**3GPP TSG RAN WG1 Meeting #104-e R1-** **200xxxx**

**e-Meeting, 25th January – 5th February 2021**

**Title: Summary of NR UE Power Saving**

**Agenda item: 7.2.7**

**Source: CATT**

**Document for: Discussion**

# Final Summary of Email Discussions and Agreements

# Email Discussion [104e-NR\_UE\_Pow\_Sav\_01]

# Email Discussion during Preparation[104e-Prep\_NR\_UE\_Pow\_Sav]

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| **Company** | **Supporting Issues** | **Comments** |
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# Summary of Open Issues

* **Issue 1: Correction on only one DRX group configured when DCI format 2\_6 and/or SCell dormancy is configured. [1]**

In Clause 10.3, the DCI format 2\_6 is used to indicate to MAC layer to start or not to start the *drx-onDurationTimer* in the configured DRX operation. In Clause 5.7 of TS38.321, a MAC entity may be configured by RRC in two DRX groups with separate DRX parameters in support of secondary DRX group introduced in Rel-16. However, the DCI format 2\_6 for UE wakeup and/or SCell dormancy would not be configured together with secondary DRX group to avoid the feature interaction, The text in Clause 10.3 is corrected to exclude the scenario of more than one DRX group is configured with draft CR as follows,

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| 10.3 PDCCH monitoring indication and dormancy/non-dormancy behaviour for SCellsA UE configured with DRX mode operation [11, TS 38.321] with only one DRX group can be provided the following for detection of a DCI format 2\_6 in a PDCCH reception on the PCell or on the SpCell [12, TS 38.331]- a PS-RNTI for DCI format 2\_6 by *ps-RNTI*- a number of search space sets, by *dci-Format2-6*, to monitor PDCCH for detection of DCI format 2\_6 on the active DL BWP of the PCell or of the SpCell according to a common search space as described in Clause 10.1- a payload size for DCI format 2\_6 by *size-DCI\_2-6*- a location in DCI format 2\_6 of a Wake-up indication bit by *psPositionDCI-2-6*- a '0' value for the Wake-up indication bit, when reported to higher layers, indicates to not start the *drx-onDurationTimer* for the next long DRX cycle [11, TS 38.321]- a '1' value for the Wake-up indication bit, when reported to higher layers, indicates to start the *drx-onDurationTimer* for the next long DRX cycle [11, TS 38.321]- a bitmap, when the UE is provided a number of groups of configured SCells by *dormancyGroupOutsideActiveTime*, where - the bitmap location is immediately after the Wake-up indication bit location- the bitmap size is equal to the number of groups of configured SCells where each bit of the bitmap corresponds to a group of configured SCells from the number of groups of configured SCells- a '0' value for a bit of the bitmap indicates an active DL BWP, provided by *dormantBWP-Id*, for the UE [11, TS38.321] for each activated SCell in the corresponding group of configured SCells- a '1' value for a bit of the bitmap indicates - an active DL BWP, provided by *firstOutsideActiveTimeBWP-Id*, for the UE for each activated SCell in the corresponding group of configured SCells, if a current active DL BWP is the dormant DL BWP- a current active DL BWP, for the UE for each activated SCell in the corresponding group of configured SCells, if the current active DL BWP is not the dormant DL BWP- an offset by *ps-Offset* indicating a time, where the UE starts monitoring PDCCH for detection of DCI format 2\_6 according to the number of search space sets, prior to a slot where the *drx-onDuarationTimer* would start on the PCell or on the SpCell [11, TS 38.321]- for each search space set, the PDCCH monitoring occasions are the ones in the first $T\_{s}$ slots indicated by *duration*, or $T\_{s}=1$ slot if *duration* is not provided, starting from the first slot of the first $T\_{s}$ slots and ending prior to the start of *drx-onDurationTimer*. On PDCCH monitoring occasions associated with a same long DRX Cycle, a UE does not expect to detect more than one DCI format 2\_6 with different values of the Wake-up indication bit for the UE or with different values of the bitmap for the UE.The UE does not monitor PDCCH for detecting DCI format 2\_6 during Active Time [11, TS 38.321].If a UE reports for an active DL BWP a *MinTimeGap* value that is X slots prior to the beginning of a slot where the UE would start the *drx-onDurationTimer*, the UE is not required to monitor PDCCH for detection of DCI format 2\_6 during the X slots, where X corresponds to the *MinTimeGap* value of the SCS of the active DL BWP in Table 10.3-1.Table 10.3-1 Minimum time gap value X

