**3GPP TSG-RAN WG4 Meeting #112 R4-2411565**

**Maastricht, Netherland, Aug 19-23, 2024**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** | - | **Current version:** |  |  |
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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:***  | 38.133 CR on handover delays for NES-based CHO |
|  |  |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell, Huawei, Vivo? |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | Netw\_Energy\_NR-Core |  | ***Date:*** | 2024-8-23 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | In current specification, the measurement time delay for NES-based conditional handover is defined based on if the DCI 2-9 command comes before or after TEvent\_DU + Tidentify\_intra\_with\_index. For the case DCI 2-9 command comes after TEvent\_DU + Tidentify\_intra\_with\_index, the UE will execute handover immediately when receiving DCI 2-9 command.*For NES-based conditional intra-frequency handover:**- If UE successfully decodes DCI 2-9 command occurs earlier than TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, then the measurement time delay equal to Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index**- If UE successfully decodes DCI 2-9 command occurs later than TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, then the measurement time delay equals to the time from the end of Tevent\_DU until UE successfully decodes DCI 2-9 command.*However, the CHO condition may vary from time to time and the NES-based CHO condition may or may not be met when receiving the DCI 2-9 command. The NES-based CHO shall be executed only if the condition of NES-based CHO is met when receiving the DCI 2-9 command. This needs to be clarified in the spec.  |
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| ***Summary of change:*** | Clarify the condition for measurement time delay when UE UE successfully decodes DCI 2-9 command later than TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index. |
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| ***Consequences if not approved:*** | The NES-based conditional handover delay requirement is not correct. |
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| ***Clauses affected:*** | 6.1.4 |
|  |  |
|  | **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:*** |  |

<Start of Change 1>

#### 6.1.4 Introduction

The requirements in this clause are applicable to conditional handover to change the NR PCell to another NR cell.

#### 6.1.4.2 NR FR1 – NR FR1 conditional handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency conditional handover from NR FR1 cell to NR FR1 cell.

6.1.4.2.1 Handover delay

Procedure delays for all procedures that can command a conditional handover are specified in TS 38.331 [2].

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

 DCHO = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution

Where:

 TRRC is the RRC procedure delay defined in clause 12 in TS 38.331 [2].

 TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until

- a condition exists at the measurement reference point which will trigger the conditional handover, or

- a condition exists at the measurement reference point which will trigger the NES-based conditional handover

 Tmeasure is the measurements time stated in clause 6.1.4.2.2.

 TCHO\_execution is the conditional execution preparation time in clause 6.1.4.2.3.

 Tinterrupt is the interruption time stated in clause 6.1.4.2.4.

The NES-based conditional handover delay requirements shall apply if UE receives a RRC message implying conditional handover before receiving the NES indication in DCI 2-9 command.

UE is not expected to receive a NES indication in DCI 2-9 command before receiving a RRC message implying NES-based conditional handover. When UE receives a RRC message implying NES-based conditional handover but no NES indication in DCI 2-9 command no NES-based conditional handover requirement is applied. The NES indication is specified in clause [5.5.4] in TS 38.331 [2].

##### 6.1.4.2.2 Measurement time

The measurement time delay is defined from the end of TEvent\_DU until UE executes a handover to a target cell and interruption time starts.

For conditional intra-frequency handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.

For conditional inter-frequency handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index defined in clause 9.3.4 or clause 9.3.9.

For NES-based conditional intra-frequency handover:

- If UE successfully decodes DCI 2-9 command earlier than the time at the end of TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, then the measurement time delay equal to Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index

- If UE successfully decodes DCI 2-9 command later than the time at the end of TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, and the condition of NES-based CHO keeps existing till UE receiving the DCI 2-9 command, then the measurement time delay equals to the time from the end of Tevent\_DU until UE successfully decodes DCI 2-9 command.

- If UE successfully decodes DCI 2-9 command later than the time at the end of TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, and the condition of NES-based CHO is not met when receiving the DCI 2-9 command, then the measurement time delay equals to the time span from the end of TEvent\_DU until a condition keeps existing for TSSB measurement period\_intra which can fulfill the NES-based conditional handover.

For NES-based conditional inter-frequency handover:

- If UE successfully decodes DCI 2-9 command earlier than the time at the end of TEvent\_DU + Tidentify\_inter\_with\_index or TEvent\_DU + Tidentify\_inter\_without\_index, then the measurement time delay equal to Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index

- If UE successfully decodes DCI 2-9 command later than the time at the end of TEvent\_DU + Tidentify\_inter\_with\_index or TEvent\_DU + Tidentify\_inter\_without\_index, and the condition of NES-based CHO keeps existing till UE receiving the DCI 2-9 command, then the measurement time delay equals to the time from the end of Tevent\_DU until UE successfully decodes DCI 2-9 command.

- If UE successfully decodes DCI 2-9 command later than the time at the end of TEvent\_DU + Tidentify\_inter\_with\_index or TEvent\_DU + Tidentify\_inter\_without\_index, and the condition of NES-based CHO is not met when receiving the DCI 2-9 command, then the measurement time delay equals to the time span from the end of TEvent\_DU until a condition keeps existing for TSSB measurement period\_inter which can fulfill the NES-based conditional handover.

