**3GPP TSG-RAN WG2 Meeting #109e *draft-*R2-2001870**

**February 24th – 6th March 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **36.304** | **CR** | **0781** | **rev** | **1** | **Current version:** | **15.5.0** |  |
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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 | **x** | Core Network |  |

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| ***Title:***  | Introduction of Rel-16 eMTC enhancements |
|  |  |
| ***Source to WG:*** | Nokia |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | LTE\_eMTC5-Core |  |  | 2020-03-10 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-16 |
|  | *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-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
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| ***Reason for change:*** | To capture the agreements of RAN2-107bis and RAN2-108 for Rel-16 eMTC enhancements. |
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| ***Summary of change:*** | Section 5.2.3.2* New criteria is added for the condition for UE to consider itself in enhanced coverage based on SIB1 and SIB1-BR acquisition status.

Section 5.3.2* Additional condition to reconsider the same cell for selection if it was barred due to unable to acquire SIB1 and SIB-1 BR and SIB-2 can be acquired in the cell.

Section 5.2.4.6a* Clarification on reselection behaviour for UE considering itself in enhanced coverage but satsifying the S criteria for normal coverage.

Section 7.1* Modification to DRX cycle to be used for RRC-INACTIVE.

Section 7.3* Changes for eDRX section for UE with 5GC connection.
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| ***Consequences if not approved:*** | Rel-16 additional enhancements for eMTC is not captured in the specification |
|  |  |
| ***Clauses affected:*** | 5.2.3.2, 5.3.1,5.2.4.6a,7.1 ,7.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 36.331 CR 4191 |
| ***affected:*** | **X** |  |  Test specifications | TS 36.306 CR 1267 |
| ***(show related CRs)*** |  | **X** |  O&M Specifications |  |
|  |  |
| ***Other comments:*** |  |

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| ***This CR's revision history:*** | R2-1914050 Initial version -RAN2-107bis agreements.R2-1916365 Version-2 : capturing agreements on eDRX paging reception for 5GC connectivity.R2-2001167: CR based on latest running CRR2-2001870: Update for RAN2-109e meeting agreements. |

First Change

#### 5.2.3.2 Cell Selection Criterion

For NB-IoT the cell selection criterion is defined in sub-clause 5.2.3.2a.

The cell selection criterion S in normal coverage is fulfilled when:

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| Srxlev > 0 AND Squal > 0 |

where:

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| Srxlev = Qrxlevmeas – (Qrxlevmin + Qrxlevminoffset) – Pcompensation - QoffsettempSqual = Qqualmeas – (Qqualmin + Qqualminoffset) - Qoffsettemp |

where:

|  |  |
| --- | --- |
| Srxlev | Cell selection RX level value (dB) |
| Squal | Cell selection quality value (dB) |
| Qoffsettemp | Offset temporarily applied to a cell as specified in TS 36.331 [3] (dB) |
| Qrxlevmeas | Measured cell RX level value (RSRP) |
| Qqualmeas | Measured cell quality value (RSRQ) |
| Qrxlevmin | Minimum required RX level in the cell (dBm) |
| Qqualmin | Minimum required quality level in the cell (dB) |
| Qrxlevminoffset | Offset to the signalled Qrxlevmin taken into account in the Srxlev evaluation as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN TS 23.122 [5] |
| Qqualminoffset | Offset to the signalled Qqualmin taken into account in the Squal evaluation as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN TS 23.122 [5] |
| Pcompensation  | If the UE supports the *additionalPmax* in the *NS-PmaxList*, if present, in SIB1, SIB3 and SIB5:max(PEMAX1 –PPowerClass, 0) – (min(PEMAX2, PPowerClass) – min(PEMAX1, PPowerClass)) (dB);else:if PPowerClass is 14 dBm:max(PEMAX1 –(PPowerClass – Poffset), 0) (dB);else:max(PEMAX1 –PPowerClass, 0) (dB) |
| PEMAX1, PEMAX2 | Maximum TX power level an UE may use when transmitting on the uplink in the cell (dBm) defined as PEMAX in TS 36.101 [33]. PEMAX1 and PEMAX2 are obtained from the *p-Max* and the *NS-PmaxList* respectively in SIB1, SIB3 and SIB5 as specified in TS 36.331 [3]. |
| PPowerClass | Maximum RF output power of the UE (dBm) according to the UE power class as defined in TS 36.101 [33] |

The signalled values Qrxlevminoffset and Qqualminoffset are only applied when a cell is evaluated for cell selection as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN TS 23.122 [5]. During this periodic search for higher priority PLMN the UE may check the S criteria of a cell using parameter values stored from a different cell of this higher priority PLMN.

