**3GPP TSG RAN WG1 Meeting #101-e R1-20xxxxx**

**E-meeting, 25 May – 5 June, 2020**

**Agenda Item: 7.2.5.1**

**Source: Moderator (Huawei)**

**Title: Email discussion/approval [101-e-NR-L1enh-URLLC-PDCCH enhancements-02] on remaining issues on scaling PDCCH monitoring capability**

**Document for: Discussion and Decision**

# Introduction

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

[101-e-NR-L1enh-URLLC-PDCCH enhancements-02] Remaining issues on scaling PDCCH monitoring capability by 5/29 and corresponding TP (if any) by 6/5 – Chengyan (Huawei) including

* Issue C-1: Corrections on span duration
* Issue C-2: Corrections on “aligned spans” case
* Issue C-3: Corrections on “unaligned spans” case
* Issue C-4: Enhanced PDCCH monitoring capability for cross-carrier scheduling

This document summarizes the above issue and provide some initial proposals for discussion. Companies are encouraged to provide the first round views by 5/26, 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 to be discussed under this email discussion.

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

### Issue C-1: Corrections on span duration

The following text has been captured in section 10 of TS38.213 to define a combination (X, Y).

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| A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span is , where is a maximum duration among durations of CORESETs that are configured to the UE and is a minimum value of in the combinations of that are reported by the UE. A last span in a slot can have a shorter duration than other spans in the slot. |

During the email discussion in RAN1#100b-e, it was observed that some further clarification are needed for the span duration in TS 38.213.

**Question C-1-1**: With the formula defined in TS 38.213, whether to allow the span duration larger than Y for a combination (X, Y).

Based on the discussion in RAN1#100b-e, it is common understanding that the span duration is not allowed to be larger than Y for a combination (X, Y), and it was observed that some further clarification is needed to reflect this in the spec. Samsung (R1-2003865), ZTE (R1-2003317), Huawei (R1-2003525) and Quectel (R1-2003942) provide some text proposal accordingly.

**Text proposal 1 (**R1-2003865**)**:

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| If a UE monitors PDCCH on a cell according to combination , the duration of a span is . A last span in a slot can have a shorter duration than other spans in the slot. |

**Feature lead view**: As shown in R1-2003865, the assumption of the above TP is that UE will determine the combination (X, Y) for PDCCH monitoring first. Firstly, if we go this way, we may need some further clarification in the spec to define the order of determination of span duration and determination of combination (X, Y). Note that in the current TS 38.213, determination of combination (X, Y) is in the later section 10.1 than the definition of span duration in section 10. Secondly, according to the agreements we made, the logic is to determine the valid combinations (X, Y), and then pick one from all the valid combinations (X, Y). Thirdly, in order to determine the separation of two consecutive spans, UE needs to know the span duration first.

**Text proposal 2 (**R1-2003317**)**:

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| 10 UE procedure for receiving control information  <---------------------------Other parts are omitted ------------------------------->  A UE reports one or more combinations of  number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span is  and is of length up to  consecutive OFDM symbols, where  is a maximum duration among durations of CORESETs that are configured to the UE and  is a minimum value of  in the combinations of  that are reported by the UE. A last span in a slot can have a shorter duration than other spans in the slot.  <---------------------------Other parts are omitted -------------------------------> |

**Feature lead view**: When UE reports more than one combination (X, Y), it is not clear which Y to be used here.

**Text proposal 3 (**R1-2003525**)**:

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| \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of TP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  10.1 UE procedure for determining physical downlink control channel assignment  < Unchanged parts are omitted >  *A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot on a serving cell in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span other than the last span in a slot is , where is a maximum duration among durations of CORESETs that are configured to the UE and is a minimum value of in the combinations of that are reported by the UE. The duration of a last span in a slot is , where is the time separation between the start of the span and the end of the slot in number of symbols.*  *When a UE reports in pdcch-MonitoringAnyOccasionsWithSpanGap combinations (X, Y) corresponding to value set 3 and is configured a CORESET with duration of 3 OFDM symbols, the UE is not expected to monitor PDCCH according to combination (2, 2).*  < Unchanged parts are omitted >  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End of TP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

**Feature lead view**: Value set 3 is not defined in the spec. In addition, it cannot preclude the case of the configuration as shown in CC3 in the figure below.



