**3GPP TSG-RAN4 Meeting #98bis-eR4-21xxxxx**

**Online, 12 – 20 April, 2021**

**Agenda item:** 8.4

**Source:** Moderator (Apple)

**Title:** Email discussion summary for [98-bis-e][216] NR\_RRM\_enh2\_1

**Document for:** Information

# Introduction

This email discussion summary includes SRS antenna port switching (8.4.2.1), and HO with PSCell (8.4.2.2).

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

* 1st round:
  + Stage 0: Session chairs announce the set of email threads (no later than Monday 8am UTC, Apr. 12)
  + Stage 1: Moderators kick off email discussion (Monday Apr. 12)
  + Stage 2: Companies provide comments for the 1st round (Apr. 12 – Wednesday 8am UTC Apr. 14)
  + 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 (Wednesday 11pm UTC, Apr. 14)
  + 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 3pm UTC, Apr. 16)
* 2nd round:
  + Stage 5: Companies provide comments for 2nd round starting from Thursday 8am UTC Apr. 15.
    - Draft WF/LS and revised CRs/TPs shall be shared by Friday 11pm UTC, Apr. 16.
    - Commenting shall stop by Monday 11pm UTC, Apr. 19.
    - Formal tdocs of WF/LS/CRs/TPs shall be uploaded to the Inbox (except Cat A CRs) by Tuesday 1am UTC, Apr. 20.
  + Stage 6: Moderators provide 2nd round summary with a formal tdoc by Tuesday 9am UTC, Apr. 20.
  + Stage 7: Session chairs announce close of sessions (no later than 5pm UTC, Apr. 20). Final decisions will be captured in Chairman meeting report (to be shared after the meeting is closed)

