**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.15

**Source:** Moderator (Apple)

**Title:** Email discussion summary for RAN4#94e\_#64\_NR\_RRM\_Enh\_RRM\_Part\_3

**Document for:** Information

# Introduction

This email discussion summary includes multiple Scell activation/deactivation (8.15.1.2), Inter-frequency measurement requirement without MG (8.15.1.5), UE-specific CBW change (8.15.1.7) and Inter-band CA requirement for FR2 UE measurement capability of independent Rx beam and/or common beam (8.15.1.10).

Candidate target of email discussion for 1st round and 2nd round

* 1st round:
  + Collect comments from companies on the topics/sub-topics and CRs by Wednesday 5pm UTC Feb. 26
  + Moderators summarize the status and possible proposals, recommending what decisions can be made for 1st round by Thursday 5pm UTC, Feb. 27
* 2nd round:
  + Companies provide comments for 2nd round and moderators provide second round summary (Monday Mar. 2 – Thursday 5pm UTC Mar. 5).

# Topic #1: Multiple Scell activation/deactivation (8.15.1.2)

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000785 | Apple | Proposal 1: In EN-DC, NE-DC, NR SA, RAN4 will define requirements only for the case where a single MAC command is used to activate multiple SCells; while in NR-DC RAN4 will define requirements for the case where one MAC command per CG is used.  Proposal 2: In NR-DC, only if UE receives two different MAC CEs of SCell activation from MN and SN respectively within 3ms window, the MAC decoding time for each SCell activation can be extended to 4ms.  Proposal 3: when interruption occurs on the L1-RSRP measurement RS of the target to-be-activated SCell, the SCell activation delay will be extended by 1 extra L1-RSRP RS periodicity.  Proposal 4: The scaling factor for cell detection time of target being-activated SCell in multiple SCell activation scenario shall be derived as below,  SFdetection\_in\_activation = Nconfig\_unknown\_SCell\_w/o\_intra-freq\_MO + Nunknown\_SCell \_being\_activated + CSSFoutside\_gap  Where,  SFdetection\_in\_activation denotes scaling factor (SF) for cell detection time in multiple SCell activation,  Nconfig\_unknown\_SCell\_w/o\_intra-freq\_MO denotes the number of unknown configured deactivated SCell without intra-frequency MO,  Nunknown\_SCell \_being\_activated denotes the number of unknown being-activated SCell,  CSSFoutside\_gap can be referred to section 9.1.5.1 in TS38.133.  Proposal 5: In EN-DC, NE-DC, NR SA, the total interruption length of multiple SCell activations shall be same as the longest single interruption time among those SCell activations.  Proposal 6: in NR-DC, if two MAC CEs are used for multiple SCell activations in different CGs, it can be up to two individual interruptions during the activation delay, and each interruption length shall be same as the longest single interruption time among SCell activations in that CG.  Proposal 7: If UE has per-FR gap capability, the existing interruption applicability shall still apply, i.e., interruption from FR1 CC will not impact CCs in FR2 and vice versa. |
| R4-2001012 | NEC | Proposal 1: Confirm that MAC PDU processing for activation of multiple cells with a single MAC command will be 3ms.  Proposal 2: In EN-DC, NE-DC, NR SA, RAN4 to define requirements only for the case where a single MAC command is used to activate multiple SCells and For NR-DC RAN4 to define requirements for the case where one MAC command per CG is used.  Proposal 3: For NR-DC when one MAC command per CG is used, MAC CE processing time is 3ms.  Proposal 4: If UE misses the RS of the target to-be-activated SCell for the L1-RSRP measurement occasion when *timeRestrictionForChannelMeasurement* is configured, then the activation delay has to be extended by TL1-RSRP\_Measurement\_Period\_CSI-RS or TL1-RSRP\_Measurement\_Period\_SSB based on the RS configured.  Proposal 5: If UE misses the RS of the target to-be-activated SCell for the L1-RSRP measurement occasion when *timeRestrictionForChannelMeasurement* is not configured, then the activation delay extension is not required.  Proposal 6: Delay extension due to searcher limitation in case of activating N unknown SCells is N\*TSMTC for FR1 and N\*8\*TSMTC for FR2. |
| R4-2001034 | MediaTek inc. | Proposal 1: The requirement scope of multiple SCell activation shall be   * In EN-DC, NE-DC, NR SA, RAN4 to define requirements only for the case where a single MAC command is used to activate multiple NR SCells * For NR-DC RAN4 to define requirements for the case where one MAC command per CG is used.   Proposal 2: When more than 1 unknown SCells are activated, the cell detection time for each SCell is scaled by N. N shall be the sum of the number of all unknown FR1 SCells being activated and the number of FR2 bands with unknown SCells being activated.  Proposal 3: In NR CA, there is no additional interruption on the L1-RSRP reporting resource of the target to-be-activated SCell and no additional delay extension is needed.  Proposal 4: In NR DC, EN-DC, NE-DC, only 1 extra L1-RSRP RS periodicity is needed when interruption occurs on the L1-RSRP reporting resource of the target to-be-activated SCell.  Proposal 5: No NR-DC requirement defined for intra-band FR2 of multiple SCell activation.  Proposal 6: If there is no active serving cell on the FR2 band and if the target SCells being activated are unknown to UE,   * Only one unknown SCell shall execute L1-RSRP measurement and reporting; * Other unknown SCells shall hold on its activation procedure until their TCI states are configured; * The TCI state configuration for these SCells shall be different; * Only single interruption due to single RF switch on is considered.   Proposal 7: If there is no active serving cell on the FR2 band and if at least one of the target SCells being activated is known cell and at least one of the target SCells is unknown cell,   * All unknown SCell won’t need L1-RSRP measurement and reporting; * All unknown SCells shall hold on its activation procedure until their TCI states are configured; * The TCI state configuration for these SCells shall be different; * Only single interruption due to single RF switch on is considered.   Observation 2: L1-RSRP measurement and reporting can be sequential for inter-band FR2 Scells.  Proposal 8: Extend the L1-RSRP measurement and reporting time for inter-band FR2 multiple SCell activation requirement.  Proposal 9: When UE supports per-FR gap, the UE needs to consider the time extension caused on the same frequency range as the target SCell and the searcher limitation.  Proposal 10: In case interruption is allowed, to simplify the requirements of multiple SCell activation, it’s not necessary to differentiate SCell addition/release or SCell activation/deactivation activities. The additional 1ms+ interruption duration (defined in SCell addition/release) will be added in the activation delay of the target to-be-activated SCell. |
| R4-2001641 | Huawei, HiSilicon | Proposal 1: For multiple SCell activation in one slot, RAN4 to define requirements only for   * a single MAC command used to activate multiple SCells in EN-DC, NE-DC, NR SA * one MAC command per CG used to activate multiple SCells in NR-DC   and the MAC CE processing time is 3ms.  Proposal 2: When interruption occurs on the L1-RSRP measurement resource of the target to-be-activated SCell, the activation delay extension is one extra L1-RSRP measurement period.  Observation 1: To define the requirements, RAN4 needs to discuss the applicability of the delay extension for each step in the activation process.  Observation 2: Which steps for the concerned SCell activation are interrupted depends on   * What steps are required for activating the concerned SCell * What steps are required for activating the other (aggressor) SCell * When is the aggressor SCell is activated * Whether the concerned SCell and the aggressor SCell are in the same band * Whether SMTC of the concerned SCell and the aggressor SCell are fully or partially overlapping   Proposal 3: For simultaneous activation,   * if the concerned SCell activation requires AGC, its activation delay is not extended; * if the concerned SCell activation does not require AGC, its activation delay is extended by one SMTC period if AGC is required by any other SCell in the same band.   Proposal 4: For non-simultaneous activation,   * if the concerned SCell activation requires AGC, its activation delay is extended by the whole AGC settling time; * if the concerned SCell activation does not require AGC, its activation delay is extended by one or two SMTC periods.   Proposal 5: When more than 1 unknown SCells are activated, the activation delay should be extended such that the cell detection time for each SCell is scaled by the CSSF value for the SCC. |
| R4-2002061 | Qualcomm Incorporated | Proposal 1: If the single MAC PDU contains MAC commands for SCell activation (multiple cells), TCI state activation for PDCCH (for SCell group), TCI state activation for PDSCH (for SCell group) and SP CSI-RS activation (for SCell group) then the MAC processing and application time should be 3ms.  Proposal 2: For NR-DC scenario, for simultaneously received MAC commands on dual NR chains, the MAC processing and application time shall be 6ms.  Proposal 3: In case of activation of multiple cells, there will be multiple interruptions to other active cells.  Proposal 3a: A group of contiguous cells being activated will only cause one interruption on already active cells.  Proposal 3b: Each non-contiguous cell being activated/deactivated can cause an independent interruption to already active cells.  Proposal 4: The length of interruptions should be the same as defined in Rel-15.  Proposal 5: For N unknown SCells being activated by the same MAC command, the search time will scale by N. |
| R4-2002089 | Ericsson | On MAC PDU processing time:  Proposal 1: In the activation delay requirement, as well as in TFirstSSB and TFirstSSB\_MAX, the processing time for MAC PDU shall be represented symbolically for later specification.  On multiple SCell activation in NR-DC:  Proposal 2: SCell activation delay requirements for activation of multiple SCells shall be conditioned on that there are no other NR SCell activations going on when the activation command is received. It shall further assume that an activation command is only received for one cell group (MCG or SCG).  On delay extension for interruption during L1-RSRP measurement:  Proposal 3: For now there is no need to consider whether delay extension is needed or not when a SSB that would have been used for L1-RSRP measurement is interrupted. The interruptions relating to other SCells have already occurred when the UE starts the L1-RSRP measurement.  On interruptions on other serving cells:  Proposal 4: It shall be specified that radio reconfigurations for the SCells being activated as much as possible shall be co-located in time. We may further look into under which conditions this is suitable. |

