**3GPP TSG-RAN WG4 Meeting # 102-e R4-220xxxx**

**Electronic Meeting, 21st February – 3rd March, 2022**

**Agenda item:** 10.10.2.2

**Source:** Moderator (vivo)

**Title:** Email discussion summary for [102-e][215] NR\_RRM\_enh2\_2

**Document for:** Information

# Introduction

This email discussion summary covers topic HO with PSCell in FeRRM WI under agenda 10.10.2.2.

# 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** |
| [R4-2203784](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203784.zip) | Apple | **Proposal 1:**  **For HO with PSCell for NR-SA to EN-DC,**   * **if explicit SMTC configuration** **of target unknown PSCell is present in RRCConnectionReconfiguration, sequential processing is used.** * **Otherwise, if explicit SMTC configuration** **of target unknown PSCell is absent in RRCConnectionReconfiguration, parallel processing is used.**   + **If source PCell has configured the UE with an MO which have the same SSB frequency and SCS as target PSCell, UE uses the SMTC in the configured MO, or**   + **If source PCell doesn’t configure the UE with MO which have the same SSB frequency and SCS as target PSCell, UE assumes 5ms as SSB periodicity for target PSCell.**   **Proposal 2: If UE SW processing and RF warm-up for PCell HO and PSCell addition/change are performed in parallel,**   * **Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change).**   **Proposal 3: RAN4 to confirm:**   * **Introduce extra margin Y ms for sequential processing case comparing to parallel processing case for UE SW processing and RF warm-up for PCell handover and PSCell addition/change**   + **Y = 10 ms**   + **Note: no extra interruption is required** |
| [R4-2203785](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203785.zip) | Apple | **Draft CR on HO with PSCell for NR SA to EN-DC\_R17** |
| [R4-2203866](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203866.zip) | Qualcomm Incorporated | **Proposal 1. PScell addition delay requirements are only applicable at NR-SA to ENDC. Otherwise HO delay requirements are used for both Pcell HO and PScell changes with different parameters accordingly.**  **PSCell addition delay= TRRC\_delay + Tprocessing + Tsearch + T∆ + TPSCell\_ DU + 2 ms, for NR-SA to ENDC**  **HO delay = TRRC\_delay +Tinterrupt = TRRC\_delay +Tsearch + TIU + Tprocessing + T∆ + Tmargin ms, otherwise**  **Proposal 2: Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) + [5 or 10]ms for parallel cases.**  **Proposal 3. Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) for parallel cases. Except T\_processing=30ms for NR-SA to ENDC.**  **Proposal 4. Tprocessing for HO with PSCell for sequential processing case is Tprocessing for parallel processing case + 10ms.**  **Proposal 5. Sequential processing is applied when SMTC of target unknown PScell is provided by to UE in the container obtained from target E-UTRAN PCell. Otherwise, parallel processing can be applied.** |
| [R4-2203923](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203923.zip) | CATT | **Proposal 1: Tprocessing should be defined independently for PCell HO and PSCell addition for the parallel processing case of HO with PSCell. No margin is needed.**  **Proposal 2: Sequential processing will be applied for HO with PSCell if explicit SMTC configuration is present in RRCConnectionReconfiguration, and UE applies PSCell SMTC configuration based on the timing reference of target EUTRA PCell. Otherwise, parallel processing case of HO with PSCell will be applied.**  **Proposal 3: We prefer option 1, i.e. postpone the requirement design of NR-U HO with PSCell until RAN4 completes the baseline requirement for HO with PSCell on licensed band. Option 3, i.e. discuss requirements for NR-U in Rel-18 is also acceptable.** |
| [R4-2204162](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204162.zip) | ZTE Corporation | **Proposal 1:Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change)**  **Proposal 2: Postpone the requirement design of NR-U HO with PSCell until RAN4 completes the baseline requirement for HO with PSCell on licensed band.** |
| [R4-2204231](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204231.zip) | Xiaomi | **Proposal 1: If UE SW processing and RF warm-up for PCell HO and PSCell addition/change are performed in parallel, the Tprocessing for HO with PSCell is defined as follows:**  ** Tprocessing = max(Tprocessing\_PCell HO, Tprocessing\_PSCell addition/change) + 5 ms**  **Proposal 2: For the HO with PSCell from NR SA to EN-DC:**   * **If the SMTC of the target PSCell is configured in *RRCConnectionReconfiguration*, UE applies the PSCell SMTC configuration based on the timing reference of target EUTRA PCell and sequential processing is assumed.** * **If the SMTC of the target PSCell is not configured in *RRCConnectionReconfiguration*,**   + **If either source PCell or source PSCell has configured the UE with an MO which have the same SSB frequency and SCS as target PSCell,**      - **UE uses the SMTC in the configured MO and parallel processing is assumed.**   + **If both source PCell and source PSCell have configured the UE with MOs which have the same SSB frequency and SCS as target PSCell,**      - **it is up to UE implementation which SMTC in the MOs are used and parallel processing is assumed.**   + **If neither source PCell nor source PSCell has configured the UE with MO which have the same SSB frequency and SCS as target PSCell,**      - **UE assumes 5ms as SSB periodicity for target PSCell and parallel processing is assumed.** |
