**3GPP TSG-RAN4 Meeting #102eR4-2207117**

**Electronic Meeting, 21 February - 3 March, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.133** | **CR** |  | **rev** |  | **Current version:** | **17.4.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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| ***Title:*** | Big CR RRM requirements for Rel-17 NR FeRRM (TS 38.133) | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Apple | | | | | | | | | |
| ***Source to TSG:*** | RAN4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_RRM\_enh2-Core | | | | |  | ***Date:*** | | | 2022-03-04 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The requirements of R17 RRM further enhancements are missing in TS38.133. FeRRM WI includes: SRS antenna port switching, HO with PSCell, and PUCCH SCell activation.  This big CR reflects the endoresed draft CRs:  **Endorsed in 102-e**:   |  |  |  | | --- | --- | --- | | TDoc Endorsed CR | CR title | Source companies | | R4-2204705 | draftCR on introduction of SRS antenna port switching | Nokia | | R4-2206863 | Draft CR on Interruption requirement to NR serving cell, and impacts to other NR RRM requirement (if applicable) | Ericsson | | R4-2206865 | Draft CR on HO with PSCell for NR SA to EN-DC\_R17 | Apple | | R4-2206867 | Drfat CR on HO with PSCell requirements for NE DC to NE-DC | Ericsson | | R4-2206868 | dratCR on HO with PSCell for NR-DC to NR-DC | Nokia, Nokia Shanghai Bell | | R4-2206870 | PUCCH Scell activation delay requirements with multiple Scell | CATT | | R4-2206871 | 38.133 draft CR on PUCCH SCell activation delay requirements | Nokia | | R4-2206872 | Draft CR on requirements for interruption requirements to NR serving Cell for PUCCH SCell activation | Huawei |   **Endorsed in 101-bis-e**:   |  |  |  | | --- | --- | --- | | R4-2202749 | draft CR for PUCCH Scell deactivation delay | MTK | | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Introduce requirement for FeRRM WI, including: SRS antenna port switching, HO with PSCell, and PUCCH SCell activation. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The requirements of R17 RRM further enhancements are missing in TS38.133. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8.2.1.1, 8.2.2.1, 8.2.3.1, 8.2.4.1, 8.2.1.2.18, 8.2.2.2.16, 8.2.3.2.16, 8.2.4.2.14, 6.1.x, 6.1.x.1, 6.1.x.2, 6.1.5.4, 6.1.5.4.1, 6.1.5.4.2, 6.1.5.4.3, 6.1.x.4, 8.3.14, 8.3.x, 8.3.y, 8.2.1.2.x, 8.2.1.2.2 and 8.2.3.2.x | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.533 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

Start of Change 1

### 8.2.1 EN-DC Interruption

#### 8.2.1.1 Introduction

This clause contains the requirements related to the interruptions on PSCell, and SCell, when

E-UTRA PCell transitions between active and non-active during DRX, or

E-UTRA PCell transitions from non-DRX to DRX, or

E-UTRA SCell in MCG or SCell in SCG is added or released, or

E-UTRA SCell in MCG or SCell(s) in SCG is activated or deactivated, or

measurements on SCC with deactivated SCell in either E-UTRA MCG or NR SCG, or

a supplementary UL carrier or an UL carrier is configured or de-configured, or

UL/DL active BWP is switched on PSCell or SCell in SCG, or

E-UTRA SCell in MCG or SCell(s) in SCG is directly activated and hibernated, or

E-UTRA SCell in MCG is hibernated, or

Multiple SCells in SCG are activated or deactivated, or

SCell dormancy switches, or

CQI/RRM measurement happens during SCell dormancy, or

UE-specific CBW is changed on PSCell or SCell in SCG, or

CGI reading of an NR neighbour cell with autonomous gaps, or

CGI reading of an E-UTRA neighbour cell with autonomous gaps.

NR SRS carrier based switching, or

E-UTRA SRS carrier based switching, or

NR SRS antenna port switching, or

UE dynamic Tx switches between two uplink carriers.

The requirements shall apply for E-UTRA-NR DC with an E-UTRA PCell.

This clause contains interruptions where victim cell is PSCell or SCell belonging to SCG. Requirements for interruptions requirements when the victim cell is E-UTRA PCell or E-UTRA SCell belonging to MCG are specified in TS 36.133 [15].

For a UE which does not support per-FR measurement gaps, interruptions to the PSCell or activated SCG SCells may be caused by EUTRA PCell, EUTRA SCells or SCells on any frequency range. For UE which support per-FR gaps, interruptions to the PSCell or activated SCG SCells may be caused by EUTRA PCell, EUTRA SCells or SCells on the same frequency range as the victim cell.

End of Change 1

Start of Change 2

### 8.2.2 SA: Interruptions with Standalone NR Carrier Aggregation

#### 8.2.2.1 Introduction

This clause contains the requirements related to the interruptions on PCell and activated SCell if configured, when

up to 7 SCells are configured, de-configured, activated or deactivated, or

a supplementary UL carrier or an UL carrier is configured or de-configured, or

measurements on SCC with deactivated SCell in NR SCG, or

UL/DL BWP is switched on PCell or SCell, or

CGI reading of an NR neighbour cell with autonomous gaps, or

CGI reading of an E-UTRA neighbour cell with autonomous gaps.