## Open issues summary

### Sub-topic 1-1: Requirement scope of multiple SCell activation

**Issue 1-1: Requirement scope of multiple SCell activation**

* Proposals
  + Option 1 (Apple, NEC, MediaTek, Huawei): In EN-DC, NE-DC, NR SA, RAN4 will define requirements only for the case where a single MAC command is used to activate multiple SCells; while in NR-DC RAN4 will define requirements for the case where one MAC command per CG is used.
  + Option 2 (Ericsson): SCell activation delay requirements for activation of multiple SCells shall be conditioned on that there are no other NR SCell activations going on when the activation command is received. It shall further assume that an activation command is only received for one cell group
* Recommended WF
  + TBA

### Sub-topic 1-2: MAC CE processing delay

**Issue 1-2: MAC CE processing delay**

* Proposals
  + Option 1 (Apple): In NR-DC, only if UE receives two different MAC CEs of SCell activation from MN and SN respectively within 3ms window, the MAC decoding time for each SCell activation can be extended to 4ms; and for other cases when one single MAC command is used for multiple SCell activation, MAC CE processing time is 3ms.
  + Option 2 (NEC, Huawei): For NR-DC when one MAC command per CG is used, MAC CE processing time is 3ms; and for other cases when one single MAC command is used for multiple SCell activation, MAC CE processing time is 3ms.
  + Option 3 (Qualcomm): For NR-DC scenario, for simultaneously received MAC commands on dual NR chains, the MAC processing and application time shall be 6ms.
* Recommended WF
  + TBA

### Sub-topic 1-3: MAC PDU processing delay

**Issue 1-3: MAC PDU processing delay**

* Proposals
  + Option 1 (Qualcomm): If the single MAC PDU contains MAC commands for SCell activation (multiple cells), TCI state activation for PDCCH (for SCell group), TCI state activation for PDSCH (for SCell group) and SP CSI-RS activation (for SCell group) then the MAC processing and application time should be 3ms.
  + Option 2 (Ericsson): In the activation delay requirement, as well as in TFirstSSB and TFirstSSB\_MAX, the processing time for MAC PDU shall be represented symbolically for later specification.
* Recommended WF
  + TBA

### Sub-topic 1-4: delay extension due to interruption on L1-RSRP measurement resource

**Issue 1-4: delay extension due to interruption on L1-RSRP measurement resource:**

* Proposals
  + Option 1 (Apple): when interruption occurs on the L1-RSRP measurement RS of the target to-be-activated SCell, the SCell activation delay will be extended by 1 extra L1-RSRP RS periodicity..
  + Option 2 (NEC): If UE misses the RS of the target to-be-activated SCell for the L1-RSRP measurement occasion when *timeRestrictionForChannelMeasurement* is configured, then the activation delay has to be extended by TL1-RSRP\_Measurement\_Period\_CSI-RS or TL1-RSRP\_Measurement\_Period\_SSB based on the RS configured. If UE misses the RS of the target to-be-activated SCell for the L1-RSRP measurement occasion when *timeRestrictionForChannelMeasurement* is not configured, then the activation delay extension is not required.
  + Option 3 (MediaTek): In NR CA, there is no additional interruption on the L1-RSRP reporting resource of the target to-be-activated SCell and no additional delay extension is needed. In NR DC, EN-DC, NE-DC, only 1 extra L1-RSRP RS periodicity is needed when interruption occurs on the L1-RSRP reporting resource of the target to-be-activated SCell.
  + Option 4 (Huawei): When interruption occurs on the L1-RSRP measurement resource of the target to-be-activated SCell, the activation delay extension is one extra L1-RSRP measurement period.
  + Option 5 (Ericsson): For now there is no need to consider whether delay extension is needed or not when a SSB that would have been used for L1-RSRP measurement is interrupted. The interruptions relating to other SCells have already occurred when the UE starts the L1-RSRP measurement.
* Recommended WF
  + TBA

### Sub-topic 1-5: scaling factor for cell detection time of target being-activated SCell

**Issue 1-5: scaling factor for cell detection time of target being-activated SCell:**

* Proposals
  + Option 1 (Apple): The scaling factor for cell detection time of target being-activated SCell in multiple SCell activation scenario shall be derived as below,

SFdetection\_in\_activation = Nconfig\_unknown\_SCell\_w/o\_intra-freq\_MO + Nunknown\_SCell \_being\_activated + CSSFoutside\_gap

Where,

SFdetection\_in\_activation denotes scaling factor (SF) for cell detection time in multiple SCell activation,

Nconfig\_unknown\_SCell\_w/o\_intra-freq\_MO denotes the number of unknown configured deactivated SCell without intra-frequency MO,

Nunknown\_SCell \_being\_activated denotes the number of unknown being-activated SCell, CSSFoutside\_gap can be referred to section 9.1.5.1 in TS38.133.

* + Option 2 (NEC, MediaTek): When more than 1 unknown SCells are activated, the cell detection time for each SCell is scaled by N. N shall be the sum of the number of all unknown FR1 SCells being activated and the number of FR2 bands with unknown SCells being activated.
  + Option 3 (Huawei): When more than 1 unknown SCells are activated, the activation delay should be extended such that the cell detection time for each SCell is scaled by the CSSF value for the SCC.
  + Option 4 (Qualcomm): For N unknown SCells being activated by the same MAC command, the search time will scale by N.
* Recommended WF
  + Suggestion from moderator: could we compromise to use option 2 and add clarification note in spec that: if other activated SCCs have intra-freq MO (CSSF) or UE has unknown configured deactivated SCCs, the activation delay would be further extended?

### Sub-topic 1-6: Interruption(s) on other serving cells when multiple SCells are being activated

**Issue 1-6: Interruption(s) on other serving cells when multiple SCells are being activated:**

* Proposals
  + Option 1 (Apple):

In EN-DC, NE-DC, NR SA, the total interruption length of multiple SCell activations shall be same as the longest single interruption time among those SCell activations.

In NR-DC, if two MAC CEs are used for multiple SCell activations in different CGs, it can be up to two individual interruptions during the activation delay, and each interruption length shall be same as the longest single interruption time among SCell activations in that CG.

* + Option 2 (MediaTek):

In case interruption is allowed, to simplify the requirements of multiple SCell activation, it’s not necessary to differentiate SCell addition/release or SCell activation/deactivation activities. The additional 1ms+ interruption duration (defined in SCell addition/release) will be added in the activation delay of the target to-be-activated SCell.

* + Option 3 (Qualcomm):

In case of activation of multiple cells, there will be multiple interruptions to other active cells.