Figure C-1-1 Whether three cells are aligned case for (2,2) or not

**Text proposal 4 (**R1-2003525**)**:

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| \*\*\* Unchanged text is omitted \*\*\*  A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span is , where is a maximum duration among durations of CORESETs that are configured to the UE and is a minimum value of in the combinations of that are reported by the UE. A last span in a slot can have a shorter duration than other spans in the slot. When is equal to 3, a UE is not expected to be configured with PDCCH monitoring occasions resulting into a separation of the first symbol of two consecutive spans that is smaller than 4.  \*\*\* Unchanged text is omitted \*\*\* |

**Feature lead view**: The only case that may have misunderstanding is when UE reports the support of combination (2, 2) together with combination (4, 3) and/or combination (7, 3). In this case, if gNB decides to configure CORESET(s) with 3-symbol duration, then gNB needs to ensure that the separation X should not be smaller than 4. It can preclude the configuration similar as what for CC3 in the figure C-1-1. It seems text proposal 4 is more complete.

***Proposal 1****: Adopt the following text proposal for section 10 in TS 38.213:*

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| \*\*\* Unchanged text is omitted \*\*\*  A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span is , where is a maximum duration among durations of CORESETs that are configured to the UE and is a minimum value of in the combinations of that are reported by the UE. A last span in a slot can have a shorter duration than other spans in the slot. When is equal to 3, a UE is not expected to be configured with PDCCH monitoring occasions resulting into a separation of the first symbol of two consecutive spans that is smaller than 4.  \*\*\* Unchanged text is omitted \*\*\* |

