**3GPP TSG-RAN WG4 Meeting # 112 R4-2404839**

**Maastricht, Netherlands, 19th – 23rd August, 2024**

**Agenda item:** 5.29.4

**Source:** Moderator (Huawei)

**Title:** Topic summary for [112][209] Netw\_Energy\_NR

**Document for:** Information

# Introduction

This topic summary includes RRM core/perf requirements for Rel-18 network energy saving (5.29.1 and 5.29.2).

**Recommended Topics to be treated online (in order of decreasing priority):**

**Issue 1-1-1: Power difference conditions**

**Issue 1-1-5: Intra-band non-contiguous CA**

**Issue 1-1-2: Multiple SSB-less SCells activation**

**Issue 1-1-4: Neighbour cells on carrier of SSB-less SCell**

**Issue 1-1-3: Relation to R15 intra-band SSB-less**

**Issue 1-2-1: When CHO condition is not met anymore**

**Issue 1-2-2: TP to address the difference cases as described in issue 1-2-1**

# Topic #1: Core requirements maintenance

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2411444**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411444.zip) | Apple | **Proposal 1: For power difference conditions in SSB-less SCell activation requirement, we support either one of the following alternatives:**   * **Alt 1: RAN4 to keep “EPRE after pre-compensation” and “12dB EPRE difference” in the spec text, and no any further change is expected.** * **Alt 2: Clarify that EPRE difference is smaller or equal to [12] dB + |20\*log (f1/f2)| - Margin, where f1 and f2 is the center frequency of reference Cell and SSB-less Cell and the value of Margin is FFS.**   **Proposal 2: for multiple SSB-less SCell activation with TRS, when all to-be-activated SCells are intra-band contiguous SSB-less SCells and all to-be-activated SCells have same QCL source cell, the multiple SCell activation delay requirements are based on TRS with the shortest periodicity, i.e., the total delay for multiple SCell activation would still be: Tfirst\_TRS\_min + TTRS\_min +[5]ms. Tfirst\_TRS\_min, TTRS\_min is the corresponding time component for the TRS with the shortest periodicity.**  **Proposal 3: for multiple SSB-less SCell activation with A-TRS, when all to-be-activated SCells are intra-band contiguous SSB-less SCells and all to-be-activated SCells have same QCL source cell, the multiple SCell activation delay requirements are based on A-TRS on the SCell which has the earliest arrived A-TRS after MAC CE decoding.**  **Proposal 4: for multiple SSB-less SCell activation, when “all to-be-activated SCells are intra-band contiguous SSB-less SCells” and “all to-be-activated SCells have same QCL source cell” and “A-TRS and TRS are configured for different to-be-activated intra-band contiguous SSB-less SCells”, the multiple SCell activation delay requirements are based on A-TRS on the SCell which has the earliest arrived A-TRS after MAC CE decoding.**  **Proposal 5: if neighbor cells on carrier of SSB-less SCell have SSB transmission, the measurement for those neighbor cells shall be treated as inter-frequency measurement without MG as long as the SSBs from those neighbor cells can be contained in the active BWP of SSB-less SCell.**  **Proposal 6: for UE supports both R18 inter-band SSB-less and R15 intra-band contiguous SSB-less SCell operation, if the to-be-activated SSB-less SCell is configured with QCL source to both intra-band contiguous and inter-band Cells, no SCell activation requirement shall be applied, regardless of whether the Rel-18 reference cell indication is configured.**  **Proposal 7: for intra-band FR1 NCCA case, the side condition of RTD for SSB-less SCell activation shall be defined as:**   * **The RTD between the target SSB-less intra-band NCCA SCell and the collocated reference serving cell is within CP where CP is corresponding to the max SCS between reference cell and target SCell.**   **Proposal 8: for intra-band FR1 NCCA case, the side condition of power imbalance for SSB-less SCell activation shall be defined as:**   * **The [EPRE] difference at the UE is smaller than or equal to [6] dB, where, [EPRE] difference is the power difference between TRS/A-TRS symbol on the SSB-less SCell and SSB symbol on the reference serving cell [after the compensation for AGC].** |
| [**R4-2411464**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411464.zip) | MediaTek inc. | **Proposal 1: Regarding the minimum requirement of multiple SSB-less SCells activation, the UE should activate each to-be-activated SCell based on the TRS on the SCell, and the requirements to be defined accordingly (Option 2).** |
| [**R4-2411482**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411482.zip) | OPPO | **Proposal 1: Clarify the “EPRE after pre-compensation for AGC” considering increased [12] dB and pathloss difference due to carrier frequency difference.** |
