**3GPP TSG-RAN WG2 Meeting #109bis-e *draft-*R2-2004042**

**Online, April 20th – April 30 2020**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **36.304** | **CR** | **0783** | **rev** | **1** | **Current version:** | **16.5.0** |  |
|  | | | | | | | | |
| *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 NB-IoT enhancements | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NB-IoTenh3-Core | | | | |  |  | | | 2019-04-20 |
|  |  | | | |  | |  | | |  |
| ***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 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)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | To capture the GWUS related agreements to specification | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | New section for GWUS group set selection, GWUS selection , WUS resource identification and WUS alternation related specifications. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Rel-16 NB-IoT enhancements for GWUS will not be supported . | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 7.5.1,7.5.2,7.5.3,7.5.4(new),7.5.5(new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 36.331 CR 4192 | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 36.300 CR 1259 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |

|  |  |
| --- | --- |
| ***This CR's revision history:*** |  |

First Change

## 7.5 Paging with Group Wake Up Signal

### 7.5.1 General

When the UE supports GWUS and GWUS configuration (*gwus-Config*) is provided in system information, the UE shall monitor GWUS using the GWUS parameters provided in System Information.

A UE supporting GWUS can be configured to monitor a group WUS and a common WUS. Upon detecting either of the WUS, UE shall monitor POs as defined in clause 7.4.

For NB-IoT, E-UTRAN may configure up to 2 WUS resources (numbered 0 and 1). The time offset, *g*0, from the end of WUS resource 0 to the start of corresponding PO is determined as defined in subclasue 7.4. When both *wus-Config-r15* and g*wus-Config-r16* are present, WUS resource 0 shares radio resources with *wus-Config-r15*.The time offset from the end of WUS resource 1 to the start of corresponding PO is sum of the time offset *g*0 and the maximum WUS duration.

For BL UEs and UEs in enhanced coverage, E-UTRAN may configure up to 4 WUS resources. The resource number, time and frequency location of these resources is determined as specified in subclause 7.5.4.

After the UE has determined the gap between end of WUS and associated PO as specified in subclause 7.4,UE selects the WUS group set for the corresponding gap as specified in clause 7.5.2. From the selected WUS group set, UE selects one WUS group as defined in subcaluse 7.5.3. If *gwus-GroupAlternation* is not present in *gwus-Config*, the UE monitors the selected the WUS group for each PO. Otherwise, the UE determines the WUS group to monitor for each PO as specified in subclause 7.5.5.

### 7.5.2 WUS group sets selection

The total number of WUS groups configured for a gap is given by:

Where:

*maxWR* is the total number of WUS resources configured in *gwus-NumGroupsList* for the gap.

*maxWG[i]* is the value of *gwus-NumGroupsList[i]* provided in *gwus-Config* for the gap.

Using *gwus-NumGroupsList* for the gap*,* the UE builds the list of WUS groups as an ordered list of pairs (, ) where the first entry corresponds to the first WUS group on the first WUS resource and the last entry corresponds to the last WUS group on the last configured WUS resource. The total number of entries in the list is maxWG*.*

For a NB-IoT UE, if *gwus-ResourcePosition* provided in *gwus-Config* is set to *secondary,*  = 0 is not used and the first entry in the list corresponds to = 1. Otherwise, is the index of the WUS resources in *gwus- NumGroupsList*.

For a BL UE or UE in enhanced coverage, UE determines of the configured resources as specified in subclause 7.x.4.

If g*wus-ProbThreshList* is present in *gwus-Config*, UE determines the WUS group set corresponding to its probability PNAS, if configured, as defined in Table 7.x-1. The total number of WUS groups set is equal to the number of entries in g*wus-ProbThreshList* + 1. The WUS groups are first assigned to WUS group set 1, followed by WUS group set 2, and so on.

Table 7.x.2-1: WUS group set definition when *wus-ProbThreshList* is configured

|  |  |  |  |
| --- | --- | --- | --- |
| ***WUS group set*** | ***gwus-ProbThreshList*** | ***WUS group index in WUS groups list*** | |
| *Lower bound* | *Upper bound* |
| 1 | PNAS ≤ Thresh1 | 0 | Nth1 -1 |
| 2 | Thresh1 < PNAS ≤ Thresh2 | Nth1 | Nth1 + Nth2 -1 |
| 3 | Thresh2 < PNAS ≤ Thresh3 | Nth1 + Nth2 | Nth1 +Nth2 + Nth3 -1 |
| 4 | PNAS > Thresh3 or PNAS not configured | Nth1 +Nth2 + Nth3 | maxWG-1 |
| where  Threshi is the value signalled in the ith entry of *wus-ProbThreshList*  Nthi is the values signalled in the ith entry of *gwus-GroupsForServiceList* | | | |
|  | | | | |

If *wus-ProbThreshList* is not present in *gwus-Config*, UE selects one WUS groups from WUS group set 1 containing all the WUS Groups configured in *gwus-NumGroupsList*.

### 7.5.3 WUS group selection

After selection of the WUS Group set as specified in sub clause 7.x.2, the UE selects the WUS group to monitor as below.