| [R4-2204256](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204256.zip) | CMCC | **Proposal 1: if UE SW processing and RF warm-up for PCell HO and PSCell addition/change are performed in parallel, Tprocessing is applied independently for PCell and PSCell (20ms or 40ms depending on whether target is same or different FR).** |
| [R4-2204275](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204275.zip) | OPPO | **Proposal 1: Extra margin Y =10 ms for sequential processing for UE SW processing and RF warm-up can apply to PCell handover and PSCell addition/change.**  **Proposal 2: If UE SW processing and RF warm-up for PCell HO and PSCell addition/change are performed in parallel:**  **Tprocessing for HO with PSCell = max (Tprocessing for PCell HO, Tprocessing for PSCell addition/change) + [X] ms.**  **Proposal 3: sequential processing shall be used for NR SA to EN-DC when SMTC of target unknown PSCell is provided to UE in the container obtained from target E-UTRAN PCell. Otherwise, parallel processing is used.**  **Proposal 4: Postpone the requirement design of NR-U HO with PSCell.** |
| [R4-2204336](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204336.zip) | vivo | **Proposal 1 Tprocessing for HO with PSCell is max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) + [X] ms, and X can be different for different HO with PSCell scenarios.**  **Observation 1 For NR-SA to EN-DC, based on R16 RAN2 signaling, UE can only perform sequential processing if SMTC of target unknown PSCell is configured the HO command.**  **Observation 2 Even if network knows the timing reference of the target PCell, it may miss the chance to provide UE such information via MO configuration before the HO command take place, which may result in unnecessary sequential timeline.**  **Observation 3 Network may not have information on whether the target PSCell is known or unknown from UE perspective. Therefore, the processing time is un-predictable to NW.**  **Proposal 2 In R17, RAN4 will further discuss and conclude the feasibility and necessity of UE parallel processing in HO with PSCell from NR-SA to EN-DC for the case when**   * **network can provide SMTC of target unknown PSCell in the HO command outside the container obtained from target E-UTRAN PCell,**   **and if needed, send LS to RAN2 asking for the corresponding signalling design.**  **Proposal 3 In R17, for HO with PSCell from NR-SA to EN-DC, RAN4 work on RRM requirements firstly assuming**   * **parallel processing for the case when target PSCell is known, and** * **sequential processing for the case when SMTC of target unknown PSCell is provided to UE in the container obtained from target E-UTRAN PCell, and** * **parallel processing for the case when SMTC of target unknown PSCell is obtained by UE from the MOs of source PCell**   **Proposal 4 If UE assumes 5ms SSB periodicity for the target PSCell by default, parallel processing is assumed. RAN4 may further discuss whether to allow larger X in Tprocessing if the SSB periodicity for either PCell HO or PSCell change is not more than 5ms.** |
| [R4-2204400](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204400.zip) | Intel Corporation | **Proposal 1: For the parallel processing case of HO with PSCell, PSCell addition delay requirements and HO delay requirements are defined separately:**   * + - **HO delay = TRRC\_delay +Tsearch + TIU + (Tprocessing\_PCell +X) + T∆ + Tmargin ms**     - **PSCell addition delay= TRRC\_delay + (Tprocessing\_PSCell +X) + Tsearch + T∆ + TPSCell\_ DU + 2 ms**   **Where Tprocessing\_PCell and Tprocessing\_PSCell are UE processing time for PCell HO and PSCell addition respectively, and X is margin with FFS value.**  **Proposal 2: For the sequential processing case of HO with PSCell, the delay requirements for PCell and PSCell are:**   * + - **THO = TRRC\_delay + Tsearch\_PCell + (Tprocessing\_PCell + X+ [10]ms) + TIU + T∆\_PCell + Tmargin**     - **TPSCell= TRRC\_delay + Tsearch\_PCell + T∆\_PCell + Tmargin + Tsearch\_PSCell + T∆\_PSCell + (Tprocessing\_PSCell + X + [10]ms) +TPSCell\_ DU + Tmargin**   **Where Tprocessing\_PCell and Tprocessing\_PSCell are UE processing time for PCell HO and PSCell addition respectively, and X is margin with FFS value.**  **Proposal 3: Postpone the requirement design of NR-U HO with PSCell until RAN4 completes the baseline requirement for HO with PSCell on licensed band.** |