# Topic #1: SRS antenna port switching (8.4.2.1)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104565**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104565.zip) | MediaTek inc. | Proposal 1: Only define the interruption requirements at SRS antenna switching in FR1, unless the transient period in FR2 gets clarification in RF session.  Proposal 2: No need to define the delay requirement for SRS antenna port switching.  Observation 1: SRS antenna switching in one band will possibly influence other bands’ DL/UL.  Proposal 3: The interruption requirement should be defined based on the band combination capability reported by UE, i.e., *txSwitchImpactToRx* or *txSwitchWithAnotherBand*.  Proposal 4: Interruption requirement of SRS antenna port switching will not depend on for per-UE or per-FR gap capability.  Proposal 5: Define the interruption requirement for SRS antenna port switching based on slot level.  Observation 2: The max number of symbols for SRS in one slot is 6, including SRS resource(s) and guard period for switching among SRS ports.  Proposal 6: The SRS antenna switching time is 15us.  Proposal 7: The SRS antenna switching interruption time should be   1. SRS Transmission time (up to 6 symbols). 2. 2 \* 15us   Proposal 8: The SRS antenna switching interruption requirement should be defined based on SCSs of aggressor cell and victim cells in NR.  Proposal 9: One single requirement to cover the synchronous and asynchronous scenarios with or without UL TA.  Proposal 10: The SRS antenna switching interruption requirement should be specified as follows.  Table 2. Interruption length (slots) due to SRS antenna switch   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Victim cell SCS(KHz) | Aggressor Cell SCS (KHz) | | | | | 15 | 30 | 60 | 120 | | 15 | 2 | 2 | 2 | 2 | | 30 | 2 | 2 | 2 | 2 | | 60 | 3 | 2 | 2 | 2 | | 120 | 5 | 3 | 3 | 2 | |
| [**R4-2104694**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104694.zip) | Xiaomi | Proposal 1: RAN4 to prioritize the requirement for SRS antenna port switching in FR1.  Proposal 2: The guard period defined in TS 38.214 is considered as the antenna switching time when defining the interruption requirement.  Proposal 3: It is proposed to define the interruption requirement based on the UE capability signaling with txSwitchImpactToRx or txSwitchWithAnotherBand respectively.  Proposal 4: If the signalling of txSwitchWithAnotherBand is reported, the interruption requirement at SRS antenna switching should be the guard period defined in TS 38.214 for the aggressor CCs in the band combination.  Proposal 5: If the signalling of txSwitchImpactToRx is reported, the interruption requirement should include the guard period defined in TS 38.214 and SRS transmission time for the aggressor CCs in the band combination.  Proposal 6: RAN4 to define the interruption requirement for SRS antenna switching based on slot level.  Proposal 7: The SRS antenna switching interruption requirement for FR1 is shown as follow.  Table 1. Interruption length (slots) due to SRS antenna switching for DC   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Victim cell SCS(KHz) | Aggressor Cell SCS (KHz) | | | | | | | signalling txSwitchWithAnotherBand | | | signalling txSwitchImpactToRx | | | | 15 | 30 | 60 | 15 | 30 | 60 | | 15 | 1 | 1 | 1 | 1 | 1 | 1 | | 30 | 2 | 1 | 1 | 2 | 1 | 1 | | 60 | 3 | 2 | 1 | 4 | 2 | 1 |   Table 2. Interruption length (slots) due to SRS antenna switching for CA   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Victim cell SCS(KHz) | Aggressor Cell SCS (KHz) | | | | | | | signalling txSwitchWithAnotherBand | | | signalling txSwitchImpactToRx | | | | 15 | 30 | 60 | 15 | 30 | 60 | | 15 | 1 | 1 | 1 | 1 | 1 | 1 | | 30 | 1 | 1 | 1 | 1 | 1 | 1 | | 60 | 1 | 1 | 1 | 2 | 1 | 1 | |
| [**R4-2104758**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104758.zip) | CATT | Proposal 1: Do not define SRS antenna port switching delay requirement in RRM.  Proposal 2: No RRM requirement would be impacted by SRS antenna port switching.  Proposal 3: It may be appropriate to define the requirement only for SRS antenna port switching in FR1.  Proposal 4: The interruption requirement should base on the band combination capability (indicated by *txSwitchImpactToRx* or *txSwitchWithAnotherBand*) reporting by UE.  Proposal 5: Use same interruption set of requirements for different SRS antenna switch patterns supported by UE capability indicated in *supportedSRS-TxPortSwitch*.  Proposal 6: The interruption requirement will be defined based on slot level.  Proposal 7: The interruption time of SRS antenna port switching in FR1 includes all guard symbols, all SRS symbols transmitted on other antenna port, and only one switching time.  Proposal 8: Interruption requirement is based on the aggressor CC SCS and victim CC SCS.  Proposal 9: The interruption requirement can differentiate between sync and async cases.  Proposal 10: No need to define the UE (not) capable of per-FR gaps requirement for SRS antenna port switching in RAN4.  Proposal 11: The interruption requirements should base on sync/async case, Aggressor Cell SCS, Victim cell SCS, number of guard symbol, and number SRS symbol transmitted on other antenna port and 15us transient period for FR1. |
| [**R4-2104831**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104831.zip) | Apple | Proposal 1: Do not define SRS antenna port switching delay requirement in RRM.  Proposal 2: Regarding the impact of SRS antenna port switching to other RRM requirements, RAN4 would clarify the relaxation or applicability in those RRM requirements whose wanted DL RS or UL RS could be interrupted by SRS antenna port switching, e.g., the delay requirement could be extended if SRS antenna port switching happens during the UE procedure, or the requirement only applies when SRS antenna port switching is not colliding with the reference signal.  Proposal 3: RAN4 defines the RRM requirements for SRS antenna port switching for FR1.  Proposal 4: The interruption requirement of SRS antenna port switching should base on the band combination capability (indicated by txSwitchImpactToRx or txSwitchWithAnotherBand) reporting by UE.  Proposal 5: RAN4 uses same interruption requirement applies to different SRS antenna port switching patterns.  Proposal 6: Interruption requirement of SRS antenna port switching shall be defined based on slot level for NR victim CC and based on subframe level for LTE victim CC respectively.  Proposal 7: The components within interruption time of SRS antenna port switching in FR1 include:   * SRS antenna port switching time (transient time) * SRS transmission time * Transient time before and after SRS transmission occasion   Proposal 8: total interruption time due to SRS antenna port switching in one UL slot could be 6 symbols + 20us.  Proposal 9: Interruption requirement is based on the aggressor CC and victim CC SCS.  Proposal 10: Interruption requirement is based on the async case for the minimum requirement.  Proposal 11: No need to differentiate the requirement for the UE with or without capability of per-FR gap for SRS antenna port switching in RAN4. But in the interruption requirement applicability condition, RAN4 shall clarify that the indication of txSwitchImpactToRx or txSwitchWithAnotherBand is not allowed to indicate any band combination cross FR1 and FR2 if UE is capable of per-FR MG.  Proposal 12: the interruption requirement of SRS antenna port switching is summarized as:   |  |  |  |  | | --- | --- | --- | --- | | Victim CC SCS(kHz) | Aggressor CC SCS (kHz) | | | | 15 | 30 | 60 | | 15 (NR or LTE) | 2 | 2 | 2 | | 30 | 2 | 2 | 2 | | 60 | 3 | 2 | 2 |   Unit of interruption requirement is slot for NR and subframe for LTE. |
| [**R4-2104909**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104909.zip) | Qualcomm, Inc. | Proposal 1: Do not specify RRM requirement for FR2 SRS antenna switching. Do not specify SRS antenna switching delay requirement in RRM.  Proposal 2: The carriers being interrupted are the union of the carrier groups specified in *txSwitchImpactToRx* and in *txSwitchWithAnotherBand* that contains the SRS antenna switching carrier.  Proposal 3: No impact to NR measurement requirements relevant to measurements based on SSB/CSI-RS due to NR SRS antenna switching, as NR measurements are always prioritized.  Proposal 4: In EN-DC and NE-DC operation,   * NR SRS antenna switching colliding with E-UTRA measurement   + Interruptions on E-UTRA measurement in the interrupted carrier group are allowed due to NR SRS antenna switching, but NOT allowed due to NR SRS antenna switching for the carriers not in the interrupted carrier group.   + Additional delay can be expected on E-UTRA measurement in the interrupted carrier group when UE is configured to perform NR SRS antenna switching.   + NR SRS antenna switching is allowed to be dropped when colliding with E-UTRA measurement in the interrupted carrier group. * E-UTRA SRS antenna switching colliding with NR measurement   + Interruptions on NR measurement in the interrupted carrier group are allowed due to LTE SRS antenna switching, but NOT allowed due to E-UTRA SRS antenna switching for the carriers not in the interrupted carrier group.   + Additional delay can be expected on NR measurement in the interrupted carrier group when UE is configured to perform E-UTRA SRS antenna switching.   + E-UTRA SRS antenna switching is allowed to be dropped when colliding with NR measurement in the interrupted carrier group.   Proposal 5: Interruption time is specified in the unit of slot.  Proposal 6: Interruption time is specified based on 2 transient period and 6 symbol time.  Proposal 7: SRS antenna switch interruption is specified as the following table for NR SA. In EN-DC, interruption on LTE carrier is the same as victim SCS = 15kHz case in NR SA.   |  |  |  |  | | --- | --- | --- | --- | |  | Interruption Length (slots) | | | | Victim SCS (kHz) | 15 | 30 | 60 | | 15 | 2 | 2 | 2 | | 30 | 2 | 2 | 2 | | 60 | 3 | 2 | 2 | |
| [**R4-2104945**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104945.zip) | CMCC | Proposal 1: considering RF has defined the transient period due to SRS antenna switching, which in our understanding is the SRS switching delay, it is not necessary to define SRS antenna port switching delay requirement in RRM  Proposal 2: since UE stay connection with the serving CCs, the interruption time for SRS antenna port switching delay includes transient periods before and after SRS transmission, and it is not necessary to consider SRS transmission time.  Proposal 3: if the interruption time only includes transient periods before and after SRS transmission, and considering that the transient period specified in FR session is 15us, it is suggested to specify the interruption requirements based on slot level. |
| [**R4-2104979**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104979.zip) | NEC | Proposal 1: RAN4 to define the SRS antenna port switching delay as RF retuning time and the SRS antenna port switching delay to be contained within the (or overlapped with) transient period.  Proposal 2: If victim CC and SRS transmission on aggressor CC are transmitted on the same antenna, interruption requirement shall include SRS antenna switching in delay/TP, SRS transmission, GP, SRS antenna switching back delay/TP.  Proposal 3: If victim CC and SRS transmission on aggressor CC are transmitted on the different antenna, interruption requirement shall include SRS antenna switching in delay/TP, SRS antenna switching back delay/TP only.  Proposal 4: RAN4 to define interruption due to SRS antenna port switching in terms of symbols.  Proposal 5: For impact on other RRM requirements due to SRS antenna port switching, RAN4 shall consider SRS carrier switching as the baseline.  Proposal 6: RAN4 should first discuss and agree on timing misalignment value before discussion of SRS antenna port switch impact on gNB measurements. |
| [**R4-2104991**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104991.zip) | LG Electronics Inc. | * Observation 1: The interruption could be different according to ‘resourceType’;   + The interruption occurs per SRS-ResourceSet for ‘aperiodic’   + The interruption occurs per SRS resource for ‘periodic’ or ‘semi-persistent’ * Observation 2: The interruption requirement depends on whether Tx antenna is required to switch back after SRS transmission. * Observation 3: The interruption requirement could depend on UL-DL or UL-DL slot configuration. * Observation 4: The interruption occurs in the uplink symbols in case of flexible symbols within a slot. * Proposal 1: Do not define SRS antenna port switching delay requirement in RRM as option 1. * Proposal 2: The interruption requirement can be defined based on slot level for full uplink symbols within a slot and based on symbol level for flexible symbols with in slot. * Proposal 3: The components within interruption time is   + Time to antenna switching before SRS transmission and SRS transmission time for ‘aperiodic’ SRS-ResourceSet   + Time to antenna switching before SRS transmission for ‘periodic’ or ‘semi-persistent’ SRS-ResourceSet   + Additionally, the time to switch back after SRS transmission depending on UE behavior * Proposal 4: Interruption requirements for SRS antenna port switching are shown in Table 1 and Table 2.   Table 1 Proposed interruption requirements per *SRS-ResourceSet* ('aperiodic')   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Victim cell SCS [kHz] | Interruption length [slot] | | | | | | | Aggressor cell SCS [kHz] | | | | | | | 15 | | 30 | | 60 | | | Case 1 | Case 2 | Case 1 | Case 2 | Case 1 | Case 2 | | 15 | 2 | 1 | 2 | 1 | 2 | 1 | | 30 | 2 | 1 | 2 | 1 | 2 | 1 | | 60 | 3 | 2 | 2 | 1 | 2 | 1 | | Case 1: UL-UL slot configuration for synchronous case, and UL-UL or UL-DL slot configuration for asynchronous case  Case 2: UL-DL slot configuration for synchronous case  Note 1: If SRS resource is configured in flexible symbols within a slot in synchronous case, the interruption requirements apply to uplink symbols. | | | | | | |   Table 2 Proposed interruption requirements per SRS resource (‘periodic’ or ‘semi-persistent’)   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Victim cell SCS [kHz] | Interruption length [slot] | | | | | | | Aggressor cell SCS [kHz] | | | | | | | 15 | | 30 | | 60 | | | Case 1 | Case 2 | Case 1 | Case 2 | Case 1 | Case 2 | | 15 | 2 | 1 | 2 | 1 | 2 | 1 | | 30 | 2 | 1 | 2 | 1 | 2 | 1 | | 60 | 2 | 1 | 2 | 1 | 2 | 1 | | Case 1: UL-UL slot configuration for synchronous and asynchronous cases  Case 2: UL-DL slot configuration for and asynchronous cases  Note 1: If SRS resource is configured in flexible symbols within a slot in synchronous case, the interruption requirements apply to uplink symbols. | | | | | | | |
| [**R4-2106409**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106409.zip) | Nokia, Nokia Shanghai Bell | Observation1: The guard period defined in RAN1 is supposed to cause interruption on the carrier within which the UE is restricted from at least uplink transmission.  Proposal1: The interruption at SRS antenna switching shall be defined at least within the guard period in Table 6.2.1.2-1 of [2].  Proposal2: The interruption requirement shall be defined when the SRS resources of a set in a slot are configured on the symbols which separated by exactly the minimum guard period.  Proposal3: RAN4 shall discuss if the interruption requirements are defined when the SRS resources of a set in a slot are separated by a length larger than a minimum guard period.  Proposal4: Add one note indicating the DL may be affected due to SRS antenna switching if *txSwitchImpactToRx* is configured.  Proposal5: It is proposed to define the interruption requirements at SRS antenna switching only for FR1 unless the transient period in FR2 gets clarified in RF session. |
| [**R4-2106462**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106462.zip) | Intel Corporation | Proposal 1: Clarify that Current SRS antenna switching time of 15us is applied for FR2 case where SRS antenna switch in the same panel.  Proposal 2: For the case that SRS antenna switching happens between different panels for FR2, it needs further discussion whether extra ramp up timing for other panels are needed.  Proposal 3: For FR1, the interruption time will include antenna switching time, SRS transmission time after switching.  Proposal 4: The interruption requirement don’t need to differentiate between sync and async cases. |
| [**R4-2106532**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106532.zip) | OPPO | Observation 1: Define the interruption requirements of SRS antenna port switching for FR1 firstly, and further study the feasibility of FR2 cases.  Observation 2: Different impact should be considered for UE capable of per UE gap or per FR gap if FR1+FR2 SRS antenna port switching was to be specified.  Proposal 1: Do not define SRS antenna port switching delay requirement in RRM.  Proposal 2: For MR-DC, the interruption requirements should be defined for E-UTRA and NR DL carriers respectively, based on band combination capability reporting by UE.  Proposal 3: Suggest one same set of requirements for different SRS antenna switch patterns.  Proposal 4: RAN4 considers antenna switching time, SRS transmission time together with transient periods for interruption time of SRS antenna port switching.   * SRS Transmission time (up to 7 symbols). * SRS antenna switching time (15us \*2) * transient period (10us\*2)   Proposal 5: For NR SRS antenna port switching impacting LTE CC, the interruption is 2 subframes.  Proposal 6: For NR SRS antenna port switching impacting NR CC, the interruption should be specified as the following table based on the SCS of the victim CC.   |  |  |  |  | | --- | --- | --- | --- | |  | Interruption Length (slots) | | | | Victim SCS (kHz) | 15 | 30 | 60 | | 15 | 2 | 2 | 2 | | 30 | 3 | 2 | 2 | | 60 | 4 | 3 | 2 | |
| [**R4-2106881**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106881.zip) | Ericsson | Proposal 1: Define SRS antenna port switching delay requirement. FFS for the value. At least RF retuning time shall be included.  Proposal 2: Further look into performance impact on timing-based measurements from SRS antenna port switching, and if needed, identify how to mitigate performance degradation (e.g. by avoiding switching during timing-based measurements).  Proposal 3: Focus on requirements for SRS antenna port switching in FR1 firstly.  Proposal 4: Interruption requirement applicability to be further discussed.  Proposal 5: Interruption requirements for SRS antenna port switching shall be defined in OFDM symbol granularity.  Proposal 6: The interruption time for SRS antenna port switching comprises at least antenna switching time and SRS transmission time.  Proposal 7: The interruption requirements depend at least on SCS for victim cell.  Proposal 8: Different interruption requirements apply for synchronous and asynchronous cases.  Proposal 9: Potential impact of UE capability for per-FR gap on interruption requirements can be further studied once the other aspects influencing the interruption time have been settled. |
| [**R4-2106986**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106986.zip) | Huawei, HiSilicon | Proposal 1: Do not define SRS antenna port switching delay requirements in RRM.  Proposal 2: Define RRM requirements for SRS antenna switching in FR1.  Proposal 3: Define the SRS antenna switching interruption requirements in symbol level.  Proposal 4: The interruption requirement should base on the band combination capability (indicated by txSwitchImpactToRx or txSwitchWithAnotherBand) reporting by UE.  Proposal 5: Discuss the impact of SRS antenna switching on positioning related measurement in Rel-17 position session. |
| [**R4-2107079**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107079.zip) | vivo | Observation 1 So far the SRS antenna port switching feature only has impact on FR1 requirements.  Observation 2 RAN1 spec has only specified gaps between SRSs, while the transient period in RAN4 RF spec covers the case of potential separation between SRS and PUSCH/PUCCH.  Observation 3 Similar to what was discussed for transient periods in RF session in R16, 15us for SRS antenna switching delay can be a loose requirement for some higher capability UE.  Proposal 1 Specify SRS antenna port switching delay requirements in R17 for FR1.  Proposal 2 For SRS antenna port switching delay, RAN4 should consider to specify UE capability to differentiate the needed minimal separation between SRSs and/or between SRS-PUSCH/PUCCH, similar to the transient period capability defined in R16.  Proposal 3 Do not consider impact to timing measurements in R17 SRS antenna port switching.  Proposal 4 Do not specify any requirements for FR2 in R17 SRS antenna port switching, unless if some clarification to the use cases can be made.  Proposal 5 Send LS to RAN1 to check the prioritization rule for SRS antenna switching, especially for the case in CA/DC operation.  Proposal 6 The interruption requirements should be based on the band combination capability (indicated by txSwitchImpactToRx or txSwitchWithAnotherBand) reporting by UE.  Proposal 7 If UE indicates that in the corresponding band the Rx or Tx is impacted by antenna port switching, then only the corresponding band is allowed to be interrupted when UE is configured to switch SRS antenna port.  Proposal 8 Do not refer antenna switching patterns in the spec when defining SRS antenna switching interruption requirements.  Proposal 9 The interruption requirement is preferred to be defined based on slot level.  Proposal 10 The interruption requirement is preferred to be defined without differentiating sync and async case, at least in R17.  Proposal 11 For interruption requirements, the interruption time is preferred to include antenna switching time and SRS transmission time.  Proposal 12 For interruption requirements, the interruption time is preferred to be based on the aggressor CC and victim CC SCS.  Proposal 13 RAN4 should firstly study whether and how network can obtain the interrupted symbol information, when SRS antenna port switching is performed in another band. |

