**3GPP TSG- Meeting # *R4-240xxxx***

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  |  | **CR** | **4446** | **rev** | **1** | **Current version:** |  |  |
|  |
| *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:***  | BigCR for NR\_FR1\_lessthan\_5MHz\_BW |
|  |  |
| ***Source to WG:*** | Nokia |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** |  |  | ***Date:*** |  |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** |  |
|  | *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 canbe 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:*** | NR\_FR1\_lessthan\_5MHz\_BW core requirements maintenance CR. * Corrected T∆ for NR FR1-FR1 handover when SSB BW of the target cell is 12 PRB.
* Include changes from R4-2408662:
* Remove brackets from Table 8.1.2.1-3
* Remove brackets from Table 8.1.2.1-4
* Remove brackets from Table 8.5.2.1-2
* Remove brackets from Table 9.2.6.1-12
* Remove brackets from Table 9.3.4-11
* Remove brackets from Table 9.3.9.1-5
* Include change from R4-2409711:
* Clarification to T\_Delta in HO requirements.
* Include change from R4-2409260:
* Introduce same change as in R4-2406330 to FR2-FR1 HO.
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|  |  |
| ***Summary of change:*** | 1. T∆ = 3\*Trs if the target cell SSB BW is 12 PRBs for both known and unknown target cell.
2. Removing brackets related to NR\_FR1\_lessthan\_5MHz\_BW
3. Clarifying T∆ for handover requirements.
4. Introducing handover requirements fror
 |
|  |  |
| ***Consequences if not approved:*** | UE requirements when SSB BW is 12 PRBs for NR\_FR1\_lessthan\_5MHz\_BW are incomplete.  |
|  |  |
| ***Clauses affected:*** | 6.1.1.2.2, 8.1.2.1, 8.5.2.1, 9.2.6, 9.3.4, 9.3.9 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | This is the formal Big CR for the Draft BigCR R4-2406330 endorsed in RAN4#110bis meeting. The CR has been updated during RAN4#111. |

**<Start of change 1>**

6.1.1.2 NR FR1 - NR FR1 Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR FR1 cell to NR FR1 cell, and to inter-frequency handover from NR FR1 cell in a carrier frequency with CCA to NR FR1 cell.

6.1.1.2.1 Handover delay

When the UE receives a RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover msec from the end of the last TTI containing the RRC command.

Where:

Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1.1.2.2.

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

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

Where:

 Tsearch is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

 - If the target cell is a known intra-frequency cell, then Tsearch = 0ms.

 - If the target cell is an unknown intra-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = Trs ms.

- If the target cell is a known inter-frequency cell, then

- if the measured SSB is the target SSB for handover of the target cell, Tsearch = 0ms;

- if the measured SSB and the target SSB for handover belong to the same NR target cell and if the UE supports *ncd-SSB-BWP-Wor-r18*, Tsearch = Trs ms provided any one of the following conditions is satisfied:

- CD-SSB in initial DL BWP is the measured SSB and NCD-SSB in first active DL BWP is the target SSB for handover

- NCD-SSB in a DL BWP is the measured SSB and CD-SSB in initial DL BWP is the target SSB for handover

- Both measured SSB and the target SSB for handover are NCD-SSB within different DL BWPs

 - If the target cell is an unknown inter-frequency cell and Tsearch = 3\* Trs ms if the target cell Es/Iot≥-2 dB.

 T∆ is time for fine time tracking, acquiring full timing information, of the target cell.

* T∆ = Trs for both known and unknown target cells operating with 20 PRB SSB BW.
* T∆ = 3\*Trs for both known and unknown target cells operating with 12 PRB SSB BW.

 Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

 Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

 TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

 Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cellin the handover command, 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 clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

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.

**<Start of change 2>**

6.1.1.3.2 Interruption time

The interruption time is the time between the 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 inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

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

Where:

 Tsearch is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

- If the target cell is a known intra-frequency cell, then Tsearch = 0ms.

- If the target cell is an unknown intra-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = Trs ms.

- If the target cell is a known inter-frequency cell, then

- if the measured SSB is the target SSB for handover of the target cell, Tsearch = 0ms;

- if the measured SSB and the target SSB for handover belong to the same NR target cell and if the UE supports *ncd-SSB-BWP-Wor-r18*, Tsearch = Trs ms provided any one of the following conditions is satisfied:

- CD-SSB in initial DL BWP is the measured SSB and NCD-SSB in first active DL BWP is the target SSB for handover

- NCD-SSB in a DL BWP is the measured SSB and CD-SSB in initial DL BWP is the target SSB for handover

- Both measured SSB and the target SSB for handover are NCD-SSB within different DL BWPs

- If the target cell is an unknown inter-frequency cell and Tsearch = 3\* Trs ms if the target cell Es/Iot≥-2 dB.

 T∆ is time for fine time tracking and acquiring full timing information of the target cell.