A group of contiguous cells being activated will only cause one interruption on already active cells.

Each non-contiguous cell being activated/deactivated can cause an independent interruption to already active cells.

The length of interruptions should be the same as defined in Rel-15.

* + Option 4 (Ericsson):

It shall be specified that radio reconfigurations for the SCells being activated as much as possible shall be co-located in time. We may further look into under which conditions this is suitable.

* Recommended WF
  + Suggestion from moderator: if we could agree on single MAC CE for multiple SCell activation in each CG, then could we agree that the interruption of RF tuning/retuning is aligned on time domain among multiple being-activated SCells within each CG?

### Sub-topic 1-7: Interruption to AGC settling

**Issue 1-7: Interruption to AGC settling:**

* Proposals (Huawei):
  + For simultaneous activation,
    - if the concerned SCell activation requires AGC, its activation delay is not extended;
    - if the concerned SCell activation does not require AGC, its activation delay is extended by one SMTC period if AGC is required by any other SCell in the same band.
  + For non-simultaneous activation,
    - if the concerned SCell activation requires AGC, its activation delay is extended by the whole AGC settling time;
    - if the concerned SCell activation does not require AGC, its activation delay is extended by one or two SMTC periods.
* Recommended WF
  + Suggestion from moderator: to simplify the requirement design, could we consider define requirements only for parallel activations for same type of SCells in each CG? Same type means: multiple being-activated SCells in a certain CG have same side conditions, e.g. unknown/known; SCell measurement cycle; FR; and intra-band/inter-band?

### Sub-topic 1-8: Activation requirement for mixed types of being-activated SCells

**Issue 1-8: Activation requirement for mixed types of being-activated SCells:**

* Proposals (MediaTek):
  + If there is no active serving cell on the FR2 band and if the target SCells being activated are unknown to UE,
    - Only one unknown SCell shall execute L1-RSRP measurement and reporting;
    - Other unknown SCells shall hold on its activation procedure until their TCI states are configured;
    - The TCI state configuration for these SCells shall be different;
    - Only single interruption due to single RF switch on is considered.
  + If there is no active serving cell on the FR2 band and if at least one of the target SCells being activated is known cell and at least one of the target SCells is unknown cell,
    - All unknown SCell won’t need L1-RSRP measurement and reporting;
    - All unknown SCells shall hold on its activation procedure until their TCI states are configured;
    - The TCI state configuration for these SCells shall be different;
    - Only single interruption due to single RF switch on is considered.
* Recommended WF
  + Suggestion from moderator: to simplify the requirement design, could we consider define requirements only for parallel activations for same type of SCells in each CG? Same type means: multiple being-activated SCells in a certain CG have same side conditions, e.g. unknown/known; SCell measurement cycle; FR; and intra-band/inter-band?

### Sub-topic 1-9: Mutiple SCell activation requirement for per-FR MG capable UE

**Issue 1-9-1: Interruption requirement for per-FR MG capable UE:**

* Proposals (Apple):
  + If UE has per-FR gap capability, the existing interruption applicability shall still apply, i.e., interruption from FR1 CC will not impact CCs in FR2 and vice versa
* Recommended WF
  + TBA

**Issue 1-9-2: Delay extension for per-FR MG capable UE:**

* Proposals (MediaTek):
  + When UE supports per-FR gap, the UE needs to consider the time extension caused on the same frequency range as the target SCell and the searcher limitation
* Recommended WF
  + TBA

### Sub-topic 1-10: Delay extention of multiple SCells activation for inter-band FR2 CA

**Issue 1-10: Delay extention of multiple SCells activation for inter-band FR2 CA:**

* Proposals (MediaTek):
  + Extend the L1-RSRP measurement and reporting time for inter-band FR2 multiple SCell activation requirement.
* Recommended WF
  + Suggestion from moderator: Since inter-band FR2 CA scenario was introduced in R16 and single SCell activation requirement was not touched yet, could we postpone this multiple SCell activation for inter-band FR2 CA discussion?

