**3GPP TSG-RAN WG4 Meeting # 100-e R4-21xxxxx**

**Electronic Meeting, 16th – 27th August 2021**

**Agenda item:** 9.10.2.2

**Source:** Moderator (vivo)

**Title:** Email discussion summary for [100-e][221] NR\_RRM\_enh2\_2

**Document for:** Information

# Introduction

This email discussion summary covers topic HO with PSCell under agenda 9.10.2.2.

# Topic #1: HO with PSCell

*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** |
| [R4-2111928](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111928.zip) | CATT | **Proposal 1: RAN4 work should following the WID, i.e. only to define RRM requirements of HO with PSCell for following scenarios:**   * **from NR SA to EN-DC** * **from EN-DC to EN-DC** * **from NE-DC to NE-DC** * **from NR-DC to NR-DC**   **Proposal 2: In Rel-17, RAN4 only considers:**   * **FR1+FR2 NR-DC for HO with PSCell from NR-DC to NR-DC** * **FR1+LTE NE-DC for HO with PSCell from NE-DC to NE-DC.**   **Proposal 3: Parallel processing shall always be assumed.**  **Proposal 4: PCell HO and PSCell addition are performed in parallel independently.**  **Proposal 5: The value of processing time of handover and the PSCell addition can be reused separately. Tprocessing for HO with PSCell will be the maximum of the processing time of handover and the processing time of the PSCell addition.**  **Proposal 6: The ending point of the delay requirement for HO with PSCell will be defined when UE to transmit the last PRACH preamble toward target PCell and PSCell.**  **Proposal 7: No optimisation, the UE’s behavior is same when the configured PSCell is same as the original one or not.**  **Proposal 8: The delay requirement will be defined as Delay = TRRC processing + max(Tinterrupt , Tconfig\_PSCell – TRRC\_delay).**  **Proposal 9: No interruption requirement should be defined during HO with PSCell.**  **Proposal 10: No need to discuss 2 step and 4 step RACH for HO with PSCell further.**  **Proposal 11: The NR-U scenario is out of scope of this WID, no need to discuss.** |
| [R4-2112125](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112125.zip) | Apple | **Proposal 1: RAN4 specifies RRM requirement for HO with PSCell for following scenarios:**   * **from NR SA to EN-DC** * **from EN-DC to EN-DC** * **from NE-DC to NE-DC** * **from NR-DC to NR-DC**   **Proposal 2: In R17 FeRRM, NR-DC and NE-DC mode in HO with PSCell are:**   * **FR1+FR2 NR-DC for HO with PSCell from NR-DC to NR-DC,** * **FR1+LTE NE-DC for HO with PSCell from NE-DC to NE-DC.**   **Proposal 3: RAN4 to recommend introducing full set of RRM requirements for FR1+FR1 NR-DC in R18 eFeRRM WI.**  **Proposal 4: In HO with PSCell for NR-DC to NR-DC, if SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16, sequential processing shall be assumed; otherwise, parallel processing shall be assumed.**  **Proposal 5: In HO with PSCell for NR-DC to NR-DC, if SMTC of target unknown PSCell is not configured in either targetcellSMTC-SCG-r16 or reconfigurationWithSync,**   * **UE uses the SMTC in the MO having the same SSB frequency and subcarrier spacing as target PSCell if either source PCell or source PSCell configured this MO, or** * **UE uses the SMTC in the MO from source PCell if both source PCell and source PSCell configured MOs having the same SSB frequency and subcarrier spacing as target PSCell, or** * **UE assumes 5ms as SSB periodicity for target PSCell if neither source PCell nor source PSCell configured MOs having the same SSB frequency and subcarrier spacing as the target PSCell.**   **Proposal 6: In HO with PSCell for NR SA to EN-DC, if SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16, sequential processing shall be assumed; otherwise, parallel processing shall be assumed.**  **Proposal 7: In HO with PSCell for NR SA to EN-DC, if SMTC of target unknown PSCell is not configured in either targetcellSMTC-SCG-r16 or reconfigurationWithSync,**   * **UE uses the SMTC in the MO having the same SSB frequency and subcarrier spacing as target PSCell, or** * **UE assumes 5ms as SSB periodicity for target PSCell if source PCell didn’t configure MO having the same SSB frequency and subcarrier spacing as the target PSCell.**   **Proposal 8: In HO with PSCell for EN-DC to EN-DC, parallel processing shall be assumed.**  **Proposal 9: In HO with PSCell for EN-DC to EN-DC, if SMTC of target unknown PSCell is not configured in RRCConnectionReconfiguration,**   * **UE uses the SMTC in the MO having the same SSB frequency and subcarrier spacing as target NR PSCell if either source LTE PCell or source NR PSCell configured this MO, or** * **UE uses the SMTC in the MO from source LTE PCell if both source LTE PCell and source NR PSCell configured MOs having the same SSB frequency and subcarrier spacing as target NR PSCell, or** * **UE assumes 5ms as SSB periodicity for target NR PSCell if neither source LTE PCell nor source NR PSCell configured MOs having the same SSB frequency and subcarrier spacing as the target NR PSCell.**   **Proposal 10: In HO with PSCell for NE-DC to NE-DC, parallel processing shall be assumed.**  **Proposal 11: RAN4 to define the requirements for both sequential processing and parallel processing cases.**  **Proposal 12: Regarding the parallel processing, PCell HO and PSCell addition, without considering RA procedures and Tprocessing, are performed in parallel independently.**  **Proposal 13:**  **For sequential processing for HO with PSCell, the total UE processing time for HO with PSCell is the sum of UE processing timing of HO and UE processing timing of PSCell addition.**  **For parallel processing for HO with PSCell, the total UE processing time for HO with PSCell could be the maximum one between UE processing timing of HO and UE processing timing of PSCell addition**  **Proposal 14: the UE processing time for HO with PSCell is:**   |  |  |  | | --- | --- | --- | | **UE processing margin (Tprocessing)** | **Target PCell and PSCell is in the same FR as old serving cell** | **Target PCell and/or target PSCell is in the different FR from old serving cell** | | **Sequential processing** | **40ms** | **60ms** | | **Parallel processing** | **20ms** | **40ms** |   **Proposal 15: the ending point of the delay requirement for HO with PSCell is:**   * **the later timing between “timing when UE shall be capable to transmit PRACH preamble towards target PCell” and “the timing when UE shall be capable to transmit PRACH preamble towards target PSCell” .**   **Proposal 16: For UE which is already configured with DC, the UE’s behaviour is same regardless of whether the configured PSCell is same as the original one or not.**  **Proposal 17: for requirement of HO with PSCell, RAN4 starts the discussion with 4 step RACH first and FFS on 2 step RACH.**  **Proposal 18: When UE is performing HO with PSCell,**   * **for FR1+FR1 EN-DC, an additional uncertainty delay due to PSCell RACH collision with PCell UL channels may be introduced if the PSCell RACH cannot be transmitted based on the criteria in TS38.213 section 7.6.1;** * **for FR1+FR1 NE-DC, an additional uncertainty delay due to PCell RACH collision with PSCell RACH may be introduced if the PCell RACH cannot be transmitted based on the criteria in TS38.213 section 7.6.2;** * **otherwise, if target PCell and target PSCell are on the different FRs for EN-DC or NR-DC, no need to consider RO collision issue.**   **Proposal 19: The NR-U scenario is out of scope of this R17 FeRRM WID, no need to discuss.**  **Proposal 20: Interruption in legacy handover delay requirement can be applied for Pcell. No interruption is defined on PSCell.**   * **If sequential processing is used for HO with PSCell, UE may have an interruption on new PCell due to the PSCell addition.** * **If parallel processing is used for HO with PSCell, no need to define interruption requirement.**   **Proposal 21:**   * If CSI-RS based CFRA is used for RACH on PSCell, the additional CSI-RS measurement and the CSI-RS to RO association period shall be considered. * The baseline requirement of PSCell addition and handover when CSI-RS based CFRA is used could be discussed in TEI16. |
| [R4-2112178](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112178.zip) | vivo | **Proposal 1 No more discussion on the new scenarios for HO with PSCell.**  **Proposal 2 For NR-DC and NE-DC mode in HO with PSCell, in R17 RAN4 considers FR1+FR2 NR-DC for HO with PSCell from NR-DC to NR-DC, and only considers FR1+LTE NE-DC for HO with PSCell from NE-DC to NE-DC.**  **Proposal 3: Take parallel processing for R17 HO with PSCell for all procedure including RACH, and for all configurations including the case that ‘targetcellSMTC-SCG-r16’ is configured.**  **Proposal 4 RF chain activation and retuning time needs to be further discussed in the timeline of HO with PSCell.**  **Proposal 5 RAN4 consider baseline for UE processing time as [30] ms for NRSA to ENDC, and the details can be further discussed. For other cases PSCell change requirement can be re-used.**  **Proposal 6 For the delay requirement, the ending point of handover with PSCell can be considered separately for PCell and PSCells.**  **Proposal 7 RAN4 assumes PCC could be scheduled for UE when PCell HO is completed but PSCell addition is not completed**  **Proposal 8 Even if PSCell is not changed during HO with PSCell, T∆ reduction seems not necessary, considering the multi-TRP deployment.**  **Proposal 9 RAN4 do not need to specify interruptions for handover with PSCell.**  **Proposal 10 RAN4 include both 2-step RA and 4-step RA into the new requirements made for handover with PSCell. No need to mention 2-step or 4-step in HO with PSCell requirements.** |
| [R4-2112419](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112419.zip) | Xiaomi | **Proposal 1: RAN4 does not specifies RRM requirement for the following additional scenarios for HO with PSCell in Rel-17.**   * **from NR SA to NE-DC** * **from NR SA to NR-DC** * **from LTE SA to EN-DC**   **Proposal 2: For NR-DC and NE-DC mode in HO with PSCell, RAN4 only consider to specify the RRM requirements for the following scenarios:**   * **FR1+FR2 NR-DC for HO with PSCell from NR-DC to NR-DC,** * **FR1+LTE NE-DC for HO with PSCell from NE-DC to NE-DC.**   **Proposal 3: The procedure of PCell HO and PSCell addition should be performed in parallel.**  **Proposal 4: The ending point of delay requirement for HO with PSCell is the later time between “the timing when UE shall be capable to transmit PRACH preamble towards target PCell” and “the timing when UE shall be capable to transmit PRACH preamble towards target PSCell”.**  **Proposal 5: the overall delay requirement for HO with PSCell is defined as TRRC\_delay + max(Tinterrupt, TSync\_PSCell), where,**   * **Tinterrupt is the interruption time for HO, which is defined in section 6.1 TS38.133;** * **TSync\_PSCell is the preparation time for synchronizing to target PSCell, which is defined in section 8.8 or 8.9 TS38.133.**   **Proposal 6: When the configured PSCell is the same as the original one or not, the requirements and UE’s behavior are the same.**  **Proposal 7: No interruption requirement should be defined for HO with PSCell.** |
| [R4-2112501](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112501.zip) | CMCC | **Observation 1: for the case of targetCellSMTC-SCG-r16 configured, the synchronization processing need to be performed in sequence, but the RACH processing can be performed in parallel.**  **Proposal 1: for the** **timeline for HO with PSCell, it is proposed that**   * **for the case that targetCellSMTC-SCG-r16 is configured, the timeline for HO with PSCell can be partially sequential**   + **RACH process can be performed in parallel, while other processing except RACH need to be performed in sequence.** * **For other cases except the configuration of targetCellSMTC-SCG-r16, parallel processing is assumed.**   **Observation 2: according to RAN2 reply LS, there is no restriction on the order on which the UE shall perform RACH towards the PCell and PSCell in handover with MR-DC configuration.**  **Proposal 2: we are OK with either of following options on the ending point of the delay requirement for HO with PSCell:**   * **Option 1:** **the ending point is the later timing between “timing when UE shall be capable to transmit PRACH preamble towards target Pcell” and “the timing when UE shall be capable to transmit PRACH preamble towards target PSCell”** * **Option 2: defining delay requirements for HO and PSCell addition/change separately with the ending points defined as Pcell PRACH and PSCell PRACH respectively**   **Proposal 3: delay for HO with PSCell is maximum (PSCell addition delay, HO delay)**   * **PSCell addition delay= TRRC\_delay + Tprocessing + Tsearch + T∆ + TPSCell\_ DU + 2 ms** * **HO delay = TRRC\_delay +Tinterrupt = TRRC\_delay +Tsearch + TIU + Tprocessing + T∆ + Tmargin ms** |
| [R4-2113139](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113139.zip) | Intel Corporation | **Proposal 1: Don’t consider FR1+FR1 NR-DC case for HO with PSCell from NR-DC to NR-DC in Rel-17.**  **Proposal 2: After RRC processing, parallel processing including RACH can be performed for PCell HO and PSCell addition.**  **Proposal 3: No requirement will be applied if targetcellSMTC-SCG-r16 is configured.**  **Proposal 4: Define delay requirements for HO and PSCell addition/change separately with the ending points defined as Pcell PRACH and PSCell PRACH respectively.**  **Proposal 5:** **The delay requirements for HO with PSCell can be described as:**  **THO\_PSCell= maximum (THO\_delay, Tconfig\_PSCell)**  **Proposal 6: Interruption in legacy handover delay requirement can still be applied for the PCell.** |
| [R4-2113202](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113202.zip) | ZTE Corporation | **Proposal 1: It is suggested to support parallel processing as baseline for HO with PSCell addition.**  **Proposal 2: Include both 2-step RA and 4-step RA into the new requirements made for handover with PSCell.** |
| [R4-2113276](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113276.zip) | OPPO | **Observation 1: RAN4 needs to consider whether or where to handle the baseline requirements of FR1+FR1 NR-DC for HO with PSCell from NR-DC to NR-DC.**  **Proposal 1: In R17 RAN4 only considers: FR1+FR2 NR-DC for HO with PSCell from NR-DC to NR-DC, FR1+LTE NE-DC for HO with PSCell from NE-DC to NE-DC.**  **Proposal 2: PCell HO and PSCell addition, without considering RA procedures and Tprocessing, are performed in parallel independently.**  **Proposal 3: Sequential RACH processing should be considered for minimum RRM requirements of HO with PSCell.**  **Proposal 4: For the case NR SA to EN-DC, we agree to extend the UE processing time to [30]ms assuming sequential UE processing timing of HO and PSCell addition.**  **For the case EN-DC to EN-DC, and NR-DC to NR-DC, the UE processing time to be [30]ms within the same FR of target PCell and PSCell; otherwise, otherwise the UE processing time shall be [50]ms as the legacy PSCell change requirement.**  **Proposal 5: The ending point of the delay requirements for HO with PSCell is the timing when UE shall be capable to transmit PRACH preamble towards target PSCell.**  **Proposal 6: For UE which is already configured with DC, the UE’s behaviour is same when the configured PSCell is same as the original one or not.**  **Proposal 7: Additional interruption may be expected on PCell due to PSCell addition.** |
| [R4-2114140](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114140.zip) | Huawei, Hisilicon | **Observation 1: For HO with PSCell in NR-DC case, If *targetCellSMTC-SCG* is configured, UE shall apply the SMTC configuration of target of target PSCell based on target PCell.**  **Proposal 1: For HO with PSCell in NR-DC, cell searching and fine timing tracking shall be performed sequentially when *targetCellSMTC-SCG* is configured.**  **Proposal 2: Tprocessing is the maximum one between UE processing timing of HO and UE processing timing of PSCell addition/change regardless whether *targetCellSMTC-SCG* is configured or not.**  **Observation 2: There is no restrictions on orders of RACH towards PCell and RACH towards PSCell.**  **Proposal 3: Define the delay requirements of HO with PSCell as the delay of HO and delay of PSCell addition/change separately. The ending point is the time when UE is capable to transmit PRACH towards target PCell and towards target PSCell respectively.**  **Proposal 4: No need to define interruption requirements.**  **Proposal 5: Define the delay requirements of HO with PSCell as above for each cases.** |
| [R4-2114152](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114152.zip) | MediaTek inc. | **Proposal 1: RAN4 will not specify the requirement of HO with PSCell for cases from NR-SA to NE-DC, from NR-SA to NR-DC, and from LTE SA to EN-DC**  **Proposal 2: In R17, RAN4 only considers FR1+FR2 NR-DC HO with PSCell for the case from NR-DC to NR-DC, and FR1+LTE NE-DC HO with PSCell for the case from NE-DC to NE-DC**  **Proposal 3: For LTE-SA to EN-DC or EN-DC to EN-DC, parallel processing on cell search and timing sync is always assumed**  **Proposal 4: For NR-DC to NR-DC, sequential processing cell search and timing sync is needed when targetCellSMTC-SCG is configured. Otherwise, parallel processing is assumed**  **Proposal 5: The overall Tprocessing for HO with PSCell should be max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) +10ms**  **Proposal 6: Define delay requirements for HO and PSCell addition/change separately by the time that UE transmits PCell PRACH and PSCell PRACH respectively. No need to define an overall delay requirement**  **Proposal 7: No new interruption requirement for HO with PSCell is needed. Interruption in legacy handover delay requirement can still be applied for the PCell** |
| [R4-2114175](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114175.zip) | Ericsson | **Proposal 1:** There shall be no extension of applicable scenarios for HO with PSCell scenarios. Original set of scenarios as captured in the WID applies.  **Proposal 2:** For NR-DC, in this WI, only FR1 – FR2 combinations are considered.  **Proposal 3:** Parallel processing shall be the baseline for delay requirements. This includes RA as well as other parts of the HO with PSCell procedure.  **Proposal 4:** For software processing for PSCell, the following values are to be used.   * 20ms, when source and target cells are different NR cells in same FR, * 40ms, when source and target cells are different NR cells in different FRs, * [40ms], when there is no source PSCell i.e. when it is a matter of PSCell addition.   **Proposal 5:** The delay requirement for HO with PSCell shall be specified separately for PCell and PSCell.  **Proposal 6:** Interruption in legacy handover delay requirement can be applied for PCell. No interruption is defined for PSCell.  **Proposal 7:** RAN4 shall define delay requirements for HO with PSCell for both 2-step and 4-step RA. Impact on delay requirements depends on timeline with respect to parallel processing of RA.  **Proposal 8:** RAN4 to further study whether RA for spCell on unlicensed carrier with CCA shall be prioritized over RA for spCell on licensed carrier, once CCA is successful. |
| [R4-2114213](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114213.zip) | Nokia, Nokia Shanghai Bell | 1. No new additional scenarios for HO with PSCell will be introduced. 2. RRM requirements for Rel-16 FR1+FR1 NR-DC will not be defined in Rel-17. 3. RAN4 should define RRM requirements for handover with PSCell only for FR1+FR2 NR-DC when considering “from NR-DC to NR-DC” scenario. 4. Both FR1+LTE NE-DC and FR2+LTE NE-DC should be supported for RRM requirements for handover with PSCell in “from NE-DC to NE-DC” scenario and “from NR SA to NE-DC” scenario. 5. In HO with PSCell, legacy HO and PSCell addition operations can be performed in parallel. 6. HO with PSCell RRM requirements can refer to existing handover requirements and PSCell addition requirements directly. 7. Agree the TP provided. 8. No additional interruption should be defined during HO with PSCell. 9. Both 2-step RA and 4-step RA are applicable for HO with PSCell and no need to mention 2-step or 4-step in HO with PSCell requirements. |
| [R4-2114429](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114429.zip) | Qualcomm CDMA Technologies | **Proposal1: Introduce a common term of search time budgeted for the joint PCell HO with PSCell, which is twice of the legacy search time Tsearch reserved for HO i.e. Tsrch=2xTsearch.**  **Proposal1.1: Also introduce a common margin time Tm which is twice of the time of legacy Tmargin i.e. Tm=2xTmargin.**  **Proposal2: Adopt the same time for loop processing as legacy T∆.**  Obervation1: RAN2 confirms spec doesnot restrict the UE in the oder to perform RACH towards PCell and PSCell.  Obervation2: UE has no motivations to complicate the handling of PSCell RACH by creating the contingency on PCell RACH.  **Proposal3: RAN4 shall discuss whether there is any fundamental advantage to define requirements for sequential RACH.**  **Proposal3.1: RAN4 define the requirements by assuming independent RACH.**  **Propsoal3.2: Define the ending points as Pcell PRACH and PSCell PRACH respectively by assuming 4-step RACH.**  **Proposal4: Stick to the WID scenarios for discussing the requirements unless new scenarios are approved by RP in the future.**  **Proposal5: Considers following schemes for NR-DC and NE-DC mode in HO with PSCell.**   * **FR1+FR2 NR-DC for HO with PSCell from NR-DC to NR-DC,** * **FR1+LTE NE-DC for HO with PSCell from NE-DC to NE-DC.**   **Proposal6: Requirement definition assumes UE run independent loop processings and RACHs towards PCell and PSCell respectively.**  **Proposal7: RAN4 to specify the delay requirement for HO with PSCell based on the assumption that some of procedures should be able to be performed in parallel.**  **Proposal7.1: if any component during the procedure has a dependency bw/ PCell and PSCell, define a common term to capture the most applicable requirement.**  Observation3: RRC processing, UE processing(to prep the RF) are proceudures common to both PCell and PSCell.  **Proposal8: Extending the UE processing time for NRSA to EN-DC joint handover by [FFS]ms and [FFS] can be 10ms as the starting point, i.e. Tprocessing = [30]ms.**  **Proposal8.1: For NRDC to NRDC, the UE processing time Tprocessing to be 20ms without FR mode switch on PSCell; otherwise, Tprocessing shall be 40ms as the legacy PSCell change requirement.** |