## 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 1-1: Scope of SRS antenna switching requirement

*Sub-topic description:*

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

**Issue 1-1-1: whether delay requirement would be defined in RRM for SRS antenna port switching**

* Proposals
  + Option 1 (MTK, CATT, Apple, QC, CMCC, LGE, OPPO, HW): Do not define SRS antenna port switching delay requirement in RRM.
  + Option 2 (NEC, Ericsson, vivo): Define SRS antenna port switching delay requirement in RRM
* Recommended WF
  + TBA
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | The transient time has already been defined in RF spec and no need to capture that in RRM spec. |
| LG | Support option 1 for FR1. Further discussion might be needed for FR2. |
| OPPO | No. The antenna port switching time has been defined in RF. |
| Huawei | Support option 1. |

**Issue 1-1-2: RAN4 defines the requirement only for SRS antenna port switching in FR1 or in both FR1 and FR2**

* Proposals
  + Option 1 (MTK, Xiaomi, CATT, Apple, QC, Nokia, OPPO, Ericsson, HW, vivo): define the RRM requirements of SRS antenna switching in FR1.
  + Option 2 (Intel): SRS antenna port switching in FR1 and FR2 are considered
* Recommended WF
  + Define the RRM requirements at SRS antenna switching only for FR1 unless the transient period in FR2 gets clarified in RF session (the scope of “RRM requirements” here depends on the conclusions from issue 1-1-1)
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support Option 1 and can also agree with the recommended WF. |
| LG | Support recommended WF |
| OPPO | Agree with the recommended WF. Define the requirements of SRS antenna port switching for FR1 firstly, and further study the feasibility of FR2 cases. |
| Huawei | Support Option 1 and can also agree with the recommended WF. |

**Issue 1-1-3: Impact of SRS antenna port switching to other RRM requirements**

* Proposals
  + Option 1 (CATT): No RRM requirement would be impacted by SRS antenna port switching.
  + Option 2 (Apple): Regarding the impact of SRS antenna port switching to other RRM requirements, RAN4 would clarify the relaxation or applicability in those RRM requirements whose wanted DL RS or UL RS could be interrupted by SRS antenna port switching, e.g., the delay requirement could be extended if SRS antenna port switching happens during the UE procedure, or the requirement only applies when SRS antenna port switching is not colliding with the reference signal.
  + Option 3 (QC):
    - No impact to NR measurement requirements relevant to measurements based on SSB/CSI-RS due to NR SRS antenna switching, as NR measurements are always prioritized.
    - In EN-DC and NE-DC operation,
      * NR SRS antenna switching colliding with E-UTRA measurement
        + Interruptions on E-UTRA measurement in the interrupted carrier group are allowed due to NR SRS antenna switching, but NOT allowed due to NR SRS antenna switching for the carriers not in the interrupted carrier group.
        + Additional delay can be expected on E-UTRA measurement in the interrupted carrier group when UE is configured to perform NR SRS antenna switching.
        + NR SRS antenna switching is allowed to be dropped when colliding with E-UTRA measurement in the interrupted carrier group.
      * E-UTRA SRS antenna switching colliding with NR measurement
        + Interruptions on NR measurement in the interrupted carrier group are allowed due to LTE SRS antenna switching, but NOT allowed due to E-UTRA SRS antenna switching for the carriers not in the interrupted carrier group.
        + Additional delay can be expected on NR measurement in the interrupted carrier group when UE is configured to perform E-UTRA SRS antenna switching.
        + E-UTRA SRS antenna switching is allowed to be dropped when colliding with NR measurement in the interrupted carrier group.
  + Option 4 (NEC): For impact on other RRM requirements due to SRS antenna port switching, RAN4 shall consider SRS carrier switching as the baseline. RAN4 should first discuss and agree on timing misalignment value before discussion of SRS antenna port switch impact on gNB measurements.
  + Option 5(Nokia): Add one note indicating the DL may be affected due to SRS antenna switching if *txSwitchImpactToRx* is configured.
  + Option 6 (Ericsson): Further look into performance impact on timing-based measurements from SRS antenna port switching, and if needed, identify how to mitigate performance degradation (e.g. by avoiding switching during timing-based measurements).
  + Option 7 (vivo): Do not consider impact to timing measurements in R17 SRS antenna port switching.
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 2. But we can agree with part of option3: NR measurement could be prioritized, like what we agreed in SRS carrier based switching requirement, and NR SRS antenna port switching could cause interruption to LTE indicated by *txSwitchImpactToRx* or *txSwitchWithAnotherBand* in case of EN-DC or NE-DC mode; but we need to further check the interruption from LTE antenna port switching to NR measurement since LTE SRS antenna port switching is not the motivation of this WID. |
| OPPO | Agree with option 2 in principle. The requirements for collision can be similar to those for SRS carrier-based switching requirements. For SA mode, NR measurements could be prioritized. For EN-DC/NE-DC, FFS whether and how to define the requirements, including the priorities of NR SRS antenna switching vs. E-UTRA measurement, E-UTRA SRS antenna switching vs. NR measurement. |
| Huawei | For option 2, it seems the transmission of SRS is prioritized. However, if we take SRS carrier switching as the baseline, thing are not always like that. E.g. for NR measurement, the SRS transmission is dropped. For impact on timing requirements, we can agree with option 7. |

**Issue 1-1-4: Impact of SRS antenna port switching to positioning related requirements**

* Proposals
  + Option 1 (Huawei): Discuss the impact of SRS antenna switching on positioning related measurement in Rel-17 position session.
* Recommended WF
  + TBA
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We are fine to not discuss this impact to positioning measurement in FeRRM WI. |
| OPPO | Option 1 is fine. |
| Huawei | Support option 1. |

### Sub-topic 1-2: Interruption requirement applicability

*Sub-topic description*

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

**Issue 1-2-1: Interruption requirement applicability**

* Proposals
  + Option 1 (MTK, Xiaomi, CATT, Apple, QC, OPPO, HW, vivo): The interruption requirement should be defined based on the band combination capability reported by UE, i.e., *txSwitchImpactToRx* or *txSwitchWithAnotherBand*.
    - Option 1a (vivo):
      * The interruption requirement should be defined based on the band combination capability reported by UE, i.e., *txSwitchImpactToRx* or *txSwitchWithAnotherBand*.
      * If UE indicates that in the corresponding band the Rx or Tx is impacted by antenna port switching, then only the corresponding band is allowed to be interrupted when UE is configured to switch SRS antenna port
  + Option 2 (Ericsson): Interruption requirement applicability to be further discussed.
* Recommended WF
  + TBA
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Both option 1 and option 1a are fine to us. |
| LG | Support option 1. |
| OPPO | OK with option 1 and 1a. |
| Huawei | Support option 1. |

**Issue 1-2-2: whether same interruption requirement applies to different SRS antenna port switching patterns**

* Proposals
  + Option 1 (CATT, Apple, OPPO, vivo): use same set of requirements for different SRS antenna switch patterns
  + Option 2 (LGE): The interruption could be different according to ‘resourceType’.
* Recommended WF
  + TBA
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 1. In our understanding, we could use the same philosophy from SRS carrier switching requirement, i.e., define a generic minimum requirement regardless of the switching pattern. Differentiating SRS switching patterns in the requirement may not result in different interruption requirement in terms of slot (ACK/NACK) loss. |
| LG | The same interruption requirement could be used for different SRS antenna port switching patterns such as 1T2R, 2T4R, and 1T4R. However, depending on ‘resourceType’ for SRS resource set such as aperiodic, periodic, or semi-persistence, interruption requirement could be different since SRS resource(s) for antenna switching could be configured within or different slot. |
| OPPO | Support option 1. We consider the minimum requirement regardless of the switching pattern. |
| Huawei | Support option 1. It is suggested to define the interruption per resource. |

**Issue 1-2-3: Would the interruption requirement based on different SCS?**

* Proposals
  + Option 1 (MTK, Xiaomi, CATT, QC, LGE, OPPO, vivo): Interruption requirement is based on the aggressor CC and victim CC SCS.
  + Option 2 (Ericsson): The interruption requirements depend at least on SCS for victim cell.
* Recommended WF
  + TBA.
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 1. |
| LG | Support option 1 |
| OPPO | Support option 1 |

**Issue 1-2-4: Would the interruption requirement differentiate between sync and async cases?**

* Proposals
  + Option 1 (MTK, Apple, Intel, vivo): No; one single requirement to cover the synchronous and asynchronous scenarios with or without UL TA.
    - Option 1a (Apple): No, interruption requirement is based on the async case for the minimum requirement.
  + Option 2 (CATT, Ericsson): Yes, the interruption requirement can differentiate between sync and async cases.
* Recommended WF
  + TBA.
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 1 and option 1a. We still believe the same assumption from SRS carrier-based switching could be used in this case since the TA between UL and DL and the MTTD needs to be considered. |
| LG | Support option 2. Interruption length would be different according to MTTD for sync and async. |
| OPPO | Support option 1 |
| Huawei | Companies should first consider whether there is significant difference between synchronous and asynchronous cases. For existing interruption requirements, one additional slot is allowed for async case as the interruption time may partially overlaps with the slots of victim CCs. But for SRS AS, the switching time is located before and after the SRS resources, which means even in sync cases, the interruption time is also misaligned with the slots of victim CCs. |

**Issue 1-2-5: Interruption requirement for UE with or without per-FR MG capability**

* Proposals
  + Option 1 (MTK, CATT): Interruption requirement of SRS antenna port switching will not depend on for per-UE or per-FR gap capability.
  + Option 2 (Apple): No need to differentiate the requirement for the UE with or without capability of per-FR gap for SRS antenna port switching in RAN4. But in the interruption requirement applicability condition, RAN4 shall clarify that the indication of *txSwitchImpactToRx* or *txSwitchWithAnotherBand* is not allowed to indicate any band combination cross FR1 and FR2 if UE is capable of per-FR MG.
  + Option 3 (OPPO): Different impact should be considered for UE capable of per UE gap or per FR gap if FR1+FR2 SRS antenna port switching was to be specified.
  + Option 4 (Ericsson): Potential impact of UE capability for per-FR gap on interruption requirements can be further studied once the other aspects influencing the interruption time have been settled.
* Recommended WF
  + TBA.
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Option 2. We think RAN4 still needs to clarify that the indication of *txSwitchImpactToRx* or *txSwitchWithAnotherBand* is not allowed to indicate any band combination cross FR1 and FR2 if UE is capable of per-FR MG; otherwise, it could have confliction between per-FR MG capability and this SRS interruption capability, e.g., UE supports per-FR MG but still indicates interruption between FR1 CC and FR2 CC in *txSwitchImpactToRx* or *txSwitchWithAnotherBand*. |
| OPPO | Support option 2 and 3. The applicability of interruption for UE capable of per UE or per FR gap should be clarified for FR1+FR2 band combination.  For example, if UE is capable of per FR gap, no interruption of SRS antenna port switching is allowed; Otherwise, the interruption requirements can apply. |
| Huawei | Option 1. We should carefully consider the relation between the per-FR gap and the other RRM requirements since the overloading issue has been discussed since Rel-16. |