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| Apple | Sub-topic 1-2: From LTE UE capability we propose 4ms as the processing time for MAC CE if UE receives two MAC CEs within a window of 3ms.  Sub-topic 1-3: we support option 1 for single MAC PDU processing time.  Sub-topic 1-5: we can compromise to use option 2 and add clarification note in spec that: if other activated SCCs have intra-freq MO (CSSF) or UE has unknown configured deactivated SCCs, the activation delay would be further extended  Sub-topic 1-7: to Huawei proposal, since we propose to have single MAC CE for activation in each CG, and therefore we only need to consider simultaneous activation case in one CG. If FR1 Unknown SCC and FR1 known SCC with 160ms measurement cycle are being activated together, the second AGC occasion for unknown SCC will cause interruption to FR1 known SCC with 160ms measurement cycle, and the activation time will still be extended. How many SMTCs are needed for activation extension is also up to how many AGC occasions are needed; e.g., FR1 unknown SCC activation needs two AGC occasions and it will cause 2 SMTC periods extension to other SCell activation. In order to simplify the requirement design, we propose to define requirements only for parallel activations for same type of SCells in each CG. Same type means: multiple being-activated SCells in a certain CG have same side conditions, e.g. unknown/known; SCell measurement cycle; FR; and intra-band/inter-band.  Sub-topic 1-8: In order to simplify the requirement design, we propose to define requirements only for parallel activations for same type of SCells in each CG. Same type means: multiple being-activated SCells in a certain CG have same side conditions, e.g. unknown/known; SCell measurement cycle; FR; and intra-band/inter-band.  Sub-topic 1-10: Since inter-band FR2 CA scenario was introduced in R16 and single SCell activation requirement was not touched yet, we propose to postpone this multiple SCell activation for inter-band FR2 CA discussion. |
| QC | Issue 1-1  We see both option 1 and 2 pretty close together. We can agree on a hybrid of the two.   1. Multiple Scell activation requirements to be defined with only one MAC command per CG 2. No other Scell activation ongoing when the above command is received.   Issue 1-2  A NR-DC modem is not the equivalent of two single NR modems in terms of HW. Thus, the MAC processing would take longer. Our view is that in order for us to allow mid-tier modem implementation in requirements this should be done sequentially.  Issue 1-4  We are fine to go with E// option under the assumption that L1-RSRP doesn’t fall in any interruption window. If that happens, UE behavior to be undefined.  Issue 1-5  We can compromise to moderator recommendation and agree with option 2. We would prefer not have CSSF in there.  Issue 1-6  When the interruptions occur would depend on the UE implementation. Time alignment of interruptions would need further study.  Issue 1-7  We are fine restricting this to only known cells. However, we would still want to define requirements for mixed case of inter and intra.  Issue 1-8  Can restrict to the case where all cells in the same band are either known or all are unknown. |
| MTK | Sub topic 1-1:  In NR-DC, since there is no good coordination between two CGs, it’s hard for network to guarantee no NR SCell activations going on in one CG but another SCell activation command is configured in the other CG. Thus, we support option 1.  Sub topic 1-2:  Support option 3. For NR-DC simultaneously MAC commands reception on dual NR chains, the MAC processing and application time shall be 6ms.  Sub topic 1-3:  Agree with option 1.  Sub topic 1-4:  Support option 3.  In NR CA, owing to only one MAC command for multiple SCells activation, UE can schedule the RF retuning occasion to avoid the collision with RS’s occasion for L1-RSRP reporting in NR CA.  In NR DC, the RF retuning occasion from different CG collides with the RS’s occasion for L1-RSRP reporting is possible. In EN-DC, NE-DC, it’s also possible to collide the RS’s occasion for L1-RSRP reporting with the RF retuning from LTE. When interruption occurs, only 1 extra L1-RSRP RS periodicity is needed.  Sub topic 1-5:  Support option 2.  In Rel-15, no scaling factor with measurement was considered in single SCell activation requirement. Generally, SCell activation is a short duration procedure compared with measurement. RAN4 don’t need to consider these short duration procedure together with a long duration procedure together.  Sub topic 1-6:  Also agree Apple’s option 1, but for the interruption duration, we suggest to use the SCell addition (the longer one) to simplify the requirement. Another choice is that we shall clarify the multiple SCell activation requirement only focus on the interruption by SCell activation not consider SCell addition.  Sub topic 1-7:  We agree with Huawei’s intention to simplify the scenarios in multiple SCell activation requirement. But we need more time to check Huawei’s proposal  Sub topic 1-8:  The intention of raising this multiple intra-band SCell activation scenarios is to simplify the requirement. If there is a known cell being activation, the unknown cell can follow the known cell procedure and reduce the L1-RSRP meas procedure, when both cells are in the same band. It can speed up unknown SCell activation procedure.  Sub topic 1-9:  Apple’s proposal is generally OK to us, but some further clarification is needed. When UE supports per-FR gap capability, the interruption will impact on only the CCs within the same FR. Therefore the delay requirement shall consider this impact on interruption. But the interruption is not the only factoring impacting the delay. For the scaling factor due to searcher limitation, it shall still consider both FR1 and FR2 even UE supporting per-FR gap.  Sub topic 1-10:  This is the first time to discuss the inter-band FR2 requirement. It’s fine for us to postpone this discussion in multiple SCell activation. |
| Ericsson | **Issue 1-3:** Support Option 1 (MAC PDU with MAC-CEs related to activation of group of cells in same CG is processed within 3ms)  **Issue 1-5:** Option 2 is acceptable under the condition that unknown SCells that are contiguous to activated cells (MRTD ≤ 260ns) are excluded from N and from scaling by N.  **Issue 1-6:** Support Option 1, but some modifications may be needed. Radio reconfigurations for activation of SCells in bands where there are no active serving cells can be bundled. Radio reconfigurations for activation of SCells in bands where there are already active cells may have to be carried out around an SMTC window for gain setting reasons. Hence a further study is needed.  **Issue 1-7**: For simultaneous activation, support that if two cells are activated in the same band and one needs AGC but the other does not, the activation time will be extended by one SMTC period for the SCell the does not need the AGC. Do not agree to moderator’s proposal on only having requirements for activation of cells that fulfill the same conditions, as it would have a negative impact on the system performance. Particularly thinking of colocation cases (contiguous intra-band).  **Issue 1-8**: Support the proposal on that SCells in same FR2 band can rely on the activation of a first (known or unknown) SCell. Do not agree to moderator’s proposal on only having requirements for activation of cells that fulfill the same conditions, as it would have a negative impact on the system performance. Particularly thinking of colocation cases (contiguous intra-band). |
| Intel | Issue 1-1: Support option 1  Issue 1-2: support option 2. In NR-DC, UE can maintain two MAC entities separately.  Issue 1-4: if interruption occurs on L1-RSRP resource for measurement, then total delay should be extended by X extra L1-RSRP RS periodicity. X is number of L1-RSRP resource for measurement being interrupted.  Issue 1-5: slightly prefer option 2. We think cell search/measurement for SCell being activated should have high priority than cell search/measurement for mobility purpose on other SCC carriers.  Issue 1-6: we are fine with recommended WF. However, if we also allow multiple MAC CE for multiple SCell activation, then we prefer option 3, i.e. each cell being activated/deactivated can cause an independent interruption to already active cells unless for a group of contiguous cells, which will cause only one interruption to other active cells.  Issue 1-7: support recommended WF.  Issue 1-8: support recommended WF.  Issue 1-9-1: support proposals from Apple. |
| Huawei, HiSilicon | Issue 1-1: We see the two options are not mutual exclusive. We suggest agree on the combination of them.  Issue 1-2: Option 2. The issue is not specific for SCell activation but for all MAC CE triggered actions. We understand UE supporting NR-DC is able to process MAC CE in parallel in two CGs, but please point out if we miss any technical issues here.  Issue 1-3: We support option 1.  Issue 1-4: If the options in Issue 1-1 can be agreed, we can compromise to option 3.  Issue 1-5: Following the moderator’s suggestion, we can compromise to option 2, but we suggest to update the clarification something like “the cell identification and RRM measurement requirements for other SCCs do not apply during the cell detection time for SCell activation”.  Issue 1-6: We agree with the suggestion from moderator. For CA case, we are fine with either option 1 or option 2. For NR-DC case, we need more time to check, especially for UE not supporting per-FR gap.  Issue 1-7: On the moderator’s suggestion, we think it may be too limiting from network perspective. If we can agree on the options in Issue 1-1, the cases where interruption impacts between the SCells being activated is limited, so we might be able to find a way to specify the requirements. Of course, we are open to further discuss on this issue.  Issue 1-8: Similar comment as Issue 1-7.  Issue 1-9-1: Support the proposal  Issue 1-9-2: For the time extension caused by interruption, we do not need to consider SCell in another FR. But for searcher limitation we still need even UE supports per-FR gap.  Issue 1-10: Support moderator’s suggestion. |
| NEC | Issue 1-2: We support Option 2. In our understanding, in NR-DC, each CG may have different MAC entities and they can be processed in parallel.  Issue 1-4: We are OK with Option 5. However, if extension is required, we support option 3, as it may depend on *timeRestrictionForChannelMeasurement*.  Issue 1-5: We are OK with topic lead recommended WF. |
| MTK | Issue 1-5: We agree with Huawei to add the clarification “the cell identification and RRM measurement requirements for other SCCs do not apply during the cell detection time for SCell activation”.  Issue 1-8: We understand moderator wants to simplify the scenarios. If we define the requirement for known+unknown case in FR2 intra-band, it has much benefit for both network and UE side. It means UE can utilize the information of known cell being activated to save much of activation processing time on L1-RSRP measurement for unknown cell’s activation. From network’s side, it means network only need to ask one of the deactivated SCell to report L3-RSRP, then it can activate several SCells together whatever it’s known or unknown. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
|  | 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 1-1 | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
|  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
|  | *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)

## 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*

|  |  |
| --- | --- |
| **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-frequency measurement requirement without MG (8.15.1.5)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000154 | vivo | Observation 1: For UE which implements this feature, it will obtain a tradeoff between intra-frequency measurement performance and inter-frequency/inter-RAT measurement performance.  Using EN-DC as an example, the detection and measurement delay for intra-frequency SCells will be downgraded whereas the detection and measurement delay for inter-frequency MOs using measurement gap and inter-RAT MOs could be improved.  Observation 2: The potential gain on throughput through this feature may be limited providing measurement gaps are still allocated to a UE when it is necessary.  Proposal 1: let UE decide whether to support this feature or not and corresponding UE capabilities signalling could be introduced. |
| R4-2000385 | Intel Corporation | Proposal 1: Define requirements based on the assumption that UE perform measurement outside gaps (same as intra-frequency measurement without MG), when configured MG is partially overlapped with interfrequency SMTC and interfrequency SSB is completely contained in the active BWP of the UE.  Proposal 2: There is no need to define an explicit signaling for indicating synchronization for inter-frequency measurement without gap.  Proposal 3: For TDD FR1 and FR2, the scheduling restriction for inter-frequency measurement without gap are the same with that of intra-frequency measurement without gap.  Proposal 4: For FR1 mixed numerology, the scheduling restriction for inter-frequency measurement without gap apply for all SSB symbols in the SMTC window. |
| R4-2000460 | MediaTek inc. | Proposal 1: For inter-frequency measurement without gap, if the SMTC occasions of an MO are partially overlapped by MG, UE is only required to conduct measurement for this MO outside measurement gap. Therefore, the factor Kp in intra-frequency measurement without gap should be re-used in this scenario.  Proposal 2: An explicit signaling is introduced to tell UE whether the synchronization between an inter-frequency MO and one UE’s serving cell can be assumed. Send an LS to RAN2 to request the corresponding signaling.  Proposal 3: For the scheduling restriction requirements for inter-frequency measurement without gap, if the synchronization signaling is provided, the scheduling restriction is applied only to those SSB symbols and OFDM symbols adjacent to SSB. Otherwise, the scheduling restriction is applied to the entire SMTC duration.  Proposal 4: When the target SSB has a different SCS grid as that of UE’s serving cell, UE is allowed to have scheduling restriction in the entire SMTC duration.  Proposal 5: UE capability is needed for the feature of inter-frequency measurement without gap.  Proposal 6: New sections for delay requirements are introduced for UE who supports inter-frequency measurement without gap. Within each new section, add sub sections for requirements with gap and without gap.  Proposal 7: For UE without CA capability, the number of search assumed in the requirement is 1. The measurement delay of PCC is doubled to allow UE to conduct inter-frequency measurement without gap. |
| R4-2000644 | CMCC | Proposal 1: It is proposed to define requirements based on the assumption that UE perform measurement outside gaps (same as intta-frequency measurement without MG) when configured MG is partially overlapped with interfrequency SMTC and interfrequency SSB is completely contained in the active BWP of the UE.  Proposal 2: it is proposed that synchronization is always assumed when UE performs inter-frequency measurement without gap, and no additional network signalling is needed.  Proposal 3: Inter-frequency measurement without MG is mandatory supported from Rel-16, and no UE capability signalling is needed. |
| R4-2000645 | CMCC | TP based on discussion paper R4-2000644 |
| R4-2000646 | CMCC | LS based on discussion paper R4-2000644 |
| R4-2000992 | OPPO | Proposal 1: Define requirements based on the assumption that UE perform measurement within gaps, when configured MG is partially overlapped with inter-frequency SMTC and inter-frequency SSB is completely contained in the active BWP of the UE.  Proposal 2: As for scheduling and measurement restriction, RAN4 considers the worst case that UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration, for FR1 mixed numerology (UE is not capable to support mixed numerologies) and FR2 cases.  Proposal 3: Check it with RAN1 on the number of restricted data symbols before SSB to be measured.  Proposal 4: No need to define such UE capability, or define it as optional without signalling. |
| R4-2001663 | Huawei, HiSilicon | Based on discussion paper R4-2001664 |
| R4-2001664 | Huawei, HiSilicon | Proposal 1: The feature is an optional capability and RAN4 shall inform RAN2 to design the corresponding capability signalling.  Proposal 2: When configured MG is partially overlapped with interfrequency SMTC and interfrequency SSB is completely contained in the active BWP of the UE, define requirements based on the assumption that UE perform measurement outside gaps.  Proposal 3: In FR1 mixed numerology(UE is not capable to support mixed numerologies) and FR2 cases, UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration. |
| R4-2002057 | Qualcomm Incorporated | Observation 1: A UE that does not support CA will have only one searcher.  Proposal 1: For UE that does not support CA, inter-frequency measurements should always happen in gaps.  Proposal 2: For inter-frequency SMTC’s that partially overlap with gaps, rel-15 requirements for measurements within gaps apply.  Proposal 3: For inter-frequency cells that partially or fully overlap with serving cell, deriveSSB-IndexFromCell flag to indicate that those cells are synchronous with serving cell. |

