**3GPP TSG-RAN WG4 Meeting # 99-e R4-210XXXX**

**Electronic Meeting, 19th – 27th May 2021**

**Agenda item:** 9.9.2.2

**Source:** Moderator (vivo)

**Title:** Email discussion summary for [99-e][225] NR\_RRM\_enh2\_2

**Document for:** Information

# Introduction

This email discussion summary includes HO with PSCell (9.9.2.2).

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

* 1st round:
	+ Stage 1: Moderators kick off email discussion (Wed. 8am UTC May 19)
	+ Stage 2: Companies provide comments for the 1st round (May 1 – Friday 12pm UTC May 21)
	+ Stage 3: Moderators summarize the status and possible proposals, recommending what decisions can be made for 1st round. A formal t-doc will be used (Friday 7pm UTC May 21)
	+ Stage 4: After receiving the summary from moderators, session chair may approve documents, make agreements or assign new CRs, WFs, LSs, etc. (no later than Friday 8am UTC, May 24)
* 2nd round:
	+ Stage 5: Companies provide comments for 2nd round starting from Monday 3am UTC May 24.
		- Draft WF/LS and revised CRs/TPs shall be shared by Monday 7pm UTC, May 24.
		- Formal tdocs of WF/LS/CRs/TPs shall be uploaded to the Inbox (except Cat A CRs) by Wednesday 3am UTC, May 26.
		- Commenting shall stop by Thursday 3am UTC, May 27.
	+ Stage 6: Moderators provide 2nd round summary with a formal tdoc by Thursday 8am UTC, May 27.
	+ Stage 7: Session chairs announce close of sessions (no later than 4pm UTC, May 27). Final decisions will be captured in Chairman meeting report (to be shared after the meeting is closed)

# 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** |
| [**R4-2108768**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2108768.zip) | ZTE Corporation | **Proposal 1: For the starting point of the delay, reuse the starting point definition from legacy HO, i.e., the end of the last TTI containing the RRC command implying handover with PSCell.**Proposal 2: The UE shall perform handover and PSCell addition in parallel.**Proposal 3: Include both 2-step RA and 4-step RA into the new requirements made for handover with PSCell.****Proposal 4: 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.** |
| [**R4-2109051**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109051.zip) | CATT | **Proposal 1: The scenarios extention should not be discussed in RAN4, and RAN4 work should following the WID, i.e. only to define RRM requirements 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, and only considers FR1+LTE NE-DC for HO with PSCell from NE-DC to NE-DC.****Proposal 3: UE will perform in parallel the PCell handover process and PSCell addition process. We should wait for RAN2 response for order of random access carried out towards PCell and PSCell.****Proposal 4: Waiting for RAN2 response for order of random access carried out towards PCell and PSCell.****Proposal 5: The UE’s behavior is same when the configured PSCell is same as the original one or not. If PSCell is not changed, it can be dealt with as a known cell.****Proposal 6: The value of processing time of handover and the PSCell addition can be reused separately. AndTprocessing for HO with PSCell including UE SW processing and RF warm-up time should be the maximum of the processing time of handover and the processing time of the PSCell addition.** **Proposal 7: The delay requirement structure can be designed as above description, and decision will be made waiting for the conclusion of other issues and RAN2 LS response.****Proposal 8: Yes, PCell could schedule UE when PCell HO is completed but PSCell addition is not completed.****Proposal 9: No interruption requirement should be defined during HO with PSCell. RRC connection interruptions in normal handover requirements can be reused in HO with PSCell.****Proposal 10: Waiting RAN2 response and conclusions of other issues for 2 step and 4 step RACH.****Proposal 11: The NR-U scenario is out of scope of this WID, no need to discuss.** |
| [**R4-2109244**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109244.zip) | Intel Corporation | **Proposal 1: Consider FR1+FR2, FR1+FR1 NR-DC for HO with PSCell and FR1+LTE NE-DC for HO with PSCell.****Proposal 2: Considering the reply LS from RAN2, RRC processing delay for HO with PSCell is:** **NR SA to EN-DC : 50ms**  **EN-DC to EN-DC: 20ms** **NE-DC to NE-DC: 16ms** **NR-DC to NR-DC: 16ms****Proposal 3:** **Tprocessing can be further split into software processing (Tprocessing\_SW) and RF warm up time(Tprocessing\_RF). For Tprocessing\_RF, it depends on whether PCell or PSCell changed across FR. For Tprocessing\_SW, PSCell can be processed in parallel with PCell handover, FFS if any extension is needed.****Proposal 4:** **Tsearch, Tmargin, T∆ can be processed in parallel for both PCell HO and PSCell addition.** |
| [**R4-2109250**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109250.zip) | Xiaomi | **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: For NR-DC and NE-DC mode in HO with PSCell, the following scenarios are considered to specify the RRM requirements:*** + - * **FR1+FR2 NR-DC and FR1+FR1 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 follow the RRC processing delay for HO with PSCell which is captured in reply LS (R4-2107622).****Proposal 4: For HO with PSCell, it is assumed that the preparation of synchronization procedures should be performed in sequentially order:*** **Cell search;**
* **Fine time tracking;**
* **UE processing time;**
* **Time for interruption uncertainty in acquiring the first available PRACH occasion in the new cell;**
* **Time for SSB post-processing**

