**3GPP TSG RAN WG1 Meeting #102-e R1-2xxxxxx**

**E-meeting, August 17-28, 2020**

**Agenda Item: 7.2.5.1**

**Source: Moderator (Huawei)**

**Title: Summary #1 of email discussion [102-e-NR-L1enh-URLLC-PDCCH enhancements-02] on remaining issues on enhanced PDCCH monitoring capability**

**Document for: Discussion and Decision**

# Introduction

The email discussion is to discuss the remaining issues on DCI format design.

[10**2**-e-NR-L1enh-URLLC-PDCCH enhancements-0**2**] Email discussion/approval on remaining issues on enhanced PDCCH monitoring capability – Chengyan (Huawei)

* Issue B-1: Corrections on span definition
* Issue B-2: Corrections on “aligned spans” case
* Issue B-5-3 & B-5-4 & B-5-6: Miscellaneous editorial corrections
* Issue B-5-2: PDCCH monitoring within a slot
* Discussion/Agreement by 8/21 and TPs by 8/28

This document summarizes the above issue and provide some initial proposals for discussion. Companies are encouraged to provide the first round views by 8/18, then we can adjust the proposals and prepare the TPs for the next step discussions.

# Enhanced PDCCH monitoring capability

This section summarize the issues on enhanced PDCCH monitoring capability.

## Remaining issues on scaling PDCCH monitoring capability if the number of CCs configured is larger than the reported capability

### Issue B-1: Corrections on span definition

The following text has been captured in section 10 of TS38.213.

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| A UE can indicate a capability to monitor PDCCH according to one or more of the combinations = (2, 2), (4, 3), and (7, 3) per SCS configuration of and . A span is a number of consecutive symbols in a slot where the UE is configured to monitor PDCCH. Each PDCCH monitoring occasion is within one span. If a UE monitors PDCCH on a cell according to combination , the UE supports PDCCH monitoring occasions in any symbol of a slot with minimum time separation of X symbols between the first symbol of two consecutive spans, including across slots. A span starts at a first symbol where a PDCCH monitoring occasion starts and ends at a last symbol where a PDCCH monitoring occasion ends, where the number of symbols of the span is up to Y. |

Regarding the text for span, the following updates were proposed by companies:

**Proposed update #1**:

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| *Apple R1-2006487*  Another issue related to PDCCH monitoring is time-invariance of span pattern across slots at a CC. Towards the end of RAN1 101-e’s email discussion, it seems companies were ready to agree on that. But due to limited time, the exact wording could not be finalized. The formulation used for Feature 3-5b “In order to determine a suitable span pattern, first a bitmap b(l), 0<=l<=13 is generated, where b(l)=1 if symbol l of any slot is part of a monitoring occasion, b(l)=0 otherwise” can be adopted to handle the span definition across all slots.  In Rel-16, scheduling latency due to limited PDCCH monitoring occasions has been extensively discussed at both the SI and WI stages, and the Rel-16 PDCCH monitoring capability is supported to reduce scheduling/alignment latency. First, we fail to see what URLLC traffic profile would benefit from time-varying span pattern across slots; second allowing time varying span pattern across slots leads to UE implementation challenge. Continuing the discussion from then, we have:  **Proposal 2: on a CC, the same span pattern repeats in every slot; adopt the text proposal for Proposal 2 in Appendix.**  --------------------------------------Start of Text Proposal on TS 38.213--------------------------------------  10 UE procedure for receiving control information  <Unchanged parts are omitted>  A UE can indicate a capability to monitor PDCCH according to one or more of the combinations = (2, 2), (4, 3), and (7, 3) per SCS configuration of and . A span is a number of consecutive symbols in a slot where the UE is configured to monitor PDCCH. Each PDCCH monitoring occasion is within one span.  The same span pattern repeats in every slot*.*  If a UE monitors PDCCH on a cell according to combination , the UE supports PDCCH monitoring occasions in any symbol of a slot with minimum time separation of X symbols between the first symbol of two consecutive spans, including across slots. A span starts at a first symbol where a PDCCH monitoring occasion starts and ends at a last symbol where a PDCCH monitoring occasion ends, where the number of symbols of the span is up to Y.  <Unchanged parts are omitted>  ---------------------------------------End of Text Proposal on TS 38.213 ---------------------------------- |

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| *Qualcomm R1-2006774*  So far, RAN1 based the design of the new PDCCH monitoring capability on FG 3-5b; some components of 3-5b are now explicitly brought into TS 38.213, while some others are still pending.  To conclude this topic, RAN1 needs to either specify or conclude the following two aspects:  **Proposal#1:**   * **Similar to FG 3-5b, spans are formed by overlaying the monitoring occasions of all search spaces in one slot, and,** * **Span patterns are repeating in every slot, i.e., the span formation is not time varying.** |

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| *Samsung R1-2006109*  It is currently allowed for the combination to be different across slots. For single cell operation, that would lead to different and in different slots – this has no specification impact but, based on the configuration of search space sets, the UE needs to compute in every slot the values of and . For CA operation, the possibility to change per slot would mean that the allocation of PDCCH candidates/non-overlapping CCEs per cell can also change per slot. This is already the case in Rel-15 as the active DL BWP on a cell can change per slot (between BWP with different SCS configuration ). Nevertheless, even for a UE supporting dynamic active DL BWP change (including between dormant and non-dormant BWPs), the UE needs to recalculate PDCCH candidates/non-overlapping CCEs once after an active DL BWP change instead of across time based on the search space set configurations. For Rel-16 PDCCH monitoring, there is no identifiable use-case for having different search space set configurations in different slots; allowing the UE to expect the same per slot is reasonable for UE complexity.  Configuration of search space sets for Rel-16 (span-based) PDCCH monitoring within a slot relies on *monitoringSymbolsWithinSlot* to determine the PDCCH MOs. A restriction from Rel-15 is that PDCCH monitoring beyond the first 3 symbols of a slot is supported only for 15 kHz SCS. For Rel-16 PDCCH monitoring, 30 kHz SCS should also be included.  **Proposal 1: A UE expects the combination on the active DL BWP of a cell to be same across slots. Update TS 38.213 v16.2.0 in Clause 10.1 as follows.** |

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| *Quectel R1-2006549*  In our view, whether this constraint is applied may have impacts to both network configuration and UE implementation. Given the constraint “the same span pattern repeats in every slot”, a UE does not need to track span distributions slot by slot and can construct a span pattern in a slot and reuse the pattern for all subsequent slots. On the other hand, even without this constraint a UE may still be able to construct span distributions across slots in advance based on RRC configuration (or reconfiguration). There could be some UE computation complexity savings when this constraint is applied. According to current search space set configurations, the monitoring occasions for a search space set are distributed over slots in a SPS-alike manner, i.e., consecutive slots every slots, . The network by this constraint may have to configure PDCCH monitoring occasions every slot. Although it is likely to configure much denser monitoring occasions for URLLC, it may still be useful for network to configure the UE to skip some slots for PDCCH monitoring. In this sense, ensuring same span pattern across slots that contain monitoring occasion could be sensible from both UE and network perspective.  **Proposal 1**: A same span pattern within a slot repeats in every slot containing a monitoring occasion.  Accordingly, the proposed text changes are as follows:  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of TP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  10.1 UE procedure for determining physical downlink control channel assignment  < Unchanged parts are omitted >  A UE can indicate a capability to monitor PDCCH according to one or more of the combinations = (2, 2), (4, 3), and (7, 3) per SCS configuration of and . A span is a number of consecutive symbols in a slot where the UE is configured to monitor PDCCH. Each PDCCH monitoring occasion is within one span. A same span pattern within a slot repeats in every slot containing a PDCCH monitoring occasion. If a UE monitors PDCCH on a cell according to combination , the UE supports PDCCH monitoring occasions in any symbol of a slot with minimum time separation of X symbols between the first symbol of two consecutive spans, including across slots. A span starts at a first symbol where a PDCCH monitoring occasion starts and ends at a last symbol where a PDCCH monitoring occasion ends, where the number of symbols of the span is up to Y.  < Unchanged parts are omitted >  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End of TP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

