguished (e.g. via capability indication, etc.) and the restrictions shall not be applied (e.g. deployment restrictions, etc.) for all UEs and all band combinations for the future of NR. (E///)
* Recommended WF
  + TBA

**Issue 1-1-3: Deployment scenarios assumption for IBM**

* Proposals
  + Option 1: non-co-located deployment for IBM UE (LG)
  + Option 2: Assumption of deployment and band pair for IBM UE and CBM UE should follow the RF session conclusions (LG)
  + Option 3: RAN4 should agree on the deployment scenario for CA configurations before deciding on the applicability of IBM or CBM to certain CA configuration (NEC)
  + Option 4: Agree that the Rel-16 IBM UE requirements for an IBM capable UE already cover the illustrated scenarios (Nokia)
    - Not exactly co-located deployment (e.g. inter-band CA cells are some distance apart (figure 1))
    - Not co-located deployment (e.g. angle between inter-band CA cells cannot be covered by one and same UE panel (figure 2))
    - Not co-located deployment (e.g. distance to the inter-CA cells is very different (figure 3))
* Recommended WF
  + TBA

**Issue 1-1-4: UE assumption for IBM**

* Proposals
  + Option 1: Capture that it is baseline UE requirement for an IBM capable UE, with more than 1 panel, to be able to have multiple panels active simultaneously. (Nokia)
* Recommended WF
  + TBA

### Sub-topic 1-2: MRTD for common beam management

*Sub-topic description:* This sub-topic discusses the MRTD requirements for common beam management, including the assumptions deriving the MRTD values and potential performance impact in FR2 inter-band CA.

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

**Issue 1-2-1: Can we assume symbol level alignment within CP length?**

* Proposals
  + Option 1: Symbol level alignment should be with CP length (Apple)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 1-2-2: How to determine MRTD for FR2 inter-band CA?**

* Proposals
  + Option 1: Reuse FR2 intra-band MRTD i.e. 260ns (Apple, Intel, OPPO)
  + Option 2: 3us (NEC, Nokia)
  + Option 3: 3us on condition of UE capability indication (E///)
  + Option 4: Rely on the BS TAE requirements and the network deployment (Huawei)
  + Option 5: Any change in MRTD should not impact already defined BS TAE of 3 µs for FR2 inter-band CA; i.e. keep Rel-15 values for BS TAE unchanged. (E///)
* Recommended WF
  + TBA

**Issue 1-2-3: Performance impact due to Rx beam switching**

* Proposals
  + Option 1: Demodulation performance degradation due to Rx beam switch should be noted in MRTD requirements for CBM UE if MRTD is larger than CP (LG)
  + Option 2: In worst case performance degradation of up to 1 OFDM symbol is allowed for UE operating in CBM during RX beam switch (NEC)
  + Option 3: RAN4 should further study in Rel-17 to reduce the worst case (1 OFDM symbol) performance degradation (NEC)
* Recommended WF
  + TBA

### Sub-topic 1-3: MRTD for independent beam management

*Sub-topic description:* This sub-topic discusses the MRTD requirements for independent beam management for FR2 inter-band CA in Rel17.

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

**Issue 1-3-1: How to determine MRTD in case of IBM?**

* Proposals
  + Option 1: The MRTD and MTTD requirements for inter-band CA in FR2 under IBM in Rel-16 are applicable for Rel-17. (Nokia)
* Recommended WF
  + TBA

### Sub-topic 1-4: MTTD for common beam management

*Sub-topic description:* This sub-topic discusses the MTTD requirements for common beam management, including how to determine the MTTD values and potential performance impact for FR2 inter-band CA

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

**Issue 1-4-1: How to determine MTTD for CBM?**

* Proposals
  + Option 1: 3.5 µs on condition of UE capability indication (E///)
  + Option 2: If CBM based FR2 inter-band UL CA would be introduced in Rel-17, then RAN4 needs to study the MTTD requirement applicable for CBM based FR2 inter-band CA (Huawei)
* Recommended WF
  + TBA

**Issue 1-4-2: Performance impact due to Tx beam switching**

* Proposals
  + Option 1: RAN4 needs to study how to handle impact on performance due to Tx beam switching (LG)
* Recommended WF
  + TBA

### Sub-topic 1-5: MTTD for independent beam management

*Sub-topic description:* This sub-topic discusses the MTTD requirements for independent beam management for FR2 inter-band CA in Rel17.

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

**Issue 1-5-1: How to determine MTTD in case of IBM?**

* Proposals
  + Option 1: The MTTD requirements for inter-band CA in FR2 under IBM in Rel-16 are applicable for Rel-17. (Nokia)
  + Option 2: The existing MTTD requirement for FR2 inter-band CA can be applied for all the IBM based CA configurations, including CA\_n257A-n259A based on IBM (Huawei)
* Recommended WF
  + TBA

### Sub-topic 1-6: RRM requirements for common beam management

*Sub-topic description:* This sub-topic discusses the RRM requirements other than MRTD and MTTD in case of CBM for FR2 inter-band DL CA.

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

**Issue 1-6-1: Scope of the RRM requirements for FR2 inter-band DL CA**

* Proposals
  + Option 1: MRTD, interruption, and SCell activation requirements of CBM UE for 2 CBM UE can be investigated in Rel-17 FR2 inter-band DL CA enhancements. (OPPO)
  + Option 2: MRTD, interruption requirements, SCell activation requirements and scheduling/measurement restriction requirements (Intel)
  + Option 3: Scaling factor CSSFoutside\_gap, interruption requirements, SCell activation requirements, Beam management requirements and scheduling/measurement restriction requirements (Huawei)
  + Option 4: TBA
* Recommended WF
  + TBA

**Issue 1-6-2: Interruption requirements**

* Proposals
  + Option 1: The existing interruption requirements of intra-band CA can be applied (Intel, OPPO)
  + Option2: The interruption requirements applied for CBM based FR2 inter-band CA need to be introduced in Rel-17, which need RF inputs on the RF architecture of CBM type UE (Huawei)
* Recommended WF
  + TBA

**Issue 1-6-3: Scheduling restriction**

* Proposals
  + Option 1: To apply an agreement from RAN4 #94-bis-e: (Intel)
    - “The scheduling availability requirements for FR2 inter-band CA scenario shall be introduced to clarify there is scheduling restriction on one FR2 band due to RLM/BFD/CBD/L1-RSRP measurements being performed on another FR2 band if UE uses common beam.
    - The existing scheduling restriction requirements on FR2 shall be extended to serving cells in different bands.”
  + Option 2: The existing scheduling/measurement restriction requirements applied for FR2 intra-band CA need to be extended to FR2 inter-band CA with CBM type UE. (Huawei)
* Recommended WF
  + TBA

**Issue 1-6-4: Measurement restriction**

* Proposals
  + Option 1: To apply an agreement from RAN4 #95-e: (Intel)
    - “For CBM UEs in FR2 inter-band CA, the existing measurement restriction requirements for FR2 is applied for the RLM/BFD/CBD/L1-RSRP measurements being performed on different FR2 bands.”
  + Option 2: For CBM UEs the measurement restriction applies when the SSB for RLM, BFD, CBD or L1- RSRP measurement on one band is in the same OFDM symbol as the CSI-RS for RLM, BFD, CBD or L1- RSRP measurement on another band (Intel)
  + Option 3: The existing scheduling/measurement restriction requirements applied for FR2 intra-band CA need to be extended to FR2 inter-band CA with CBM type UE (Huawei)
* Recommended WF
  + TBA

**Issue 1-6-5: SCell activation delay requirements**

* Proposals
  + Case 1: SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band:
    - Option1: Existing SCell activation delay requirements in Case 1 can be applied.(Intel, Huawei)
  + Case 2: SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2
    - Option1 (Intel):
      * If the target SCell is known, the existing known SCell requirement in Case 2 shall be applied.
      * In the case when SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2 and the target SCell is unknown the existing SCell activation delay requirements for FR1+FR2 CA without L1-RSRP measurement delay can be reused.
    - Option2: The SCell activation requirements in Case 2 applied for CBM type UE need to be defined. How to define the SCell activation requirements for CBM type UE depends on the RF architecture and MRTD requirements for CBM type UE (Huawei)
    - Option3: Scell activation delay would be reduced for the case if the PCell/PSCell and the target SCell are in a FR2 band pair with CBM, and the target SCell is unknown. (OPPO)
* Recommended WF
  + TBA

**Issue 1-6-6: Scaling factor CSSFoutside\_gap**

* Proposals
  + Option 1: The requirements on scaling factor CSSFoutside\_gap need to be revised if FR2 inter-band CA with more than two bands will be introduced in Rel-17 (Huawei)
* Recommended WF
  + TBA