| [**R4-2411564**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411564.zip) | Nokia, Nokia Shanghai Bell | 1. **A value higher than 12dB is expected for EPRE difference condition hence either Option 1 or Option 2 can be the starting point for the discussion.** 2. **The SCell activation delay requirement for activating multiple SSB-less SCells is defined based on P-TRS with the shortest periodicity, i.e. Option 1 is preferred.** 3. **It is not expected that the to-be-activated SCell is configured with QCL source to both intra-band contiguous and inter-band Cells.**   **Observation 1: 260ns TAE is assumed only for intra-band contiguous CA.**  **Observation 2: For FR1 intra-band non-contiguous CA, UE shall be able to handle up to 3us receive timing difference which is derived from 3us TAE.**  **For FR1 intra-band non-contiguous CA, reuse the SSB-less SCell activation delay requirement defined for FR1 co-located inter-band CA with the same RTD side condition i.e. RTD within CP.**  **Observation 3: Existing NES-based condition handover delay assumes that the CHO condition remains fulfilled/met from the end of Tevent\_DU until UE successfully decodes DCI 2-9 command.**  **Observation 4: For the case DCI 2-9 command comes after TEvent\_DU + Tidentify\_intra\_with\_index, the NES-based CHO condition may or may not be met when receiving the DCI 2-9 command.**  **The NES-based conditional handover delay shall be defined considering the possible channel variation when DCI 2-9 command comes after TEvent\_DU + Tidentify\_intra\_with\_index.**  **The NES-based CHO shall be executed only if the condition of NES-based CHO is met when receiving the DCI 2-X command after TEvent\_DU + Tidentify\_intra\_with\_index.**  **If the condition of NES-based CHO is not met when receiving the DCI 2-9 command after TEvent\_DU + Tidentify\_intra\_with\_index.,**   * **Tevent\_DU is defined as the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until “a condition exists at the measurement reference point after receiving DCI 2-9 which will trigger the NES-based conditional handover”, and** * **Tmeasure equals to TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter.** |
| [**R4-2411565**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411565.zip) | Nokia, Nokia Shanghai Bell | **38.133 CR on handover delays for NES-based CHO** |
| [**R4-2411721**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411721.zip) | Qualcomm Technologies Ireland | **Observation 1: The power difference conditions should be defined in absolute terms, independent on the carrier frequencies. Option 1 in the way forward above does not meet this condition.**  **Proposal 1: We propose to adopt option 3 for issue 1-1-1: power difference conditions. The power difference condition could be further increased beyond EPRE = 12 dB. In this case one more P-TRS occurrence should be allowed for AGC convergence.**  **Proposal 2: The wording [after the compensation for AGC] in [2] should be removed from the specification in [2].**  **Observation 2: For option 1, it is not obvious that the AGC state and time/frequency tracking states can be directly taken from the first SCell that has been brought up. For the clarification of the requirements in the CR, further lengthy studies may be needed.**  **Proposal 3: Requirements should be defined based on option 2 for issue 1-1-3: Multiple SSB-less SCell activation**  **Proposal 4: Since there is no reference, also no requirements for multiple SSB-less SCell activation should be defined for A-TRS in Rel-18.** |
| [**R4-2411757**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411757.zip) | CMCC | **Proposal 1: RAN4 should consist on the previous agreement that the spec should support the EPRE difference larger [12]dB.**  **Proposal 2: Clarify that EPRE difference is smaller or equal to [12] dB + |20\*log (f1/f2)|, where f1 and f2 is the center frequency of reference Cell and SSB-less SCell.**  **Observation 1: The methodology of Option 3 can be used in P-TRS case, to update the requirements with one more P-TRS sample when EPRE difference larger than [12]dB.**  **Observation 2: Whether the methodology of Option 3 can be used in A-TRS case should be further studied.**  **Observation 3: The methodology of Option 3 will cause longer activation delay when EPRE difference larger than [12]dB.**  **Proposal 3: For all to-be-activated SSB-less SCells are in contiguous bands and have same QCL source cell case, the side condition from single SSB-less SCell case can be reused, the requirement could be defined as:**  **Tactivation\_time = min(Tactivation\_time\_SCell1, ... , Tactivation\_time\_SCelln), n = 1, .. , the number of to-be-activated SSB-less SCells in contiguous bands and have same QCL source cell**   * **Tactivation\_time\_SCelln = Tfirst\_TRS\_Scelln + TTRS\_Scelln + 5ms, if aperiodic CSI-RS resources are not configured for SCell activation or UE do not support aperiodicCSI-RS-FastScellActivation-r17** * **Tactivation\_time\_SCelln =Tfirst\_ATRS\_Scelln + Tgap\_Scelln + TATRS\_Scelln + 5ms, if aperiodic CSI-RS resources are configured for Scell activation for UE supporting aperiodicCSI-RS-FastScellActivation-r17**   + **Tfirst\_TRS\_Scelln is the time to the end of the first complete periodic CSI-RS burst for the nth SCell activation after slot n + .**   + **TTRS\_Scelln is the periodicity of the periodic CSI-RS burst for the nth SCell activation.**   + **Tfirst\_ATRS\_Scelln is the time to the end of the first complete CSI-RS burst for the nth SCell activation after slot n + where the CSI-RS burst is defined as four CSI-RS resources in two consecutive slots.**   + **TATRS\_Scelln is the CSI-RS burst for the nth SCell activation where the CSI-RS burst is defined as four CSI-RS resources in two consecutive slots.**   + **Tgap\_Scelln is the gap length between two aperiodic CSI-RS bursts for the nth SSB-less SCell.** |