| [R4-2204870](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204870.zip) | Huawei, Hisilicon | **Proposal 1: Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) for parallel case, and extended by 10 ms for sequential case.**  **Proposal 2:**  **If the SMTC of the target PSCell is configured in RRCConnectionReconfiguration:**  **Sequential processing is assumed that UE applies the PSCell SMTC configuration based on the timing reference of target EUTRA PCell**  **Otherwise, parallel processing is assumed.** |
| [R4-2204871](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204871.zip) | Huawei, Hisilicon | **Draft CR on requirements for HO with PSCell from EN-DC to EN-DC** |
| [R4-2205838](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205838.zip) | Ericsson | **Proposal 1: RAN4 to agree that combined Tprocessing is not needed to be discussed. Individual/independent Tprocessing for PCell HO and PSCell can be applied in the delay requirement.**  **Proposal 2: RAN4 to agree that extra margin Y ms for sequential processing case comparing to parallel processing case for UE SW processing and RF warm-up for [PCell handover] and PSCell addition/change is 5ms. In other words, RAN4 to agree Y as 5ms.**  **Proposal 3: If explicit SMTC for PSCell is configured in RRCConnectionReconfiguration, HO with PSCell requirements are to be defined assuming sequential operation for cell search and timing acquisition. In other cases, requirements can be defined assuming parallel processing.**  **Proposal 4: Tsearch + T∆ + Tmargin for PCell HO and PSCell addition/change, when PSCell is on unlicensed carrier, can reuse principles of licensed carrier operation.**  **Proposal 5: For EN-DC to EN-DC HO with PSCell with PSCell under CCA, the delay requirement shall be specified separately for PCell and PSCell and shall use ending points as PRACH preamble transmission in PCell and PSCell, respectively.**  **Proposal 6: For NR PSCell change with target NR PSCell under CCA (band n46), the NR PSCell addition requirement in TS 36.133 clause 7.31A.2 can be used as baseline, with the following modification:**   * **Tprocessing = 20ms when source and target cells are in same FR** * **Tprocessing = 40ms when source and target cells are in different FRs**   **Proposal 7: When PSCC is under CCA, if UE is incapable of simultaneous PRACH preamble transmission in PCell and PSCell, and RACH occasions in PCell and PSCell collide, then UE shall prioritize PRACH preamble transmission on the carrier with CCA. An additional uncertainty term or redefinition of TIU is introduced for the leg without CCA.** |
| [R4-2205839](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205839.zip) | Ericsson | **Drfat CR on HO with PSCell requirements for NE DC to NE-DC** |
| [R4-2205863](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205863.zip) | MediaTek Inc. | Proposal 1: The overall Tprocessing for HO with PSCell should be:  max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) +10ms .  Proposal 2: Processing timeline for the NR SA to EN-DC:   * Sequential processing, if the SMTC of the target PSCell is configured in HO command:   + UE follows the timing reference of target E-UTRA PCell, where sequential processing should be performed to obtain the target PCell timing first. * Parallel processing, if the SMTC of the target PSCell is not configured in HO command:   + If UE is configured with source PCell MO, UE follows the SMTC in this MO.   + If UE is not configured with source PCell MO, UE assumes SSB has 5ms periodicity.   Proposal 3: Postpone the requirement design of NR-U HO with PSCell until RAN4 completes the baseline requirement for HO with PSCell on licensed band. |
| [R4-2205876](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205876.zip) | Nokia, Nokia Shanghai Bell | 1. Tprocessing applies independently for PCell and PSCell in HO with PSCell RRM requirements for both parallel processing and sequential processing 2. Extra margin Y ms for UE RF adjustment in sequential processing compared to parallel processing is only applied for PSCell addition/change in HO with PSCell requirements. 3. In HO with PSCell for NR-DC to NR-DC, parallel processing delay requirements which will reuse legacy HO and PSCell addition will fulfill the delay in this specific case when SMTC of target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*. 4. In HO with PSCell for NR-SA to EN-DC, parallel processing delay requirements which will reuse legacy HO and PSCell addition will fulfill the delay in this specific case when SMTC of target unknown PSCell is configured by source NR PCell in *RRCConnectionReconfiguration* of targetRAT-*MessageContainer*. 5. HO with PSCell RRM requirements can refer to existing handover requirements and PSCell addition requirements directly for all supported scenarios. 6. Define the delay requirements for HO with PSCell for NR-DC to NR-DC as reusing current HO and PSCell addition/change requirements directly for both parallel processing and sequential processing and apply the additional margin for Tprocessing for sequential processing in PSCell addition/change. |
| [R4-2205877](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205877.zip) | Nokia, Nokia Shanghai Bell | **dratCR on HO with PSCell for NR-DC to NR-DC** |

