**3GPP TSG-RAN WG4 Meeting # 109 R4-23xxxxx**

Chicago, US, November 13 – 17, 2023

**Agenda item:** 8.34.3 and 8.34.4

**Source:** Moderator (Huawei)

**Title:** Topic summary for [109][234] Netw\_Energy\_NR

**Document for:** Information

# Introduction

This topic summary includes RRM core/perf requirements for Rel-18 network energy saving (8.34.3 and 8.34.4).

*List of candidate target of discussions for this topic.*

* 1st round: mainly discuss on
  + Issues in Topic#1, #2 and #3
* 2nd round: all issues are discussed based on the conclusions from 1st round issues

# Topic #1: Core: SSB-less SCell operation

*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** |
| R4-2318343 | CATT | **Proposal 1: RS of SCell without SSB is QCL-A with TRS of the SCell without SSB, and the TRS(s) of the SCell is (are) further QCL-TypeC with SSB(s) of an inter-band active serving cell.**  **Proposal 2: The reference cell should also be the QCL source of the SSB-less SCell.**  **Proposal 3: If the indication is not provided, the default reference cell can be any one of the active cells within the same TAG as the SSB-less SCell.**  **Proposal 4: When the side conditions on RTD, power difference and QCL relation are met, the SCell activation requirement is defined as Tactivation\_time = Tfirst\_TRS +3 ms or Tfirst\_ATRS+3 ms.**  **Proposal 5: The requirements together with corresponding side conditions specified for inter-band SSB-less SCell could also be applied to intra-band non-contiguous SSB-less SCell.**  **Proposal 6: Introduce per BC UE capability to indicate the support SSB less operation for inter-band and intra-band non-contiguous CA.** |
| R4-2318401 | Samsung | **Proposal 1: With single set of side condition (RTD and received power difference) for SSB-less SCell operation under Scenario 1, basic UE assumption for deriving RAN4 RRM requirements in Rel-18:**   * **UE rely on SSB from active cells under inter-band CA for coarse time/frequency tracking.** * **UE rely on TRS and or A-TRS from SSB-less Scell for fine time/frequency tracking and AGC control.** * **Separate AGC control assumed for SSB-less cell.**   **Proposal 2: (Issue 1-2-3: Power difference conditions for scenario 1) The maximum received Power difference can be up to [25] dB**  **Observation 1: UE shall derive coarse time/frequency synchronization from referred SSB(s) from active serving cell based on “Dedicated reference cell indication from NW and or Default assumption specified in RAN4”.**  **Proposal 3 (Issue 1-2-4: QCL/TCI indication) ：Option 2 Without QCL configuration between the RSs from inter-band carriers. Proposal 4 (Issue 1-2-5: TRS related): Bothe A-TRS and TRS based on Scell activation shall be supported**  **Proposal 5 (Issue 1-3-1: SCell activation requirements): SCell activation requirements with single side condition for scenario 1 in Rel-18 as following:**   * Tactivation\_time is Tfirst\_TRS + TTRS +3 ms or Tfirst\_ATRS+Tgap + TATRS +3 ms.   **Proposal 7 (Issue 1-6-2: Reference Cell indication): If NW didn’t provide “Reference Cell indication”, UE can take any active serving cell(s) with SSB(s) under current inter-band CA operation which UE capable of supporting inter-band SSB-less Scell operation as reference cell.**  **Proposal 8 (Issue 1-6-4: UE capability): Option 1 per BC.**   * Whether new dedicated capability or expanded existing capability subject to RAN2 decision * No need to consider Frequency separation in Rel-18   **Proposal 9 (Issue 1-6-5: Intra-band CA): Intra-band non-collocated CA out of existing Rel-18 NES WI scope, open to consider it in future release pending on RAN-P guidance.**  **Proposal 10 (Issue 1-6-7: TAE requirements): No need to discuss TAE requirements in RRM session.**  **Proposal 11 Issue 1-6-10: Demodulation performance): No discussion in RRM session/agenda for demodulation requirements impact.** |
| R4-2318462 | MediaTek inc. | **Proposal 1: If the refence cell is not indicated, it is up to UE to select an active serving cell within the TAG.**  **Proposal 2: Requirements does not apply if the reference SSB/TCI is not in the activated TCI of the refence Cell.**  **Proposal 3: No need to introduce new signalling for the reference SSB/TCI indication.** |
| R4-2318657 | Apple | **Proposal 1: to adopt one of following alternatives for the side condition of Rx power difference:**   * **Alt 1 (consider the UE implementation only): use 9dB for power difference between reference cell and target SSB-less SCell, without any clarification on BW size difference, carrier frequency difference, and PSD at gNB Tx.**   + **If larger Rx power difference is assumed based on alt 1, then UE shall be allowed to have more samples for AGC settling on SSB-less SCell.** * **Alt 2 (consider all aspects that impact the Rx power): use X=Y+6dB for difference between reference cell and target SSB-less SCell, Y is decided by the BW size difference, carrier frequency difference, and PSD difference at gNB Tx.**   **Proposal 2: to adopt one of the following options, and both of them are acceptable to us:**  **To support the SSB-less SCell operation for inter-band CA for FR1 and co-located cells,**   * **Option 1: the RS of SCell without SSB is QCL-A with TRS of the SCell without SSB, and the TRS(s) of the SCell is (are) further QCL-TypeC with SSB(s) of an inter-band active serving cell.** * **Option 2: the RS of SCell without SSB is QCL-A with TRS of the SCell without SSB, and the TRS/A-TRS of the SCell without SSB can reuse the coarse timing from an inter-band reference cell.**   **Proposal 3: RAN4 to consider A-TRS for SSB-less SCell activation only, and to consider periodic TRS for all the other SSB-less SCell operations.**  **Proposal 4: use fast SCell Activation Delay Requirement for FR1(section 8.3.16 of TS38.133) as the baseline to specify the requirement for FR1 SSB-less SCell activation,**   * **If RTD ≤ CP and Rx power difference within 9dB: Two A-TRSs are used for fine timing tracking and fine AGC settling, i.e., TFirstATRS + Tgap + TATRS + 5ms. Tgap can be same value as specified in section 8.3.16 of TS38.133.