### Sub-topic 1-3: Interruption requirement design

*Sub-topic description*

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

**Issue 1-3-1: The interruption requirement is defined based on slot level or symbol level**

* Proposals
  + Option 1 (MTK, Xiaomi, CATT, Apple, QC, vivo): based on slot level
  + Option 2 (CMCC): if the interruption time only includes transient periods before and after SRS transmission, and considering that the transient period specified in FR session is 15us, it is suggested to specify the interruption requirements based on slot level.
  + Option 3 (LGE): The interruption requirement can be defined based on slot level for full uplink symbols within a slot and based on symbol level for flexible symbols with in slot.
  + Option 4 (NEC, Ericsson, HW): based on symbol level
* Recommended WF
  + TBA.
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 1, considering the uncertain TA and MTTD. Furthermore, the legacy interruption requirement would be verified by the ACK/NACK loss which is also a slot level loss, and we prefer to reuse the same philosophy from SRS carrier based switching. |
| LG | Support option 3. At least synchronous case, when SRS antenna switching is performed in the slot composed of flexible symbols (DL / UL symbols), it would have no impact on DL symbols in the slot. So symbol level interruption could be considered. |
| OPPO | Option 1, slot level is preferred. |
| Huawei | Considering the switching time which is even shorter than 1 OFDM symbol, the slot level interruption means resource some slot is wasted even most of symbols are not affected. But we also agree that is hard to verify the performance in the test if the symbol level interruption is defined. Prefer option 3 but could compromise to option 1. |

**Issue 1-3-2: The components within interruption time of SRS antenna port switching in FR1**

* Proposals
  + Option 1 (MTK, Intel, vivo): includes antenna switching time and SRS transmission time
    - Option 1a(Ericsson): The interruption time for SRS antenna port switching comprises at least antenna switching time and SRS transmission time.
  + Option 2 (Xiaomi): The guard period defined in TS 38.214 is considered as the antenna switching time when defining the interruption requirement.
    - If the signalling of *txSwitchWithAnotherBand* is reported, the interruption requirement at SRS antenna switching should be the guard period defined in TS 38.214 for the aggressor CCs in the band combination.
    - If the signalling of *txSwitchImpactToRx* is reported, the interruption requirement should include the guard period defined in TS 38.214 and SRS transmission time for the aggressor CCs in the band combination.
  + Option 3 (CATT): The interruption time of SRS antenna port switching in FR1 includes all guard symbols, all SRS symbols transmitted on other antenna port, and only one switching time.
  + Option 4 (Apple, OPPO): The components within interruption time of SRS antenna port switching in FR1 include:
    - SRS antenna port switching time (transient time)
    - SRS transmission time
    - Transient time before and after SRS transmission occasion
  + Option 5 (CMCC):
    - Since UE stay connection with the serving CCs, the interruption time for SRS antenna port switching delay includes transient periods before and after SRS transmission, and it is not necessary to consider SRS transmission time.
  + Option 6 (NEC):
    - If victim CC and SRS transmission on aggressor CC are transmitted on the same antenna, interruption requirement shall include SRS antenna switching in delay/TP, SRS transmission, GP, SRS antenna switching back delay/TP.
    - If victim CC and SRS transmission on aggressor CC are transmitted on the different antenna, interruption requirement shall include SRS antenna switching in delay/TP, SRS antenna switching back delay/TP only.
  + Option 7 (LGE):
    - The components within interruption time is
      * Time to antenna switching before SRS transmission and SRS transmission time for ‘aperiodic’ SRS-ResourceSet
      * Time to antenna switching before SRS transmission for ‘periodic’ or ‘semi-persistent’ SRS-ResourceSet
      * Additionally, the time to switch back after SRS transmission depending on UE ehaviour
  + Option 8 (Nokia):
    - The interruption at SRS antenna switching shall be defined at least within the guard period in Table 6.2.1.2-1 of [TS38.214].
      * The interruption requirement shall be defined when the SRS resources of a set in a slot are configured on the symbols which separated by exactly the minimum guard period.
      * RAN4 shall discuss if the interruption requirements are defined when the SRS resources of a set in a slot are separated by a length larger than a minimum guard period.
* Recommended WF
  + TBA.
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Option 1 and option 4 is quite similar. We think the SRS transmission time and transient time shall be counted in, and transient time includes transient before and after SRS occasion and transient between SRS symbols. Eventually, the total time could be 6 symbols for SRS transmission time and two transient times. |
| LG | For ‘aperiodic’ SRS-ResourceSet, SRS transmission time and SRS antenna switching time could be considered since SRS resources are within a slot. However, if single SRS resource within a slot in case of ‘periodic’ or ‘semi-persistence’ SRS-ResourceSet, only SRS antenna switching time could be considered.  Additionally, RAN4 needs to clarify the UE behavior for SRS antenna port switching whether UE should switch back after SRS transmission. |
| OPPO | Support option 4 |
| Huawei | Support option 1. |

**Issue 1-3-3: if option 1 or option 4 is adopted in issue 1-3-2, details of the interruption time in FR1**

* Proposals
  + Option 1 (MTK, QC): Interruption time is specified based on 2 transient period (2\*15us) and 6 symbol time
  + Option 2 (Apple): Interruption time is specified based on 2 transient period (2\*10us) and 6 symbol time
  + Option 3 (OPPO): Interruption time is specified based on SRS Transmission time (up to 7 symbols), SRS antenna switching time (15us \*2) and transient period (10us\*2)
* Recommended WF
  + TBA.
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Fine with option 1. |
| LG | Support option 1, and further check whether transient period time after SRS transmission should be counted. |
| OPPO | OK with either option 1 or option 3. |
| Huawei | We are fine with option 1. |

**Issue 1-3-4: If option 2 in issue 1-1-2 is adopted, the components within interruption time of SRS antenna port switching in FR2**

* Proposals
  + Option 1 (Intel):
    - Clarify that Current SRS antenna switching time of 15us is applied for FR2 case where SRS antenna switch in the same panel.
    - For the case that SRS antenna switching happens between different panels for FR2, it needs further discussion whether extra ramp up timing for other panels are needed.
* Recommended WF
  + Wait the conclusion from issue 1-1-2
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We prefer to only discuss SRS antenna port switching in FR1 only, but can wait the conclusion from issue 1-1-2. |
| LG | Support recommended WF |
| OPPO | Support recommended WF |

**Issue 1-3-8: Interruption requirement proposals**

* Proposals
  + Option 1 (MTK): The SRS antenna switching interruption requirement should be specified as follows.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Victim cell SCS(KHz) | Aggressor Cell SCS (KHz) | | | |
| 15 | 30 | 60 | 120 |
| 15 | 2 | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 | 2 |
| 60 | 3 | 2 | 2 | 2 |
| 120 | 5 | 3 | 3 | 2 |

* + Option 2 (Xiaomi): The SRS antenna switching interruption requirement for FR1 is shown as follow.

Table 1. Interruption length (slots) due to SRS antenna switching for DC

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Victim cell SCS(KHz) | Aggressor Cell SCS (KHz) | | | | | |
| signalling txSwitchWithAnotherBand | | | signalling txSwitchImpactToRx | | |
| 15 | 30 | 60 | 15 | 30 | 60 |
| 15 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30 | 2 | 1 | 1 | 2 | 1 | 1 |
| 60 | 3 | 2 | 1 | 4 | 2 | 1 |

Table 2. Interruption length (slots) due to SRS antenna switching for CA

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Victim cell SCS(KHz) | Aggressor Cell SCS (KHz) | | | | | |
| signalling txSwitchWithAnotherBand | | | signalling txSwitchImpactToRx | | |
| 15 | 30 | 60 | 15 | 30 | 60 |
| 15 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30 | 1 | 1 | 1 | 1 | 1 | 1 |
| 60 | 1 | 1 | 1 | 2 | 1 | 1 |

* + Option 3 (Apple, QC): the interruption requirement of SRS antenna port switching is summarized as:

|  |  |  |  |
| --- | --- | --- | --- |
| Victim CC SCS(kHz) | Aggressor CC SCS (kHz) | | |
| 15 | 30 | 60 |
| 15 (NR or LTE) | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 3 | 2 | 2 |

Unit of interruption requirement is slot for NR and subframe for LTE.

* + Option 4 (LGE): Interruption requirements for SRS antenna port switching are shown in Table 1 and Table 2.

Table 1 Proposed interruption requirements per *SRS-ResourceSet* (‘aperiodic’)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Victim cell SCS [kHz] | Interruption length [slot] | | | | | |
| Aggressor cell SCS [kHz] | | | | | |
| 15 | | 30 | | 60 | |
| Case 1 | Case 2 | Case 1 | Case 2 | Case 1 | Case 2 |
| 15 | 2 | 1 | 2 | 1 | 2 | 1 |
| 30 | 2 | 1 | 2 | 1 | 2 | 1 |
| 60 | 3 | 2 | 2 | 1 | 2 | 1 |
| Case 1: UL-UL slot configuration for synchronous case, and UL-UL or UL-DL slot configuration for asynchronous case  Case 2: UL-DL slot configuration for synchronous case  Note 1: If SRS resource is configured in flexible symbols within a slot in synchronous case, the interruption requirements apply to uplink symbols. | | | | | | |

Table 2 Proposed interruption requirements per SRS resource (‘periodic’ or ‘semi-persistent’)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Victim cell SCS [kHz] | Interruption length [slot] | | | | | |
| Aggressor cell SCS [kHz] | | | | | |
| 15 | | 30 | | 60 | |
| Case 1 | Case 2 | Case 1 | Case 2 | Case 1 | Case 2 |
| 15 | 2 | 1 | 2 | 1 | 2 | 1 |
| 30 | 2 | 1 | 2 | 1 | 2 | 1 |
| 60 | 2 | 1 | 2 | 1 | 2 | 1 |
| Case 1: UL-UL slot configuration for synchronous and asynchronous cases  Case 2: UL-DL slot configuration for and asynchronous cases  Note 1: If SRS resource is configured in flexible symbols within a slot in synchronous case, the interruption requirements apply to uplink symbols. | | | | | | |

* + Option 5 (OPPO):
    - For NR SRS antenna port switching impacting LTE CC, the interruption is 2 subframes.
    - For NR SRS antenna port switching impacting NR CC, the interruption should be specified as the following table based on the SCS of the victim CC.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Interruption Length (slots) | | |
| Victim SCS (kHz) | 15 | 30 | 60 |
| 15 | 2 | 2 | 2 |
| 30 | 3 | 2 | 2 |
| 60 | 4 | 3 | 2 |

* Recommended WF
  + TBA.
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Option 3, and this issue is based on the conclusions from other issues. |
| LG | Wait the conclusion from other open issues |
| OPPO | Support option 5, and can also compromise to option 3. FFS the cases for FR2. |
| Huawei | Depend on the conclusions from other issues. |

### Sub-topic 1-4: Others

*Sub-topic description*

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

**Issue 1-4-1: if option 2 in issue 1-1-1 is adopted, how to define the SRS antenna port switching delay requirement**

* Proposals
  + Option 1 (vivo): For SRS antenna port switching delay, RAN4 should consider to specify UE capability to differentiate the needed minimal separation between SRSs and/or between SRS-PUSCH/PUCCH, similar to the transient period capability defined in R16
* Recommended WF
  + Wait the conclusion from issue 1-1-1
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We propose to not have delay requirement for SRS antenna port switching and we could wait the conclusion from issue 1-1-1. |
| YYY |  |

**Issue 1-4-2: LS to RAN1 to check the prioritization rule for SRS antenna switching**

* Proposals
  + Option 1 (vivo): Send LS to RAN1 to check the prioritization rule for SRS antenna switching, especially for the case in CA/DC operation.