**Feature lead view**: The main idea of the proposal from the companies are similar, and as to the TP it looks like one from Samsung better considering we don’t have definition of “span pattern” in the specification.

***Proposal 2.1-1****: Endorse the text proposal in R1-2xxxxxx for TS 38.213 Section 10.*

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| 10 UE procedure for receiving control information **\*\*\* Unchanged text is omitted \*\*\***  If a UE indicates a capability to monitor PDCCH according to multiple combinations and a configuration of search space sets to the UE for PDCCH monitoring on a cell results to a separation of every two consecutive PDCCH monitoring spans that is equal to or larger than the value of for one or more of the multiple combinations , the UE monitors PDCCH on the cell according to the combination , from the one or more combinations , that is associated with the largest maximum number of and defined in Table 10.1-2A and Table 10.1-3A. The UE expects the combination on the active DL BWP of a cell with SCS configuration to be same across slots.  **\*\*\* Unchanged text is omitted \*\*\*** |

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| *Company* | *View* |
| *Samsung* | *Support the above proposal (2.1-1).* |
| CATT | Support. |
| Spreadtrum | Support |
| vivo | Support. |
| *Sharp* | *Support the proposal.* |
| *Qualcomm* | *Not support. Keeping the span combination unchanged does not mean that the span patterns are not changing from slot to slot. Our proposal is to make it clear that spans are formed by overlaying all MOs of all search space sets in one slot. The span pattern then repeats in all slots.* |
| *Intel* | *Cannot support proposal 2.1-1.*  *The proposed text implies that the PDCCH MOs in each slot needs to the same. However, this is not the intention. Conceptually agree with Qualcomm, but we think the following should be sufficient from spec perspective without having to use “overlaying of MOs” (could be a bit ambiguous). This says that a single (X,Y) has to work for all slots, irrespective of the actual PDCCH MOs in each slot, in turn implying that the (X,Y) combination has to work for the union of the MOs across slots (or set of “overlaid MOs”).*  --------------------------------------Start of Text Proposal on TS 38.213--------------------------------------  10 UE procedure for receiving control information  <Unchanged parts are omitted>  A UE can indicate a capability to monitor PDCCH according to one or more of the combinations = (2, 2), (4, 3), and (7, 3) per SCS configuration of and . A span is a number of consecutive symbols in a slot where the UE is configured to monitor PDCCH. Each PDCCH monitoring occasion is within one span. On the active DL BWP of a cell with SCS configuration a single combination applies to all slots.    If a UE monitors PDCCH on a cell according to combination , the UE supports PDCCH monitoring occasions in any symbol of a slot with minimum time separation of X symbols between the first symbol of two consecutive spans, including across slots. A span starts at a first symbol where a PDCCH monitoring occasion starts and ends at a last symbol where a PDCCH monitoring occasion ends, where the number of symbols of the span is up to Y.  <Unchanged parts are omitted>  ---------------------------------------End of Text Proposal on TS 38.213 ---------------------------------- |
| *DOCOMO* | *Support the main idea but the proposal from Intel seems better.* |
| Quectel | Support the text changes proposed by Intel. |
| ZTE | Support the proposal. There could be multiple combinations applicable to all slots, while the chosen one ( with the largest maximum number of M and C) should be the same across (or saying ‘apply to all slots’). In this sense, we think the current proposal is clearer. |
| Ericsson | * First, we share the same understanding with Intel that the PDCCH MOs in each slot do not need to be the same, although a single (X,Y) works for all slots. It seems that both proposal 2.1-1 TP and Intel TP reflects this. We do not see proposal 2.1-1 TP forces PDCCH MOs to be the same across all slots. * Second, regarding “Span pattern repeats in every slot”, we disagree.   There was extensive debate to reach agreement on this spec text:  *TS38.213 V16.2.0 Section 10:*  *“A span starts at a first symbol where a PDCCH monitoring occasion starts and ends at a last symbol where a PDCCH monitoring occasion ends, where the number of symbols of the span is up to Y.”*  The above is a different approach than the monitoring span definition in FG3-5b. With the above, it was implicitly agreed that the span pattern can change from slot to slot. Although the combination (X,Y) is the same across slots,it should be understood that PDCCH monitoring occasions can vary slot to slot, and span pattern vary accordingly. |
| HW/HiSi | Support the TP |
| MediaTek | In our view, the TP in Proposal 2.1-1 and the TP from Intel achieve the same thing: i.e. same (X, Y) combination rather than same PDCCH MOs for all slots.  So, we are fine to support Intel’s TP if it is preferred by more companies. |

#### Summary of the status for issue B-1 (i.e. proposal 2.1-1)

* ***Support proposal 2.1-1****: Samsung, CATT, Spreadtrum, Vivo, Sharp, ZTE, Huawei/HiSilicon, Ericsson, MTK*
* ***Not support****: Qualcomm, Intel* 
  + ***Reasons***
    - ***Qualcomm****: Keeping the span combination unchanged does not mean that the span patterns are not changing from slot to slot. Make it clear that spans are formed by overlaying all MOs of all search space sets in one slot. The span pattern then repeats in all slots.*
    - ***Intel****: The proposed text implies that the PDCCH MOs in each slot needs to the same.*
  + ***Proposal from Intel:*** *DOCOMO, Quectel*

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A UE can indicate a capability to monitor PDCCH according to one or more of the combinations = (2, 2), (4, 3), and (7, 3) per SCS configuration of and . A span is a number of consecutive symbols in a slot where the UE is configured to monitor PDCCH. Each PDCCH monitoring occasion is within one span. On the active DL BWP of a cell with SCS configuration a single combination applies to all slots.

