**3GPP TSG RAN WG1#104bis-e R1-2nnnnnn**

**e-Meeting, April 12th – 20th, 2021**

**Agenda Item: 7.2.2**

**Source: Moderator (Lenovo)**

**Title: Feature lead summary for NR-U DL Signals and Channels**

**Document for: Discussion, Decision**

# Topic DL-A: PDCCH Monitoring

## Issue DL-A1 (R1-2102786): Maximum size of switchTriggerToAddModList-r16 and switchTriggerToReleaseList-r16

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| Background:***FL Note: Please refer to the detailed background given in R1-2102786.*** |
| Proposal:**To align 38.213 and 38.331 with RAN1's original intention, request RAN2 to increase the maximum size of the lists switchTriggerToAddModList-r16 and switchTriggerToReleaseList-r16 to maxNrofAggregatedCellsPerCellGroup (i.e., max 16 instead of 4).** |

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# Topic DL-B: CSI Measurement, Report

## Issue DL-B1 (R1-2102326): Action when an inapplicable value for HARQ-ACK feedback timing is provided in the DCI scheduling the PDSCH (K1=-1)

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| Background:From RAN1’s perspective, UE shall apply the deactivation command based on the original scheduled HARQ-ACK time indicated by K1 in the DCI. However, another general issue is identified about the application timing for the MAC CE when an inapplicable value for HARQ-ACK feedback timing is provided in the DCI scheduling the PDSCH (K1=-1). It could be observed from current spec of TS 38.213 and TS 38.214 that the application time for MAC CE command is bundled by the HARQ-ACK transmission time for the corresponding PDSCH carrying the MAC CE. For instance, when UE receives in a PDSCH a SCell activation command in slot n, the corresponding actions shall be applied in slot n+k, where k is  and K1 is the number of slots for a PUCCH transmission with HARQ-ACK indicated by PDSCH-to-HARQ\_feedback timing indicator field in the DCI format scheduling the PDSCH. The inapplicable value (k1=-1) for HARQ-ACK feedback is introduced in NR-U, which indicate UE the PUCCH resource for HARQ feedback is not allocated and will be provided in the following DCI. The action time when an inapplicable value is provided in the DCI scheduling the PDSCH carrying the MAC CE is not clear now. Based on the current spec, the exact action time when an inapplicable K1 is provided is not clear. It does not make sense by using k1=-1 when calculating the action time because it will reduce the processing time shorter than UE capability. Deferring UE’s action time until the HARQ-ACK is actually transmitted is also not preferred because of unnecessary long latency of activation behavior. Same principle as the approved LS reply could be applied that the action time shall base on the original scheduled HARQ-ACK transmission time instead of the actual transmission time which will introduce unnecessary delay. Considering there is no applicable K1 provided in DCI, it is reasonable for UE to determine the action time based on the earliest slot that UE is able to provide the valid HARQ-ACK, i.e. N1as defined in clause 5.3 of TS 38.214.  |
| Proposal:***When an inapplicable value for K1 is provided in the DCI format scheduling the PDSCH carrying the MAC CE, the application time for the corresponding actions for the MAC CE shall be determined by the first slot that UE is able to provide the valid HARQ-ACK as defined in clause 5.3 in TS 38.214 according to the PDSCH processing time. The corresponding text proposals are in the TP#1 and TP#2 in the appendix.*** |

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## Issue DL-B2 (various): Measurement during SCell activation

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| In RAN1#104-e, the LS from RAN4 was discussed [5]. There was consensus on Question 1 and a reply LS [6] was sent to RAN4 clarifying the understanding from RAN1.For the other 3 questions: **Question by RAN4** (1) When none of the RRC parameters *CO-DurationPerCell-r16*, *SlotFormatIndicator*, and *CSI-RS-ValidationWith-DCI-r16* is configured for a UE on the being-activated SCell,1. What is the expected UE behaviour for this P/SP CSI-RS measurement and report on the being-activated SCell?