## 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: Capability of supporting inter-frequency measurement without MG

**Issue 2-1: Capability of supporting inter-frequency measurement without MG**

* Proposals
  + Option 1 (VIVO, MediaTek, Huawei): UE capability is needed for the feature of inter-frequency measurement without gap.
  + Option 2 (CMCC): Inter-frequency measurement without MG is mandatory supported from Rel-16, and no UE capability signalling is needed.
  + Option 3 (OPPO): No need to define such UE capability, or define it as optional without signalling.
* Recommended WF
  + TBA

### Sub-topic 2-2: UE behaviour for inter-frequency measurement w/o MG partially overlapped with MG

**Issue 2-2: UE behaviour for inter-frequency measurement w/o MG partially overlapped with MG**

* Proposals
  + Option 1 (Intel, MediaTek, CMCC, Huawei, HiSilicon): Define requirements based on the assumption that UE perform measurement outside gaps (same as intra-frequency measurement without MG), when configured MG is partially overlapped with inter-frequency SMTC and inter-frequency SSB is completely contained in the active BWP of the UE.
  + Option 2 (OPPO, Qualcomm): Define requirements based on the assumption that UE perform measurement within gaps, when configured MG is partially overlapped with inter-frequency SMTC and inter-frequency SSB is completely contained in the active BWP of the UE.
* Recommended WF
  + TBA

### Sub-topic 2-3: Scheduling restriction for inter-frequency measurement w/o MG

**Issue 2-3: Scheduling restriction for inter-frequency measurement w/o MG**

* Proposals
  + Option 1 (Intel, CMCC, Apple):

There is no need to define an explicit signaling for indicating synchronization for inter-frequency measurement without gap.

For TDD FR1 and FR2, the scheduling restriction for inter-frequency measurement without gap are the same with that of intra-frequency measurement without gap.

For FR1 mixed numerology (FDD), the scheduling restriction for inter-frequency measurement without gap apply for all SSB symbols in the SMTC window.

* + Option 2 (MediaTek):

An explicit signaling is introduced to tell UE whether the synchronization between an inter-frequency MO and one UE’s serving cell can be assumed.

For the scheduling restriction requirements for inter-frequency measurement without gap, if the synchronization signaling is provided, the scheduling restriction is applied only to those SSB symbols and OFDM symbols adjacent to SSB. Otherwise, the scheduling restriction is applied to the entire SMTC duration.

* + Option 3 (OPPO):

As for scheduling and measurement restriction, RAN4 considers the worst case that UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration, for FR1 mixed numerology (UE is not capable to support mixed numerologies) and FR2 cases.

* + Option 4 (Huawei):

In FR1 mixed numerology(UE is not capable to support mixed numerologies) and FR2 cases, UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration.

Option 5 (Qualcomm):

For inter-frequency cells that partially or fully overlap with serving cell, *deriveSSB-IndexFromCell* flag to indicate that those cells are synchronous with serving cell.

* Recommended WF
  + TBA

### Sub-topic 2-4: Scheduling restriction when the target SSB has a different SCS grid

**Issue 2-4: Scheduling restriction when the target SSB has a different SCS grid**

* Proposals (MediaTek)
  + When the target SSB has a different SCS grid as that of UE’s serving cell, UE is allowed to have scheduling restriction in the entire SMTC duration.
* Recommended WF
  + TBA

### Sub-topic 2-5: UE measurement behaviour if it doesn’t support CA

**Issue 2-5: UE measurement behaviour if it doesn’t support CA**

* Proposals
  + Option 1 (MediaTek): For UE without CA capability, the number of search assumed in the requirement is 1. The measurement delay of PCC is doubled to allow UE to conduct inter-frequency measurement without gap.
  + Option 2 (Qualcomm): For UE that does not support CA, inter-frequency measurements should always happen in gaps.
* Recommended WF
  + TBA

### Sub-topic 2-6: Spec structure for inter-frequency measurement w/o MG

**Issue 2-6: Spec structure for inter-frequency measurement w/o MG**

* Proposals
  + Option 1 (MediaTek): New sections for delay requirements are introduced for UE who supports inter-frequency measurement without gap. Within each new section, add sub sections for requirements with gap and without gap.
* Recommended WF
  + Suggestion from moderator: Can be discussed in the CMCC TP