RAN4 respectfully ask RAN1 that for CA/DC scenarios, whether SRS transmission for antenna port switching in one of the active serving cell can be prioritized over the following transmissions/receptions on any other active serving cells

• SSB/CSI-RS for L1/L3 measurements

• PUSCH/PUCCH transmission with priority index 1 or DL pre-emption transmission

• PUSCH/PUCCH transmission carrying HARQ-ACK/positive SR/RI/CRI/SSBRI and/or PRACH

• PUSCH transmission carrying aperiodic CSI (if periodic/semi-persistent SRS resources are configured)

* Recommended WF
  + TBA
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | This issue is related with the discussion in issue 1-1-3. If RAN4 agrees to prioritize NR measurement, then SSB/CSI-RS based measurement shall not be impacted. For other channels’ priority, in current RAN1 TS38.213, the prioritization is applied when the UE Tx power is exceeded, and we did not have such prioritization in RAN4 requirement for previous SRS carrier based switching. So we think more justification is needed for this LS and we are open to discuss in RAN4 first. |
| OPPO | Do not see the urgency to send LS. |
| Huawei | Prefer to discuss the issue in RAN4 first. |

## 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

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

|  |  |
| --- | --- |
| **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”* |

# Topic #2: HO with PSCell (8.4.2.2)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104685**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104685.zip) | Xiaomi | Proposal 1: For HO with PSCell, it is assumed that the following procedures should be performed in sequentially order:   1. Cell search; 2. Fine time tracking; 3. UE processing time; 4. Time for interruption uncertainty in acquiring the first available PRACH occasion in the new cell; 5. Time for SSB post-processing   Proposal 2: the timeline of the delay requirement for HO with PSCell should be the time when the UE receives a RRC message implying handover with PSCell the UE shall be capable to transmit PRACH preamble towards target PSCell within Thandover\_with\_PSCell from the end of the last TTI containing the RRC command. Where Thandover\_with\_PSCell is the delay requirement of HO with PSCell.  Proposal 3: When the configured PSCell is the same as the original one or not, the requirements and UE’s ehaviour are the same.  Proposal 4: No interruption requirement should be defined during HO with PSCell. |
| [**R4-2104759**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104759.zip) | CATT | Proposal 1: In Rel-17, RAN4 only considers legacy 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 2: The starting point of the delay requirement for HO with PSCell is the end of the last TTI containing the RRC command implying handover with PSCell. The ending point should be defined the later PRACH transmission on Pcell or PSCell.  Proposal 3: UE will perform in parallel the PCell handover process and PSCell addition process.  Proposal 4: The optimization for the case when PSCell is unchanged may not be necessary.  Proposal 5: Tprocessing for HO with PSCell can be used the values for handover requirements and for PSCell addition requirement.  Proposal 6: The HO with PSCell delay requirement can be defined as longer delay requirement between legacy handover delay requirement and legacy PSCell addition delay requirement, with HO with PSCell RRC procedure delay replacing the legacy RRC procedure delay separately.  Proposal 7: Interruption in legacy handover delay requirement can be applied for PCell. No interruption is defined on PSCell.  Proposal 8: The delay requirements for HO with PSCell are not relative with 2 step or 4 step RACH if the ending point of delay is defined as PRACH transmission of UE.  Proposal 9: There is no need to further consider the RO collision issue between PCell and PSCell from RAN4’s perspective.  Proposal 10: RAN4 specified delay requirements HO with PSCell by UE sent PRACH on PCell and PSCell. Failure cases should not defined in RAN4 specification. |
| [**R4-2104832**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104832.zip) | Apple | Proposal 1: RAN4 specifies RRM requirement for HO with PSCell for following scenarios:   * from NR SA to EN-DC * from EN-DC to EN-DC * from NE-DC to NE-DC * from NR-DC to NR-DC   Proposal 2: In R17 RAN4 only considers legacy 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: A new R17 UE capability is introduced to indicate whether UE can support sequential processing or parallel processing for HO with PSCell.  Proposal 4: For delay requirement of HO with PSCell,   * reuse the starting point definition from legacy HO, i.e., the end of the last TTI containing the RRC command implying handover with PSCell. * the ending point is:   + the timing when UE shall be capable to transmit PRACH preamble towards target PSCell if sequential 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” if the parallel processing is used   Proposal 5: for UE which is already configured with DC, the UE’s behaviour is same regardless of whether the configured PSCell is same as the original one or not.  Proposal 6:  If UE only supports 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.  If UE can support 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 7: the UE processing time for HO with PSCell is:   |  |  |  | | --- | --- | --- | | UE processing margin (Tprocessing) | Target PCell and PSCell is in the same FR as old PCell | Target PCell and/or target PSCell is in the different FR from old PCell | | Sequential processing capable UE | 40ms | 60ms | | Parallel processing capable UE | 20ms | 40ms |   Proposal 8: for requirement of HO with PSCell, RAN4 starts the discussion with 4 step RACH first and FFS on 2 step RACH.  Proposal 9: 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.   Proposal 10:  If sequential processing is used, UE transmits PSCell RACH later than PCell RACH.  If parallel processing is used, there is no time order limitation between PCell RACH and PSCell RACH for HO with PSCell.  Proposal 11: For sequential processing capable UE, RAN4 assumes that UE performs target PSCell addition after receiving RAR (msg 2) from target PCell in the requirement of HO with PSCell.  Proposal 12: For parallel processing capable UE, RAN4 assumes that UE performs target PCell HO and target PSCell addition independently after decoding the HO command.  Proposal 13:  If sequential processing is used for HO with PSCell, UE would have an interruption on new Pcell due to the PSCell addition.  If parallel processing is used for HO with PSCell and PSCell addition is completed earlier than Pcell HO, no need to define interruption requirement since interruption has been reflected by HO delay.  If parallel processing is used for HO with PSCell and PSCell addition is completed later than Pcell HO, UE may have an interruption on new Pcell due to RF tuning for PSCell addition. |
| [**R4-2104932**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104932.zip) | NTT DOCOMO, INC. | Proposal 1: Some of procedures of HO with PSCell should be able to be performed in parallel.  Proposal 2: HO to the PCell and random access to the PSCell should be performed sequentially. |
| [**R4-2104943**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104943.zip) | CMCC | Proposal 1: the starting point of the delay requirement for HO with PSCell is the end of last TTI containing the RRC command implying handover with PSCell.  Proposal 2: the ending point is the last one between HO and PSCell addition to transmit PRACH preamble.  Proposal 3: for HO with PSCell, it is proposed to consider parallel way to perform HO and PSCell addition.  Proposal 4: delay requirement for HO with PSCell is maximum (PSCell addition delay, HO delay)   * PSCell addition delay= TRRC\_delay + Tprocessing + Tsearch + T∆ + TPSCell\_ DU + 2 ms * HO delay = TRRC\_delay +Tinterrupt = TRRC\_delay +Tsearch + TIU + Tprocessing + T∆ + Tmargin ms |
| [**R4-2104980**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104980.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: For NR SA to EN-DC and NE-DC to NE-DC, RAN4 to agree that cell search of Pcell and PSCell is performed in sequential order. For NR-DC to NR-DC, RAN4 to agree that cell search is performed in parallel for FR1+FR2 NR-DC and FR1+FR1 NR-DC.  Proposal 4: RAN4 to agree that components that contribute to TIU delay are the TA acquisition delay in Pcell, delay uncertainty in acquiring resources for RRC connection Reconfiguration Complete message on Pcell and PRACH acquisition uncertainty delay in PSCell.  Proposal 5: RAN4 to agree that interruption uncertainty (TIU) for Pcell and PSCell is sequential process.  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.  Proposal 7: RAN4 to define both 2-step and 4-step RACH requirements for handover with PSCell. |
| [**R4-2106463**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106463.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.  Observation 1: RACH procedure of PSCell will happen after the RACH procedure of Pcell.  Observation 2: Cell search, timing tracking, UE processing can still be processed in parallel.  Proposal 2: RACH procedure of PSCell will happen after the RACH procedure of Pcell. While Cell search, timing tracking, UE processing can still be processed in parallel.  Proposal 3: The ending point of delay requirement for HO with PSCell will be the time when PSCell is capable to transmit PRACH preamble.  Proposal 4: For HO with PSCell from NR-DC to NR-DC, Tprocessing can be split into software processing (Tprocessing\_SW) and RF warm up time(Tprocessing\_RF). Tprocessing\_SW=[20]ms needs further discussion if some extension is needed. Tprocessing\_RF will be dependent on different scenarios, i.e. whether Pcell or PSCell change across FRs.  Proposal 5: For HO with PSCell from NR SA to EN-DC, Tprocessing only includes software processing time (Tprocessing\_SW). Tprocessing\_SW=[20]ms needs further discussion if some extension is needed. |
| [**R4-2106533**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106533.zip) | OPPO | Observation 1: The components of procedures for PCell HO and PSCell addition/change can be allowed partially overlapped during “HO with PSCell” procedure.  Proposal 1: 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 are suggested to be considered.  Proposal 2: The timeline of “HO with PSCell” procedure should be longer than either that of PCell HO standalone or PSCell addition/change standalone.  Proposal 3: The delay of HO with PSCell starts from   * + the end of the last TTI containing the RRC command implying handover with PSCell,   and ends with   * + transmission of the available PRACH preambles of both PCell and Pscell.   Proposal 4: Wait for the reply LS from RAN2 on RRC processing delay for HO with PSCell and failure case definition for HO with PSCell before RAN4’s decision.  Proposal 5: UE’s behaviour is supposed to be the same no matter the configured PSCell is same as the original one or not. |
| [**R4-2106882**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106882.zip) | Ericsson | Proposal 1: RAN4 to derive RRM requirements for the following NR-DC and NE-DC scenarios: FR1+FR2 NR-DC to NR-DC, FR1+FR1 NR-DC to NR-DC, and FR1+LTE NE-DC to NE-DC. FFS on FR2+LTE NE-DC to NE-DC.  Proposal 2: The delay requirement for handover with PSCell is using the following starting and ending points. Starting point: same as for conventional handover. Ending point: whichever comes last of PRACH preamble transmission towards Pcell and PSCell. In case RAN4 defines scenarios where PRACH preamble transmission towards PSCell is not needed, ending point for those scenarios is PRACH preamble transmission towards Pcell.  Proposal 3: When source and target PSCell is the same cell, then fine time tracking T∆=0 shall apply.  Proposal 4: The value of Tprocessing\_SW for PSCell is as follows:   * + Tprocessing\_SW\_PSCell = 0 ms, when source and target PSCells are the same cell,   + Tprocessing\_SW\_PSCell = 20 ms, when source and target PSCells are different cells but in same FR   + Tprocessing\_SW\_PSCell = 40 ms, when source and target PSCells are different cells in different FRs   How Tprocessing\_SW\_PSCell impacts the handover with PSCell timeline depends on assumptions on parallel or sequential processing.  Proposal 5: The handover with PSCell delay (interruption) requirement shall have two checkpoints: time until the UE is transmitting PRACH preamble in Pcell, and time until later of UE transmitting PRACH preamble in Pcell and UE transmitting PRACH preamble in PSCell.  Proposal 6: Both 2-step RA and 4-step RA shall be supported in RRM requirements for Handover with PSCell.  Proposal 7: 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. |
| [**R4-2106924**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106924.zip) | ZTE Corporation | Observation 1: Procedures for handover with PSCell addition is similar to handover followed by PSCell addition immediately after.  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: For interruption requirements, consider the following options:  - Specify a total interruption for handover and PSCell addition  - Specify separate interruptions for handover and PSCell addition.  Proposal 3: Include both 2-step RA and 4-step RA into the new requirements made for handover with PSCell. |
| [**R4-2106987**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106987.zip) | Huawei, HiSilicon | Proposal 1: Define 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   Observation 1: Upon receiving HO and PSCell command, all serving CC will be released, and UE is capable to perform HO and PSCell addition/change in parallel.  Proposal 1: Define the requirements for HO with PSCell based on the assumption that the procedure is performed in parallel.  Observation 2: Separate delay requirements shall be define for HO and PSCell addition/change. The same starting point is assumed for Pcell and Pscell and then ending points should be defined as Pcell PRACH and PSCell PRACH respectively.  Proposal 2: 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.  Observation 3: There is no other serving CCs in the HO with PSCell procedure.  Proposal 3: Not to have interruption requirements for HO with PSCell as there is no other serving CCs during the procedure.  Observation 4: UE shall transmit RRC complete message no matter whether the synchronization to the PSCell is completed or not.  Observation 5: UE will report SCG failure If UE fails to synchronize to the target PSCell. |
| [**R4-2107080**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107080.zip) | vivo | Proposal 1 RAN4 consider parallel processing capable UE in R17 as baseline and further identify the needed sequential processing during HO with PSCell.  Proposal 2 PRACH occasion collision is considered as one factor in the requirements for HO with PSCell, if UE only supports single uplink in the NE-DC or EN-DC.  Proposal 3 RF chain activation and retuning time needs to be considered in the timeline of HO with PSCell.  Proposal 4 For the delay requirement, the ending point of handover with PSCell can be considered separately for Pcell and PSCells.  Proposal 5 For NR-DC and NE-DC mode in HO with PSCell, we support Option 2 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 6 Even if PSCell is not changed during HO with PSCell, T∆ reduction seems not necessary, considering the multi-TRP deployment.  Proposal 7 RAN4 do not need to specify interruptions for handover with PSCell.  Proposal 8 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. |
| [**R4-2107123**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107123.zip) | MediaTek inc. | Observation 1: HO procedure and PSCell change procedure might be performed in parallel for DC capable UE  Proposal 1: RAN4 to clarify whether requirements from LTE-SA to EN-DC and from NR-SA to NR-DC are needed  Proposal 2: For the scenario from NR-DC to NR-DC, the overall delay requirement of HO with PSCell procedure might be specified as DHO\_with\_PSCell = TRRC\_delay + max(Dhandover- TRRC\_delay, Tconfig\_PSCell - TRRC\_delay)  Proposal 3: RAN4 to specify the PCell interruption time for the overall HO with PSCell procedure  Proposal 4: For the scenario from NE-DC to NE-DC, RAN4 to clarify whether to remove the delay uncertainty of PCell PRACH preamble transmission from the delay requirement of HO with PSCell procedure |
| [**R4-2107224**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107224.zip) | Nokia, Nokia Shanghai Bell | 1. RAN4 specifies RRM requirements for handover with PSCell for following scenarios besides of the agreed scenarios in RAN4#98e:  * From NR SA to NR-DC * From NR SA to NE-DC * From E-UTRAN to EN-DC  1. Both FR1+FR2 NR-DC and FR1+FR1 NR-DC should be supported for RRM requirements for handover with PSCell in “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. Starting point of the delay requirements for HO with PSCell can reuse the starting point of legacy HO. 4. Once the UE is ready to transmit PRACH preamble towards target PSCell marks the ending point for HO with PSCell procedure. 5. In HO with PSCell, legacy HO and PSCell addition operations can be performed partly in parallel while RA procedure for first for the target PCell and then for the target PSCell will be performed sequentially. 6. The delay requirements for HO with PSCell can be described as: DHO\_with\_PSCell = TRRC\_delay + Tsearch + Tprocessing + T∆ + Tmargin +TFFS + TPcell\_IU + TPSCell\_DU.Where TFFS is the delay related to performing and finalizing the Pcell random access procedure before the RA preamble can be transmitted on the PSCell |
| [**R4-2107249**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107249.zip) | Qualcomm CDMA Technologies | Proposal1: For issue 2-2-3 raised in 98-e, parallel HO and PSCell change/addition operations shall be assumed for defining RAN4 requirements.  Observation1: RAN4 agrees when there is a mode switch of frequency ranges, the maximum UE processing time Tprocessing is doubled.  Observation2: DC capable Ues can handle the tasks of ACQ, loops and RACH independently for both Pcell and PSCell since this is already the case in the connection mode.  Proposal2: Reuse the same time for Tsearch, Tmargin, T∆ and TIU as the Pcell only handover per 38.133 6.1.1 for the joint Pcell w/ PSCell handover.  Observation3: Longer RRC procedural delay TRRC shall beconsidered for NRSA to EN-DC HO w/ PSCell.  Proposal3: RAN4 to adopt RAN2 recommended numbers for TRRC.  Proposal4: 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.  Proposal5: 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.  Proposal5.1: For NRDC to NRDC, only consider FR1 for Pcell.  Proposal6: Re-use the same definitions of starting point and end point as legacy HO. |