## 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 2-2 Delay requirement design of HO with PSCell

*Sub-topic description:*

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

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

*In the previous two meetings, following common understanding is reached regarding processing timing for legacy PCell handover and PSCell addition/change.*

* Tprocessing for PCell HO
  + Reuse the Tprocessing defined for legacy PCell HO
    - 20ms, when source and target cells are in the same FR
    - 40ms, when source and target cells are in different FRs
* Tprocessing for PSCell change for NR-DC and EN-DC
  + 20ms, when source and target cells are in the same FR
  + 40ms, when source and target cells are in different FRs
* Tprocessing for PSCell addition for NR-DC and EN-DC
  + 20ms, when NR PSCell is in the same FR as PCell
  + 40ms, when NR PSCell is in the different FR from PCell
* Proposals
  + Option 1: (Apple, ZTE, Huawei)
    - Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change)
  + Option 1a: (Qualcomm, vivo, Xiaomi, MTK, Apple, OPPO)
    - Tprocessing for HO with PSCell = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) + [X] ms.
    - X=5 (Qualcomm, Xiaomi, OPPO)
    - X=10 (MTK, Apple, Qualcomm, OPPO)
    - X= can be different for different HO with PSCell scenarios (vivo)
    - Tprocessing 30ms for NR-SA to ENDC exceptional. (Qualcomm)
  + Option 2: (CATT, Ericsson, Nokia)
    - Tprocessing applies independently for PCell and PSCell.
    - No margin is needed. (CATT)
    - 20ms or 40ms depending on whether target is same or different FR (CMCC)
  + Option 3: (Intel)
    - For the parallel processing case of HO with PSCell, PSCell addition delay requirements and HO delay requirements are defined separately:
    - HO delay = TRRC\_delay +Tsearch + TIU + (Tprocessing\_PCell +X) + T∆ + Tmargin ms
    - PSCell addition delay= TRRC\_delay + (Tprocessing\_PSCell +X) + Tsearch + T∆ + TPSCell\_ DU + 2 ms
    - Where Tprocessing\_PCell and Tprocessing\_PSCell are UE processing time for PCell HO and PSCell addition respectively, and X is margin with FFS value.
* Recommended WF
  + Further discussion in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Support option 1 and can compromise to option 1a. For parallel processing, UE prepares the SW and RF warm up for both PCell and PSCell in parallel, and therefore PCell HO and PSCell HO shall share the same processing time. |
| MTK | Support Option 1a. UE SW processing and RF warm-up for PCell HO and PSCell addition/change should be defined as an overall based on the maximum Tprocessing value between PCell HO and PSCell addition/change plus an additional margin of 10 ms. This margin is introduced to consider a worst-case scenario when some RF components or SW resources might be shared between PCell HO and PSCell addition/change at the same time. |
| Intel | Support option 3. Since some companies mention that there may be some dependency between PCell and PSCell SW processing or RF preparation, While we can compromise to option 1 or 1a to move forward. |
| Nokia | We support option 2. We already agreed that for the parallel processing case of HO with PSCell, PSCell addition delay requirements and HO delay requirements are defined separately and the ending points are also agreed as separately for each. From our view, all the processing in PCell HO and PSCell addition/change will be performed in dependently for parallel process, the Tprocessing applies independently for PCell and PSCell without any margin. |
| Huawei | We support option1. As commented several times in previous meetings, we don’t fully understand the meaning of Processing in parallel/sequential. RAN4 has discussed parallel/sequential processing considering whether SMTC should be based on target PCell. But regarding SW processing and RF warm-up, which is much implementation specific, it is confused to specify this implementation margin in parallel or sequential. Thus, we support to have identical value for PCell and PSCell instead of independent value. For sake of progress, we can also comprise to option 1a. |
| ZTE | Support option 1 and can compromise to option 1a. The actual Tprocessing the UE experiences is the maximum value between Tprocessing for PCell HO and Tprocessing for PSCell addition/change. |
| Qualcomm | Support option 1a for both 5ms and 10ms. We are also okay with option1 but one exception for NR-SA to ENDC where T\_processing = 30ms. |
| CMCC | Our preference is option 2, but can compromise to option 1. In our view, Tprocessing applies independently for PCell and PSCell, since for parallel case, it was agreed to define delay requirements for HO and PSCell addition/change separately with the ending points defined as PCell PRACH and PSCell PRACH respectively. However, to move forward, we are also fine with option 1 to apply identical value of Tprocessing for PCell and PSCell respectively.  For option 1a, we do not see the necessity to have additional margin. Some companies mentioned that there may be some shared component, we can understand this for sequential case, as we already agreed in last meeting to have additional margin for sequential case, but for parallel cases, we are not sure about it. |
| Xiaomi | Option 1a, share the similar views as MTK, when the RF components and SW resource are shared between PCell HO and PSCell addition, the additional margin should be considered. |
| OPPO | Option 1a. Either 5ms or 10ms is fine. |
| Ericsson | Delay requirements are specified separately for PCell HO and PSCell addition/change.  May be one question regarding option 1/1a.  For example, if we take PCell HO is same FR to same FR and PSCell addition is one FR to another FR. Then processing delay for PCell HO is 20ms and processing delay for PSCell addition/change 40ms. In this example if we take max value for processing delay, processing delay of PCell will be 40ms if we do not agree additional margin. Does this mean, UE takes 40ms for PCell HO software processing and RF warm-up?  If additional margin agreed (let’s say 5ms), then PCell HO processing is 45ms?  That means, in legacy HO, software processing and RF warm-up completes in 20ms and further operations like cell search and timing acquisition takes place after 20ms. In this case since we are agreeing 40ms/45ms as processing delay, UE may not perform other procedure till 40/45ms. We do not understand why UE needs to wait for additional 20/25ms compared to legacy PCell HO.  Since PRACH is agreed as ending point for PCell HO, with this max processing delay approach, total delay required to complete PCell HO will be additional 20/25ms.  Can anyone explain if this understanding is correct or not. If it is correct why UE needs additional delay for PCell HO.  This may be more problematic when sequential cell search needs to be performed. Cell search and time tracking takes additional 25ms for PSCell HO if UE takes 40/45ms for PCell HO Software processing and RF warm-up. |
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**Issue 2-2-3c: If UE SW processing and RF warm-up for PCell HO and PSCell addition/change are performed in sequential**