**Issue 1-6-7: Beam management requirement**

* Proposals
  + Option 1: The existing BFD/CBD requirements in Rel-16 can be applied for CBM type UE (Huawei)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Issue 1-1-1:   * Fine with Option 2. Need input from RF. * Option 5 seems reasonable, but it should be RF/band discussion   Issue 1-1-2: Need input from RF. Ok for Option 1.  Issue 1-1-3: Fine with Option 2. Need input from RF.  Issue 1-1-4: More discussion is needed. Does it have impact on the MRTD or other requirements? Baseline requirement should be based on R15 assumption, and it should allow UE to receive 2 bands with 1 panel.  Issue 1-2-1: Support Option 1. Otherwise it will have performance degradation.  Issue 1-2-2: Support Option 1.  Issue 1-2-3:   * It is depending on 1-2-2. No need to discuss it if Option 1 in 1-2-2 is agreed. * Option 2 & 3 are similar. It may also need to consider how frequent UE would switch the RX beam. * This 1 OFDM symbol most likely to be control channel, and it will have huge performance degradation.   Issue 1-3-1: Clarification would be needed. IBM has been specified in R16. Not sure we need to agree on this again in R17.  Issue 1-4-1: Option 2.  Issue 1-4-2: OK with Option 1.  Issue 1-5-1: Clarification would be needed, similar to Issue 1-3-1. It seems transparent to the RRM requirement in 133. Should we capture it in the 133?  Issue 1-6-1: Option 3, which is more complete than other options.  Issue 1-6-2: Option 1, but also ok for Option 2.  Issue 1-6-3: Prefer to Option 1, which is more specific.  Issue 1-6-4: Prefer to Option 2 with some clarification on “*same* OFDM symbol”. For different band, the symbol boundary may not perfectly aligned. The wording can be clarified as  For CBM UEs the measurement restriction applies when the SSB for RLM, BFD, CBD or L1- RSRP measurement on one band is in the ~~same~~ OFDM symbols overlapping with the CSI-RS for RLM, BFD, CBD or L1- RSRP measurement on another band (Intel)  Issue 1-6-5:   * For case 1, fine with Option 1. * For Case 2, ok for option 1 and 2. L1-RSRP is not needed, and it also depends on MRTD. Option 3 can be included by option 1 because the delay can be reduced if L1-RSRP is not needed.   Issue 1-6-6: Is this proposal only for CBM or it is also for IBM?  Issue 1-6-7: OK with Option 1. |
| LG Electronics | Issue 1-1-1: Option 1 & Option 2 are fine.  Issue 1-1-2: Option 1 is fine. For Option 2, follow RF’s conclusion.  Issue 1-1-3: Option 1 & Option 2 are fine.  Issue 1-1-4: It seems closer to RF issue rather than RRM. Our understanding is that so far, any requirements have not been specified with assumption of multiple panels active simultaneously. For consistency, one panel active from more than 1 panel needs to be kept.  Issue 1-2-1: It is related to TAE in co-located deployment. If 260ns is possible as TAE, Option 1 can be supported. If MRTD > CP length, performance degradation will be expected.  Issue 1-2-2: Preference is Option 1. However, it needs to be aligned with TAE requirements for BS Type 2-O(FR2 OTA in TS38.104). Our understanding is that the existing TAE requirement of 3us was specified with assumption of non-co-located deployment for FR2 inter-band CA. So, we need to check whether it is possible to update TAE with 260ns regarding co-located deployment.  Issue 1-2-3: If MRTD > CP length, performance degradation will occur. As MTK mentioned, performance degradation can be significant if interrupted symbol is control channel.  Issue 1-3-1: Rel-16 MRTD requirements for FR2 inter-band CA under IBM can be reused for Rel-17 FR2 inter-band CA under IBM.  Issue 1-4-1: Option 2 is fine.  Issue 1-4-2: Option 1 is fine.  Issue 1-5-1: Rel-16 MTTD requirements for FR2 inter-band CA under IBM can be reused for Rel-17 FR2 inter-band CA under IBM.  Issue 1-6-1: Consider RRM requirements listed in Option1, 2 and 3 as scope.  Issue 1-6-2: Option 1 is fine.  Issue 1-6-3: Option 1 is fine. For second bullet, need clarification. Are the existing requirements for which one between inter-band CA and intra-band CA?  Issue 1-6-4: Option 1 and Option 2 are fine. For option 1, need clarification. Are the existing measurement restriction requirements for which one between inter-band CA and intra-band CA?  Issue 1-6-5:  Issue 1-6-6: Need clarification whether FR2 inter-band CA consider more than 2 bands or not. Our understanding, 2 bands is in-scope in Rel-17.  Issue 1-6-7: Need clarification. Are the existing BFD/CBD requirements for which one between inter-band CA and intra-band CA? |
| Qualcomm | **Issue 1-1-1: Deployment scenarios assumption for CBM**  In principle, Option 5 is the most reasonable way of technical discussion. For more detailed/clearer discussion, we propose the group to tabulate the differences between co-located and non-co-located deployments in terms of, e.g. MRTD, expected directivity gain gap between the two bands, expected pathloss differences between the two bands, etc. Unless we clearly see what aspects and how much UE should be able to cope with in non-co-located deployment scenarios, we cannot support CBM UE for non-co-located scenario. Therefore, we support Option 1 for now.  **Issue 1-1-2: UE assumptions for CBM**  Option 1 by default.  **Issue 1-1-3: Deployment scenarios assumption for IBM**  Based on our understanding of the TAE/MTTD/MRTD for inter-band FR2 CA and the agreement “IBM UEs shall be able to add/configure/activate cells on both FR2 inter-band CCs only when beam management resources are configured in the both bands” made in the last RAN4 meeting, there doesn’t seem any restriction on deployment scenario. And an issue of deployment in terms of “L+L” and “H+H” should be discussed in RF session.  **Issue 1-1-4: UE assumption for IBM**  In principle, agree to Option 1, however, regarding # of panels, RF session is a better place to discuss it with a crystal-clear definition of panel.  **Issue 1-2-1: Can we assume symbol level alignment within CP length?**  To us, it is a bit unclear what is the assumption on slot boundary alignment. And for symbol level alignment, the CP length of “the second OFDM symbol in a slot” with respect to the largest SCS can be an upper bound of MRTD. And RAN4 needs to further investigate how much additional margin is needed not to lose scheduling flexibility, performance, etc. When the timing offset is the same as CP length and SCSs for both cells are identical, beam switching will be carried outside of the CP, which results in performance losses.  **Issue 1-2-2: How to determine MRTD for FR2 inter-band CA?**  Support Option 1.  For some observations provided by companies about performance impact due to beam switching in the useful OFDM symbol duration due to timing offset larger than CP, we do not agree to those observations that performance impact is expected to be marginal. If the OFDM symbol that wasn’t perfectly received by the UE due to beam sweeping on the other band includes DMRS and/or PDCCH, it may detrimentally affect demodulation performance in the slot a lot.  And for the observation about UE beam switching in a guard period, UE Rx beam switching instance shouldn’t be limited to a specific time period because the time instances for that can differ by the purposes of beam switching/sweeping.  **Issue 1-2-3: Performance impact due to Rx beam switching**  Same comment as Issue 1-2-1.  **Issue 1-3-1: How to determine MRTD in case of IBM?**  Same comment as MTK, “Clarification would be needed. IBM has been specified in R16. Not sure we need to agree on this again in R17.”  **Issue 1-4-1: How to determine MTTD for CBM?**  Okay with Option 2, and it needs to take into account Issue 1-1-1 and 1-1-2.  **Issue 1-4-2: Performance impact due to Tx beam switching**  Okay with Option 1, but there can be some different aspects compared to DL because UE in general won’t switch its Tx beam unless explicitly requested by NW. We want to hear other companies’ views on this.  **Issue 1-5-1: How to determine MTTD in case of IBM?**  Same comment as MTK, “Clarification would be needed, similar to Issue 1-3-1. It seems transparent to the RRM requirement in 133. Should we capture it in the 133?”  **Issue 1-6-1: Scope of the RRM requirements for FR2 inter-band DL CA**  Okay with Option 3.  **Issue 1-6-2: Interruption requirements**  Okay with Option 1. For Option 2, RAN4 can further investigate it.  **Issue 1-6-3: Scheduling restriction**  Okay with Option 1.  **Issue 1-6-4: Measurement restriction**  Okay with Option 1 and further study is needed on Option 2.  **Issue 1-6-5: SCell activation delay requirements**  For Case 1, okay with Option 1. For Case 2, further study is needed on both Option 1 and Option 2. Agree to Option 2 that a reference RF architecture and MRTD requirements need to be first established.  **Issue 1-6-6: Scaling factor CSSFoutside\_gap**  Okay with Option 1.  **Issue 1-6-7: Beam management requirement**  Oaky with Option 1 as a starting point. |
| Xiaomi | Issue 1-1-1: Support option 1, for CBM case, the transmitted signal from CCs should have the same downlink spatial domain transmission filter on one OFDM, thus, the co-located should be assumed for CBM case.  Issue 1-1-2: no need to have UE assumption for CBM. UE may support both CBM and IBM manner.  Issue 1-1-3: prefer option 4  Issue 1-1-4: OK with option 1  Issue 1-2-1: Yes, support option 1  Issue 1-2-2: Option 1  Issue 1-2-3: Option 1, agree with LG observation the performance degradation is expected due to Rx beam switching if MRTD for CBM is larger than CP.  Issue 1-3-1: OK with option 1.  Issue 1-4-1: it depends on the conclusion on MRTD value for CBM.  Issue 1-4-2: it depends on the conclusion on MTTD value for CBM, and the MTTD value should be defined as smaller than CP.  Issue 1-5-1: OK with both option 1 and option 2.  Issue 1-6-1: MRTD/MTTD requirement, Scaling factor CSSFoutside\_gap, interruption requirements, SCell activation requirements, Beam management requirements and scheduling/measurement restriction requirements.  Issue 1-6-2: Option 2, we need more input from RF session on the RF architecture of CBM type UE.  Issue 1-6-3: need more discussion  Issue 1-6-4: need more discussion.  Issue 1-6-5: Tend to agree with Huawei, it depend the RF architecture for CBM type UE.  Issue 1-6-6: Option 1  Issue 1-6-7: Option 1 |
| Huawei | Issue1-1-1: We agree with that the deployment for CBM UE follows RF session conclusions.  Issue1-1-2: CBM UE is assumed to be only capable of receiving FR2 inter-band CA signals with same beam direction. However, the implementation assumptions for antenna panel and RF architecture for CBM UE needs RF inputs.  Issue1-1-3: IBM UE is assumed to be only capable of receiving signals for FR2 inter-bands CA with different beam directions. The existing IBM UE requirements in Rel-16 can be applied for both co-located deployments and non-co-located deployments. There is no need to further discuss it in Rel-17.  Issue1-1-4: Same comments as for issue 1-1-3, no need to discuss it in Rel-17.  Issue 1-2-1: RAN4 should focus on how to define MRTD requirements for CBM UE.  Issue 1-2-2: For CBM UE, 3us MRTD requirements can be applied for co-located deployment and >3us MRTD requirements can be applied for non-co-located deployment.  Issue 1-2-3: Support option 1, performance degradation can be allowed when the receive timing difference is larger than CP length.  Issue 1-3-1: Support Option 1. For IBM UE, the existing MRTD requirements in Rel-16 can be applied in Rel-17.  Issue 1-4-1: The If the feasibility of inter-band UL CA for CBM is confirmed in RF session, then the MTTD requirements for CBM UE can be defined and shall be based on the conclusion of MRTD requirements for CBM UE.  Issue 1-4-2: We can agree with Option 1.  Issue 1-5-1: Option 2 has the same understanding as Option 1. The existing MTTD requirement for FR2 inter-band CA in Rel-16 can be applied to Rel-17.  Issue 1-6-1: Support Option 3 with adding MRTD requirements.  Issue 1-6-2: Support Option 2. Whether CBM UE has a shared RF chain or separate RF chains for FR2 inter-band CA will determine how to define the interruption requirements for CBM UE. So, RF input on RF architecture for CBM UE is needed.  Issue 1-6-3: Prefer Option 2, Option 1 is also acceptable.  Option 1 and Option 2 both agree with that the existing scheduling restriction requirements on FR2 shall be extended to serving cells in different bands for CBM UE.  The existing scheduling restriction requirements between different carriers in same FR2 band are defined due to UE using common beam for FR2 intra-band CA. It is assumed that CBM UE will use common beam for FR2 inter-band CA. So, the existing scheduling restriction requirements between different carriers in same FR2 band can be extended to different carriers in different FR2 bands.  Issue 1-6-4: Prefer Option 3.  Similar comments as issue 1-6-3, the existing measurement restriction requirements between different carriers in same FR2 band can be extended to different carriers in different FR2 bands.  Issue 1-6-5:  For case 1, support Option 1.  For case 2 with known target SCell, support Option 1.  For case 2 with unknown target SCell, support Option 2, the inputs on RF architecture and MRTD requirements for CBM UE are needed.  Issue 1-6-6: If FR2 inter-band CA with two bands are only considered in Rel-17, then the existing requirements on scaling factor CSSFoutside\_gap in Rel-16 can be applied to Rel-17. Otherwise, the existing on scaling factor CSSFoutside\_gap need to be revised.  Issue 1-6-7: Support Option 1.  CBM UE performs BFD/CBD on only one serving cell per set of bands with common beam. |