UE-specific CBW is changed on PCell or SCell, or

NR SRS carrier based switching, or

NR SRS antenna port switching, or

UE dynamic Tx switches between two uplink carriers.

Note: interruptions at SCell addition/release, activation/deactivation and during measurements on SCC may not be required by all UEs.

The interruptions shall not interrupt RRC signalling or ACK/NACKs related to RRC reconfiguration procedure according to TS38.331 [2] for SCell addition/release or MAC control signalling according to TS37.340 [17] for SCell activation/deactivation command.

This clause additionally contains requirements related to interruptions at inter-frequency SFTD between PCell in FR1 and neighbour cell in FR2.

For a UE which does not support per-FR measurement gap, interruptions to the PCell and activated SCell may be caused by SCells on any frequency range. For a UE which supports per-FR gaps, interruptions to PCell and activated SCell may be caused by SCells on the same frequency range as the victim cell.

In addition to standalone NR carrier aggregation when no CCA is configured, the requirements in clause 8.2.2. and all subclauses of 8.2.2 apply when the UE is configured with

-A PCell not using CCA in downlink and one or more SCells using CCA in downlink or

-A PCell and one or more SCells using CCA in downlink

End of Change 2

Start of Change 3

#### 8.2.3.1 Introduction

This clause contains the requirements related to the interruptions on PCell and SCell, when

E-UTRA PSCell transitions between active and non-active during DRX, or

E-UTRA PSCell transitions from non-DRX to DRX, or

E-UTRA PSCell/SCell in SCG or SCell in MCG is added or released, or

E-UTRA PSCell/SCell in SCG or SCell(s) in MCG is activated or deactivated, or

measurements on SCC with deactivated SCell in either E-UTRA SCG or NR MCG or

PUSCH/PUCCH carrier configuration and deconfiguration in NR MCG, or

UL/DL BWP is switched on PCell or SCell in MCG, or

CGI reading of an NR neighbour cell with autonomous gaps, or

CGI reading of an E-UTRA neighbour cell with autonomous gaps.

NR SRS carrier based switching, or

E-UTRA SRS carrier based switching, or

NR SRS antenna port switching.

The requirements shall apply for NE-DC with an NR PCell.

This clause contains interruptions where victim cell is PCell or SCell belonging to MCG. Requirements for interruptions requirements when the victim cell is E-UTRA PSCell or E-UTRA SCell belonging to SCG are specified in TS 36.133 [15].

For a UE which does not support per-FR measurement gap, interruptions to the PCell, E-UTRA PSCell or activated MCG SCells may be caused by EUTRA PSCell, EUTRA SCells or SCells on any frequency range. For UE which support per-FR gap, interruptions to the PCell, E-UTRA PSCell or activated MCG SCells may be caused by EUTRA PSCell, EUTRA SCells or SCells on the same frequency range as the victim cell.

End of Change 3

Start of Change 4

### 8.2.4 NR-DC: Interruptions

#### 8.2.4.1 Introduction

This clause contains the requirements related to the interruptions on PCell, PSCell and activated SCell if configured, when

up to 1 SCell in FR1 and up to 7 SCell(s) in FR2 are configured, deconfigured, activated or deactivated or,

a supplementary UL carrier or an UL carrier is configured or de-configured, or

measurements on SCC with deactivated SCell in NR SCG, or

UL/DL BWP is switched on PCell, PSCell or SCell.

transitions between active and non-active during DRX, or

transitions from non-DRX to DRX, or

CGI reading of an NR neighbour cell with autonomous gaps, or

CGI reading of an E-UTRA neighbour cell with autonomous gaps.

NR SRS carrier based switching, or

NR SRS antenna port switching.

Note: interruptions at SCell addition/release, activation/deactivation and during measurements on SCC may not be required by all UEs.

The interruptions shall not interrupt RRC signalling or ACK/NACKs related to RRC reconfiguration procedure [2] for SCell addition/release or MAC control signalling [17] for SCell activation/deactivation command.

The requirements shall apply for NR-DC with an NR PCell, PSCell or SCell.

For a UE which does not support per-FR measurement gap, interruptions to the PCell and activated SCell may be caused by SCells on any frequency range. For a UE which supports per-FR gaps, interruptions to PCell, PSCell and activated SCell may be caused by SCells on the same frequency range as the victim cell.

End of Change 4

Start of Change 5

8.2.1.2.18 Interruptions at NR SRS antenna port switching

The requirements in this clause are applicable to SRS antenna port switching on FR1.

The UE shall perform SRS antenna port switching only if the below conditions are met.

- the SRS switching is not colliding with any other transmission with higher priority defined in TS 38.214 [26] if the carrier on which the higher priority transmission is performed is one entry of *txSwitchWithAnotherBand* or is the same carrier on which SRS is transmitted.

- the SRS switching is not colliding with any NR measurements (i.e., SSB/CSI-RS based L1/L3 measurements) and the measurements for RLM/BFD/CBD if the carrier on which the NR measurements and the measurements for RLM/BFD/CBD is performed is one entry of *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted.