If cell selection criterion S in normal coverage is not fulfilled for a cell, UE shall consider itself to be in enhanced coverage if the cell selection criterion S for enhanced coverage is fulfilled, where:

|  |  |
| --- | --- |
| Qrxlevmin | UE applies coverage specific value Qrxlevmin\_CE (dBm) |
| Qqualmin | UE applies coverage specific value Qqualmin\_CE (dB) |

If cell selection criteria S in normal coverage is fulfilled for a cell, UE [may] consider itself to be in enhanced coverage if *SystemInformationBlockType1* cannot be acquired but UE is able to acquire *MasterInformationBlock, SystemInformationBlockType1-BR* and *SystemInformationBlockType2*.

If cell selection criterion S in normal coverage is not fulfilled for a cell and UE does not consider itself in enhanced coverage based on coverage specific values Qrxlevmin\_CE and Qqualmin\_CE, UE shall consider itself to be in enhanced coverage if UE supports CE Mode B and CE mode B is not restricted by upper layers and the cell selection criterion S for enhanced coverage is fulfilled, where:

|  |  |
| --- | --- |
| Qrxlevmin | UE applies coverage specific value Qrxlevmin\_CE1 (dBm) |
| Qqualmin | UE applies coverage specific value Qqualmin\_CE1 (dB) |

For the UE in enhanced coverage, coverage specific values Qrxlevmin\_CE and Qqualmin\_CE (orQrxlevmin\_CE1 and Qqualmin\_CE1)are only applied for the suitability check in enhanced coverage (i.e. not used for measurement and reselection thresholds).

Next Change

## 5.3 Cell Reservations and Access Restrictions

There are two mechanisms which allow an operator to impose cell reservations or access restrictions. The first mechanism uses indication of cell status and special reservations for control of cell selection and reselection procedures. The second mechanism, referred to as Access Control, shall allow preventing selected classes of users or ACDC categories from sending initial access messages for load control reasons. For Access Control based on Access Classes, at subscription, one or more Access Classes are allocated to the subscriber and stored in the USIM TS 22.011 [4]. For Access Control based on ACDC categories, at subscription at least four ACDC categories are allocated to the subscriber and stored in the ACDC MO TS 24.105 [31] or USIM TS 31.102 [32].

### 5.3.1 Cell status and cell reservations

Cell status and cell reservations are indicated in the *SystemInformationBlockType1* message (or *SystemInformationBlockType1-BR* message or *SystemInformationBlockType1-NB* message) TS 36.331 [3] by means of the following fields:

- *cellBarred* (IE type: "barred" or "not barred")
This field indicates if the cell is barred for connectivity to EPC.
This field is ignored by the UEs supporting *crs-IntfMitig* while *crs-IntfMitigEnabled* is included in SIB1.
This field is ignored by the BL UEs or UEs in CE supporting *ce-CRS-IntfMitig* while *crs-IntfMigitNumPRBs* is included in SIB1-BR.
In case of multiple EPC PLMNs indicated in SIB1/SIB1-BR, this field is common for all EPC PLMNs

- *cellBarred-5GC* (IE type: "barred" or "not barred")
This field indicates if the cell is barred for connectivity to 5GC.
This field is ignored if the UE does not support E-UTRA connected to 5GC or if the UE supports network-based CRS interference mitigation and *nw-BasedCRS-InterferenceMitigation* is included in *SystemInformationBlockType1*.
In case of multiple 5GC PLMNs indicated in SIB1, this field is common for all 5GC PLMNs.

- *cellReservedForOperatorUse* (IE type: "reserved" or "not reserved")
This field indicates if the cell is reserved for operator use.
This field is ignored by the UEs supporting *crs-IntfMitig* while *crs-IntfMitigEnabled* is included in SIB1.
This field is ignored by the BL UEs or UEs in CE supporting *ce-CRS-IntfMitig* while *crs-IntfMigitNumPRBs* is included in SIB1-BR.
In case of multiple EPC or 5GC PLMNs indicated in SIB1/SIB1-BR, this field is specified per EPC or 5GC PLMN.

- *cellBarred-CRS* (IE type: "barred" or "not barred")
This field indicates if the cell is barred for connectivity to EPC for UEs supporting network-based CRS interference mitigation.
*barred* means the cell is barred for UEs supporting *crs-IntfMitig* while *crs-IntfMitigEnabled* is included in SIB1. For BL UEs or UEs in CE capable of *ce-CRS-IntfMitig*, *barred* means the cell is barred while *crs-IntfMitigNumPRBs* is included in SIB1-BR.
This field is ignored by the UE if the UE does not support CRS interference mitigation or while *crs-IntfMitigConfig* is not included in SIB1 (SIB1-BR for BL UEs or UEs in CE).
In case of multiple PLMNs indicated in SIB1/SIB1-BR, this field is common for all PLMNs.

- *cellBarred-5GC-CRS* (IE type: "barred" or "not barred")
This field indicates if the cell is barred for connectivity to 5GC for UEs supporting network-based CRS interference mitigation.
This field is ignored if the UE does not support E-UTRA connected to 5GC or network-based CRS interference mitigation.
In case of multiple 5GC PLMNs indicated in SIB1, this field is common for all 5GC PLMNs.