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Sub-topic 2-2: we support option 1.  Sub-topic 2-4: we need more time to think about this case, and we are not sure why it’s different from other inter-freq without MG measurement. If the inter-freq SSB is partially overlap with serving SSB on the frequency domain, if the serving cell SCS is same as inter-freq SSB SCS, why we need to have scheduling restriction?  Sub-topic 2-5: we agree on option 1. If single carrier case means inter-frequency measurement is always with MG, there is no gain for serving cell throughput. We think even UE can only support 1 searcher, but the inter-frequency measurement can still be performed without MG as long as it can meet the corresponding conditions, since serving cell data reception will not use the searcher resource. |
| QC | Issue 2-1  Support option 1  Issue 2-4  Agree with MTK proposal. |
| CMCC | Issue 2-1: We support option 2, and optional or mandatory can be discussed later together with other Rel-16 features.  Issue 2-2: We support option 1  Issue 2-3: We support option 1. For partial or fully overlapping TDD carriers, synchronization is necessary to avoid interference. Hence, we support to assume synchronization for TDD carriers for inter-frequency measurement without MG. Reuse existing *deriveSSB-IndexFromCell*  can also be considered (option 5)  Issue 2-4: The proposal seems not a reasonable deployment that target SSB has a different SCS grid. The impact on UE measurement is not sure. Need more time to check.  Issue 2-5: We prefer not to consider the non-CA case, which will make the specification more complex (option 1). We don’t agree with option2, even UE only has 1 searcher, the inter-frequency measurement can still be performed without MG. CA is a typical implementation for NR UE and we prefer not to consider the non-CA case. |
| OPPO | Issue 2-1: Support option 3. If UE capability was to be defined, prefer it as optional.  Issue 2-2: Support option 2.  Issue 2-3: Support option 3/4. They are the same.  Issue 2-4: Agree with MTK proposal.  Issue 2-5: Support option 2. |
| MTK | **Issue 2-2: UE behaviour for inter-frequency measurement w/o MG partially overlapped with MG**  Support Option 1  **Issue 2-3: Scheduling restriction for inter-frequency measurement w/o MG**  In our view an explicit signaling to tell UE about the synchronization between a serving cell and a target frequency is needed. So that UE can have the confidence to reduce the time domain window for cell search from the entire SMTC duration to the SSB symbols plus 1 symbol margin. If the signaling is not agreed, we prefer to go with Options 3 and 4 (They are the same.)  **Issue 2-4: Scheduling restriction when the target SSB has a different SCS grid**  It is OK to us if companies needs more time to think.  The main reason for the grid mis-alignment is that the ARFCN granularity can be smaller than SSB SCS. Therefore, even with the same SCS, e.g., 15KHz, the serving cell carrier can be on the grid 15KHz\*n, but the target cell could be on the grid 15KHz\*n+5KHz. We also believe that network should have no intention to deploy cells in this way, but it hurts nothing to have some clarification in spec to reduce the scenarios that need to be considered by UE.  **Issue 2-5: UE measurement behaviour if it doesn’t support CA**  In our view, Option 1 can be further revised if there are more than one inter-frequency layers to be measured without gap. We think this kind of low-cost UE is coming to the market now.  **Issue 2-6: Spec structure for inter-frequency measurement w/o MG**  OK to the suggestion from moderator. For efficiency, some fundamental issues must be resolved before discussing TP. |
| Ericsson | **Issue 2-1:** Support Option 1. In general any mandatory release 16 feature without capability would be problematic from our perspective because it means no other optional release 16 functionality can be introduced until the industry completes IODT testing. We are fine with interfrequency measurements without gap being mandatory with capability. We additionally think a configuration flag is needed, in addition to the capability flag, would be needed unless the RRM delays are “backwards compatible”, in other words, if the RRM delays are the same when network configures gaps for a release 16 UE and when NW does not configure gaps for a release 16 UE (see also issue 2-2)  **Issue 2-2:** Support Option 2. This would give backwards compatibility w.r.t. measurement performance for the case when the network configures gaps.  **Issue 2-3:** Support Option 3 / 4.  **Issue 2-4:** May need further discussions. The benefit over measurements in gaps is not clear.  **Issue 2-5:** Agree with Option 2, i.e., for UE not supporting CA, inter-frequency measurements should always be carried out in gaps. Single carrier R16 UE’s shouldn’t be expected to implement 2 seachers. |
| vivo | **Issue 2-1: Capability of supporting inter-frequency measurement without MG**  **Support option 1**  **Issue 2-2: UE behaviour for inter-frequency measurement w/o MG partially overlapped with MG**  **Prefer option 1**  **Issue 2-5: UE measurement behaviour if it doesn’t support CA**  **Option 1 and 2 are possible solutions for this issue and we think option 2 is more strigthforward.** |
| Intel | Issue 2-4: support proposal from MTK.  Issue 2-5: it is rational to assume a UE which does not support CA would implement 1 searcher. However, it doesn’t necessarily mean inter-f measurement cannot be done w/o gap. E.g. there is non-overlapped SMTC on target inter-frequency layer, which can be used for inter-f measurement w/o gap. Therefore, under certain condition inter-f measurement w/o gap is feasible. But we don’t agree to extend measurement delay on PCC. We believe mobility performance on PCC is more important compared to other CCs. Alternatively, measurement delay on inter-frequency can be extended, w/o any impact on measurement on PCC. |
| Huawei, HiSilicon | Issue 2-1: Support option1. Supporting inter-frequency measurement without gap depends on UE implementation. The feature can be regarded as a kind of measurement enhancement. We suggest the feature is an optional capability.  Issue 2-2: support option 1.  Issue 2-3: Option 4. For inter-frequency measurement within gap, deriveSSB-IndexFromCell is not applicable. Since the timing alignment is not guaranteed for the serving cell and the target inter-frequency measurement, for the UE not capable to support mixed numerologies, UE is not expected to transmit on all symbols within SMTC window duration.  Issue 2-4: Huawei’s view is not captured in the summary. We have the same proposal with MTK.  Issue 2-5: This depends on UE implementation and format. This needs more discussion, alternative way is to exclude the single carrier case in spec.  Issue 2-6: agree with recommended WF. |
| NEC | Issue 2-1: We support option 1  Issue 2-2: We support option 1 |
| NTT DOCOMO, INC. | Issue 2-2: We prefer option 1. UE could perform SMTC based measurement even if measurement gap is configured.  Issue 2-3: We support option 2 if such new signalling like “deriveSSB-IndexFromCel” can be introduced for inter-frequency measurement case.  Issue 2-5: We are not sure why this case should be discussed in this WI, Even if UE does not support CA, basically UE shall perform inter-frequency measurement. If we consider 1 cell searcher case, e.g., IoT or low cost UE, in the future, we could revisit this issue. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2000645 (TP) | MTK: Suggest to work on some fundamental issues first. With conclusion, TP are straightforward. |
| Company B |
|  |
| R4-2000646 (LS) | MTK: Suggest to work on some fundamental issues first. |
| Ericsson: In our view both a capability and a configuration flag would be needed. |
|  |
| R4-2001663 (LS) | MTK: Suggest to work on some fundamental issues first. |
| ericsson: We further need to discuss whether a configuration flag is needed, and then update the LS accordingly. |
|  |

* Suggestion from moderator: Could CMCC and Huawei split the work? E.g. CMCC on TP and Huawei on LS?

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| Sub-topic 2-1 | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| Sub topic 2-2 |  |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## 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*

|  |  |
| --- | --- |
| **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 #3: UE-specific CBW change (8.15.1.7)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000461 | MediaTek inc. | Observation 1: Changing UE specific channel bandwidth means to signal a different values for either carrierBandwidth or offsetToCarrier.  Observation 2: Changing UE-specific channel BW may or may not involve change on the frequency location of UE-specific BWP because the reference 1st PRB for a BWP aligns the 1st PRB of the channel bandwidth.  Proposal 1: The delay and interruption requirements for UE-specific channel BW switch is the same as those for RRC-based BWP switch. |
| R4-2002065 | Qualcomm Incorporated | Observation 1: UE specific channel BW change is done via an RRC command.  Proposal 1: The time to switch UE specific channel BW TChannelBWSwitch = TRRC Processing + TUE processing  Proposal 2: RAN4 to define the UE processing time for UE specific channel BW switch. |

## 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 3-1: RRM requirement for UE-specific channel BW switch

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

**Issue 2-1: RRM requirement for UE-specific channel BW switch**

* Proposals
  + Option 1 (MediaTek): The delay and interruption requirements for UE-specific channel BW switch is the same as those for RRC-based BWP switch.
  + Option 2 (Qualcomm): The time to switch UE specific channel BW TChannelBWSwitch = TRRC Processing + TUE processing. RAN4 to define the UE processing time for UE specific channel BW switch.
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Sub topic 2-1:  We think Option 1 and 2 can actually be merged. |
| Huawei, HiSilicon | Since this is the first time we have papers on this issue, we suggest to make decisions on the exact requirements in next meeting. In addition, we would like to confirm if it is a common understanding that UE-specific channel BW means the reconfiguration of offsetToCarrier or carrierBandwidth as mentioned in MTK paper R4-2000461. |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