**   **Proposal 5: if network does not indicate reference cell to UE for FR1 inter-band SSB-less SCell operation, the “by default cell” as reference cell is:**   * **NR SpCell if UE has active FR1 NR SpCell in the same TAG as target FR1 inter-band SSB-less SCell,** * **Otherwise, any active NR FR1 SCell in the same TAG as target FR1 inter-band SSB-less SCell.**   **Proposal 6: If option 1 in proposal 2 is adopted, not to consider the reference cell and QCL source cell are different.**  **Proposal 7: adopt one of the follow alternatives for UE capability of SSB-less SCell operation, and both of them are acceptable to us.**   * **Alt 1: For FR1 inter-band SSB-less SCell operation, the existing capability scellWithoutSSB can be expanded to cover the R18 FR1 inter-band CA case together with the FD separation, i.e., per-UE indication to support SSB-less SCell operation within a FD range (between reference CC and target SCC).** * **Alt 2: UE capability for SSB-less SCell should be defined per FSPC. The BC indication can be based on the reference cell, which means UE only needs to indicate the bands combined with the reference cell CC.**   + **One example for the UE capability design is as in the annex.**   **Proposal 8: If neighbor cells on carrier of SSB-less SCell have SSB transmission, the measurement for those neighbor cells shall be treated as intra-frequency measurement as long as the SSBs from those neighbor cells can be contained in the active BWP of SSB-less SCell.** |
| R4-2318910 | CMCC | **Proposal 1: The maximum received Power difference can be up to 25 dB.**  **Proposal 2: Define FR1 inter-band SSB less activation requirements based on TRS and A-TRS separately.**  **Proposal 3:**   * **When AGC adjustment and fine time/frequency sync is based on TRS, the Tactivation\_time can be Tfirst\_TRS + TTRS +3 ms** * **When AGC adjustment and fine time/frequency sync is based on A-TRS, the Tactivation\_time can be Tfirst\_ATRS+Tgap + TATRS +3 ms.**   **Proposal 4: If network indicate the reference cell and configure the QCL info for TRS, then the network indicated reference cell and QCL source cell shall be same.**  **Proposal 5: If network doesn’t indicate the reference cell, but configure the QCL info for TRS, then the QCL source cell shall be the default reference cell.**  **Proposal 6: The UE capability for inter-band SSB less SCell activation can be defined per band combination.**  **Proposal 7: The activation requirements together with corresponding side conditions specified for inter-band SSB-less SCell could also be applied to intra-band non-contiguous SSB-less SCell activation.** |
| R4-2319009 | Nokia, Nokia Shanghai Bell | **Proposal 1: No impact to RRM spec due to performance degradation as long as RTD is within CP.**  **Proposal 2: The UE shall indicate if RTD condition is fulfilled so that network is aligned with UE on the expected behavior.**  **Observation #1:** For inter-band SSB-less operation, the difference of reception power may vary up to 25dB.  **Proposal 3: Do not define receive power difference as a side condition for inter-band SSB-less operation.**  **Proposal 4: Do not define QCL relation as a side condition for inter-band SSB-less operation.**  **Proposal 5: Define FR1 inter-band SSB less activation delay requirements based on TRS and A-TRS separately.**  **Proposal 6: When A-TRS is used for SSB-less SCell activation, the SCell activation delay requirement is defined as TFirstATRS + Tgap + TATRS + 5ms.**  **Proposal 7: When TRS is used for SSB-less SCell activation, it is up to UE implementation to determine the TRS for SCell activation. RAN4 to discuss if considering the case where TRS ID for SCell activation is not explicitly indicated by the network.**  **Proposal 8: The default cell is the PCell or PSCell which is in the same CG of the SSB-less SCell.**  **Proposal 9: Do not consider the case where reference cell and QCL source cell are different when QCL is configured.** |
| R4-2319058 | vivo | **Proposal 1 RS of SCell without SSB is QCL-A with TRS of the SCell without SSB, and the TRS(s) of the SCell is (are) further QCL-TypeC with SSB(s) of an inter-band active serving cell.**  **Proposal 2 From RRM requirements perspective, UE use SpCell as the reference cell if no explicit signalling on the reference cell is provided.**   * **No UE RRM requirements are applicable, if SSB-less SCell is configured in sTAG and no explicit signalling on the reference cell is provided by network.**   **Proposal 3 Inter-band SSB-less SCell is a per-Feature-Set UE capability.** |
| R4-2319133 | Intel Corporation | **Proposal 1: TRS which is QCLed with the SSB on an active serving cell is transmitted on the inter-band SSB-less target SCell to guarantee fair performance of the UE activation.**  **Proposal 2: There is no activation requirement applicable to the UE if the indicated reference cell does not transmit the QCL source of the target SCell scheduling.**  **Proposal 3: Introduce the optional with capability signalling per FS indication of UE supporting inter-band SSB-less SCell activation in Rel-18.**  **Proposal 4: Together with the specification of inter-band cases, RAN4 specifies requirements also for intra-band non-contiguous CA.**  **Proposal 5: Activation requirements specified for inter-band CA SSB-less SCell also apply to intra-band non-contiguous CA SSB-less SCell activation.** |