| OPPO | Issue 1-1-1: Support option 1, co-located should be assumed for CBM case.  Issue 1-1-2: We assume the same beam for CBM UE. But the antenna panel is up to UE implementation.  Issue 1-1-3: There seem no restriction on deployment scenario for IBM UE.  Issue 1-1-4: It is better to be discussed in RF session.  Issue 1-2-1: Support option 1  Issue 1-2-2: Support option 1  Issue 1-2-3: Support option 1, performance degradation is expected due to Rx beam switching if MRTD for CBM is larger than CP.  Issue 1-3-1: Option 1 is fine. And share the similar concern to discuss IBM requirements again in Rel16  Issue 1-4-1: It depends on the conclusion on MRTD value for CBM.  Issue 1-6-1: OK with option 1/2/3.  Issue 1-6-2: Support option 1 as baseline. For Option 2, RAN4 can further investigate it after conclusion from RF session.  Issue 1-6-3: need more discussion  Issue 1-6-4: need more discussion.  Issue 1-6-5: OK with option 1 for Case 1. Support option 3 for Case 2 but also can compromise to Option 2 for further discussion after conclusion from RF session.  Issue 1-6-6: Option 1 is fine.  Issue 1-6-7: Option 1 can be as baseline. |
| Apple | 1-1-1: we are OK with option 1, 2 and 5.  1-1-2: option 1  1-1-3: option 2,3 and 4 are not contradict to each other. The deployment scenario for IBM can be flexible.  1-1-4: agree with option 1 in principle  1-2-1: option 1  1-2-2: option 1  1-2-3: the impact of Rx switch can be beyond 1 symbol. In many cases, if one symbol reception is failed, the whole slot cannot be detected. It may also impact on other slot due to failed ack/nack reception.  1-3-1: option 1.  1-4-1: it should be based on the decision on MRTD.  1-4-2: it also depends on the conclusion of MRTD/MTTD  1-5-1: both option 1 and 2 seem OK  1-6-1: hybrid between options,  e.g. MRTD/MTTD, Scaling factor CSSFoutside\_gap, interruption requirements, SCell activation requirements, Beam management requirements and scheduling/measurement restriction requirements  1-6-2: option 2  1-6-3/4/5/6: need to be further studied. |
| NEC | Issue1-1-1: We feel that unless deployment scenario for a CA configuration is finalized, it may be difficult to get build consensus on MRTD for CBM UE (for both co-located and non-collocated). Due to this, in our view option 5 may be a good starting point. We also agree that deployment scenario is RF issue.  Issue1-1-3: The existing IBM UE requirements in Rel-16 can be applied for both co-located deployments and non-co-located deployments. There is no need to further discuss it in Rel-17.  Issue 1-2-1: We did not fully understand the issue. Need further discussion.  Issue 1-2-2: Option 2 (3us) with current understanding unless further clarification on deployment scenario can be received from RF session for co-located deployment (using same panel and different panel) and non-collocated.  Issue 1-2-3: idea behind option 2 and 3 is, UE can differ the RX beam switching to a location where the performance degradation can be minimum and confined to one OFDM symbol. RAN4 can further study techniques to mitigate the performance degradation.  Issue 1-3-1: Support Option 1. Existing MRTD requirements in Rel-16 can be applied to Rel-17 also.  Issue 1-6-1: OK with option 3.  Issue 1-6-2: OK with Option 2.  Issue 1-6-3 to 1-6-7: Need further study by taking current proposals as starting point |
| Ericsson | Issue 1-1-1: We support option 2 and that UE which is only capable of common beam management for a band combination where common beam management is possible, may, assume collocated site, in this case. (CR R4-2101868 and R4-2101868). This is marked as “option 6”.  Issue 1-1-2: Option 2.  Issue 1-1-3: Option 2.  Issue 1-1-4: Option 1.  Issue 1-2-1: We cannot assume symbol level alignment for common beam management. MRTD = TAE + delta\_RF\_propagation and TAE = 3 µs in existing specification. The UE may assume the same spatial filter, but this does not imply synchronization.  Issue 1-2-2: We support option 2 in general with MRTD = 3 µs. We also support our own proposal of MRTD = 3 µs with UE capability indication (option 3) and that any change in MRTD should not impact already defined BS TAE of 3 µs for FR2 inter-band CA; i.e. keep Rel-15 values for BS TAE unchanged (option 5). We also think it is correct to rely on BS TAE requirements as per option 4, since MRTD = TAE + delta\_RF\_propagation.  Issue 1-2-3: There are many options before scheduling restrictions are needed, like available time in UL and DL (if carriers not full) and UL to DL switch, where UE could safely switch beams.  Issue 1-3-1: Option 1.  Issue 1-4-1: Option 1.  Issue 1-4-2: It is OK to study performance impact due to beam switching as per option 1. However, we also think that there are many options before scheduling restrictions are needed, like available time in UL and DL (if carriers not full) and UL to DL switch, where UE could safely switch beams, so the impact can be managed.  Issue 1-5-1: Option 1 and option 2 are fine for us. They look similar.  Issue 1-6-1: Option 1,2,3 are fine. It is contribution driven. Why do we need detailed scope limitation already?  Issue 1-6-2: Option 2.  Issue 1-6-3: Option 2. We agree existing measurement restriction requirements defined for intra-band CA in FR2 can be reused for inter-band CA in FR2.  Issue 1-6-4: Option 3. We agree existing measurement restriction requirements defined for intra-band CA in FR2 can be reused for inter-band CA in FR2.  Issue 1-6-5:  Case 1: Option 1,  Case 2: For known SCell: Option 1, for unknown SCell: Option 3 (no beamsweeping needed)  Issue 1-6-6: Option 1.  Issue 1-6-7: Option 1 ok as baseline. |
| Intel | **Issue 1-1-1: Deployment scenarios assumption for CBM**  Agree with Option 1. If RF session will have different agreement, we’ll need to extend the requirements.  **Issue 1-1-2: UE assumptions for CBM**  Agree with Option 1  **Issue 1-1-3: Deployment scenarios assumption for IBM**  We don’t see any restrictions on deployment for IBM  **Issue 1-1-4: UE assumption for IBM**  Better to discuss it in RF session  **Issue 1-2-1: Can we assume symbol level alignment within CP length?**  Not sure why we need to discuss this separately from MRTD  **Issue 1-2-2: How to determine MRTD for FR2 inter-band CA?**  We support option 1.  However, TAE requirements should also been taken into account. So, we agree with the comment from LG that we need to check whether it is feasible to achieve smaller TAE  An alternative option is to define different sets of requirements (260ns vs 3us) based on the UE capability.  **Issue 1-2-3: Performance impact due to Rx beam switching**  We prefer to avoid performance degradation due to MRTD>CP issue. We encourage RAN4 to further study in Rel-17 the ways to reduce this degradation (which can be more than 1 symbol as it was mentioned by some companies).  An alternative option is to define different sets of requirements (260ns vs 3us) based on the UE capability and leave the degradation issue resolution to UE implementation.  **Issue 1-3-1: How to determine MRTD in case of IBM?**  Agree with option 1. We do not expect any extensions of IBM in Rel-17 which can affect MRTD  **Issue 1-4-1: How to determine MTTD for CBM?**  Ok with Option 2  **Issue 1-4-2: Performance impact due to Tx beam switching**  Agree with Option 1  **Issue 1-5-1: How to determine MTTD in case of IBM?**  Agree with option 1. We do not expect any extensions of IBM in Rel-17 which can affect MTTD.  **Issue 1-6-1: Scope of the RRM requirements for FR2 inter-band DL CA**  Agree to consider all requirements listed in Options 1,2,3  **Issue 1-6-2: Interruption requirements**  Option 1  **Issue 1-6-3: Scheduling restriction**  Option 1  **Issue 1-6-4: Measurement restriction**  Option 1  **Issue 1-6-5: SCell activation delay requirements**  Option 1 for Case 1  Option 1 for Case 2  **Issue 1-6-6: Scaling factor CSSFoutside\_gap**  Agree with Option 1  **Issue 1-6-7: Beam management requirement**  Need further discussion |
| Nokia | Issue 1-1-1: we support option 4. For CBM, we could have non-co-located deployment, we should not limit the deployment of co-location for CBM. option 3 has the similar view as option4. option 2 follow RF session conclusion is also fine.  Issue 1-1-2: we support option 1. It is similar to Rel-15 baseline UE assumption.  Issue 1-1-3: we support option 4. In Rel-16, RF session already has conclusion that co-located and non-co-located deployment will be assumed for IBM in WF R4-2005736 as below:   |  | | --- | | * Network assumes IBM UE supports both co-located and non-co-located deployments. |   Issue 1-1-4: We support option 1. UE with IBM capability can receive or transmit on multiple panels simultaneously.  Issue 1-2-1: option 1 is not OK. the MRTD for intra-band FR2 CA equals to BS TAE. According to the applicability rule for intra-band FR2, UE shall assume that the transmitted signals from the serving cells should have the same downlink spatial domain transmission filter on one OFDM symbol in the same band in FR2. It is because TAE is defined as 260ns for inter-band FR2 CA which fulfill the assumption, not because we need to fulfill the assumption then define the MRTD requirement. Here what we are talking is for inter-band FR2 CA with CBM, it is different from intra-band FR2 CA. Inter-band FR2 DL CA for CBM could be co-located or non-co-located deployment, and for inter-band DL CA, MRTD is based on BS TAE and propagation delay. This should be discussed together with issue 1-2-2.  Issue 1-2-2: we support option 2. option3 and option 4 are similar to option 2. We also agree with option 5 that any change in MRTD should not impact BS TAE, it is decided in RF session.  Issue 1-2-3: we assume the Rx beam switch is done simultaneously on both bands for CBM UE. could companies clarify if this impact of Rx Beam switch is related to SCS?  Issue 1-3-1: we support option 1  Issue 1-4-1: we support option 1, but we can wait the conclusion of FR2 inter-band UL CA in RF session.  Issue 1-4-2: RRM discussion should be hold until we have conclusion of FR2 inter-band UL CA in RF session.  Issue 1-5-1: we support option 1. option 2 are also talking the same thing as option 1.  Issue 1-6-1: more discussion is needed. We need to analyses any impact from CBM for inter-band DL CA on RRM requirements.  Issue 1-6-2: We assume existing R15 requirements can be used as the baseline for CBM UE. Could companies clarify what is the change in RF architecture of CBM type UE compared to R15 UE?  Issue 1-6-3: same view as Issue 1-6-2  Issue 1-6-4: same view as Issue 1-6-2  Issue 1-6-5: same view as Issue 1-6-2  Issue 1-6-6: same view as Issue 1-6-2  Issue 1-6-7: same view as Issue 1-6-2 |