**Please provide your views and your reasons on the above proposal 1**.

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| *Company* | *View* |
| *Samsung* | *There is no need for proposal 1 - it only describes a network misconfiguration and does not solve anything. The issue to resolve is what the UE determines first - the combination (X, Y) to use or the duration of the span. It should be the combination (X, Y) to avoid restricting the network to have to configure a CORESET of 3 symbols in order to avoid the resulting combination to always be (2, 2) - a 3-symbol CORESET duration is also inappropriate for URLLC.*  *Chengyan: In order to determine the combination (X, Y), the first thing we need to determine is X, however in order to determine which X to choose, we need to know the span duration first, since X is the separation of two consecutive spans.*  *As shown in the text highlight in yellow below, in order to determine the candidate (X, Y) for choosing based on the largest M and C, UE needs to know the span duration first, then UE knows the staring symbol of each span and then can know the combinations (X, Y) that has value of X larger than the separation of spans?*  *Unless the assumption here is that when checking whether X=2 is valid or not automatically assuming span duration 2 is used, and when checking whether X=4 or 7 is valid or not automatically assuming span duration 3? If that is the understanding, then the proposal from Samsung can work. However, the current text looks more straightforward to say determining the duration first.*  *=======================*  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 . If the 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 two or more of the multiple combinations , the UE is expected to monitor PDCCH on the cell according to the combination associated with the largest maximum number of and .  *========================* |
| *Quectel* | *UE behavior may be unclear for us if a UE reports combination (2, 2) then a dedicated 3-symbol CORESET is configured.*  *Chengyan: With the TP, this case won’t happen. gNB would see that if it configures 3-symbol CORSET, then d\_span is 3, however in this case the separation cannot be smaller than 4, which is not met by the reported (2, 2).* |
| Qualcomm | Not quite clear what the issue is; perhaps, the only missing part is to add “where each span is of length up to Y consecutive OFDM symbols of a slot.” Which had been captured for FG 3-5b.  *Chengyan: The problem is when UE reports (2, 2) together with either (4, 3) or (7, 3), then what value to use for Y here is not clear if we only simply add this sentence.* |
| Intel | For a given span combination (X, Y), duration of a span should not be more than Y symbols. There should be no confusion about this.  Next, for FG 3-5b, the determination of d\_span was necessary for the UE to identify the (X,Y) combination in case the UE reported multiple (X,Y) combinations, and towards that, the determination of d\_span was necessary to ensure that UE and gNB are aligned in applying the rules to determine the applicable (X, Y).  However, now, we already have a rule defined for determination of (X, Y) that utilizes the BD/CCE limits to select the applicable span combination. Thus, we agree with Samsung that the correct option for our case at hand would be to apply the change below (from Samsung tdoc R1-2003865):  If a UE monitors PDCCH on a cell according to combination , the duration of a span is . A last span in a slot can have a shorter duration than other spans in the slot.  *Chengyan: Similar reply to Aris above* |
| HW/HiSi | Our goal is that we want to ensure that we can determine the (X, Y) on each cell so that the 2-step procedure described by the FL in issue C2-1 can be carried out.  For this issue here, my understanding is that we need to discuss whether a clarification of the span duration is needed in order to determine the (X, Y).  Regarding the comment from Samsung (“*The issue to resolve is what the UE determines first - the combination (X, Y) to use or the duration of the span”*):  I am not really sure, if this is the issue. I think that the duration of a span is needed to order to obtain the applicable (X, Y), at least for some cases. But I tend to agree with Samsung that it could be a network misconfiguration in the example shown in figure C1-1.  I have described my understanding below and it would be great to hear some more views.  The description in the UE FG is the following: “*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. The first span in the span pattern begins at the smallest l for which b(l)=1. The next span in the span pattern begins at the smallest l not included in the previous span(s) for which b(l)=1. The span duration is max{maximum value of all CORESET durations, minimum value of Y in the UE reported candidate value}*”  For the example of Figure C-1-1, assume that the UE has reported (2,2) and (4,3)    If firstly the (X, Y) is determined, then the Y for CC1 and CC2 would be 2 symbols. And then X would be the separation of the start of 2 consecutive spans, i.e. X=3. Thus, CC1 and CC2 would both be (2, 2) configurations.  But for CC3 I think that the applicable (X, Y) could not be determined, if we don’t consider the span duration. If we look at the bitmap for CC3, it would have all ones from Symbol #0 until Symbols #5, which is larger than the both Y=2 and Y=3 that the UE has reported as a capability. In this case, we know that we have back-to-back spans and we need to consider the span duration max{d\_CORESET, Y\_min} in order to determine the separation between two spans. If the CORESET duration is 3OS, then the span duration and span separation would be 3 symbols.  Thus, for the particular example in in Figure C1-1, I think we would have a (3, 3) configuration which is not supported. In this case I tend to agree with Samsung that it is a network misconfiguration, But I am not really sure and would like to hear other views.  *Chengyan: If following my reply to Aris and Debdeep, then CC3 is not valid configuration* |
| Ericsson | We don’t support the proposal.  The proposal adds an unnecessary restriction. The span definition according to FG 3-5b as captured in the existing specification text should not be further narrowed.  For example:  The CORSET duration , thus . The configuration of CORSET and search space below should be allowed as UE is capable of (2,2). Current definition (which follows UE feature 3-5b) allows this configuration, but proposal above will forbid this.    *Chengyan: From last meeting, people understanding is that for combination (X, Y), then the span duration is up to 2, therefore here 3-symbol CORESET is not allowed. That is why we tried to make this common understanding clear in the spec.* |
| Sharp | On the comment from Samsung (“*The issue to resolve is what the UE determines first - the combination (X, Y) to use or the duration of the span”*), our view is that,  From network side, network would determine first which combination (X, Y) is applied to a UE if the UE reports more than one combinations of (X,Y) for a cell. Certainly, network would ensure the PDCCH configuration so that the span duration and time separation would fulfill the determined combination (X, Y). For example, if (2,2) is determined by network or UE only reports (2,2) for a cell, the network would not configure the CORESET with 3 symbols to the UE on the cell.  From UE side, the duration of span would be determined first. Because the UE would not know which combination (X, Y) should be used if the UE reports more than one combinations (X,Y). Therefore, the UE would, according to PDCCH configuration from network, first determine the duration of span and then know the staring symbol of each span which would be used by the UE to determine which reported combination (X,Y) is a valid combination and used. If multiple combinations are valid, the one with maximum BDs/CCEs are used.  These are our views based on our understanding. It is important for us to have a common understanding for the issue, which would be helpful for the TP discussion.  *Chengyan: I have similar views as you before. But as I replied to Aris and Debdeep, if we assume Y for each combination (X, Y) when check which combination to choose, then probably ok with deleting the formula for d\_span.* |
| vivo | We understand the intention of the TP.  On the comment from Samsung (“*The issue to resolve is what the UE determines first - the combination (X, Y) to use or the duration of the span”*), we agree that it is needed to align our understanding. From our understanding, the duration of the span may need to be determined first in order to determine the span combination (X, Y) corresponding to the determined span duration. We are open to discuss it.  For a given span combination (X, Y), duration of a span should not be more than Y symbols. So, regarding the TP in proposal 1, we don’t think it is a correct configuration by NW thus there may be no need for such TP. Or we can add“where each span is of length up to Y consecutive OFDM symbols of a slot” for the determination of duration of span as described for FG 3-5b.  *Chengyan: the problem is that before determining the valid combination (X, Y), then UE doesn’t know which Y to use with the sentence you suggest here.* |
| ZTE | We agree fine with the proposal.  Regarding Samsung’s comment, our understanding is the UE should determine the span duration first, which is also aligns the current spec as FL noted. In addition, if a UE doesn’t know the start and the duration of a span, the UE would not know the separation across spans and would not know which combination (X, Y) should be applied.  Based on this understanding, if UE reports both (2,2) and (4,3), then  and  if the CORESET duration is no larger than 2. If the span separation is no less than 4, the case in CC2 in Ericsson’s figure should be valid.    So, if we just want to avoid the case in CC3 in Figure C-1-1, the current proposal should be fine.  *Chengyan: I agree. The point now is whether companies agree that from the text, span duration should be determined first.* |
| CATT | There is no doubt that the duration of a span cannot exceed the Y value. Any span should follow the current supported (X,Y) combinations, i.e. X and Y should be satisfied simultaneously.  We agree with FL’s proposal which make thing clearer. But we are also OK with Samsung’s TP if Samsung’s explanation is the common understanding |