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| SCS (kHz) | Minimum Time Gap X (slots)  |
| Value 1 | Value 2 |
| 15 | 1 | 3 |
| 30 | 1 | 6 |
| 60 | 1 | 12 |
| 120 | 2 | 24 |

If a UE is provided search space sets to monitor PDCCH for detection of DCI format 2\_6 in the active DL BWP of the PCell or of the SpCell and the UE detects DCI format 2\_6, the physical layer of a UE reports the value of the Wake-up indication bit for the UE to higher layers [11, TS 38.321] for the next long DRX cycle.If a UE is provided search space sets to monitor PDCCH for detection of DCI format 2\_6 in the active DL BWP of the PCell or of the SpCell and the UE does not detect DCI format 2\_6, the physical layer of the UE does not report a value of the Wake-up indication bit to higher layers for the next long DRX cycle.If a UE is provided search space sets to monitor PDCCH for detection of DCI format 2\_6 in the active DL BWP of the PCell or of the SpCell and the UE - is not required to monitor PDCCH for detection of DCI format 2\_6, as described in Clauses 10, 11.1, 12, and in Clause 5.7 of [11, TS 38.321] for all corresponding PDCCH monitoring occasions outside Active Time prior to a next long DRX cycle, or - does not have any PDCCH monitoring occasions for detection of DCI format 2\_6 outside Active Time of a next long DRX cyclethe physical layer of the UE reports a value of 1 for the Wake-up indication bit to higher layers for the next long DRX cycle.If a UE is provided search space sets to monitor PDCCH for detection of DCI format 0\_1 and DCI format 1\_1 and if one or both of DCI format 0\_1 and DCI format 1\_1 include a SCell dormancy indication field when only one DRX group is configured, - the SCell dormancy indication field is a bitmap with size equal to a number of groups of configured SCells, provided by *dormancyGroupWithinActiveTime*, - each bit of the bitmap corresponds to a group of configured SCells from the number of groups of configured Scells- if the UE detects a DCI format 0\_1 or a DCI format 1\_1 that does not include a carrier indicator field, or detects a DCI format 0\_1 or DCI format 1\_1 that includes a carrier indicator field with value equal to 0 - a '0' value for a bit of the bitmap indicates an active DL BWP, provided by *dormantBWP-Id*, for the UE for each activated SCell in the corresponding group of configured SCells- a '1' value for a bit of the bitmap indicates - an active DL BWP, provided by *firstWithinActiveTimeBWP-Id*, for the UE for each activated SCell in the corresponding group of configured SCells, if a current active DL BWP is the dormant DL BWP- a current active DL BWP, for the UE for each activated SCell in the corresponding group of configured SCells, if the current active DL BWP is not the dormant DL BWP- the UE sets the active DL BWP to the indicated active DL BWPIf a UE is provided search space sets to monitor PDCCH for detection of DCI format 1\_1 when only one DRX group is configured, and if- the CRC of DCI format 1\_1 is scrambled by a C-RNTI or a MCS-C-RNTI, and if - a one-shot HARQ-ACK request field is not present or has a '0' value, and if- the UE detects a DCI format 1\_1 on the primary cell that does not include a carrier indicator field, or detects a DCI format 1\_1 on the primary cell that includes a carrier indicator field with value equal to 0, and if- *resourceAllocation* = *resourceAllocationType0* and all bits of the frequency domain resource assignment field in DCI format 1\_1 are equal to 0, or- *resourceAllocation* = *resourceAllocationType1* and all bits of the frequency domain resource assignment field in DCI format 1\_1 are equal to 1, or- *resourceAllocation = dynamicSwitch* and all bits of the frequency domain resource assignment field in DCI format 1\_1 are equal to 0 or 1the UE considers the DCI format 1\_1 as indicating SCell dormancy, not scheduling a PDSCH reception or indicating a SPS PDSCH release, and for transport block 1 interprets the sequence of fields of- modulation and coding scheme- new data indicator- redundancy versionand of- HARQ process number- antenna port(s)- DMRS sequence initializationas providing a bitmap to each configured SCell, in an ascending order of the SCell index, where- a '0' value for a bit of the bitmap indicates an active DL BWP, provided by *dormantBWP-Id*, for the UE for a corresponding activated SCell - a '1' value for a bit of the bitmap indicates - an active DL BWP, provided by *firstWithinActiveTimeBWP-Id*, for the UE for a corresponding activated SCell, if a current active DL BWP is the dormant DL BWP- a current active DL BWP, for the UE for a corresponding activated SCell, if the current active DL BWP is not the dormant DL BWP- the UE sets the active DL BWP to the indicated active DL BWPIf an active DL BWP provided by *dormantBWP-Id* for a UE on an activated SCell is not a default DL BWP for the UE on the activated SCell, as described in Clause 12, the BWP inactivity timer is not used for transitioning from the active DL BWP provided by *dormantBWP-Id* to the default DL BWP on the activated SCell.A UE is expected to provide HARQ-ACK information in response to a detection of a DCI format 1\_1 indicating SCell dormancy after $N$ symbols from the last symbol of a PDCCH providing the DCI format 1\_1. If *processingType2Enabled* of *PDSCH-ServingCellConfig* is set to *enable* for the serving cell with the PDCCH providing the DCI format 1\_1, $N=7$ for $μ=0$, $N=7.5$ for $μ=1$, and $N=15$ for $μ=2$; otherwise, $N=14$ for $μ=0$, $N=16$ for $μ=1$, $N=27$ for $μ=2$, and $N=31$ for $μ=3$, where $μ$ is the smallest SCS configuration between the SCS configuration of the PDCCH providing the DCI format 1\_1 and the SCS configuration of a PUCCH with the HARQ-ACK information in response to the detection of the DCI format 1\_1. |