### 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.*

Moderator comments: According to Andrey’s email, the two CRs will be postponed and not be included in the email discussion.

1. [98e][230] NR\_RF\_FR2\_req\_enh2\_RRM
   1. 2 CRs submitted (R4-2101868, R4-2101869) by E///. No CR / Draft CR submissions allowed for this WI based on meeting agenda (“No CR / Draft CR submissions allowed except for AIs where it is explicitly allowed”). The CRs will be postponed and shall not be included in the email discussion.

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | **Issue 1-1-1: Deployment scenarios assumption for CBM**   * Views after 1st round comments:   + Option 1: In case of common beam management, it is assumed that gNB for all CC are collocated (Apple, LG, NEC, QC, Xiaomi, OPPO, Intel)   + Option 2: Assumption of deployment and band pair for IBM UE and CBM UE should follow the RF session conclusions (LG, MTK, Huawei, Apple, NEC, E///, Nokia)   + , NokiaOption 4: The deployment of co-located or non co-located is up to network configuration. (Nokia)   + Option 5: RAN4 should agree on the deployment scenario for CA configurations before deciding on the applicability of IBM or CBM to certain CA configuration (NEC, MTK, QC, Apple)   + Option 6: A UE which is only capable of common beam management for a band combination where common beam management is possible, may, assume collocated site, in this case. (CR R4-2101868 and R4-2101868) (E///)   Moderator’s comments:  Based on the comments, Option 3 is replaced with Option 6 with more clear wording. Companies are encouraged to check/confirm in 2nd round if this is being discussed in RF session. If Yes, I would suggest going for Option 2 to avoid duplicated discussion in RRM session.  *Tentative agreements:* No.  *Candidate options:*  *Recommendations for 2nd round:*  Companies are encouraged to check/confirm in 2nd round if this is being discussed in RF session. If Yes, we can go for Option 2 to avoid duplicated discussion in RRM. |
|  | **Issue 1-1-2: UE assumptions for CBM**   * Views after 1st round comments:   + Option 1: Similar to Rel-15 baseline UE assumption i.e. UE can receive with one panel and beam at a time. (Nokia, MTK, LG, QC, Apple, Intel)   Option 1a: CBM UE is assumed to be only capable of receiving FR2 inter-band CA signals with same beam direction. However, the implementation assumptions for antenna panel and RF architecture for CBM UE needs RF inputs (Huawei, OPPO)   * + Option 2: The relevant UEs should be identified and distinguished (e.g. via capability indication, etc.) and the restrictions shall not be applied (e.g. deployment restrictions, etc.) for all UEs and all band combinations for the future of NR. (E///)   + Option 3: follow RF conclusion (MTK, LG)   + Option 4: No need to discuss UE assumption (Xiaomi)   Moderator’s comments:  It is understood majority of the companies support Option1 or Option 1a. In Option 1a, some companies agree with the UE assumption of same beam direction, but have concerns on the panel assumption and expect RF inputs. It is suggested to reach consensus on the beam assumption and more comments are welcome in 2nd round on the panel assumption aspects.  *Tentative agreements:*  For CBM capable UE, UE is assumed to receive with one beam at a time, i.e. similar to Rel-15 baseline UE assumption.  *Recommendations for 2nd round:*  To confirm the tentative agreements are agreeable. In addition, companies are encouraged to comment on panel assumption aspects in 2nd round:   * + Option 1: Similar to Rel-15 baseline UE assumption i.e. UE can receive with one panel at a time.   + Option 2: The implementation assumptions for antenna panel and RF architecture for CBM UE needs RF inputs. |
|  | **Issue 1-1-3: Deployment scenarios assumption for IBM**   * Views after 1st round comments:   + Option 1: non-co-located deployment for IBM UE (LG, Xiaomi)   + Option 2: Assumption of deployment and band pair for IBM UE and CBM UE should follow the RF session conclusions (LG, MTK, E///)   + Option 3: RAN4 should agree on the deployment scenario for CA configurations before deciding on the applicability of IBM or CBM to certain CA configuration (NEC)   + Option 4: Agree that the Rel-16 IBM UE requirements for an IBM capable UE already cover the illustrated scenarios (Nokia)     - Not exactly co-located deployment (e.g. inter-band CA cells are some distance apart (figure 1))     - Not co-located deployment (e.g. angle between inter-band CA cells cannot be covered by one and same UE panel (figure 2))     - Not co-located deployment (e.g. distance to the inter-CA cells is very different (figure 3))   + Option 5: There is no restriction on deployment scenario i.e. IBM UE requirements can be applied for both co-located deployments and non-co-located deployments. (QC, Huawei, OPPO, Apple, NEC, Intel, Nokia)   Moderator’s comments:  It is understood majority of the companies do not see any restriction on deployment scenarios for IBM UEs e.g. Option 4 and Option 5. If this has been the conclusion from Rel16 as cited below, I would suggest following the conclusion and there is no need to repeat the discussion in Rel17.  In Rel-16, RF session already has agreement that co-located and non-co-located deployment will be assumed for IBM in WF R4-2005736 as below:   |  | | --- | | * Network assumes IBM UE supports both co-located and non-co-located deployments. |   *Tentative agreements:*   * Follow the agreements in Rel16 i.e. there is no restriction on deployment scenario i.e. network assumes IBM UE supports both co-located and non-co-located deployments.   *Recommendations for 2nd round:*  *The tentative agreements are agreeable.* |
|  | **Issue 1-1-4: UE assumption for IBM**   * Views after 1st round comments:   + Option 1: Capture that it is baseline UE requirement for an IBM capable UE, with more than 1 panel, to be able to have multiple panels active simultaneously. (Nokia, Qualcomm, Xiaomi, Apple, E///)   + Option 2: Baseline requirement should be based on R15 assumption, and it should allow UE to receive 2 bands with 1 panel (MTK)   + Option 3: Any requirements have not been specified with assumption of multiple panels active simultaneously. For consistency, one panel active from more than 1 panel needs to be kept (LG)   + Option 4: IBM UE is assumed to be only capable of receiving signals for FR2 inter-bands CA with different beam directions (Huawei)   + Option 5: Discuss in RF session (OPPO, Intel)   Moderator’s comments:  From the comments received so far, it seems companies have diverged views on the UE assumptions of IBM capable UE. Let’s continue the discussion in 2nd round.  *Tentative agreements:* No.  *Recommendations for 2nd round:*   * + Continue the discussion in 2nd round. |
| **Sub-topic#1-2** | **Issue 1-2-1: Can we assume symbol level alignment within CP length?**   * Views after 1st round comments:   + Option 1: Symbol level alignment should be with CP length (Apple, MTK, Xiaomi, OPPO)   + Option 2: We cannot assume symbol level alignment for common beam management (E///, Nokia).   + Option 3: RAN4 should focus on how to define MRTD requirements for CBM UE (Huawei, Intel)   Moderator’s comments:  In addition to the views listed above, some companies ask for further clarification on this issue. The component company please provide more explanation on the proposal and especially how it would impact MRTD. It is suggested to continue the discussion in 2nd round.  *Tentative agreements: No.*  *Recommendations for 2nd round:*   * + The component company please provide more explanation on the proposal and especially how it would impact MRTD. Continue the discussion in 2nd round. |
|  | **Issue 1-2-2: How to determine MRTD for FR2 inter-band CA?**   * Views after 1st round comments:   + Option 1: Reuse FR2 intra-band MRTD i.e. 260ns (Apple, Intel, OPPO, MTK, LG, QC, Xiaomi)   + Option 2: 3us (NEC, Nokia, E///)   + Option ~~3: 3us on condition of UE capability indication (E///)~~   + Option ~~4: Rely on the BS TAE requirements and the network deployment (Huawei)~~   + Option ~~5: Any change in MRTD should not impact already defined BS TAE of 3 µs for FR2 inter-band CA; i.e. keep Rel-15 values for BS TAE unchanged. (E///)~~   + Option 6: 3us MRTD requirements can be applied for co-located deployment and >3us MRTD requirements can be applied for non-co-located deployment (Huawei)   Moderator’s comments:  Based on the comments received, it is understood Option 3 and Option 5 can be merged with Option 2. In addition, Option 4 is replaced by Option 6 to be more specific on the proposal. I would like to suggest continuing the discussion in 2nd round on the updated options due to different views from companies.  *Tentative agreements:*   * + Continue the discussion in 2nd round by down scoping the options   *Candidate options:*   * + Option 1: Reuse FR2 intra-band MRTD i.e. 260ns (Apple, Intel, OPPO, MTK, LG, QC, Xiaomi)   + Option 2: 3us (NEC, Nokia, E///)   + Option 3: 3us MRTD requirements can be applied for co-located deployment and >3us MRTD requirements can be applied for non-co-located deployment (Huawei)   *Recommendations for 2nd round:*   * + Continue the discussion in 2nd round. |
|  | **Issue 1-2-3: Performance impact due to Rx beam switching**   * Views after 1st round comments:   + Option 1: Demodulation performance degradation due to Rx beam switch should be noted in MRTD requirements for CBM UE if MRTD is larger than CP (LG, Xiaomi, Huawei, OPPO)   + Option 2: In worst case performance degradation of up to 1 OFDM symbol is allowed for UE operating in CBM during RX beam switch (NEC)   - Option 2a: The impact of Rx switch can be beyond 1 symbol. (Apple, Intel)   * + Option 3: RAN4 should further study in Rel-17 to reduce the worst case (1 OFDM symbol or beyond) performance degradation (NEC, Intel)   + Option 4: UE could safely switch beams (E///)   + Option 5: Define different sets of requirements (260ns vs 3us) based on the UE capability and leave the degradation issue resolution to UE implementation. (Intel)   Moderator’s comments:  Based on the comments, companies have different understandings on when/if performance degradation would happen and how to cope with the performance degradation. It is suggested the proponent company gives more clarification on the issue and let’s continue the discussion in 2nd round.  *Tentative agreements: No.*  *Recommendations for 2nd round:*   * + More clarification is needed on the issue. Continue the discussion in 2nd round. |
| **Sub-topic 1-3** | **Issue 1-3-1: How to determine MRTD in case of IBM?**   * Views after 1st round comments:   + Option 1: The MRTD and MTTD requirements for inter-band CA in FR2 under IBM in Rel-16 are applicable for Rel-17. (Nokia, LG, Xiaomi, Huawei, OPPO, Apple, NEC, E///, Intel)   + Option 2: IBM has been specified in Rel16. (MTK, QC)   Moderator’s comments:  It is understood both Option1 and Option2 are proposing for IBM capable UE, the Rel16 MRTD requirements for FR2 inter-band CA can be applied in Rel-17 and no additional discussion is required in Rel17.  *Tentative agreements:*  For IBM capable UE, the Rel16 MRTD requirements for FR2 inter-band CA can be applied in Rel-17 and no additional discussion is required in Rel17.  *Recommendations for 2nd round:*  *The tentative agreements are agreeable.* |