**Proposal 5: The ending point of HO with PSCell is the timing when UE is capable to transmit PRACH preamble towards target PSCell.****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.** |
| [**R4-2109309**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109309.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: NR-DC and NE-DC mode in HO with PSCell are:**** ***FR1+FR2 NR-DC and FR1+FR1 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.***
* ***Note: the baseline PSCell addition requirement for FR1+FR1 NR-DC would be discussed in TEI16.***

***Proposal 3: In HO with PSCell, if SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16, sequential processing shall be assumed; otherwise parallel processing shall be assumed for all the other cases.******Proposal 4: the ending point*** ***of the delay requirement for HO with PSCell is:**** ***if sequential processing is used, the timing when UE shall be capable to transmit PRACH preamble towards target PSCell***
* ***if the parallel processing is used, 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 5: 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 6: the RRC procedure delay in requirement of HO with PSCell is defined based on RAN2 reply LS R2-2104580.******Proposal 7:*** ***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 8: 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 9: for requirement of HO with PSCell, RAN4 starts the discussion with 4 step RACH first and FFS on 2 step RACH.******Proposal 10: If sequential processing is used, there is no need to consider RACH occasion (RO) collision between PCell and PSCell.*** ***If parallel processing is used:**** ***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 the PCell and PSCell are on the different FRs or FR1+FR1 NR-DC, no need to consider RO collision issue.***

***Proposal 11: RAN4 assumes PCC could be scheduled for UE when PCell HO is completed but PSCell addition is not completed.******Proposal 12:*** ***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.*** |
| [**R4-2109510**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109510.zip) | CMCC | ***Proposal 1: for HO with PSCell, except the agreed scenario including HO from NR SA to EN-DC, HO from EN-DC to EN-DC, HO from NE-DC to NE-DC and HO from NR-DC to NR-DC, it is proposed to include the following new scenarios:*** * ***HO from NR SA to NE-DC***
* ***HO from NR SA to NR-DC***
* ***HO from LTE SA to EN-DC***

***Proposal 2: supporting FR1+FR2 NR-DC and FR1+FR1 NR-DC for HO with PSCell from NR-DC to NR-DC, and the baseline PSCell addition requirement for FR1+FR1 NR-DC would be discussed in TEI16.*** ***Proposal 3: RRC processing delay for HO with PSCell is specified as following table according to RAN2 reply LS.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scenario | Source PCell | Target PCell | Target PSCell | RRC procedure delay for HO with PSCell |
| NR SA to EN-DC | NR (incl. FR1 and FR2) | LTE | NR (incl. FR1 and FR2) | [50ms] |
| EN-DC to EN-DC | LTE | LTE | NR (incl. FR1 and FR2) | 20ms |
| NE-DC to NE-DC | NR FR1 | NR FR1 | LTE | 16ms |
| NR-DC to NR-DC | NR FR1 | NR FR1 | NR FR2 | 16ms |

