**3GPP TSG-RAN WG2 Meeting #111-e *R2-2008591***

**Online, 17th – 28th August 2020**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **36.300** | **CR** | **1265** | **rev** | **3** | **Current version:** | **16.2.0** |  |
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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 | **X** |

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| ***Title:*** | System support for Wake Up Signal | | | | | | | | | |
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| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
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| ***Work item code:*** | NB\_IOTenh2-Core, LTE\_eMTC4-Core, NB\_IOTenh3-Core, LTE\_eMTC5-Core | | | | |  | ***Date:*** | | | 2020-09-04 |
|  |  | | | |  | |  | | |  |
| ***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 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-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:*** | | SA2 sent LSs (R2-200068/S2-2001578, R2-2004317/S2-2003217) indicating that SA2 has discussed the impact of WUS on the MME paging strategy and concluded that with some MME paging strategies, e.g. always paging a UE in the entire TA list, this may lead to increased power consumption for UEs using WUS.  SA2 has approved a CR which restricts the usage of WUS to the last used cell (i.e. the cell in which the UE’s RRC connection was last released/ suspended).  SA2 also sent LS (R2-2008544/S2-2006478) indicating that the scenario where a UE could be unreachable for a period if it remains in the same cell, after a release occurs and the S1 connection was not established, exists and be better addressed at RAN level. | | | | | | | | |
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| ***Summary of change:*** | | UE in RRC\_IDLE only monitors (G)WUS in the last used cell, i.e. on which the cell in which the UE's RRC connection was last completed normally.  **Impact analysis**  Impacted functionality:  Paging with (Group) Wake Up Signal  Inter-operability:  If the UE is implemented according to this CR and the network is not, there is no inter-operability issue.  If the network is implemented according to the CR and the UE is not, the UE may misinterpret the non indication of WUS and miss the paging.  Backward compatibiliy:  The CR is considered mandatory to support (G)WUS. | | | | | | | | |
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| ***Consequences if not approved:*** | | Depending of MME/AMF paging strategy, (G)WUS may increase rather than decrease UE power consumption | | | | | | | | |
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| ***Clauses affected:*** | | 10.1.4 | | | | | | | | |
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|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 23.401 CR 36300, 3583  TS 23.501 CR 2407  TS 25.502 CR 2345  TS 36.304 CR 0796  TS 36.331 CR 4447 | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
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| ***Other comments:*** | | Functionally, this CR is a mirror CR to CR 1265. It also applies to R16 GWUS and connection to 5GC. | | | | | | | | |
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| ***This CR's revision history:*** | |  | | | | | | | | |

### 10.1.4 Paging and C-plane establishment

Paging groups (where multiple UEs can be addressed) are used on PDCCH:

- Precise UE identity is found on PCH;

- DRX configurable via BCCH and NAS;

- Only one subframe allocated per paging interval per UE;

- The network may divide UEs to different paging occasions in time;

- There is no grouping within paging occasion;

- One paging RNTI for PCH.

When extended DRX (eDRX) is used in idle mode, the following are applicable:

- The DRX cycle is extended up to and beyond 10.24s in idle mode, with a maximum value of 2621.44 seconds (43.69 minutes); For NB-IoT, the maximum value of the DRX cycle is 10485.76 seconds (2.91 hours);

- The hyper SFN (H-SFN) is broadcast by the cell and increments by one when the SFN wraps around;

- Paging Hyperframe (PH) refers to the H-SFN in which the UE starts monitoring paging DRX during a Paging Time Window (PTW) used in ECM-IDLE. The PH is determined based on a formula that is known by the MME/AMF, UE and (ng-)eNB as a function of eDRX cycle and UE identity;

- During the PTW, the UE monitors paging for the duration of the PTW (as configured by NAS) or until a paging message is including the UE's NAS identity received for the UE, whichever is earlier. The possible starting offsets for the PTW are uniformly distributed within the PH and defined in TS 36.304 [11];

- MME/AMF uses the formulas defined in TS 36.304 [11] to determine the PH as well as the beginning of the PTW and sends the S1 paging request just before the occurrence of the start of PTW or during PTW to avoid storing paging messages in the (ng-)eNB;

- ETWS, CMAS, PWS requirement may not be met when a UE is in eDRX. For EAB, if the UE supports SIB14, when in extended DRX, it acquires SIB14 before establishing the RRC connection;

- When the eDRX cycle is longer than the system information modification period, the UE verifies that stored system information remains valid before establishing an RRC connection. Paging message can be used for system information change notification, when including *systemInfoModification-eDRX*, for a UE configured with eDRX cycle longer than the system information modification period.

NB-IoT UEs, BL UEs or UEs in enhanced coverage can use (G)WUS, when configured in the cell, to reduce the power consumption related to paging monitoring.

When GWUS is used in RRC\_IDLE, the following are applicable:

- Multiple WUS groups, possibly distributed over multiple WUS resources, can be configured in the cell;

- If the UE supports WUS assistance information, the MME/AMF may provide the UE with UE paging probability information (see TS 24.301 [20] and TS 24.501 [91]);

- UE selects one WUS group based on its UE paging probability information and /or its UE NAS identity as defined in TS 36.304 [11];

- A common WUS group may be used to wake up all UEs monitoring the same WUS resource.

When (G)WUS is used in RRC\_IDLE, the following are applicable:

- The UE monitors (G)WUS only in the last used cell, i.e. the cell in which the UE’s RRC connection was last completed normally.

- The WUS or WUS group is used to indicate that the UE shall monitor MPDCCH or NPDCCH to receive paging in that cell;

- For a UE not configured with extended DRX, the WUS or WUS group is associated to one paging occasion (N = 1);

- For a UE configured with extended DRX, the WUS or WUS group can be associated to one or multiple paging occasion(s) (N ≥ 1) in a PTW;

- If UE detects the WUS or WUS group, the UE shall monitor the following N paging occasions unless it has received a paging message;

- The paging operation in the MME is not aware of the use of the WUS in the eNB;

- To reduce WUS use in cells not monitored by the UE, WUS-capable eNBs provide UE's last cell information to MME in the S1 UE Context Release Complete or UE Context Suspend Request messages for all UEs, as described in TS 23.401 [17].

The timing between WUS and the paging occasion (PO) is illustrated in Figure 10.1.4-1. The timing between GWUS and the paging occasion (PO) is illustrated in Figure 10.1.4-2 and Figure 10.1.4-3. The UE can expect WUS repetitions during "Configured maximum WUS duration" but the actual WUS transmission can be shorter, e.g. for UE in good coverage. The UE does not monitor WUS during the non-zero "Gap".



Figure 10.1.4-1: Illustration of WUS timing



Figure 10.1.4-2: Illustration of GWUS timing for NB-IoT UEs



Figure 10.1.4-3: Illustration of GWUS timing for BL UEs and UEs in enhanced coverage

NOTE: WUS1/WUS3 could be higher or lower frequency than WUS0/WUS2.

For NB-IoT, UE in RRC\_IDLE receives paging on the anchor carrier or on a non anchor carrier based on system information.