**Reply by RAN1:** As in Rel-15, the UE is expected to receive the P/SP CSI-RS.**Question 2:** When RRC parameters *CSI-RS-ValidationWith-DCI-r16* is configured, but *SlotFormatIndicator* and *CO-DurationPerCell-r16* are not configured for the being-activated SCell, what is the expected UE behavior for this P/SP CSI-RS measurement and report on the being-activated SCell? Does UE need to decode a DCI format from other active serving cell (indicating an aperiodic CSI-RS reception or scheduling a PDSCH reception in the set of symbols of the slot) for this being-activated SCell to validate this P/SP CSI-RS?**Question 3:** When RRC parameters *CO-DurationPerCell-r16* is configured but *SlotFormatIndicator* is not configured for the being-activated SCell, what is the expected UE behavior for this P/SP CSI-RS measurement and report on the being-activated SCell? Does UE need to decode a DCI format 2\_0 (indicating remaining channel occupancy duration) from other active serving cell for this being-activated SCell to validate the CSI-RS?**Question 4:** When RRC parameters *CO-DurationPerCell-r16* is not configured but *SlotFormatIndicator* is configured for the being-activated SCell, what is the expected UE behavior for this P/SP CSI-RS measurement and report on the being-activated SCell? Does UE need to detect a DCI format 2\_0 (indicating the starting point of CO duration and the slot format) from other active serving cell for this being-activated SCell to validate the CSI-RS? |
| Proposal (R1-2102326):(For Question 2) ***The configuration of CSI-RS-ValidationWith-DCI will take effect only after the SCell is activated.***(For Question 3/4) ***The behavior of CSI-RS validation during SCell activation when either CO-DurationPerCell-r16 or SlotFormatIndicator is configured has been already defined in the section 11.1.1 in TS38.213.***Proposal (R1-2102787):***Provide answers to RAN4 regarding Questions 2, 3, and 4 stating that the currently specified behavior in 38.213 Section 11.1.1 for p/sp-CSI-RS cancellation / validation applies also to an SCell being activated.***Proposal (R1-2103335):**Proposal #1:*For a UE on a being-activated SCell, before the SCell is activated,******- The UE does not monitor any DCI on the SCell.******- The UE does not monitor a DCI on other activated cell (e.g., PCell) that can schedule PDSCH on the being-activated SCell.******- The UE is not required to use information of the being-activated SCell in DCI format 2\_0 on other activated cell.******- The UE is not required to use information of the being-activated SCell in UL grant on other activated cell that can trigger aperiodic CSI-RS on the being-activated SCell.*****Proposal #2: When RRC parameter *csi-RS-ValidationWithDCI-r16* is configured, but *CO-DurationsPerCell* and *SlotFormatCombinationsPerCell* are not configured for a UE on a being-activated SCell, before the SCell is activated, UE is not required to receive P/SP-CSI-RS for the being-activated SCell.****Proposal #3: When one of *CO-DurationsPerCell* and *SlotFormatCombinationsPerCell* is configured for a UE on a being-activated SCell, before the SCell is activated, UE is not required to receive P/SP-CSI-RS for the being-activated SCell.**Proposal (R1-2103485):**Proposal 1: Table 1 provides three alternatives for understanding “2> not monitor the PDCCH for the SCell;” for deactivated SCell and/or being-activated SCell. Among them, Alt 1 is a more appropriate understanding unless RAN2 will further specify the detailed PDCCH types that UE does not monitor.*** **Alt 1: Above is applied for any types of DCI, including cross-carrier scheduling of PDSCH/PUSCH, cross-carrier triggering of ap-CSI-RS, and DCI format 2\_0**
* **Alt 2: Above is applied for a DCI cross-carrier scheduling of PDSCH/PUSCH and cross-carrier triggering of ap-CSI-RS, but not for DCI format 2\_0**
* **Alt 3: Above is applied for a DCI cross-carrier scheduling of PDSCH/PUSCH, but not for cross-carrier triggering of ap-CSI-RS and DCI format 2\_0**