## Discussion on 2nd round (if applicable)

## 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*

|  |  |
| --- | --- |
| **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 #4: Inter-band CA requirement for FR2 UE measurement capability of independent Rx beam and/or common beam (8.15.1.10)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000381 | Intel Corporation | Observation 1: existing RRM requirements in idle/inactive mode still apply for inter-band CA in FR2 for UE which supports independent beam management.  Proposal 1: there is no impact on idle/inactive mode requirement.  Proposal 2: there is no impact on inter-frequency cell search and measurement requirement in TS38.133 section 9.3.  Proposal 3: CSSF for FR2 inter-band CA needs to be discussed and specified.  Observation 2: most likely beam management requirement being discussed in R16 eMIMO work item can also apply for inter-band CA.  Observation 3: supporting independent beam management for inter-band CA has no impact on the SCell activation RRM requirement.  Observation 4: interruption requirement for inter-band CA in FR2 are already there in TS38.133.  Proposal 4: no impact on interruption RRM requirements.  Proposal 5: new scheduling availability and measurement restriction needs to be specified. |
| R4-2000560 | NTT DOCOMO INC. | Observation 1: If the transmission point of each band is non co-located and UE has only common beam, UE may hardly receive signals transmitted from each transmission point simultaneously.  Observation 2: UE can measure each band parallelly under the assumption that the UE is capable of simultaneous reception and has at least two cell searchers.  Observation 3: The current SCell activation requirements for FR2 SCell are specified regardless of PCell or PSCell frequency range.  Observation 4: The current interruption requirement does not preclude the case of FR2 inter-band CA.  Observation 5: Based on the assumption that UE is assumed to have the capability of simultaneous measurement for each FR2 band, scheduling in each band is not restricted by other bandCCs.  Proposal 1: The scenarios other than that UE has only common beam and transmission points are non co-located shall be prioritized.  Proposal 2: Rel-15 Cell detection/measurement requirement shall be reused for FR2 inter-band CA. More specifically, the following additional value sets of CSSFoutside\_gap,i shall be added in Table 9.1.5.1.1-1 and 9.1.5.1.2-1 of current spec.  Proposal 3 Rel-15 beam management requirement for FR1+FR2 CA shall be reused for FR2 inter-band CA scenario as is.  Proposal 4: Rel-15 SCell activation requirements for FR2 SCell shall be reused for FR2 inter-band CA scenario as is.  Proposal 5: Rel-15 interruption requirement shall be reused for FR2 inter-band CA scenario as is.  Proposal 6: Rel-15 scheduling restriction requirement shall be reused for FR2 inter-band CA scenario as is. |
| R4-2001582 | Huawei, HiSilicon | Proposal 1: The scaling factor CSSFoutside\_gap for FR2 inter-band CA shall be defined for inter-frequency measurement without gaps, which can be defined as Table 1.  Proposal 2: For UE capable of common Rx beam, the layer 1 measurement restrictions requirements need to be defined for FR2 inter-band carrier aggregation.  Proposal 3: For UE capable of common Rx beam, the layer 1 measurement restrictions requirements for FR2 inter-band carrier aggregation can be defined as follows:   * When a RS for L1 measurement in one FR2 band is fully or partially overlapped with the OFDM symbol of another RS for L1 measurement in different FR2 band, UE is required to measure one of the two RSs.   Proposal 4: For SCell activation delay requirements, the following case shall be considered for FR2 inter-band CA:   * the 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.   Proposal 5:The definition of TSMTC\_MAX and TFirstSSB\_MAX used in SCell activation delay requirements need to be defined for FR2 inter-band CA scenario.  Proposal 6:The existing interruption requirements for CA can also be applied for FR2 inter-band CA scenario.  Proposal 7: For UE capable of common Rx beam, the existing scheduling restriction requirements shall be extended to FR2 inter-band carrier aggregation. |
| R4-2002064 | Qualcomm Incorporated | Proposal 1: RAN4 to define requirements for bands in which the UE can use a common beam. These requirements need to be defined for co-location, spatial filter, MRTD/MTTD and power imbalance. RAN4 to use intra-band requirements as baseline.  Proposal 2: Cell detection and measurement requirements for independent beams remain the same as in Rel-15.  Proposal 3: UE should be configured with beam management resources on one cell in each band for which it is using independent beams.  Proposal 4: RAN4 to use SCell beam management requirements as being defined in eMIMO WID as baseline.  Proposal 5: For known Scell activation with independent beams, the same requirements as Rel-15 apply.  Proposal 6: Interruptions requirements with independent beams to be the same as that from Rel-15.  Proposal 7: No scheduling restrictions on a band that is using an independent beam from the band on which the procedure (RLM, Beam Management, L1-RSRP) measurements is being performed. |

## 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 4-1: Cell detection/measurement requirement

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

**Issue 4-1: Cell detection/measurement requirement**

* Proposals (Intel, NTT DOCOMO, Qualcomm)
  + There is no impact on idle/inactive mode requirement. Rel-15 Cell detection/measurement requirement shall be reused for FR2 inter-band CA.
* Recommended WF
  + TBA

### Sub-topic 4-2: CSSF

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

**Issue 4-2: CSSF**

* Proposals
  + Option 1 (NTT DOCOMO): The following additional value sets of CSSFoutside\_gap,i shall be added in Table 9.1.5.1.1-1 and 9.1.5.1.2-1 of current spec.

Table 9.1.5.1.1-1: CSSFoutside\_gap,i scaling factor for EN-DC mode

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR1 PSCC | *CSSF*outside\_gap,i for FR1 SCC | *CSSF*outside\_gap,i for FR2 PSCC | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is required Note 2 | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is not required |
| **EN-DC with FR2 inter-band CA** | N/A | N/A | 1 | 2 | 2×(Number of configured SCell(s)-1) |

Table 9.1.5.1.2-1: CSSFoutside\_gap,i scaling factor for SA mode

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR1 PCC | *CSSF*outside\_gap,i for FR1 SCC | *CSSF*outside\_gap,i for FR2 PCC | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is required | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is not required |
| **FR2 inter-band CA** | N/A | N/A | 1 | 2 | 2×(Number of configured SCell(s)-1) |

* + Option 2(Huawei): The scaling factor CSSFoutside\_gap for FR2 inter-band CA shall be defined for inter-frequency measurement without gaps, which can be defined as Table 1.

Table 1: CSSFoutside\_gap,i scaling factor for FR2 inter-band CA

|  |  |  |  |
| --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR2 PCC (in SA or NE-DC mode) or PSCC (in EN-DC mode) | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is required | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is not required |
| **FR2 inter-band CA** | 1 | 2×(Number of configured FR2 band(s) - 1) | 2×(Number of configured SCell(s) – (Number of configured FR2 band(s) -1)) |

* Recommended WF
  + TBA

### Sub-topic 4-3: Impact on interruption requirement

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

**Issue 4-3: Impact on interruption requirement**

* Proposals (Intel, NTT DOCOMO, Huawei, Qualcomm)
  + The existing interruption requirements for CA can also be applied for FR2 inter-band CA scenario.
* Recommended WF
  + The existing interruption requirements for CA can also be applied for FR2 inter-band CA scenario.

### Sub-topic 4-4: beam management requirement

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

**Issue 4-4: beam management requirement**

* Proposals
  + Option 1 (NTT DOCOMO): Rel-15 beam management requirement for FR1+FR2 CA shall be reused for FR2 inter-band CA scenario as is.
  + Option 2 (Qualcomm): UE should be configured with beam management resources on one cell in each band for which it is using independent beams. RAN4 to use SCell beam management requirements as being defined in eMIMO WID as baseline.
* Recommended WF
  + TBA

### Sub-topic 4-5: Scheduling restriction requirement

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

**Issue 4-5-1: Scheduling restriction requirement for UE supporting independent beam**

* Proposals
  + Option 1 (Intel): new scheduling availability and measurement restriction needs to be specified.
  + Option 2 (NTT DOCOMO): Rel-15 scheduling restriction requirement shall be reused for FR2 inter-band CA scenario as is.
  + Option 3 (Qualcomm): No scheduling restrictions on a band that is using an independent beam from the band on which the procedure (RLM, Beam Management, L1-RSRP) measurements is being performed.
* Recommended WF
  + TBA

**Issue 4-5-2: Scheduling restriction requirement for UE supporting common beam only**

* Proposals (Huawei):
  + For UE capable of common Rx beam, the existing scheduling restriction requirements shall be extended to FR2 inter-band carrier aggregation.
* Recommended WF
  + TBA

### Sub-topic 4-6: Measurement restriction requirement

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

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

* Proposals (Huawei)
  + For UE capable of common Rx beam, the layer 1 measurement restrictions requirements need to be defined for FR2 inter-band carrier aggregation.
  + For UE capable of common Rx beam, the layer 1 measurement restrictions requirements for FR2 inter-band carrier aggregation can be defined as follows:
    - When a RS for L1 measurement in one FR2 band is fully or partially overlapped with the OFDM symbol of another RS for L1 measurement in different FR2 band, UE is required to measure one of the two RSs.
* Recommended WF
  + TBA

### Sub-topic 4-7: SCell activation delay requirements

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

**Issue 4-7: SCell activation delay requirements**

* Proposals
  + Option 1(NTT DOCOMO):

Rel-15 SCell activation requirements for FR2 SCell shall be reused for FR2 inter-band CA scenario as is.