| **Sub-topic 1-4** | **Issue 1-4-1: How to determine MTTD for CBM?**   * Views after 1st round comments:   + Option 1: 3.5 µs on condition of UE capability indication (E///, Nokia)   + Option 2: If CBM based FR2 inter-band UL CA would be introduced in Rel-17, then RAN4 needs to study the MTTD requirement applicable for CBM based FR2 inter-band CA (Huawei, MTK, LG, QC, Intel, Nokia)   + Option 3: It depends on the conclusion of MRTD for CBM (Xiaomi, Huawei, OPPO, Apple)   Moderator’s comments:  It is understood MTTD has been discussed based on the MRTD value for IBM capable UE in Rel16. Now the question here is whether MTTD discussion is conditioned on if CBM based FR2 inter-band UL CA would be introduced in Rel-17. In this sense, Option 2 and Option 3 can be merged and it is suggested to continue the discussion in 2nd round.  *Tentative agreements:*   * + Agree on the merged candidate options and continue the discussion in 2nd round.   *Candidate options:*   * + Option 1: 3.5 µs on condition of UE capability indication   + Option 2: If CBM based FR2 inter-band UL CA would be introduced in Rel-17, then RAN4 needs to study the MTTD requirement applicable for CBM based FR2 inter-band CA, and it is based on the conclusion of MRTD requirements for CBM UE.   *Recommendations for 2nd round:*   * + Companies are encouraged to comment if “CBM based FR2 inter-band UL CA would be introduced in Rel-17” shall be taken as a condition for defining MTTD. |
|  | **Issue 1-4-2: Performance impact due to Tx beam switching**   * Views after 1st round comments:   + Option 1: RAN4 needs to study how to handle impact on performance due to Tx beam switching (LG, MTK, LG, QC, Huawei, E///, Intel, Nokia)   Moderator’s comments:  It is understood there was no objection to study the impact on performance due to Tx beam switching. Some companies think this depends on MRTD and MTTD discussion and some clarification is expected. I would suggest concluding on the study of this issue and companies are encouraged to bring detailed analysis on this issue in 2nd round or next meeting.  *Tentative agreements:*  RAN4 needs to study how to handle impact on performance due to Tx beam switching.  *Recommendations for 2nd round:*  The tentative agreements are agreeable. Comments are welcome on the detailed analysis on the performance degradation. |
|  | **Issue 1-5-1: How to determine MTTD in case of IBM?**   * Views after 1st round comments:   + Option 1: The MTTD requirements for inter-band CA in FR2 under IBM in Rel-16 are applicable for Rel-17. (Nokia, LG, Xiaomi, Huawei, Apple, E///, Intel)   + Option 2: The existing MTTD requirement for FR2 inter-band CA can be applied for all the IBM based CA configurations, including CA\_n257A-n259A based on IBM (Huawei, Xiaomi, Apple, E///, Nokia)   + Option 3: Clarification would be needed. It seems transparent to the RRM requirement in 133. (MTK, QC)   Moderator’s comments:  It is understood both Option1 and Option2 are proposing for IBM capable UE, the Rel16 MTTD requirements for FR2 inter-band CA can be applied in Rel-17 and no additional discussion is required in Rel17.  *Tentative agreements:*  For IBM capable UE, the Rel16 MTTD requirements for FR2 inter-band CA can be applied in Rel-17 and no additional discussion is required in Rel17.  *Recommendations for 2nd round:*  The tentative agreements are agreeable. |
|  | **Issue 1-6-1: Scope of the RRM requirements for FR2 inter-band DL CA**   * Views after 1st round comments:   + Option 1: MRTD, interruption, and SCell activation requirements of CBM UE for 2 CBM UE can be investigated in Rel-17 FR2 inter-band DL CA enhancements. (OPPO)   + Option 2: MRTD, interruption requirements, SCell activation requirements and scheduling/measurement restriction requirements (Intel)   + Option 3: MRTD, Scaling factor CSSFoutside\_gap, interruption requirements, SCell activation requirements, Beam management requirements and scheduling/measurement restriction requirements (Huawei, MTK, LG, QC, Xiaomi, OPPO, Apple, NEC, Intel)   Moderator’s comments:  It is understood companies are fine with studying the RRM requirements aspects listed in all options. It is suggested to start from Option 3 which comprises the scope in Option1 and Option2.  *Tentative agreements:*  Scope of the RRM requirements for FR2 inter-band DL CA includes but not limited to MRTD, Scaling factor CSSFoutside\_gap, interruption requirements, SCell activation requirements, Beam management requirements and scheduling/measurement restriction requirements  *Recommendations for 2nd round:*  The tentative agreements are agreeable. |
|  | **Issue 1-6-2: Interruption requirements**   * Views after 1st round comments:   + Option 1: The existing interruption requirements of intra-band CA can be applied (Intel, OPPO, MTK, LG, QC, OPPO, Intel, Nokia)   + Option2: The interruption requirements applied for CBM based FR2 inter-band CA need to be introduced in Rel-17, which need RF inputs on the RF architecture of CBM type UE (Huawei, MTK, Xiaomi, OPPO, Apple, NEC, E///)   Moderator’s comments:  As there is no consensus on this issue, it is suggested to continue the discussion in 2nd round.  *Tentative agreements: No.*  *Recommendations for 2nd round:*  Continue the discussion in 2nd round. |
|  | **Issue 1-6-3: Scheduling restriction**   * Views after 1st round comments:   + Option 1: To apply an agreement from RAN4 #94-bis-e: (Intel, MTK, LG, QC, Huawei, Intel)     - “The scheduling availability requirements for FR2 inter-band CA scenario shall be introduced to clarify there is scheduling restriction on one FR2 band due to RLM/BFD/CBD/L1-RSRP measurements being performed on another FR2 band if UE uses common beam.     - The existing scheduling restriction requirements on FR2 shall be extended to serving cells in different bands.”   + Option 2: The existing scheduling/measurement restriction requirements applied for FR2 intra-band CA need to be extended to FR2 inter-band CA with CBM type UE. (Huawei, Xiaomi, E///, Nokia)   + Option 3: Need more discussion (Xiaomi, OPPO, Apple, NEC)   Moderator’s comments:  Based on the comments, some companies propose applying the existing scheduling requirements to Rel17, but did not crystalize if existing requirements refer to the requirements for FR2 intra-band CA. Please clarify if the proposal can be fit into Option2. As there is no consensus on this issue, it is suggested to continue the discussion in 2nd round.  *Tentative agreements: No.*  *Recommendations for 2nd round:*  Continue the discussion in 2nd round. |
|  | **Issue 1-6-4: Measurement restriction**   * Views after 1st round comments:   + Option 1: To apply an agreement from RAN4 #95-e: (Intel, LG, QC, Intel)     - “For CBM UEs in FR2 inter-band CA, the existing measurement restriction requirements for FR2 is applied for the RLM/BFD/CBD/L1-RSRP measurements being performed on different FR2 bands.”   + Option 2: For CBM UEs the measurement restriction applies when the SSB for RLM, BFD, CBD or L1- RSRP measurement on one band is in the same OFDM symbol as the CSI-RS for RLM, BFD, CBD or L1- RSRP measurement on another band (Intel)   - Option 2a: For CBM UEs the measurement restriction applies when the SSB for RLM, BFD, CBD or L1- RSRP measurement on one band is in the ~~same~~ OFDM symbols overlapping with the CSI-RS for RLM, BFD, CBD or L1- RSRP measurement on another band (MTK, LG)   * + Option 3: The existing scheduling/measurement restriction requirements applied for FR2 intra-band CA need to be extended to FR2 inter-band CA with CBM type UE (Huawei, E///, Nokia)   + Option 4: More discussion is needed. (Xiaomi, OPPO, Apple, NEC)   Moderator’s comments:  As there is no consensus on this issue, it is suggested to continue the discussion in 2nd round.  *Tentative agreements: No.*  *Recommendations for 2nd round:*  Continue the discussion in 2nd round. |
|  | **Issue 1-6-5: SCell activation delay requirements**   * Views after 1st round comments:   + Case 1: SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band:     - Option1: Existing SCell activation delay requirements in Case 1 can be applied.(Intel, Huawei, MTK, QC, Huawei, OPPO, E///, Nokia)   + Case 2: SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2     - Option1 (Intel, MTK):       * If the target SCell is known, the existing known SCell requirement in Case 2 shall be applied. (E///, Nokia)       * In the case when SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2 and the target SCell is unknown the existing SCell activation delay requirements for FR1+FR2 CA without L1-RSRP measurement delay can be reused.     - Option2: The SCell activation requirements in Case 2 applied for CBM type UE need to be defined. How to define the SCell activation requirements for CBM type UE depends on the RF architecture and MRTD requirements for CBM type UE (Huawei, MTK, QC, Xiaomi, OPPO)     - Option3: Scell activation delay would be reduced for the case if the PCell/PSCell and the target SCell are in a FR2 band pair with CBM, and the target SCell is unknown. (OPPO, E///)     - Option 4: Need further discussion (Apple, NEC)   Moderator’s comments:  There seems to be consensus to reuse existing SCell activation delay requirements in Case 1. I would suggest concluding on Case1 and let’s continue the discussion in 2nd round for Case 2.  *Tentative agreements:*   * + Case 1: SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band:     - Existing SCell activation delay requirements in Case 1 can be applied   *Candidate options for Case 2:*   * + Case 2: SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2     - Option1 (Intel, MTK):       * If the target SCell is known, the existing known SCell requirement in Case 2 shall be applied. (E///, Nokia)       * In the case when SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2 and the target SCell is unknown the existing SCell activation delay requirements for FR1+FR2 CA without L1-RSRP measurement delay can be reused.     - Option2: The SCell activation requirements in Case 2 applied for CBM type UE need to be defined. How to define the SCell activation requirements for CBM type UE depends on the RF architecture and MRTD requirements for CBM type UE (Huawei, MTK, QC, Xiaomi, OPPO)     - Option3: Scell activation delay would be reduced for the case if the PCell/PSCell and the target SCell are in a FR2 band pair with CBM, and the target SCell is unknown. (OPPO, E///)     - Option 4: Need further discussion (Apple, NEC)   *Recommendations for 2nd round:*  The tentative agreements are agreeable. Continue the discussion in 2nd round on Case 2. |
|  | **Issue 1-6-6: Scaling factor CSSFoutside\_gap**   * Views after 1st round comments:   + Option 1: If FR2 inter-band CA with two bands are only considered in Rel-17, then the existing requirements on scaling factor CSSFoutside\_gap in Rel-16 can be applied to Rel-17. The requirements on scaling factor CSSFoutside\_gap need to be revised if FR2 inter-band CA with more than two bands will be introduced in Rel-17 (Huawei, QC, Xiaomi, OPPO, E///, Intel)   + Option 2: Existing R15 requirements can be used as the baseline for CBM UE (Nokia).   + Option 3: Need further discussion (LG, Apple, NEC)   Moderator’s comments:  As there is no consensus on this issue, it is suggested to continue the discussion in 2nd round.  *Tentative agreements: No.*  *Recommendations for 2nd round:*  Continue the discussion in 2nd round. |
|  | **Issue 1-6-7: Beam management requirement**   * Views after 1st round comments:   + Option 1: The existing BFD/CBD requirements in Rel-16 can be applied for CBM type UE (Huawei, MTK, QC, Xiaomi, OPPO, E///, NEC, Nokia)   + Option 2: Need further discussion (LG, Intel)   Moderator’s comments:  It is understood majority companies agree going for Option 1. Some companies are asking the question: are the existing BFD/CBD requirements for which one between inter-band CA and intra-band CA. The proponent companies are encouraged to provide clarification on this question, and we can continue the discussion in 2nd round.  *Tentative agreements: No.*  *Recommendations for 2nd round:*  The proponent companies are encouraged to provide clarification on this question: are the existing BFD/CBD requirements for which one between inter-band CA and intra-band CA? |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
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### 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** |
| 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)