## 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(Apple, HW): 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
  + Option 2(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)
  + Option 3(MTK): 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

And RAN4 to clarify whether requirements from LTE-SA to EN-DC and from NR-SA to NR-DC are needed

* Recommended WF
  + TBA
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | We support option 1, but we are open to hear views from operators. One more thing is, in WID only 4 scenarios were listed for selecting, if companies want more scenarios, it needs to be added into WID in RAN plenary first. |
| Qualcomm | Option1 is supported in line with the scope defined in WID. |
| OPPO | Agree with Apple’s view. |

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

* Proposals
  + Option 1(CATT, Apple, OPPO): 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 (NEC, Intel, vivo):
    - 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.
  + Option 3 (Ericsson):
    - 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,
    - FFS on FR2+LTE NE-DC for HO with PSCell from NE-DC to NE-DC.
  + Option 4 (Nokia):
    - FR1+FR2 NR-DC and FR1+FR1 NR-DC for HO with PSCell from NR-DC to NR-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
  + TBA
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1 is preferable, since so far RAN4 had no baseline RRM PSCell addition or measurement requirement for FR1+FR1 NR-DC or FR2+LTE NE-DC. We think HO with PSCell is an optimized feature based on legacy PSCell addition and HO requirement, and therefore it makes more sense to first discuss FR1+FR1 NR-DC or FR2+LTE NE-DC in baseline RRM requirement, and then we could extend them to this WI. |
| Qualcomm | Option2 can be supported. |
| OPPO | Support option 1 as baseline. For FR1+FR1 NR-DC, clear demands from operators could be important for further discussion. |

### 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 (Xiaomi, Apple, ZTE): PCell HO and PSCell addition is performed in a sequential order.
  + Option 2 (CATT, CMCC, Huawei, MTK, QC): PCell HO and PSCell addition is performed in parallel.
    - Option 2a (vivo): RAN4 consider parallel processing capable UE in R17 as baseline and further identify the needed sequential processing during HO with PSCell.
  + Option 3 (Apple): A new R17 UE capability is introduced to indicate whether UE can support sequential processing or parallel processing for HO with PSCell.
  + Option 4 (NTT DOCOMO, Intel, OPPO, Nokia): Some of procedures of HO with PSCell should be able to be performed in parallel, but RACH processing is performed in a sequential order (RACH procedure of PSCell will happen after the RACH procedure of PCell).
  + Option 5 (NEC): For NR SA to EN-DC and NE-DC to NE-DC, RAN4 to agree that cell search of PCell and PSCell is performed in sequential order. For NR-DC to NR-DC, RAN4 to agree that cell search is performed in parallel for FR1+FR2 NR-DC and FR1+FR1 NR-DC.
* Recommended WF
  + [Moderator suggestion]: In order to accommodate the possible UE implementations of parallel or sequential processing, could we consider a compromised way of having UE capability indication for that?
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | We prefer option 1 since both of sequential and parallel processing are UE implementation methods and RAN4 shall consider the minimum requirement. But in order to move forward, we propose a compromised solution in option 3 with UE capability indication. |
| Qualcomm | Overall Option2 is supported.  1. Beyond legacy, R17 evolves to facilitate the joint handover. A sequential flow results in substantially longer HO delay which defies the motivation of this WI.  2. RAN2 defines the HO command with SCG configuration for UE to initiate both MCG and SCG procedures sooner.  3. In our view, while search, loops, RACH may parallelize, the UE processing for RF/SW preparations may have certain dependency. Thus, minimum requirements may be discussed for Tprocessing. Regarding this, we propose option2b. Can Moderator please include it? This could be an alternative compromise. Thanks!  ***Option 2b (Qualcomm): PCell HO and PSCell addition are performed in parallel after UE side processing (e.g. RF and SW preparations) is completed.***  Note the parallel assumption saves RAN4’s effort to discuss applicability of 2-step v.s. 4-step RACH in the process because the unified definition of the end points for Pcell and PSCell.  Also note in legacy, NW can already sequentially issue commands for Pcell HO and add PSCell and direct a UE to follow a two-step flow. There is no tangible purpose to introduce/define the requirements again. |
| ZTE | We can support Option 2. Agree that the new feature should demand the UE capable of handling the two processes in parallel. |
| OPPO | Support option 4 that the procedures of physical layer are performed in a sequential order, while procedures of high layer can be in parallel.  We can also compromise to option 1, with some clarification of the timeline/procedures for physical layer.  Besides, UE capability is not preferred from our side. We prefer to have one single delay requirement for HO with PSCell to ensure the flexibility of UE implementation. |
| Huawei | Support option 2. For option 4, the uncertainty could be considered but it has been defined in TS 38.213. |