***Proposal 4: the ending point is related with whether RACH processing is performed in a sequential order or in a parallel order, and can be further discussed after we get the feedback from RAN2.******Proposal 5: for HO with PSCell, it is proposed to consider parallel way to perform HO and PSCell addition except RACH processing, as for whether RACH processing can be performed in parallel or not, it depends on RAN2 reply and can be further discussed.******Proposal 6: 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***
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| [**R4-2109732**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109732.zip) | Qualcomm CDMA Technologies | **Proposal1: RAN4 to agree an overall parallel flow can be assumed for defining the requirements of HO with PSCell.****Proposal2: Parallel RACH is preferred for defining the RRM requirements.****Proposal2.1: It’s necessary to understand the network side’s limitation not to support parallel RACHs.** |
| [**R4-2109885**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109885.zip) | MediaTek inc. | **Proposal 1: 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. FFS what kinds of components in the overall delay requirement, e.g., Tprocessing, will have dependency between PCell and PSCell.****Proposal 2: The overall Tprocessing for HO with PSCell should be max(Tprocessing for PCell HO, Tprocessing for PSCell addition) +10ms****Proposal 3: RAN4 to confirm that PCC could also be scheduled for UE when PCell HO is completed but PSCell addition is not completed****Proposal 4: No new interruption requirement for HO with PSCell is needed. Interruption in legacy handover delay requirement can still be applied for the PCell** |
| [**R4-2109891**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109891.zip) | NEC | **Proposal 1: RAN4 to consider defining requirements for NR SA to NE-DC, NR SA to NR-DC and LTE SA to EN-DC.** **Proposal 2: RAN4 to consider FR1+FR1 mode, FR1+FR2 mode for HO with PSCell from NR-DC to NR-DC and FR1+LTE mode for HO with PSCell from NE-DC to NE-DC.****Proposal 3: RAN4 to confirm 50ms as RRC processing delay for NR SA to EN-DC scenario.****Proposal 4: RAN4 to agree that cell search is performed in parallel for HO with PSCell.****Proposal 5: RAN4 to postpone the discussion on interruption uncertainty (TIU) till reply LS from RAN2 is received.** **Proposal 6: Tprocessing is the UE processing time. Tprocessing is the maximum value of PCell HO and PSCell addition; and T∆ is time for fine time tracking and acquiring full timing information of the PCell and PSCell and it can be performed parallel.** **Proposal 7: RAN4 to define both 2-step and 4-step RACH requirements for handover with PSCell.** |
| [**R4-2110062**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110062.zip) | OPPO | **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: RRM requirements are defined as minimum requirements assuming PCell HO and PSCell addition is performed in a sequential order.****Proposal 3: 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 4: 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 5: Additional interruption may be expected on PCell due to PSCell addition, if PCC could be scheduled when PCell HO is completed but PSCell addition is not completed.** |
| [**R4-2110147**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110147.zip) | NTT DOCOMO, INC. | **Proposal 1: Ending point of the delay requirement should be defined as the timing when the UE shall be capable to transmit PRACH preamble towards target PSCell(i.e., option1).** |
| [**R4-2110344**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110344.zip) | Huawei, HiSilicon | **Observation 1: There is no baseline RRM requirements for FR1+FR1 NR-DC.****Proposal 1: Consider FR1+FR2 NR-DC for HO with PSCell from NR-DC to NR-DC and FR1+LTE NE-DC for HO with PSCell from NE-DC to NE-DC.****Proposal 2: RAN4 to define HO with PSCell requirements based on parallel processing assumption.****Observation 2: Based on the parallel processing assumption, the extra delay uncertainty of RACH to NR could be included for EN-DC and NE-DC.****Proposal 3: Wait for LS reply from RAN2 about whether there is strict order of RACH to PCell and RACH to PSCell before considering the RACH delay uncertainty.****Observation 3: Whether to consider additional delay for searching procedure depends on whether to include FR1+FR1 NR-DC case.** **Observation 4: UE processing time is the maximum valure of PCell HO and PSCell addition, and FFS whether to extend the processing time for NR SA to EN-DC and the value if needed.****Proposal 4: Define delay requirements for HO and PSCell addition/change separately with the ending points defined as PCell PRACH and PSCell PRACH respectively. No need to define overall delay requirement.****Proposal 5: No interruption requirements to be defined during HO with PSCell.** |
| [**R4-2110971**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110971.zip) | Ericsson | **Proposal 1:** As a starting point, RRM requirements are defined for the following handover 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:** As a starting point, RRM requirements are defined for the following NR-DC and NE-DC handover scenarios.* FR1+FR2 NR-DC to NR-DC
* FR1+FR1 NR-DC to NR-DC
* FR1+LTE NE-DC to NE-DC