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* ***Feature lead view****: The essential idea of the proposal in original proposal 2.1-1 and the proposal from Intel is the same. It seems the proposal from Intel does preclude any potential misunderstanding. Therefore, it is recommended to take the TP from Intel for further discussion.*

***Revised Proposal 2.1-1****: Endorse the text proposal in R1-2xxxxxx for TS 38.213 Section 10.*

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| 10 UE procedure for receiving control information **\*\*\* Unchanged text is omitted \*\*\***  A UE can indicate a capability to monitor PDCCH according to one or more of the combinations = (2, 2), (4, 3), and (7, 3) per SCS configuration of and . A span is a number of consecutive symbols in a slot where the UE is configured to monitor PDCCH. Each PDCCH monitoring occasion is within one span. On the active DL BWP of a cell with SCS configuration a single combination applies to all slots.  **\*\*\* Unchanged text is omitted \*\*\*** |

**Please comment if you have strong concern on the revised proposal 2.1-1.**

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| *Company* | *View* |
| *Feature lead* | *It is common understanding that PDCCH MOs in each slot do not need to be the same. Even there are different PDCCH MOs in each slot, according to the rule to determine the span pattern as defined in TR 38.822, the span pattern would be the same across slots.*  *============*  In order to determine a suitable span pattern, first a bitmap b(l), 0<=l<=13 is generated, where b(l)=1 if symbol l of any slot is part of a monitoring occasion, b(l)=0 otherwise.  *=============*  *Hope the above clarification can address the concern from both side, that is with the current specification or common understanding is as below:*   * *PDCCH monitoring occasions in different slots can be different* * *Same span patter across slots* |
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### Issue B-2: Corrections on “aligned spans” case

The following text has been captured in section 10.1 of TS38.213 for scaling PDCCH monitoring capability.

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| If a UE is configured only with downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with of the downlink cells using combination for PDCCH monitoring, where , a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs  - per set of spans on the active DL BWP(s) of all scheduling cell(s) from the downlink cells, if the union of PDCCH monitoring occasions on all scheduling cells from the downlink cells results to PDCCH monitoring according to the combination and any pair of spans in the set is within symbols, where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols  - per set of spans across the active DL BWP(s) of all scheduling cells from the downlink cells, with at most one span per scheduling cell for each set of spans, otherwise  where is a number of configured cells with SCS configuration . If a UE is configured with downlink cells for which the UE is provided both *monitoringCapabilityConfig-r16* = *r15monitoringcapability* and *monitoringCapabilityConfig-r16* = *r16monitoringcapability*, is replaced by . |

Regarding the text for “aligned spans” case, the following updates were proposed by companies:

**Proposed update #1**:

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| *Ericsson R1-2005506*  In RAN1 #101-e, the following TP in [R1-2005117](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Docs/R1-2005117.zip) was endorsed for the editor’s CR on TS 38.213 for the CA scaling for the “aligned spans” case. However, not all the details are captured in the specification. For completeness, we propose the following TP.   1. The following TP is adopted to completely capture the agreement from RAN1 #101\_e for the CA scaling for the “aligned spans” case.  |  | | --- | | **------------------------------ Text Proposal for 38.213, Section 10.1 --------------------------------------**  \*\*\* Unchanged text is omitted \*\*\*  If a UE is configured only with downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with of the downlink cells using combination for PDCCH monitoring, where , a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs  - per set of spans on the active DL BWP(s) of all scheduling cell(s) from the downlink cells within every X symbols, if the union of PDCCH monitoring occasions on all scheduling cells from the downlink cells results to PDCCH monitoring according to the combination and any pair of spans in the set is within symbols, where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols  - per set of spans across the active DL BWP(s) of all scheduling cells from the downlink cells, with at most one span per scheduling cell for each set of spans, otherwise  \*\*\* Unchanged text is omitted \*\*\*  ----------------------------------------------End of proposed TP ---------------------------------------------------- | |

**From feature view**: It is true that “within every X symbols” is missing and the correction is necessary.

***Proposal 2.1-2****: Endorse the text proposal in R1-2xxxxxx for TS 38.213 Section 10.1.*

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| 10 UE procedure for receiving control information \*\*\* Unchanged text is omitted \*\*\*  If a UE is configured only with downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with of the downlink cells using combination for PDCCH monitoring, where , a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs  - per set of spans on the active DL BWP(s) of all scheduling cell(s) from the downlink cells within every X symbols, if the union of PDCCH monitoring occasions on all scheduling cells from the downlink cells results to PDCCH monitoring according to the combination and any pair of spans in the set is within symbols, where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols  - per set of spans across the active DL BWP(s) of all scheduling cells from the downlink cells, with at most one span per scheduling cell for each set of spans, otherwise  \*\*\* Unchanged text is omitted \*\*\* |

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| *Company* | *View* |
| *Samsung* | *Proposal 2.2-2 (probably it needs to be 2.1-2) is unnecessary because it is already captured that “*where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols”.  *Nevertheless, proposal 2.2-2 is not problematic and is not objectionable.* |
| CATT | OK with the TP. |
| Vivo | We are fine with the TP. |
| *Sharp* | *Support the proposal.* |
| *Qualcomm* | *Fine with the proposal.* |
| *Intel* | *Fine with Proposal 2.2-2.* |
| *Apple* | *Support proposal 2.2-2* |
| *DOCOMO* | *Support the proposal* |
| Quectel | Fine with the TP. |
| ZTE | Fine with the TP. |
| HW/HiSi | Support the TP |
| MediaTek | Support the TP |

#### Summary of the status for proposal 2.1-2

* ***Support proposal 2.1-2****: CATT, Vivo, Sharp, Qualcomm, Intel, Apple, DOCOMO, Quectel, ZTE, Huawei/HiSilicon, Ericsson, MTK* 
  + ***Reasons***
    - *The “Identifier for DCI formats” field in DCI formats can always be used to differentiate UL DCI format and DL DCI format, therefore no need for gNB to ensure different DCI size.*
* ***Not necessary but fine****: Samsung* 
  + ***Reasons***
    - *Proposal 2.1-2 is unnecessary because it is already captured that “where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols”. Nevertheless, proposal 2.2-2 is not problematic and is not objectionable.*

**Proposed update #2**:

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| *Apple R1-2006487*  The scaled limits for Rel-16 PDCCH monitoring are for carrier aggregation. Two cases can be considered separately: intra-band CA and inter-band CA. In the RAN4 specification, the MRTD (Maximum Receive Time Difference) requirements for intra-band CA and inter-band CA are specified. It can be seen for inter-band CA, the MRTD can be as high as 33 microseconds, roughly equal to one symbol duration at 30 KHz SCS.  Image  Figure Nominally aligned CCs are unaligned in reality due to MRTD  From the example in Figure 5, it is seen when the maximum 33 microseconds’ MRTD is present, the nominally aligned spans across CC1 and CC2 are actually unaligned, the scaled limit no longer reflects well the UE processing complexity.    For all practical purposes, the limits for the “unaligned” case should be applied instead of those for the aligned case. Hence the inter-band CA case, irrespective of the PDCCH monitoring configurations by the gNB, all the spans of CCs at the same numerology should be considered as unaligned. Without that, declaring the UE capability to support Rel-16 PDCCH monitoring capability constitutes the support for both intra-band CA and inter-band CA cases. Either the UE modem processing capability has to be powerful/complicated enough to handle all cases, or the UE won’t declare such a capability even the UE can handle the intra-band case and encounters problem with the inter-band case only. We see neither case as desirable. Thus, we have  **Proposal 1: for inter-band CA, at a given numerology and given span pattern, all CCs are considered unaligned; adopt text proposal for Proposal 1 in Appendix.**  --------------------------------------Start of Text Proposal on TS 38.213--------------------------------------  10.1 UE procedure for determining physical downlink control channel assignment  <Unchanged parts are omitted>  If a UE is configured only with downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with of the downlink cells using combination for PDCCH monitoring, where , a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs  - for intra-band carrier aggregation, per set of spans on the active DL BWP(s) of all scheduling cell(s) from the downlink cells, if the union of PDCCH monitoring occasions on all scheduling cells from the downlink cells results to PDCCH monitoring according to the combination and any pair of spans in the set is within symbols, where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols  - per set of spans across the active DL BWP(s) of all scheduling cells from the downlink cells, with at most one span per scheduling cell for each set of spans, otherwise  where is a number of configured cells with SCS configuration . If a UE is configured with downlink cells for which the UE is provided both monitoringCapabilityConfig-r16 = r15monitoringcapability and monitoringCapabilityConfig-r16 = r16monitoringcapability, is replaced by .  <Unchanged parts are omitted>  ---------------------------------------End of Text Proposal on TS 38.213 ------------------------------------- |