**Proposal 2: RAN1 can send a LS to RAN2 for confirming whether RAN1 has a correct understanding and whether RAN2 has other understandings on “2> not monitor the PDCCH for the SCell;”.****Proposal 3: Table 1 provides two opinions for considering whether section 11 in TS 38.213 is also applicable to a being-activated SCell. Among them, Opt 2 is preferred as UE will not monitor any PDCCH during SCell activation.*** **Opt 1: Section 11 in TS 38.213 is applied for a active cell and/or a being activated SCell**
* **Opt 2: Section 11 in TS 38.213 is only applied for a active cell**

**Proposal 4: If RAN1 can reach a consensus on Alt 1 and Opt 2, the same answer given in Table 1 can be adopted for answering Q1~Q4 from RAN4, that is, UE proceeds with the p/sp-CSI-RS measurement in the set of symbols of the slot during SCell activation as in Rel-15.****Proposal 5: If RAN1 can reach a consensus on Alt 1 and Opt 1, the answers given in Table 1 can be adopted for answering Q1~Q4 from RAN4.*** **Answer for Q1: UE receives/cancels p/sp-CSI-RS as in Rel-15**
* **Answer for Q2: UE cancels p/sp-CSI-RS reception as in Rel-16 NR-U**
* **Answer for Q3: UE receives/cancels p/sp-CSI-RS as in Rel-15**
* **Answer for Q4: UE receives/cancels p/sp-CSI-RS as in Rel-15**
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## Issue DL-B3 (R1-2103335): CSI measurement across DL bursts

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| Background:***FL Note: Please refer to the detailed background given in R1-2103335.*** |
| Proposal:**Adopt the following text proposal in TS 38.214 Clause 5.2.1.4.2.**

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| For operation with shared spectrum channel access, if the UE is configured with a *CSI-ReportConfig* with higher layer parameter *reportQuantity* set to 'cri-RI-PMI-CQI ', 'cri-RI-i1', 'cri-RI-i1-CQI', 'cri-RI-CQI' or 'cri-RI-LI-PMI-CQI', the UE shall derive:- the CSI parameters without averaging two or more instances of any periodic or semi-persistent *nzp-CSI-RS-Resources* in the corresponding *NZP-CSI-RS-ResourceSet* for channel measurement or for interference measurement located in different DL transmissions,- the instances of the *nzp-CSI-RS-Resources* are not in the same channel occupancy duration indicated by DCI format 2\_0, if the UE is provided at least one of *SlotFormatIndicator* or co*-DurationList*; or- the instances of the *nzp-CSI-RS-Resources* occur within a set of consecutive symbols which are not all occupied by PDSCH(s) and/or aperiodic CSI-RS(s) indicated by DCI formats and, if any, the corresponding PDCCH(s), if the UE is neither provided with *CO-DurationPerCell* nor *SlotFormatIndicator*, but is provided with *csi-RS-ValidationWith-DCI*- the interference measurements for computing CSI value based on periodic/semi-persistent CSI-IM measured only in OFDM symbol(s) that fulfill the same conditions under which the UE is expected to receive periodic/semi-persistent CSI-RS as described in Clause 11.1 and Clause 11.1.1 of [6, TS 38.213]. |

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# Topic DL-C: DMRS for PDSCH mapping type B

