**3GPP TSG-RAN WG2 Meeting #120 R2-2213049**

**Toulouse, France, November 14th – 18th, 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **38.304** | **CR** | **0301** | **rev** | **1** | **Current version:** | **17.2.0** |  |
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| *For* [***HELP***](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:***  | Correction on iPo determination for UE operates with eDRX |
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| ***Source to WG:*** | ZTE Corporation, Sanechips |
| ***Source to TSG:*** | R2 |
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| ***Work item code:*** | NR\_redcap-Core, NR\_UE\_pow\_sav\_enh-Core |  | ***Date:*** | 2022-11-30 |
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| ***Category:*** | **F** |  | ***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 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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | In PEI function, *iPO* is used to determine which bit in PEI is associated to UE’s paging occasion. When the bit in PEI is “0”, UE is not required to read associated paging occasion. Thus *iPO* mismatch between UE and network will result in paging failure.The *iPO* is determined based on *i\_s.* The *iPO* used for RRC\_IDLE is determined by *i\_s* for RRC\_IDLE. The *iPO* used for RRC\_INACTIVE is determined by *i\_s* for RRC\_INACTIVE. The *i\_s* values for RRC\_IDLE and RRC\_inactive may be different due to the different values of DRX cycle T in the case of RRC\_IDLE and RRC\_Inactive, thenthe *iPO* used for RRC\_IDLE and *iPO* used for RRC\_INACTIVE may be different.Similar to *i\_s* mismatch issue, the *iPO* mismatch exists for UE in RRC\_INACTIVE. When network for some reason release the UE to RRC\_IDLE, the *iPO* used in network side and the *iPO* used in UE side will be different. In current release, the *iPO* mismatch issue is partly resolved as following[38.304, 7.2.1]:In RRC\_INACTIVE state, if the UE supports *inactiveStatePO-Determination* and the network broadcasts *ranPagingInIdlePO* with value "true", the UE shall use the same *iPO* as for RRC\_IDLE state. Otherwise, the UE determines the *iPO* based on the formula defined in clause 10.4a in TS 38.213 [4].However, the *iPO* mismatch issue still exists in following scenario:In RRC\_INACTIVE state, if eDRX value configured by upper layers and *eDRX-Allowed*I*nactive* is signaled in SIB1, but *ranPagingInIdlePO* is not signaled in SIB1.There are two cases of *iPO* mismatch in above scenario: Case 1: UE and network use different *i\_s* to determine *iPO* .In the scenario described above, UE will apply *i\_s* for RRC\_IDLE without checking *ranPagingInIdlePO*. [38.304, 7.1]:In RRC\_INACTIVE state, if eDRX value configured by upper layers is no longer than 1024 radio frames, the UE shall use the same i\_s as for RRC\_IDLE state.In RRC\_INACTIVE state, if eDRX value configured by upper layers is longer than 1024 radio frames, during CN PTW, the UE shall use the same i\_s as for RRC\_IDLE state.But it is unclear in the spec which *i\_s* is used to determine *iPO* in this scenario. Some implementation may use *i\_s* for RRC\_IDLE because *i\_s* for RRC\_IDLE is used to determine paging occasion, while others may use *i\_s* for RRC\_INACTIVE with the reason that current RRC state is RRC\_INACTIVE. Then there will be *iPO* mismatch between different UE and network implementations.Case 2: *iPO* mismatch due to RRC state mismatch between UE and network.If the *i\_s* for RRC\_INACTIVE is used for *iPO* determination in above scenario, *iPO* mismatch still occurs due to RRC state mismatch. I.e. UE is in RRC\_INACTIVE while network regard UE in RRC\_IDLE for some reasons. Solution:The straight forward solution is to use the *iPO* for RRC\_IDLE state when *i\_s* for RRC\_IDLE state is used, i.e. to align the rule to apply *iPO* for RRC\_IDLE and *i\_s* RRC\_IDLE.Thus in above scenario, UE in RRC\_INACTIVE will apply *iPO* for RRC\_IDLE, no matter *ranPagingInIdlePO* is signaled in SIB1 or not.Note that according to 7.1, the UE operates in eDRX will apply IDLE *i\_s* no matter the gNB signal *ranPagingInIdlePO* or not. This means the gNB can support *ranPagingInIdlePO* feature if it can support eDRX. Thus, we see no reason not to resolve the *iPO* mismatch issue in the described scenario.  |
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| ***Summary of change:*** | 1. In 7.2.1 Paging Early Indication reception, change the condition for UE in RRC\_INACTIVE to apply same *iPO* as for RRC\_IDLE state.