| R4-2319380 | Huawei, HiSilicon | **Proposal 1: When Received power difference between SSB-less SCell and reference cell is less than 12dB, one TRS /ATRS is needed for AGC.**  **Observation 1: As per existing RAN1 specification, ATRS, CSI-RS for CQI or CSI-RS for PDCCH/PDSCH shall be QCL-TypeA with the periodic TRS.**  **Observation 2: As per existing RAN1 specification, a complete TCI chain shall be associated with of an SSB.**  **Observation 3: As per existing RAN1 specification, for periodic TRS, UE shall expect QCL-type C with SSB.**  **Proposal 2: The QCL relation is supposed to be:**  **The RS of SCell being activated is QCL-TypeA with TRS of the SSB-less SCell, and the TRS of the SSB-less SCell is further QCL-TypeC with SSB of reference cell on different band.**  **Proposal 3:**   * **If there is only one active cell in the same TAG, if no indication of reference is indicated, the active cell is regarded as “by default reference cell”.** * **If there are more than one active cell in the same pTAG, if no indication of reference is indicated, SpCell is regarded as “by default reference cell”.** * **If there are more than one active cell in the same sTAG, it would cause problem if UE use any of the activated SCells as the reference cell. Dedicated indication of reference cell is expected to be provided in this case.**   **Proposal 4: RAN4 to specify requirements for TRS based SSB-less SCell activation and ATRS based SSB-less SCell activation.**  **Proposal 5: Under side condition of less than CP RTD and within [12]dB power difference, Tactivation\_time is**  **Tfirst\_TRS + TTRS +3 ms, or**  **Tfirst\_ATRS+Tgap + TATRS +3 ms if ATRS is configured and UE supports ATRS based SSB-less SCell activation, where Tgap is defined as R17 fast SCell activation.**  **Proposal 6: Define per FS (per band per band combination) UE capability: Defines whether the UE supports configuration of SCell that does not transmit SS/PBCH block in the band combination. This is for inter-band collocated CA.**  **Proposal 7: Define a per band UE capability: whether ATRS based inter-band SSB-less SCell activation is supported.** |
| R4-2319382 | Huawei, HiSilicon | **CR on SCell activation/deactivation requirements for inter-band SSB-less** |
| R4-2319523 | China Telecom | **Proposal 1: For QCL/TCI indication, RS of SCell without SSB is QCL-A with TRS of the SCell without SSB, and the TRS(s) of the SCell is (are) further QCL-TypeC with SSB(s) of an inter-band active serving cell.**  **Proposal 2: FR1 inter-band SSB-less SCell activation requirements can be defined based on TRS or A-TRS.**  **Proposal 3: If A-TRS is configured, FR1 inter-band SSB-less SCell activation can be performed based on A-TRS.**  **Proposal 4: For FR1 inter-band SSB-less SCell activation, the RRM requirements shall be defined based on TRS/A-TRS, the activation delay is TFirstTRS + TTRS + 5ms or TFirstATRS + Tgap + TATRS + 5ms.**  **Proposal 5: UE capability for FR1 inter-band SSB-less SCell activation can be defined per band combination.** |
| R4-2320429 | ZTE Corporation | **Proposal 1: So as to apply SSB-less SCell operation, the actual RTD should be less than CP to accommodate the SSB based timing estimation error, TRS based timing estimation error, and EVM windows, these margin can not be ignored in practice.**  **Proposal 2: The side condition on receiving power difference between the SSB-less SCell and the reference cell can be up to about 30 dB for the BC of 700MHz + 4.9GHz and 800MHz +3.5GHz.**  **Observation 1: There are multiple solutions to identify the reference timing given that multiple SSBs transmitted in the reference cell.**  **Proposal 3: To identify the coarse timing used for the SSB-less SCell, two solutions are preferred:**  **- via QCL-C, i.e. same as legacy intra-band CA, the QCL-C relationship should be met between the TRS of SSB-less SCell and the SSB of the reference cell.**  **- UE trains through all SSB indexes to derive the proper reference SSB index**  **Proposal 4: TCI state indication is not necessary during SSB-less SCell activation.**  **Proposal 5: The fine sync between all the RSs within the SSB-less SCell should be guaranteed by default.**  **Observation 2: According to RAN1 specification, A-TRS must tie with P-TRS since the QCL-A of A-TRS should be associated with P-TRS in the same cell.**  **Proposal 6: the total delay of SSB-less SCell is TTRS+3ms. The component of TTRS is used for fine time tracking and possible AGC refining.** |
| R4-2320492 | Qualcomm Incorporated | **Observation:** P-TRS is required to achieve QCL relation with SSB from the reference cell for decoding PDCCH/PDSCH.  **Observation**: it is mandatory to define QCL relation to utilize A-TRS.  **Proposal : RS of SCell without SSB is QCL-A with TRS of the SCell without SSB, and the TRS(s) of the SCell is (are) further QCL-TypeC with SSB(s) of an inter-band active serving cell where the inter-band active serving cell is the reference cell.**  **Observation**: Default cell concept makes UE confusion whether SSBless SCell is supported or not by NW. There is benefit from not including PCell at the reference cell indication.  **Proposal: Reference cell indication indicates PCell, PSCell, or SCell, where PSCell and SCell are active serving Cells.**  **Proposal: RAN4 does not define default reference cell concept. Using the reference cell indication is enough**.  **Proposal:** **The reference cell shall be active upon the SCell addition and SCell activation, and when SSBless SCell is active.**  **Observation:** UE can achieve initial timing and AGC information from the reference cell. Fine synchronization and AGC is needed for SSBless SCell activation because RTD < CP and maximum receive power difference can be larger than 6dB.  **Proposal : UE requires two A-TRS bursts for the SSBless SCell activation. Two A-TRS bursts are used for fine time/freq tracking and fine AGC.**   * **FFS : whether fixed or upper bound of gap between two bursts is needed.**   **Proposal**: **Same R17 fast SCell activation delay requirement is reused for SSBless SCell activation delay where TFirstATRS + Tgap + TATRS + 5ms** |
| R4-2320783 | Ericsson | 1. UE shall use TRS/A-TRS for computing AGC and there is no need to specify power difference side condition (X) explicitly. 2. RAN4 to define SSB less SCell activation for both TRS and A-TRS. 3. TCI state indication is not needed to complete the SSB less SCell activation and reference timing is derived from explicit indication of the cell and not through QCL relation. 4. For TRS based SCell activation, SCell activation delay is Tfirst\_TRS + TTRS +3 ms 5. For A-TRS based SCell activation, SCell activation delay is Tfirst\_ATRS+Tgap + TATRS +3 ms. 6. RAN4 to agree to introduce UE capability to indicate which bands UE can support SSB less operation. 7. ​ RAN4 to agree to introduce NW flag to further indicate in which bands SSB less operation will be configured. |
| R4-2320784 | Ericsson | **CR on SCell activation procedures for SSB-less inter-band SCell in FR1** |