**Proposal 3:** RAN4 shall wait for LS reply from RAN2/RAN3 on whether RA can be carried out in parallel, before further discussing the detailed timeline and associated delay requirements.**Proposal 4:** The delay requirement for HO with PSCell shall be specified separately for PCell and PSCell. **Proposal 5:** HO with PSCell delay requirements shall allow UE to carry out fine time tracking (contributing with T∆ in the time line) regardless of whether source and target PSCell is the same cell.**Proposal 6:** For software processing for PSCell, the following values are to be used.* 0ms, when source and target PSCells are the same same NR or LTE cell,
* 20ms, when source and target PSCells are different NR cells in same FR,
* 40ms, when source and target PSCells 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 7:** RAN4 shall assume that UE can be scheduled on PCC after RA towards PCell has been completed, even if RA towards PSCell has not been completed.**Proposal 8:** Interruption in legacy handover delay requirement can be applied for PCell. No interruption is defined for PSCell.**Proposal 9:** 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 10:** 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. |
| [**R4-2111042**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111042.zip) | Nokia, Nokia Shanghai Bell | 1. In addition to the scenarios agreed RAN4#98e, RAN4 specifies RRM requirements for handover with PSCell for following scenarios:
* **From NR SA to NR-DC**
* **From NR SA to NE-DC**
* **From E-UTRAN to EN-DC**
1. RAN4 should define RRM requirements for handover with PSCell including FR1+FR2 NR-DC and FR1+FR1 NR-DC when considering “from NR-DC to NR-DC” scenario.
2. 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.
3. In HO with PSCell, legacy HO and PSCell addition operations can be performed in parallel except RA procedure.
4. The UE processing time in HO with PSCell can be 20ms if source & target PCell is in same frequency range and source & target PSCell in same frequency range, 40ms otherwise.
5. The cell searching time in HO with PSCell can be the maximum searching time of target PCell and PSCell.
6. The delay requirements for HO with PSCell can be described as: DHO\_with\_PSCell = TRRC\_delay + Tsearch + Tprocessing + T∆ + Tmargin +TFFS.Where TFFS is the delay in acquiring the first available PRACH occasion in the target cells
7. No additional interruption should be defined during HO with PSCell.
8. 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.
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| [**R4-2111265**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111265.zip) | vivo | **Proposal 1 Further discuss the newly added scenarios in the RAN plenary, and before that RAN4 will not discuss on this issue.****Proposal 2 For NR-DC and NE-DC mode in HO with PSCell, we support Option 2/2a from last meeting, i.e. in R17 RAN4 considers FR1+FR2 NR-DC and FR1+FR1 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 RAN4 proceed requirements discussion on HO with PSCell with 2 case: RACH is performed in sequential and RACH is performed in parallel.** **Proposal 4 The requirements defined for the case RACH performed in sequential is only applicable for certain band combination and for some certain cases of the uplink PRACH power.****Proposal 5 RF chain activation and retuning time needs to be considered in the timeline of HO with PSCell.****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 start the discussion with 4 step RACH, and the applicability rule for 2-step RACH can be updated later, considering the same expression of requirements will be used.** |

## 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, Xiaomi, Apple, MTK, Ericsson, vivo): 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
		- Note: The extension of WI scope should be discussed in RAN plenary.
	+ Option 2(CMCC, NEC, Nokia): 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
		- from NR SA to NE-DC (newly added)
		- from NR SA to NR-DC (newly added)
		- from LTE SA to EN-DC (newly added)
* Recommended WF
	+ RAN4 concludes that RRM requirements are needed for the additional scenarios for HO with PSCell. It is up to RAN plenary decision whether to extend the scope the WID.
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| CMCC | We support option 2 and we are OK with moderator’s recommended WF. We have potential deployment of NR-DC, NE-DC, if there is no significant impact on RAN4 workload. it is suggested to specify the HO requirements for the additional scenarios to guarantee the performance. |