**From feature view**: In Rel-15 we don’t differentiate intra-band CA and inter-band CA either. However, more views are needed from other companies.

**Please provide your views on the above TP on limiting aligned span case to intra-band CA case**.

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| *Company* | *View* |
| *Samsung* | *Agree with the TP* |
| CATT | It was discussed before and concluded that we don’t need to consider the unalignment between CCs. From our understanding, the span is defined on each CC and the MRTD can be compensated at the UE side.  We don’t see the necessity to adopt the TP. |
| Spreadtrum | We support the TP.  For inter-band CA, the impact of MRTD to the span patterns across the carriers cannot be ignored. The spans of different carriers may be overlapped just similar as non-aligned span case. It can mixed the PDCCH monitoring occasions form the different spans. So limiting aligned span case to intra-band CA case is suitable solution. |
| Vivo | Agree with FL’s assessment.  It was discussed before and the time misalignment between CCs does not need to be considered. The TP is not needed. |
| Qualcomm | We do not think any change is needed. |
| Intel | We share same understanding as CATT and others, and do not see the need for the TP either. |
| Apple | We support the TP. Note from previous meetings, many examples concerning aligned & unaligned cases were exhibited, and the refinement on aligned and unaligned definitions was taken consequently considering UE implementation and network configuration flexibility. We believe the support of the PDCCH monitoring capability shall not be so difficult so few UE implementations can actually support it. |
| DOCOMO | We share the same understanding with CATT. |
| Quectel | Agree with FL’s assessment.  The problem already exists in Rel-15, and no special handling was specified then. |
| ZTE | Agree with FL’s assessment and comments from CATT. |
| Ericsson | Do not support the TP  We agree with FL view that intra-band CA and inter-band CA were not differentiated in Rel-15. Similarly, no differentiation is necessary in Rel-16. |
| HW/HiSi | We do not need a TP for this issue. |
| MediaTek | We don’t see the TP as essential. |

#### Summary of the status for the impact on aligned span case from MRTD for inter-band CA

* ***Support TP from Apple****: Samsung, Spreadturm, Apple*
* ***Not support the TP from Apple:*** *CATT, Vivo, Qualcomm, Intel, DOCOMO, Quectel, ZTE, Ericsson, Huawei/HiSilicon, MTK*
  + ***Reasons***
    - ***CATT****: No need to consider the unalignment between CCs. The span is defined on each CC and the MRTD can be compensated at the UE side.*
* ***Feature lead view****: It seems the reason given by CATT is reasonable. Note that there is no differentiation between intra-band CA and inter-band CA in Rel-15 also. It is recommended the proponents to re-evaluate whether it is needed or not.*

***Conclusion 2.1-1****: No change needed due to MRTD from inter-band CA on the aligned span case for Rel-16 PDCCH monitoring capability.*

**Please comment if you have strong concern on the above conclusion 2.1-1.**

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| *Company* | *View* |
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## Miscellaneous corrections

### Issue B-5-2: PDCCH monitoring within a slot

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| *Samsung* *R1-2006109*  Configuration of search space sets for Rel-16 (span-based) PDCCH monitoring within a slot relies on *monitoringSymbolsWithinSlot* to determine the PDCCH MOs. A restriction from Rel-15 is that PDCCH monitoring beyond the first 3 symbols of a slot is supported only for 15 kHz SCS (e.g. to support LTE-NR coexistence). For Rel-16 PDCCH monitoring, 30 kHz SCS should be included. Also, for PDCCH monitoring for detection of DCI format 2\_4, 30 kHz should be included.  Further, in the current text below, the “that are same in every slot where the UE monitors PDCCH for all search space sets” may be considered to be removed to avoid potential confusion as the “that are same in every slot where the UE monitors PDCCH” is a consequence of the RRC signaling and not additional specification and the “for all search space sets” can be misinterpreted as meaning that the “consecutive symbols are same in every slot” among all search space sets.  **Proposal 4: Capture in Clause 10.1 of TS 38.213 v16.2.0 that a UE configured for Rel-16 PDCCH monitoring or for detection of DCI format 2\_4 is expected to be able to monitor PDCCH within a slot for 30 kHz SCS.** |

**Feature lead view**: The restriction of 15 kHz is mainly for PDCCH monitoring case 1-2, while the URLLC features is mainly based on PDCCH monitoring case 2. Therefore, it seems not necessary to do the extension here. However, the current specification may result in that only 15 kHz SCS is allowed even for PDCCH monitoring case 2. Therefore, some clarification is necessary here.

As to the above TP, it can avoid limiting case 2 to 15 kHz, however the question is whether it will result in the impression that PDCCH monitoring case 1-2 can be used for other SCS also in Rel-16? More inputs are needed before making the decision here.

**Question 2.2-1**: Do you think that the TP in R1-2006109 will result in the misunderstanding that other SCS can be applied to PDCCH monitoring case 1-2 also? If yes, do you think it is a problem? If it is a problem, do you have any suggestion on how to update the TP?