## Open issues summary

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

### Sub-topic 1-1 Feasibility conditions

*Background:*

*For* ***RTD*** *conditions, following agreements were reached in RAN4#108bis R4-2317405.*

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| **RAN4#108bis**  **Issue 1-2-1: RTD conditions for scenario 1 – whether to consider RTD ≤ 260 ns**  Agreement:   * One set of condition (i.e. RTD ≤ CP agreed in RAN4#108) and one requirement * TRS/A-TRS is needed for Scell activation   **Issue 1-2-2: RTD conditions for scenario 1 – clarifications on CP length**  Agreement:  The CP corresponds to the SCS of SSB-less SCell |

*Open issues and candidate options before meeting:*

**Issue 1-1-1: RTD conditions for scenario 1 – whether to consider additional margin**

* Proposals:
  + Option 1: So as to apply SSB-less SCell operation, the actual RTD should be less than CP to accommodate the SSB based timing estimation error, TRS based timing estimation error, and EVM windows, these margin can not be ignored in practice. (ZTE)
* Recommended WF
  + Moderator: Consider that the RTD issue has been discussed for many meetings, it is suggested to follow the previous agreement. Whether to consider additional margin can be discussed in performance stage.

**Issue 1-1-2: Power difference conditions for scenario 1**

*For* ***reception******power difference*** *conditions, following agreements were reached in RAN4#108bis R4-2317405*

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| **Online discussion on October 12 (Thursday)**  **Agreement:**  **Issue 1-2-3: Power difference conditions for scenario 1**   * One set of condition (Set 2) and one requirement * Set 2: The maximum received Power difference can be up to [X] dB, and X is larger than 6. * TRS/A-TRS is needed for Scell activation |

* Proposals
  + Option 1: The maximum received Power difference can be up to [25] dB. (Samsung, CMCC, Intel?)
  + Option 2: use 9dB for power difference between reference cell and target SSB-less SCell, without any clarification on BW size difference, carrier frequency difference, and PSD at gNB Tx. (Apple)
    - If larger Rx power difference is assumed based on alt 1, then UE shall be allowed to have more samples for AGC settling on SSB-less SCell
  + Option 3: use X=Y+6dB for difference between reference cell and target SSB-less SCell, Y is decided by the BW size difference, carrier frequency difference, and PSD difference at gNB Tx. (Apple)
  + Option 4: When Received power difference between SSB-less SCell and reference cell is less than 12dB, one TRS /ATRS is needed for AGC. (Huawei)
  + Option 5: The maximum received Power difference can be up to 30 dB (ZTE)
  + Option 6: Do not define receive power difference as a side condition (Nokia, Ericsson)
* Recommended WF
  + Moderator: No clear majority on each option. Based on the proposals from companies, 6 out of 8 companies state that the power difference could be larger if TRS/A-TRS is allowed for AGC (option 1/5/6). The recommended WF for online discussion are as follows:
    - Based on the assumption that two samples TRS/A-TRS are allowed for T/F tracking AND AGC to define the SCell activation requirements, discuss the value during the meeting.

**Issue 1-1-3: QCL/TCI indication**

*For* ***TCI/QCL assumptions****, following agreements were reached in RAN4#108bis R4-2317405*

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| **Issue 1-2-4: QCL/TCI indication**   * Proposals   + Option 1: RS of SCell without SSB is QCL-A with TRS of the SCell without SSB, and the TRS(s) of the SCell is (are) further QCL-TypeC with SSB(s) of an inter-band active serving cell. (QC, CATT, Apple, Nokia, Huawei, MTK, CTC, Intel)   + Option 2: Without QCL configuration between the RSs from inter-band carriers (Nokia, CMCC, ZTE, Ericsson)     - Option 2a: timing is derived from explicit indication of the cell and not through QCL relation. (Ericsson)     - Option 2b: The condition of QCL-C relation between the TRS of the SSB-less SCell and the SSB of the reference cell is not always necessary. (ZTE)       * Provided that the RTD is limited within 260ns, the reference cell and the associated SSB can be identified at UE side, no need to consider this condition.       * Otherwise, this condition is needed.     - Option 2c: The fine sync between all the RSs within the SSB-less SCell should be guaranteed by default. (ZTE) |

* Proposals
  + Option 1: RS of SCell without SSB is QCL-A with TRS of the SCell without SSB, and the TRS(s) of the SCell is (are) further QCL-TypeC with SSB(s) of an inter-band active serving cell. (CATT, MTK, Apple, Vivo, Intel, Huawei, CTC, ZTE, QC)
    - Option 1a: The reference cell should also be the QCL source of the SSB-less SCell. (CATT, CMCC, QC)
    - Option 1b: Requirements does not apply if the reference SSB/TCI is not in the activated TCI of the refence Cell. (MTK)
    - Option 1c: There is no activation requirement applicable to the UE if the indicated reference cell does not transmit the QCL source of the target SCell scheduling. (Intel)
  + Option 2: Without QCL configuration between the RSs from inter-band carriers (Samsung, Nokia, Apple, ZTE, Ericsson)
    - Option 2a: The RS of SCell without SSB is QCL-A with TRS of the SCell without SSB, and the TRS/A-TRS of the SCell without SSB can reuse the coarse timing from an inter-band reference cell. (Apple)
    - Option 2b: Do not consider the case where reference cell and QCL source cell are different when QCL is configured. (Nokia)
    - Option 2c: (ZTE)
      * UE trains through all SSB indexes to derive the proper reference SSB index.
      * The fine sync between all the RSs within the SSB-less SCell should be guaranteed by default.
* Recommended WF
  + Moderator:10 companies support that option 1 with inter-band QCL. 5 companies support option 2 that inter-band QCL relation is not needed.
  + To aligned the understanding on this issue, companies are encouraged to discuss following questions:
    - Q1: Whether inter-band QCL is needed apart from acquiring coarse reference timing (e.g. doppler shift estimation)
  + Check whether following is agreeable:
    - RS of SCell without SSB is QCL-A with TRS of the SCell without SSB, and the TRS(s) of the SCell is (are) further QCL-TypeC with SSB(s) of an inter-band active serving cell, and the inter-band active serving cell shall be same as the reference cell.

**Issue 1-1-4: TRS related**

* Requirements based on TRS/A-TRS
  + Option 1: Define FR1 inter-band SSB less activation requirements based on TRS and A-TRS separately. (CATT, Samsung, CMCC, Nokia, Huawei, CMCC, CTC, Ericsson)
  + Option 2: RAN4 to consider A-TRS for SSB-less SCell activation only, and to consider periodic TRS for all the other SSB-less SCell operations. (Apple, QC?)
* Recommended WF
  + Moderator: 8 companies support option 1 and 2 companies support option 2. From moderator’s views, TRS based SCell activation is the baseline while A-TRS could be optionally supported by UE. If only define A-TRS based requirements, it means UE has to support A-TRS at the same time to support inter-band SSB less. Companies please check whether following is agreeable:
    - Define FR1 inter-band SSB less activation requirements based on TRS and A-TRS separately

