**3GPP TSG-RAN WG2 Meeting #116bis-e *R2-2203581***

**Online, 17 - 25 Jan 2022**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **36.304** | **CR** | **0844** | **rev** | **1** | **Current version:** | **16.5.0** |  |
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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 Enhancements for NB-IoT/eMTC | | | | | | | | | |
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| ***Source to WG:*** | Nokia | | | | | | | | | |
| ***Source to TSG:*** | RAN2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NB\_IOTenh4\_LTE\_eMTC6-Core | | | | |  | ***Date:*** | | | 2022-02-22 |
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| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
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| ***Reason for change:*** | | Introduce Release 17 enhancements for NB-IoT and eMTC | | | | | | | | |
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| ***Summary of change:*** | | Introduce Rel-17 enhancement for NB-IoT and eMTC for the following   * Coverage based paging carrier selection. | | | | | | | | |
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| ***Consequences if not approved:*** | | Release 17 enhancements for NB-IoT and eMTC will not be supported. | | | | | | | | |
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| ***Clauses affected:*** | | 7.1, 7.X (New) | | | | | | | | |
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|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 36.300 CR 1354,  TS 36.306 CR 1841,  TS 36.321 CR xxxx,  TS 36.331 CR 4760 | | |
| ***affected:*** | |  |  | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  |  | O&M Specifications | | | | TS/TR ... CR ... | | |
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| ***Other comments:*** | |  | | | | | | | | |
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| ***This CR's revision history:*** | | R2-2200058 – Initial version.  R2-2201791 – V1  R2-2203756 –Incorporation of further comments until RAN2-117e (not endorsed) | | | | | | | | |

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| Start of first change |

# 7 Paging

## 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:

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, wg, and the NB-IoT paging carrier:

- T: DRX cycle of the UE.

In RRC\_IDLE state:

- 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.

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, if configured, the UE specific paging cycle, if allocated by upper layers, and the default paging cycle.

In RRC\_INACTIVE state if extended DRX is configured by upper layers according to 7.3:

- If a UE specific extended DRX value of 512 radio frames is configured, T is determined by the shortest of the RAN paging cycle, if configured, and 512 radio frames.

- If a UE specific extended DRX value other than 512 radio frames is configured:

- During the PTW, T is determined by the shortest of the RAN paging cycle, if configured, the UE specific paging cycle, if allocated by upper layers, and the default paging cycle. Outside the PTW, T is determined by the RAN paging cycle, if configured.

In RRC\_INACTIVE state, a BL UE or a UE in enhanced coverage uses the T value applicable for RRC\_IDLE state for the determination of PNB and i\_s.

For NB-IoT: If the UE has selected a paging carrier from the coverage-based paging carrier group determined according to clause 7.x and UE specific DRX value is allocated by upper layers, T = min (default DRX value, max (UE specific DRX value, *ue-SpecificDRX-CycleMin-r17* value configured for the corresponding coverage-based paging carrier group)). Otherwise if UE specific DRX value is allocated by upper layers and minimum UE specific DRX value is broadcast in system information, T = min (default DRX value, max (UE specific DRX value, *ue-SpecificDRX-CycleMin-r16*)). If UE specific DRX is not configured by upper layers or if the minimum UE specific DRX value is not broadcast in system information, the default DRX value is applied.

- 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. If the UE has selected paging carrier configured from the coverage-based paging carrier group, it is nB value configured for the coverage-based paging carrier group.

- N: min(T,nB)

- Ns: max(1,nB/T)

- Nn: number of paging narrowbands (for P-RNTI monitored on MPDCCH) or paging carriers configured without coverage-based paging carrier selection (for P-RNTI monitored on NPDCCH) if the UE is not configured for coverage-based paging carrier selection . If the UE is configured for coverage-based paging carrier selection, it is the number of paging carriers determined according to clause 7.X.

If UE monitors GWUS according to clause 7.5.1:

this is the number of paging narrowbands (paging carriers) that are configured with GWUS.

else:

this is the number of paging narrowbands (paging carriers) 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.

5G-S-TMSI mod 16384, if P-RNTI is monitored on NPDCCH or MPDCCH.

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). If UE monitors GWUS according to clause 7.5.1, Total weight of all NB-IoT paging carriers configured with GWUS.

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.

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| Next Change |

## 7.X Coverage based paging carrier selection

Coverage-based paging carrier selection is only used in the cell in which the UE most recently entered RRC-IDLE triggered by:

- reception of *RRCEarlyDataComplete* or *RRCConnectionRelease*.

- and the message includes *cbpcg-Config*

Coverage-based carrier selection is enabled when at least one DL carrier in *dl-CarrierConfigList* isconfiguredwith *cbpcg-Index.*

When coverage-based carrier selection is used, the UE shall:

- if *cbpc-HystTimer* is not running:

- if Srxlev > *cbpcg-Threshold* in *cbpcg-ConfigList* indexed by value of *cbpcg-Config*:

- use the list of DL carriers in *dl-CarrierConfigList* configured with *pcch-Config-r17* andwith *cbpcg-Index* equal to the value of *cbpcg-Config*.

- else:

- use the list of DL carriers in *dl-CarrierConfigList* configured with *pcch-Config-r14* for carrier selection as described in clause 7.1.

- else:

- continue using the same DL carriers as previously selected as described in clause 7.1.

- when UE switches between paging carriers configured with *pcch-Config-r14* andpaging carriers configured with *pcch-Config-r17* forcarrier selection:

- start *cbpc-HystTimer*;

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| End of Changes |