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| *Company* | *View* |
| *Samsung* | *Regardless of UE features for various cases, the specifications do not allow configuration of PDCCH monitoring within a slot for SCS other than 15 kHz. A CR may also be needed for Rel-15.*  *Support the TP and OK with any resolution that enables specification support of PDCCH monitoring within a slot for at least 30 kHz.* |
| CATT | There may be a need to discuss the possible cases separately:  Case1: only one MO is configured per slot for 30 kHz. It’s true that the current specification forbid the configuration with a MO occupying at least one symbol after the first three symbols. However, what is the motivation or use case to configure a search space not at the beginning of the slot? There is not CRS in the first three symbols as LTE-NR co-existence is not allowed for 30 kHz.  Case2: more than one MOs which occupies discontinuous symbols or more than three symbols for 30 kHz. This case is allowed and we can leave it in this discussion.  From our understanding, case 1 is the only impacted case. It is always good to remove any potential restrictions on the configuration. But it seems the current specification is still workable by proper configuration. |
| Spreadtrum | We agree with FL’s comments about the restriction of 15 kHz is for PDCCH monitoring case 1-2. However, we have two questions for this TP:  Q1: Why case 1-2 should be supported by 30kHz? In our understanding and also pointed by Samsung case 1-2 only introduced for the coexistence of LTE and NR. But 30kHz don’t have this problem.  Q2: what is the relationship of case 1-2 and Rel-16 PDCCH monitoring? There are up to one pattern of three consecutive symbols in case 1-2. It is not a kind of Rel-16 PDCCH monitoring.  So before further commons, we would like to better understand the reasons of this TP. |
| *vivo* | The current text for restriction of 15 kHz is mainly for PDCCH monitoring case 1-2, while the URLLC features is mainly based on PDCCH monitoring case 2 which is described in the spec as well. We don’t need to mix them together. |
| *Sharp* | *We do not think the current specification may result in that only 15kHz SCS is allowed even for case 2. For a UE capable of PDCCH monitoring case 2, as long as the UE is configured to monitor PDCCH for all SS sets in more than one subset in a slot, the restriction is not applied any more. After all, the original motivation of case 2 is to provide more than one MOs in a slot. Thus the current specification seems to only restrict a case that the UE is capable of case 2 but is configured to monitor PDCCH for all SS sets only in one subset of up to 3 consecutive symbols. Agree with CATT that the specification is still workable according to the gNB’s configuration.* |
| *Qualcomm* | *There is no need for any change. Both FG 3-5b and the new PDCCH monitoring capability can be supported for different SCS values without any change.* |
| *Intel* | *In principle, we agree with Samsung. This is an error since Rel-15.*  *On the other hand, we also understand that the adverse impact may not be significant. Given that “fixing it” should also include fixing it for Rel-15 (which perhaps is best left untouched), we would also be fine with not changing current specifications.* |
| *DOCOMO* | *We are fine with either way; to adopt the TP to remove the potential restriction, or to keep the spec unchanged. The restriction of 15 kHz is only for PDCCH monitoring case 1-2 and thus not for case 2 and Rel-16 PDCCH monitoring capability. The current spec would work without the change. On the other hand, as CATT mentioned, it should be possible to allow 30 kHz to be used with configuration of monitoringSymbolsWithinSlot, while the motivation and use case is unclear for now. In this sense, it is also a good way to remove the restriction.* |
| Quectel | Share same view as Intel.  The adverse impact may be insignificant, and it is better to not touch Rel-15. |
| ZTE | We agree on the intention of this TP. If a UE reports support of case 1-2 and also Rel-16 URLLC PDCCH monitoring, it should be clear that SCS 30kHZ is supported. Or we can avoid such UE capability reporting. |
| Ericsson | The TP is not necessary.  The restriction of 15 kHz is very narrow and for PDCCH monitoring case 1-2. For 30 kHz and URLLC, this can be easily avoided, e.g., not exactly the same in every slot. |
| HW/HiSI | In our view, the TP does not seem necessary.  The text in the spec is reflecting the PDCCH monitoring case 1-2 that was specified in Rel-15 and there is a risk with the current wording that case 1-2 also is supported for 30 kHz, which should not be the case. |

#### Summary of the status for issue B-5-2

* ***Support the TP in R1-2006109****: Samsung,*
* ***Not support****: CATT , vivo, Sharp, Qualcomm, Intel, Quectel, DOCOMO, Ericsson, Huawei/HiSilicon*
  + ***Reasons***
    - ***CATT****: No strong motivation to configure a search space not at the beginning of the slot (i.e. PDCCH monitoring case 1-2) but not for LTE-NR co-existence case.*
    - ***Sharp****: We do not think the current specification may result in that only 15 kHz SCS is allowed even for case 2. The original motivation of case 2 is to provide more than one MOs in a slot.*
    - ***Intel:*** *This is an error since Rel-15. On the other hand, we also understand that the adverse impact may not be significant. “fixing it” should also include fixing it for Rel-15 (which perhaps is best left untouched).*
  + ***Feature lead:*** *Based on the views above, it is recommended not to make any change for the spec, and it seems no misunderstanding that case 2 is not applicable for other SCS. However, if there is any good wording to make it clearer, we can consider it also, not sure if we have any RRC parameter that is only applied to LTE-NR co-existence, if there is any probably we can use it to make the spec clearer here.*

***Conclusion 2.2-1****: No change needed for clarifying other SCS in addition to 15 kHz can be applied to PDCCH monitoring case 2.*

**Please comment if you have strong concern on the above conclusion 2.2-1.**

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| *Company* | *View* |
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### Issue B-5-3: PDCCH candidate having common REs with a SS/PBCH block

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| *Samsung R1-2006109*  The “or in a span” has been missed in the second paragraph of the text below. It is suggested to add it or, preferably, remove the “in a slot and in a span” from the first paragraph and the “in a slot” from the second paragraph to avoid unnecessary text and be consistent with the text in the remaining paragraphs where “in a slot or in a span” is not mentioned.  **Proposal 5: Update TS 38.213 v16.2.0 in Clause 10 as follows.** |

**Feature lead view**: The correction is necessary.

***Proposal 2.2-1****: Endorse the text proposal in R1-2xxxxxx for TS 38.213 Section 10.*

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| 10 UE procedure for receiving control information \*\*\* Unchanged text is omitted \*\*\*  For monitoring of a PDCCH candidate by a UE, if the UE  - has received *ssb-PositionsInBurst* in *SIB1* and has not received *ssb-PositionsInBurst* in *ServingCellConfigCommon* for a serving cell, and  - does not monitor PDCCH candidates in a Type0-PDCCH CSS set, and  - at least one RE for a PDCCH candidate overlaps with at least one RE of a candidate SS/PBCH block corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *SIB1*,  the UE is not required to monitor the PDCCH candidate.  For monitoring of a PDCCH candidate by a UE, if the UE  - has received *ssb-PositionsInBurst* in *ServingCellConfigCommon* for a serving cell, and  - does not monitor PDCCH candidates in a Type0-PDCCH CSS set, and  - at least one RE for a PDCCH candidate overlaps with at least one RE of a candidate SS/PBCH block corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon*,  the UE is not required to monitor the PDCCH candidate.  If a UE monitors the PDCCH candidate for a Type0-PDCCH CSS set on the serving cell according to the procedure described in Clause 13, the UE may assume that no SS/PBCH block is transmitted in REs used for monitoring the PDCCH candidate on the serving cell.  If at least one RE of a PDCCH candidate for a UE on the serving cell overlaps with at least one RE of *lte-CRS-ToMatchAround*, or of *LTE-CRS-PatternList-r16*, the UE is not required to monitor the PDCCH candidate.  If a UE is provided *availableRB-SetPerCell-r16,* the UE is not required to monitor PDCCH candidates that overlap with any RB from RB sets that are indicated as unavailable for receptions by DCI format 2\_0 as described in Clause 11.1.1.  \*\*\* Unchanged text is omitted \*\*\* |

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| *Company* | *View* |
| *Samsung* | *Support the above proposal (2.2-1).* |
| CATT | Support |
| Spreadtrum | Support |
| vivo | Support the TP. |
| *Sharp* | *Support the proposal.* |
| *Qualcomm* | *Support* |
| *Intel* | *Support Proposal 2.2-1.* |
| *DOCOMO* | *Support* |
| Quectel | Support |
| ZTE | Support |
| Ericsson | Support Proposal 2.2-1 |
| HW/HiSi | Support |
| MediaTek | Support |

#### Summary of the status for issue B-5-3

* ***Support****: Samsung CATT, Spreadtrum, vivo, Sharp, Qualcomm, Intel, Quectel, DOCOMO, ZTE, Ericsson, Huawei/HiSilicon, MTK*

### Issue B-5-4: Maximum number of UE-specific DCI formats for CA operation

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| *Samsung R1-2006109*  The maximum number of activated cells for CA operation remains 16 and DCI formats 0\_2 and 1\_2 need to also be captured in the following.  **Proposal 6: Update TS 38.213 v16.2.0 in Clause 10.1 as follows.** |

Sharp (R1-2006563) proposed the same thing as Samsung.