### Sub-topic 1-2 RRM requirements for SSB-less Scell activation

**Issue 1-2-1: SCell activation requirements**

* Proposals
  + Option 1: Tactivation\_time = Tfirst\_TRS +3 ms or Tfirst\_ATRS+3 ms. (CATT, ZTE)
  + Option 2: Tactivation\_time = Tfirst\_TRS + TTRS +3 ms or Tfirst\_ATRS+Tgap + TATRS +3 ms (Samsung, CMCC, CTC, Ericsson, Huawei)
    - Option 2a: Tactivation\_time = Tfirst\_ATRS+Tgap + TATRS +3 ms, Tgap can be same value as specified in section 8.3.16 of TS38.133 (Apple)
    - Option 2b: Tactivation\_time = Tfirst\_ATRS+Tgap + TATRS +3 ms, Tgap FFS (QC)
    - Option 2c: Tactivation\_time  = Tfirst\_ATRS+Tgap + TATRS +5 ms. (Nokia)
  + Option 3: When TRS is used for SSB-less SCell activation, it is up to UE implementation to determine the TRS for SCell activation. RAN4 to discuss if considering the case where TRS ID for SCell activation is not explicitly indicated by the network. (Nokia)
* Recommended WF
  + Moderator: Based on the contributions, 8 out of 10 companies support that 2 samples (TRS or A-TRS) are needed for Scell activation delay. 2 companies support one sample for Scell activation delay.
  + Please check whether following is agreeable:
    - For TRS based Scell activation, Tactivation\_time = Tfirst\_TRS + TTRS + [3] ms;
    - For A-TRS based Scell activation, Tactivation\_time = Tfirst\_ATRS+Tgap + TATRS +[3] ms;
    - The applicable conditions are discussed in sub-topic 1-1.
    - Whether to define both TRS and A-TRS based SCell activation requirements depends on the conclusion in issue 1-1-4.
  + Discuss CR R4-2319382 and R4-2320784.

### Sub-topic 1-3 Others

**Issue 1-3-1: By default reference cell when the reference cell indication is not provided.**

*For* ***RTD*** *conditions, following agreements were reached in RAN4#108bis R4-2317405.*

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| **RAN4#108bis**  **Issue 1-6-1: Reference Cell**  **Agreement:**  The reference cell is not restricted to PCell. And the reference cell shall has SSB.  **Issue 1-6-2: Reference Cell indication**  Agreement:   * Introduce indication from NW to UE to indicate which cell (e.g., PCI, SSB frequency, etc.) is the reference cell. * RAN4 will define “by default cell” as reference cell if the indication is not provided. * Reference cell means the timing and AGC source of SSB-less Cell.   + FFS whether to consider the reference cell and QCL source cell are different.     - Whether QCL is needed will be discussed in other issue. * The details of the signalling is up to RAN2. * If the reference cell is an SCell, it should be activated. * RAN4 FFS the conditions for reference cell. (e.g. activated SCell)   **Issue 1-6-3: SSB-less Cell indication**  Agreement:  If the UE is not provided with SSB configuration (absoluteFrequencySSB) in the SCell (FrequencyInfoDL) nor SMTC configuration for the SCell, this cell is regarded as SSB-less SCell.  Note: update the wording in RAN4 requirements for inter-band SSB-less. |

* + Option 1: If the indication is not provided, the default reference cell can be any one of the active cells within the same TAG as the SSB-less SCell. (CATT)
    - Option 1a: If NW didn’t provide “Reference Cell indication”, UE can take any active serving cell(s) with SSB(s) under current inter-band CA operation which UE capable of supporting inter-band SSB-less Scell operation as reference cell. (Samsung)
    - Option 1b: If the refence cell is not indicated, it is up to UE to select an active serving cell within the TAG. No need to introduce new signalling for the reference SSB/TCI indication. (MTK)
  + Option 2: QCL source cell shall be the default reference cell (CMCC)
  + Option 3: UE use SpCell as the reference cell. (Vivo, Nokia, Apple, Huawei)
    - Option 3a: The default cell is the PCell or PSCell which is in the same CG of the SSB-less SCell. (Nokia)
    - Option 3b: (Apple)
      * NR SpCell if UE has active FR1 NR SpCell in the same TAG as target FR1 inter-band SSB-less SCell,
      * Otherwise, any active NR FR1 SCell in the same TAG as target FR1 inter-band SSB-less SCell
    - Option 3c: (Huawei)
      * If there is only one active cell in the same TAG, if no indication of reference is indicated, the active cell is regarded as “by default reference cell”.
      * If there are more than one active cell in the same pTAG, if no indication of reference is indicated, SpCell is regarded as “by default reference cell”.
      * If there are more than one active cell in the same sTAG, it would cause problem if UE use any of the activated SCells as the reference cell. Dedicated indication of reference cell is expected to be provided in this case.
    - Option 4d: No UE RRM requirements are applicable, if SSB-less SCell is configured in sTAG and no explicit signalling on the reference cell is provided by network. (Vivo)
  + Option 4:
    - RAN4 does not define default reference cell concept. (QC)
    - The reference cell shall be active upon the SCell addition and SCell activation, and when SSBless SCell is active.
* Recommended WF
  + No clear majority on the options. Several companies proposed that it could up to UE to choose any SCell as reference cell under certain case. Companies please first be aligned on following question:
    - Whether NW and UE should have consistent understanding on which Cell is the reference cell?
  + From moderator’s perspective, the benefits of having default cell is to reduce signalling overhead in some cases which is quite limited. It is not expected to create additional complexity and ambiguities to NW and UE.

**Issue 1-3-2: Intra-band CA**

* Proposals
  + Option 1: The activation requirements together with corresponding side conditions specified for inter-band SSB-less SCell could also be applied to intra-band non-contiguous SSB-less SCell activation. (CATT, CMCC, Intel)
  + Option 2: Intra-band non-collocated CA out of existing Rel-18 NES WI scope, open to consider it in future release pending on RAN-P guidance. (Samsung)
* Recommended WF
  + Prioritize the inter-band case based on the WID. Whether the requirement can apply to intra-band NCCA can be discussed after the requirements for inter-band case are completed, which may depends on RP guidance.

**Issue 1-3-3: TAE requirements**

* Proposals
  + Option 1: No need to discuss TAE requirements in RRM session. (Samsung)
* Recommended WF
  + No need for discussion. The issue is concluded in RF R4-2317738.

**Issue 1-3-4: Whether to indicate that RTD condition is fulfilled.**

* Proposals
  + Option 1: The UE shall indicate if RTD condition is fulfilled so that network is aligned with UE on the expected behavior. (Nokia)
* Recommended WF
  + Moderator: It is recommended not to introduce such indication, which is common for all side conditions.

**Issue 1-3-5: Neighbor cells on carrier of SSB-less SCell.**

* Proposals
  + Option 1: If neighbor cells on carrier of SSB-less SCell have SSB transmission, the measurement for those neighbor cells shall be treated as intra-frequency measurement as long as the SSBs from those neighbor cells can be contained in the active BWP of SSB-less SCell. (Apple)
* Recommended WF
  + Moderator: Common issue as R15. Deprioritize the discussion in this WI.

**Issue 1-3-6: Performance degradation/impact.**

* Proposals
  + Option 1: No impact to RRM spec due to performance degradation as long as RTD is within CP. (Nokia)
  + Option 2: No discussion in RRM session/agenda for demodulation requirements impact. (Samsung)
* Recommended WF
  + Moderator: Option 2 is straightforward. Option 1 is fine in principle, but it may need further clarification, since RTD is not the only side conditions and which requirements are referred to needs further clarification. The recommended WF are as follows:
    - Agree on option 2. For option 1, further discuss and clarify in performance part.