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

* Proposals: For delay requirement of HO with PSCell, the starting point definition is:
  + Option 1 (Xiaomi, CATT, Apple, CMCC, OPPO, Ericsson, ZTE, HW, Nokia, QC):
    - the end of the last TTI containing the RRC command implying handover with PSCell
* Recommended WF
  + For delay requirement of HO with PSCell, the starting point is the end of the last TTI containing the RRC command implying handover with PSCell.
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Support the recommended WF |
| Qualcomm | Option1 is supported and agreeable.  Recommended WF is NOT clear to us due to the wording “implying”. |
| ZTE | Support the recommended WF. Wording can be slightly updated by changing *implying* to *commanding*. |
| OPPO | Support the recommended WF |
| Huawei | Support the recommended WF. |

**Issue 2-2-3: ending point of the delay requirement for HO with PSCell**

* Proposals: For delay requirement of HO with PSCell, the ending point definition is:
  + Option 1 (Xiaomi, Intel, ZTE, Nokia):
    - When the UE shall be capable to transmit PRACH preamble towards target PSCell within Thandover\_with\_PSCell from the end of the last TTI containing the RRC command implying handover with PSCell. Where Thandover\_with\_PSCell is the delay requirement of HO with PSCell.
  + Option 2 (CATT, CMCC, OPPO):
    - the later timing between “timing when UE shall be capable to transmit PRACH preamble towards target PCell” and “the timing when UE shall be capable to transmit PRACH preamble towards target PSCell”
  + Option 2a (Ericsson):
    - 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”
    - In case RAN4 defines scenarios where PRACH preamble transmission towards PSCell is not needed, ending point for those scenarios is PRACH preamble transmission towards Pcell.
  + Option 3 (Apple):
    - 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 (HW, 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.
  + Option 5 (QC):
    - same definitions of end point as legacy HO
* Recommended WF
  + Up to the conclusion from issue 2-2-1.
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 3. It’s up to the issue 2-2-1. If the sequential processing is used, the ending point would be PSCell RACH without any doubt. But if parallel processing is supported, our original understanding is there is no limitation of timing order between PCell RACH and PSCell RACH since they are handled independently, but we are fine to have more discussion. We prefer to have one single delay requirement for each processing of HO with PSCell; and with one single delay requirement UE could be more flexible to coordinate the processing between HO and PSCell as long as the whole HO with PSCell could be completed within the required delay. |
| Qualcomm | We can compromise to Option2.  Option4 can be further discussed. |
| ZTE | Can support Option 4. |
| OPPO | Agree with the recommended WF. Option 3 can be used as guideline. |
| Huawei | We support option 4 based on the parallel processing assumption. |

**Issue 2-2-4: checking point of the delay requirement for HO with PSCell**

* Proposals
  + Option 1(Ericsson): The handover with PSCell delay (interruption) requirement shall have two checkpoints: time until the UE is transmitting PRACH preamble in PCell, and time until later of UE transmitting PRACH preamble in PCell and UE transmitting PRACH preamble in PSCell.
* Recommended WF
  + TBA
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | It’s up to the discussion in issue 2-2-3. |
| Qualcomm | The intention of option1 is a bit vague to us. In real deployment, we expect PCell and PSCell RACH can happen in parallel mostly. Option1 implies the order of PCell firstly completes and PSCell follows. More clarifications are appreciated. |
| OPPO | Up to the discussion in issue 2-2-3. |
| Huawei | Depend on issue 2-2-3. |

**Issue 2-2-5: optimisation for the case when PSCell is not changed during HO with PSCell**

* Proposals
  + Option 1(Xiaomi, CATT, Apple, OPPO, vivo): 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.
  + Option 2 (Ericsson): When source and target PSCell is the same cell, then fine time tracking T∆=0 shall apply.
* Recommended WF
  + TBA
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 1. |
| Qualcomm | Option1 can be supported.  Note during the joint HO, PSCell may be suspended, so it may be needed to restart the tracking rather than resume it. |
| OPPO | Support option 1. |
| Huawei | Prefer option 1. If the PSCell before and after is same, it could be handled as a known cell if the corresponding conditions are met. |

**Issue 2-2-6: RRC processing delay for HO with PSCell**

* Proposals
  + Option 1 (OPPO, QC): Wait for the reply LS from RAN2 on RRC processing delay for HO with PSCell.
* Recommended WF
  + RAN4 waits for the reply LS from RAN2 on RRC processing delay for HO with PSCell.
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Support recommend WF |
| Qualcomm | Support recommend WF |
| OPPO | Support option 1. |
| Huawei | Support the recommended WF. |

**Issue 2-2-7: UE SW processing and RF warm-up(if needed) time for HO with PSCell**

* Proposals
  + Option 1 (CATT): Tprocessing for HO with PSCell can be used the values for handover requirements and for PSCell addition requirement
  + Option 2 (Apple):
    - If UE only supports 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.
    - If UE can support 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

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

* + Option 3 (NEC):
    - Tprocessing is the UE processing time. Tprocessing is the maximum value of PCell HO and PSCell addition;
  + Option 4 (Intel):
    - For HO with PSCell from NR-DC to NR-DC, Tprocessing can be split into software processing (Tprocessing\_SW) and RF warm up time(Tprocessing\_RF). Tprocessing\_SW=[20]ms needs further discussion if some extension is needed. Tprocessing\_RF will be dependent on different scenarios, i.e. whether PCell or PSCell change across FRs.
    - For HO with PSCell from NR SA to EN-DC, Tprocessing only includes software processing time (Tprocessing\_SW). Tprocessing\_SW=[20]ms needs further discussion if some extension is needed.
  + Option 5 (Ericsson):
    - The value of Tprocessing\_SW for PSCell is as follows:
      * Tprocessing\_SW\_PSCell = 0 ms, when source and target PSCells are the same cell,
      * Tprocessing\_SW\_PSCell = 20 ms, when source and target PSCells are different cells but in same FR
      * Tprocessing\_SW\_PSCell = 40 ms, when source and target PSCells are different cells in different FRs
    - How Tprocessing\_SW\_PSCell impacts the handover with PSCell timeline depends on assumptions on parallel or sequential processing.
  + Option 6 (vivo): RF chain activation and retuning time needs to be considered in the timeline of HO with PSCell.
  + Option 7 (QC):
    - 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.
      * For NRDC to NRDC, only consider FR1 for PCell.
* Recommended WF
  + Up to the conclusion from issue 2-2-1.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Support option 2 for all possible cases. We think the shortest processing time for SW and RF warm-up shall be 20ms based on the requirement in legacy HO and legacy PSCell addition. Regarding the different processing capability and different serving cell’s FR status, the processing delay shall be differentiated. |
| Qualcomm | Option7 is supported. |
| Huawei | Support option 3. |

**Issue 2-2-8: Delay requirement design if sequential processing is assumed (from issue 2-2-1)**

* Proposals
  + Option 1 (Xiaomi):
    - For HO with PSCell, it is assumed that the following 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
  + Option 2 (Apple):
    - For sequential processing capable UE, RAN4 assumes that UE performs target PSCell addition after receiving RAR (msg 2) from target PCell in the requirement of HO with PSCell.
    - If sequential processing is used, UE transmits PSCell RACH later than PCell RACH.
    - The delay requirement is summarized as:

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| When the UE receives a RRC message implying handover to EN-DC on slot n, the delay of HO with PSCell for NR SA to EN-DC could be,  Thandover\_with\_PSCell = TRRC\_procedure\_delay + Tinterrupt + Tmsg2 + Tconfig\_PSCell – 20ms  Where,  Tinterrupt is as defined in TS38.133 section 6.1.2.1.3 (HO from NR to LTE).  Tmsg2 is delay from slot n + (TRRC\_procedure\_delay + Tinterrupt)/NR slot length until UE has obtained RACH response (msg2) from the target PCell.  Tconfig\_PSCell is as defined in TS36.133 section 7.31.2 (PSCell addition for EN-DC). TPSCell\_ DU in Tconfig\_PSCell is the delay uncertainty in acquiring the first available PRACH occasion in the NR PSCell.  When the UE receives a RRC message implying handover to EN-DC on slot n, the delay of HO with PSCell for EN-DC to EN-DC could be,  Thandover\_with\_PSCell = TRRC\_procedure\_delay + Tinterrupt + Tmsg2 + Tconfig\_PSCell – 20ms  Where,  Tinterrupt is as defined in TS36.133 section 5.1.2.1.2.1 (HO from LTE to LTE).  Tmsg2 is delay from slot n + (TRRC\_procedure\_delay + Tinterrupt)/NR slot length until UE has obtained RACH response (msg2) from the target PCell.  Tconfig\_PSCell is as defined in TS36.133 section 7.31.2 (PSCell addition for EN-DC). TPSCell\_ DU in Tconfig\_PSCell is the delay uncertainty in acquiring the first available PRACH occasion in the NR PSCell.  When the UE receives a RRC message implying handover to NE-DC on slot n, the delay of HO with PSCell for NE-DC to NE-DC could be,  Thandover\_with\_PSCell = TRRC\_procedure\_delay + Tinterrupt + Tmsg2 + Tconfig\_EUTRAN-PSCell – 20ms  Where,  Tinterrupt is as defined in TS38.133 section 6.1.1.2.2 (HO from NR FR1 to NR FR1).  Tmsg2 is delay from slot n + (TRRC\_procedure\_delay + Tinterrupt)/NR slot length until UE has obtained RACH response (msg2) from the target PCell.  Tconfig\_EUTRAN-PSCell is as defined in TS38.133 section 8.8.2 (PSCell addition for NE-DC).  When the UE receives a RRC message implying handover to NR-DC on slot n, the delay of HO with PSCell for NR-DC to NR-DC could be,  Thandover\_with\_PSCell = TRRC\_procedure\_delay + Tinterrupt + Tmsg2 + Tconfig\_PSCell – 16ms  Where,  Tinterrupt is as defined in TS38.133 section 6.1.1.2.2 (HO from NR FR1 to NR FR1).  Tmsg2 is delay from slot n + (TRRC\_procedure\_delay + Tinterrupt)/NR slot length until UE has obtained RACH response (msg2) from the target PCell.  Tconfig\_PSCell is as defined in TS38.133 section 8.9.2 (PSCell addition for NR-DC). |