No requirements apply to the aperiodic L1-RSRP/L1-SINR measurements configured if the carrier on which the aperiodic L1-RSRP/L1-SINR configured is one entry of txSwitchImpactToRx or is the same carrier on which aperiodic SRS is scheduled/configured.

When SRS antenna port switching is performed, interruption requirements does not depend on per-FR gap.

For interruption caused by SRS antenna port switching, the victim CC would be based on the band groups signaled in *txSwitchImpactToRx* or *txSwitchWithAnotherBand* regardless of per-FR MG capability. e.g., an UL interruption is allowed on any of the serving cells belonging to the same group to the SRS carrier as indicated in *txSwitchWithAnotherBand*, and a DL interruption is allowed on any of the serving cells belongs to the same group to the SRS carrier as indicated by *txSwitchImpactToRx*.

When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggresor and victim carriers are synchronized, the interruption requirement in Table 8.2.1.2.18-1 applies. When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim carriers are asynchronized, the interruption requirement in Table 8.2.1.2.18-2 applies. For the rest of SRS configurations, the interruption requirement in Table 8.2.1.2.18-3 applies.

Table 8.2.1.2.18-1: Interruption length in symbols when 1 SRS symbol is configured and aggressor and victim CC are synchronized

|  |  |  |  |
| --- | --- | --- | --- |
| Victim CC SCS(kHz) | Aggressor CC SCS (kHz) | | |
| 15 | 30 | 60 |
| 15 (NR or LTE) | 3 | 2 | 2 |
| 30 | 4 | 3 | 3 |
| 60 | 8 | 6 | 5 |
| 120 | 14 | 10 | 8 |

Table 8.2.1.2.18-2: Interruption length in slots when 1 SRS symbol is configured and aggressor and victim CC are asynchronized

|  |  |  |  |
| --- | --- | --- | --- |
| Victim CC SCS(kHz) | Aggressor CC SCS (kHz) | | |
| 15 | 30 | 60 |
| 15 (NR or LTE) | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 2 | 2 | 2 |
| 120 | 2 | 2 | 2 |

Table 8.2.1.2.18-3: Interruption length in slots for rest of the SRS configurations for syncronised and asynchronized scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| 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 |
| 120 | 5 | 3 | 3 |

End of Change 5

Start of Change 6

8.2.2.2.16 Interruptions at NR SRS antenna port switching

The requirements in this clause are applicable to SRS antenna port switching on FR1.

The interruption requirement in this clause is defined based on the band combination capability reported by UE, i.e., based on *txSwitchImpactToRx* or *txSwitchWithAnotherBand*.

The UE shall perform SRS antenna port switching only if the below conditions are met.

- the SRS switching is not colliding with any other transmission with higher priority defined in TS 38.214 [26] if the carrier on which the higher priority transmission is performed is one entry of *txSwitchWithAnotherBand* or is the same carrier on which SRS is transmitted.

- the SRS switching is not colliding with any NR measurements (i.e., SSB/CSI-RS based L1/L3 measurements) and the measurements for RLM/BFD/CBD if the carrier on which the NR measurements and the measurements for RLM/BFD/CBD is performed is one entry of *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted.

- the SRS switching is not colliding with E-UTRA measurement if the carrier on which the E-UTRA measurement is performed is one entry of *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted.

No requirements apply to the aperiodic L1-RSRP/L1-SINR measurements configured if the carrier on which the aperiodic L1-RSRP/L1-SINR configured is one entry of txSwitchImpactToRx or is the same carrier on which aperiodic SRS is scheduled/configured.

When SRS antenna port switching is performed, interruption requirements does not depend on per-FR gap.

For interruption caused by SRS antenna port switching, the victim CC would be based on the band groups signaled in *txSwitchImpactToRx* or *txSwitchWithAnotherBand* regardless of per-FR MG capability. e.g., an UL interruption is allowed on any of the serving cells belongs to the same group to the SRS carrier as indicated in *txSwitchWithAnotherBand*, and a DL interruption is allowed on any of the serving cells belongs to the same group to the SRS carrier as indicated by *txSwitchImpactToRx*.

When 1 SRS symbol is transmitted and the aggresor and victim carriers are synchronized, the interruption requirement in Table 8.2.2.2.16-1 applies. When 1 SRS symbol is transmitted and the aggressor and victim carriers are asynchronized, the interruption requirement in Table 8.2.2.2.16-2 applies. For the rest of configurations, the interruption requirement in Table 8.2.2.2.16-3 applies.

Table 8.2.2.2.16-1: Interruption length in symbols when 1 SRS symbol is configured and aggressor and victim CC are synchronized

|  |  |  |  |
| --- | --- | --- | --- |
| Victim CC SCS(kHz) | Aggressor CC SCS (kHz) | | |
| 15 | 30 | 60 |
| 15 (NR or LTE) | 3 | 2 | 2 |
| 30 | 4 | 3 | 3 |
| 60 | 8 | 6 | 5 |
| 120 | 14 | 10 | 8 |

Table 8.2.2.2.16-2: Interruption length in slots when 1 SRS symbol is configured and aggressor and victim CC are asynchronized

|  |  |  |  |
| --- | --- | --- | --- |
| Victim CC SCS(kHz) | Aggressor CC SCS (kHz) | | |
| 15 | 30 | 60 |
| 15 (NR or LTE) | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 2 | 2 | 2 |
| 120 | 2 | 2 | 2 |

Table 8.2.2.2.16-3: Interruption length in slots for rest of the SRS configurations for syncronised and asynchronized scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| 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 |
| 120 | 5 | 3 | 3 |

End of Change 6

Start of Change 7

8.2.3.2.16 Interruptions at NR SRS antenna port switching

The requirements in this clause are applicable to SRS antenna port switching on FR1.