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

The view on proposal 1 is still diverse, the main reason is that different companies have different understanding on a few things.

* ***Common understanding from RAN1#100b-e***
  + *If a UE monitors PDCCH on a cell according to combination, then a CORESET with duration larger than Y is not allowed.*
  + *With the above understanding, then the example in the figure below is not allowed.*



* ***Whether to determine the combination (X, Y) first or determine the span duration first based on the current specification, if UE reports the capability of supporting combination (2, 2) together with combination (4, 3) and/or (7, 3)?***

*=======================*

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 . If the 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 two or more of the multiple combinations , the UE is expected to monitor PDCCH on the cell according to the combination associated with the largest maximum number of and .

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* + ***Understanding 1****: UE determines the span duration first, then determine the valid combination (X, Y)* 
    - ***Support****: Sharp, Vivo, ZTE, Huawei*
    - ***Reasons***
      * *From the text highlight in yellow in the spec, it looks more nature that* 
        + *UE will determine the span duration first,*
        + *then based on the span duration get the span separation,*
        + *then based on the span separation get the (X, Y) that with X smaller than the span separation,*
        + *then determine the used combination (X, Y) among the more than one (X, Y) combinations by checking which combination has the largest M and C*
  + ***Understanding 2****: UE determines the span duration first, then determine the valid combination (X, Y)* 
    - ***Support****: Samsung, Intel*
    - ***Reasons (guess from FL)***
      * *Check the candidate combinations (X, Y) directly first, by assuming when checking whether X=2 is valid or not automatically assuming span duration 2 is used, and when checking whether X=4 or X=7 is valid or not automatically assuming span duration 3;*
      * *then determine the used combination (X, Y) among the more than one (X, Y) combinations by checking which combination has the largest M and C*
  + ***Feature lead****: Both ways could work, as long as we achieve common understanding here. More views are needed.*

**Question C-1-2**: Whether to keep “A last span in a slot can have a shorter duration than other spans in the slot. ”, and if yes whether any further clarification needed.

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| *Samsung R1-2003865*  **Last span in a slot can have shorter duration**  Another issue is the following statement that was inherited from FG 3-5b in Rel-15.   |  | | --- | | A last span in a slot can have a shorter duration than other spans in the slot. |   The above may be beneficial for example as it allows for PDCCH monitoring to start at the beginning of a slot and have at the 13th symbol of the slot. However, in that case, the following statement is not applicable for the “including across slots”.   |  | | --- | | 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. |   **Proposal 4: RAN1 to clarify when and how both following statements are applicable. If no such case, remove the second statement from the specifications as otherwise the UE behavior is ambiguous.**   |  | | --- | | 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. |   and   |  | | --- | | A last span in a slot can have a shorter duration than other spans in the slot. | |

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| *Quectel R1-2003942*  Calculations of the duration of a last span in a slot should be specifically captured in the specification as well.  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 reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot on a serving cell in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span other than the last span in a slot is , where is a maximum duration among durations of CORESETs that are configured to the UE and is a minimum value of in the combinations of that are reported by the UE. The duration of a last span in a slot is , where is the time separation between the start of the span and the end of the slot in number of symbols.*  *When a UE reports in pdcch-MonitoringAnyOccasionsWithSpanGap combinations (X, Y) corresponding to value set 3 and is configured a CORESET with duration of 3 OFDM symbols, the UE is not expected to monitor PDCCH according to combination (2, 2).*  < Unchanged parts are omitted >  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End of TP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

**Feature lead view**: The text “A last span in a slot can have a shorter duration than other spans in the slot. ” can be kept, even consider the separation for cross slots, it can be valid when the first span in the slot doesn’t start at the beginning of the slot. The text proposal from R1-2003942 can make the specification clearer.