For BL UE, UE in enhanced coverage, the UE determines wg, index of the WUS group within the WUS groups set determined in subclause 7.x.2, as below:

For NB-IoT, the UE determines wg, index of the WUS group within the WUS groups set determined in subclause 7.x.2, as below:

where:

UE\_ID, N, Ns, Nn and Ware definedin subclause7.1

Nw is the number of WUS groups in the selected WUS groups set.

wg is the index of the WUS group in the selected WUS groups set, 0 .. Nw-1

Then, the UE determines WG, the index of the corresponding WUS group within the WUS groups list, as below:

Table 7.5.3-1: Index of the WUS group to monitor

|  |  |
| --- | --- |
| ***WUS group set*** | **WG** |
|
| 1 | wg |
| 2 | wg + Nth1 |
| 3 | wg + Nth1 + Nth2 |
| 4 | wg + Nth1 + Nth2 + Nth3 |
| Where Nthi is defined in table 7.x.1 | |

The entry corresponding to WGin theWUS groups list defined in subclause 7.5.2 provides (, as specified in TS 36.211 [xx].

### 7.5.4 WUS Resource Location for BL UEs and UEs in Enhanced coverage

A BL UE or UE in enhanced coverage determines the time/frequency location of WUS resources based on FreqLocation IE in wus-Config-r15 if Rel-15 WUS is configured, otherwise based on FreqLocation IE in wus-Config-r16. In both cases FreqLocation IE indicates the Frequency location of WUS Resource ID 0 (. Frequency location of other WUS Resources (Resource ID 1,2,3) based on FreqLocation IE is given in Table 7.5.4-1.

Table 7.5.4-1: WUS Resource frequency location

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***WUS Resource***  ***()*** | ***FreqLocation IE (Frequency location of WUS Resource ID)*** | | | | | |
| ***NB below centre frequency*** | | | ***NB above centre frequency*** | | |
| ***n0*** | ***n2*** | ***n4 (Note 1)*** | ***n0*** | ***n2*** | ***n4 (Note)*** |
| WUS Resource 1 | n2 | n0 | n2 | n2 | n4 | n2 |
| WUS Resource 2 | n0 | n2 | n4 | n0 | n2 | n4 |
| WUS Resource 2  (Note 2) | n4 | n4 | n0 | n4 | n0 | n0 |
| WUS Resource 3 | n2 | n0 | n2 | n2 | n4 | n2 |
| Note 1: This coloumn is applicable if wus-Config-r15 is present.  Note 2 : This row is applicable for gwus-ResourcePattern ID 7. | | | | | | |

The time offset, *g*0, from the end of WUS resource 0 and WUS resource 1 to the start of corresponding PO is determined as defined in subclasue 7.4. The time offset from the end of WUS resource 2 and WUS resource 3 to the start of corresponding PO is sum of the time offset *g*0 and the maximum WUS duration for all value of gwus-ResourcePattern IDs except 7. The time offset g0 for WUS resource 2 is same as WUS resource 0 and 1 for gwus-ResourcePattern ID 7.

The WUS Resource IDs for WUS Groups are selected based on gwus-ResourcePattern as given in Table 7.5.4-2.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Resource Pattern-ID(**gwus-ResourcePattern) | | | | | | | |
| ***0*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6*** | ***7*** |
| **WUS Resource**  ***()*** | ***0*** | X |  | X |  | X |  | X | X |
| ***1*** |  | X | X | X | X | X | X | X |
| ***2*** |  |  |  | X | X | X | X | X |
| ***3*** |  |  |  |  |  | X | X |  |
| ***Number of***  ***WUS Resources*** | | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 3 |

If = 0 is not used for WUS Groups the first entry in the *gwus- NumGroupsList*. corresponds to = 1. Otherwise, is the index of the WUS resources in *gwus- NumGroupsList*.

### 7.5.5 WUS Group Alternation

If *gwus-GroupAlternation* is present in *gwus-Config*:

- if *gwus-ProbThreshList* is not present in *gwus-Config* and *gwus-CommonSequence* is set to *legacyWUS*, the UE determines the WUS group to monitor for the current PO as follows:

where:

Tcell is the default DRX cycle for the cell.

maxWG is the total number of WUS group configured in *gwus-NumGroupsList* for the gap.

Gmin is the lowest number of groups configured amongst all the WUS resources for the gap.

WGcurrent is the index of the WUS Group to monitor for the current PO.

WGinitial is the index, WG, of the WUS Group determined in sub-clause 7.x.3

The entry corresponding to WGcurrent in the WUS groups list defined in subclause 7.x.2 provides (, as specified in TS 36.211 [xx].

- else, the UE determines the WUS group to monitor for the current PO as follows:

where:

Tcell is the default DRX cycle for the cell.

maxWR is the total number of WUS resources configured in *gwus-NumGroupsList* for the gap.

minitial:

For a NB-IoT UE :in the entry corresponding to the index WG determined in sub-clause 7.x.3 .

For a BL UE or UE in enhanced coverage:

if = 0 is configured:

- 1, where is given in the entry corresponding to the index WG determined in sub-clause 7.x.3

else:

, where is given in the entry corresponding to the index WG determined in sub-clause 7.x.3

mcurrent is used to determine of the WUS group to monitor for the current PO

For a NB-IoT UE := mcurrent

For a BL UE or UE in enhanced coverage:

if is configured:

= mcurrent

else:

= mcurrent +1

of the WUS group to monitor for the current PO is given in the entry corresponding to the index WG determined in sub-clause 7.x.3

End of Changes