## Open issues summary

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

### Sub-topic 2-1 Scenarios for RRM requirement of HO with PSCell

*Sub-topic description:*

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

**Issue 2-1-1:** Scenarios for RRM requirement of HO with PSCell

* Proposals
  + Option 1(CATT, Apple, vivo, Xiaomi, MTK, Ericsson, Nokia, Qualcomm): RAN4 specifies RRM requirement for HO with PSCell for the following scenarios as in the WID RP-202874:
    - from NR SA to EN-DC
    - from EN-DC to EN-DC
    - from NE-DC to NE-DC
    - from NR-DC to NR-DC
* Recommended WF
  + RAN4 specifies RRM requirement for HO with PSCell for the following scenarios as in the WID RP-202874:
    - from NR SA to EN-DC
    - from EN-DC to EN-DC
    - from NE-DC to NE-DC
    - from NR-DC to NR-DC
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Agree with recommended WF |
| Xiaomi | Support the recommended WF |
| Qualcomm | Option1 is supported in accordance with the RP decision. |
| OPPO | Agree with recommended WF |
| Huawei | Support the recommended WF. |
| Intel | OK with the recommended WF |
| Ericsson | Agree with the recommended WF. It is in line with the outcome from plenary. |
| ZTE | Agree with the recommended WF. |
| vivo | Support the recommended WF. |
| CATT | Fine with the recommended WF. |
| Nokia | We are fine with the recommended WF |
| MTK | Agree with the recommended WF. |
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**Issue 2-1-2: NR-DC and NE-DC mode in HO with PSCell**

* Proposals
  + Option 1(CATT, Apple, vivo, Xiaomi, Intel, OPPO, MTK, Qualcomm): In Rel-17 RAN4 define RRM requirements for
    - FR1+FR2 NR-DC
    - FR1+LTE NE-DC
  + Option 2 (Ericsson): In Rel-17 RAN4 define RRM requirements for
    - FR1+FR2 NR-DC
  + Option 3 (Nokia): In Rel-17 RAN4 define RRM requirements for
    - FR1+FR2 NR-DC
    - FR1+LTE NE-DC
    - FR2+LTE NE-DC
* Recommended WF
  + FR1+FR2 NR-DC is supported.
  + FR1+LTE NE-DC is supported.
  + FR2+LTE NE-DC is FFS.
    - Companies are encouraged to provide comments on the FR2+LTE NE-DC scenario.
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Option 1. |
| Xiaomi | Option 1, as the band combination for FR2 + LTE NE-DC case was not supported in this WI. |
| Qualcomm | Option1 is supported and we think FR2 on PCell shall be deprioritized in general. |
| OPPO | Option 1 |
| Huawei | Support option 1. |
| Intel | Support Option 1. |
| Ericsson | Support the recommended WF.  (Option 2 is not captured correctly since our proposal was in the context of NR-DC only). |
| ZTE | Option 1. |
| vivo | Option 1. |
| CATT | Option 1. |
| Nokia | We are fine with the recommended WF. From our view, we would need to consider this scenario in RRM Since FR2+LTE NE-DC is supported in Rel17 RF session. To make progress, we can compromise to Option 1. |

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| MTK | Support option 1 |

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**Issue 2-1-2a: Baseline requirements for FR1+FR1 NR-DC**

* Proposals
  + Option 1 (Apple):
    - RAN4 to recommend introducing full set of RRM requirements for FR1+FR1 NR-DC in R18 eFeRRM WI.
  + Option 2 (OPPO):
    - RAN4 needs to consider whether or where to handle the baseline requirements of FR1+FR1 NR-DC for HO with PSCell from NR-DC to NR-DC
* Recommended WF
  + Further discussion
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Option 1. |
| Xiaomi | The scope of RRM requirements for FR1+FR1 NR-DC should be discussed in RAN plenary meeting. |
| Qualcomm | Suggest we leave this to the plenary level discussion.  From work load pov, it’s preferred not to handle this in the current WI. |
| OPPO | Option 2. Agree that how to handle the baseline requirements of FR1+FR1 NR-DC can be discussed in RAN-P as well. |
| Huawei | Generally fine with the idea to supplement the FR1+FR2 NR-DC requirements. But from our understanding, the decision should not be made in this WI. |
| Ericsson | In our view, where to handle FR1-FR1 NR-DC and what recommendation RAN4 is to provide to plenary, is not within the scope of this WI. |
| vivo | Agree with option 1 in principle, but fine to discuss in RAN plenary. |
| CATT | Fine with option 1. But we agree the decision should be made in RAN plenary. And from the conclusion in last meeting, the FR1+FR1 requirements are not included in this WI at this stage. |
| Nokia | RAN#92 has made conclusion that FR1+FR1 NR-DC will not be defined in Rel17 timeline. However, RAN4 should consider to define FR1+FR1 NR-DC RRM requirements, when and how to define these requirements would depend on RAN plenary. |
| MTK | It should be discussed in RAN plenary |
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### Sub-topic 2-2 Delay requirement design of HO with PSCell