The interruption requirement in this clause is defined based on the band combination capability reported by UE, i.e., based on *txSwitchImpactToRx* or *txSwitchWithAnotherBand*.

The UE shall perform SRS antenna port switching only if the below conditions are met.

- the SRS switching is not colliding with any other transmission with higher priority defined in TS 38.214 [26] if the carrier on which the higher priority transmission is performed is one entry of *txSwitchWithAnotherBand* or is the same carrier on which SRS is transmitted.

- the SRS switching is not colliding with any NR measurements (i.e., SSB/CSI-RS based L1/L3 measurements) and the measurements for RLM/BFD/CBD if the carrier on which the NR measurements and the measurements for RLM/BFD/CBD is performed is one entry of *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted.

No requirements apply to the aperiodic L1-RSRP/L1-SINR measurements configured if the carrier on which the aperiodic L1-RSRP/L1-SINR configured is one entry of txSwitchImpactToRx or is the same carrier on which aperiodic SRS is scheduled/configured.

When SRS antenna port switching is performed, interruption requirements does not depend on per-FR gap.

For interruption caused by SRS antenna port switching, the victim CC would be based on the band groups signaled in *txSwitchImpactToRx* or *txSwitchWithAnotherBand* regardless of per-FR MG capability. e.g., an UL interruption is allowed on any of the serving cells belongs to the same group to the SRS carrier as indicated in *txSwitchWithAnotherBand*, and a DL interruption is allowed on any of the serving cells belongs to the same group to the SRS carrier as indicated by *txSwitchImpactToRx*.

When 1 SRS symbol is transmitted and the aggresor and victim carriers are synchronized, the interruption requirement in Table 8.2.3.2.16-1 applies. When 1 SRS symbol is transmitted and the aggressor and victim carriers are asynchronized, the interruption requirement in Table 8.2.3.2.16-2 applies. For the rest of configurations, the interruption requirement in Table 8.2.3.2.16-3 applies.

Table 8.2.3.2.16-1: Interruption length in symbols when 1 SRS symbol is configured and aggressor and victim CC are synchronized

|  |  |  |  |
| --- | --- | --- | --- |
| Victim CC SCS(kHz) | Aggressor CC SCS (kHz) | | |
| 15 | 30 | 60 |
| 15 (NR or LTE) | 3 | 2 | 2 |
| 30 | 4 | 3 | 3 |
| 60 | 8 | 6 | 5 |
| 120 | 14 | 10 | 8 |

Table 8.2.3.2.16-2: Interruption length in slots when 1 SRS symbol is configured and aggressor and victim CC are asynchronized

|  |  |  |  |
| --- | --- | --- | --- |
| Victim CC SCS(kHz) | Aggressor CC SCS (kHz) | | |
| 15 | 30 | 60 |
| 15 (NR or LTE) | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 2 | 2 | 2 |
| 120 | 2 | 2 | 2 |

Table 8.2.3.2.1-3: Interruption length in slots for rest of the SRS configurations for syncronised and asynchronized scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| 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 |
| 120 | 5 | 3 | 3 |

End of Change 7

Start of Change 8

8.2.4.2.14 Interruptions at NR SRS antenna port switching

The requirements in this clause are applicable to SRS antenna port switching on FR1.

The interruption requirement in this clause is defined based on the band combination capability reported by UE, i.e., based on *txSwitchImpactToRx* or *txSwitchWithAnotherBand*.

The UE shall perform SRS antenna port switching only if the below conditions are met.

- the SRS switching is not colliding with any other transmission with higher priority defined in TS 38.214 [26] if the carrier on which the higher priority transmission is performed is one entry of *txSwitchWithAnotherBand* or is the same carrier on which SRS is transmitted.

- the SRS switching is not colliding with any NR measurements (i.e., SSB/CSI-RS based L1/L3 measurements) and the measurements for RLM/BFD/CBD if the carrier on which the NR measurements and the measurements for RLM/BFD/CBD is performed is one entry of *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted.

- the SRS switching is not colliding with E-UTRA measurement if the carrier on which the E-UTRA measurement is performed is one entry of *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted.

No requirements apply to the aperiodic L1-RSRP/L1-SINR measurements configured if the carrier on which the aperiodic L1-RSRP/L1-SINR configured is one entry of txSwitchImpactToRx or is the same carrier on which aperiodic SRS is scheduled/configured.

When SRS antenna port switching is performed, interruption requirements does not depend on per-FR gap.

For interruption caused by SRS antenna port switching, the victim CC would be based on the band groups signaled in *txSwitchImpactToRx* or *txSwitchWithAnotherBand* regardless of per-FR MG capability. e.g., an UL interruption is allowed on any of the serving cells belongs to the same group to the SRS carrier as indicated in *txSwitchWithAnotherBand*, and a DL interruption is allowed on any of the serving cells belongs to the same group to the SRS carrier as indicated by *txSwitchImpactToRx*.