### Sub-topic 1-4 UE capabilities

**Issue 1-4-1: UE capability indication for inter-band SSB-less**

* Proposals
  + Option 1: Introduce per BC UE capability. (CATT, Samsung, CMCC, CTC)
  + Option 2: Introduce per FS UE capability (Vivo, Intel, Apple, Huawei)
    - Option 2a: Introduce per FSPC UE capability The BC indication can be based on the reference cell, which means UE only needs to indicate the bands combined with the reference cell CC. (Apple)
    - Option 2b: Define per FS (per band per band combination) UE capability. (Huawei)
  + Option 3: Introduce per-UE indication to support SSB-less SCell operation within a FD range (between reference CC and target SCC). (Apple)
  + Option 4: (Ericsson)
    - RAN4 to agree to introduce UE capability to indicate which bands UE can support SSB less operation.
    - RAN4 to agree to introduce NW flag to further indicate in which bands SSB less operation will be configured.
* Recommended WF
  + Moderator: Majority view is that the UE capability shall be at least per BC. In addition, whether it should be per FS (per band per BC) or FSPC (per CC per band per BC). Following options are recommended for discussion in the meeting:
    - Per BC
    - Per FS (per band per BC)
    - Per FSPC (per CC per band per BC)

**Issue 1-4-2: UE capability indication for A-TRS based inter-band SSB-less SCell activation**

* Proposals
  + Option 1: Define a per band UE capability: whether ATRS based inter-band SSB-less SCell activation is supported. (Huawei)
* Recommended WF:  
  + Agree on option 1.

# Topic #2: Core: RRM impacts of other objectives

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318656 | Apple | **Proposal 1: the current definition of time uncertainty in TCSI-reporting can already well cover the case when P/SP CSI-RS for CQI is outside the DTX active window, and therefore there is no impact on the SCell activation requirements of Cell DTX.**  **Proposal 2: there is no RRM impacts on CHO requirement in Rel 18 NES WI.** |
| R4-2318909 | CMCC | **Observation 1: It is not typical that network configure SSB-less SCell activation and SSB-less SCell DTX simultaneously.**  **Proposal 1: No need to further consider the impact on SCell activation requirements of cell DTX.**  **Proposal 2: Use the legacy CHO requirement as the starting point and wait more output from RAN2.** |
| R4-2319010 | Nokia, Nokia Shanghai Bell | **Observation #1: The channel measurements on P/SP-CSI-RS may be interrupted by non-active periods of cell DTX if configured on SCell, hence SCell activation delay may be extended by cell DTX.**  **Observation #2: The CSI report may be interrupted by non-active periods of cell DRX if configured on PCell hence SCell activation delay may be further extended by cell DRX.**  **Proposal 1: RAN4 to agree the SCell activation delay shall not be extended due to cell DTX/DRX.**  **Proposal 2: Send LS to RAN1/2 informing the SCell activation procedure shall not be impacted by non-active periods of cell DTX/DRX.**  **Proposal 3: The SCell activation delay requirement is defined assuming cell DTX/DRX is not active on PCell or SCell.**  **Proposal 4: RAN4 to study the impact on RRM requirements due to CHO enhancement. At least the handover delay needs to be revisited.** |
| R4-2319012 | Nokia, Nokia Shanghai Bell | **draftCR on SCell activation due to Cell DTX/DRX** |
| R4-2319057 | vivo | **Draft CR on L1 measurement reporting requirements for R18 NES** |
| R4-2319067 | vivo | **draft CR on conditional handover requirements for network energy saving** |
| R4-2319068 | vivo | **Observation 1: Cell DTX/DRX will not impact UE measurement behaviour, but Cell DRX may impact UE reporting behaviour correspondingly. This is different from UE DRX which impacts both UE measurement and reporting behaviour.**  **Proposal 1: Clarify in TS 38.133 that L1-RSRP/L1-SINR reporting requirements will be impacted by cell DRX and the detailed UE reporting requirements can be referred to TS 38.321.**  **Observation 2: Before UE receive DCI 2-X command, the evaluations of NES-based CHO are constantly being performed upon the CHO configuration is received**  **Proposal 2: For NES-based CHO, RAN4 to reuse existing delay requirements on CHO with the following adjustments:**  **Adding triggering conditions on NES-based CHO execution as below,**   * **If UE successfully decodes DCI 2-X command occurs later than the condition of CHO is met, the measurement delay equals to from to the time from the end of Tevent\_DU until UE successfully decodes DCI 2-X command.** * **If UE successfully decodes DCI 2-X command occurs earlier than the condition of CHO is met, then the measurement time delay is same as Tmeasure in the legacy CHO** |
| R4-2319134 | Intel Corporation | **Proposal 1: RAN4 is to discuss new triggering of CHO in core requirements and test cases according to further RAN2 conclusions.** |
| R4-2319152 | Ericsson | **Observation 1: RAN2 agrees the CHO reference scenario where the UE has already performed CHO conditions evaluation by the time the source cell starts some “NES-mode”.**  **Proposal 1: SCell activation delay may be impacted due to Cell DTX/DRX.**  **Proposal 2: RAN4 to discuss the impact to Cell DTX/DRX activation due to deactivated/dormant SCells.**  **Proposal 3: RAN4 to define the NES-based CHO delay requirement starting from UE receiving NES DCI indication.**  **Proposal 4: Before the NES DCI indication, UE may perform a relaxed measurement during TEvent\_DU.**  **Proposal 5: RAN4 to define NES-based CHO based on the following scenarios**   * **When NES CHO condition is met before the DCI indication, UE shall execute the handover immediately after receiving the DCI indication.** * **When NES CHO condition is met after the DCI indication, UE shall perform measurement based on SMTC only once receiving the DCI indication.**   **Proposal 6: RAN4 to study UE behaviour when serving cell will switch off but the handover channel condition hasn’t met.** |
| R4-2319364 | Huawei, HiSilicon | **Observation 1: Base on RAN1/2 design, NW has the flexibility to keep the SCell activation delay with extension (deactivate Cell DTX and P/SP CSI-RS is transmitted in normal approach) or keep the Cell DTX mode for power saving with extended SCell activation.**  **Observation 2: Compared with current RAN1/2 deign, the restriction that that P/SP CSI-RS has to be transmitted in normal approach during Scell activation is less flexibility and without performance gain. At the same time, NW lose the chance for energy saving when the SCell activation delay is not time-crucial.**  **Observation 3: It is hard to define the “exception period” by default assumption, since the defining of during SCell activation may cause confusion in real network.**  **Observation 4: The “exception period” during SCell activation means that NW has to bundle Cell DTX status with any UE’s SCell activation action.**  **Proposal 1: No RRM impact on SCell activation requirements of Cell DTX/DRX.**  **Observation 5: The report periodicity is directly referred to what has been defined in RAN1/2 specification.**  **Proposal 2: For Cell DRX, the CSI report periodicity shall follow the rule defined in RAN1/2 specification as usual, and no RAN4 specification impacts.**  **Observation 6: For NES event triggered CHO, an event configured with nesEvent is considered as fulfilled when the measurement criteria is met AND lower layer indication (DCI 2\_X) is received.**  **Proposal 3: For NES event triggered CHO, the requirements are updated as follows:**   |  | | --- | | **For intra-frequency handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.**  **- If DCI 2\_X is received earlier than TEvent\_DU + Tidentify intra\_ with index or TEvent\_DU + Tidentify intra\_ without index, then the measurement time delay equal to Tidentify intra\_ with index or Tidentify\_intra \_without\_index.**  **- If DCI 2\_X is received later than TEvent\_DU + Tidentify intra\_ with index or TEvent\_DU + Tidentify intra\_ without index, then the measurement time delay equals to the time from the end of Tevent\_DU until DCI 2\_X is received.**  **For inter-frequency handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index defined in clause 9.3.4.**  **- If DCI 2\_X is received earlier than TEvent\_DU + Tidentify inter\_ with index or TEvent\_DU + Tidentify inter\_ without index, then the measurement time delay equal to Tidentify inter\_ with index or Tidentify\_inter \_without\_index.**  **- If DCI 2\_X is received later than TEvent\_DU + Tidentify inter\_ with index or TEvent\_DU + Tidentify inter\_ without index , then the measurement time delay equals to the time from the end of Tevent\_DU until DCI 2\_X is received.** | |