***Proposal 2****: Adopt the following text proposal for section 10 in TS 38.213:*

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| \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of TP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  10.1 UE procedure for determining physical downlink control channel assignment  < Unchanged parts are omitted >  *A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span is , where is a maximum duration among durations of CORESETs that are configured to the UE and is a minimum value of in the combinations of that are reported by the UE. The duration of a last span in a slot is , where is the time separation between the start of the span and the end of the slot in number of symbols.*  < Unchanged parts are omitted >  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End of TP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

**Please provide your views and your reasons on the above proposal 2**.

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| *Company* | *View* |
| *Samsung* | *The proposal is not needed – the issue is a Rel-15 one and is addressed by network configuration - it is also captured in Rel-15 that a PDCCH MO does not cross the slot boundary (the proposal is essentially a corollary of that). The only question is how can both of the following be satisfied: (a) minimum separation of all PDCCH MOs in different spans is X symbols, including across slots, and (b) the span duration is less than Y symbols at the end of the slot.* |
| *Quectel* | Clarification is preferred to make specification clearer. We think “*A last span in a slot can have a shorter duration than other spans in the slot*. ” means the duration of the last span can be 1 or 2 symbols given .  A clarification for is needed also as shown below:  *“The duration of a span other than the last span in a slot is ,”* |
| Qualcomm | Not clear why any change is needed. Span configuration is exactly the same as in FG 3-5b. As is captured for FG 3-5b, “The separation between consecutive spans within and across slots may be unequal but the same (X, Y) limit must be satisfied by all spans.” |
| Intel | As highlighted by Samsung, the statement in current specs can indeed be seen as a corollary to spans not crossing slot boundary, but we do not see any contradiction between: *(a) minimum separation of all PDCCH MOs in different spans is X symbols, including across slots, and (b) the span duration is less than Y symbols at the end of the slot.*  On the other hand, we also agree with Qualcomm that the existing text seems clear enough, and the change suggested in Proposal 2 may not be strictly necessary. |
| HW/HiSi | This proposal can make the description clearer, but it is not the most important issue in this thread. Don’t have a strong view on this proposal. |
| Ericsson | We don’t see the need for an explicit expression as in the proposal. If needed, it is sufficient to use a similar description of span from FG3-5b, i.e., a span does not cross a slot boundary, to capture the intention of the proposal. We propose the following TP instead.  < Unchanged parts are omitted >  *A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span is , where is a maximum duration among durations of CORESETs that are configured to the UE and is a minimum value of in the combinations of that are reported by the UE. A span does not cross a slot boundary so a ~~A~~ last span in a slot can have a shorter duration than other spans in the slot.*  < Unchanged parts are omitted > |
| Sharp | Specs has described that a span is in a slot as below, which implies that span would not across the slot boundary. We are fine to make the description of specs clearer.  *A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates.* |
| vivo | We think current spec is clear, maybe not clear enough. The TP is intended to make it clearer. We are fine either to adopt the TP or not to adopt any TP for this. |
| ZTE | No need to change. If we want to make it clearer, the text from Ericsson looks better. |
| CATT | We think the current specification works well and don’t see the necessity to have the TP. It is unnecessary to capture the duration of the last span in a slot as it is up to gNB configuration. |

#### Summary of the status for proposal 2 under issue C-1

* ***Support****: Quectel, Huawei, Sharp, Vivo*
* ***Reasons***
  + *With the current spec, it is not clear what the exact duration is for the last span, because the current spec just say “has shorter duration…”. For example, if d\_span is 2, then whether 1 or 2 should be taken for the last span.*
  + ***Feature lead:*** *With the sentence “A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates”, it should be able to implicitly get whether the exact duration. Though I do agree no harm to make the spec clearer.*
* ***Not support****: Samsung, Qualcomm, Intel, Ericsson, ZTE, CATT* 
  + ***Qualcomm:*** *Not clear why the change is needed*
  + ***Feature lead:*** *With the current spec, it is not clear what the exact duration is for the last span, because the current spec just say “has shorter duration…”. For example, if d\_span is 2, then whether 1 or 2 should be taken for the last span.*
* ***Feature lead recommendation:*** *Since more companies think not necessary, I would suggest not to take the text proposal, though I do think no harm to make the spec clearer.*