When 1 SRS symbol is transmitted and the aggresor and victim carriers are synchronized, the interruption requirement in Table 8.2.4.2.14-1 applies. When 1 SRS symbol is transmitted and the aggressor and victim carriers are asynchronized, the interruption requirement in Table 8.2.4.2.14-2 applies. For the rest of configurations, the interruption requirement in Table 8.2.4.2.14-3 applies.

Table 8.2.4.2.14-1: Interruption length in symbols when 1 SRS symbol is configured and aggressor and victim CC are synchronized

|  |  |  |  |
| --- | --- | --- | --- |
| Victim CC SCS(kHz) | Aggressor CC SCS (kHz) | | |
| 15 | 30 | 60 |
| 15 (NR or LTE) | 3 | 2 | 2 |
| 30 | 4 | 3 | 3 |
| 60 | 8 | 6 | 5 |
| 120 | 14 | 10 | 8 |

Table 8.2.4.2.14-2: Interruption length in slots when 1 SRS symbol is configured and aggressor and victim CC are asynchronized

|  |  |  |  |
| --- | --- | --- | --- |
| Victim CC SCS(kHz) | Aggressor CC SCS (kHz) | | |
| 15 | 30 | 60 |
| 15 (NR or LTE) | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 2 | 2 | 2 |
| 120 | 2 | 2 | 2 |

Table 8.2.4.2.14-3: Interruption length in slots for rest of the SRS configurations for syncronised and asynchronized scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| 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 |
| 120 | 5 | 3 | 3 |

End of Change 8

Start of Change 9

### 6.1.x NR Handover with PSCell

#### 6.1.x.1 Introduction

The purpose of NR handover with PSCell is to change the NR PCell to another NR cell or E-UTRA cell and add or change the PSCell along with PCell handover. The requirements in this clause are applicable to:

* Handover with PSCell from NR SA to EN-DC
* Handover with PSCell from NR-DC to NR-DC
  + Requirements in this clause only applies to FR1+FR2 NR-DC
* Handover with PSCell from NE-DC to NE-DC
  + Requirements in this clause only applies to NE-DC with FR1 PCell

#### 6.1.x.2 Handover with PSCell from NR SA to EN-DC

The requirements in this clause are applicable to inter-RAT handover from NR to E-UTRAN and FR1/FR2 PSCell addition.

When the UE receives a RRC message implying handover with PSCell, the UE shall be ready to start the transmission of the new uplink PRACH channel on target E-UTRA PCell within DHOwithPSCell\_PCell msec from the end of the last TTI containing the RRC command, and the UE shall be ready to start the transmission of the new uplink PRACH channel on target PSCell within DHOwithPSCell\_PSCell msec from the end of the last TTI containing the RRC command.

Where:

DHOwithPSCell\_PCell equals the applicable RRC procedure delay (i.e., 50ms) plus the interruption time stated in clause 6.1.x.2.1.

DHOwithPSCell\_PSCell equals the PSCell addition delay stated in clause 6.1.x.2.2.

##### 6.1.x.2.1 Interruption time for inter-RAT HO from NR to E-UTRAN

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay

When handover with PSCell from NR SA to EN-DC is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch\_HO + TIU + Tprocessing

Where:

Tsearch\_HO is same as the Tsearch defined in section 6.1.2.1.3.

TIU is same as the one defined in section 6.1.2.1.3.

Tprocessing is the SW processing time needed by UE, including RF warm up period. When target PSCell is unknown and SMTC configuration of target unknown PSCell is present in *RRCConnectionReconfiguration* [2], Tprocessing = 30ms if new PSCell is in FR1, Tprocessing = 50ms if new PSCell is in FR2; otherwise, Tprocessing = 25ms if new PSCell is in FR1, Tprocessing = 45ms if new PSCell is in FR2.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant E-UTRA cell identification requirements are described in clause 9.4.1.

##### 6.1.x.2.2 PSCell addition in HO with PSCell for NR SA to EN-DC

The requirements in this section shall apply for PSCell addition during handover with PSCell from NR SA to EN-DC.

When handover with PSCell from NR SA to EN-DC is commanded, the PSCell addition time shall be less than DHOwithPSCell\_PSCell:

DHOwithPSCell\_PSCell = TRRC\_delay + Tprocessing + Tsearch\_HO + Tsearch\_PSCell + T∆ + TPSCell\_ DU + 2 ms

Where:

TRRC\_delay is the RRC procedure delay. TRRC\_delay = 50ms.

Tprocessing is as defined in section 6.1.x.2.1.

Tsearch\_HO is as defined in section 6.1.x.2.1.

Tsearch\_PSCell is same as Tsearch in section 7.31.2 of TS36.133[15], and T∆ and TPSCell\_ DU is same as the one defined in section 7.31.2 of TS36.133[15]. The Trs definition from section 7.31.2 of TS36.133[15] is modified as following for requirement in this section:

Trs is the SMTC periodicity of the target NR cell if target PSCell is unknown and SMTC configuration of target unknown PSCell is present in *RRCConnectionReconfiguration* [2], otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this section is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

PSCell known and unknown condition is as defined in section 7.31.2 of TS36.133[15].