*Sub-topic description*

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

**Issue 2-2-1a: Condition of parallel processing without considering RACH**

* Proposals
  + Option 1a (Apple):
    - In HO with PSCell for NR-DC to NR-DC, if SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16, sequential processing shall be assumed; otherwise, parallel processing shall be assumed.
    - In HO with PSCell for NR-DC to NR-DC, if SMTC of target unknown PSCell is not configured in either targetcellSMTC-SCG-r16 or reconfigurationWithSync,
      * UE uses the SMTC in the MO having the same SSB frequency and subcarrier spacing as target PSCell if either source PCell or source PSCell configured this MO, or
      * UE uses the SMTC in the MO from source PCell if both source PCell and source PSCell configured MOs having the same SSB frequency and subcarrier spacing as target PSCell, or
      * UE assumes 5ms as SSB periodicity for target PSCell if neither source PCell nor source PSCell configured MOs having the same SSB frequency and subcarrier spacing as the target PSCell.
    - In HO with PSCell for NR SA to EN-DC, if SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16, sequential processing shall be assumed; otherwise, parallel processing shall be assumed.
    - In HO with PSCell for NR SA to EN-DC, if SMTC of target unknown PSCell is not configured in either targetcellSMTC-SCG-r16 or reconfigurationWithSync,
      * UE uses the SMTC in the MO having the same SSB frequency and subcarrier spacing as target PSCell, or
      * UE assumes 5ms as SSB periodicity for target PSCell if source PCell didn’t configure MO having the same SSB frequency and subcarrier spacing as the target PSCell.
    - In HO with PSCell for EN-DC to EN-DC, parallel processing shall be assumed.
    - In HO with PSCell for EN-DC to EN-DC, if SMTC of target unknown PSCell is not configured in RRCConnectionReconfiguration,
      * UE uses the SMTC in the MO having the same SSB frequency and subcarrier spacing as target NR PSCell if either source LTE PCell or source NR PSCell configured this MO, or
      * UE uses the SMTC in the MO from source LTE PCell if both source LTE PCell and source NR PSCell configured MOs having the same SSB frequency and subcarrier spacing as target NR PSCell, or
      * UE assumes 5ms as SSB periodicity for target NR PSCell if neither source LTE PCell nor source NR PSCell configured MOs having the same SSB frequency and subcarrier spacing as the target NR PSCell.
    - In HO with PSCell for NE-DC to NE-DC, parallel processing shall be assumed.
  + Option 1b (CMCC):
    - For the case that targetCellSMTC-SCG-r16 is configured, the timeline for HO with PSCell can be partially sequential
    - For other cases except the configuration of targetCellSMTC-SCG-r16, parallel processing is assumed.
  + Option 1c (Huawei):
    - For HO with PSCell in NR-DC, cell searching and fine timing tracking shall be performed sequentially when targetCellSMTC-SCG is configured.
  + Option 1d (MTK):
    - For NR-DC to NR-DC, sequential processing cell search and timing sync is needed when targetCellSMTC-SCG is configured.
    - Otherwise, parallel processing is assumed
  + Option 2a (CATT, Xiaomi, ZTE, Ericsson, Nokia):
    - Parallel processing shall be the baseline for delay requirements
  + Option 2b (vivo):
    - Take parallel processing for R17 HO with PSCell for all procedure including RACH, and for all configurations including the case that ‘targetcellSMTC-SCG-r16’ is configured
  + Option 2c (Intel):
    - After RRC processing, parallel processing including RACH can be performed for PCell HO and PSCell addition.
  + Option 2d (OPPO):
    - PCell HO and PSCell addition, without considering RA procedures and Tprocessing, are performed in parallel independently.
* Recommended WF
  + Further discussion in the 1st round
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | We would like to revise option 1a to correct the configuration of NR-SA to EN-DC case.   * + Option 1a (Apple):     - In HO with PSCell for NR-DC to NR-DC, if SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16, sequential processing shall be assumed; otherwise, parallel processing shall be assumed.     - In HO with PSCell for NR-DC to NR-DC, if SMTC of target unknown PSCell is not configured in either targetcellSMTC-SCG-r16 or reconfigurationWithSync,       * UE uses the SMTC in the MO having the same SSB frequency and subcarrier spacing as target PSCell if either source PCell or source PSCell configured this MO, or       * UE uses the SMTC in the MO from source PCell if both source PCell and source PSCell configured MOs having the same SSB frequency and subcarrier spacing as target PSCell, or       * UE assumes 5ms as SSB periodicity for target PSCell if neither source PCell nor source PSCell configured MOs having the same SSB frequency and subcarrier spacing as the target PSCell.     - In HO with PSCell for NR SA to EN-DC, if SMTC of target unknown PSCell is configured in RRCConnectionReconfiguration in targetRAT-MessageContainer, sequential processing shall be assumed; otherwise, parallel processing shall be assumed.     - In HO with PSCell for NR SA to EN-DC, if SMTC of target unknown PSCell is not configured ~~in either targetcellSMTC-SCG-r16 or reconfigurationWithSync~~,       * UE uses the SMTC in the MO having the same SSB frequency and subcarrier spacing as target PSCell, or       * UE assumes 5ms as SSB periodicity for target PSCell if source PCell didn’t configure MO having the same SSB frequency and subcarrier spacing as the target PSCell.     - In HO with PSCell for EN-DC to EN-DC, parallel processing shall be assumed.     - In HO with PSCell for EN-DC to EN-DC, if SMTC of target unknown PSCell is not configured in RRCConnectionReconfiguration,       * UE uses the SMTC in the MO having the same SSB frequency and subcarrier spacing as target NR PSCell if either source LTE PCell or source NR PSCell configured this MO, or       * UE uses the SMTC in the MO from source LTE PCell if both source LTE PCell and source NR PSCell configured MOs having the same SSB frequency and subcarrier spacing as target NR PSCell, or       * UE assumes 5ms as SSB periodicity for target NR PSCell if neither source LTE PCell nor source NR PSCell configured MOs having the same SSB frequency and subcarrier spacing as the target NR PSCell.     - In HO with PSCell for NE-DC to NE-DC, parallel processing shall be assumed.   We don’t think parallel processing could be assumed as baseline. The reason is:   1. In NR-DC to NR-DC case, smtc configuration in reconfigurationWithSync is a very common case, and RAN2 also clarified this case in last meeting in CR R2-2106754 2. In NR-SA to EN-DC, the PSCell SMTC can only be configured in RRCConnectionReconfiguration in targetRAT-MessageContainer; and this SMTC can only be based on reference timing from target LTE PCell, so only sequential processing shall be used when SMTC is configured for NR-SA to EN-DC case. |
| Xiaomi | We are fine with the proposal of “For HO with PSCell in NR-DC, cell searching and fine timing tracking shall be performed sequentially when targetCellSMTC-SCG is configured.” And for other cases, the parallel processing is assumed. |
| CMCC | For the case that targetCellSMTC-SCG-r16 is not configured, parallel processing is assumed.  For the case that targetCellSMTC-SCG-r16 is configured, since UE is expected to use target PCell timing as reference for PSCell SMTC, fully parallel processing is not suitable for this case. But we think fully sequential processing is not suitable either, for example, the RACH can be performed in parallel. That is the reason we suggest partially sequential. As for which part need to be performed in sequence, in our understanding, cell search and timing tracking can be considered. Based on above consideration, we are also OK with option 1c/1d. |
| Qualcomm | Option2a can be a starting point.  Beyond that, we would like to hear from infra and operators whether it is common to have targetcellSMTC-SCG-r16 configured by the network in NRDC to NRDC HO.  If yes, we agree to further discuss which portion of processing shall be sequential under this case(targetcellSMTC-SCG-r16 is configured). For which, we think cell search(and the SSB post processing) can be sequential and the following procedures of time sync and RACH are independently running for MN and SN. So option1b is supported. |
| Qualcomm post 0816 GTW session | Per GTW, it seems to us that the baseline is parallel processing and then RAN4 can identify cases that could result in partial parallel or partial sequential processing. Just to summarize R2-2106754 as below.   |  |  |  | | --- | --- | --- | | ***Target PSCell time reference*** | *reconfigurationWithSync present* | *reconfigurationWithSync not present* | | *targetCellSMTC-SCG received* | **Case1: Follow target NR PCell** | **Case2: Follow target NR PCell** | | *targetCellSMTC-SCG not received* | **Case2: source PSCell** | **Case4: SMTC in the measObjectNR** |   It seems case1 and case2 creates the dependency of target PSCell on the target PCell as a time reference.  Further question remains on whether and how to capture the requirements in the baseline requirements based. |
| OPPO | As agreed in GTW, parallel processing is baseline and sequential processing under some condition is assumed.   * Agreements:   + In HO with PSCell for NR-DC to NR-DC     - Parallel processing shall be the baseline for delay requirements     - Sequential processing shall be assumed for the following cases       * Case 1: If SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16 but not configured in reconfigurationWithSync.       * Sequential processing is used for cell search and [timing sync]. FFS if additional margin shall be added. |
| Huawei | Generally fine with option 1a(revised)/b/c/d.  Regarding the cases mentioned in the GTW session and in QC’s comments (case 1) when both targetCellSMTC-SCG and reconfigurationWithSync are configured. We think it is not a typical cases. It implies that UE shall determine the SMTC based on the timing of target PCell OR source PCell?  Companies have different views on whether timing tracking shall be included in the sequential processing. From our understanding, the common understanding in RAN4 is that UE will obtain the SFN in Tdelta. Then to determine the SMTC based on the target PCell, SFN is needed. Then Cell Search and timing sync shall be done in sequence.  For the case of NR SA to EN-DC as clarified in Apple’s comments need further investigation. |
| Intel | Already discussed in the GTW session. Further discuss the partially sequentially processing in more detail if targetCellSMTC-SCG is configured, e.g. how to consider the case if target PCell is known or not. |
| vivo | Our understanding for the GTW agreement is that, there are two conditions for sequential processing for NR-DC to NR-DC,  1. SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16  2. SMTC of target unknown PSCell is not configured in reconfigurationWithSync  And only if both conditions are met, UE is allowed to use sequential processing.  For case 1 in QC’s comment, we found the following in TS 37.340.  “In (NG)EN-DC and NR-DC, SMTC can be used for PSCell addition/PSCell change to assist the UE in finding the SSB in the target PSCell. In case the SMTC of the target PSCell is provided by both MN and SN it is up to UE implementation which one to use.”  This is similar to the RACH discussion. Since it is up to UE implementation, UE should use the source PSCell as reference timing for target PSCell so as to prevent the necessary sequential processing.  **For the case of NR-SA to EN-DC, we are fine to the revised option 1a.** Based on RAN2 spec, it seems only target EUTRA PCell timing can be used, and sequential processing is also needed. However, since in most cases the NR SA cell and the PSCell in EN-DC should share the same freq, network may also allow parallel processing by ensuring the SMTC of target PSCell is configure in source cell MO.  **For all other cases, parallel processing should be assumed.** |
| CATT | Follow GTW agreement. |
| Nokia | Comments after GTW session:  In GTW, we only focus on the scenario from NR-DC to NR-DC. Since parallel processing will be the general case, we think parallel processing shall be the baseline for HO with PSCell for other defined scenarios also.  For the case that ‘targetcellSMTC-SCG-r16’ is configured, we think it is a specific case, further analysis on the impact of partially sequential processing for this case, and we can discuss further if we need to and how to specify for this specific case. |

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| MTK | Our understanding is   |  |  |  | | --- | --- | --- | | Cases | Target PSCell SMTC configured based on timing of | Parallel or sequential | | LTE-SA to EN-DC or  EN-DC to EN-DC | LTE source PCell  (source and target LTE PCell are synchronized | **Known reference timing**:  (Parallel processing) Tconfig\_PSCell = TRRC\_delay+ Tprocessing + Tsearch\_PSCell + T∆\_PSCell + **TPCell\_DU** + TPSCell\_ DU + 2 ms | | NR-DC to NR-DC | Target PCell or source PSCell | **Unknown reference timing**:  need to check whether targetCellSMTC-SCG and reconfigurationWithSync are configured   * Case 1: If both targetCellSMTC-SCG and reconfigurationWithSync are configured (Parallel processing)  Specified in RAN2 spec 37.340 7.2, UE can choose to refer the timing based on the configuration 1 (perform PSCell change based on target PSCell timing) or configuration 2 (perform PSCell change based on source PSCell timing). Considering that UE already know the source PSCell timing, it is possible for UE to perform parallel processing  |  | | --- | | In case the SMTC of the target PSCell is provided by both MN and SN it is **up to UE implementation which one to use.** |  * Case 2: If only targetCellSMTC-SCG is configured (Sequential processing)   UE had ever reported the reference cell  Tconfig\_PSCell = TRRC\_delay+ Tprocessing + T∆\_HO+ Tsearch\_PSCell + T∆\_PSCell + TPSCell\_ DU + 2\*2 ms  UE never reported the reference cell  Tconfig\_PSCell = TRRC\_delay+ Tprocessing +Tsearch\_HO+ + T∆\_HO+ Tsearch\_PSCell + T∆\_PSCell + TPSCell\_ DU + 2\*2 ms   * Case 3: If only reconfigurationWithSync is configured (Parallel processing)  Tconfig\_PSCell = TRRC\_delay+ Tprocessing + Tsearch\_PSCell + T∆\_PSCell + TPSCell\_ DU + 2 ms * Case 4: If both targetCellSMTC-SCG and reconfigurationWithSync are not configured (Parallel processing)   o If smtc was configured in measurement object, UE follows smtc in MO (UE refer to source PCell timing). UE does not need to acquire target PCell timing for PSCell addition/change. 🡪Parallel processing   * o If no smtc can be leveraged, UE assumes 5ms periodicity on the target PSCell SSB (No need any timing reference). UE does not need to acquire target PCell timing for PSCell addition/change. 🡪 Parallel processing   Tconfig\_PSCell = TRRC\_delay+ Tprocessing + Tsearch\_PSCell + T∆\_PSCell + TPSCell\_ DU + 2 ms | | NR SA to EN-DC | Target PCell/source PSCell /Source PSCell | **Similar with NR-DC to NR-DC case** The reference timing is not yet determined in RAN2 | | NE-DC to NE-DC |  | Since in this case LTE is as a target PSCell and no SMTC shall be considered for target LTE PSCell, the (Parallel processing) could be assumed | |

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**Issue 2-2-1b: Whether requirements for sequential processing are needed if parallel processing is only possible under certain condition**

* Proposals
  + Option 1 (Apple):
    - RAN4 to define the requirements for both sequential processing and parallel processing cases.
  + Option 2 (Intel):
    - No requirement will be applied if targetcellSMTC-SCG-r16 is configured.
* Recommended WF
  + Further discussion in the 1st round
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1. Smtc configuration in targetcellSMTC-SCG-r16 is not a corner case based on RAN2 spec (in TS38.331 this case has been clarified explicitly). |
| Xiaomi | RAN4 should define the requirements for the case when targetcellSMTC-SCG-r16 is configured. |
| CMCC | Both the case with targetcellSMTC-SCG-r16 configured and the the case without targetcellSMTC-SCG-r16 configured need to be considered to specify the requirements.  For the case without targetcellSMTC-SCG-r16 configured, parallel processing is used.  For the case with targetcellSMTC-SCG-r16 configured, cell search and timing tracking is performed in sequence, other procedures are performed in parallel. |
| Qualcomm | As we shared in the previous issue, if configuration of targetcellSMTC-SCG-r16 is not common, we are fine with option2. |
| Qualcomm post 0816 GTW session | Our proposal of option2c in issue2-2-2 can be considered as a generic requirement to accommodate both parallel and partial parallel processing. |
| OPPO | Per GTW agreement in issue 2-2-1a, option 1 is fine. |
| Huawei | Support option 1. |
| Intel | Fine with option 1 since both parallel and sequentially processing scenario are identified. |
| ZTE | Agree to define requirements for partially sequentially processing. |
| vivo | Fine with option 1 according to GTW. |
| CATT | Fine with option 1. Since the case with targetcellSMTC-SCG-r16 is defined in RAN2, we are fine to define requirements for the case. |
| Nokia | Comments after GTW session:  As agreed in GTW, sequential processing will be assumed for the case if targetcellSMTC-SCG-r16 is configured. Further analysis on the impact of partially sequential processing, and we can discuss further if we need to and how to specify for this specific case. |

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| MTK | Support option 1. |

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**Issue 2-2-2: Parallel processing timeline without considering Tprocessing and RA procedures**

*The entire delay for HO with PSCell may include RRC processing delay, PCell handover and PSCell addition delay.*

*The PCell handover and PSCell addition may be performed in parallel or sequential depending on outcome of Issue 2-2-1a.*

*Even for sequential processing of PCell handover and PSCell addition, there are views that partially parallel processing is also possible.*

*The Tprocessing during PCell handover and PSCell addition are discussed in Issue 2-2-3 separately.*

*The RA procedures during the entire HO with PSCell are discussed in Issue 2-2-4 separately.*