## Issue DL-C1 (R1-2102326): Processing time for at least l\_d=5

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| Background:For PDSCH mapping type B with durations larger than 6, the restriction on DMRS shifting is enough considering it does not pose additional requirement on UE processing timeline than Rel-15 considering such restriction already exists for $l\_{d}=6 $and $l\_{d}=7$. However for $l\_{d}=5$, it does not help when DMRS is shifted as shown in Figure 1 below. With no DMRS shift, the UE can start channel estimation immediately after the first symbol and then the subsequent demodulation and decoding in the following Tproc,1 plus 4 symbols. If DMRS is shifted, the channel estimation operation and the subsequent demodulation/decoding will be delayed by at most 3 symbols (only 1 symbol left before the end of PDSCH) and UE processing time budget would be reduced to Tproc,1 plus 1 symbol. For capability 2 UEs, the Tproc,1 is only 3 symbols for 15kHz SCS and UE processing time budget will be reduced by as much as 43%. UE is not able to finish the PDSCH decoding and HARQ-ACK preparation in such a short time. In order to overcome the above mentioned problems, the processing time for $l\_{d}=5$ should be relaxed when DMRS is shifted. The simple relaxation is to add the number of shifted symbols into Tproc,1 calculation to provide enough time for the UE processing.Figure 1 the timeline with vs without DMRS shift for 5 symbols PDSCH with *dmrs-AdditionalPosition = 'pos0'* |
| Proposal:***In order to address the issue of a reduced UE processing time budget in case of DMRS shift, relaxation of the UE processing time requirement i.e. add the number of shifted symbols to Tproc,1****,* ***is supported at least for 5 symbols PDSCH. The corresponding text proposal is in the TP#3 in the appendix.*** |

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# Topic DL-D: Missing description of PDCCH features for shared spectrum in TS38.300

## Issue DL-D1 (R1-2102326): Missing description of PDCCH features for shared spectrum in TS38.300

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| Background:The functionalities of physical downlink control channels (PDCCH) are described in section 5.2.3 of TS38.300. However, the new features introduced in NR-U Rel-16 were not reflected in the description, which results incompleteness of the specification. The missing features includes:* Indicating Available RB set
* Indicating COT duration
* Trigger search space set group switching
* Indicating CG-DFI indication
* Triggering one-shot HARQ codebook feedback
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| Proposal:***Add description of PDCCH features introduced for shared spectrum operation in TS38.300.***TP#4: in TS38.3005.2.3 Physical downlink control channelsThe Physical Downlink Control Channel (PDCCH) can be used to schedule DL transmissions on PDSCH and UL transmissions on PUSCH, where the Downlink Control Information (DCI) on PDCCH includes:- Downlink assignments containing at least modulation and coding format, resource allocation, and hybrid-ARQ information related to DL-SCH;- Uplink scheduling grants containing at least modulation and coding format, resource allocation, and hybrid-ARQ information related to UL-SCH.In addition to scheduling, PDCCH can be used to for- Activation and deactivation of configured PUSCH transmission with configured grant;- Activation and deactivation of PDSCH semi-persistent transmission;- Notifying one or more UEs of the slot format;- Notifying one or more UEs of the PRB(s) and OFDM symbol(s) where the UE may assume no transmission is intended for the UE;- Transmission of TPC commands for PUCCH and PUSCH;- Transmission of one or more TPC commands for SRS transmissions by one or more UEs;- Switching a UE's active bandwidth part;- Initiating a random access procedure;- Indicating the UE(s) to monitor the PDCCH during the next occurrence of the DRX on-duration;- In IAB context, indicating the availability for soft symbols of an IAB-DU.- Triggering one shot HARQ-ACK codebook feedback- Notifying one or more UEs of the available RB sets, COT duration and search space set group switching for shared spectrum operation.- Indicating downlink feedback information for configured grant PUSCH (CG-DFI) for shared spectrum operationA UE monitors a set of PDCCH candidates in the configured monitoring occasions in one or more configured COntrol REsource SETs (CORESETs) according to the corresponding search space configurations.A CORESET consists of a set of PRBs with a time duration of 1 to 3 OFDM symbols. The resource units Resource Element Groups (REGs) and Control Channel Elements (CCEs) are defined within a CORESET with each CCE consisting a set of REGs. Control channels are formed by aggregation of CCE. Different code rates for the control channels are realized by aggregating different number of CCE. Interleaved and non-interleaved CCE-to-REG mapping are supported in a CORESET.Polar coding is used for PDCCH.Each resource element group carrying PDCCH carries its own DMRS.QPSK modulation is used for PDCCH. |

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