* + Option 2 (Huawei):

For SCell activation delay requirements, the following case shall be considered for FR2 inter-band CA:

* + - the 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.

The definition of TSMTC\_MAX and TFirstSSB\_MAX used in SCell activation delay requirements need to be defined for FR2 inter-band CA scenario.

* + Option 3 (Qualcomm):

For known Scell activation with independent beams, the same requirements as Rel-15 apply, but For multiple unknown cells, the timeline for L1-RSRP measurement on multiple bands needs FFS.

* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Sub-topic 4-2: so far RF only supports two bands aggregation for FR2, so option 1 makes more sense.  Sub-topic 4-5: Issue 4-5-1:  agree on option1, because now there is no inter-band FR2 scheduling availability or measurement restriction. Option 3 only applies when the SCS are same or UE supports mixed numerology. |
| QC | Issue 4-2:  The exact values may not be agreeable in this meeting. Can DCM/moderator propose some high level agreements for this issue.  Issue 4-5-2 and Issue 4-6  For UE common beam operation we first need to agree what the scenario (gNB limitation in terms of col-location, MRTD, spatial transmission filter etc) are before agreeing to any UE requirements. |
| MTK | **Issue 4-1: Cell detection/measurement requirement**  Ok to the proposal  **Issue 4-2: CSSF**  Better to work on some high-level principle first before touching the spec. For example, whether the total number of searchers remains the same as Rel-15 value.  **Issue 4-3: Impact on interruption requirement**  Ok to the WF  **Issue 4-4: beam management requirement**  Both proposals are not 100% clear to us. Regarding Option 1, we are not sure about the so-called “Rel-15 beam management requirement for FR1+FR2 CA”. Regarding Option 2, we need more detail on “SCell beam management requirements as being defined in eMIMO WID”. Perhaps it is even not ready at this moment? Besides, we are not sure if eMIMO is going to be a mandatory feature in Rel-16.  **Issue 4-5-1: Scheduling restriction requirement for UE supporting independent beam**  The Rel-15 scheduling restriction focuses on intra-band case. Therefore the Rel-15 requirements should of course be inherited by Rel-16 inter-band FR2 CA. We think the discussion point is whether to have additional scheduling restriction requirements for inter-band CA on top of what we already have in Rel-15. In our view, we need to check the RF session if there is still serious desense issue on the Rx of a band when UE is transmitting on another band.  **Issue 4-5-2: Scheduling restriction requirement for UE supporting common beam only**  We need to first check this assumption of common beam is only applicable to 28+28 and 39+39 or also apply to 28+39 because the MRTD could be different. Thus the scheduling restriction requirements may also be different.  **Issue 4-6: Measurement restriction requirement**  Huawei’s proposal is OK in principle, but we need to check the final MRTD value. If it is larger than CP, then we need extra 1 symbol margin before and after the RS for L1 measurement.  **Issue 4-7: SCell activation delay requirements**  RAN4 should start the discussion with one single SCell being activated only, while at the same time waiting for the conclusion of multiple SCell activation in another agenda item. We also need to consider whether UE is using the same Rx beam or different Rx beams for the activated SCell and the SCell being activated. Another factor to be considered is the MRTD requirements which determines whether UE has to perform cell search for coarse timing. |
| Ericsson | **Issue 4-1:** Support the proposal of Intel/QC/Docomo, no impact to idle requirements.  **Issue 4-2:** Prefer Option 1.At this stage in R16 we are considering 2 FR2 bands, and the requirement could be revisited in case of >2 bands (eg are 2 searchers still sufficient in that case).  **Issue 4-3:** Support the recommended WF.  **Issue 4-4:** Support Option 2.  **Issue 4-5-1:** Support Option 3.  **Issue 4-5-2:** Further discussions on the scenario is needed – see also issue 4-6.  **Issue 4-6:** Further discussions on the scenario is needed. For instance, if the UE can only operate using a common beam for data reception in the two bands, then it seems that the gNB has to beamform the downlink in a similar way on both bands and have a common set of TCI states, why then would UE not be able to measure both L1-RSRP resouces at the same time?  **Issue 4-7:** Support Option 3. |
| Intel | Issue 4-2: suggest working on some high-level principle first. e.g. whether to consider intra-band CA + inter-band CA, how to share searcher among these carriers and so on.  Issue 4-4: support option 2.  Issue 4-7: suggest working on single cell activation first. existing R15 requirement can be reused. |
| Huawei, HiSilicon | Sub topic 4-1:  Current Rel-15 cell detection/measurement requirements can be reused for FR2 inter-band CA.  Sub topic 4-2:  If there are only two FR2 bands, there is no difference between option 1 and option 2.  If three (or more) FR2 bands are aggregated, there will be one PCC/PSCC and two (or more) SCCs for performing neighbor cells measurements. SCCs for performing neighbor cells measurements share 50% opportunities, and SCCs only for performing serving cells measurements share the other 50% opportunities. Option 2 is proposed.  Sub topic 4-3:  The existing interruption requirements for CA can also be applied for FR2 inter-band CA scenario. No additional interruption requirements need to be introduced.  Sub topic 4-4:  Option 2 is fine for us.  Sub topic 4-5-1:  Support option 3.  For UE supporting independent beam, there is no scheduling restriction on one FR2 band due to layer 1 measurements on another FR2 band  Sub topic 4-5-2:  For UE supporting common beam, there is scheduling restriction on one FR2 band due to layer 1 measurements on another FR2 band.  Sub topic 4-6:  For UE supporting common beam, there is measurement restriction between two FR2 bands due to layer 1 (RLM/BFD/CBD /L1-RSRP reporting) measurements.  For example, when a SSB for L1-RSRP measurement in one FR2 band is fully or partially overlapped with the OFDM symbol of CSI-RS for RLM/BFD/CBD/L1-RSRP measurement in different FR2 band, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS.  Sub topic 4-7:  Tactivation\_time shall be clarified for the case of “the 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”.  The definition of Tactivation\_time in case of “the 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” can be reused. |
| NTT DOCOMO, INC. | Issue 4-1: Current Rel-15 cell detection/measurement requirements can be reused for FR2 inter-band CA not only for IDLE/INACTIVE mode but also for CONNECTED mode.  Issue 4-2: Since the scope of this discussion is inter-band CA for 28 GHz + 39 GHz so far, we would like to focus on at least 2 bands case.  Issue 4-3: Support the recommended WF.  Issue 4-4: We assume that UE has at least two cell searchers based on current RAN4 assumption. In this case UE can measure each band parallelly, thus the requirement for FR2 inter-band CA and for FR1+FR2 CA can be same. If some parts of ongoing eMIMO discussion are related to this issue, it should be included after making consensus.  Issue 4-5-1: Our original proposal assumes scenarios where UE has common beam and BSs are co-located or UE has independent beam and BSs are co-located or non co-located. Based on this assumption, option 2 and 3 are equivalent.  Issue 4-5-2: We understood Huawei’s proposal is only for non co-located case. In co-locaed case, existing Rel-15 requirement shall be reused.  Issue 4-6: We understood Huawei’s proposal is only for non co-located case. In co-locaed case, existing Rel-15 requirement shall be reused.  Issue 4-7: According to current spec, at least TSMTC\_MAX shall be modified because it is used to define the interruption duration. On the other hand there is other discussion on agenda item 6.10.8, Rel-15 SCell activation delay requirements modification which proposes to substitute TFirstSSB or TFirstSSB\_MAX for TSMTC\_MAX. After made an agreement, we would like to discuss detail again. |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

## Discussion on 2nd round (if applicable)

## 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*

|  |  |
| --- | --- |
| **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”* |