*RRC processing is not considered in this issue.*

*This issue is focusing on other procedures during PCell handover and PSCell addition that may be performed in parallel independently or at least in partial parallel.*

* Proposals
  + Option 1 (Apple, CATT, Xiaomi, ZTE, Ericsson, Nokia, vivo, Intel, OPPO):
    - PCell HO and PSCell addition are performed in parallel independently
  + Option 2a (CMCC):
    - For the case that targetCellSMTC-SCG-r16 is configured, the timeline for HO with PSCell can be partially sequential
    - For other cases except the configuration of targetCellSMTC-SCG-r16, parallel processing is assumed.
  + Option 2b (MTK, Huawei):
    - For NR-DC to NR-DC, sequential processing cell search and timing sync is needed when targetCellSMTC-SCG is configured.
    - Otherwise, parallel processing is assumed
  + Option 2c (Qualcomm):
    - Only if partial parallel processing is assumed when targetCellSMTC-SCG is configured, Tsearch can be extended for sequential processing cell search, e.g. Tsrch= Tsearch\_MCG+Tsearch\_SCGand the time for SSB post-processing may also be extended e.g. Tm=2xTmargin
      * Adopt the same time for loop processing as legacy T∆ i.e. the fine time tracking and acquiring full timing information of the target cell shall be assumed running independently for each CG
    - Otherwise, parallel processing is assumed
* Recommended WF
  + Further discussion in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1 |
| Xiaomi | Option 1 |
| CMCC | This issue needs to be discussed case by case.  For the case that targetcellSMTC-SCG-r16 is not configured, parallel processing is used, we are OK with option 1.  For the case that targetcellSMTC-SCG-r16 is configured, cell search and timing tracking is performed in sequence, other procedures are performed in parallel. |
| Qualcomm | Depending on the RAN4 agreement to support the case when targetcellSMTC-SCG-r16 is configured, we support option 2c(if supported) or option1(if not supported).  Please note a correction on option2c shall be Tsrch=Tsearch\_MCG+Tsearch\_SCG |
| Qualcomm post 0816 GTW session | Tsearch\_MCG and Tsearch\_SCG are based on the SMTC periodicities for target PCell and target PSCell respectively.  Question to proponents of Option2b, thanks for any elaborations on the need to perform sequential processing of time sync? In our view, the TRS being the target cell SMTC periodicity which has been derived for both target PCell and target PSCell by extending the search time and SSB post processing time. Thanks |
| Huawei | Same views as CMCC |
| Intel | From our understanding, if targetcellSMTC-SCG-r16 is configured, UE will perform cell search and fine timing tracking for target PCell first, all the timing information including SFN of PCell are obtained. Then according to SSB-MTC configured in targetcellSMTC-SCG-r16, UE can find the SMTC of PSCell and perform the following processing. |
| vivo | According to GTW agreements, sequential processing of cell search and sync can be at least considered under certain conditions and parallel processing is considered otherwise.  For sequential processing, we think companies would need more time to check the details. Better come back in the next meeting. |
| CATT | Based on the GTW discussion and agreement, we share the same view as CMCC. |
| Nokia | Comments after GTW session:  We support Option 1. According to the agreement in GTW session, we have the common understanding that parallel processing shall be the general case and have the clear view on the parallel processing, we should focus on the general case firstly. Non-typical cases need further discussion. |

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| MTK | For the case of parallel processing, option 1 is acceptable. |

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**Issue 2-2-3: UE SW processing and RF warm-up(if needed) time for HO with PSCell**

* Proposals
  + Option 1 (CATT):
    - The value of processing time of handover and the PSCell addition can be reused separately. Tprocessing for HO with PSCell will be the maximum of the processing time of handover and the processing time of the PSCell addition.
  + Option 2 (Apple):
    - For sequential processing for HO with PSCell, the total UE processing time for HO with PSCell is the sum of UE processing timing of HO and UE processing timing of PSCell addition.
    - For parallel processing for HO with PSCell, the total UE processing time for HO with PSCell could be the maximum one between UE processing timing of HO and UE processing timing of PSCell addition
    - the UE processing time for HO with PSCell is:

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| UE processing margin (Tprocessing) | Target Pcell and PSCell is in the same FR as old serving cell | Target Pcell and/or target PSCell is in the different FR from old serving cell |
| Sequential processing | 40ms | 60ms |
| Parallel processing | 20ms | 40ms |

* + Option 3 (Huawei):
    - Tprocessing is the maximum one between UE processing timing of HO and UE processing timing of PSCell addition/change regardless whether *targetCellSMTC-SCG* is configured or not.
  + Option 4 (Ericsson):
    - For software processing for PSCell, the following values are to be used.
      * 20ms, when source and target cells are different NR cells in same FR,
      * 40ms, when source and target cells are different NR cells in different FRs,
      * [40ms], when there is no source PSCell i.e. when it is a matter of PSCell addition.
  + Option 5 (Nokia):
    - HO with PSCell RRM requirements can refer to existing handover requirements and PSCell addition requirements directly
  + Option 6 (OPPO):
    - For the case NR SA to EN-DC, we agree to extend the UE processing time to [30]ms assuming sequential UE processing timing of HO and PSCell addition.
    - For the case EN-DC to EN-DC, and NR-DC to NR-DC, the UE processing time to be [30]ms within the same FR of target PCell and PSCell; otherwise, otherwise the UE processing time shall be [50]ms as the legacy PSCell change requirement.
  + Option 7 (MTK):
    - The overall Tprocessing for HO with PSCell should be max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) +10ms
  + Option 8 (vivo):
    - RAN4 consider baseline for UE processing time as [30] ms for NRSA to ENDC, and the details can be further discussed. For other cases PSCell change requirement can be re-used.
  + Option 9 (Qualcomm):
    - Extending the UE processing time for NRSA to EN-DC joint handover by [FFS]ms and [FFS] can be 10ms as the starting point, i.e. Tprocessing = [30]ms.
    - For NRDC to NRDC, the UE processing time to be 20ms without FR mode switch on PSCell; otherwise, the UE processing time shall be 40ms as the legacy PSCell change requirement.
* Recommended WF
  + Further discussion in the 1st round
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 2. The principle shall reply on which processing is used. In order to define a minimum requirement, we think the principle shall be:   * For sequential processing for HO with PSCell, the total UE processing time for HO with PSCell is the sum {legacy UE processing timing of HO, legacy UE processing timing of PSCell addition}. * For parallel processing for HO with PSCell, the total UE processing time for HO with PSCell is the max{legacy UE processing timing of HO, legacy UE processing timing of PSCell addition}. |
| Qualcomm | Option9 is supported |
| Huawei | Support option 3 but can compromise to some extension. |
| Ericsson | We support Option 4 and Option 9. The difference is that in Option 4, 10ms more than in Option 9 is assumed for loading SW for target NR PSCell. We are fine with either. The justification for our assumption is that it is based on the maximum of processing time for HO from NR to LTE, and processing time for NR PSCell addition. The latter is amounting to 40ms and is the larger of the two. |
| vivo | We see many options but the technical content would be aligned in most options.  We would like to revise our proposal as follows:   * For parallel processing,   + for ENDC to ENDC, NE-DC to NE-DC and NR-DC to NR-DC     - UE processing time (including SW processing and RF warm-up(if needed) time) is 20 ms, for the case source and target cells are in the same FR.     - UE processing time is 40 ms, for the case source and target cells are in different FR.   + For NR-SA to EN-DC     - Additional [10]ms is considered based on above UE processing time. * FFS sequential processing. |
| CATT | Option 1 and option 3. We think the two options are the same. And we think the processing time is irrespective whether *targetCellSMTC-SCG* is configured or not. Because the RF and SW preparation for PCell and PSCell should be done in parallel. Additional margin need further discussion, we are not sure the motivation so far. |
| Nokia | Comments after GTW session:  We support option 5. According the agreement in GTW, parallel processing is the baseline for HO with PSCell. We would focus to the baseline firslty. PCell Handover and PSCell addition can be performed in parallel in dependently, the total delay requirements for HO with PSCell are not needed, current existing PCell Handover and PSCell addition can be reused. Hence, we do not to consider the separate UE SW processing and RF warm-up(if needed) time for HO with PSCell. |

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| MTK | Support option 7. |

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**Issue 2-2-4: RACH processing for Pcell and PSCell**

* Proposals
  + Option 1 (vivo, Xiaomi, CMCC, ZTE, Huawei, CATT, MTK, Ericsson, Nokia, Qualcomm, Apple):
    - RACH processing for PCell and PSCell are performed in parallel independently.
  + Option 2 (OPPO):
    - Sequential RACH processing should be considered for minimum RRM requirements of HO with PSCell.
  + Option 2b (Qualcomm):
    - RAN4 shall discuss whether there is any fundamental advantage to define requirements for sequential RACH.
* Recommended WF
  + Further discussion in the 1st round

* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1 |
| Xiaomi | Option 1 |
| CMCC | Option 1 |
| Qualcomm | Option1 is supported as it appears clear that majority view is not to consider sequential RACH processing. |
| OPPO | Regarding majority views, we can compromise to Option 1 |
| Huawei | Option 1 |
| Intel | Support option 1. |
| Ericsson | We support Option1.  RACH processing for PCell and PSCell shall be carried out in parallel, but a further discussion on how to handle cases where UE is under Tx power limitation and thereby cannot transmit on both carriers simultaneously, may be needed. The latter would only apply to collision of PRACH preamble transmissions, and not to the rest of the RA procedures running in PCell and PSCell. |
| ZTE | Support option 1. |
| vivo | Support option 1. |
| CATT | Option 1. |
| Nokia | We support option 1. RAN2 has clarified clearly in the replied LS. |

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| MTK | Option 1 based on RAN2 reply |

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**Issue 2-2-5: Ending point of the delay requirement for HO with PSCell**

* Proposals:
  + Option 1 (Apple, Xiaomi, CMCC, CATT):
    - the later timing between “timing when UE shall be capable to transmit PRACH preamble towards target PCell” and “the timing when UE shall be capable to transmit PRACH preamble towards target PSCell”.
  + Option 2 (vivo, CMCC, Intel, Huawei, MTK, Ericsson, Qualcomm):
    - Defining delay requirements for HO and PSCell addition/change separately with the ending points defined as PCell PRACH and PSCell PRACH, respectively.
  + Option 3 (OPPO):
    - The timing when UE shall be capable to transmit PRACH preamble towards target PSCell.
* Recommended WF
  + Further discussion in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1. Question to Option 2: what’s the starting point of PSCell addition delay in sequential processing case? |
| Xiaomi | Option 1, prefer to define the overall delay requirement for HO with PSCell. |
| Qualcomm | Both option1 and option2 can be further discussed depending on the conclusions of previous issues. |
| OPPO | If RACH processing for Pcell and PSCell are assumed in parallel independently, option 1 should be the minimum requirement. |
| Huawei | If UE could meet the delay requirements of RACH to PCell and RACH to PSCell in option 2, obviously UE could meet the later timing point in option1.  Response to Apple’s question: From our understanding, for sequential processing case, the starting point of PSCell addition is same as that of PCell change, and additional delay in PSCell addition shall be considered for cell searching and [time sync] in PCell. |
| Intel | For parallel processing, option 2 can applied. For sequentially processing, option 1 is OK. |
| Ericsson | We support Option 2. We think even should there be RO collision, it does not mean RACH procedures shall run sequentially. Hence Option 2 is still valid. |
| vivo | Support option 2. But since the details of sequential processing is FFS, we think option 2 should be adopted at least for the case of parallel processing. |
| CATT | Prefer option 1, but can compromise to option 2. |
| Nokia | PCell Handover and PSCell addition can be performed in parallel in dependently, the total delay requirements for HO with PSCell are not needed, current existing PCell Handover and PSCell addition can be reused. Hence it is no need to discuss and define the ending point of HO with PSCell. |

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| MTK | Option 2. Reply to Apple: starting point of PCell HO and PSCell change/addition are the same. |

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**Issue 2-2-6: Optimisation for the case when PSCell is not changed during HO with PSCell**

* Proposals
  + Option 1 (CATT, Apple, vivo, Xiaomi, OPPO, Qualcomm):
    - For UE which is already configured with DC, the UE’s behavior is same when the configured PSCell is same as the original one or not.
* Recommended WF
  + For UE which is already configured with DC, the UE’s behavior is same when the configured PSCell is same as the original one or not.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1. |
| Xiaomi | Option 1 |
| Qualcomm | Option1 is supported. |
| OPPO | Option 1 |
| Intel | Support option 1. |
| Ericsson | We are fine with the recommended WF i.e. Option 1. |
| ZTE | Agree with the recommended WF. |
| vivo | Option 1 |
| CATT | Option 1. |
| Nokia | We are fine with the recommended WF. |

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| MTK | Option 1 |

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**Issue 2-2-8: Delay requirements design**