## Open issues summary

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

### Sub-topic 2-1 Cell DTX/DRX(Obj#2)

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 2-1: RRM impacts of Cell DTX/DRX – SCell activation**

* Proposals
  + Option 1: Current requirements already cover, thus no impacts on SCell activation requirements. (Apple, CMCC, Huawei)
    - Option 1a: SCell activation delay may be impacted due to Cell DTX/DRX. (Ericsson)
  + Option 2: (Nokia)
    - Proposal 1: RAN4 to agree the SCell activation delay shall not be extended due to cell DTX/DRX.
    - Proposal 2: Send LS to RAN1/2 informing the SCell activation procedure shall not be impacted by non-active periods of cell DTX/DRX.
    - Proposal 3: The SCell activation delay requirement is defined assuming cell DTX/DRX is not active on PCell or SCell.
  + Option 3: RAN4 to discuss the impact to Cell DTX/DRX activation due to deactivated/dormant SCells. (Ericsson)
* Recommended WF
  + Moderator: Discuss above issue and CR R4-2319012

**Issue 2-3: RRM impacts of Cell DTX/DRX – L1 reporting**

* Proposals
  + Option 1: Clarify in TS 38.133 that L1-RSRP/L1-SINR reporting requirements will be impacted by cell DRX and the detailed UE reporting requirements can be referred to TS 38.321. (Vivo)
  + Option 2: For Cell DRX, the CSI report periodicity shall follow the rule defined in RAN1/2 specification as usual, and no RAN4 specification impacts. (Huawei)
* Recommended WF
  + Moderator: Discuss above issue and CR R4-2319057

### Sub-topic 2-2 CHO (Obj#5)

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 2-3: RRM impacts of CHO**

* Proposals
  + Option 1: No RRM impacts on CHO requirements. (Apple)
  + Option 2: Define NES event triggered CHO. (Huawei, Vivo, Intel, Ericsson, Nokia, CMCC)
    - Option 2a: For NES-based CHO, RAN4 to reuse existing delay requirements on CHO with the following adjustments: (Vivo)

Adding triggering conditions on NES-based CHO execution as below,

* + - * If UE successfully decodes DCI 2-X command occurs later than the condition of CHO is met, the measurement delay equals to from to the time from the end of Tevent\_DU until UE successfully decodes DCI 2-X command.
      * If UE successfully decodes DCI 2-X command occurs earlier than the condition of CHO is met, then the measurement time delay is same as Tmeasure in the legacy CHO
    - Option 2b: For NES event triggered CHO, the requirements are updated as follows. (Huawei)
      * If DCI 2\_X is received earlier than TEvent\_DU + Tidentify intra\_ with index or TEvent\_DU + Tidentify intra\_ without index, then the measurement time delay equal to Tidentify intra\_ with index or TEvent\_DU + Tidentify intra\_ without index
      * If DCI 2\_X is received later than TEvent\_DU + Tidentify intra\_ with index or TEvent\_DU + Tidentify intra\_ without index,then the measurement time delay equals to the time from the end of Tevent\_DU until DCI 2\_X is received.
    - Option 2c: Before the NES DCI indication, UE may perform a relaxed measurement during TEvent\_DU. (Ericsson)
      * When NES CHO condition is met before the DCI indication, UE shall execute the handover immediately after receiving the DCI indication.
      * When NES CHO condition is met after the DCI indication, UE shall perform measurement based on SMTC only once receiving the DCI indication.
    - Option 2d: Use the legacy CHO requirement as the starting point and wait more output from RAN2. (CMCC)
    - Option 2e: RAN4 is to discuss new triggering of CHO in core requirements and test cases according to further RAN2 conclusions. (Intel)
    - Option 2f: RAN4 to study the impact on RRM requirements due to CHO enhancement. At least the handover delay needs to be revisited. (Nokia)
  + Option 3: RAN4 to study UE behaviour when serving cell will switch off but the handover channel condition hasn’t met. (Ericsson)
* Recommended WF
  + Discuss above proposals and CR R4-2319067