* Recommended WF
  + Up to the conclusion from issue 2-2-1 and other issues.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Can hold on until we have conclusions on other issues. |
| OPPO | Agree with the recommended WF. |

**Issue 2-2-9: Delay requirement design if parallel processing is assumed (from issue 2-2-1)**

* Proposals
  + Option 1 (CATT, OPPO):
    - The HO with PSCell delay requirement can be defined as longer delay requirement between legacy handover delay requirement and legacy PSCell addition delay requirement, with HO with PSCell RRC procedure delay replacing the legacy RRC procedure delay separately.
  + Option 2 (Apple):
    - If parallel processing is used, there is no time order limitation between PCell RACH and PSCell RACH for HO with PSCell.
    - For parallel processing capable UE, RAN4 assumes that UE performs target PCell HO and target PSCell addition independently after decoding the HO command.
    - The delay requirement is summarized as:

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| When the UE receives a RRC message implying handover to EN-DC on slot n, the delay of HO with PSCell for NR SA to EN-DC could be,  Thandover\_with\_PSCell = TRRC\_procedure\_delay + max {Tinterrupt, Tconfig\_PSCell – 20ms}  Where,  Tinterrupt is as defined in TS38.133 section 6.1.2.1.3 (HO from NR to LTE).  Tconfig\_PSCell is as defined in TS36.133 section 7.31.2 (PSCell addition for EN-DC). TPSCell\_ DU in Tconfig\_PSCell is the delay uncertainty in acquiring the first available PRACH occasion in the NR PSCell.  When the UE receives a RRC message implying handover to EN-DC on slot n, the delay of HO with PSCell for EN-DC to EN-DC could be,  Thandover\_with\_PSCell = TRRC\_procedure\_delay + max {Tinterrupt, Tconfig\_PSCell – 20ms}  Where,  Tinterrupt is as defined in TS36.133 section 5.1.2.1.2.1 (HO from LTE to LTE).  Tconfig\_PSCell is as defined in TS36.133 section 7.31.2 (PSCell addition for EN-DC). TPSCell\_ DU in Tconfig\_PSCell is the delay uncertainty in acquiring the first available PRACH occasion in the NR PSCell.  When the UE receives a RRC message implying handover to NE-DC on slot n, the delay of HO with PSCell for NE-DC to NE-DC could be,  Thandover\_with\_PSCell = TRRC\_procedure\_delay + max{Tinterrupt, Tconfig\_EUTRAN-PSCell – 20ms}  Where,  Tinterrupt is as defined in TS38.133 section 6.1.1.2.2 (HO from NR FR1 to NR FR1). TIU in Tinterrupt is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell.  Tconfig\_EUTRAN-PSCell is as defined in TS38.133 section 8.8.2 (PSCell addition for NE-DC).  When the UE receives a RRC message implying handover to NR-DC on slot n, the delay of HO with PSCell for NR-DC to NR-DC could be,  Thandover\_with\_PSCell = TRRC\_procedure\_delay + max{Tinterrupt, Tconfig\_PSCell – 16ms}  Where,  Tinterrupt is as defined in TS38.133 section 6.1.1.2.2 (HO from NR FR1 to NR FR1).  Tconfig\_PSCell is as defined in TS38.133 section 8.9.2 (PSCell addition for NR-DC). TPSCell\_DU in Tconfig\_PSCell is the delay uncertainty in acquiring the first available PRACH occasion in the PSCell. |

* + Option 3 (CMCC):
    - delay requirement for HO with PSCell is maximum (PSCell addition delay, HO delay)
      * PSCell addition delay= TRRC\_delay + Tprocessing + Tsearch + T∆ + TPSCell\_ DU + 2 ms
      * HO delay = TRRC\_delay +Tinterrupt = TRRC\_delay +Tsearch + TIU + Tprocessing + T∆ + Tmargin ms
  + Option 4 (MTK):
    - For the scenario from NR-DC to NR-DC, the overall delay requirement of HO with PSCell procedure might be specified as DHO\_with\_PSCell = TRRC\_delay + max(Dhandover- TRRC\_delay, Tconfig\_PSCell - TRRC\_delay).
  + Option 5 (Nokia):
    - The delay requirements for HO with PSCell can be described as: DHO\_with\_PSCell = TRRC\_delay + Tsearch + Tprocessing + T∆ + Tmargin +TFFS + TPcell\_IU + TPSCell\_DU.Where TFFS is the delay related to performing and finalizing the PCell random access procedure before the RA preamble can be transmitted on the PSCell.
  + Option 6 (QC):
    - Reuse the same time for Tsearch, Tmargin, T∆ and TIU as the PCell only handover per 38.133 6.1.1 for the joint PCell w/ PSCell handover.
* Recommended WF
  + Up to the conclusion from issue 2-2-1 and other issues.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Can hold on until we have conclusions on other issues. |
| OPPO | Agree with the recommended WF. |

### 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 : Yes
  + Option 2 : No.
* Recommended WF
  + Moderator note:
    - This issue is newly added by moderator, because it’s an essential question to answer before we can determine if the interruption requirement is needed or not.
* 1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Option 1. In RAN2 TS38.133 it defined that “NOTE 1: The order the UE sends the *RRCConnectionReconfigurationComplete* message and performs the Random Access procedure towards the SCG is left to UE implementation.” So, after UE sending RRC complete for HO, network can schedule the data on new PCell while PSCell addition is still under processing, for both sequential processing and parallel processing implementation. |
| Qualcomm | Option1 is supported |
| OPPO | For HO with PScell, the agreements in RAN2 that “it is left to UE implementation” should also apply. It is more feasible that the network can be not allowed to schedule data on PCell to ensure all UEs can meet the minimum requirements. |

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

* Proposals
  + Option 1 (Xiaomi, HW, vivo): No interruption requirement should be defined during HO with PSCell
  + Option 2 (CATT): Interruption in legacy handover delay requirement can be applied for PCell. No interruption is defined on PSCell.
  + Option 3(Apple):
    - If sequential processing is used for HO with PSCell, UE would have an interruption on new PCell due to the PSCell addition.
    - If parallel processing is used for HO with PSCell and PSCell addition is completed earlier than PCell HO, no need to define interruption requirement since interruption has been reflected by HO delay.
    - If parallel processing is used for HO with PSCell and PSCell addition is completed later than PCell HO, UE may have an interruption on new PCell due to RF tuning for PSCell addition.
  + Option 4 (ZTE): For interruption requirements, consider the following options:
    - Specify a total interruption for handover and PSCell addition
    - Specify separate interruptions for handover and PSCell addition.
  + Option 5 (MTK): RAN4 to specify the PCell interruption time for the overall HO with PSCell procedure.
* Recommended WF
  + Up to issue 2-2-1 and issue 2-3-1.
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Up to issue 2-2-1 and issue 2-3-1. |
| Qualcomm | Option1 can be supported that no new interruptions are identified. |
| ZTE | Can support Option 1 not to define new interruptions. |
| OPPO | Agree with the recommended WF. If issues 2-3-1 goes to “No”, then no interruption (Option 1) is allowed; Otherwise, an interruption on new PCell would be expected due to PScell addition. |
| Huawei | Support option 1. |

### 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 1 (CATT): The delay requirements for HO with PSCell are not relative with 2 step or 4 step RACH if the ending point of delay is defined as PRACH transmission of UE.
  + Option 2 (Apple, vivo): for requirement of HO with PSCell, RAN4 starts the discussion with 4 step RACH first and FFS on 2 step RACH.
  + Option 3 (NEC, Ericsson, ZTE): RAN4 to define both 2-step and 4-step RACH requirements for handover with PSCell.
* Recommended WF
  + TBA.
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Option 2. |
| Qualcomm | Option1 is supported |
| ZTE | Option 3. On Option 1: the end point is not settled yet. If the delay requirements are specified in a way that is identical with 2-step RACH and 4-step RACH, we can further check whether we need to mention the RACH type. |
| OPPO | Support option 2. |

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

* Proposals
  + Option 1 (CATT): There is no need to further consider the RO collision issue from RAN4’s perspective.
  + Option 2 (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.
  + Option 3 (NEC):
    - RAN4 to agree that components that contribute to TIU delay are the TA acquisition delay in Pcell, delay uncertainty in acquiring resources for RRC connection Reconfiguration Complete message on Pcell and PRACH acquisition uncertainty delay in PSCell.
    - RAN4 to agree that interruption uncertainty (TIU) for Pcell and PSCell is sequential process.
  + Option 4 (vivo): PRACH occasion collision is considered as one factor in the requirements for HO with PSCell, if UE only supports single uplink in the NE-DC or EN-DC.
  + Option 5 (MTK): For the scenario from NE-DC to NE-DC, RAN4 to clarify whether to remove the delay uncertainty of Pcell PRACH preamble transmission from the delay requirement of HO with PSCell procedure
* Recommended WF
  + TBA.
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 2. If parallel processing is used, the RO colliding case has been clarified in RAN1 spec TS38.213, and RAN4 shall follow RAN1 definition to add some RO uncertainty for Tx power limitation issue and single Tx issue. |
| Qualcomm | FFS |
| OPPO | Partially agree with option 2, if sequential processing is used then no need to consider RACH occasion (RO) collision. |
| Huawei | Agree with the second bullet in option 2. It has been clearly defined in RAN1 spec. |

**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.
* Recommended WF
  + Moderator: The NR-U scenario is out of scope of this WID, no need to discuss.
* 1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We think the NR-U scenario is out of scope of this WID, no need to discuss. |
| Qualcomm | Agree with the recommended WF |
| OPPO | Agree with the recommended WF. |
| Huawei | Agree with the recommended WF. |

### Sub-topic 2-5 Others

*Sub-topic description*

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

**Issue 2-5: Failure case definition for HO with PSCell**

* Proposals
  + Option 1 (CATT): RAN4 specified delay requirements HO with PSCell by UE sent PRACH on PCell and PSCell. Failure cases should not defined in RAN4 specification.
  + Option 2 (Huawei): UE shall transmit RRC complete message no matter whether the synchronization to the PSCell is completed or not. UE will report SCG failure If UE fails to synchronize to the target PSCell.
* Recommended WF
  + RAN4 may wait for the reply LS from RAN2 before any decision.
* 1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Support recommended WF. |
| Qualcomm | Support recommended WF. |
| OPPO | Support recommended WF. |

## Companies views’ collection for 1st round

### Open issues

Comments are collected in section 2.2

### 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

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

|  |  |
| --- | --- |
| **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** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**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

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

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