- *cellReservedForOperatorUse-CRS* (IE type: "reserved" or "not reserved")
This field indicates if the cell is reserved for operator use for UEs supporting network-based CRS interference mitigation.
*reserved* means the cell is "reserved" for operator use for UEs supporting *crs-IntfMitig* while *crs-IntfMitigEnabled* is included in SIB1.
For BL UEs or UEs in CE capable of *ce-CRS-IntfMitig*, *reserved* means the cell is "reserved" for operator use while *crs-IntfMitigNumPRBs* is included in SIB1-BR.
This field is ignored if the UE does not support CRS interference mitigation or while *crs-IntfMitigConfig* is not included in SIB1 (SIB1-BR for BL UEs or UEs in CE).
In case of multiple PLMNs indicated in SIB1/SIB1-BR, this field is specified per PLMN.

The following description for handling of barred and reserved cells is per CN type. If the UE supports more than one CN type, the UE shall only exclude a cell as candidate for selection/reselection if it is excluded for both CN types.

NOTE: Fields *cellBarred-CRS* and *cellReservedForOperatorUse-CRS* are not indicated in *SystemInformationBlockType1-NB*

When cell status is indicated as "not barred" and "not reserved" for operator use,

- All UEs shall treat this cell as candidate during the cell selection and cell reselection procedures.

When cell status is indicated as "not barred" and "reserved" for operator use for any PLMN,

- UEs assigned to Access Class 11 or 15 operating in their HPLMN/EHPLMN shall treat this cell as candidate during the cell selection and reselection procedures if the field *cellReservedForOperatorUse* for that PLMN set to "reserved".

- UEs assigned to an Access Class in the range of 0 to 9, 12 to 14 shall behave as if the cell status is "barred" in case the cell is "reserved for operator use" for the registered PLMN or the selected PLMN.

NOTE: ACs 11, 15 are only valid for use in the HPLMN/ EHPLMN; ACs 12, 13, 14 are only valid for use in the home country TS 22.011 [4].

When cell status "barred" is indicated or to be treated as if the cell status is "barred",

- The UE is not permitted to select/reselect this cell, not even for emergency calls.

- The UE shall consider other cells for cell selection/reselection according to the following rule:

- If the cell is to be treated as if the cell status is "barred" due to being unable to acquire the *MasterInformationBlock (*or *MasterInformationBlock-NB),* the *SystemInformationBlockType1 (*or *SystemInformationBlockType1-BR* message or *SystemInformationBlockType1-NB),* or the *SystemInformationBlockType2 (*or *SystemInformationBlockType2-NB)*:

- the UE may exclude the barred cell as a candidate for cell selection/reselection for up to 300 seconds.

- the UE may select another cell on the same frequency if the selection criteria are fulfilled.

- the UE may select the same cell in normal coverage if the UE was barred in the cell due to being unable to acquire *MasterInformationBlock*, *SystemInformationBlockType1-BR*, or *SystemInformationBlockType2* in enhanced coverage, but was able to acquire *MasterInformationBlock*, *SystemInformationBlockType1*, and *SystemInformationBlockType2* in normal coverage, if the selection criteria are fulfilled.

- the UE may select the same cell in enhanced coverage if the UE was barred in the cell due to being unable to acquire MasterInformationBlock, SystemInformationBlockType1, or SystemInformationBlockType2 in normal coverage, but was able to acquire MasterInformationBlock, SystemInformationBlockType1-BR, and SystemInformationBlockType2, if the selection criteria are fulfilled.

- else

- If the cell is a CSG cell:

- the UE may select another cell on the same frequency if the selection/reselection criteria are fulfilled.

- else

- If the field *intraFreqReselection* in field *cellAccessRelatedInfo* in *SystemInformationBlockType1 (*or *SystemInformationBlockType1-BR* message or *SystemInformationBlockType1-NB)* message is set to "allowed", the UE may select another cell on the same frequency if re-selection criteria are fulfilled.

- The UE shall exclude the barred cell as a candidate for cell selection/reselection for 300 seconds.

- If the field *intraFreqReselection* in field *cellAccessRelatedInfo* in *SystemInformationBlockType1* (or *SystemInformationBlockType1-BR* message or *SystemInformationBlockType1-NB*) message is set to "not allowed" the UE shall not re-select a cell on the same frequency as the barred cell;

- The UE shall exclude the barred cell and the cells on the same frequency as a candidate for cell selection/reselection for 300 seconds.

The cell selection of another cell may also include a change of RAT or, if the previous and selected cell are both E-UTRA cells, a change of the CN type.

Next Change

#### 5.2.4.2 Measurement rules for cell re-selection

For NB-IoT measurement rules for cell re-selection is defined in sub-clause 5.2.4.2.a.

When evaluating Srxlev and Squal of non-serving cells for reselection purposes, the UE shall use parameters provided by the serving cell.

Following rules are used by the UE to limit needed measurements:

- If the serving cell fulfils Srxlev> SIntraSearchP and Squal > SIntraSearchQ, the UE may choose not to perform intra-frequency measurements.

- Otherwise, the UE shall perform intra-frequency measurements.