| [**R4-2412124**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412124.zip) | China Telecom | **Proposal 1: It’s no need to consider larger EPRE difference since 12 dB is large enough.**  **Observation 1: When considering multiple SSB-less SCells activation, since all to-be-activated SCells are SSB-less on the same band and SCells are contiguous, and all to-be activated SCells have same QCL source cell, the AGC and T/F information of one of SCells can be reused for all other SCells activation.**  **Proposal 2: The multiple SCell activation delay requirements are based on TRS with the shortest periodicity.** |
| [**R4-2412200**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412200.zip) | Huawei, HiSilicon | **CR on core requirements maintenance for NES CHO** |
| [**R4-2412218**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412218.zip) | Huawei, HiSilicon | **Proposal 1: EPRE difference is smaller or equal to [12] dB + |20\*log (f1/f2)| - Margin, where f1 and f2 is the center frequency of reference Cell and SSB-less Cell and SSB-less Cell and the margin can be 4dB.**  **Proposal 2: When all to-be-activated SSB-less SCells are contiguous in same band, the single SSB-less SCell activation delay can be applied to each to-be-activated SSB-less SCell respectively.**  **Proposal 3: For UE supports both R18 inter-band SSB-less and R15 intra-band contiguous SSB-less, when R18 reference cell indication is configured, network shall configure QCL source to associate with the inter-band Cell.**  **Proposal 4: For UE supports both R18 inter-band SSB-less and R15 intra-band contiguous SSB-less, when R18 reference cell indication is configured, Rel-18 SSB-less requirement is applied.**  **Observation 1: The NES-based CHO is triggered when following conditions are met:**  **Condition 1: NES mode indication has been received.**  **Condition 2: The entry condition is now fulfilled.**  **Observation 2: If we want to model the procedure clearly, it could be divided into following two cases:**   * **NES based CHO is triggered when DCI 2-9 with NES-mode indication is decoded when condition keeps existing within Tidentifybefore UE successfully decodes DCI 2-9 with NES-mode indication** * **Otherwise, NES based CHO is triggered until condition keeps existing for Tidentifyafter DCI 2-9 with NES-mode indication is decoded.**   **Observation 3: It is very difficult to define Tevent\_DU based on current framework which ignores the receiving of DCI 2-9.**  **Proposal 5: Modify the requirements for NES-based CHO as follows:**   |  | | --- | | **6.1.4.2.1 Handover delay**  **Procedure delays for all procedures that can command a conditional handover are specified in TS 38.331 [2].**  **When the UE receives a RRC message implying conditional handover the UE shall be ready to start the transmission of the new uplink PRACH channel within DCHO seconds from the end of the last TTI containing the RRC command.**  **DCHO = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution**  **Where:**  **TRRC is the RRC procedure delay defined in clause 12 in TS 38.331 [2].**  **TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until**  **- a condition exists at the measurement reference point which will trigger the conditional handover, or**  **- UE successfully decodes DCI 2-9 with NES-mode indication**  **<<unchanged part>>**  **6.1.4.2.2 Measurement time**  **The measurement time delay is defined from the end of TEvent\_DU until UE executes a handover to a target cell and interruption time starts.**  **For conditional 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.**  **For conditional 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 or clause 9.3.9.**  **For NES-based conditional intra-frequency handover:**  **- If a condition exists at the measurement reference point which fulfills the conditions for NES-based conditional handover, and it keeps existing for Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index before UE successfully decodes the DCI 2-9 with NES-mode indication, Tmeasure = 0**  **- Otherwise, Tmeasure equal to the time span from the end of TEvent\_DU until a condition keeps existing for Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index which can fulfill the NES-based conditional handover.** | |
| [**R4-2412219**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412219.zip) | Huawei, HiSilicon | **Update on SSB-less based SCell activation** |
| [**R4-2412420**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412420.zip) | Intel Corporation | **Proposal 1: Adopt WF Alternative 1:**   * **Specify only assuming separate chains and reuse largely the requirements specified for inter-band cases;** * **Specify UE optional capability signalling for intra-band NCCA SSB-less SCell operations in a similar way as for inter-band cases;** * **UE with single chain implementation does not indicate support for intra-band NCCA SSB-less SCell operations and does not need to meet the requirements.**   **Proposal 2: Introduce the optional with capability signalling with per FS granularity for UE supporting intra-band NCCA SSB-less SCell operation in Rel-18.** |