**Feature lead view**: The correction is necessary.

***Proposal 2.2-2****: Endorse the text proposal in R1-2xxxxxx for TS 38.213 Section 10.1.*

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| 10.1 UE procedure for determining physical downlink control channel assignment \*\*\* Unchanged text is omitted \*\*\*  For a scheduled cell and at any time, a UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol.  \*\*\* Unchanged text is omitted \*\*\* |

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| *Company* | *View* |
| *Samsung* | *Support the above proposal (2.2-2).* |
| CATT | Support |
| Spreadtrum | Support |
| vivo | Support the TP. |
| *Sharp* | *Support the proposal.* |
| *Qualcomm* | *Support* |
| *Intel* | *Support Proposal 2.2-2.* |
| *Apple* | *Support proposal 2.2-2* |
| *DOCOMO* | *Support* |
| Quectel | Support |
| ZTE | Support |
| Ericsson | Support Proposal 2.2-2. |
| HW/HiSI | Support |
| MediaTek | Support |

#### Summary of the status for issue B-5-4

* ***Support****: Samsung CATT, Spreadtrum, vivo, Sharp, Qualcomm, Intel, Quectel, DOCOMO, ZTE, Ericsson, Huawei/HiSilicon, MTK*

### Issue B-5-6: Missing descriptions on PDCCH monitoring capability for Rel-16 cells in CA case 2 and case 3 if configured carrier number is equal to or less than UE capability

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| *ZTE R1-2005413*  In addition, there are some missing descriptions for  or  in case the number of cells configured is not larger than the reported capability, and corresponding Text Proposal #5 is provided.  ***Proposal 4****: Adopt the following Text Proposal #5 for section 10.1 in TS38.213.*  **--------------------------------------------Text Proposal #5 for Section 10 in TS38.213------------------------** |

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| *Spreadtrum R1-2006278*  For the limits of Rel-16 PDCCH monitoring BDs/non-overlapped CCEs, there is only the definition of the limits for the condition of configured carrier number is more than UE capability. However, it misses the condition of configured carrier number is equal to or less than UE capability. So the following text proposal for 38.213 section 10.1 should be adopted.   1. ***Adopted the text proposal for BDs/non-overlapped CCEs limits.***   \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  10.1 UE procedure for determining physical downlink control channel assignment  <Text omitted>  If a UE is configured only with downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with of the downlink cells using combination for PDCCH monitoring, where , the UE is not required to monitor, on the active DL BWP of the scheduling cell more than PDCCH candidates or more than non-overlapped CCEs per slot for each scheduled cell.  If a UE is configured only with downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with of the downlink cells using combination for PDCCH monitoring, where , a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs  - per set of spans on the active DL BWP(s) of all scheduling cell(s) from the downlink cells, if the union of PDCCH monitoring occasions on all scheduling cells from the downlink cells results to PDCCH monitoring according to the combination and any pair of spans in the set is within symbols, where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols  - per set of spans across the active DL BWP(s) of all scheduling cells from the downlink cells, with at most one span per scheduling cell for each set of spans, otherwise  where is a number of configured cells with SCS configuration . If a UE is configured with downlink cells for which the UE is provided both *monitoringCapabilityConfig-r16* = *r15monitoringcapability* and *monitoringCapabilityConfig-r16* = *r16monitoringcapability*, is replaced by .  For each scheduled cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell, from the downlink cells using combination , more than PDCCH candidates or more than non-overlapped CCEs per span.  <Text omitted>  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

**From feature view**: The issue is valid and correction is needed. It seems the TP from ZTE is more complete but as to the location of the change it seems the one from Spreadtrum is better.

***Proposal 2.2-3****: Endorse the text proposal in R1-2xxxxxx for TS 38.213 Section 10.1.*

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| 10.1 UE procedure for determining physical downlink control channel assignment \*\*\* Unchanged text is omitted \*\*\*  If a UE  - is configured with downlink cells for which the UE is not provided *monitoringCapabilityConfig-r16* or is provided *monitoringCapabilityConfig-r16* = *r15monitoringcapability*,  - with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , where , and  - a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell,  the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs per slot on the active DL BWP(s) of scheduling cell(s) from the downlink cells.  For each scheduled cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell from the downlink cells more than  PDCCH candidates or more than  non-overlapped CCEs per slot.  For each scheduled cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell from the downlink cells  - more than PDCCH candidates or more than non-overlapped CCEs per slot  - more than PDCCH candidates or more than non-overlapped CCEs per slot for CORESETs with same *CORESETPoolIndex* value  If a UE is configured with  downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with  of the  downlink cells using combination (X,Y) for PDCCH monitoring, where , the UE is not required to monitor, on the active DL BWP of the scheduling cell,  - more than  PDCCH candidates or more than  non-overlapped CCEs per span for each scheduled cell when the scheduling cell is from the  downlink cells. If a UE is configured with downlink cells for which the UE is provided both *monitoringCapabilityConfig-r16* = *r15monitoringcapability* and *monitoringCapabilityConfig-r16* = *r16monitoringcapability*,  is replaced by .  If a UE is configured only with downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with of the downlink cells using combination for PDCCH monitoring, where , a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs  - per set of spans on the active DL BWP(s) of all scheduling cell(s) from the downlink cells, if the union of PDCCH monitoring occasions on all scheduling cells from the downlink cells results to PDCCH monitoring according to the combination and any pair of spans in the set is within symbols, where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols  - per set of spans across the active DL BWP(s) of all scheduling cells from the downlink cells, with at most one span per scheduling cell for each set of spans, otherwise  where is a number of configured cells with SCS configuration . If a UE is configured with downlink cells for which the UE is provided both *monitoringCapabilityConfig-r16* = *r15monitoringcapability* and *monitoringCapabilityConfig-r16* = *r16monitoringcapability*, is replaced by .  For each scheduled cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell, from the downlink cells using combination , more than PDCCH candidates or more than non-overlapped CCEs per span.  \*\*\* Unchanged text is omitted \*\*\* |