- The UE shall apply the following rules for E-UTRAN inter-frequencies and inter-RAT frequencies which are indicated in system information and for which the UE has priority provided as defined in 5.2.4.1:

- For an E-UTRAN inter-frequency or inter-RAT frequency with a reselection priority higher than the reselection priority of the current E-UTRA frequency the UE shall perform measurements of higher priority E-UTRAN inter-frequency or inter-RAT frequencies according to TS 36.133 [10].

- For an E-UTRAN inter-frequency with an equal or lower reselection priority than the reselection priority of the current E-UTRA frequency and for inter-RAT frequency with lower reselection priority than the reselection priority of the current E-UTRAN frequency:

- If the serving cell fulfils Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, the UE may choose not to perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority unless the UE is triggered to measure an E-UTRAN inter-frequency which is configured with *redistributionInterFreqInfo*.

- Otherwise,the UE shall perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority according to TS 36.133 [10].

- If the UE supports relaxed monitoring and *s-SearchDeltaP* is present in *SystemInformationBlockType3*, the UE may further limit the needed measurements, as specified in sub-clause 5.2.4.12.

#### 5.2.4.2a Measurement rules for cell re-selection for NB-IoT

When evaluating Srxlev and Squal of non-serving cells for reselection purposes, the UE shall use parameters provided by the serving cell.

Following rules are used by the UE to limit needed measurements:

- If the serving cell fulfils Srxlev> SIntraSearchP, the UE may choose not to perform intra-frequency measurements.

- Otherwise, the UE shall perform intra-frequency measurements.

- The UE shall apply the following rules for NB-IoT inter-frequencies which are indicated in system information:

- If the serving cell fulfils Srxlev > SnonIntraSearchP, the UE may choose not to perform inter-frequency measurements.

- Otherwise,the UE shall perform inter-frequency measurements.

- If the UE supports relaxed monitoring and *s-SearchDeltaP* is present in *SystemInformationBlockType3-NB*, the UE may further limit the needed measurements, as specified in sub-clause 5.2.4.12.

#### 5.2.4.3 Mobility states of a UE

Besides Normal-mobility state a High-mobility and a Medium-mobility state are applicable if the parameters (TCRmax, NCR\_H, NCR\_M, TCRmaxHyst and *cellEquivalentSize*) are sent in the system information broadcast of the serving cell.

**State detection criteria:**

Medium-mobility state criteria:

- If number of cell reselections during time period TCRmax exceeds NCR\_M and not exceeds NCR\_H

High-mobility state criteria:

- If number of cell reselections during time period TCRmax exceeds NCR\_H

The UE shall not count consecutive reselections between same two cells into mobility state detection criteria if same cell is reselected just after one other reselection. If the UE is capable of HSDN and the *cellEquivalentSize* is configured, the UE counts the number of cell reselections for this cell as *cellEquivalentSize* configured for this cell.

**State transitions:**

The UE shall:

- if the criteria for High-mobility state is detected:

- enter High-mobility state.

- else if the criteria for Medium-mobility state is detected:

- enter Medium-mobility state.

- else if criteria for either Medium- or High-mobility state is not detected during time period TCRmaxHys**t**:

- enter Normal-mobility state.

If the UE is in High- or Medium-mobility state, the UE shall apply the speed dependent scaling rules as defined in subclause 5.2.4.3.1.

##### 5.2.4.3.1 Scaling rules

UE shall apply the following scaling rules:

- If neither Medium- nor Highmobility state is detected:

- no scaling is applied.

- If High-mobility state is detected:

- Add the *sf-High* of "Speed dependent ScalingFactor for Qhyst" to Qhyst if sent on system information

- For E-UTRAN cells multiply TreselectionEUTRA by the *sf-High* of "Speed dependent ScalingFactor for TreselectionEUTRA" if sent on system information

- For UTRAN cells multiply TreselectionUTRA by the *sf-High* of "Speed dependent ScalingFactor for TreselectionUTRA" if sent on system information

- For GERAN cells multiply TreselectionGERA by the *sf-High* of "Speed dependent ScalingFactor for TreselectionGERA state" if sent on system information

- For CDMA2000 HRPD cells Multiply TreselectionCDMA\_HRPD by the *sf-High* of "Speed dependent ScalingFactor for TreselectionCDMA\_HRPD" if sent on system information

- For CDMA2000 1xRTT cells Multiply TreselectionCDMA\_1xRTT by the *sf-High* of "Speed dependent ScalingFactor for TreselectionCDMA\_1xRTT" if sent on system information

- For NR cells multiply TreselectionNR by the *sf-High* of "Speed dependent ScalingFactor for TreselectionNR" if sent on system information

- If Medium-mobility state is detected:

- Add the *sf-Medium* of "Speed dependent ScalingFactor for Qhyst" to Qhyst if sent on system information

- For E-UTRAN cells multiply TreselectionEUTRA by the *sf-Medium* of "Speed dependent ScalingFactor for TreselectionEUTRA" if sent on system information

