**3GPP TSG-RAN2 Meeting #114-e *R2-210xxxx***

**Online, 19th May 2021 - 27th May 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **36.304** | **CR** | **0830** | **rev** | **1** | **Current version:** | **16.3.0** |  |
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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:***  | Clarifications on paging DRX cycle |
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| ***Source to WG:*** | , Qualcomm Incorporated |
| ***Source to TSG:*** | RAN2 |
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| ***Work item code:*** | LTE\_eMTC5-Core |  | ***Date:*** | 2021-05-xx |
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| ***Category:*** | **F** |  | ***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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | 1. The paging resource determination considers the DRX cycle (T) which is based on the DRX information in system information and optionally includes UE specific DRX parameters such as UE specific DRX, RAN paging DRX. The current general description is inconsistent with the related formulae and may cause misunderstanding that paging resource determination is solely based on broadcast parameters.2. Some parameters, e.g., T, nB etc, are used for the calculation of the PF, i\_s, PNB and the NB-IoT paging carrier. The calculation of wg also uses these parameters. But wg is not mentioned in the related description.3. In the current specification, for DRX cycle determination in RRC\_INACTIVE, “if allocated by upper layers” is applied to the *default paging cycle.* But as the *default paging cycle* is always provided, and the *UE specific paging cycle* is optionally allocated by upper layers. “*if allocated by upper layers*” should apply to the *UE specific paging cycle* and not to *default paging cycle*. Moreover, RAN paging cycle is also optionally configured but in the current specification there is no description to indicate this.4. In RRC\_IDLE, the half HSN value of the extended DRX cycle has special process, i.e, PTW is not used and T is always equal to 512. Such special process has not been considered for the RRC\_INACTIVE case.5. As determination rule of DRX cycle(T) for RRC\_IDLE is different from that for RRC\_INACTIVE, and as T is involved in the calculation of PNB, i\_s, it’s possible that PNB, i\_s calculation for RRC\_IDLE is different from PNB, i\_s calculation for RRC\_INACTIVE if the T value are different. Such difference would cause determined paging resources for monitoring/sending CN paging are different for UE and network and further cause paging failure. |
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| ***Summary of change:*** | 1. (Editorial) Remove “*using the DRX parameters provided in System Information*” from the description “*PF, PO, and PNB are determined by following formulae using the DRX parameters provided in System Information:*”.
2. (Editorial)To add “wg” in this sentence “*The following Parameters are used for the calculation of the PF, i\_s, PNB, and the NB-IoT paging carrier*”.
3. For DRX cycle determination in RRC\_INACTIVE, “*if allocated by upper layers*” is applied to the *UE specific paging cycle* other than to *default paging cycle*. “*If configured*” is added for the RAN paging cycle.
4. To add description that for UE in RRC\_INACTIVE, if extended DRX value of 512 radio frames is configured by upper layers according to 7.3, the Paging DRX cycle T in RRC\_INACTIVE should be determined by the shortest of the RAN paging cycle and 512 radio frames.
5. To add correction that, for BL UE or UE in enhanced coverage, if it’s in RRC\_INACTIVE state, the T corresponding to RRC\_IDLE state is used for determination of PNB and i\_s.

**Impact Analysis**Impacted functionality:The changes only impacts paging DRX cycle determination for UE in RRC\_INACTIVE state.Inter-operability:If the UE is implemented according to this CR and the network is not, or vice versa, the UE and network may have inconsistant understanding of paging resource and the CN paging may be lost.Backward compatibiliy:The #4 and #5 changes are considered mandatory to support RRC\_INACTIVE state. |
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| ***Consequences if not approved:*** | 1. Without #4 change, the UE behaviour is unspecified if the UE specific extended DRX value is configured to 512 radio frames.
2. Without #5 change, different paging narrowband, paging subframe may be selected between UE and eNB in some scenarios and this may lead to paging failure.
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| ***Clauses affected:*** | 7.1 |
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|  | **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 ...  |
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| ***Other comments:*** |  |
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| ***This CR's revision history:*** |  |

**<Start of the 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:

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 corresponding to RRC\_IDLE state for the determination of PNB and i\_s.

For NB-IoT: 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, minimum UE specific DRX value broadcast in system information)). 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.

- 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) determined as follows:

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.

**<End of the change>**