| [**R4-2412421**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412421.zip) | Intel Corporation | **DraftCR on intra-band NCCA SSB-less Scell activation** |
| [**R4-2412600**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412600.zip) | vivo | **Proposal 1: To address the EPRE difference issue, RAN4 further discuss the value and whether one more P-TRS is needed.**  **Proposal 2: For the delay requirement on NES-based CHO, RAN4 to revise the definition of TEvent\_DU as follows:**  **TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until**   * **a condition exists within 2\*Tidentify\_intra\_with\_index or 2\*Tidentify\_intra\_without\_index before UE successfully decodes DCI 2-9, at the measurement reference point which will trigger the NES-based conditional handover**   **Proposal 3: RAN4 to revise the starting point of TCHO\_execution as follows:**  **TCHO\_execution is the UE execution preparation time for conditional handover.**  **For NES-based conditional handover,**   * **It starts after UE realizes the condition of CHO is met and identity of the target cell is determined provided that UE has already successfully decoded DCI 2-9.** * **Otherwise, it starts after UE successfully decodes DCI 2-9.** |
| [**R4-2412605**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412605.zip) | vivo | **CR for conditional handover requirements on network energy saving** |
| [**R4-2413013**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413013.zip) | Ericsson | 1. **RAN4 to agree that EPRE side condition for reference cell and SSB-less SCell as 12 dB while considering the precompensation.** 2. **When R18 reference cell indication is configured, network configure with QCL source to both intra-band contiguous and inter-band Cells, SSB less activation should follow Rel-15 requirement.** |
| [**R4-2413014**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413014.zip) | Ericsson | **CR to TS 38.133 on core requirement maintenance for NES** |
| [**R4-2413075**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413075.zip) | ZTE Corporation, Sanechips | **Observation 1: The principle of only allowing a single set of condition and a single relevant requirements was identified in previous meeting.**  **Observation 2: At this maintenance state, overriding previous requirement should be cautious.**  **Proposal 1: Compared with all the options, Option 1 and Option 2 are preferred by us.**  **Proposal 2: For multiple SSB-less SCell activation contiguous in the same band, and all SSB-less SCells have same QCL source cell,**   * **For P-TRS based activation, the multiple SCell activation delay requirements are based on TRS with the shortest periodicity.** * **For A-TRS based activation, applying single SSB-less SCell activation requirements for each SCell respectively.**   **Observation 3: Only the UE capable of both R15 intra-band SSB-less operation and R18 inter-band SSB-less operation has to face such mixture case.**  **Observation 4: For the UE capable of both R15 intra-band SSB-less and R18 inter-band SSB-less, it is possible that only intra-band SSB-less enabled or only inter-band SSB-less enabled or both enabled by NW under co-located deployment. Totally 9 cases probably happen, and no ambiguity exists for each case provided a single QCL-C source configured for each SSB-less SCell.**  **Observation 5: For the UE capable of both R15 intra-band SSB-less and R18 inter-band SSB-less, if both intra-band contiguous QCL-C source and inter-band QCL-C source configured for a single SSB-less SCell, no ambiguity as long as the explicit reference cell indicated to UE. But actually the R15 intra-band SSB-less operation is not always applicable.**  **Proposal 3: Following the general principle“It is not expected that the to-be-activated SCell is configured with QCL source to both intra-band contiguous and inter-band Cells”for each SSB-less SCell for any case. Not introduce any extension besides existing R15 intra-band SSB-less/R18 inter-band SSB-less operation.**  **Proposal 4: If the SSB of neighbour cell is fully contained by the active BWP of the SSB-less SCell, the SSB based neighbour cell measurment is defined as intra-frequency measurement, and no gap is needed. Otherwise, the SSB based neighbour cell measurement is defined as inter-frequency measurement and gap is needed.**  **Proposal 5: To move forward, we prefer to specify two sets of requirements respectively assuming single and separate chains, where the requirements of inter-band case are largely reused for the separate chains assumption, and the requirements of intra-band contiguous case are largely reused for the single chain assumption. Two optional UE capabilities refers to the two cases. If neither of them supported by the UE, then UE does not support the SSB-less SCell activation for intra-band non-contiguous CA.** |
| [**R4-2413083**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413083.zip) | ZTE Corporation, Sanechips | **CR on R18 NES SSB-less operation** |