- For UTRAN cells multiply TreselectionUTRA by the *sf-Medium* of "Speed dependent ScalingFactor for TreselectionUTRA" if sent on system information

- For GERAN cells multiply TreselectionGERA by the *sf-Medium* of "Speed dependent ScalingFactor for TreselectionGERA" if sent on system information

- For CDMA2000 HRPD cells Multiply TreselectionCDMA\_HRPD by the *sf-Medium* of "Speed dependent ScalingFactor for TreselectionCDMA\_HRPD" if sent on system information

- For CDMA2000 1xRTT cells Multiply TreselectionCDMA\_1xRTT by the *sf-Medium* of "Speed dependent ScalingFactor for TreselectionCDMA\_1xRTT" if sent on system information

- For NR cells multiply TreselectionNR by the *sf-Medium* of "Speed dependent ScalingFactor for TreselectionNR" if sent on system information

In case scaling is applied to any TreselectionRAT parameter the UE shall round up the result after all scalings to the nearest second.

#### 5.2.4.4 Cells with cell reservations, access restrictions or unsuitable for normal camping

For the highest ranked cell (including serving cell) according to cell reselection criteria specified in subclause 5.2.4.6, for the best cell according to absolute priority reselection criteria specified in subclause 5.2.4.5, the UE shall check if the access is restricted according to the rules in subclause 5.3.1.

If that cell and other cells have to be excluded from the candidate list, as stated in subclause 5.3.1, the UE shall not consider these as candidates for cell reselection. This limitation shall be removed when the highest ranked cell changes.

If the highest ranked cell or best cell according to absolute priority reselection rules is an intra-frequency or inter-frequency cell which is not suitable for a CN type due to being part of the "list of forbidden TAs for roaming" or belonging to a PLMN which is not indicated as being equivalent to the registered PLMN, the UE shall not consider this cell and other cells on the same frequency, as candidates for reselection for the CN type for a maximum of 300s. If the UE enters into state *any cell selection*, any limitation shall be removed. If the UE is redirected under E-UTRAN control to a frequency for which the timer is running, any limitation on that frequency shall be removed.

If the highest ranked cell or best cell according to absolute priority reselection rules is an inter-RAT cell which is not suitable due to being part of the "list of forbidden TAs for roaming" or belonging to a PLMN which is not indicated as being equivalent to the registered PLMN, the UE shall not consider this cell and other cells on the same frequency as candidates for reselection for a maximum of 300s. In case of UTRA further requirements are defined in the TS 25.304 [8]. In case of NR further requirements are defined in the TS 38.304 [38]. If the UE enters into state *any cell selection*, any limitation shall be removed. If the UE is redirected under E-UTRAN control to a frequency for which the timer is running, any limitation on that frequency shall be removed.

If the highest ranked cell or best cell according to absolute priority reselection rules is a CSG cell which is not suitable due to not being a CSG member cell, the UE shall not consider this cell as candidate for cell reselection but shall continue considering other cells on the same frequency for cell reselection.

#### 5.2.4.5 E-UTRAN Inter-frequency and inter-RAT Cell Reselection criteria

For NB-IoT inter-frequency cell reselection shall be based on ranking as defined in sub-clause 5.2.4.6.

If *threshServingLowQ* is provided in *SystemInformationBlockType3* and more than 1 second has elapsed since the UE camped on the current serving cell, cell reselection to a cell on a higher priority E-UTRAN frequency or inter-RAT frequency than the serving frequency shall be performed if:

- A cell of a higher priority EUTRAN, NR or UTRAN FDD RAT/ frequency fulfils Squal > ThreshX, HighQ during a time interval TreselectionRAT; or

- A cell of a higher priority UTRAN TDD, GERAN or CDMA2000 RAT/ frequency fulfils Srxlev > ThreshX, HighP during a time interval TreselectionRAT.

Otherwise, cell reselection to a cell on a higher priority E-UTRAN frequency or inter-RAT frequency than the serving frequency shall be performed if:

- A cell of a higher priority RAT/ frequency fulfils Srxlev > ThreshX, HighP during a time interval TreselectionRAT; and

- More than 1 second has elapsed since the UE camped on the current serving cell.

Cell reselection to a cell on an equal priority E-UTRAN frequency shall be based on ranking for Intra-frequency cell reselection as defined in sub-clause 5.2.4.6.

If *threshServingLowQ* is provided in *SystemInformationBlockType3* and more than 1 second has elapsed since the UE camped on the current serving cell, cell reselection to a cell on a lower priority E-UTRAN frequency or inter-RAT frequency than the serving frequency shall be performed if:

- The serving cell fulfils Squal < ThreshServing, LowQ and a cell of a lower priority EUTRAN, NR or UTRAN FDD RAT/ frequency fulfils Squal > ThreshX, LowQ during a time interval TreselectionRAT; or

- The serving cell fulfils Squal < ThreshServing, LowQ and a cell of a lower priority UTRAN TDD, GERAN or CDMA2000 RAT/ frequency fulfils Srxlev > ThreshX, LowP during a time interval TreselectionRAT.