### Open issues

**Issue 1-1-1: Deployment scenarios assumption for CBM**

*Tentative agreements: No.*

*Candidate options (after 1st round comments):*

* + Option 1: In case of common beam management, it is assumed that gNB for all CC are collocated (Apple, LG, NEC, QC, Xiaomi, OPPO, Intel)
  + Option 2: Assumption of deployment and band pair for IBM UE and CBM UE should follow the RF session conclusions (LG, MTK, Huawei, Apple, NEC, E///, Nokia)
  + Option 3: A UE which is only capable of common beam management for a band combination where common beam management is possible, may, assume collocated site, in this case. (CR R4-2101868 and R4-2101868) (E///)
  + Option 4: The deployment of co-located or non co-located is up to network configuration. (Nokia)
  + Option 5: RAN4 should agree on the deployment scenario for CA configurations before deciding on the applicability of IBM or CBM to certain CA configuration (NEC, MTK, QC, Apple)

*Recommendations for 2nd round:*

Companies are encouraged to check/confirm in 2nd round if this is being discussed in RF session. If Yes, we can go for Option 2 to avoid duplicated discussion in RRM.

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| **Company** | **Comments** |
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**Issue 1-1-2: UE assumptions for CBM**

*Tentative agreements:*

* For CBM capable UE, UE is assumed to receive with one beam at a time, i.e. similar to Rel-15 baseline UE assumption.

*Recommendations for 2nd round:*

To confirm the tentative agreements are agreeable. In addition, companies are encouraged to comment on panel assumption aspects in 2nd round.

* + Option 1: Similar to Rel-15 baseline UE assumption i.e. UE can receive with one panel at a time.
  + Option 2: The implementation assumptions for antenna panel and RF architecture for CBM UE needs RF inputs.