## 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 SSB-less related

**Issue 1-1-1: Power difference conditions**

*Background*

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| **RAN4#111 R4-2410269**  **Issue 1-1-1: Power difference conditions**  **Agreement:**  Clarify that EPRE difference is based on the EPRE normalized by SCSs of SSB of reference Cell and A-TRS/P-TRS of SSB-less Cell.  Only change [9] dB to [12] dB in this meeting.  Further discuss whether and how to support larger EPRE difference in next meeting:   * Option 1: Clarify that EPRE difference is smaller or equal to [12] dB + |20\*log (f1/f2)| - Margin, where f1 and f2 is the center frequency of reference Cell and SSB-less Cell and the value of Margin is FFS. * Option 2: Further increase [12] dB and the value is FFS * Option 3: Update the requirements with one more P-TRS sample for larger EPRE difference * Other options are no precluded. |

* Proposals
  + Option 1: Clarify that EPRE difference is smaller or equal to [12] dB + |20\*log (f1/f2)| - Margin, where f1 and f2 is the center frequency of reference Cell and SSB-less Cell and the value of Margin is FFS. (Apple, OPPO, Nokia, CMCC, Huawei, ZTE)
  + Option 2: Further increase [12] dB. (Nokia, Vivo, ZTE)
  + Option 3: The power difference condition could be further increased beyond EPRE = 12 dB. In this case one more P-TRS occurrence should be allowed for AGC convergence. Remove [after the compensation for AGC]. (QC, Vivo)
  + Option 4: RAN4 to keep “EPRE after pre-compensation” and “12dB EPRE difference” in the spec text, and no any further change is expected. (Apple, CTC, Ericsson)
* Moderator:
  + 6/10 companies support option 1
  + 3/10 companies support option 2
  + 2/10 companies support option 3.
  + 3/10 companies support option 4.

Though there is majority supporting for option 1, there is also strong objection behind each option based on the discussion in last meeting. Considering that it is already late stage, let’ try to conclude this issue in this meeting.

* Recommended WF:
  + Threat this issue online and try to conclude it in this meeting.

**Issue** **1-1-2: Multiple SSB-less SCells activation**

*Background:*

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| **RAN4#111 R4-2410269**  **Issue 1-1-3: Multiple SSB-less SCells activation**  **Agreements:**   * + Also define requirements for following scenario:     - When all to-be-activated SCells are SSBless on the same band and SCells are contiguous.     - All to-be-activated SCells have same QCL source cell.     - P-TRS is used.       * Option 1: The multiple SCell activation delay requirements are based on TRS with the shortest periodicity. The detailed requirements can be discussed in the CR.       * Option 2: UE activate each to-be-activated SCell based on the TRS on the SCell, and the requirements to be defined accordingly (i.e. single CC delay)     - FFS A-TRS based requirements. |

* Proposals

TRS-based:

* + Option 1: For multiple SSB-less SCell activation with TRS, when all to-be-activated SCells are intra-band contiguous SSB-less SCells and all to-be-activated SCells have same QCL source cell, the multiple SCell activation delay requirements are based on TRS with the shortest periodicity. (Apple, Nokia, CMCC, CTC, ZTE)
  + Option 2: Regarding the minimum requirement of multiple SSB-less SCells activation, the UE should activate each to-be-activated SCell based on the TRS on the SCell, and the requirements to be defined accordingly. (MTK, QC, Huawei)

A-TRS based:

* + Option 1: For multiple SSB-less SCell activation with A-TRS, when all to-be-activated SCells are intra-band contiguous SSB-less SCells and all to-be-activated SCells have same QCL source cell, the multiple SCell activation delay requirements are based on A-TRS on the SCell which has the earliest arrived A-TRS after MAC CE decoding. (Apple, CMCC)
  + Option 2: When all to-be-activated SSB-less SCells are contiguous in same band, the single SSB-less SCell activation delay can be applied to each to-be-activated SSB-less SCell respectively. (Huawei, ZTE)
  + Option 3: No requirements for multiple SSB-less SCell activation should be defined for A-TRS in Rel-18. (QC)