Otherwise, cell reselection to a cell on a lower priority E-UTRAN frequency or inter-RAT frequency than the serving frequency shall be performed if:

- The serving cell fulfils Srxlev < ThreshServing, LowP and a cell of a lower priority RAT/ frequency fulfils Srxlev > ThreshX, LowP during a time interval TreselectionRAT; and

- More than 1 second has elapsed since the UE camped on the current serving cell.

Cell reselection to a higher priority RAT/ frequency shall take precedence over a lower priority RAT/ frequency, if multiple cells of different priorities fulfil the cell reselection criteria.

The UE shall not perform cell reselection to NR or UTRAN FDD cells for which the cell selection criterion S is not fulfilled.

For cdma2000 RATs, Srxlev is equal to -FLOOR(-2 x 10 x log10 Ec/Io) in units of 0.5 dB, as defined in [18], with Ec/Io referring to the value measured from the evaluated cell.

For cdma2000 RATs, ThreshX, HighP and ThreshX, LowP are equal to -1 times the values signalled for the corresponding parameters in the system information.

In all the above criteria the value of TreselectionRAT is scaled when the UE is in the medium or high mobility state as defined in subclause 5.2.4.3.1. If more than one cell meets the above criteria, the UE shall reselect a cell as follows:

- If the highest-priority frequency is an E-UTRAN frequency, a cell ranked as the best cell among the cells on the highest priority frequency(ies) meeting the criteria according to clause 5.2.4.6;

- If the highest-priority frequency is from another RAT, a cell ranked as the best cell among the cells on the highest priority frequency(ies) meeting the criteria of that RAT.

Cell reselection to another RAT, for which Squal based cell reselection parameters are broadcast in system information, shall be performed based on the Squal criteria if the UE supports Squal (RSRQ) based cell reselection to E-UTRAN from all the other RATs provided by system information which UE supports. Otherwise, cell reselection to another RAT shall be performed based on Srxlev criteria.

Cell reselection to NR, for which a cell reselection parameter, *q-RxLevMinSUL* is broadcast in system information and the UE supports SUL, shall be performed based on Srxlev criteria taking the parameter into account.

#### 5.2.4.6 Intra-frequency and equal priority inter-frequency Cell Reselection criteria

The cell-ranking criterion Rs for serving cell and Rn for neighbouring cells is defined by:



where:

|  |  |
| --- | --- |
| Qmeas | RSRP measurement quantity used in cell reselections. |
| Qoffset | For intra-frequency: Equals to Qoffsets,n, if Qoffsets,n is valid, otherwise this equals to zero.For inter-frequency:Except for NB-IoT, equals to Qoffsets,n plus Qoffsetfrequency, if Qoffsets,n is valid, otherwise this equals to Qoffsetfrequency.For NB-IoT equals to QoffsetDedicatedfrequency for any frequency other than the frequency of the dedicated frequency offset, if QoffsetDedicatedfrequency is valid, otherwise this equals to Qoffsetfrequency (if QoffsetDedicatedfrequency is valid Qoffsetfrequency is not used). |
| Qoffsettemp | Offset temporarily applied to a cell as specified in TS 36.331 [3] |
| QoffsetSCPTM | Offset temporarily applied to an SC-PTM frequency as specified below. The offset is applied to all cells on the SC-PTM frequency. If QoffsetSCPTM is valid, Qoffset for inter-frequency neighbour cells is not used. |

If the NB-IoT UE or UE in enhanced coverage is capable of SC-PTM reception and is receiving or interested to receive an MBMS service and can only receive this MBMS service while camping on a frequency on which it is provided (SC-PTM frequency), the UE considers QoffsetSCPTM to be valid during the MBMS session TS 36.300 [2] as long as the following condition is fulfilled:

Either:

- SIB15 (or SIB15-NB) of the serving cell indicates for that frequency one or more MBMS SAIs included in the MBMS User Service Description (USD) TS 26.346 [22] of this service; or

- SIB15 (or SIB15-NB) is not broadcast in the serving cell and that frequency is included in the USD of this service.

NOTE: UE should search for a higher ranked cell on another frequency for cell reselection as soon as possible after the UE stops using QoffsetSCPTM.

The UE shall perform ranking of all cells that fulfil the cell selection criterion S, which is defined in 5.2.3.2 (5.2.3.2a for NB-IoT), but may exclude all CSG cells that are known by the UE not to be CSG member cells.

The cells shall be ranked according to the R criteria specified above, deriving Qmeas,n and Qmeas,s and calculating the R values using averaged RSRP results.

If a cell is ranked as the best cell the UE shall perform cell reselection to that cell. If this cell is found to be not-suitable, the UE shall behave according to subclause 5.2.4.4.

In all cases, the UE shall reselect the new cell, only if the following conditions are met:

- the new cell is better ranked than the serving cell during a time interval TreselectionRAT;

- more than 1 second has elapsed since the UE camped on the current serving cell.