When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency handover or Tidentify\_inter\_without\_index for inter-frequency handover. If a cell which has been detectable at least for the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency handover or Tidentify\_inter\_without\_index for inter-frequency handover becomes undetectable for a period and then the cell becomes detectable again and triggers a handover, the measurement time delay shall be less than TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/$2^{µ}$ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

6.1.4.2.3 Preparation time

TCHO\_execution is the UE execution preparation time for conditional handover, and starts after UE realizes the condition of CHO is met and identity of the target cell is determined. TCHO\_execution can be up to 10ms.

6.1.4.2.4 Interruption time

The interruption time is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.

For intra-frequency or inter-frequency conditional conditional handover, the interruption time shall be less than

 Tinterrupt = Tprocessing + TIU + T∆ + Tmargin ms

Where:

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

 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]

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

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

 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 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.

NOTE 1: The actual value of TIU shall depend upon the PRACH configuration used in the target cell.

#### 6.1.4.3 NR FR2 – NR FR1 conditional handover

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

The requirements defined in clause 6.1.4.2 applies assuming inter-frequency handover and:

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

#### 6.1.4.4 NR FR2 – NR FR2 conditional handover

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

##### 6.1.4.4.1 Handover delay

Procedure delays for all procedures that can command a conditional handover are specified in TS 38.331 [2].

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

 DCHO = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution

Where:

 TRRC is the RRC procedure delay defined in clause 12 in TS 38.331 [2].

 TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until

- a condition exists at the measurement reference point which will trigger the conditional handover, or

- a condition exists at the measurement reference point which will trigger the NES-based conditional handover if NES-based conditional handover applies

 Tmeasure is the measurements time stated in clause 6.1.4.4.2.

 TCHO\_execution is the conditional execution preparation time in clause 6.1.4.4.3. Tinterrupt is the interruption time stated in clause 6.1.4.4.4.

The NES-based conditional handover delay requirements shall apply if UE receives a RRC message implying conditional handover before receiving the NES indication in DCI 2-9 command.

UE is not expected to receive a NES indication in DCI 2-9 command before receiving a RRC message implying NES-based conditional handover. When UE receives a RRC message implying NES-based conditional handover but no NES indication in DCI 2-9 command, no NES-based conditional handover requirement is applied. The NES indication is specified in clause [5.5.4] in TS 38.331 [2].

##### 6.1.4.4.2 Measurement time

The measurement time delay is defined from the end of TEvent\_DU until UE executes a handover to a target cell and interruption time starts.

For conditional intra-frequency handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.

For conditional inter-frequency handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index defined in clause 9.3.4 or clause 9.3.9.

For NES-based conditional intra-frequency handover:

- If UE successfully decodes DCI 2-9 command occurs earlier than the time at the end of TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, then the measurement time delay equal to Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index

* If UE successfully decodes DCI 2-9 command occurs later than the time at the end of TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, and the condition of NES-based CHO keeps existing till UE receiving the DCI 2-9 command, then the measurement time delay equals to the time from the end of Tevent\_DU until UE successfully decodes DCI 2-9 command.
* If UE successfully decodes DCI 2-9 command later than the time at the end of TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, and the condition of NES-based CHO is not met when receiving the DCI 2-9 command, then the measurement time delay equals to the time span from the end of TEvent\_DU until a condition keeps existing for TSSB measurement period\_intra which can fulfill the NES-based conditional handover.

For NES-based conditional inter-frequency handover:

- If UE successfully decodes DCI 2-9 command occurs earlier than the time at the end of TEvent\_DU + Tidentify\_inter\_with\_index or TEvent\_DU + Tidentify\_inter\_without\_index, then the measurement time delay equal to Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index

- If UE successfully decodes DCI 2-9 command occurs later than the time at the end of TEvent\_DU + Tidentify\_inter\_with\_index or TEvent\_DU + Tidentify\_inter\_without\_index, and the condition of NES-based CHO keeps existing till UE receiving the DCI 2-9 command, then the measurement time delay equals to the time from the end of Tevent\_DU until UE successfully decodes DCI 2-9 command.

- If UE successfully decodes DCI 2-9 command later than the time at the end of TEvent\_DU + Tidentify\_inter\_with\_index or TEvent\_DU + Tidentify\_inter\_without\_index, and the condition of NES-based CHO is not met when receiving the DCI 2-9 command, then the measurement time delay equals to the time span from the end of TEvent\_DU until a condition keeps existing for TSSB measurement period\_inter which can fulfill the NES-based conditional handover.

When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency handover or Tidentify\_inter\_without\_index for inter-frequency handover. If a cell which has been detectable at least for the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency handover or Tidentify\_inter\_without\_index for inter-frequency handover becomes undetectable for a period and then the cell becomes detectable again and triggers a handover, the measurement time delay shall be less than TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/$2^{µ}$ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

##### 6.1.4.4.3 Preparation time

TCHO\_execution is the UE execution preparation time for conditional handover, and starts after UE realizes the condition of CHO is met and identity of the target cell is determined. TCHO\_execution can be up 10ms.

##### 6.1.4.4.4 Interruption time

The interruption time is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.

For intra-frequency or inter-frequency conditional conditional handover, the interruption time shall be less than

 Tinterrupt = Tprocessing + TIU + T∆ + Tmargin ms

Where:

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

 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]

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

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

 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 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.

NOTE 1: The actual value of TIU shall depend upon the PRACH configuration used in the target cell.

#### 6.1.4.5 NR FR1 – NR FR2 conditional handover

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

The requirements defined in clause 6.1.4.4 applies assuming inter-frequency handover and:

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

<End of Change 1>