* Proposals
  + Option 1: (Intel)
    - For the sequential processing case of HO with PSCell, PSCell addition delay requirements and HO delay requirements are defined separately:
    - HO delay = TRRC\_delay +Tsearch + TIU + (Tprocessing\_PCell +X+ [10]ms) + T∆ + Tmargin ms
    - PSCell addition delay= TRRC\_delay + (Tprocessing\_PSCell +X+ [10]ms) + Tsearch + T∆ + TPSCell\_ DU + 2 ms
    - Where Tprocessing\_PCell and Tprocessing\_PSCell are UE processing time for PCell HO and PSCell addition respectively, and X is margin with FFS value.
  + Option 2: (Nokia)
    - Tprocessing applies independently for PCell and PSCell.
* Recommended WF
  + Further discussion in the 1st round. Companies’ views are to be collected.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | It was agreed in last meeting that,   * + Introduce extra margin Y ms for sequential processing case comparing to parallel processing case for UE SW processing and RF warm-up for [PCell handover] and PSCell addition/change     - Y = [10] ms   So we think same processing time could be used for both PCell HO and PSCell addition: max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) + [X] + [Y] |
| MTK | We have a similar view as Apple. The agreement from previous meeting was to introduce extra margin Y ms for sequential processing case comparing to parallel processing case. Therefore, we should first agree on the Tprocessing in parallel processing (in Issue 2-2-3b) first, then we can discuss how to define the extra Y ms margin for sequential processing case. Since we support Option 1a for Issue 2-2-3b, Tprocessing for sequential processing can then be defined as:  Tprocessing= max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) + 10ms + [Y] |
| Intel | This issue also related to the discussion about Tprocessing. Similar as parallel processing, we can compromise that max Tprocessing between PCell HO and PSCell addition can be used for Tprocessing. |
| Nokia | We support option 2. For sequential processing, we have concluded that the sequential processing is only applied for cell search, SSB processing margin (i.e. 2ms) and fine time/frequency tracking and acquiring timing information for PCell. UE SW processing and RF warm-up in PCell HO and PSCell addition/change still performs in parallel and independently. We think option 1 also has the similar view on Tprocessing for PCell HO and PSCell addition/change independently, the value may need further discussion. |
| Huawei | Same comments as issue 2-2-3b. What is the meaning of UE SW processing and RF warm-up are performed in sequential? Does it target the case when target PCell’s timing is needed to determine the SMTC of PSCell? |
| Qualcomm | We have different understanding from Apple and MTK about the previous agreement as no extra interruption is required.   * + Introduce extra margin Y ms for sequential processing case comparing to parallel processing case for UE SW processing and RF warm-up for PCell handover and PSCell addition/change     - Y = [10] ms     - Note: no extra interruption is required   We think T\_processing for sequential processing case is  [T\_processing for parallel processing case from Issue 2-2-3b] + Y ms, where Y= [10]ms. |
| Xiaomi | Support Apple’s proposal, add the extra margin Y for sequential processing case based on parallel processing case.  Tprocessing = max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) + [X] + [Y] |
| OPPO | We should first agree on the Tprocessing in parallel processing first. The max Tprocessing between PCell HO and PSCell addition can be used. |
| Ericsson | If we agree max(Tprocessing for PCell HO, Tprocessing for PSCell addition/change) + [X] + [Y], for X=5 and Y=5, and PCell HO processing 20ms and PSCell HO processing 40ms, does it mean each PCell HO and PSCell processing delay is 50ms?  We do not agree as PCell HO cell search can start after 20ms if we use individual values for processing delay. When we introduce this max equation, PCell HO processing delay becomes 50ms. |
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**Issue 2-2-3c-1: Applicability and value of extra margin Y ms for sequential processing**

*GTW agreements in RAN4#101-bis-e meeting. The agreements in brackets need to be discussed and confirmed.*

* Agreement
  + Introduce extra margin Y ms for sequential processing case comparing to parallel processing case for UE SW processing and RF warm-up for [PCell handover] and PSCell addition/change
    - Y = [10] ms
    - Note: no extra interruption is required
* Proposals
  + Option 1: (Apple, Qualcomm, OPPO, Huawei)
    - Introduce extra margin Y ms for sequential processing case comparing to parallel processing case for UE SW processing and RF warm-up for PCell handover and PSCell addition/change
      * Y = 10 ms
      * Note: no extra interruption is required
  + Option 2: (Ericsson)
    - Introduce extra margin Y ms for sequential processing case comparing to parallel processing case for UE SW processing and RF warm-up for [PCell handover] and PSCell addition/change
      * Y = 5 ms
      * Note: no extra interruption is required
  + Option 3: (Nokia)
    - Extra margin Y ms for UE RF adjustment in sequential processing compared to parallel processing is only applied for PSCell addition/change in HO with PSCell requirements.
* Recommended WF
  + Further discussion in the 1st round. Companies’ views are to be collected.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1. We think the processing time of Yms shall be applied to PCell HO as well as PSCell addition. The reason is: for PSCell RF warm up or SW preparation, if it’s not implemented simultaneously as RF warm up for PCell HO, it may cause interruption to PCell DL RS during PSCell processing time, and PCell cannot either use this Yms for DL synchronization, and therefore we propose to apply this Yms extra margin for both PCell HO and PSCell addition in sequential processing scenarios. |
| MTK | We are also fine with option 1. |
| Intel | Fine with option 1. |
| Nokia | We support option 3, When we discuss and conclude on the sequential processing, it is the specific cases which the SMTC of the target unknown PSCell is not configured and UE applies the SMTC configuration based on the timing reference of NR PCell for the target unknown PSCell. Only PSCell addition/change delay will be impacted in the sequential processing.  For the margin Y ms for PSCell addition/change, we think 5ms given in option2 may be sufficient. |
| Huawei | Fine with option 1. |
| Qualcomm | Option 1.  We are okay Y=5, 10ms. We think this T\_processing+[Y]ms is total T\_processing for joint HO w/ PScell for sequential processing. Thus, we need to [Y]ms added T\_processing is applied for both Pcell and PScell HO where sequential processing is assumed such as some cases at NR-SA to ENDC and If SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16 but not configured in reconfigurationWithSync |
| Xiaomi | Support option 1. |
| OPPO | Option 1. 10ms is fine. |
| Ericsson | I think this additional margin of Yms may be for PSCell addition if individual values are considered. |
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**Issue 2-2-3d: Processing timeline for NR SA to EN-DC**