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| *Company* | *View* |
| *Samsung* | *Support the above proposal (2.2-3).* |
| CATT | Support |
| Spreadtrum | Support |
| vivo | Support the TP. |
| *Sharp* | *Support the proposal with adding a ‘only’ in the if condition to more precisely describe the CA Case 3 as like ‘* If a UE is configured only with  downlink cells*’.* |
| *Qualcomm* | *Support* |
| *Intel* | *Support Proposal 2.2-3.* |
| *Apple* | *Support proposal 2.2-3* |
| *DOCOMO* | *Support* |
| Quectel | Support |
| ZTE | Support |
| Ericsson | Support Proposal 2.2-3 |
| HW/HiSi | Support |
| MediaTek | Support |

#### Summary of the status for issue B-5-6

* ***Support****: Samsung CATT, Spreadtrum, vivo, Qualcomm, Intel, Quectel, DOCOMO, ZTE, Ericsson, Huawei/HiSilicon, MTK*
* ***Sharp:*** *Support the proposal with adding a ‘only’ in the if condition to more precisely describe the CA Case 3 as like ‘* If a UE is configured only with  downlink cells
* ***Feature lead:*** *Sounds reasonable. “only” will be added in the revised proposal.*

***Proposal 2.2-3****: Endorse the following text proposal in R1-2xxxxxx for TS 38.213 Section 10.1.*

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| 10.1 UE procedure for determining physical downlink control channel assignment \*\*\* Unchanged text is omitted \*\*\*  If a UE  - is configured with downlink cells for which the UE is not provided *monitoringCapabilityConfig-r16* or is provided *monitoringCapabilityConfig-r16* = *r15monitoringcapability*,  - with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , where , and  - a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell,  the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs per slot on the active DL BWP(s) of scheduling cell(s) from the downlink cells.  For each scheduled cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell from the downlink cells more than  PDCCH candidates or more than  non-overlapped CCEs per slot.  For each scheduled cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell from the downlink cells  - more than PDCCH candidates or more than non-overlapped CCEs per slot  - more than PDCCH candidates or more than non-overlapped CCEs per slot for CORESETs with same *CORESETPoolIndex* value  If a UE is configured only with  downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with  of the  downlink cells using combination (X,Y) for PDCCH monitoring, where , the UE is not required to monitor, on the active DL BWP of the scheduling cell,  - more than  PDCCH candidates or more than  non-overlapped CCEs per span for each scheduled cell when the scheduling cell is from the  downlink cells. If a UE is configured with downlink cells for which the UE is provided both *monitoringCapabilityConfig-r16* = *r15monitoringcapability* and *monitoringCapabilityConfig-r16* = *r16monitoringcapability*,  is replaced by .  If a UE is configured only with downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with of the downlink cells using combination for PDCCH monitoring, where , a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs  - per set of spans on the active DL BWP(s) of all scheduling cell(s) from the downlink cells, if the union of PDCCH monitoring occasions on all scheduling cells from the downlink cells results to PDCCH monitoring according to the combination and any pair of spans in the set is within symbols, where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols  - per set of spans across the active DL BWP(s) of all scheduling cells from the downlink cells, with at most one span per scheduling cell for each set of spans, otherwise  where is a number of configured cells with SCS configuration . If a UE is configured with downlink cells for which the UE is provided both *monitoringCapabilityConfig-r16* = *r15monitoringcapability* and *monitoringCapabilityConfig-r16* = *r16monitoringcapability*, is replaced by .  For each scheduled cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell, from the downlink cells using combination , more than PDCCH candidates or more than non-overlapped CCEs per span.  \*\*\* Unchanged text is omitted \*\*\* |

# Proposal for Wednesday conference call

The section summarize the potential proposals for Wednesday conference call based on the views from the first round email discussion.

### Issue B-1: Corrections on span definition

#### Summary of the status for issue B-1

* ***Support proposal 2.1-1****: Samsung, CATT, Spreadtrum, Vivo, Sharp, ZTE, Huawei/HiSilicon, Ericsson, MTK* 
  + ***Reasons***
    - *The “Identifier for DCI formats” field in DCI formats can always be used to differentiate UL DCI format and DL DCI format, therefore no need for gNB to ensure different DCI size.*
* ***Not support****: Qualcomm, Intel* 
  + ***Reasons***
    - ***Qualcomm****: Keeping the span combination unchanged does not mean that the span patterns are not changing from slot to slot. Make it clear that spans are formed by overlaying all MOs of all search space sets in one slot. The span pattern then repeats in all slots.*
    - ***Intel****: The proposed text implies that the PDCCH MOs in each slot needs to the same.*
  + ***Proposal from Intel:*** *DOCOMO, Quectel*

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A UE can indicate a capability to monitor PDCCH according to one or more of the combinations = (2, 2), (4, 3), and (7, 3) per SCS configuration of and . A span is a number of consecutive symbols in a slot where the UE is configured to monitor PDCCH. Each PDCCH monitoring occasion is within one span. On the active DL BWP of a cell with SCS configuration a single combination applies to all slots.

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* ***Feature lead view****: The essential idea of the proposal in original proposal 2.1-1 and the proposal from Intel is the same. It seems the proposal from Intel does preclude any potential misunderstanding. Therefore, it is recommended to take the TP from Intel for further discussion.*

***Revised Proposal 2.1-1****: Endorse the text proposal in R1-2xxxxxx for TS 38.213 Section 10.*

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| 10 UE procedure for receiving control information **\*\*\* Unchanged text is omitted \*\*\***  A UE can indicate a capability to monitor PDCCH according to one or more of the combinations = (2, 2), (4, 3), and (7, 3) per SCS configuration of and . A span is a number of consecutive symbols in a slot where the UE is configured to monitor PDCCH. Each PDCCH monitoring occasion is within one span. On the active DL BWP of a cell with SCS configuration a single combination applies to all slots.  **\*\*\* Unchanged text is omitted \*\*\*** |

**Please comment if you have strong concern on the revised proposal 2.1-1.**

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| --- | --- |
| *Company* | *View* |
| *Feature lead* | *It is common understanding that PDCCH MOs in each slot do not need to be the same. Even there are different PDCCH MOs in each slot, according to the rule to determine the span pattern as defined in TR 38.822, the span pattern would be the same across slots.*  *============*  In order to determine a suitable span pattern, first a bitmap b(l), 0<=l<=13 is generated, where b(l)=1 if symbol l of any slot is part of a monitoring occasion, b(l)=0 otherwise.  *=============*  *Hope the above clarification can address the concern from both side, that is with the current specification or common understanding is as below:*   * *PDCCH monitoring occasions in different slots can be different* * *Same span patter across slots* |
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### Issue B-2: Corrections on “aligned spans” case

***Proposal 2.1-2****: Endorse the text proposal in R1-2xxxxxx for TS 38.213 Section 10.1.*

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| 10 UE procedure for receiving control information \*\*\* Unchanged text is omitted \*\*\*  If a UE is configured only with downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with of the downlink cells using combination for PDCCH monitoring, where , a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs  - per set of spans on the active DL BWP(s) of all scheduling cell(s) from the downlink cells within every X symbols, if the union of PDCCH monitoring occasions on all scheduling cells from the downlink cells results to PDCCH monitoring according to the combination and any pair of spans in the set is within symbols, where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols  - per set of spans across the active DL BWP(s) of all scheduling cells from the downlink cells, with at most one span per scheduling cell for each set of spans, otherwise  \*\*\* Unchanged text is omitted \*\*\* |