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| **Company** | **Comments** |
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**Issue 1-1-3: Deployment scenarios assumption for IBM**

*Tentative agreements:*

* Follow the agreements in Rel16 i.e. there is no restriction on deployment scenario i.e. network assumes IBM UE supports both co-located and non-co-located deployments.

*Recommendations for 2nd round:* The tentative agreements are agreeable.

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| **Company** | **Comments** |
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**Issue 1-1-4: UE assumption for IBM**

*Tentative agreements: No.*

*Candidate options (after 1st round comments):*

* + Option 1: Capture that it is baseline UE requirement for an IBM capable UE, with more than 1 panel, to be able to have multiple panels active simultaneously. (Nokia, Qualcomm, Xiaomi, Apple, E///)
  + Option 2: Baseline requirement should be based on R15 assumption, and it should allow UE to receive 2 bands with 1 panel (MTK)
  + Option 3: Any requirements have not been specified with assumption of multiple panels active simultaneously. For consistency, one panel active from more than 1 panel needs to be kept (LG)
  + Option 4: IBM UE is assumed to be only capable of receiving signals for FR2 inter-bands CA with different beam directions (Huawei)
  + Option 5: Discuss in RF session (OPPO, Intel)

*Recommendations for 2nd round:* Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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**Issue 1-2-1: Can we assume symbol level alignment within CP length?**

*Tentative agreements: No.*

*Candidate options (after 1st round comments):*

* + Option 1: Symbol level alignment should be with CP length (Apple, MTK, Xiaomi, OPPO)
  + Option 2: We cannot assume symbol level alignment for common beam management (E///, Nokia).
  + Option 3: RAN4 should focus on how to define MRTD requirements for CBM UE (Huawei, Intel)

*Recommendations for 2nd round:*

The component company please provide more explanation on the proposal and especially how it would impact MRTD. Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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**Issue 1-2-2: How to determine MRTD for FR2 inter-band CA?**

*Tentative agreements:* Continue the discussion in 2nd round by down scoping the options

*Candidate options (after 1st round comments):*

* + Option 1: Reuse FR2 intra-band MRTD i.e. 260ns (Apple, Intel, OPPO, MTK, LG, QC, Xiaomi)
  + Option 2: 3us (NEC, Nokia, E///)
  + Option 3: 3us MRTD requirements can be applied for co-located deployment and >3us MRTD requirements can be applied for non-co-located deployment (Huawei)

*Recommendations for 2nd round:* Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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**Issue 1-2-3: Performance impact due to Rx beam switching**

*Tentative agreements:* No.

*Candidate options:*

* + Option 1: Demodulation performance degradation due to Rx beam switch should be noted in MRTD requirements for CBM UE if MRTD is larger than CP (LG, Xiaomi, Huawei, OPPO)
  + Option 2: In worst case performance degradation of up to 1 OFDM symbol is allowed for UE operating in CBM during RX beam switch (NEC)

- Option 2a: The impact of Rx switch can be beyond 1 symbol. (Apple, Intel)

* + Option 3: RAN4 should further study in Rel-17 to reduce the worst case (1 OFDM symbol or beyond) performance degradation (NEC, Intel)
  + Option 4: UE could safely switch beams (E///)
  + Option 5: Define different sets of requirements (260ns vs 3us) based on the UE capability and leave the degradation issue resolution to UE implementation. (Intel)

*Recommendations for 2nd round:*

* + More clarification is needed on the issue. Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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**Issue 1-3-1: How to determine MRTD in case of IBM?**

*Tentative agreements:*

* For IBM capable UE, the Rel16 MRTD requirements for FR2 inter-band CA can be applied in Rel-17 and no additional discussion is required in Rel17.

*Recommendations for 2nd round:* The tentative agreements are agreeable.

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| **Company** | **Comments** |
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**Issue 1-4-1: How to determine MTTD for CBM?**

*Tentative agreements:*

* Agree on the merged candidate options and continue the discussion in 2nd round.

*Candidate options (after 1st round comments):*

* + Option 1: 3.5 µs on condition of UE capability indication
  + Option 2: If CBM based FR2 inter-band UL CA would be introduced in Rel-17, then RAN4 needs to study the MTTD requirement applicable for CBM based FR2 inter-band CA, and it is based on the conclusion of MRTD requirements for CBM UE.

*Recommendations for 2nd round:*

* Companies are encouraged to comment if “CBM based FR2 inter-band UL CA would be introduced in Rel-17” shall be taken as a condition for defining MTTD.

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| **Company** | **Comments** |
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**Issue 1-4-2: Performance impact due to Tx beam switching**

*Tentative agreements:*

* RAN4 needs to study how to handle impact on performance due to Tx beam switching.

*Recommendations for 2nd round:* The tentative agreements are agreeable. Comments are welcome on the detailed analysis on the performance degradation.

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| **Company** | **Comments** |
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**Issue 1-5-1: How to determine MTTD in case of IBM?**

*Tentative agreements:*

* For IBM capable UE, the Rel16 MTTD requirements for FR2 inter-band CA can be applied in Rel-17 and no additional discussion is required in Rel17.

*Recommendations for 2nd round:* The tentative agreements are agreeable.

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| **Company** | **Comments** |
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**Issue 1-6-1: Scope of the RRM requirements for FR2 inter-band DL CA**

*Tentative agreements:*

* Scope of the RRM requirements for FR2 inter-band DL CA includes but not limited to MRTD, Scaling factor CSSFoutside\_gap, interruption requirements, SCell activation requirements, Beam management requirements and scheduling/measurement restriction requirements

*Recommendations for 2nd round:* The tentative agreements are agreeable.

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| **Company** | **Comments** |
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**Issue 1-6-2: Interruption requirements**

*Tentative agreements: No.*

*Candidate options:*

* + Option 1: The existing interruption requirements of intra-band CA can be applied (Intel, OPPO, MTK, LG, QC, OPPO, Intel, Nokia)
  + Option2: The interruption requirements applied for CBM based FR2 inter-band CA need to be introduced in Rel-17, which need RF inputs on the RF architecture of CBM type UE (Huawei, MTK, Xiaomi, OPPO, Apple, NEC, E///)

*Recommendations for 2nd round:* Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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**Issue 1-6-3: Scheduling restriction**

*Tentative agreements: No.*

*Candidate options:*

* + Option 1: To apply an agreement from RAN4 #94-bis-e: (Intel, MTK, LG, QC, Huawei, Intel)
    - “The scheduling availability requirements for FR2 inter-band CA scenario shall be introduced to clarify there is scheduling restriction on one FR2 band due to RLM/BFD/CBD/L1-RSRP measurements being performed on another FR2 band if UE uses common beam.
    - The existing scheduling restriction requirements on FR2 shall be extended to serving cells in different bands.”
  + Option 2: The existing scheduling/measurement restriction requirements applied for FR2 intra-band CA need to be extended to FR2 inter-band CA with CBM type UE. (Huawei, Xiaomi, E///, Nokia)
  + Option 3: Need more discussion (Xiaomi, OPPO, Apple, NEC)

*Recommendations for 2nd round:* Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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**Issue 1-6-4: Measurement restriction**

*Tentative agreements: No.*

*Candidate options:*

* + Option 1: To apply an agreement from RAN4 #95-e: (Intel, LG, QC, Intel)
    - “For CBM UEs in FR2 inter-band CA, the existing measurement restriction requirements for FR2 is applied for the RLM/BFD/CBD/L1-RSRP measurements being performed on different FR2 bands.”
  + Option 2: For CBM UEs the measurement restriction applies when the SSB for RLM, BFD, CBD or L1- RSRP measurement on one band is in the same OFDM symbol as the CSI-RS for RLM, BFD, CBD or L1- RSRP measurement on another band (Intel)

- Option 2a: For CBM UEs the measurement restriction applies when the SSB for RLM, BFD, CBD or L1- RSRP measurement on one band is in the OFDM symbols overlapping with the CSI-RS for RLM, BFD, CBD or L1- RSRP measurement on another band (MTK, LG)

* + Option 3: The existing scheduling/measurement restriction requirements applied for FR2 intra-band CA need to be extended to FR2 inter-band CA with CBM type UE (Huawei, E///, Nokia)
  + Option 4: More discussion is needed. (Xiaomi, OPPO, Apple, NEC)

*Recommendations for 2nd round:* Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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**Issue 1-6-5: SCell activation delay requirements**

*Tentative agreements:*

* + Case 1: SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band:
    - Existing SCell activation delay requirements in Case 1 can be applied

*Candidate options for Case 2:*

* + Case 2: SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2
    - Option1 (Intel, MTK):
      * If the target SCell is known, the existing known SCell requirement in Case 2 shall be applied. (E///, Nokia)
      * In the case when SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2 and the target SCell is unknown the existing SCell activation delay requirements for FR1+FR2 CA without L1-RSRP measurement delay can be reused.
    - Option2: The SCell activation requirements in Case 2 applied for CBM type UE need to be defined. How to define the SCell activation requirements for CBM type UE depends on the RF architecture and MRTD requirements for CBM type UE (Huawei, MTK, QC, Xiaomi, OPPO)
    - Option3: Scell activation delay would be reduced for the case if the PCell/PSCell and the target SCell are in a FR2 band pair with CBM, and the target SCell is unknown. (OPPO, E///)
    - Option 4: Need further discussion (Apple, NEC)

*Recommendations for 2nd round:*

The tentative agreements are agreeable. Continue the discussion in 2nd round on Case 2.