**Issue 2-1-2: NR-DC and NE-DC mode in HO with PSCell**

* Proposals
	+ Option 1(CATT, OPPO, Huawei): 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.
	+ Option 2 (Intel, Xiaomi, Apple, MTK, NEC, Ericsson, vivo):
		- FR1+FR2 NR-DC and FR1+FR1 NR-DC for HO with PSCell from NR-DC to NR-DC
			* Note: the baseline PSCell addition requirement for FR1+FR1 NR-DC would be discussed in TEI16.
		- FR1+LTE NE-DC for HO with PSCell from NE-DC to NE-DC.
	+ Option 2a (CMCC, Nokia): For NR-DC to NR-DC:
		- FR1+FR2 NR-DC and FR1+FR1 NR-DC for HO with PSCell from NR-DC to NR-DC,
			* Note: the baseline PSCell addition requirement for FR1+FR1 NR-DC would be discussed in TEI16.
	+ Option 3 (Nokia): For NE-DC to NE-DC and NR-SA to NE-DC
		- FR1+LTE and FR2+LTE NE-DC for HO with PSCell from NE-DC to NE-DC,
		- FR1+LTE and FR2+LTE NE-DC for HO with PSCell from NR SA to NE-DC.
* Recommended WF
	+ FR1+FR2 NR-DC for HO with PSCell from NR-DC to NR-DC is supported.
	+ FR1+LTE NE-DC for HO with PSCell from NE-DC to NE-DC is supported.
	+ FR1+FR1 NR-DC for HO with PSCell from NR-DC to NR-DC is FFS
		- the baseline PSCell addition requirement for FR1+FR1 NR-DC would be discussed in TEI16.
	+ FR2+LTE NE-DC for HO with PSCell from NE-DC to NE-DC is FFS.

Companies are encouraged to provide comments on the FFS issues, including whether baseline PSCell addition requirement for FR1+FR1 NR-DC would be discussed in TEI16.

* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CMCC | For HO with PSCell from NR-DC to NR-DC, we are OK with option 2 and option 2a. It seems that option 2 and option 2a are the same. |

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

*Sub-topic description*

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

**Issue 2-2-1: Timeline for HO with PSCell**

* Proposals
	+ Option 1 (CMCC, CATT, QC, ZTE, Intel, NEC, Huawei, Ericsson, Nokia, MTK, vivo): For HO with PSCell, PCell HO and PSCell addition are performed in parallel for at least some of procedures, except RACH processing
		- Note: How and what procedures, including RACH processing, can be performed in parallel are discussed in Issue 2-2-2, Issue 2-2-3 and Issue 2-2-4 respectively.
	+ Option 2 (Apple): In HO with PSCell, if SMTC of target unknown PSCell is configured in targetcellSMTC-SCG-r16, sequential processing shall be assumed; otherwise parallel processing shall be assumed for all the other cases.
	+ Option 3 (Xiaomi, OPPO): For HO with PSCell, it is assumed that the preparation of synchronization procedures should be performed in sequentially order:
		- Cell search;
		- Fine time tracking;
		- UE processing time;
		- Time for interruption uncertainty in acquiring the first available PRACH occasion in the new cell;
		- Time for SSB post-processing
* Recommended WF
	+ Further discussion in the 1st round

* 1st round Comment collection:

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| **Company** | **Comments** |
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**Issue 2-2-2: Parallel processing for HO with PSCell**

* Proposals
	+ Option 1a (QC, Nokia, ZTE, CMCC, CATT, Ericsson, vivo):
		- PCell HO and PSCell addition are performed in parallel independently without considering RA procedures and Tprocessing.
	+ Option 1b (Intel):
		- Tsearch, Tmargin, T∆ can be processed in parallel for both PCell HO and PSCell addition. Tsearch is the time required to search the target cell. T∆ is time for fine time tracking and acquiring full timing information of the target cell. Tmargin is time for SSB post-processing.
	+ Option 1c (Huawei):
		- Based on the parallel processing assumption
		- Whether to consider additional delay for searching procedure depends on whether to include FR1+FR1 NR-DC case
	+ Option 2a (NEC):
		- T∆ is time for fine time tracking and acquiring full timing information of the PCell and PSCell and it can be performed parallel.
		- Cell search is performed in parallel for HO with PSCell.
	+ Option 2b (MTK):
		- 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.
		- FFS what kinds of components in the overall delay requirement, e.g., Tprocessing, will have dependency between PCell and PSCell.
* Recommended WF
	+ Further discussion in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
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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. And Tprocessing for HO with PSCell including UE SW processing and RF warm-up time should be the maximum of the processing time of handover and the processing time of the PSCell addition.
	+ Option 2 (Intel): Tprocessing can be further split into software processing (Tprocessing\_SW) and RF warm up time(Tprocessing\_RF). For Tprocessing\_RF, it depends on whether PCell or PSCell changed across FR. For Tprocessing\_SW, PSCell can be processed in parallel with PCell handover, FFS if any extension is needed.
	+ Option 3 (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 4 (Huawei): UE processing time is the maximum value of PCell HO and PSCell addition, and FFS whether to extend the processing time for NR SA to EN-DC and the value if needed.
	+ Option 5 (Ericsson): For software processing for PSCell, the following values are to be used.
		- 0ms, when source and target PSCells are the same same NR or LTE cell,
		- 20ms, when source and target PSCells are different NR cells in same FR,
		- 40ms, when source and target PSCells 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 6 (Nokia):
		- The UE processing time in HO with PSCell can be 20ms if source & target PCell is in same frequency range and source & target PSCell in same frequency range, 40ms otherwise.
		- No additional RF retuning interruption should be defined during HO with PSCell..
	+ Option 7 (NEC): Tprocessing is the UE processing time. Tprocessing is the maximum value of PCell HO and PSCell addition
	+ Option 8 (MTK): The overall Tprocessing for HO with PSCell should be max(Tprocessing for PCell HO, Tprocessing for PSCell addition) +10ms
	+ Option 9 (vivo): RF chain activation and retuning time needs to be considered in the timeline of HO with PSCell.
	+ Option 10:
		- 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** |
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**Issue 2-2-4: RA processing for PCell and PSCell**

