**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 be1. 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 |

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| [**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 |

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| [**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 |

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| [**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 RRMProposal 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 caseNote 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 casesNote 1: If SRS resource is configured in flexible symbols within a slot in synchronous case, the interruption requirements apply to uplink symbols. |

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| [**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** |
| XXX |  |
| YYY |  |

**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** |
| XXX |  |
| YYY |  |

**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** |
| XXX |  |
| YYY |  |

**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** |
| XXX |  |
| YYY |  |

### 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** |
| XXX |  |
| YYY |  |

**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** |
| XXX |  |
| YYY |  |

**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** |
| XXX |  |
| YYY |  |

**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** |
| XXX |  |
| YYY |  |

**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** |
| XXX |  |
| YYY |  |

### 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** |
| XXX |  |
| YYY |  |

**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 behavior
	+ 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** |
| XXX |  |
| YYY |  |

**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** |
| XXX |  |
| YYY |  |

**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** |
| XXX |  |
| YYY |  |

**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 caseCase 2: UL-DL slot configuration for synchronous caseNote 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 casesCase 2: UL-DL slot configuration for and asynchronous casesNote 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** |
| XXX |  |
| YYY |  |

### 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** |
| XXX |  |
| 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** |
| XXX |  |
| YYY |  |

## 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 behavior 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 additionProposal 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 UEProposal 1: RAN4 to clarify whether requirements from LTE-SA to EN-DC and from NR-SA to NR-DC are neededProposal 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 procedureProposal 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
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| [**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** |
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**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** |
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### Sub-topic 2-2 Delay requirement design of HO with PSCell

*Sub-topic description*

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

**Issue 2-2-1: 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** |
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**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** |
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**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** |
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**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** |
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**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** |
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**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** |
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**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** |
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**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 – 20msWhere,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 – 20msWhere,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 – 20msWhere,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 – 16msWhere,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** |
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**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** |
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### Sub-topic 2-3 Interruption requirement design of HO with PSCell

*Sub-topic description*

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

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

* Proposals
	+ Option 1 : 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:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |

**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:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |

### 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** |
| XXX |  |
| YYY |  |

**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** |
| XXX |  |
| YYY |  |

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |

### 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:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |

## 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”* |