Mixed scenario (TRS-based and A-TRS based):

* + Option 1: For multiple SSB-less SCell activation, when “all to-be-activated SCells are intra-band contiguous SSB-less SCells” and “all to-be-activated SCells have same QCL source cell” and “A-TRS and TRS are configured for different to-be-activated intra-band contiguous SSB-less SCells”, the multiple SCell activation delay requirements are based on A-TRS on the SCell which has the earliest arrived A-TRS after MAC CE decoding. (Apple)
* Moderator:
  + It was agreed in previous meeting to define multiple SCell activation requirements at least for TRS-based case. Option 1 is one step further enhancement compared with option 2. Considering it is already late stage, Companies please check with option 2 can be agreed, and further enhancement can be considered in later release. A-TRS and mixed (TRS and A-TRS), can be discussed after TRS-based case.
* Recommended WF:
  + For TRS-based multiple SSB-less SCell activation, agree on option 2. Further enhancement (e.g. option 1) can be considered in further release.
  + Discuss whether/how to define requirements for A-TRS based and mixed scenario (TRS-based and A-TRS based):

**Issue 1-1-3: Relation to R15 intra-band SSB-less**

* Proposals
  + Option 1: For UE supports both R18 inter-band SSB-less and R15 intra-band contiguous SSB-less SCell operation, if the to-be-activated SSB-less SCell is configured with QCL source to both intra-band contiguous and inter-band Cells, no SCell activation requirement shall be applied, regardless of whether the Rel-18 reference cell indication is configured. (Apple, Nokia, Huawei, ZTE)
    - Option 1a: (Huawei)
    - For UE supports both R18 inter-band SSB-less and R15 intra-band contiguous SSB-less, when R18 reference cell indication is configured, network shall configure QCL source to associate with the inter-band Cell.
    - For UE supports both R18 inter-band SSB-less and R15 intra-band contiguous SSB-less, when R18 reference cell indication is configured, Rel-18 SSB-less requirement is applied.
  + Option 2: When R18 reference cell indication is configured, network configure with QCL source to both intra-band contiguous and inter-band Cells, SSB less activation should follow Rel-15 requirement. (Ericsson)
* Recommended WF:
  + Agree on option 1, which means no spec impacts.

**Issue 1-1-4: Neighbour 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 inter-frequency measurement without MG as long as the SSBs from those neighbor cells can be contained in the active BWP of SSB-less SCell (Apple, ZTE)
* Recommended WF:
  + Intra-frequency/Inter-frequency: Inter-frequency based on existing definition.
  + With/without gap:
    - Option 1: For UE supporting R18 SSB-less, UE autonomously supports inter-f w/o gap as long as the SSB is within the active BWP.
    - Option 2: Whether UE can support inter-f w/o gap following existing rules (conditions in 9.3.1, e.g supporting of R16 inter-frequency without gap, R17 R18 NeedForGap)

**Issue 1-1-5: Intra-band non-contiguous CA**

* Proposals
  + Option 1: (Apple)
    - The [EPRE] difference at the UE is smaller than or equal to [6] dB, where, [EPRE] difference is the power difference between TRS/A-TRS symbol on the SSB-less SCell and SSB symbol on the reference serving cell [after the compensation for AGC].
    - The RTD between the target SSB-less intra-band NCCA SCell and the collocated reference serving cell is within CP where CP is corresponding to the max SCS between reference cell and target SCell.
  + Option 2: (Nokia, Intel)
    - For FR1 intra-band non-contiguous CA, reuse the SSB-less SCell activation delay requirement defined for FR1 co-located inter-band CA with the same RTD side condition i.e. RTD within CP
  + Option 2a: (Intel)
    - Specify only assuming separate chains and reuse largely the requirements specified for inter-band cases;
    - Specify UE optional capability signalling for intra-band NCCA SSB-less SCell operations in a similar way as for inter-band cases;
    - UE with single chain implementation does not indicate support for intra-band NCCA SSB-less SCell operations and does not need to meet the requirements.
    - Introduce the optional with capability signalling with per FS granularity for UE supporting intra-band NCCA SSB-less SCell operation in Rel-18.
  + Option 3: (ZTE)
    - Two sets of requirements respectively assuming single and separate chains, where the requirements of inter-band case are largely reused for the separate chains assumption, and the requirements of intra-band contiguous case are largely reused for the single chain assumption. Two optional UE capabilities refers to the two cases. If neither of them supported by the UE, then UE does not support the SSB-less SCell activation for intra-band non-contiguous CA.
* Moderator: Considering the late stage, suggest to conclude this issue online in this meeting.
* Recommended WF:
  + Conclude this issue online in this meeting.