* Proposals
  + Option 1a (Apple)
    - if explicit SMTC configuration of target unknown PSCellis present in*RRCConnectionReconfiguration*, sequential processing is used.
    - Otherwise, if explicit SMTC configuration of target unknown PSCellis absent in*RRCConnectionReconfiguration*, parallel processing is used.
    - If source PCell has configured the UE with an MO which have the same SSB frequency and SCS as target PSCell, UE uses the SMTC in the configured MO, or
    - If source PCell doesn’t configure the UE with MO which have the same SSB frequency and SCS as target PSCell, UE assumes 5ms as SSB periodicity for target PSCell.
  + Option 1b (MTK)
    - Sequential processing, if the SMTC of the target PSCell is configured in HO command:
    - UE follows the timing reference of target E-UTRA PCell, where sequential processing should be performed to obtain the target PCell timing first.
    - Parallel processing, if the SMTC of the target PSCell is not configured in HO command:
    - If UE is configured with source PCell MO, UE follows the SMTC in this MO.
    - If UE is not configured with source PCell MO, UE assumes SSB has 5ms periodicity.
  + Option 1c (Qualcomm, OPPO)
    - Sequential processing is applied when SMTC of target unknown PScell is provided by to UE in the container obtained from target E-UTRAN PCell. Otherwise, parallel processing can be applied.
  + Option 1d (CATT)
    - Sequential processing will be applied for HO with PSCell if explicit SMTC configuration is present in *RRCConnectionReconfiguration*, and UE applies PSCell SMTC configuration based on the timing reference of target EUTRA PCell. Otherwise, parallel processing case of HO with PSCell will be applied.
  + Option 1e (Ericsson)
    - If explicit SMTC for PSCell is configured in *RRCConnectionReconfiguration,* HO with PSCell requirements are to be defined assuming sequential operation for cell search and timing acquisition. In other cases, requirements can be defined assuming parallel processing.
  + Option 1f (Xiaomi)
    - Sequential processing will be applied for HO with PSCell if explicit SMTC configuration is present in *RRCConnectionReconfiguration*, and UE applies PSCell SMTC configuration based on the timing reference of target EUTRA PCell. Otherwise, parallel processing case of HO with PSCell will be applied.
    - If the SMTC of the target PSCell is configured in *RRCConnectionReconfiguration*, UE applies the PSCell SMTC configuration based on the timing reference of target EUTRA PCell and sequential processing is assumed.
    - If the SMTC of the target PSCell is not configured in *RRCConnectionReconfiguration*,
    - If either source PCell or source PSCell has configured the UE with an MO which have the same SSB frequency and SCS as target PSCell,
      * UE uses the SMTC in the configured MO and parallel processing is assumed.
    - If both source PCell and source PSCell have configured the UE with MOs which have the same SSB frequency and SCS as target PSCell,
      * it is up to UE implementation which SMTC in the MOs are used and parallel processing is assumed.
    - If neither source PCell nor source PSCell has configured the UE with MO which have the same SSB frequency and SCS as target PSCell,
      * UE assumes 5ms as SSB periodicity for target PSCell and parallel processing is assumed.
  + Option 1g (vivo)
    - sequential processing for the case when SMTC of target unknown PSCell is provided to UE in the container obtained from target E-UTRAN PCell, and
    - parallel processing for the case when target PSCell is known, and
    - parallel processing for the case when SMTC of target unknown PSCell is obtained by UE from the MOs of source PCell
    - If UE assumes 5ms SSB periodicity for the target PSCell by default, parallel processing is assumed.
    - RAN4 may further discuss whether to allow larger X in Tprocessing if the SSB periodicity for either PCell HO or PSCell change is not more than 5ms.
  + Option 2 (Nokia)
    - In HO with PSCell for NR-SA to EN-DC, parallel processing delay requirements which will reuse legacy HO and PSCell addition will fulfill the delay in this specific case when SMTC of target unknown PSCell is configured by source NR PCell in *RRCConnectionReconfiguration* of *targetRAT-MessageContainer*.
* Recommended WF
  + If explicit SMTC of target unknown PSCell is configured by source NR PCell in *RRCConnectionReconfiguration* of *targetRAT-MessageContainer*,
    - UE follows the timing reference of target E-UTRA PCell and sequential processing is assumed.
  + Otherwise
    - UE follows the timing reference of source NR PCell and parallel processing is assumed.
      * If source NR PCell has configured the UE with an MO which have the same SSB frequency and SCS as target NR PSCell, UE uses the SMTC in the configured MO, or
      * If source NR PCell doesn’t configure the UE with MO which have the same SSB frequency and SCS as target NR PSCell, UE assumes 5ms as SSB periodicity for target NR PSCell.