* **Issue 2:** Editorial Corrections [2][3]
	+ **Issue 2-1:** Suggest Editor to change the ‘The minimum scheduling restriction’ to ‘minimum scheduling offset restriction’ in section 6.1.2.1.1 of TS 38.214.[2]

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| 6.1.2.1.1 Determination of the resource allocation table to be used for PUSCH======skipped text======When the UE is configured with *minimumSchedulingOffsetK2* in an active UL BWP it applies a minimum scheduling offset restriction indicated by the '*Minimum applicable scheduling offset indicator*' field in DCI format 0\_1 or DCI format 1\_1 if the same field is available. When the UE configured with *minimumSchedulingOffsetK2* in an active UL BWP and it has not received '*Minimum applicable scheduling offset indicator*' field in DCI format 0\_1 or 1\_1, the UE shall apply a minimum scheduling offset restriction indicated based on '*Minimum applicable scheduling offset indicator*' value '0'. When the minimum scheduling offset restriction is applied the UE is not expected to be scheduled with a DCI in slot *n* to transmit a PUSCH scheduled with C-RNTI, CS-RNTI, MCS-C-RNTI or SP-CSI-RNTI with *K*2 smaller than$\left⌈K\_{2min}⋅\frac{2^{μ^{'}}}{2^{μ}}\right⌉$, where *K*2min and $μ$ are the applied minimum scheduling offset restriction and the numerology of the active UL BWP of the scheduled cell when receiving the DCI in slot *n*, respectively, and $μ^{'}$ is the numerology of the new active UL BWP in case of active UL BWP change in the scheduled cell and is equal to $μ$, otherwise. The minimum scheduling offset restriction is not applied when PUSCH transmission is scheduled by RAR UL grant or fallbackRAR UL grant for RACH procedure, or when PUSCH is scheduled with TC-RNTI. The application delay of the change of the minimum scheduling offset restriction is determined in Clause 5.3.1. |

* + **Issue 2-2:** Remove the postfix ‘*-r16*’ of parameter *minimumSchedulingOffsetK0* in section 5.2.1.5.1a of TS38.214.[2]

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| 5.2.1.5.1a Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies======skipped text======Aperiodic CSI-RS timing:- When the aperiodic CSI-RS is used with aperiodic CSI reporting, the CSI-RS triggering offset *X* is configured per resource set by the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffset-r16,* including the case that the UE is not configured with *minimumSchedulingOffsetK0* for any DL BWP or *minimumSchedulingOffsetK2~~-r16~~* for any UL BWP and all the associated trigger states do not have the higher layer parameter *qcl-Type* set to 'typeD' in the corresponding TCI states. The CSI-RS triggering offset has the values of {0, 1, …, 31} slots when the µPDCCH < µCSIRS and {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} when the µPDCCH > µCSIRS.. The aperiodic CSI-RS is transmitted in a slot , if UE is configured with ca-SlotOffset for at least one of the triggered and triggering cell, and *Ks* = , otherwise, and where |