### Sub-topic 1-2 NES-based CHO related

**Issue 1-2-1: When CHO condition is not met anymore**

* + Option 1: (Nokia)
    - For FR1 intra-band non-contiguous CA, reuse the SSB-less SCell activation delay requirement defined for FR1 co-located inter-band CA with the same RTD side condition i.e. RTD within CP
    - The NES-based CHO shall be executed only if the condition of NES-based CHO is met when receiving the DCI 2-X command after TEvent\_DU + Tidentify\_intra\_with\_index.
* Recommended WF:
  + Discuss in CR in issue 1-2-2.

**Issue 1-2-2: TP to address the difference cases as described in issue 1-2-1**

* Proposals
  + Option 1: (Nokia R4-2411565)

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| TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until#  - a condition exists at the measurement reference point which will trigger the conditional handover, or   * a condition exists after receiving DCI 2-9 command which will trigger the NES-based conditional handover, provided DCI 2-9 command comes after TEvent\_DU + Tidentify\_intra\_with\_index and the condition of NES-based CHO is met when receiving the DCI 2-9 command, or   - a condition exists at the measurement reference point which will trigger the NES-based conditional handover , otherwise.  For NES-based conditional intra-frequency handover:  - If UE successfully decodes DCI 2-9 command occurs earlier than the time at the end of 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 UE successfully decodes DCI 2-9 command occurs later than the time at the end of TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, and the condition of NES-based CHO is met when receiving the DCI 2-9 command, then the measurement time delay equals to the time from the end of Tevent\_DU until UE successfully decodes DCI 2-9 command.   * If UE successfully decodes DCI 2-9 command later than the time at the end of TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, and the condition of NES-based CHO is not met when receiving the DCI 2-9 command, then the measurement time delay equals to TSSB\_measurement\_period\_intra. |

* + Option 2: (Huawei R4-2412200)

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| TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until  - a condition exists at the measurement reference point which will trigger the conditional handover, or  - UE successfully decodes DCI 2-9 with NES-mode indication.  <<unchanged part>>  6.1.4.2.2 Measurement time  The measurement time delay is defined from the end of TEvent\_DU until UE executes a handover to a target cell and interruption time starts.  For conditional 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.  For conditional 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.  For NES-based conditional intra-frequency handover:  - If a condition exists at the measurement reference point which fulfills the conditions for NES-based conditional handover, and it keeps existing for Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index before UE successfully decodes the DCI 2-9 with NES-mode indication, Tmeasure = 0.  - Otherwise, Tmeasure equal to the time span from the end of TEvent\_DU until a condition keeps existing for Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index. which can fulfill the NES-based conditional handover. |

* + Option 3: Vivo R4-2412605

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| --- |
| TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until  - a condition exists at the measurement reference point which will trigger the conditional handover, or  - a condition exists within 2\*Tidentify\_intra\_with\_index or 2\*Tidentify\_intra\_without\_index before UE successfully decodes DCI 2-9, which will trigger the NES-based conditional intra-frequency handover if NES-based conditional handover applies, or  - a condition exists within 2\*Tidentify\_inter\_with\_index or 2\*Tidentify\_inter\_without\_index before UE successfully decodes DCI 2-9, which will trigger the NES-based conditional inter-frequency handover if NES-based conditional handover applies.  TCHO\_execution is the UE execution preparation time for conditional handover.  For conditional handover, it starts after UE realizes the condition of CHO is met and identity of the target cell is determined.  For NES-based conditional handover:  - It starts after UE realizes the condition of CHO is met and identity of the target cell is determined provided that UE has already successfully decoded DCI 2-9.  - Otherwise, it starts after UE successfully decodes DCI 2-9. |

* Recommended WF:
  + Discuss in the CR in this meeting.

### CR handling

Discuss following CR during the meeting.