Moderator would like to collect comments for the recommended WF above. Improvement on wording is encouraged.

* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | We support the recommended WF. |
| MTK | Options 1a, 1b, 1c, and 1d are similar, but options 1a and 1b provide further details, which is also recommended by the moderator as a WF. Therefore, we support the recommended WF. |
| Intel | Fine with the recommended WF. |
| Nokia | We are fine with the recommended WF. |
| Huawei | Fine with recommended WF. |
| ZTE | Support the recommended WF. |
| Qualcomm | Support recommended WF with minor revision   * + If explicit SMTC of target unknown PSCell is configured by source NR PCell in *RRCConnectionReconfiguration* of *targetRAT-MessageContainer*,     - UE apply SMTC configuration based on the timing reference of target E-UTRA PCell   + Otherwise     - * If source NR PCell has configured the UE with an MO which have the same SSB frequency and SCS as target NR PSCell, UE uses the SMTC in the configured MO, or       * If source NR PCell doesn’t configure the UE with MO which have the same SSB frequency and SCS as target NR PSCell, UE assumes 5ms as SSB periodicity for target NR PSCell. |
| CMCC | OK with the recommended WF |
| Xiaomi | Fine with the recommended WF. |
| OPPO | Fine with recommended WF. |
| Ericsson | OK with recommended WF. |
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**Issue 2-2-3d-1: Supporting of SMTC configuration for NR SA to EN-DC**

* Proposals
  + Option 1 (vivo)
    - In R17, RAN4 will further discuss and conclude the feasibility and necessity of UE parallel processing in HO with PSCell from NR-SA to EN-DC for the case when
    - network can provide SMTC of target unknown PSCell in the HO command outside the container obtained from target E-UTRAN PCell,
    - and if needed, send LS to RAN2 asking for the corresponding signalling design.
* Recommended WF
  + Further discussion in the 1st round
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | We propose to not discuss option 1 since this is decided by RAN2 and this meeting is the last one to close the core part. Based on the RAN2 reply LS, if SMTC is provided, we only need to consider one case that SMTC is in the *RRCConnectionReconfiguration* of *targetRAT-MessageContainer*. |
| Huawei | Suggest not to discuss this in Rel-17. |
| Ericsson | Similar views as Apple. |
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**Issue 2-2-8b-1: Clarification on HO with PSCell delay requirements**

* Proposals
  + Option 1: (Qualcomm)
    - PScell addition delay requirements are only applicable at NR-SA to ENDC. Otherwise HO delay requirements are used for both Pcell HO and PScell changes with different parameters accordingly.
    - PSCell addition delay= TRRC\_delay + Tprocessing + Tsearch + T∆ + TPSCell\_ DU + 2 ms, for NR-SA to ENDC
    - HO delay = TRRC\_delay +Tinterrupt = TRRC\_delay +Tsearch + TIU + Tprocessing + T∆ + Tmargin ms, otherwise
* Recommended WF
  + Collecting comments for option 1 in the 1st round
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | We can discuss it directly in CR, but we think for other cases HO delay is still different from PSCell addition delay due to RACH collision (e.g., EN-DC to EN-DC) and RACH uncertainty. For NR-DC to NR-DC we also have sequential processing case, and the HO delay is different from PSCell addition delay in such sequential case. |
| Huawei | Not very clear about option 1. Clarification is needed. |
| Qualcomm | The structure is not clear. Although T\_processing is under discussion, HO delay requirements will apply for both Pcell and PScell HO. As there is no “addition” at during HO in EN-DC to EN-DC, NR-DC to NR-DC and NE-DC to NE-DC, HO delay formula will be applied for both Pcell and PScell. PSCell addition formula is applicable at PScell for NR-SA to ENDC.  We are proposing to use same HO delay formula structure in both Pcell and PScell with different definition/value for Pcell and PSCell per cases. And PScell addition delay formula is used for PSCell in case of NR-SA to ENDC. |
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**Issue 2-2-8b-2: Structure for HO with PSCell delay requirements**