Impacted 5G architecture options:NR SA Impacted functionality:RedCap, eDRX, PEIInter-operability:If UE implemented and NW not, or vice versa, paging may fail due to *iPO* mismatch between UE and network when eDRX is configured by upper layers and *eDRX-AllowedInactive* is signaled in SIB1, but network does not broadcast *ranPagingInIdlePO* with value "true".  |
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| ***Consequences if not approved:*** | If the change is not approved, there is *iPO* mismatch when eDRX is configured by upper layers and *eDRX-AllowedInactive* is signaled in SIB1, but network does not broadcast *ranPagingInIdlePO* with value "true". Paging for UE in RRC\_INACTIVE may fail due to *iPO* mismatch. |
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| ***Clauses affected:*** | 7.2.1 |
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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:*** |  |

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| START OF CHANGE |

7.2.1 Paging Early Indication reception

The UE may use Paging Early Indication (PEI) in RRC\_IDLE and RRC\_INACTIVE states in order to reduce power consumption. If PEI configuration is provided in system information, the UE in RRC\_IDLE or RRC\_INACTIVE state supporting PEI (except for the UEs expecting multicast session activation notification) can monitor PEI using PEI parameters in system information according to the procedure described below.

If *lastUsedCellOnly* is configured in system information of a cell, the UE monitors PEI in the cell only if the UE most recently received *RRCRelease* without *noLastCellUpdate* in this cell. Otherwise (i.e., if *lastUsedCellOnly* is not configured in system information of a cell), the UE monitors PEI in the camped cell.

The UE monitors one PEI occasion per DRX cycle. A PEI occasion (PEI-O) is a set of PDCCH monitoring occasions (MOs) and can consist of multiple time slots (e.g. subframes or OFDM symbols) where PEI can be sent (TS 38.213 [4]). In multi-beam operations, the UE assumes that the same PEI is repeated in all transmitted beams and thus the selection of the beam(s) for the reception of the PEI is up to UE implementation.

The time location of PEI-O for UE's PO is determined by a reference point and an offset:

- The reference point is the start of a reference frame determined by a frame-level offset from the start of the first PF of the PF(s) associated with the PEI-O, provided by *pei-FrameOffset* in SIB1;

- The offset is a symbol-level offset from the reference point to the start of the first PDCCH MO of this PEI-O, provided by *firstPDCCH-MonitoringOccasionOfPEI-O* in SIB1.

If one PEI-O is associated with POs of two PFs, the two PFs are consecutive PFs calculated by the parameters *PF\_offset*, *T*, *Ns*, and *N*. The first PF of the PFs associated with the PEI-O is provided by (SFN for PF) - floor (*iPO*/*Ns*)\**T*/*N*, where SFN for PF is determined in clause 7.1, *iPO* is defined in clause 10.4a in TS 38.213[4], *T*, *Ns*, and *N* are determined in clause 7.1.

The PDCCH MOs for PEI are determined as specified in TS 38.213 [4] according to *pei-SearchSpace*, *pei-FrameOffset*, *firstPDCCH-MonitoringOccasionOfPEI-O* and *nrofPDCCH-MonitoringOccasionPerSSB-InPO* ifconfigured as specified in TS 38.331 [3]. When *SearchSpaceId* = 0 is configured for *pei-SearchSpace*, the PDCCH MOs for PEI are same as for RMSI as defined in clause 13 in TS 38.213 [4]. UE determines first PDCCH MO for PEI-O based on *pei-FrameOffset* and *firstPDCCH-MonitoringOccasionOfPEI-O*, as for the case with *SearchSpaceId* > 0 configured.

When *SearchSpaceId* = 0 is configured for *pei-SearchSpace*, the UE monitors the PEI-O according to *searchSpaceZero*. When *SearchSpaceId* other than 0 is configured for *pei-SearchSpace,* the UE monitors the PEI-O according to the search space of the configured *SearchSpaceId*.

A PEI occasion is a set of 'S\*X' consecutive PDCCH monitoring occasions, where 'S' is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1*, and X is the *nrofPDCCH-MonitoringOccasionPerSSB-InPO* if configured or is equal to 1 otherwise. The [x\*S+K]thPDCCH MO for PEI in the PEI occasion corresponds to the Kth transmitted SSB, where x=0,1,…,X-1, K=1,2,…,S. The PDCCH MOs for PEI which do not overlap with UL symbols (determined according to *tdd-UL-DL-ConfigurationCommon*) are sequentially numbered from zero starting from the first PDCCH MO for PEI in the PEI-O. When the UE detects a PEI within its PEI-O, the UE is not required to monitor the subsequent monitoring occasion(s) associated with the same PEI-O.

If the UE detects PEI and the PEI indicates the subgroup the UE belongs to monitor its associated PO, as specified in clause 10.4a in TS 38.213 [4], the UE monitors the associated PO as specified in clause 7.1. If the UE does not detect PEI on the monitored PEI occasion or the PEI does not indicate the subgroup the UE belongs to monitor its associated PO, as specified in clause 10.4a in TS 38.213 [4], the UE is not required to monitor the associated PO as specified in clause 7.1.

If the UE is unable to monitor the PEI occasion (i.e. all valid PDCCH MO for PEI) corresponding to its PO, e.g. during cell re-selection, the UE monitors the associated PO according to clause 7.1.

In RRC\_INACTIVE state, when the UE uses the same i­\_sas for RRC\_IDLE state as specified in clause 7.1, the UE shall use the same *iPO* as for RRC\_IDLE state. Otherwise, the UE determines the *iPO* based on the formula defined in clause 10.4a in TS 38.213 [4].

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| END OF CHANGE |