- T∆ = Trs for both known and unknown target cells operating with 20 PRB SSB BW.

- T∆ = 3\*Trs for both known and unknown target cells operating with 12 PRB SSB BW.

 Tprocessing is time for UE processing. Tprocessing can be up to 40ms.

 Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

 TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

 Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cell in the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If such measObjectNRs 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 clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms.

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.

**<Start of change 3>**

8 Signalling characteristics

8.1 Radio Link Monitoring

8.1.2 Requirements for SSB based radio link monitoring

8.1.2.1 Introduction

**Table 8.1.2.1-3: PDCCH transmission parameters for out-of-sync evaluation** **for a UE operating on a cell with less than 5MHz BW**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER Configuration #0** |
| **Channel BW** | **3MHz** | **5MHz** |
| **[DL Transmission BW]** | **12 PRBs** |  **15 PRBs** |  **20 PRBs** |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 | 3 | 3 |
| Aggregation level (CCE) | 4 | 8 | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 4dB |
| Bandwidth (PRBs) | 12 | 15 | 20 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed | Non-DistributedNote 1 | Distributed |
| NOTE 1: For 15 PRB Transmission BW, distributed mapping may lead to unexpected out-of-sync indication. |

**Table 8.1.2.1-4: PDCCH transmission parameters for in-sync evaluation for a UE operating on a cell with less than 5MHz BW**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER Configuration #0** |
| **Channel BW** | **3MHz** | **5MHz** |
| **[DL Transmission BW]** | **12 PRBs** |  **15 PRBs** |  **20 PRBs** |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 | 3 | 3 |
| Aggregation level (CCE) | 2 | 4 | 4 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 12 | 15 | 20 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed | Non-Distributed | Distributed |

**<Start of change 4>**

8.5 Link Recovery Procedures

8.5.1 Introduction

8.5.2 Requirements for SSB based beam failure detection

8.5.2.1 Introduction

**Table 8.5.2.1-2: PDCCH transmission parameters for beam failure instance for a UE operating on a cell with less than 5MHz BW**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER**  |
| **Channel BW** | **3MHz** | **5MHz** |
| **[DL Transmission BW]** |  **12 PRBs** | **15 PRBs** | **20 PRBs** |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 | 3 | 3 |
| Aggregation level (CCE) | 4 | 8 Note 1 | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 12 | 15 | 20 |
| Sub-carrier spacing (kHz) | Same as the SCS of RMSI CORESET |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed | Non-DistributedNote2 | [Distributed] |
| NOTE 1: PDCCH puncturing as defined in 38.214 [26] applies.NOTE 2: For 15PRB Transmission BW, distributed mapping may lead to unexpected beam failure detection. |

**<Start of change 5>**

9 Measurement Procedure

9.2 NR intra-frequency measurements

9.2.6 Intra-frequency measurements with measurement gaps

**Table 9.2.6.1-12: Time period for time index detection for a UE operating on a target cell with 12 PRB SSB (Frequency range FR1) (Frequency range FR1)**

|  |  |
| --- | --- |
| **DRX cycle** | **TSSB\_time\_index\_intra\_less\_than\_5Mhz** |
| No DRX | max(120ms, 7 x max(MGRP, SMTC period)) x CSSFintra\_less\_than\_5Mhz |
| DRX cycle≤ 320ms | max(120ms, ceil(1.5 x 7) x max(MGRP, SMTC period,DRX cycle) x CSSFintra\_less\_than\_5Mhz) |
| DRX cycle>320ms | 7 x max(MGRP, DRX cycle) x CSSFintra\_less\_than\_5Mhz |
| Note 1: CSSFintra\_less\_than\_5Mhz is 1NOTE 2: FFS When *highSpeedMeasInterFreq-r17* |

**<Start of change 6>**

9.3 NR inter-frequency measurements

9.3.4 Inter-frequency measurement with measurement gaps

**Table 9.3.4-11: Time period for time index detection for a UE operating on a target cell with 12 PRB SSB (Frequency range FR1)**

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter\_less\_than\_5Mhz** |
| No DRX | Max(120ms, Ceil(6 \* Kgap)× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(6 × 1.5 \* Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(6\* Kgap)× DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: FFS When *highSpeedMeasInterFreq-r17* |

**<Start of change 7>**

9.3 NR inter-frequency measurements

9.3.9 Inter frequency measurements without measurement gaps

**Table 9.3.9.1-5: Time period for time index detection for a UE operating on a target cell with 12 PRB SSB (FR1)**

|  |  |
| --- | --- |
| **DRX cycle** | **TSSB\_time\_index\_inter\_less\_than\_5MHz** |
| No DRX | max(120ms, ceil( 6 x Kp )x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(120ms, ceil (M2 x 6 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | Ceil( 6 x Kp) x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: FFS When *highSpeedMeasInterFreq-r17*  |

**<End of changes>**