* Proposals
  + Option 1: (Nokia)
    - HO with PSCell RRM requirements can refer to existing handover requirements and PSCell addition requirements directly for all supported scenarios.
* Recommended WF
  + Further discuss in the 1st round. It may also be part of CR discussion.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | We can discuss it directly in CR, but we agree if the requirement is same as legacy HO or PSCell addition, it’s preferable to directly refer to the existing requirement. |
| MTK | If these requirements are the same as the existing ones, it can be referred to them. |
| Intel | No strong view. If the requirements are the same as legacy, it can refer to existing requirement. |
| Nokia | We would suggest to have a common agreement on the CR structure so that all CRs will share the same way. If the requirements are the same as legacy PCell HO or PSCell addition/change, it’s recommended to refer to the existing requirements directly. |
| Huawei | No strong view. Can be referred to existing requirements if there requirements are same. Otherwise, it is prefer to have complete sections to define the requirements, which is more readable to readers. |
| Qualcomm | No strong view. The requirements can refer to legacy one. |
| Xiaomi | If the requirements are the same, it is ok to refer these legacy requirements. |
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### Sub-topic 2-5 Requirements for NR-U

*Sub-topic description*

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

**Issue 2-5-1: Requirements for HO with PSCell for NR-U**

* Proposals
  + Option 1 (CATT, MTK, ZTE, Intel, OPPO):
    - Postpone the requirement design of NR-U HO with PSCell until RAN4 completes the baseline requirement for HO with PSCell on licensed band.
  + Option 2 (Ericsson):
    - Tsearch + T∆ + Tmargin for PCell HO and PSCell addition/change, when PSCell is on unlicensed carrier, can reuse principles of licensed carrier operation.
    - For EN-DC to EN-DC HO with PSCell with PSCell under CCA, the delay requirement shall be specified separately for PCell and PSCell and shall use ending points as PRACH preamble transmission in PCell and PSCell, respectively.
    - For NR PSCell change with target NR PSCell under CCA (band n46), the NR PSCell addition requirement in TS 36.133 clause 7.31A.2 can be used as baseline, with the following modification:
    - Tprocessing = 20ms when source and target cells are in same FR
    - Tprocessing = 40ms when source and target cells are in different FRs
    - When PSCC is under CCA, if UE is incapable of simultaneous PRACH preamble transmission in PCell and PSCell, and RACH occasions in PCell and PSCell collide, then UE shall prioritize PRACH preamble transmission on the carrier with CCA. An additional uncertainty term or redefinition of TIU is introduced for the leg without CCA.
  + Option 3 (CATT):
    - Discuss requirements for NR-U in Rel-18.

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| **Company** | **Comments** |
| Qualcomm | We are okay with option1.  Option2 is similar to what RAN4 agreed for licensed band in general. However, we have concern about prioritizing PRACH preamble transmission. If companies want further discuss about option2, we are okay except the last bullet about prioritizing PRACH. |
| Ericsson | May be a clarification question for option 1.  Since this is last meeting for requirements definition, does option 1 mean, we will discuss this in maintenance. If it is the understanding, we agree with option 1.  Having said that since we are expected to agree on the CR this meeting as most of the issues are about to close, we think we are in a position to discuss this from 2nd round. |
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## Companies’ views collection for 1st round

### Open issues

Comments are collected in section 1.2.

### CRs/TPs comments collection

*Companies are encouraged to provide comments on the structure and technical part of requirements.*

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| **CR/TP number** | **Comments collection** |
| [R4-2203785](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203785.zip) | MTK: we suggest keeping Tprocessing FFS. It should be based on Issue 2-2-3b conclusion. |
| Qualcomm: Thanks for the CR. We are okay with CR structure in general while Tprocessing is FFS. |
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| [R4-2204871](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204871.zip) | MTK: we suggest keeping Tprocessing FFS. It should be based on Issue 2-2-3b conclusion. |
| Qualcomm: Thanks for the CR. We have same view as MTK about Tprocessing.  @Huewei Does 5.x.y.1 propose for LTE Pcell HO? If not it is duplicated with 5.x.y.2 as HO delay is RRC delay + interruption. |
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| [R4-2205839](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205839.zip) | Qualcomm: Thanks for the CR. In general, I am not sure about defining different LTE HO delay requirement structure than 36.133. Assuming we are adding delay requirement for PSCell in NE-DC to NE-DC in 38.133, we can borrow the definition of PSCell delay requirement from 36.133 with minor modification for T\_processing.  @Ericsson  Should we point 36.331 for PSCell T\_RRC\_delay?  Could you clarify about this scenario? “If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, T∆\_PCell is FFS”  Not sure why T\_PScell\_IU is FFS, can we point 36.133? |
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| [R4-2205876](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205876.zip) | Huawei: We believe the right tdoc number of the CR is R4-2205877.  For the sequential case (SMTC configured in targetcellSMTC-SCG-r16), additional delay to obtain the reference timing of target PCell should be considered in PSCell change requirements. |
| Qualcomm: Thanks for the CR. Current CR looks okay. |
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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 2-2 Delay requirement design of HO with PSCell**

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|  | **Status summary** |
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**Sub-topic 2-5 Requirement for NR-U**

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|  | **Status summary** |
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### CRs/TPs

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

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

## Discussion on 2nd round

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

## Summary on 2nd round (if applicable)

# Recommendations for Tdocs

## 1st round

**New tdocs**

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| **Title** | **Source** | **Comments** |
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**Existing tdocs**

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

1. Please include the summary of recommendations for all tdocs across all sub-topics.
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. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
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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)