* Proposals
	+ Option 1 (CMCC, CATT, Intel, NEC, Huawei, Ericsson, Nokia, MTK): Whether RACH processing can be performed in parallel or not, it depends on RAN2 reply and can be further discussed.
	+ Option 2 (vivo): The requirements defined for the case RACH performed in sequential is only applicable for certain band combination and for some certain cases of the uplink PRACH power. Otherwise, RACH is performed in parallel.
	+ Option 3 (QC, ZTE): RA procedures for PCell and PSCell are performed in parallel completely.
		- Note: It’s necessary to understand the network side’s limitation if parallel RACHs are not favoured.
* Recommended WF
	+ Further discussion in the 1st round

* 1st round Comment collection:

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

* Proposals:
	+ Option 1 (CATT, CMCC): Waiting for RAN2 response for order of random access carried out towards PCell and PSCell.
	+ Option 2 (Xiaomi, OPPO, DoCoMo): The ending point of HO with PSCell is the timing when UE is capable to transmit PRACH preamble towards target PSCell.
	+ Option 3 (Apple): the ending point of the delay requirement for HO with PSCell is:
		- if sequential processing is used, the timing when UE shall be capable to transmit PRACH preamble towards target PSCell
		- if the parallel processing is used, 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 4 (Huawei, Ericsson, QC, vivo):
		- Define delay requirements for HO and PSCell addition/change separately with the ending points defined as PCell PRACH and PSCell PRACH respectively. No need to define overall delay requirement.
* Recommended WF
	+ Further discussion in the 1st round. Relevant to the conclusion of issue 2-2-4.
* 1st round Comment collection:

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| **Company** | **Comments** |
| CMCC | For option 4, we have one question for clarification. If we go with option 4, whether to define the total delay of HO with PSCell, e.g. maximum (delay for Pcell HO, delay for PScell addition)?  |

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

* Proposals
	+ Option 1 (ZTE, CATT, Apple, OPPO, Ericsson, vivo): 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
	+ Agree on option 1.
* 1st round Comment collection:

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| **Company** | **Comments** |
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**Issue 2-2-7: RRC processing delay for HO with PSCell**

* Proposals
	+ Option 1 (Intel, Xiaomi, Apple, CMCC, NEC): Considering the reply LS from RAN2, RRC processing delay for HO with PSCell is:
		- NR SA to EN-DC : 50ms
		- EN-DC to EN-DC: 20ms
		- NE-DC to NE-DC: 16ms
		- NR-DC to NR-DC: 16ms
* Recommended WF
	+ Agree on option 1.
* 1st round Comment collection:

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| **Company** | **Comments** |
| CMCC | We support the recommended WF. |