End of Change 9

Start of Change 10

#### 6.1.5.4 HO with PSCell from NE-DC to NE-DC

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR PCell to NR PCell on FR1, and the PSCell addition is on LTE.

##### 6.1.5.4.1 Handover delay

When the UE receives a RRC message implying PCell handover with PSCell change, the UE shall be ready to start the transmission of the new uplink PRACH channel on target NR PCell within DHOwithPSCell\_PCell from the end of the last TTI containing the RRC command, and UE shall be ready to start the transmission of the new uplink PRACH channel on target E-UTRA PSCell within DHOwithPSCell\_PSCell from the end of the last TTI containing the RRC command.

The PCell handover delay, DHOwithPSCell\_PCell, is equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the PCell interruption time (Tinterrupt) define in clause 6.1.5.4.2.

PSCell addition/change delay, DHOwithPSCell\_PSCell is defined in clause 6.1.5.4.3.

##### 6.1.5.4.2 HO with PSCell - PCell Interruption time

When intra-frequency or inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch\_PCell + T∆\_PCell + Tmargin\_PCell + TIU\_PCell + Tprocessing ms

Where:

* If the source cell is in FR1 and target cell is in FR1, Tsearch\_PCell,  T∆\_PCell, Tmargin\_PCell, TIU\_PCell is same as the Tsearch, T∆, Tmargin, TIU defined in section 6.1.1.2.2 respectively. Tprocessing is UE software processing and RF warmup delay for PCell HO and for this case Tprocessing can be up to 25ms.

##### 6.1.5.4.3 PSCell addition/change in NE-DC to NE-DC HO with PSCell

When HO with PSCell addition is commanded, the PSCell addition/change time shall be less than DHOwithPSCel\_PSCell.

Where DHOwithPSCel\_PSCell is same as Tconfig\_PSCell defined in clause 7.14.2 of TS 36.133, except that UE processing delay for software processing and RF warmup is same as processing delay specified for PCell HO in 6.1.5.4.2.

End of Change 10

Start of Change 11

#### 6.1.x.4 HO with PSCell from NR-DC to NR-DC

The requirements in this clause are applicable to handover with PSCell from NR-DC to NR-DC. The requirements in this clause are only applicable to FR1+FR2 NR-DC.

This clause defines requirements for the delay within which the UE shall be able to handover from NR cell to NR cell and add NR PSCell in the meantime.

When the UE receives a RRC message implying handover with PSCell,

* The UE shall be ready to start the transmission of the new uplink PRACH channel of the target PCell within DHOwithPSCell\_PCell ms from the end of the last TTI containing the RRC command, and
* The UE shall be capable of transmitting PRACH preamble towards the target PSCell no later than DHOwithPSCell\_PSCell ms from the end of the last TTI containing the RRC command.

Where,

DHOwithPSCell\_PCell equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1.x.4.1.

DHOwithPSCell\_PSCell is the PSCell change delay stated in clause 6.1.x.4.2.

6.1.x.4.1 HO with PSCell – PCell Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When handover with PSCell from NR-DC to NR-DC is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

Tsearch, TIU, T∆ and Tmargin are the same as defined in clause 6.1.1.2.2.

Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 25 ms. If SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*, Tprocessing = 30 ms.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant cell identification requirements are described in Clause 9.2.5 for intra-frequency handover and Clause 9.3.4 for inter-frequency handover.

6.1.x.4.2 HO with PSCell – PSCell change delay

The requirements in this section shall apply for PSCell change during handover with PSCell from NR DC to NR-DC.

When handover with PSCell from NR-DC to NR-DC is commanded, the PSCell change time shall be less than DHOwithPSCell\_PSCell:

DHOwithPSCell\_PSCell = TRRC\_delay + Tprocessing + Tsearch\_PCell + Tsearch\_PSCell + T∆ + TPSCell\_ DU + 2 ms

Where:

TRRC\_delay Tprocessing, Tsearch\_PSCell, T∆ and TPSCell\_ DU are the same as defined in clause 8.9.2.

Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 25 ms. If SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*, Tprocessing = 30 ms.

Tsearch\_PCell is the time for obtaining the timing reference of target PCell. If SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*, Tsearch\_PCell = Tsearch + TΔ + Tmargin, where Tsearch, TΔ and Tmargin are specified in clause 6.1.x.4.1. Otherwise, Tsearch\_PCell = 0 ms.

The Trs definition from clause 8.9.2 is modified as following for requirements in this section:

Trs is the SMTC periodicity of the target NR cell if target PSCell is unknown and SMTC configuration of target unknown PSCell is present in either *targetcellSMTC-SCG-r16* or *reconfigurationWithSync*, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this section is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

PSCell known and unknown condition is as defined in clause 8.9.2.

End of Change 11

Start of Change 12

### [8.3.14] SCell activation delay Requirement for Deactivated PUCCH Scell with Multiple SCells

The requirements in this clause shall apply for the UE configured with multiple deactivated downlink SCells and PUCCH is configured for a SCell, and when PUCCH SCell with downlink SCell(s) are activated by one MAC command.