When the UE uses infinite dBs for QoffsetSCPTM, the UE shall use QoffsetSCPTM zero and rank the cells on the SC-PTM frequency(ies) only first. If the UE cannot find a suitable cell on an SC-PTM frequency, the UE shall rank the cells on all frequencies.

#### 5.2.4.6a Reselection for enhanced coverage

Ranking as defined in sub-clause 5.2.4.6 is applied for intra-frequency and inter-frequency cell reselection (irrespective of configured frequency priorities, if any) while the UE is in enhanced coverage.

If a UE considers itself to be in enhanced coverage when S criteria for normal coverage is fulfilled, the absolute priority reselection cell reselection criteria as defined in sub-clause 5.2.4.5 is applied for inter-frequency cell reselection.

Next Change

## 7.1 Discontinuous Reception for paging

The UE may use Discontinuous Reception (DRX) in idle mode in order to reduce power consumption. One Paging Occasion (PO) is a subframe where there may be P-RNTI transmitted on PDCCH or MPDCCH or, for NB-IoT on NPDCCH addressing the paging message. In P-RNTI transmitted on MPDCCH case, PO refers to the starting subframe of MPDCCH repetitions. In case of P-RNTI transmitted on NPDCCH, PO refers to the starting subframe of NPDCCH repetitions unless subframe determined by PO is not a valid NB-IoT downlink subframe then the first valid NB-IoT downlink subframe after PO is the starting subframe of the NPDCCH repetitions. The paging message is same for both RAN initiated paging and CN initiated paging.

The UE initiates RRC Connection Resume procedure upon receiving RAN paging. If the UE receives a CN initiated paging in RRC\_INACTIVE state, the UE moves to RRC\_IDLE and informs NAS.

One Paging Frame (PF) is one Radio Frame, which may contain one or multiple Paging Occasion(s). When DRX is used the UE needs only to monitor one PO per DRX cycle.

One Paging Narrowband (PNB) is one narrowband, on which the UE performs the paging message reception.

PF, PO, and PNB are determined by following formulae using the DRX parameters provided in System Information:

PF is given by following equation:

SFN mod T= (T div N)\*(UE\_ID mod N)

Index i\_s pointing to PO from subframe pattern defined in 7.2 will be derived from following calculation:

i\_s = floor(UE\_ID/N) mod Ns

If P-RNTI is monitored on MPDCCH, the PNB is determined by the following equation:

PNB = floor(UE\_ID/(N\*Ns)) mod Nn

If P-RNTI is monitored on NPDCCH and the UE supports paging on a non-anchor carrier, and if paging configuration for non-anchor carrier is provided in system information, then the paging carrier is determined by the paging carrier with smallest index n (0 ≤ n ≤ Nn-1) fulfilling the following equation:

floor(UE\_ID/(N\*Ns)) mod W < W(0) + W(1) + … + W(n)

System Information DRX parameters stored in the UE shall be updated locally in the UE whenever the DRX parameter values are changed in SI. If the UE has no IMSI, for instance when making an emergency call without USIM, the UE shall use as default identity UE\_ID = 0 in the PF, i\_s, and PNB formulas above. If the UE has no 5G-S-TMSI, for instance when the UE has not yet registered onto the network, the UE shall use as default identity UE\_ID = 0 in the PF and i\_s formulas above.

The following Parameters are used for the calculation of the PF, i\_s, PNB, and the NB-IoT paging carrier:

- T: DRX cycle of the UE. Except for NB-IoT, if a UE specific extended DRX value of 512 radio frames is configured by upper layers according to 7.3, T =512. Otherwise, T is determined by the shortest of the UE specific DRX value, if allocated by upper layers, and a default DRX value broadcast in system information. If UE specific DRX is not configured by upper layers, the default value is applied. UE specific DRX is not applicable for NB-IoT. In RRC\_INACTIVE state, if extended DRX is not configured by upper layers as defined in 7.3 T is determined by the shortest of the RAN paging cycle, the UE specific paging cycle, and the default paging cycle, if allocated by upper layers. Otherwise, in RRC\_INACTIVE state when extended DRX is configured by upper layers, T is determined by the shortest of the RAN paging cycle, the UE specific paging cycle, if allocated by upper layers and the default paging cycle during the PTW as defined in 7.3, and by the RAN paging cycle outside the PTW.

- nB: 4T, 2T, T, T/2, T/4, T/8, T/16, T/32, T/64, T/128, and T/256, and for NB-IoT also T/512, and T/1024.

- N: min(T,nB)

- Ns: max(1,nB/T)

- Nn : number of paging narrowbands (for P-RNTI monitored on MPDCCH) or paging carriers (for P-RNTI monitored on NPDCCH) provided in system information

- UE\_ID:

If the UE supports E-UTRA connected to 5GC and NAS indicated to use 5GC for the selected cell:

5G-S-TMSI mod 1024, if P-RNTI is monitored on PDCCH.

else

IMSI mod 1024, if P-RNTI is monitored on PDCCH.