# Topic #3: Perf: Performance part for NES

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2318911](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318911.zip) | CMCC | **Proposal 1: Define test case for FR1 inter-band SSB-less activation.**  **Proposal 2: Separate test cases should be defined for TRS and A-TRS cases if separate core requirements are defined.**  **Proposal 3: For transmit timing difference between SSB-less SCell and reference cell in test cases, consider 4µs for 15kHz SCS and 2µs for 30kHz SCS.** |
| [R4-2319011](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319011.zip) | Nokia, Nokia Shanghai Bell | **Proposal 1: Test cases shall be defined to verify the SCell activation delay for SSB-less SCell, taking into account at least the RTD side condition, QCL relation, frequency separation etc.**  **Proposal 2: The accuracy performance for CSI-RS based L3/L1 measurement needs to be verified on SSB-less SCell.**  **Proposal 3: The accuracy performance for CSI-RS based L3/L1 measurement needs to be verified when cell DTX/DRX is active.**  **Proposal 4: Test cases shall be defined to verify the SCell activation delay for cell DTX/DRX operation.**  **Proposal 5: Test cases shall be defined at least to verify the handover delay for CHO enhancement due to cell off.** |
| [R4-2319153](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319153.zip) | Ericsson | **Proposal 1: RAN4 to define the following test cases for SSB-less SCell activation with RTD<=CP**   * **TC1: SSB-less SCell Activation and deactivation of known SCell in FR1 in non-DRX**   **Proposal 2: RAN4 to define the following test cases for Cell DTX/DRX procedure.**   * **TC1: Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with CSI-RS-based RLM in Cell DTX mode** * **TC2: Radio Link Monitoring In-sync Test for FR1 PCell configured with CSI-RS-based RLM in Cell DTX mode** * **TC3: SA event triggered reporting tests without gap under Cell DTX** * **TC4: SA event triggered reporting tests with per-UE gaps under Cell DTX**   **Proposal 3: RAN4 to wait core requirement progress on Cell DTX/DRX impact to SCell activation and CHO enhancement for the test case design.** |
| [R4-2319365](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319365.zip) | Huawei, HiSilicon | **Observation 1: The RTD and power different conditions shall be considered in the test cases for inter-band SSB-less activation.**  **Observation 2: TRS based/A-TRS based SCell activation test cases may be considered separately**  **Proposal 1: RAN4 to define test case for FR1 inter-band SSB-less activation/deactivation, and the detailed condition (e.g. RTD/power difference) shall wait for further agreement in core discussion.**  **Proposal 2: Discuss whether to define separate test cases for TRS based/A-TRS based FR1 inter-band SSB-less activation with more conclusion of core requirements.**  **Proposal 3: RAN4 to define test case for NES CHO.**  **Proposal 4: Define test cases for R18 NES as Table I.** |
| [R4-2319524](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319524.zip) | China Telecom | **Proposal 1: Test case for FR1 inter-band SSB-less activation based on TRS/A-TRS in non-DRX need to be defined primarily.**  **Proposal 2: If requirement based on TRS and requirement based on A-TRS are both defined, different test cases for TRS based and A-TRS based FR1 inter-band SSB-less activation can be defined.** |
| [R4-2320493](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320493.zip) | Qualcomm Incorporated | **Proposal : RAN4 does not need to introduce RRM performance requirement because there is no RRM impact from other aspects of network energy saving.**  **Proposal : RAN4 does not need to introduce RRM performance requirement for SSBless SCell for inter-band CA because this is not about SCell activation enhancement.** |

## Open issues summary

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

### Sub-topic 3-1 Performance part related to SSB-less

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 3-1-1: Test case for FR1 inter-band SSB-less activation/deactivation**

* Proposals
  + Option 1: Define test case for FR1 inter-band SSB-less activation. (CMCC, Nokia, Huawei, Ericsson, CTC)
    - Option 1a: (CMCC)
      * Separate test cases should be defined for TRS and A-TRS cases if separate core requirements are defined.
      * For transmit timing difference between SSB-less SCell and reference cell in test cases, consider 4µs for 15kHz SCS and 2µs for 30kHz SCS.
    - Option 1b: (Nokia)
      * Test cases shall be defined to verify the SCell activation delay for SSB-less SCell, taking into account at least the RTD side condition, QCL relation, frequency separation etc.
      * The accuracy performance for CSI-RS based L3/L1 measurement needs to be verified on SSB-less SCell
    - Option 1c: (Ericsson)
      * RAN4 to define the following test cases for SSB-less SCell activation with RTD≤CP
      * TC1: SSB-less SCell Activation and deactivation of known SCell in FR1 in non-DRX
    - Option 1d: (Huawei)
      * RAN4 to define test case for FR1 inter-band SSB-less activation/deactivation, and the detailed condition (e.g. RTD/power difference) shall wait for further agreement in core discussion.
      * Discuss whether to define separate test cases for TRS based/A-TRS based FR1 inter-band SSB-less activation with more conclusion of core requirements
    - Option 1e: Test case for FR1 inter-band SSB-less activation based on TRS/A-TRS in non-DRX need to be defined primarily. (CTC)
    - If requirement based on TRS and requirement based on A-TRS are both defined, different test cases for TRS based and A-TRS based FR1 inter-band SSB-less activation can be defined.
  + Option 2:
    - RAN4 does not need to introduce RRM performance requirement for SSBless SCell for inter-band CA because this is not about SCell activation enhancement. (Qaulcomm)
* Recommended WF
  + Moderator:
    - Define test case for FR1 inter-band SSB-less activation.
    - Whether to define both TRS/A-TRS based TC depends on conclusion on issue 1-1-4
    - FFS detailed test configurations.
    - FFS whether there is other performance impact for inter-band SSB-less

### Sub-topic 3-2 Performance part related to other objectives

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 3-2-1: RRM performance impacts of Cell DTX/DRX**

* Proposals
  + Option 1: The accuracy performance for CSI-RS based L3/L1 measurement needs to be verified when cell DTX/DRX is active. (Nokia)
  + Option 2: Test cases shall be defined to verify the SCell activation delay for cell DTX/DRX operation. (Nokia)
  + Option 3: RAN4 to define the following test cases for Cell DTX/DRX procedure. (Ericsson)
    - TC1: Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with CSI-RS-based RLM in Cell DTX mode
    - TC2: Radio Link Monitoring In-sync Test for FR1 PCell configured with CSI-RS-based RLM in Cell DTX mode
    - TC3: SA event triggered reporting tests without gap under Cell DTX
    - TC4: SA event triggered reporting tests with per-UE gaps under Cell DTX
* Recommended WF
  + Moderator: Wait for core part conclusions.

**Issue 3-3-1: RRM performance impacts of CHO**

* Proposals
  + Option 1: RAN4 to define test case for NES CHO. (Huawei)
    - Option 1a: Test cases shall be defined at least to verify the handover delay for CHO enhancement due to cell off. (Nokia)
  + Option 2: RAN4 to wait core requirement progress on CHO enhancement for the test case design. (Nokia)
* Recommended WF
  + Moderator: Wait for core part conclusions.