Upon receiving SCell activation command in slot *n* for PUCCH SCell with multiple downlink SCell(s), for PUCCH Scell

If the UE has a valid TA for transmitting on a PUCCH SCell then the UE shall be able to transmit valid CSI report and apply actions related to the SCell activation command as specified in [7] for the SCell being activated on the PUCCH SCell no later than in slot *n*+ Tactivate\_total.

Where:

- A TA is considered to be valid provided that the *TimeAlignmentTimer* [2] associated with the TAG containing the PUCCH SCell is running.

- Tactivate\_total is FFS.

If the UE does not have a valid TA for transmitting on an SCell then the UE shall be capable to perform downlink actions related to the SCell activation command as specified in [7] for the SCell being activated on the PUCCH SCell no later than in slot *n*+Tactivate\_basic, and shall be capable to perform uplink actions related to the SCell activation command as specified in [7] for the SCell being activated on the PUCCH SCell no later than in slot *n*+Tdelay\_PUCCH\_multiple\_SCells and shall transmit valid CSI report for the SCell being activated on the PUCCH SCell no later than in slot *n*+Tdelay\_PUCCH\_multiple\_SCells,where Tdelay\_PUCCH\_multiple\_SCells = FFS.

For each of other to-be-activated downlink SCell, the UE shall be capable to transmit valid CSI report and apply actions related to the activation command for the SCell being activated no later than in slot *n*+Tactivate\_basic, where Tactivate\_total = FFS.

The interruption on the PCell specified in section 8.2.2.2.7 shall meet.

End of Change 12

Start of Change 13

### 8.3.x SCell Activation Delay Requirement for Deactivated PUCCH SCell

The requirements in this clause shall apply for the UE configured with one downlink SCell and when PUCCH is configured for the SCell being activated.

If the UE has a valid TA for transmitting on an SCell then the UE shall be capable to transmit valid CSI report and apply actions related to the activation command for the SCell being activated on the PUCCH SCell no later than in slot n+,



Where:

- A TA is considered to be valid provided that the *TimeAlignmentTimer* [2] associated with the TAG containing the PUCCH SCell is running.

- THARQ (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].

- Tactivation\_time for FR1 is the SCell activation delay in millisecond as specified in section 8.3.2.

- Tactivation\_time for FR2 is the SCell activation delay in millisecond as specified in section 8.3.2 in which Tuncertainty\_MAC is updated as below:

- Tuncertainty\_MAC is the time period between reception of the last activation command for PDCCH TCI, PDSCH TCI (when applicable), UL spatial relation relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

- TCSI\_reporting is the delay (in ms) specified in clause 8.3.2

- [X] sample measurement time is introduced in FR2 when PL-RS of target PUCCH SCell is known

- FFS under what condition the [X] = 0 or [X] = 5

If the UE does not have a valid TA for transmitting on an SCell then the UE shall be capable to perform downlink actions related to the SCell activation command as specified in [7] for the SCell being activated on the PUCCH SCell no later than in slot n+, and shall be capable to perform uplink actions related to the SCell activation command as specified in [7] for the SCell being activated on the PUCCH SCell no later than in slot and shall transmit valid CSI report for the SCell being activated on the PUCCH SCell no later than in slot , where:



Tdelay\_PUCCH\_SCell = Tactivation\_time + [X] + max ((TFirst\_available\_CSI + TCSI\_processing), (T1+T2+T3)) + TCSI\_reporting\_after

Where:

- Tactivation\_time is the SCell activation delay in millisecond as specified in section 8.3.2.

- [X] sample measurement time is introduced in FR2 when PL-RS of target PUCCH SCell is known

- FFS under what condition the [X] = 0 or [X] = 5

- TFirst\_available\_CSI: the delay uncertainty in acquiring the first available downlink CSI reference resource.

- TCSI\_processing: the UE processing time for CSI reporting.

- TCSI\_reporting\_after: the delay uncertainty in acquiring the first available CSI reporting resource after T3

- T1 is the delay uncertainty in acquiring the first available PDCCH triggered PRACH occasion in the PUCCH SCell after Tactivation\_time.

- T1 is up to the summation of a delay uncertainty for reception of PDCCH order, SSB to PRACH occasion association period and 10 ms, where SSB to PRACH occasion association period is defined in the table 8.1-1 of TS 38.213

- T2 is the delay from slot n + (THARQ + Tactivation\_time +T1)/NR slot length until UE has obtained a valid TA command for the target PUCCH Scell being activated. Slot n is the slot where the UE receives PUCCH SCell activation command.

- T3 is the delay for applying the received TA for uplink transmission on target PUCCH SCell being activated, and greater than or equal to k+1 slot, where k is defined in clause 4.2 in TS 38.213.

The pathloss reference signal is known for known PUCCH SCell during activation if the following conditions are met during the period between the last transmission of the RS resource used for L3 RSRP measurement reporting and the completion of PUCCH SCell activation, where the RS resource is the target pathloss reference signal or QCLed (with Type D) to the target pathloss reference signal:

* The target pathloss reference signal determination is based on the latest L3 RSRP measurement reporting
* The target pathloss reference signal remains detectable during the PUCCH SCell activation period
  + SNR of the target pathloss reference signal≥-3dB
* The associated SSBs with the target pathloss reference signal remain detectable during the PUCCH SCell activation period
  + SNR of the associated SSB ≥-3dB
* Otherwise, the pathloss reference signal is unknown.