* Proposals
  + Option 1 (CATT):
    - The delay requirement will be defined as Delay = TRRC processing + max(Tinterrupt , Tconfig\_PSCell – TRRC\_delay).
      * TRRC processing is RRC processing time defined as in introduction.
      * Tinterrupt is interruption time defined in requirements of handover in every scenarios.
      * Tconfig\_PSCell is delay requirement for PSCell addition.
      * TRRC\_delay is RRC processing time defined for PSCell addition.
  + Option 2 (Xiaomi):
    - the overall delay requirement for HO with PSCell is defined as TRRC\_delay + max(Tinterrupt, TSync\_PSCell), where,
      * Tinterrupt is the interruption time for HO, which is defined in section 6.1 TS38.133;
      * TSync\_PSCell is the preparation time for synchronizing to target PSCell, which is defined in section 8.8 or 8.9 TS38.133.
  + Option 3 (CMCC):
    - Delay for HO with PSCell is maximum (PSCell addition delay, HO delay)
      * PSCell addition delay= TRRC\_delay + Tprocessing + Tsearch + T∆ + TPSCell\_ DU + 2 ms
      * HO delay = TRRC\_delay +Tinterrupt = TRRC\_delay +Tsearch + TIU + Tprocessing + T∆ + Tmargin ms
  + Option 4 (Intel):
    - The delay requirements for HO with PSCell can be described as:
      * THO\_PSCell= maximum (THO\_delay, Tconfig\_PSCell)
      * THO\_delay = TRRC\_delay + Tsearch + Tprocessing +TIU + T∆ + Tmargin ms
      * Tconfig\_PSCell = TRRC\_delay + Tsearch + Tprocessing + TPSCell\_ DU + T∆ + 2 ms
        + TRRC\_delay is the RRC procedure delay as specified in TS 38.331.
        + Tsearch is the time required to search the target cell.
        + Tprocessing is the SW processing time needed by UE, including RF warm up period.
        + T∆ is time for fine time tracking and acquiring full timing information of the target cell.
        + TIU and TPSCell\_ DU are the interruption uncertainty in acquiring the first available PRACH occasion in the PCell and PSCell.
  + Option 5 (Nokia):
    - HO with PSCell RRM requirements can refer to existing handover requirements and PSCell addition requirements directly
    - Agree the TP provided in R4-2114213
  + Option 6 (Qualcomm):
    - Requirement definition assumes UE run independent loop processings and RACHs towards PCell and PSCell respectively.
    - RAN4 to specify the delay requirement for HO with PSCell based on the assumption that some of procedures should be able to be performed in parallel.
    - If any component during the procedure has a dependency bw/ PCell and PSCell, define a common term to capture the most applicable requirement.
    - RRC processing, UE processing(to prep the RF) are proceudures common to both PCell and PSCell
    - Introduce a common term of search time budgeted for the joint PCell HO with PSCell, which is twice of the legacy search time Tsearch reserved for HO i.e. Tsrch= Tsearch\_MCG+Tsearch\_SCG.
    - Also introduce a common margin time Tm which is twice of the time of legacy Tmargin i.e. Tm=2xTmargin.
    - Adopt the same time for loop processing as legacy T∆.
  + Option 7 (Huawei):
    - **For NR SA to EN-DC, the delay of HO and PSCell addition:**
    - THO = TRRC\_delay +Tsearch\_PCell + TIU + TProcessing
    - TPSCell= TRRC\_delay + Tprocessing + Tsearch\_PSCell + T∆ + TPSCell\_ DU + TPCell\_DU+ Tmargin ms
    - Where TRRC\_delay = 50 ms, TPCell\_DU is the delay uncertainty due to PCell RACH preamble transmission defined in TS 38.213.
    - **For EN-DC to EN-DC, the delay of HO and PSCell addition:**
    - THO = TRRC\_delay +Tsearch\_PCell + TIU + TProcessing
    - TPSCell= TRRC\_delay + Tprocessing + Tsearch\_PSCell + T∆ + TPSCell\_ DU + TPCell\_DU+ Tmargin ms
    - Where TRRC\_delay = 20 ms, TPCell\_DU is the delay uncertainty due to PCell RACH preamble transmission defined in TS 38.213.
    - **For NE-DC to NE-DC, the delay of HO and PSCell addition:**
    - THO = TRRC\_delay + Tsearch\_PCell + Tprocessing + TIU + TPSCell\_DU + T∆ + Tmargin
    - TPSCell= TRRC\_delay + Tprocessing + Tactivation\_time + TE-UTRAN-PSCell\_ DU
    - Where TRRC\_delay = 16 ms, TPSCell\_DU is the delay uncertainty due to PSCell RACH preamble transmission defined in TS 38.213.
    - **For NR-DC to NR-DC (FR1+FR2 NR-DC), the delay of HO and PSCell addition:**
    - THO = TRRC\_delay + Tsearch\_PCell + Tprocessing + TIU + T∆ + Tmargin
    - TPSCell= TRRC\_delay + Tprocessing + Tsearch\_DU+ Tsearch\_PSCell + T∆ + TPSCell\_ DU + Tmargin ms
    - Where TRRC\_delay = 16 ms. Tsearch\_DU is delay uncertainty due to time tracking of PCell if targetCellSMTC-SCG is configured; Tsearch\_DU = 0 otherwise.
    - It should be noted Tprocessing depends on the conclusion of related issues.
* Recommended WF
  + Further discussion in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Can wait for more conclusions from other issues. |
| Xiaomi | Option 1 and 2, as commented in issue 2-2-5, the overall delay requirement for HO with PSCell is proposed, and the T\_RRC\_delay should be counted once, and the T\_interrup (Tsearch + TIU + Tprocessing + T∆ + Tmargin) for HO and T\_sync\_PSCell (Tprocessing + Tsearch + T∆ + TPSCell\_ DU + 2 ms) for PSCell addition delayHO delay is accounted in parallel or partial sequential based on whether the targetCellSMTC-SCG-r16 is configured or not. |
| Qualcomm | Prefer to defer this to the 2nd round discussion till previous issues are agreed.  One outstanding issue we sense is about whether to assume any dependency of PSCell time tracking on the availability of the PCell fine timing. |
| OPPO | OK with Apple’s comment. |
| Huawei | Same views as Apple. |
| Intel | Dependent on many previous issues. |
| ZTE | As Apple’s comment , this issue could be discussed later. |
| vivo | FFS depend on other issues. |
| CATT | Waiting for the conclusions of other views. |
| Nokia | We support option 5. PCell Handover and PSCell addition can be performed in parallel in dependently, the total delay requirements for HO with PSCell are not needed, current existing PCell Handover and PSCell addition can be reused directly.  We provided following TP as example in R4-2114213 (Take from SA to EN-DC as an example):  When the UE receives a RRC message implying handover with PSCell,   * The UE shall be ready to start the transmission of the new uplink PRACH channel of the target E-UTRAN PCell within Dhandover ms from the end of the last TTI containing the RRC command where Dhandover is specified in clause 6.1.2.1, and * The UE shall be capable of transmitting PRACH preamble towards the target PSCell no later than specified in clause 8.9.2 of TS 36.133 [15]. |

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| MTK | As the table we provide in Issue 2-2-1a |

### Sub-topic 2-3 Interruption requirement design of HO with PSCell

*Sub-topic description*

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

**Issue 2-3-2: Interruption requirement for HO with PSCell**

* Proposals
  + Option 1 (CATT, vivo, Xiaomi, Huawei):
    - No interruption requirement should be defined during HO with PSCell
  + Option 2a (Intel, MTK, Ericsson, Nokia):
    - No new interruption requirement for HO with PSCell is needed. Interruption in legacy handover delay requirement can still be applied for the PCell
  + Option 2b (Ericsson):
    - Interruption in legacy handover delay requirement can be applied for PCell. No interruption is defined for PSCell.
  + Option 3 (Apple):
    - Interruption in legacy handover delay requirement can be applied for Pcell. No interruption is defined on PSCell.
      * If sequential processing is used for HO with PSCell, UE may have an interruption on new PCell due to the PSCell addition.
      * If parallel processing is used for HO with PSCell, no need to define interruption requirement.
  + Option 4 (OPPO):
    - Additional interruption may be expected on PCell due to PSCell addition.
* Recommended WF
  + Further discussion in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 3. In sequential processing, the RF tuning for PSCell addition/change may interrupt the PCell scheduling. To define the minimum requirement, we need to consider possible UE implementation, e.g., UE performs the RF tuning for PSCell addition/change later than the RF tuning for PCell HO in the sequential processing case for saving power. |
| Xiaomi | When partial sequential processing is assumed, the interruption due to PSCell addition should be considered. When parallel processing is assumed for HO with PSCell, no interruption requirement should be defined. |
| Qualcomm | Option2a is supported. |
| OPPO | We share the similar view that if sequential processing is used for HO with PSCell, UE may have an interruption on new PCell due to the PSCell addition. Option 4 considers the worst case. Option 3 is also ok. |
| Huawei | Option 1. We recognize the views by companies that there may be interruptions due to PCell addition. Howerver, as explained in our paper, even for sequential processing, UE could tune the RF for target PCell and target PSCell together. One may argue that this may lead to unnecessary power consumption. But the interruption could be avoided, and the power consumption is negligible which only exists in the time of cell searching and [time sync] of PCell. |
| Intel | Fine with option 3. |
| Ericsson | We support Option 2a. |
| vivo | Fine with option 2a or option 3 if it refers to T\_interrupt in legacy HO requirements. Our intension is that there should be no interruption to PCell during PSCell addition, especially if parallel processing is considered. |
| CATT | Option 1. Same view as Huawei that the RF tuning for PCell and PSCell is performed together. |
| Nokia | We support option 2a. there is no additional interruption requirements for HO with PSCell, legacy interruption requirements defined for PCell should be applied. |

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| MTK | We prefer to clarify the meaning of interruption. It seems that some companies discuss the data interruption, some companies discuss the RF interruption. |

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### Sub-topic 2-4 Generic RACH assumption for HO with PSCell

*Sub-topic description*

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

**Issue 2-4-1: 2 step and 4 step RACH for HO with PSCell**

* Proposals
  + Option 1a (ZTE, Nokia, vivo, CATT):
    - Include both 2-step RA and 4-step RA into the new requirements made for handover with PSCell. No need to mention 2-step or 4-step in HO with PSCell requirements.
  + Option 1b (Ericsson):
    - RAN4 shall define delay requirements for HO with PSCell for both 2-step and 4-step RA. Impact on delay requirements depends on timeline with respect to parallel processing of RA.
  + Option 2 (Apple):
    - For requirement of HO with PSCell, RAN4 starts the discussion with 4 step RACH first and FFS on 2 step RACH.
  + Option 3 (Qualcomm):
    - Define the ending points as Pcell PRACH and PSCell PRACH respectively by assuming 4-step RACH
* Recommended WF
  + Further discussion in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 2 |
| Xiaomi | Prefer option 2. |
| Qualcomm | Option3 is supported for discussions and RAN4 may discuss to add applicability to 2-step RACH when requirements are shaped. I.e.  we can compromise to Option2 as well. |
| OPPO | Option 2. |
| Intel | Fine with option 2. |
| Ericsson | We support Option 1a/1b (can be merged into one). |
| ZTE | Support 1a and 1b. |
| vivo | Option 1a/1b at least for parallel process. |
| CATT | Option 1a and 1b. Since the procedure is ended when UE transmit PRACH, it should be irrespective of 2-step or 4-step RACH. |
| Nokia | We support option 1a. RACH procedure do not impact the requirements for current PCell Handover and PSCell addition, and both 2-step RA and 4-step RA are applied for current PCell Handover and PSCell addition. The same applicability should be applied for HO with PSCell. |
| MTK | Option 2 |

**Issue 2-4-2: RACH occasion collision between Pcell and PSCell**

* Proposals
  + Option 1 (Apple):
    - for FR1+FR1 EN-DC, an additional uncertainty delay due to PSCell RACH collision with PCell UL channels may be introduced if the PSCell RACH cannot be transmitted based on the criteria in TS38.213 section 7.6.1;
    - for FR1+FR1 NE-DC, an additional uncertainty delay due to PCell RACH collision with PSCell RACH may be introduced if the PCell RACH cannot be transmitted based on the criteria in TS38.213 section 7.6.2;
    - otherwise, if target PCell and target PSCell are on the different FRs for EN-DC or NR-DC, no need to consider RO collision issue.
* Recommended WF
  + Discussion option 1 in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1. Reason is as described in our discussion paper. |
| Qualcomm | Support this to be FFS. |
| Huawei | Support option 1 |
| Ericsson | In general we are fine with Option 1, i.e., if UE is power limited and cannot transmit in PCell and PSCell at the same time, additional time/uncertainty delay is allowed. However, we can further discuss how to capture it in RAN4 requirements and how to tie it to existing RAN1 rules. |
| vivo | Fine with option 1. |
| CATT | Fine with option 1 in principle. |
| Nokia | We are fine to continue whether delays may need to be introduced for LTE-FR1 EN-DC and FR1-LTE NE-DC as stated in option 1. We are fine with the latter bullet. |

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| MTK | Support option 1 |

**Issue 2-4-3: RACH occasion on NR-U CC for HO with PSCell**

* Proposals
  + Option 1 (Ericsson):
    - RAN4 to further study whether RA for spCell on unlicensed carrier with CCA shall be prioritized over RA for spCell on licensed carrier, once CCA is successful.
  + Option 2 (CATT, Apple):
    - The NR-U scenario is out of scope of this WID, no need to discuss.
* Recommended WF
  + Further discussion in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 2. The reason is as below,   1. the CCA on target carrier would not only impact the UL RACH but also the DL synchronization procedure, and therefore it would introduce extra big working scope for this topic (not only impact on RACH uncertainty). 2. All the on-going R17 WIs didn’t by default consider NR-U scenario in the requirement design, e.g., power saving enhancement, FeMIMO, MG enhancement and so on. NR-U is optional feature and there are many optional features in R16, we cannot by default consider all the other R16 features in the HO with PSCell, e.g., mobility enhancement in R16 was not by-default considered in this HO with PSCell. 3. In the justification part of this WID, the motivation to design this set of RRM requirement is based on RAN2 consideration in R2-1916600, and NR-U and other R16 new features were not in the scope of that LS. 4. Moreover, regarding the scenario, in R16 NR-U the requirements were only designed for scenario A/B/C, only the scenario B is EN-DC of licensed LTE + NR-U. However, the whole scope of the HO with PSCell covers all EN-DC/NE-DC/NR-DC cases, so we think before considering HO with PSCell with NR-U, we need to make up another important scenario of NR-U in RRM first, i.e., scenario E (NR-DC). |
| Qualcomm | Option1 is supported as we believe the principle is to include NR-U for any new R17 features by default and RAN4 can further discuss if TU shall be extended for addressing the spec effort as needed. |
| Ericsson | Option 1 already agreed during GTW.   * Agreement: Continue discussion on RACH occasion on NR-U CC for HO with PSCell in RAN4 #101e   + Prioritize EN-DC to EN-DC scenario   + Companies are encouraged to provide inputs on the candidate requirements   + FFS whether to introduce requirements |
| CATT | Option 2. Same view as Apple. And we don’t think the principle is to include NR-U in any R17 feature. |

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| MTK | Option 2. |

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**Issue 2-4-4: CSI-RS based CFRA**

* Proposals
  + Option 1 (Apple):
    - If CSI-RS based CFRA is used for RACH on PSCell, the additional CSI-RS measurement and the CSI-RS to RO association period shall be considered.
    - The baseline requirement of PSCell addition and handover when CSI-RS based CFRA is used could be discussed in TEI16.
* Recommended WF
  + Further discussion in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1 |
| Qualcomm | Prefer to follow the same assumption as legacy HO requirements and donot need to discuss CSI-RS based CFRA since CSI-RS based L3 measurement is an optional feature or if the baseline requirements can be approved in TEI16, this can be further discussed. |
| Huawei | Not urgent in this WI from our views. Suggest to be FFS. |
| Ericsson | Suggest FFS on whether to account for CSI-RS based CFRA in the requirements. The necessary baseline for doing so is missing, and it is outside the scope of this WI to determine what goes into TEI etc. |
| vivo | FFS. |
| Nokia | We can discuss this further but we also prefer to start with the legacy HO requirements as suggested by QC. |

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| MTK | HO with PSCell is a Rel-15 feature, CSI-RS RRM based HO is a Rel-16 feature, a requirement of Rel-15 feature should not consider a Rel-16 feature. |

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## Companies’ views collection for 1st round

### Open issues

Comments are collected in section 1.2.