**Issue 2-2-8: Delay requirement design if parallel processing is assumed**

* Proposals
	+ Option 1 (CATT):
		- If parallel processing is assumed and having order limit of PRACH, the delay requirement can be defined as:
			* Delay = RRC processing time + max(Tprocessing for handove, Tprocessing for addition) + max(Tinterrupt –Tprocessing for handove , Tconfig\_PSCell – TRRC\_delay –Tprocessing for addition–TPSCell\_ DU) + TPSCell\_ DU
		- If parallel processing is assumed and having not order limit of PRACH, the delay requirement can be defined as:
			* Delay = RRC processing time + max(Tinterrupt , Tconfig\_PSCell – TRRC\_delay)
	+ Option 2 (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 3 (Nokia):
		- The delay requirements for HO with PSCell can be described as: DHO\_with\_PSCell = TRRC\_delay + Tsearch + Tprocessing + T∆ + Tmargin +TFFS.Where TFFS is the delay in acquiring the first available PRACH occasion in the target cells.
			* The cell searching time in HO with PSCell can be the maximum searching time of target PCell and PSCell.
* Recommended WF
	+ Further discussion in the 1st round. Relevant to outcome of previous issues in Sub-topic 2-2.
* 1st round Comment collection:

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| **Company** | **Comments** |
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**Issue 2-2-9: Delay requirement design if sequential processing is assumed**

* Proposals
	+ Option 1 (CATT):
		- If sequential processing is assumed, the delay requirement can be defined as:
			* Delay = RRC processing time + max(Tprocessing for handove, Tprocessing for addition) + (Tinterrupt –Tprocessing for handove) + (Tconfig\_PSCell – TRRC\_delay –Tprocessing for addition)
	+ Option 2:
		- Other options are not precluded.
* Recommended WF
	+ Further discussion in the 1st round. Relevant to outcome of Issue 2-2-1
* 1st round Comment collection:

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| **Company** | **Comments** |
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### Sub-topic 2-3 Interruption requirement design of HO with PSCell

*Sub-topic description*

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

**Issue 2-3-1: whether or not RAN4 assumes PCC could be scheduled for UE when Pcell HO is completed but PSCell addition is not completed**

* Proposals
	+ Option 1 (CATT, Apple, MTK, Ericsson, vivo): Yes
	+ Option 1a (OPPO): Yes, but Additional interruption may be expected on PCell due to PSCell addition, if PCC could be scheduled when PCell HO is completed but PSCell addition is not completed.
* Recommended WF
	+ Further discussion in the 1st round.
* 1st round Comment collection:

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

* Proposals
	+ Option 1 (CATT, Xiaomi, Huawei, Nokia, vivo): No interruption requirement should be defined during HO with PSCell
	+ Option 2 (MTK, Ericsson): No new interruption requirement for HO with PSCell is needed. Interruption in legacy handover delay requirement can still be applied for the PCell
	+ 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, if PCC could be scheduled when PCell HO is completed but PSCell addition is not completed.
	+ Option 5 (NEC): RAN4 to postpone the discussion on interruption uncertainty (TIU) till reply LS from RAN2 is received.
* Recommended WF
	+ Further discussion in the 1st round.
* 1st round Comment collection:

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| **Company** | **Comments** |
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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): 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 (NEC, Ericsson): RAN4 to define both 2-step and 4-step RACH requirements for handover with PSCell.
	+ 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 (CATT): Waiting RAN2 response and conclusions of other issues for 2 step and 4 step RACH.
* Recommended WF
	+ Further discussion in the 1st round.
* 1st round Comment collection:

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

* Proposals
	+ Option 1 (Apple):
		- If sequential processing is used, there is no need to consider RACH occasion (RO) collision between Pcell and PSCell.
		- If parallel processing is used:
			* 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 the Pcell and PSCell are on the different FRs, 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** |
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**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): 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** |
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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:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-1-2: NR-DC and NE-DC mode in HO with PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

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

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|  | **Status summary**  |
| **Issue 2-2-1: timeline for HO with PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-2-2: Parallel processing for HO with PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-2-3: UE SW processing and RF warm-up(if needed) time for HO with PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-2-4: RA processing for PCell and PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-2-5: Ending point of the delay requirement for HO with PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-2-6: Optimisation for the case when PSCell is not changed during HO with PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-2-7: RRC processing delay for HO with PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-2-8: Delay requirement design if parallel processing is assumed** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-2-9: Delay requirement design if sequential processing is assumed** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

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

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 2-3-1: whether or not RAN4 assumes PCC could be scheduled for UE when Pcell HO is completed but PSCell addition is not completed** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-3-2: Interruption requirement for HO with PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 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** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-4-2: RACH occasion collision between Pcell and PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Issue 2-4-3: RACH occasion on NR-U CC for HO with PSCell** | *Tentative agreements:**Candidate options:**Recommendations for 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 (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Recommendations for Tdocs

## 1st round

**New tdocs**

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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