The pathloss reference signal is known for unknown PUCCH SCell during activation if the following conditions are met during the period between the last transmission of the RS resource used for L1-RSRP measurement reporting and the completion of PUCCH SCell activation, where the RS resource is the target pathloss reference signal or QCLed (with Type D) to the target pathloss reference signal.

* The target pathloss reference signal determination is based on the latest L1-RSRP measurement reporting
* The target pathloss reference signal remains detectable during the PUCCH SCell activation period
  + SNR of the target pathloss reference signal≥-3dB
* The associated SSBs with the target pathloss reference signal remain detectable during the PUCCH SCell activation period
  + SNR of the associated SSB ≥-3dB
* Otherwise, the pathloss reference signal is unknown.

The above delay requirement (Tdelay\_PUCCH SCell) shall apply provided that:

- The RA on PUCCH SCell is not interrupted by the RA on PCell otherwise additional delay to activate the SCell is expected; and

- No SRS carrier based switching occurs during the SCell activation procedure otherwise the PUCCH SCell activation delay (Tdelay\_PUCCH\_SCell) can be extended. The starting point and the end-point of an interruption window on PCell or any activated SCell in MCG for NR standalone mode, or on PSCell or any activated SCell in SCG for EN-DC mode is the same as the interruption in single SCell activation requirement in clause 8.3.2.

- For unknown PUCCH SCell activation, the requirements only apply when UE supports cross PUCCH group CSI reporting capability [TBD], and UE is configured with CSI reporting via SpCell. And the PDCCH order (when applicable) and the activation command for TCI, UL spatial relation, and PL-RS are based on latest valid L1-RSRP reporting via Primary PUCCH group.

End of Change 13

Start of Change 14

##### 8.2.1.2.x Interruptions due to PUCCH SCell activation/deactivation

When one SCell in SCG configured with PUCCH is activated or deactivated,

* The UE is allowed an interruption on active serving cell in SCG as defined in clause 8.2.1.2.4.
* The starting time of interruption shall be within the delay as defined in clause 8.x.y.

*Editor notes: FFS on whether to define interruptions due to PUCCH SCell RACH has different SCS from spCell data/control channel*

End of Change 14

Start of Change 15

##### 8.2.2.2.x Interruptions due to PUCCH SCell activation/deactivation

When one SCell configured with PUCCH is activated or deactivated,

* The UE is allowed an interruption on active serving cell as defined in clause 8.2.2.2.2.
* The starting time of interruption shall be within the delay as defined in clause 8.x.y.

*Editor notes: FFS on whether to define interruptions due to PUCCH SCell RACH has different SCS from spCell data/control channel*

End of Change 15

Start of Change 16

##### 8.2.3.2.x Interruptions due to PUCCH SCell activation/deactivation

When one SCell in MCG configured with PUCCH is activated or deactivated,

* The UE is allowed an interruption on active serving cell in MCG as defined in clause 8.2.3.2.4.
* The starting time of interruption shall be within the delay as defined in clause 8.x.y.

*Editor notes: FFS on whether to define interruptions due to PUCCH SCell RACH has different SCS from spCell data/control channel*

End of Change 16

Start of Change 17

### 8.3.x SCell Deactivation Delay Requirement for Activated PUCCH SCell

The requirements in this clause shall apply for the UE configured with one SCell configured with PUCCH in EN-DC, or in standalone NR carrier aggregation, or in NE-DC.

Upon receiving PUCCH SCell deactivation command in slot *n*, the UE shall accomplish the deactivation actions for the PUCCH SCell being deactivated no later than in slot *n +*. The starting point of an interruption window on spCell or any activated SCell, as specified in clause 8.2, shall not occur before slot n+1+ and not occur after slot n+1+, where NR slot length is with respect to the numerology used in the PUCCH SCell being deactivated.

The length of the interruption window may be different for different victim cells, and depends on the applicable scenario and on the frequency band relation between the aggressor cell and the victim cell.

End of Change 17

Start of Change 18

### 8.3.y SCell Deactivation Delay Requirement for Activated PUCCH SCell with Multiple Downlink SCells

The requirements in this clause shall apply for the UE configured with multiple downlink SCells and one SCell configured with PUCCH in EN-DC, or in standalone NR carrier aggregation, or in NE-DC, provided that,

- in each single CG, there are no other SCell activation, deactivation, addition or release before deactivation is completed for all the SCells deactivated by the single MAC CE in this clause, and

- in EN-DC and NE-DC, there are no E-UTRAN SCell activation, deactivation, addition or release before multiple SCell deactivation is completed in this clause, and

- in EN-DC, NE-DC and standalone NR, UE only receives one single MAC command for multiple SCell deactivation within the deactivation period defined in this clause

Upon receiving SCell deactivation command in slot *n*, the UE shall accomplish the deactivation actions for the SCells (including one SCell configured with PUCCH) being deactivated within the same delay as specified in clause 8.3.x.

The starting point and the end-point of an interruption window on PCell or any activated SCell in MCG for NR standalone mode, or on PSCell or any activated SCell in SCG for EN-DC mode is same as single SCell activation requirement in clause 8.3.x.

End of Change 18