### CRs/TPs comments collection

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

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

### Open issues

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

**Sub-topic 2-1 Scenarios for RRM requirement of HO with PSCell**

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|  | **Status summary** |
| **Issue 2-1-1: Scenarios for RRM requirement of HO with PSCell** | *Tentative agreements:*   * RAN4 specifies RRM requirement for HO with PSCell for the following scenarios as in the WID RP-202874:   + from NR SA to EN-DC   + from EN-DC to EN-DC   + from NE-DC to NE-DC   + from NR-DC to NR-DC   *Recommendations for 2nd round:*  No action |
| **Issue 2-1-2: NR-DC and NE-DC mode in HO with PSCell** | Thank Nokia very much for the compromise to make progress. Moderator understands option 1 would be agreeable then.  *Tentative agreements:*   * In Rel-17, RAN4 define RRM requirements for NR-DC and NE-DC mode   + FR1+FR2 NR-DC   + FR1+LTE NE-DC   *Recommendations for 2nd round:*  No action. |
| **Issue 2-1-2a: Baseline requirements for FR1+FR1 NR-DC** | Most of the companies agree the decision on whether/how/when baseline RRM requirements for FR1+FR1 NR-DC are specified should be up to RAN plenary discussion.  *Tentative agreements:*  The baseline RRM requirements for FR1+FR1 NR-DC is not in the scope of Rel-17 FeRRM WI. It is up to RAN plenary decision whether and in which release the baseline RRM requirements for FR1+FR1 NR-DC are specified.  *Candidate options:*  *Recommendations for 2nd round:*  To confirm if the tentative agreements is agreeable/acceptable. |

**Sub-topic 2-2 Delay requirement design of HO with PSCell**

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|  | **Status summary** |
| **Issue 2-2-1a: Condition of parallel processing without considering RACH** | Agreements on NR-DC to NR-DC have been made during GTW session.   * Agreements in the GTW:   + In HO with PSCell for NR-DC to NR-DC     - Parallel processing shall be the baseline for delay requirements     - Sequential processing shall be assumed for the following cases       * Case 1: If SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16 but not configured in reconfigurationWithSync.       * Sequential processing is used for cell search and [timing sync]. FFS if additional margin shall be added.   *Tentative agreements:*   * + In HO with PSCell for EN-DC to EN-DC     - Parallel processing shall be the baseline for delay requirements   + In HO with PSCell for NE-DC to NE-DC     - Parallel processing shall be the baseline for delay requirements   *Candidate options:*  **Issue 2-2-1a-1: Condition of parallel processing without considering RACH for NR SA to EN-DC**   * Proposals   + Option 1     - Parallel processing shall be the baseline for delay requirements     - Sequential processing shall be assumed for the following cases       * If SMTC of target unknown PSCell is configured in RRCConnectionReconfiguration in targetRAT-MessageContainer   + Option 1     - Parallel processing shall be the baseline for delay requirements     - Sequential processing shall be assumed for the following cases       * FFS since the reference timing is not yet determined in RAN2   + Option 3     - Parallel processing shall be the baseline for delay requirements   + Option 4     - Sequential processing shall be the baseline for delay requirements   *Recommendations for 2nd round:*  To check if the tentative agreements are agreeable/acceptable.  Further discussion on Issue 2-2-1a-1 |
| **Issue 2-2-1b: Whether requirements for sequential processing are needed if parallel processing is only possible under certain condition** | Majority companies thinkRAN4 should define the requirements for both sequential processing and parallel processing.  Qualcomm proposes to define unified requirements to cover both parallel processing and sequential processing.  Nokia commented further discussion is needed on if and how to specify requirements for the sequential processing case.  *Tentative agreements:*  RRM requirements for HO with PSCell are defined for both parallel processing and sequential processing cases.  FFS how the requirements are specified, e.g., unified requirements for both cases or separated requirements for different cases.  *Recommendations for 2nd round:*  To check if the tentative agreements are agreeable/acceptable. |
| **Issue 2-2-2: Parallel processing timeline without considering Tprocessing and RA procedures** | There is no obvious consensus on how the processing timing line (mainly for cell search, T/F tracking loop) should be. It also depends on conclusion of Issue 2-2-1b.  To facilitate discussion, moderator would like to re-organize the issue with the assumption that RRM requirements for HO with PSCell will be defined for both parallel processing cases and sequential processing cases.  *Tentative agreements:*  None.  *Candidate options:*  **Issue 2-2-2a: How the requirements for parallel processing and sequential processing are defined without considering Tprocessing and RA procedures**  *The parallel processing cases and sequential processing cases are discussed under Issue 2-2-1a and Issue 2-2-1a-1. It is also noted that it was agreed during GTW that parallel processing shall be the baseline for delay requirements for NR-DC to NR-DC.*   * Proposals   + Option 1:     - Different requirements for parallel processing cases and sequential processing cases   + Option 2:     - Unified requirements to cover both parallel processing cases and sequential processing cases   **Issue 2-2-2b: Timeline for delay requirements without considering Tprocessing and RA procedures**  *The parallel processing cases and sequential processing cases are discussed under Issue 2-2-1a. Though this issue is dependent on Issue 2-2-2a, it is also encouraged to elaborate the requirements if either unified or different requirements is agreed.*   * Proposals   + Option 1     - For parallel processing cases, PCell HO and PSCell addition are performed in parallel independently     - For sequential processing cases,       * Option A: Sequential processing of cell search and timing sync for PCell handover and PSCell addition.       * Option B: Tsearch can be extended for sequential processing cell search, e.g. Tsrch= Tsearch\_MCG+Tsearch\_SCGand the time for SSB post-processing may also be extended e.g. Tm=2xTmargin         + Adopt the same time for loop processing as legacy T∆ i.e. the fine time tracking and acquiring full timing information of the target cell shall be assumed running independently for each CG       * Option C: Other options are not precluded.   + Option 2     - For both parallel processing cases and sequential processing cases     - Option A:       * Tsearch can be extended for sequential processing cell search, e.g. Tsrch= Tsearch\_MCG+Tsearch\_SCGand the time for SSB post-processing may also be extended e.g. Tm=2xTmargin         + Adopt the same time for loop processing as legacy T∆ i.e. the fine time tracking and acquiring full timing information of the target cell shall be assumed running independently for each CG     - Option B:       * Other options are not precluded   *Recommendations for 2nd round:*  Continue discussion on new organized issues. |
| **Issue 2-2-3: UE SW processing and RF warm-up(if needed) time for HO with PSCell** | There is no obvious consensus on how the Tprocessing time could be.  To facilitate discussion, moderator would like to re-organize the issue by taking all the comments into account.  *Tentative agreements:*  None.  *Candidate options:*  **Issue 2-2-3a: Timeline of Tprocessing (UE SW processing and RF warm-up(if needed) time) for HO with PSCell**  *The parallel processing cases and sequential processing cases are discussed under Issue 2-2-1a.*   * Proposals   + Option 1:     - For both parallel processing cases and sequential processing cases, UE SW processing and RF warm-up for PCell handover and PSCell addition/change are performed in parallel.   + Option 2:     - For parallel processing cases, UE SW processing and RF warm-up for PCell handover and PSCell addition/change are performed in parallel.     - For sequential processing cases, UE SW processing and RF warm-up for PCell handover and PSCell addition/change are performed in sequential.   **Issue 2-2-3b: If UE SW processing and RF warm-up for PCell HO and PSCell addition/change are performed in parallel**   * Proposals   + Option 1:     - Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change)   + Option 2:     - Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) + 10ms   + Option 3:     - No need to define Tprocessing for HO with PSCell since HO with PSCell can refer to current legacy PCell HO and PSCell addition requirement directly.   + Option 4:     - Other options are not precluded   **Issue 2-2-3c: If UE SW processing and RF warm-up for PCell HO and PSCell addition/change are performed in sequential**  *It further depends on conclusion of Issue 2-2-3a whether this is needed or not.*   * Proposals   + Option 1:     - Tprocessing for HO with PSCell = sum(Tprocessing for PCell HO, Tprocessing for PSCell addition/change)   + Option 2:     - Other options are not precluded   **Issue 2-2-3d: Tprocessing for PCell HO**  *Based on moderator’s understanding, it should be the legacy UE SW processing time for PCell HO. Since there are different types of proposals from companies, moderator would like to encourage the group to achieve common understanding of the requirements.*   * Proposals   + Option 1:     - 20ms, when source and target cells are in the same FR     - 40ms, when source and target cells are in different FRs   + Option 2:     - Other options are not precluded   **Issue 2-2-3e: Tprocessing for PSCell addition/change**  *Based on moderator’s understanding, it should be the legacy UE SW processing time for PSCell addition/change. Since there are different types of proposals from companies, moderator would like to encourage the group to achieve common understanding of legacy requirements.*   * Proposals   + Option 1:     - For PSCell change       * 20ms, when source and target cells are in the same FR       * 40ms, when source and target cells are in different FRs     - For PSCell addition       * 20ms, when NR PSCell is in FR1       * 40ms, when NR PSCell is in FR2   + Option 2:     - Other options are not precluded   *Recommendations for 2nd round:*  Continue discussion on new organized issues. |
| **Issue 2-2-4: RA processing for PCell and PSCell** | *Tentative agreements:*   * RACH processing for PCell and PSCell are performed in parallel independently.   *Recommendations for 2nd round:*  No action. |
| **Issue 2-2-5: Ending point of the delay requirement for HO with PSCell** | *Tentative agreements:*  None.  *Candidate options:*  **Issue 2-2-5: Ending point of the delay requirement for HO with PSCell**   * Proposals:   + Option 1 (Apple, Xiaomi, CMCC, CATT, Qualcomm, OPPO):     - the later timing between “timing when UE shall be capable to transmit PRACH preamble towards target PCell” and “the timing when UE shall be capable to transmit PRACH preamble towards target PSCell”.   + Option 2 (vivo, CMCC, Intel, Huawei, MTK, Ericsson, Qualcomm, CATT):     - Defining delay requirements for HO and PSCell addition/change separately with the ending points defined as PCell PRACH and PSCell PRACH, respectively.   + Option 3 (Nokia):     - No need to discuss and define the ending point of HO with PSCell.   *Recommendations for 2nd round:*  Further discussion in the 2nd round. |
| **Issue 2-2-6: Optimisation for the case when PSCell is not changed during HO with PSCell** | *Tentative agreements:*   * For UE which is already configured with DC, the UE’s behavior is the same whether the configured PSCell is same as the original one or not.   *Recommendations for 2nd round:*  No action. |
| **Issue 2-2-8: Delay requirement design** | Majority companies’ view is that it depends on other issues. Suggest coming back in the next meeting.  *Tentative agreements:*  None  *Candidate options:*  Original. No change.  *Recommendations for 2nd round:*  Come back in the next meeting. |

**Sub-topic 2-3 Interruption requirement design of HO with PSCell**

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|  | **Status summary** |
| **Issue 2-3-2: Interruption requirement for HO with PSCell** | It seems companies have different understanding of interruption requirements to be addressed in this issue. Moderator would like to re-organize the issue to facilitate the discussion.  *Tentative agreements:*  None*.*  *Candidate options:*  **Issue 2-3-2a: Interruption requirements, similar as Tinterrupt for in legacy handover requirements, for HO with PSCell**   * Proposals   + Option 1a     - No new interruption requirement for HO with PSCell is needed. Interruption in legacy handover delay requirement can still be applied for the PCell HO.   + Option 1b:     - Interruption in legacy handover delay requirement can be applied for PCell. No interruption is defined for PSCell.   + Option 2     - Other options are not precluded.   **Issue 2-3-2b: Interruption requirements on PCell/PSCell due to PSCell/PCell RF retuning**   * Proposals   + Option 1     - No interruption requirement should be defined during HO with PSCell   + Option 2     - Interruption in legacy handover delay requirement can be applied for Pcell. No interruption is defined on PSCell.       * If sequential processing is used for HO with PSCell, UE may have an interruption on new PCell due to the PSCell addition.       * If parallel processing is used for HO with PSCell, no need to define interruption requirement.   + Option 3     - Other options are not precluded.   *Recommendations for 2nd round:*  Further discussion on the re-organized issues in the 2nd round. |

**Sub-topic 2-4 Generic RACH assumption for HO with PSCell**

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|  | **Status summary** |
| **Issue 2-4-1: 2 step and 4 step RACH for HO with PSCell** | Companies’ views are diverse. Continue discussion in the 2nd round.  *Tentative agreements:*  None.  *Candidate options:*  **Issue 2-4-1: 2 step and 4 step RACH for HO with PSCell**   * Proposals   + Option 1a (ZTE, Nokia, vivo, CATT, Ericsson):     - Include both 2-step RA and 4-step RA into the new requirements made for handover with PSCell. No need to mention 2-step or 4-step in HO with PSCell requirements.   + Option 1b (Ericsson, ZTE, CATT):     - RAN4 shall define delay requirements for HO with PSCell for both 2-step and 4-step RA. Impact on delay requirements depends on timeline with respect to parallel processing of RA.   + Option 2 (Apple, Xiaomi, OPPO, Intel, MTK):     - For requirement of HO with PSCell, RAN4 starts the discussion with 4 step RACH first and FFS on 2 step RACH.   + Option 3 (Qualcomm):     - Define the ending points as Pcell PRACH and PSCell PRACH respectively by assuming 4-step RACH   *Recommendations for 2nd round:*  Continue discussion in the 2nd round. |
| **Issue 2-4-2: RACH occasion collision between Pcell and PSCell** | Majority companies are fine with option 1. Qualcomm commented to FFS. Nokia commented to further discuss on the first 2 bullet, but is fine with the last bullet.  Tentative agreements:  None.  Candidate options:  Original. No change.  Recommendations for 2nd round:  Qualcomm and Nokia are encouraged to provide technical concerns, if any, in the 2nd round. |
| **Issue 2-4-3: RACH occasion on NR-U CC for HO with PSCell** | *Tentative agreements:*   * Agreement in the GTW session:   + Continue discussion on RACH occasion on NR-U CC for HO with PSCell in RAN4 #101e     - Prioritize EN-DC to EN-DC scenario     - Companies are encouraged to provide inputs on the candidate requirements     - FFS whether to introduce requirements   *Recommendations for 2nd round:*  None |
| **Issue 2-4-4: CSI-RS based CFRA** | *Tentative agreements:*  None.  *Candidate options:*  **Issue 2-4-4: CSI-RS based CFRA**   * Proposals   + Option 1 (Apple):     - If CSI-RS based CFRA is used for RACH on PSCell, the additional CSI-RS measurement and the CSI-RS to RO association period shall be considered.     - The baseline requirement of PSCell addition and handover when CSI-RS based CFRA is used could be discussed in TEI16.   + Option 2 (Huawei, Ericsson, vivo):     - FFS   + Option 3 (Qualcomm, Nokia):     - Follow the same assumption as legacy HO requirements and do not need to discuss CSI-RS based CFRA   + Option 4 (MTK):     - Should not consider the Rel-16 feature   *Recommendations for 2nd round:*  Further discussion in the 2nd round |

### CRs/TPs

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

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

## Discussion on 2nd round

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

### Sub-topic 2-1 Scenarios for RRM requirement of HO with PSCell

**Issue 2-1-2a: Baseline requirements for FR1+FR1 NR-DC**

*Tentative agreements below were recommended in the 1st round summary. Companies may confirm if it is agreeable.*

* The baseline RRM requirements for FR1+FR1 NR-DC is not in the scope of Rel-17 FeRRM WI. It is up to RAN plenary decision whether and in which release the baseline RRM requirements for FR1+FR1 NR-DC are specified.
* Proposals
  + Tentative agreements in the 1st round
* Recommended WF
  + Agree on tentative agreements
* 2nd round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Xiaomi | Fine with the tentative agreement |
| Apple | We can compromise to recommended WF. |
| Huawei | Fine with the recommended WF |
| Qualcomm | Fine with the recommended WF |
| vivo | Support the recommended WF. |
| Intel | Fine with the recommended WF |
| OPPO | Fine with the recommended WF |
| CATT | Fine with the recommended WF. |
| Ericsson | We are fine with the recommended WF |
| ZTE | Fine with the recommended WF. |
| Nokia | Fine with the recommended WF. |
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### Sub-topic 2-2 Delay requirement design of HO with PSCell

*Sub-topic description*

*Open issues and candidate options after 1st round:*

**Issue 2-2-1a: Condition of parallel processing without considering RACH**

* Agreements in the GTW:
  + In HO with PSCell for NR-DC to NR-DC
    - Parallel processing shall be the baseline for delay requirements
    - Sequential processing shall be assumed for the following cases
      * Case 1: If SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16 but not configured in reconfigurationWithSync.
      * Sequential processing is used for cell search and [timing sync]. FFS if additional margin shall be added.

*Tentative agreements in the 1st round:*

* + In HO with PSCell for EN-DC to EN-DC
    - Parallel processing shall be the baseline for delay requirements
  + In HO with PSCell for NE-DC to NE-DC
    - Parallel processing shall be the baseline for delay requirements
* Recommended WF
  + Agree on tentative agreements
* 2nd round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Xiaomi | Fine with the tentative agreements |
| Apple | Support recommended WF |
| Huawei | Fine with the recommended WF |
| Qualcomm | Fine with the recommended WF |
| vivo | Fine with the recommended WF |
| Intel | Fine with the recommended WF |
| OPPO | Fine with the recommended WF |
| CATT | Fine with the recommended WF. |
| Ericsson | We are fine with the recommended WF |
| ZTE | Fine with the recommended WF. |
| CMCC | OK with the recommended WF |
| Nokia | Fine with the recommended WF. |
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**Issue 2-2-1a-1: Condition of parallel processing without considering RACH for NR SA to EN-DC**

* Proposals
  + Option 1
    - Parallel processing shall be the baseline for delay requirements
    - Sequential processing shall be assumed for the following cases
      * If SMTC of target unknown PSCell is configured in RRCConnectionReconfiguration in targetRAT-MessageContainer
  + Option 2
    - Parallel processing shall be the baseline for delay requirements
    - Sequential processing shall be assumed for the following cases
      * FFS since the reference timing is not yet determined in RAN2
  + Option 3
    - Parallel processing shall be the baseline for delay requirements
  + Option 4
    - Sequential processing shall be the baseline for delay requirements
* Recommended WF
  + Further discussion
* 2nd round Comment collection:

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| **Company** | **Comments** |
| Xiaomi | Fine with option 1 |
| Apple | Option 4 shall be used when smtc of target NR PSCell is configured. The reason is: In NR-SA to EN-DC, the PSCell SMTC can only be configured in RRCConnectionReconfiguration in targetRAT-MessageContainer; and this SMTC can only be based on reference timing from target LTE PCell, so only sequential processing shall be used when SMTC is configured for NR-SA to EN-DC case.  However, if the smtc is not configured for target NR PSCell,   * UE uses the SMTC in the MO having the same SSB frequency and subcarrier spacing as target PSCell, or * UE assumes 5ms as SSB periodicity for target PSCell if source PCell didn’t configure MO having the same SSB frequency and subcarrier spacing as the target PSCell. |
| Huawei | Option 1. We tend to agree with Apple’s observation that NR-SA to EN-DC, if SMTC is configured within the RRC message, timing of target LTE PCell shall be considered as the reference cell. |
| Qualcomm | Option2 is supported because we share the same observation as MTK comments in the first round that RAN2 has not closed this discussion on choice of reference timing for NRSA to ENDC. |
| vivo | Fine with option 1 and option 2. |
| Intel | Option 1. For the 2nd bullet of option 1, if the target PCell is known, can it still be parallel? |
| OPPO | Option 1 is fine |
| CATT | Option 2. Need to check RAN2 progress. |
| Ericsson | We are fine with Option 2. |
| ZTE | Support option 2. |
| CMCC | OK with option 2 |
| Nokia | We support option 3. |
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**Issue 2-2-1b: Whether requirements for sequential processing are needed if parallel processing is only possible under certain condition**

*Tentative agreements:*

RRM requirements for HO with PSCell are defined for both parallel processing and sequential processing cases.

FFS how the requirements are specified, e.g., unified requirements for both cases or separated requirements for different cases.

* Recommended WF
  + Company may confirm if the following is agreeable.
    - RRM requirements for HO with PSCell are defined for both parallel processing and sequential processing cases.
  + Note: How the requirements are specified is discussed under Issue 2-2-2a.
* 2nd round Comment collection:

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| **Company** | **Comments** |
| Xiaomi | Agree with the recommended WF. |
| Apple | Agree with recommended WF. |
| Huawei | Agree with recommended WF. |
| Qualcomm | Recommended WF is not clear to us if the FFS is still open. So maybe we shall focus on 2-2-2a/2-2-2b before concluding 2-2-1b.  So we doNOT agree with the recommended WF. |
| vivo | Support the recommended WF. |
| Intel | Agree with recommended WF. |
| OPPO | Agree with recommended WF. |
| CATT | Fine with the recommended WF. |
| CMCC | We are OK with the recommended WF. We support to define requirements for both parallel processing and sequential processing. And we prefer to have separate requirements for these two cases, but we are OK to have further discussion. |
| Nokia | We share the same view as Qualcomm, we do not think it is essential to decide this point. |
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**Issue 2-2-2a: How the requirements for parallel processing and sequential processing are defined without considering Tprocessing and RA procedures**

*The parallel processing cases and sequential processing cases are discussed under Issue 2-2-1a and Issue 2-2-1a-1. It is also noted that it was agreed during GTW that parallel processing shall be the baseline for delay requirements for NR-DC to NR-DC.*

* Proposals
  + Option 1:
    - Different requirements for parallel processing cases and sequential processing cases
  + Option 2:
    - Unified requirements to cover both parallel processing cases and sequential processing cases

**Issue 2-2-2b: Timeline for delay requirements without considering Tprocessing and RA procedures**

*The parallel processing cases and sequential processing cases are discussed under Issue 2-2-1a. Though this issue is dependent on Issue 2-2-2a, it is also encouraged to elaborate the requirements if either unified or different requirements is agreed.*

* Proposals
  + Option 1
    - For parallel processing cases, PCell HO and PSCell addition are performed in parallel independently
    - For sequential processing cases,
      * Option A: Sequential processing of cell search and timing sync for PCell handover and PSCell addition.
      * Option B: Tsearch can be extended for sequential processing cell search, e.g. Tsrch= Tsearch\_MCG+Tsearch\_SCGand the time for SSB post-processing may also be extended e.g. Tm=2xTmargin
        + Adopt the same time for loop processing as legacy T∆ i.e. the fine time tracking and acquiring full timing information of the target cell shall be assumed running independently for each CG
      * Option C: Other options are not precluded.
  + Option 2
    - For both parallel processing cases and sequential processing cases
    - Option A:
      * Tsearch can be extended for sequential processing cell search, e.g. Tsrch= Tsearch\_MCG+Tsearch\_SCGand the time for SSB post-processing may also be extended e.g. Tm=2xTmargin
        + Adopt the same time for loop processing as legacy T∆ i.e. the fine time tracking and acquiring full timing information of the target cell shall be assumed running independently for each CG
    - Option B:
      * Other options are not precluded
* 2nd round Comment collection:

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| **Company** | **Comments** |
|  | **Issue 2-2-2a**  **Issue 2-2-2b** |
| Xiaomi | **Issue 2-2-2a: prefer option 1**  **Issue 2-2-2b: prefer option 1** |
| Apple | **Issue 2-2-2a**: option 1. But OK to FFS.  **Issue 2-2-2b**: option 1 and option D, as we think the SSB processing delay shall could be in a sequential processing.   * For sequential processing cases,   **Option D:**   * Option A: Sequential processing of cell search, timing sync and SSB processing time for PCell handover and PSCell addition. |
| Huawei | Issue 2-2-2a:  Prefer option 1 to avoid unnecessary extension of the delay requirements.  Issue 2-2-2b: Prefer option 1-A |
| Qualcomm | Issue 2-2-2a:  Option2 is supported for simplifying the requirements which accommodate the worst case and, potentially reducing the number of test cases  *To Huawei, we prefer the same set of RAN4 requirements to cover the various cases including the worse case that requires partially sequential scenarios.*  *To proponents of option1, we think option2 could cover the case of option1.*  Issue 2-2-2b:  **We support option2-A** for this issue because we support option2 for issue2-2-2a.\*  *\* For T∆, considering companies’ feedbacks, we need to further check if it shall be extended as T∆\_PCell +T∆\_PSCell due to dependency of PSCell on target PCell.* |
| vivo | **Issue 2-2-2a**  Prefer option 1. We see the requirements for parallel processing can only be applied to some special scenario. Therefore, we do not think unified requirements for both scenarios are needed. Network may know the UE’s performance under certain conditions.  Regarding QC’s concern on test cases, that can be further discussed in the performance part.  **Issue 2-2-2b**  Prefer option 1-A. But OK to FFS for option 1-D. |
| Intel | Issue 2-2-2a:  Prefer option 1 to make it more clear.  Issue 2-2-2b: Prefer option 1. The detail sub-option can be further discussed. |
| OPPO | Issue 2-2-2a: prefer option 1  Issue 2-2-2b: prefer option 1. FFS how to consider sequential processing of cell search, timing sync and SSB processing time for PCell handover and PSCell addition. |
| CATT | Issue 2-2-2a:  Option 1.  Issue 2-2-2b:  Option 1 and the details are FFS. |
| ZTE | **Issue 2-2-2a**: Option 1 is more clear. |
| CMCC | **Issue 2-2-2a:**  **Option 1**  **Issue 2-2-2b:**  **We are OK with the parallel processing part of Option 1, for the sequential processing case, we are open to have further discussion.** |
| Nokia | Issue 2-2-2a:  We support aiming at unified requirements, this will obviously depend on the different delay that are needed. So we basically identify each delay parameter for each handover (PCell Handover, PSCell addition). More discussion is needed if the delay for parallel or sequential processing will be the same or not.  Issue 2-2-2b:  This will depend on the conclusion on Issue 2-2-2a. |
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**Issue 2-2-3a: Timeline of Tprocessing (UE SW processing and RF warm-up(if needed) time) for HO with PSCell**

*The parallel processing cases and sequential processing cases are discussed under Issue 2-2-1a.*

* Proposals
  + Option 1:
    - For both parallel processing cases and sequential processing cases, UE SW processing and RF warm-up for PCell handover and PSCell addition/change are performed in parallel.
  + Option 2:
    - For parallel processing cases, UE SW processing and RF warm-up for PCell handover and PSCell addition/change are performed in parallel.
    - For sequential processing cases, UE SW processing and RF warm-up for PCell handover and PSCell addition/change are performed in sequential.

**Issue 2-2-3b: If UE SW processing and RF warm-up for PCell HO and PSCell addition/change are performed in parallel**

* Proposals
  + Option 1:
    - Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change)
  + Option 2:
    - Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) + 10ms
  + Option 3:
    - No need to define Tprocessing for HO with PSCell since HO with PSCell can refer to current legacy PCell HO and PSCell addition requirement directly.
  + Option 4:
    - Other options are not precluded

**Issue 2-2-3c: If UE SW processing and RF warm-up for PCell HO and PSCell addition/change are performed in sequential**

*It further depends on conclusion of Issue 2-2-3a whether this is needed or not.*

* Proposals
  + Option 1:
    - Tprocessing for HO with PSCell = sum(Tprocessing for PCell HO, Tprocessing for PSCell addition/change)
  + Option 2:
    - Other options are not precluded

**Issue 2-2-3d: Tprocessing for PCell HO**

*Based on moderator’s understanding, it should be the legacy UE SW processing time for PCell HO. Since there are different types of proposals from companies, moderator would like to encourage the group to achieve common understanding of the requirements.*

* Proposals
  + Option 1:
    - 20ms, when source and target cells are in the same FR
    - 40ms, when source and target cells are in different FRs
  + Option 2:
    - Other options are not precluded

**Issue 2-2-3e: Tprocessing for PSCell addition/change**

*Based on moderator’s understanding, it should be the legacy UE SW processing time for PSCell addition/change. Since there are different types of proposals from companies, moderator would like to encourage the group to achieve common understanding of legacy requirements.*

* Proposals
  + Option 1:
    - For PSCell change
      * 20ms, when source and target cells are in the same FR
      * 40ms, when source and target cells are in different FRs
    - For PSCell addition
      * 20ms, when NR PSCell is in FR1
      * 40ms, when NR PSCell is in FR2
  + Option 2:
    - Other options are not precluded
* 2nd round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | **Issue 2-2-3a:**  Option 2.  **Issue 2-2-3b**  Option 1.  **Issue 2-2-3c**  Option 1.  **Issue 2-2-3d**  Option 1.  **Issue 2-2-3e**  Option 1 or NR-DC and EN-DC. |
| Huawei | **Issue 2-2-3a:**  Option 1.  **Issue 2-2-3b**  Option 1.  **Issue 2-2-3d**  Option 1.  **Issue 2-2-3e**  Option 1for NR-DC and EN-DC |
| Qualcomm | **Issue 2-2-3a:**  Option 1.  **Issue 2-2-3b**  Option4, e.g.   * *Extending the UE processing time for NRSA to EN-DC joint handover by [FFS]ms and [FFS] can be 10ms as the starting point, i.e. Tprocessing = [30]ms.* * *For NRDC to NRDC, the UE processing time to be 20ms without FR mode switch on PSCell; otherwise, the UE processing time shall be 40ms as the legacy PSCell change requirement.*   **Issue 2-2-3c**  *depends on conclusion of Issue 2-2-3a whether this is needed or not*  **Issue 2-2-3d**  Option 1.  **Issue 2-2-3e**  Option 1for NR-DC and EN-DC |
| vivo | **Issue 2-2-3a: Option 1 but OK to FFS for the sequential part.**  **Issue 2-2-3b: Option 1 for EN-DC, NR-DC and NE-DC. additional [10] ms is needed for NR-SA to EN-DC**  **Issue 2-2-3c: FFS**  **Issue 2-2-3d: Option 1;**  **Issue 2-2-3e: Option 1;.** |
| Intel | **Issue 2-2-3a:**  Option 1.  **Issue 2-2-3b**  Option 1.  **Issue 2-2-3c:**  Option 1.  **Issue 2-2-3d**  Option 1.  **Issue 2-2-3e**  Option 1 for NR-DC and EN-DC. |
| OPPO | **Issue 2-2-3a:**  Fine with Option 2.  **Issue 2-2-3b**  Option 1.  **Issue 2-2-3c**  Option 1.  **Issue 2-2-3d**  Option 1.  **Issue 2-2-3e**  Option 1 or NR-DC and EN-DC. |
| CATT | Issue 2-2-3a:  Option 1.  Issue 2-2-3b  Option 1.  Issue 2-2-3c  Option 1 |
| Ericsson | **Issue 2-2-3a**  We prefer Option 1  **Issue 2-2-3b**  We prefer Option 1  **Issue 2-2-3c**  **Issue 2-2-3d**  We support Option 1  **Issue 2-2-3e**  We support Option 1 |
| ZTE | **Issue 2-2-3a**  Option 1  **Issue 2-2-3b**  Option 1  **Issue 2-2-3c**  Option 1  **Issue 2-2-3d**  Option 1  **Issue 2-2-3e**  Option 1 |
| Nokia | Issue 2-2-3a:  Option 1  Issue 2-2-3b:  Option 3  Issue 2-2-3c:  depends on the conclusion of 2-2-3a.  Issue 2-2-3d:  it would be the same as the legacy UE SW processing time for PCell HO.  Issue 2-2-3e:  We understand that in this case it would be the same as the legacy UE SW processing time for PSCell addition. |
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**Issue 2-2-5: Ending point of the delay requirement for HO with PSCell**

* Proposals:
  + Option 1 (Apple, Xiaomi, CMCC, CATT, Qualcomm, OPPO):
    - the later timing between “timing when UE shall be capable to transmit PRACH preamble towards target PCell” and “the timing when UE shall be capable to transmit PRACH preamble towards target PSCell”.
  + Option 2 (vivo, CMCC, Intel, Huawei, MTK, Ericsson, Qualcomm, CATT):
    - Defining delay requirements for HO and PSCell addition/change separately with the ending points defined as PCell PRACH and PSCell PRACH, respectively.
  + Option 3 (Nokia):
    - No need to discuss and define the ending point of HO with PSCell.
* Recommended WF
  + Further discussion.
* 2nd round Comment collection:

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| **Company** | **Comments** |
| Xiaomi | Option 1 |
| Apple | Prefer Option 1. The benefit for option 1 is UE could have more flexibility to coordinate the PCell HO and PSCell addition as long as it can meet the unified requirement. But understand the HW and MTK’s replies in 1st round, we could compromise to option 2 if majority companies support it. |
| Huawei | Prefer option 2. |
| Qualcomm | Slightly prefer Option 2 as the requirements for PCell and PSCell shall consider respective TRS |
| vivo | Option 2. |
| Intel | Prefer option 2. |
| OPPO | Option 1 is preferred. |
| CATT | Prefer option 1. |
| Ericsson | We support Option 2. |
| Nokia | We support Option 3. We think we can reuse current legacy PCell HO and PSCell addition independently. |
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### Sub-topic 2-3 Interruption requirement design of HO with PSCell

**Issue 2-3-2a: Interruption requirements, similar as Tinterrupt for in legacy handover requirements, for HO with PSCell**

* Proposals
  + Option 1a
    - No new interruption requirement for HO with PSCell is needed. Interruption in legacy handover delay requirement can still be applied for the PCell HO.
  + Option 1b:
    - Interruption in legacy handover delay requirement can be applied for PCell. No interruption is defined for PSCell.
  + Option 2
    - Other options are not precluded.

**Issue 2-3-2b: Interruption requirements on PCell/PSCell due to PSCell/PCell RF retuning**

* Proposals
  + Option 1
    - No interruption requirement should be defined during HO with PSCell
  + Option 2
    - Interruption in legacy handover delay requirement can be applied for Pcell. No interruption is defined on PSCell.
      * If sequential processing is used for HO with PSCell, UE may have an interruption on new PCell due to the PSCell addition.
      * If parallel processing is used for HO with PSCell, no need to define interruption requirement.
  + Option 3
    - Other options are not precluded.
* Recommended WF
  + Further discuss on the new issues above. Company may clarify on understanding/interpretation of the interruption requirements.
* 2nd round Comment collection:

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| **Company** | **Comments** |
|  | **Issue 2-3-2a**  **Issue 2-3-2b** |
| Xiaomi | Issue 2-3-2a: Option 1b  Issue 2-3-2b: Option 2 |
| Apple | **Issue 2-3-2a:** option 1b.  **Issue 2-3-2b:** option 2. We disagree to restrict UE implementation to perform the RF tuning at the same time for PCell HO and PSCell addition/change when sequential processing is used. Even go with option 2, the UE is still allowed to perform the one-time RF tuning. |
| Huawei | **Issue 2-3-2a:** option 1b.  **Issue 2-3-2b:**  Option 1. For option 2, we think first companies can agree that for parallel processing, there is no additional interruption caused by RF tuning. For sequential processing, if UE is allowed tuning the RF of PSCell independently, then we will consider when the SSB for searching in PCell is dropped/ when the PRACH in PCell is interrupted, the delay of HO is unpredictable. |
| Qualcomm | **Issue 2-3-2a:** option 1b.  **Issue 2-3-2b:**  As our assumption is RF retuning has been considered during the stage of Tprocessing, which is needed for search anyway, so PSCell and PCell retunings are absorbed in the same period of time before parallel or sequential search starts. So there should be no interruptions caused by PSCell on PCell traffic.  Option1 is thus supported. |
| vivo | **Issue 2-3-2a: Option 1b.**  **Issue 2-3-2b: Prefer option 1 but OK to FFS for the sequential bullet in option 2. At least we can agree on the parallel part.** |
| Intel | **Issue 2-3-2a**  option 1b.  **Issue 2-3-2b**  Slightly prefer Option 1 since RF re-tuning may not happen at the same time for PCell and PSCell. Can be further discussed. |
| OPPO | Issue 2-3-2a: Option 1b  Issue 2-3-2b: Option 2. Agree with Apple’s observation. |
| CATT | Issue 2-3-2a: Option 1b  Issue 2-3-2b: Option 1. |
| Ericsson | **Issue 2-3-2a**  We support Option 1b  **Issue 2-3-2b**  We support Option 1 |
| Nokia | Issue 2-3-2a:  We support option 1a, but we do not see much difference between option 1a and option 1b.  Issue 2-3-2b:  We support Option 1. |
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### Sub-topic 2-4 Generic RACH assumption for HO with PSCell

**Issue 2-4-1: 2 step and 4 step RACH for HO with PSCell**

* Proposals
  + Option 1a (ZTE, Nokia, vivo, CATT, Ericsson):
    - Include both 2-step RA and 4-step RA into the new requirements made for handover with PSCell. No need to mention 2-step or 4-step in HO with PSCell requirements.
  + Option 1b (Ericsson, ZTE, CATT):
    - RAN4 shall define delay requirements for HO with PSCell for both 2-step and 4-step RA. Impact on delay requirements depends on timeline with respect to parallel processing of RA.
  + Option 2 (Apple, Xiaomi, OPPO, Intel, MTK):
    - For requirement of HO with PSCell, RAN4 starts the discussion with 4 step RACH first and FFS on 2 step RACH.
  + Option 3 (Qualcomm):
    - Define the ending points as Pcell PRACH and PSCell PRACH respectively by assuming 4-step RACH
* Recommended WF
  + Companies may provide initial views on the difference of 2 step RACH requirements and 4-step RACH requirements. If there is not much difference, then there would be no prioritization needed. Moderator would like to encourage proponent companies to provide their analysis of requirements difference.
* 2nd round Comment collection:

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| **Company** | **Comments** |
| Xiaomi | Prefer option 2 |
| Apple | Option 2. |
| Qualcomm | Option3 and can compromise to option2  For option1, how to avoid mentioning 2 or 4-step RACH? Do we not mention message 1 or message A? |
| vivo | Slightly prefer option 1 but ok to FFS. |
| Intel | Prefer option 2 |
| OPPO | Prefer option 2 |
| CATT | Option 1. We think there is no difference between the requirements for 4-step and 2-step RACH. |
| Ericsson | Option 1a.  To Qualcomm: Correct, depending on how the wording is chosen, one might mention both alternatives. The point is however that essentially the same timeline applies up to the point the UE is transmitting PRACH.  Regarding Option 3, it is our view too that PRACH preamble transmission shall be the ending point. However we do not agree to limit it to 4-step RA only, and we do not see that different timeline would result depending on whether 4-step or 2-step RA is used. Rather, we see that the same set of requirements can be applied.  Can Qualcomm consider a compromise where ending points are PRACH preamble transmission in PCell and PSCell, respectively, and where PRACH preamble transmission can be in response to either a 4-step or a 2-step RA procedure? |
| ZTE | We support option 1. Both 2-step RA and 4-step RA are considered in the applicability rules of HO requirements and PSCell addition delay requirements in clause 3.6.8 of TS 38.133. |
| Nokia | We support option 1a. Same comments as provided in 1st round. |
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**Issue 2-4-2: RACH occasion collision between Pcell and PSCell**

* Proposals
  + Option 1 (Apple):
    - for FR1+FR1 EN-DC, an additional uncertainty delay due to PSCell RACH collision with PCell UL channels may be introduced if the PSCell RACH cannot be transmitted based on the criteria in TS38.213 section 7.6.1;
    - for FR1+FR1 NE-DC, an additional uncertainty delay due to PCell RACH collision with PSCell RACH may be introduced if the PCell RACH cannot be transmitted based on the criteria in TS38.213 section 7.6.2;
    - otherwise, if target PCell and target PSCell are on the different FRs for EN-DC or NR-DC, no need to consider RO collision issue.
* Recommended WF
  + Qualcomm and Nokia are encouraged to provide further views and concerns if any.
* 2nd round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1. All the bullets are based on RAN1 definition in TS38.213 section 7.6.1 and 7.6.2. |
| Qualcomm | Can support option1 with an FFS on how to capture the extra uncertain delay. |
| Ericsson | We are fine with Option 1. |
| Nokia | We do not think we need the additional delay need to be introduced for LTE-FR1 EN-DC and FR1-LTE NE-DC as stated in option 1. |
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**Issue 2-4-4: CSI-RS based CFRA**

* Proposals
  + Option 1 (Apple):
    - If CSI-RS based CFRA is used for RACH on PSCell, the additional CSI-RS measurement and the CSI-RS to RO association period shall be considered.
    - The baseline requirement of PSCell addition and handover when CSI-RS based CFRA is used could be discussed in TEI16.
  + Option 2 (Huawei, Ericsson, vivo):
    - FFS
  + Option 3 (Qualcomm, Nokia):
    - Follow the same assumption as legacy HO requirements and do not need to discuss CSI-RS based CFRA
  + Option 4 (MTK):
    - Should not consider the Rel-16 feature
* Recommended WF
  + Further discussion.
* 2nd round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1, but fine to FFS. |
| Huawei | Prefer option 3. Focus on defining the requirements for HO with PSCell based on legacy HO requirements and PSCell change/addition requirements. |
| Qualcomm | Option3 |
| Ericsson | We are fine with Option 3 |
| Nokia | We support option 3. |
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## Summary on 2nd round (if applicable)

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on further RRM enhancement for NR and MR-DC – HO with PSCell | vivo |  |
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**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| [R4-2111928](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111928.zip) | Further discussion on HO with PSCell | CATT | Noted |  |
| R4-2111929 | The requirements for HO with PSCell | CATT | Withdraw | Not available |
| [R4-2112125](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112125.zip) | Discussion on RRM requirement for handover with PSCell | Apple | Noted |  |
| [R4-2112178](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112178.zip) | Discussion on RRM requirements for HO with PSCell | vivo | Noted |  |
| [R4-2112419](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112419.zip) | Further discussion on RRM requirements for handover with PSCell | Xiaomi | Noted |  |
| [R4-2112501](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112501.zip) | Discussion on HO with PSCell | CMCC | Noted |  |
| [R4-2113139](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113139.zip) | Discussion about HO with PSCell | Intel Corporation | Noted |  |
| [R4-2113202](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113202.zip) | Discussion on requirements for HO with PSCell | ZTE Corporation | Noted |  |
| [R4-2113276](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113276.zip) | RRM requirements for HO with PSCell | OPPO | Noted |  |
| [R4-2114140](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114140.zip) | Discussion on requirements for HO with PSCell | Huawei, Hisilicon | Noted |  |
| [R4-2114152](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114152.zip) | Discussion on HO with PSCell | MediaTek inc. | Noted |  |
| [R4-2114175](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114175.zip) | On RRM requirements for handover with PSCell | Ericsson | Noted |  |
| [R4-2114213](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114213.zip) | discussion on HO with PSCell | Nokia, Nokia Shanghai Bell | Noted |  |
| [R4-2114429](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114429.zip) | Views on HO w PSCell | Qualcomm CDMA Technologies | Noted |  |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

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| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
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Notes:

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   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)