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| **Company** | **Comments** |
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**Issue 1-6-6: Scaling factor CSSFoutside\_gap**

*Tentative agreements: No.*

*Candidate options:*

* + Option 1: If FR2 inter-band CA with two bands are only considered in Rel-17, then the existing requirements on scaling factor CSSFoutside\_gap in Rel-16 can be applied to Rel-17. The requirements on scaling factor CSSFoutside\_gap need to be revised if FR2 inter-band CA with more than two bands will be introduced in Rel-17 (Huawei, QC, Xiaomi, OPPO, E///, Intel)
  + Option 2: Existing R15 requirements can be used as the baseline for CBM UE (Nokia).
  + Option 3: Need further discussion (LG, Apple, NEC)

*Recommendations for 2nd round:* Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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**Issue 1-6-7: Beam management requirement**

*Tentative agreements: No.*

*Candidate options:*

* + Option 1: The existing BFD/CBD requirements in Rel-16 can be applied for CBM type UE (Huawei, MTK, QC, Xiaomi, OPPO, E///, NEC, Nokia)
  + Option 2: Need further discussion (LG, Intel)

*Recommendations for 2nd round:* The proponent companies are encouraged to provide clarification on this question: are the existing BFD/CBD requirements for which one between inter-band CA and intra-band CA?

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| **Company** | **Comments** |
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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** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Inter-band UL CA

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

## Companies’ contributions summary

Moderator comments: All the contributions discussing or partially discussing the RRM requirements for FR2 inter-band CA UL enhancements are listed here. According to the meeting guideline, all CRs will be postponed so the CR relevant to this topic is marked with ”~~strikethrough~~”.

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2101687 | Huawei, HiSilicon | Observation 1: The existing MTTD requirement for FR2 inter-band CA can be applied for all the IBM based CA configurations, including CA\_n257A-n259A based on IBM.  Proposal 1: If CBM based FR2 inter-band UL CA would be introduced in Rel-17, then RAN4 needs to study the MTTD requirement applicable for CBM based FR2 inter-band CA.  Observation 2: The existing interruption and delay requirements for UL carrier RRC reconfiguration can be applied when new inter-band UL CA configurations are introduced.  Observation 3: The existing interruption requirements for UE switching between two uplink carriers are not applicable for FR2 inter-band UL CA.  Proposal 2: RAN4 investigates the interruption requirements for NR SRS carrier based switching applicable for inter-band SRS carrier switching in FR2. |
| ~~R4-2101869~~ | ~~Ericsson~~ | ~~Updates on MTTD requirements for FR2 inter-band DL CA~~ |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1: RRM requirements

*Sub-topic description:* This sub-topic discusses the RRM requirements for FR2 inter-band UL CA.

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

**Issue 2-1-1: interruption requirements due to** **UL carrier RRC reconfiguration**

* Proposals
  + Option 1: The existing interruption and delay requirements for UL carrier RRC reconfiguration can be applied when new inter-band UL CA configurations are introduced (Huawei)
* Recommended WF
  + TBA

**Issue 2-1-2: DL interruption at UE switching between two uplink carriers**

* Proposals
  + Option 1: The existing interruption requirements for UE switching between two uplink carriers are not applicable for FR2 inter-band UL CA (Huawei)
* Recommended WF
  + TBA

**Issue 2-1-3: DL interruption at NR SRS carrier based switching**

* Proposals
  + Option 1: RAN4 investigates the interruption requirements for NR SRS carrier based switching applicable for inter-band SRS carrier switching in FR2. (Huawei)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| MTK | Issue 2-1-1: More discussion would be needed. In our understanding, SUL is only for FR1.  Issue 2-1-2: Fine with Option 1.  Issue 2-1-3: Need input from RF input for the switching time for inter-band. Ok to investigate. |
| LG Electronics | Issue 2-1-1: Option is fine. For information, Rel-16 requirements were specified in NR standalone CA for both FR1 and FR2(8.2.2.2.4 in TS38.133).  Issue 2-1-2: Option1 is fine. For information, the existing interruption requirements for UE switching between two uplink carriers were specified for FR1.  Issue 2-1-3: Option 1 is fine. |
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| Qualcomm | **Issue 2-1-1: interruption requirements due to UL carrier RRC reconfiguration**  Agree to the relevant observation in R4-2101687, but we want a further check.  **Issue 2-1-2: DL interruption at UE switching between two uplink carriers**  Agree to the relevant observation in R4-2101687, but we want a further check.  **Issue 2-1-3: DL interruption at NR SRS carrier based switching**  Okay with Option 1. |
| OPPO | Issue 2-1-1: Support Option 1 in principle.  Issue 2-1-2: FFS for FR2.  Issue 2-1-3: Option 1 is fine. |
| Apple | 2-1-1/2/3: more discussion is needed and it also depends on the decision in RF session. |
| Ericsson | Issue 2-1-1: Option 1.  Issue 2-1-2: OK in R4-2101697 Huawei writes “It is common understanding that carriers with one or more transmit antenna connectors only belong to FR1. The capability uplinkTxSwitchingPeriod is also FR1-only. Hence, the existing interruption requirements for UE switching between two uplink carriers are only applied for FR1 inter-band UL CA.”. This makes it reasonable to go for Option 1.  Issue 2-1-3: Option 1. |
| Intel | Issue 2-1-1: Prefer to keep it FFS  Issue 2-1-2: Agree with Option 1.  Issue 2-1-3: Option 1 is fine. |
| Nokia | Issue 2-1-1: RRM discussion should be hold until we have conclusion of FR2 inter-band UL CA in RF session.  Issue 2-1-2: Same view as issue 2-1-1.  Issue 2-1-3: Same view as issue 2-1-1. |

### 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.*

Moderator comments: According to Andrey’s email, the two CRs will be postponed and not be included in the email discussion.

1. [98e][230] NR\_RF\_FR2\_req\_enh2\_RRM
   1. 2 CRs submitted (R4-2101868, R4-2101869) by E///. No CR / Draft CR submissions allowed for this WI based on meeting agenda (“No CR / Draft CR submissions allowed except for AIs where it is explicitly allowed”). The CRs will be postponed and shall not be included in the email discussion.

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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
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| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

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

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|  | **Status summary** |
| **Sub-topic#1** | **Issue 2-1-1: interruption requirements due to UL carrier RRC reconfiguration**   * Views after 1st round discussion   + Option 1: The existing interruption and delay requirements for UL carrier RRC reconfiguration can be applied when new inter-band UL CA configurations are introduced (Huawei, LG, QC, OPPO, E///)   + Option 2: More discussion is needed. (MTK, Apple, Intel)   + Option 3: RRM discussion should be hold until we have conclusion of FR2 inter-band UL CA in RF session. (Nokia, Apple)   *Tentative agreements: No.*  *Recommendations for 2nd round:*  Continue the discussion in 2nd round. |
|  | **Issue 2-1-2: DL interruption at UE switching between two uplink carriers**   * Views after 1st round discussion   + Option 1: The existing interruption requirements for UE switching between two uplink carriers are not applicable for FR2 inter-band UL CA (Huawei, MTK, LG, QC, E///, Intel)   + Option 2: More discussion is needed. (OPPO, Apple)   + Option 3: RRM discussion should be hold until we have conclusion of FR2 inter-band UL CA in RF session. (Nokia)   *Tentative agreements: No.*  *Recommendations for 2nd round:*  Continue the discussion in 2nd round. |
|  | **Issue 2-1-3: DL interruption at NR SRS carrier based switching**   * Views after 1st round discussion   + Option 1: RAN4 investigates the interruption requirements for NR SRS carrier based switching applicable for inter-band SRS carrier switching in FR2. (Huawei, MTK, LG, QC, OPPO, E///, Intel)   + Option 2: More discussion is needed. (Apple)   + Option 3: RRM discussion should be hold until we have conclusion of FR2 inter-band UL CA in RF session. (Nokia)   *Tentative agreements: No.*  *Recommendations for 2nd round:*  Continue the discussion in 2nd round. |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
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### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

### Open issues

**Issue 2-1-1: interruption requirements due to UL carrier RRC reconfiguration**

*Tentative agreements: No.*

*Candidate options (after 1st round comments):*

* + Option 1: The existing interruption and delay requirements for UL carrier RRC reconfiguration can be applied when new inter-band UL CA configurations are introduced (Huawei, LG, QC, OPPO, E///)
  + Option 2: More discussion is needed. (MTK, Apple, Intel)
  + Option 3: RRM discussion should be hold until we have conclusion of FR2 inter-band UL CA in RF session. (Nokia, Apple)

*Recommendations for 2nd round:* Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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**Issue 2-1-2: DL interruption at UE switching between two uplink carriers**

*Tentative agreements: No.*

*Candidate options (after 1st round comments):*

* + Option 1: The existing interruption requirements for UE switching between two uplink carriers are not applicable for FR2 inter-band UL CA (Huawei, MTK, LG, QC, E///, Intel)
  + Option 2: More discussion is needed. (OPPO, Apple)
  + Option 3: RRM discussion should be hold until we have conclusion of FR2 inter-band UL CA in RF session. (Nokia)

*Recommendations for 2nd round:* Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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**Issue 2-1-3: DL interruption at NR SRS carrier based switching**

*Tentative agreements: No.*

*Candidate options (after 1st round comments):*

* + Option 1: RAN4 investigates the interruption requirements for NR SRS carrier based switching applicable for inter-band SRS carrier switching in FR2. (Huawei, MTK, LG, QC, OPPO, E///, Intel)
  + Option 2: More discussion is needed. (Apple)
  + Option 3: RRM discussion should be hold until we have conclusion of FR2 inter-band UL CA in RF session. (Nokia)

*Recommendations for 2nd round:* Continue the discussion in 2nd round.

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| **Company** | **Comments** |
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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** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |