**3GPP TSG-WG4 Meeting # 111 *R4-240xxxx***

 **Fukuoka, Japan, May 20th – May 24th**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  | **38.133** | **CR** | **4445** | **rev** | **1** | **Current version:** | **18.5.0** |  |
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| *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:***  | CR clarifying the handover interruption time requirements  |
|  |  |
| ***Source to WG:*** | Nokia |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_BWP\_wor-Core |  | ***Date:*** | 2024-05-23 |
|  |  |  |  |  |
| ***Category:*** | D |  | ***Release:*** | Rel-18 |
|  | *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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** | Clarification of the interruption time requirements |
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| ***Summary of change:*** | When introducing the interruption time requirements for UEs supporting [FG 53-3]/*ncd-SSB-BWP-Wor-r18* some parts remained unclear. Following clarifications have been made:* Re-ordering the wording
* Removing Editor’s note related to a p1 with no mentioning in the paragraph
* Clarifying measured SSB and target SSB to avoid future confuson

Listing requirements applicable to UE supporting FG 53-3 clearly separated. |
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| ***Consequences if not approved:*** | Unclear specification with risk of future confusion. |
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| ***Clauses affected:*** | 6.1.1.2, 6.1.1.3, 6.1.1.4 and 6.1.1.5 |
|  |  |
|  | **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:*** | Resubmission of DraftCr R4-2405743 |
|  |  |
| ***This CR's revision history:*** |  |

## <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 operating with 12 PRB SSB bandwidth, then Tsearch = [3]\*Trs ms.

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

- For a UE supporting *ncd-SSB-BWP-Wor-r18*:

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

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

- if the measured SSB of the target cell and the target SSB of the handover target cell belong to the same NR target cell, Tsearch = Trs ms provided one of the following conditions is fulfilled:

- The measured SSB is the CD-SSB in the active DL BWP and the target SSB of the handover target cell is the NCD-SSB in the first active DL BWP, or

- The measured SSB is the NCD-SSB in the active DL BWP and target SSB of the handover target cell is the CD-SSB in the first active DL BWP, or

- The measured SSB is the NCD-SSB and the target SSB is the NCD-SSB of the handover target cell and both are within different DL BWPs

- If the target cell is an unknown inter-frequency cell operating with 12 PRB SSB bandwidth, then Tsearch = [5] \*Trs ms.

- 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 cell.

 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.

6.1.1.3 NR FR2- NR FR1 Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR2 cell to NR FR1 cell.

6.1.1.3.1 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  ms 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 6.1.1.3.2.

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.

- For a UE supporting *ncd-SSB-BWP-Wor-r18*:

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

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

- if the measured SSB of the target cell and the target SSB of the handover target cell belong to the same NR target cell, Tsearch = Trs ms provided one of the following conditions is fulfilled:

- The measured SSB is the CD-SSB in the active DL BWP and the target SSB of the handover target cell is the NCD-SSB in the first active DL BWP, or

- The measured SSB is the NCD-SSB in the active DL BWP and target SSB of the handover target cell is the CD-SSB in the first active DL BWP, or

- The measured SSB is the NCD-SSB and the target SSB is the NCD-SSB of the handover target cell and both are within different DL BWPs

- Otherwise, 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 cell.

 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.

6.1.1.4 NR FR2- NR FR2 Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR FR2 cell to NR FR2 cell.

6.1.1.4.1 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 ms 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 6.1.1.4.2.

6.1.1.4.2 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 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 = N\* Trs ms.

- For a UE supporting *ncd-SSB-BWP-Wor-r18*:

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

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

- if the measured SSB of the target cell and the target SSB of the handover target cell belong to the same NR target cell, Tsearch = Trs ms provided one of the following conditions is fulfilled:

- The measured SSB is the CD-SSB in the active DL BWP and the target SSB of the handover target cell is the NCD-SSB the in first active DL BWP, or

- The measured SSB is the NCD-SSB in the active DL BWP and the target SSB of the handover target cell is the CD-SSB in the first active DL BWP, or

- The measured SSB is the NCD-SSB and the target SSB is the NCD-SSB of the handover target cell and both are within different DL BWPs

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

Where N = 8 when the target cell is in FR2-1, and N = 12 when the target cell is in FR2-2.

 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.

 T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = Trs for both known and unknown target cell.

 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. 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 FR2, the target cell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the handover command:

- the UE has sent a valid measurement report for the target cell and

- One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.2 for intra-frequency cell and in clause 9.3 for inter-frequency cell,

- One of the SSBs measured from the target cell also remains detectable during the handover delay according to the cell identification conditions specified in clause 9.2 for intra-frequency cell and in clause 9.3 for inter-frequency cell.

otherwise it is unknown.

6.1.1.5 NR FR1- NR FR2 Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR1 cell to NR FR2 cell.

6.1.1.5.1 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 ms 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 6.1.1.5.2.

6.1.1.5.2 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 in 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 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 = N\* Trs ms.

- For a UE supporting *ncd-SSB-BWP-Wor-r18*:

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

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

- if the measured SSB of the target cell and the target SSB of the handover target cell belong to the same NR target cell, Tsearch = Trs ms provided one of the following conditions is fulfilled:

- The measured SSB is the CD-SSB in the active DL BWP and the target SSB of the handover target cell is the NCD-SSB in the first active DL BWP, or

- The measured SSB is the NCD-SSB in the active DL BWP and the target SSB of the handover target cell is the CD-SSB in the first active DL BWP, or

- The measured SSB is the NCD-SSB and the target SSB is the NCD-SSB of the handover of the target cell and both are within different DL BWPs

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

Where N = 8 when the target cell is in FR2-1, and N = 12 when the target cell is in FR2-2.

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

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

 T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = Trs for both known and unknown target cell.

 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 FR2, the target cell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the handover command:

- the UE has sent a valid measurement report for the target cell and

- One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.3,

- One of the SSBs measured from the target cell also remains detectable during the handover delay according to the cell identification conditions specified in clause 9.3.

otherwise it is unknown.

## <End of Change #1>