IMSI mod 4096, if P-RNTI is monitored on NPDCCH.

IMSI mod 16384, if P-RNTI is monitored on MPDCCH or if P-RNTI is monitored on NPDCCH and the UE supports paging on a non-anchor carrier, and if paging configuration for non-anchor carrier is provided in system information.

- W(i): Weight for NB-IoT paging carrier i.

- W: Total weight of all NB-IoT paging carriers, i.e. W = W(0) + W(1) + … + W(Nn-1).

IMSI is given as sequence of digits of type Integer (0..9), IMSI shall in the formulae above be interpreted as a decimal integer number, where the first digit given in the sequence represents the highest order digit.

For example:

 IMSI = 12 (digit1=1, digit2=2)

In the calculations, this shall be interpreted as the decimal integer "12", not "1x16+2 = 18".

5G-S-TMSI is a 48 bit long bit string as defined in TS 23.501 [39]. 5G-S-TMSI shall in the PF and i\_s formulae above be interpreted as a binary number where the left most bit represents the most significant bit.

Next Change

## 7.3 Paging in extended DRX

The UE may be configured by upper layers with an extended DRX (eDRX) cycle TeDRX. Except for NB-IoT, the UE may operate in extended DRX only if the UE is configured by upper layers and the cell indicates support for eDRX in System Information. For NB-IoT, the UE may operate in extended DRX only if the UE is configured by upper layers. If the UE is configured with a TeDRX cycle of 512 radio frames, it monitors POs as defined in 7.1 with parameter T = 512. Otherwise, a UE configured with eDRX monitors POs as defined in 7.1 (i.e, based on the upper layer configured DRX value and a default DRX value determined in 7.1 or if the UE is in RRC-INACTIVE based on the upper layer configured DRX value,default DRX cycle and RAN paging cycle determined in 7.1), during a periodic Paging Time Window (PTW) configured for the UE or until a paging message including the UE's NAS identity is received for the UE during the PTW, whichever is earlier. The PTW is UE-specific and is determined by a Paging Hyperframe (PH), a starting position within the PH (PTW\_start) and an ending position (PTW\_end). PH, PTW\_start and PTW\_end are given by the following formulae:

The PH is the H-SFN satisfying the following equation:

H-SFN mod TeDRX,H= (UE\_ID\_H mod TeDRX,H), where

- UE\_ID\_H:

- 10 most significant bits of the Hashed ID, if P-RNTI is monitored on PDCCH or MPDCCH

- 12 most significant bits of the Hashed ID, if P-RNTI is monitored on NPDCCH

- T eDRX,H : eDRX cycle of the UE in Hyper-frames, (TeDRX,H =1, 2, …, 256 Hyper-frames) (for NB-IoT, TeDRX,H =2, …, 1024 Hyper-frames) and configured by upper layers.

PTW\_start denotes the first radio frame of the PH that is part of the PTW and has SFN satisfying the following equation:

SFN = 256\* ieDRX, where

- ieDRX = floor(UE\_ID\_H /TeDRX,H) mod 4

PTW\_end is the last radio frame of the PTW and has SFN satisfying the following equation:

SFN = (PTW\_start + L\*100 - 1) mod 1024, where

- L = Paging Time Window length (in seconds) configured by upper layers

Hashed ID is defined as follows:

Hashed\_ID is Frame Check Sequence (FCS) for the bits b31, b30…, b0 of S-TMSI or 5G-S-TMSI. 5G-S-TMSI is used for Hashed-ID if the UE supports connection to 5GC and NAS indicated to use 5GC for the selected cell.

S-TMSI = <b39, b38, …, b0> as defined in TS 23.003 [35]

5G-S-TMSI = <b47, b46, …, b0> as defined in TS 23.003 [35].

The 32-bit FCS shall be the ones complement of the sum (modulo 2) of Y1 and Y2, where

- Y1 is the remainder of xk (x31 + x30 + x29 + x28 + x27 + x26 + x25 + x24 + x23 + x22 + x21 + x20 + x19 + x18 + x17 + x16 + x15 + x14 + x13 + x12 + x11 + x10 + x9 + x8 + x7 + x6 + x5 + x4 + x3 + x2 + x1 + 1) divided (modulo 2) by the generator polynomial x32 + x26 + x23 + x22 + x16 + x12 + x11 + x10 + x8 + x7 + x5 + x4 + x2 + x + 1, where k is 32; and

- Y2 is the remainder of Y3 divided (modulo 2) by the generator polynomial x32 + x26 + x23 + x22 + x16 + x12 + x11 + x10 + x8 + x7 + x5 + x4 + x2 + x + 1, where Y3 is the product of x32 by "b31, b30…, b0 of S-TMSI or 5G-S-TMSI", i.e., Y3 is the generator polynomial x32 (b31\*x31 + b30\*x30 + … + b0\*1).

NOTE: The Y1 is 0xC704DD7B for any S-TMSI or 5G-S-TMSI value. An example of hashed ID calculation is in Annex B.

End of changes