* + **Issue 2-3:** Add “*DRX-config*” in Clause 5.2.2.5 CSI reference resource definition of TS38.214 [3]

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| <begin TP1 for 38.214>5.2.2.5 CSI reference resource definition<omit unchanged text>When DRX is configured, the UE reports a CSI report only if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement in DRX Active Time no later than CSI reference resource and drops the report otherwise. When the UE is configured to monitor DCI format 2\_6 and if the UE configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP' and 'ssb-Index-RSRP' when *drx-onDurationTimer* is not started, the UE shall report CSI during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in Clause 5.2.1.4 if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise. When the UE is configured to monitor DCI format 2\_6 and if the UE configured by higher layer parameter *ps-TransmitPeriodicL1-RSRP* to report L1-RSRP with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to 'cri-RSRP' or 'ssb-Index-RSRP' when *drx-onDurationTimer* is not started, the UE shall report L1-RSRP during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in clause 5.2.1.4 and when *reportQuantity* set to '*cri-RSRP'* if receiving at least one CSI-RS transmission occasion for channel measurement during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise.<omit unchanged text><end TP1 for 38.214> |

* + **Issue 2-4:** Change “*Size-DCI-2-6*” to “*SizeDCI-2-6”* in Clause 10.3 of TS38.213 [3]

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| <Begin TP for 38.213>10.3 PDCCH monitoring indication and dormancy/non-dormancy behaviour for SCellsA UE configured with DRX mode operation [11, TS 38.321] can be provided the following for detection of a DCI format 2\_6 in a PDCCH reception on the PCell or on the SpCell [12, TS 38.331]- a PS-RNTI for DCI format 2\_6 by *ps-RNTI*- a number of search space sets, by *dci-Format2-6*, to monitor PDCCH for detection of DCI format 2\_6 on the active DL BWP of the PCell or of the SpCell according to a common search space as described in Clause 10.1- a payload size for DCI format 2\_6 by *~~sizeDCI-2-6~~ sizeDCI-2-6*- a location in DCI format 2\_6 of a Wake-up indication bit by *ps-PositionDCI-2-6*<End TP for 38.213> |

# Contributions summary and proposals

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| CATT [1] |  Correct the UE behavior when UE is configured DCI format 2\_6 for DRX adaptation and SCell dormancy indication only when one DRX group is configured without the support of additional feature interaction between secondary DRX and DRX adaptation/SCell dormancy |
| Huawei, HiSilicon [2] | * Proposal 1: Suggest Editor to change the ‘The minimum scheduling restriction’ to ‘minimum scheduling offset restriction’ in section 6.1.2.1.1 of TS 38.214.
* Proposal 2: Remove the postfix ‘*-r16*’ of parameter *minimumSchedulingOffsetK0* in section 5.2.1.5.1a of TS38.214.
* Proposal 3: Conclude that when a BWP is configured with *maxMIMO-Layers*, the *CSI-ReportConfig* associated with the BWP should allow the UE to report the PMI of ranks which are smaller or equal to the configured maximum MIMO layer corresponding to the *maxMIMO-Layers* of the BWP.

<Moderator’s comment> The configuration of CSI feedback is gNB implementation. If there is an issue in the PMI/RI feedback in the CSI-ReportConfig for a given BWP, it should be discussed in MIMO agenda. UE power saving AI would only discuss the configuration of maximum MIMO layer for each BWP to achieve UE power saving in sptail domain.  |
| Ericsson [3] | * Add “DRX-config” in Clause 5.2.2.5 CSI reference resource definition of TS38.214
* Change “Size-DCI-2-6” to “SizeDCI-2-6” in Clause 10.3 of TS38.213
* Change “SpCell” to “PSCell” in Clause10.3 of TS38.213

<Moderator’s comment> Current spec is based on RAN2 agreements WUS is supported at PCell for CA and SpCell for DC. This issue was proposed to change several times last year. It was not agreed.  |

# Reference

1. R1-2100341 Draft TS38.213 CR on UE behavior of DRX group configuration CATT

1. R1-2101258 Remaining issues for Rel-16 UE power saving Huawei, HiSilicon

1. R1-2101552 Maintenance for Rel-16 UE power savings Ericsson