#### Summary of the status for proposal 2.1-2: Agreeable

* ***Support proposal 2.1-2****: CATT, Vivo, Sharp, Qualcomm, Intel, Apple, DOCOMO, Quectel, ZTE, Huawei/HiSilicon, Ericsson, MTK* 
  + ***Reasons***
    - *The “Identifier for DCI formats” field in DCI formats can always be used to differentiate UL DCI format and DL DCI format, therefore no need for gNB to ensure different DCI size.*
* ***Not necessary but fine****: Samsung* 
  + ***Reasons***
    - *Proposal 2.1-2 is unnecessary because it is already captured that “where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols”. Nevertheless, proposal 2.2-2 is not problematic and is not objectionable.*

### Issue B-5-3: PDCCH candidate having common REs with a SS/PBCH block

***Proposal 2.2-1****: Endorse the following text proposal in R1-2xxxxxx for TS 38.213 Section 10.*

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| 10 UE procedure for receiving control information \*\*\* Unchanged text is omitted \*\*\*  For monitoring of a PDCCH candidate by a UE, if the UE  - has received *ssb-PositionsInBurst* in *SIB1* and has not received *ssb-PositionsInBurst* in *ServingCellConfigCommon* for a serving cell, and  - does not monitor PDCCH candidates in a Type0-PDCCH CSS set, and  - at least one RE for a PDCCH candidate overlaps with at least one RE of a candidate SS/PBCH block corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *SIB1*,  the UE is not required to monitor the PDCCH candidate.  For monitoring of a PDCCH candidate by a UE, if the UE  - has received *ssb-PositionsInBurst* in *ServingCellConfigCommon* for a serving cell, and  - does not monitor PDCCH candidates in a Type0-PDCCH CSS set, and  - at least one RE for a PDCCH candidate overlaps with at least one RE of a candidate SS/PBCH block corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon*,  the UE is not required to monitor the PDCCH candidate.  If a UE monitors the PDCCH candidate for a Type0-PDCCH CSS set on the serving cell according to the procedure described in Clause 13, the UE may assume that no SS/PBCH block is transmitted in REs used for monitoring the PDCCH candidate on the serving cell.  If at least one RE of a PDCCH candidate for a UE on the serving cell overlaps with at least one RE of *lte-CRS-ToMatchAround*, or of *LTE-CRS-PatternList-r16*, the UE is not required to monitor the PDCCH candidate.  If a UE is provided *availableRB-SetPerCell-r16,* the UE is not required to monitor PDCCH candidates that overlap with any RB from RB sets that are indicated as unavailable for receptions by DCI format 2\_0 as described in Clause 11.1.1.  \*\*\* Unchanged text is omitted \*\*\* |

### Issue B-5-4: Maximum number of UE-specific DCI formats for CA operation

***Proposal 2.2-2****: Endorse the following text proposal in R1-2xxxxxx for TS 38.213 Section 10.1.*

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| 10.1 UE procedure for determining physical downlink control channel assignment \*\*\* Unchanged text is omitted \*\*\*  For a scheduled cell and at any time, a UE expects to have received at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PDSCH receptions for which the UE has not received any corresponding PDSCH symbol and at most 16 PDCCHs for DCI formats with CRC scrambled by C-RNTI, CS-RNTI, or MCS-C-RNTI scheduling 16 PUSCH transmissions for which the UE has not transmitted any corresponding PUSCH symbol.  \*\*\* Unchanged text is omitted \*\*\* |

### Issue B-5-6: Missing descriptions on PDCCH monitoring capability for Rel-16 cells in CA case 2 and case 3 if configured carrier number is equal to or less than UE capability

***Proposal 2.2-3****: Endorse the following text proposal in R1-2xxxxxx for TS 38.213 Section 10.1.*

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| 10.1 UE procedure for determining physical downlink control channel assignment \*\*\* Unchanged text is omitted \*\*\*  If a UE  - is configured with downlink cells for which the UE is not provided *monitoringCapabilityConfig-r16* or is provided *monitoringCapabilityConfig-r16* = *r15monitoringcapability*,  - with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , where , and  - a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell,  the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs per slot on the active DL BWP(s) of scheduling cell(s) from the downlink cells.  For each scheduled cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell from the downlink cells more than  PDCCH candidates or more than  non-overlapped CCEs per slot.  For each scheduled cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell from the downlink cells  - more than PDCCH candidates or more than non-overlapped CCEs per slot  - more than PDCCH candidates or more than non-overlapped CCEs per slot for CORESETs with same *CORESETPoolIndex* value  If a UE is configured only with  downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with  of the  downlink cells using combination (X,Y) for PDCCH monitoring, where , the UE is not required to monitor, on the active DL BWP of the scheduling cell,  - more than  PDCCH candidates or more than  non-overlapped CCEs per span for each scheduled cell when the scheduling cell is from the  downlink cells. If a UE is configured with downlink cells for which the UE is provided both *monitoringCapabilityConfig-r16* = *r15monitoringcapability* and *monitoringCapabilityConfig-r16* = *r16monitoringcapability*,  is replaced by .  If a UE is configured only with downlink cells for which the UE is provided *monitoringCapabilityConfig-r16* = *r16monitoringcapability* and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , and with of the downlink cells using combination for PDCCH monitoring, where , a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs  - per set of spans on the active DL BWP(s) of all scheduling cell(s) from the downlink cells, if the union of PDCCH monitoring occasions on all scheduling cells from the downlink cells results to PDCCH monitoring according to the combination and any pair of spans in the set is within symbols, where first symbols start at a first symbol with a PDCCH monitoring occasion and next symbols start at a first symbol with a PDCCH monitoring occasion that is not included in the first symbols  - per set of spans across the active DL BWP(s) of all scheduling cells from the downlink cells, with at most one span per scheduling cell for each set of spans, otherwise  where is a number of configured cells with SCS configuration . If a UE is configured with downlink cells for which the UE is provided both *monitoringCapabilityConfig-r16* = *r15monitoringcapability* and *monitoringCapabilityConfig-r16* = *r16monitoringcapability*, is replaced by .  For each scheduled cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the scheduling cell, from the downlink cells using combination , more than PDCCH candidates or more than non-overlapped CCEs per span.  \*\*\* Unchanged text is omitted \*\*\* |

# References

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2. [R1-2005413](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005413.zip) Remaining issues on PDCCH enhancements for NR URLLC ZTE
3. [R1-2005506](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005506.zip) Remaining Issue of PDCCH Enhancements for NR URLLC Ericsson
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9. [R1-2006278](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006278.zip) Remaining issues of PDCCH enhancements for URLLC Spreadtrum Communications
10. [R1-2006487](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006487.zip) Remaining issues on PDCCH enhancements Apple
11. [R1-2006549](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006549.zip) Remaining Issues on PDCCH Enhancements for Rel-16 URLLC Quectel
12. [R1-2006563](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006563.zip) Remaining issues on PDCCH enhancements for NR URLLC Sharp
13. [R1-2006774](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006774.zip) Remaining issues on PDCCH Enhancements for URLLC Qualcomm Incorporated
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