**CR for SSB-less operation**

|  |  |  |  |
| --- | --- | --- | --- |
| **Tdoc** | **Source** | **Changes** | **Recommendation** |
| R4-2412219 | Huawei | Updating for EPRE condition  Updating for multiple SCell activation  Clarification when multiple TRS is configured | Pending on Issue 1-1-1/Issue 1-1-2. |
| R4-2412421 | Intel | Requirements updating for intra-band NCCA | Pending on Issue 1-1-6. |
| R4-2413014 | Ericsson | Updating for EPRE condition | Pending on Issue 1-1-1. |

**CR for NES-based CHO**

|  |  |  |  |
| --- | --- | --- | --- |
| **Tdoc** | **Source** | **Changes** | **Recommendation** |
| R4-2411565 | Nokia | Updating for NES-based CHO requirements considering condition variation. | Pending on Issue 1-2-2 |
| R4-2412200 | Huawei | Updating for NES-based CHO requirements considering condition variation. | Pending on Issue 1-2-2 |
| R4-2412605 | Vivo | Updating for NES-based CHO requirements considering condition variation. | Pending on Issue 1-2-2 |

# Topic #2: Performance maintenance

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2411445**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411445.zip) | Apple | **Proposal 1: Do not introduce pathloss margin [ΔEPRE] for inter-band SSB-less SCell activation test cases.** |
| [**R4-2411566**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411566.zip) | Nokia, Nokia Shanghai Bell | **Proposal 1: The test cases where DCI 2-9 command is decoded “after” the RSRP condition of CHO is met needs to be updated considering additional sub-test where CHO condition is not met when receiving DCI 2-9 command.** |
| [**R4-2411567**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411567.zip) | Nokia, Nokia Shanghai Bell | **Correction CR on NES based CHO HO delay TCs** |
| [**R4-2412201**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412201.zip) | Huawei, HiSilicon | **Observation 1: With Cell DTX, UE can only be scheduled with PUSCH for L3 reporting in on-duration, which will increase measurement reporting delay.**  **Proposal 1: For Cell DTX test, UE can be scheduled with PUSCH for L3 reporting during on-duration of Cell DTX. The delay uncertainty for next available PUSCH should be considered in the test requirements.** |
| [**R4-2412422**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412422.zip) | Intel Corporation | **Test case maintenance for NES triggering inter-frequency target CHO delay from FR2 to FR1** |
| [**R4-2412521**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412521.zip) | vivo | **Proposal 1 For cell DTX test case, the TAT is set to 1280ms, and the UE shall be scheduled with PUSCH at every cell DTX cycle.**  **Proposal 2 Test 40ms Cell DTX periodicity instead of 640ms.** |
| [**R4-2412522**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412522.zip) | vivo | **CR on test cases for Cell DTX** |
| [**R4-2413015**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413015.zip) | Ericsson | 1. **RAN4 to set EPRE difference as 12 dB + ΔPL - margin in the test cases** 2. **RAN4 to use free space propagation delay difference to compute the ΔPL based on the carrier frequency difference and BW difference.** |
| [**R4-2413016**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413016.zip) | Ericsson | **CR on TC for A-TRS based inter-band SSB-less SCell activation delay for EN-DC** |

## 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 Performance part related to SSB-less

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 2-1-1: Test case for SSB-less**

* + Option 1: Do not introduce pathloss margin [ΔEPRE] for inter-band SSB-less SCell activation test cases. (Apple)
  + Option 2: (Ericsson)
    - RAN4 to set EPRE difference as 12 dB + ΔPL - margin in the test cases
    - RAN4 to use free space propagation delay difference to compute the ΔPL based on the carrier frequency difference and BW difference.
* Recommended WF:
  + Discuss this issue with core maintenance issue 1-1-1 in this meeting.

**Issue 2-1-2: Test case for NES CHO**

* + Option 1: The test cases where DCI 2-9 command is decoded “after” the RSRP condition of CHO is met needs to be updated considering additional sub-test where CHO condition is not met when receiving DCI 2-9 command. (Nokia)
* Recommended WF:
  + Discuss above option.

**Issue 2-1-3: Test case for Cell DTX**

* + Option 1: For Cell DTX test, UE can be scheduled with PUSCH for L3 reporting during on-duration of Cell DTX. The delay uncertainty for next available PUSCH should be considered in the test requirements. (Huawei)
  + Option 2: For cell DTX test case, the TAT is set to 1280ms, and the UE shall be scheduled with PUSCH at every cell DTX cycle. (Vivo)
  + Option 3: Test 40ms Cell DTX periodicity instead of 640ms. (Vivo)
* Recommended WF:
  + Discuss above option.

### Sub-topic 2-2 CR handling

Discuss following CRs during the meeting.

|  |  |  |
| --- | --- | --- |
| **Tdoc** | **Source** | **Recommendation** |
| R4-2411567 | Nokia | To be checked during the meeting. |
| R4-2412422 | Intel | To be checked during the meeting. |
| R4-2412522 | Vivo | Related to issue 2-1-3. To be checked during the meeting. |
| R4-2413016 | Ericsson | Related to issue 2-1-1. To be checked during the meeting. |