In addition, Samsung raised a question that *how can both of the following be satisfied:* *(a) minimum separation of all PDCCH MOs in different spans is X symbols, including across slots, and (b) the span duration is less than Y symbols at the end of the slot.*

* ***Intel****: Don't see any contradiction*
* ***Feature lead:*** *Agree with Intel no contradiction. When there is a shorter span at the end of a slot, as long as the first span in the next slot doesn’t start at the beginning of the next slot with enough gap, the separation even across slots can be met also. Of course, if the first span in the next slot starts from the beginning, then gNB need to ensure there is no PDCCH monitoring occasions at the end of the slot to get a shorter span there.*

### Issue C-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 using Rel-16 PDCCH monitoring capability, and with of the downlink cells using combination for PDCCH monitoring, and having active DL BWPs using SCS configuration , 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 span 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 ,  - TBD, otherwise  where is a number of configured cells using Rel-16 PDCCH monitoring capability with SCS configuration . If a UE is configured with downlink cells using both Rel-15 PDCCH monitoring capability and Rel-16 PDCCH monitoring capability, is replaced by . |

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

**Update #1 for discussion**:

|  |
| --- |
| *Ericsson R1-2003439*  However, we found that the term “per span” used in the above TP is not clear. A span is defined for a cell only, not for multiple cells. For the CA case, there are multiple cells, and the total limits and should be applied to PDCCH monitoring occasions in multiple spans across the DL cells.  Moreover, if a UE reports different sets of (X,Y) value(s) for each cell from the   downlink cells, the span duration in different cells may not even be the same. This is illustrated in Figure 3 where for CC2, when max CORESET duration is not more than 2, the span duration according to the span definition in the specification is equal to 2. However, according to the specification, CC2 is considered as monitoring with the limit corresponding to (7,3) and therefore grouped together with CC1 for the purpose of CA limit scaling.  **Span with (7,3)**  **Span with (7,3)**  **Span with (7,3)**  **Span with (7,3)**    Figure 3 Example of different DL cells from the   downlink cells having different span durations. A UE repots (7,3) for CC1 and (2,2),(4,3),(7,3) for CC2. For each CC, spans pattern are determined according to the span definition in the specification where span duration = max(max CORESET duration, Ymin).  Hence, the term “per span” should be changed or at least clarified. It is more appropriate, e.g., to refer instead to a “resulting span” derived from the union of PDCCH monitoring occasions which then includes all PDCCH monitoring occasions in the “aligned” spans across the DL cells.   1. It is reasonable to base the definition of “aligned span” on PDCCH monitoring occasions on all the cells from the   downlink cells. 2. Span is defined only for a cell. It is not clear to use the term “per span” for the total limits and since they are applied to PDCCH monitoring occasions in multiple spans across the DL cells. 3. Revise the TP above by clarifying that the span in “per span” refers to the resulting span derived from the union of PDCCH monitoring occasions on all scheduling cells. |

**From feature view**: the above change is not needed. Following the definition of span pattern, combination (7, 3) should be used for CC2 shown in the above example, i.e. span duration is 3 not 2. In addition, according to the current specification, only the cells using the same combination (X, Y) will be grouped together, that is the span duration is aligned among all the serving cells. Therefore, similar as Rel-15, it is ok to use the terminology “per span” in this case.

**Update #2 for discussion**:

|  |  |
| --- | --- |
| *Intel R1-2003737*  The above definition may cause ambiguity in identification of certain span combinations across cells as aligned or non-aligned. For instance, when UE is configured with 1-symbol CORESET(s), then the above text still satisfies the condition defined for “union of PDCCH monitoring occasions” for the example in Figure 1, while this case should be considered as unaligned.    **Figure 1:** An example case of unaligned span combinations across CC1 and CC2 that may be identified as aligned spans per current definition of “aligned spans”.  To address this, the following alternative characterization that was also discussed during RAN1 #100b-E meeting is proposed:   |  | | --- | | < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0>  per span on the active DL BWP(s) of all scheduling cell(s) from the downlink cells, if any pair of spans on the active DL BWP(s) of any two scheduling cells from the downlink cells are within a same set of up to consecutive symbols, or have their first symbols separated by at least symbols,  < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0> | |

* *Support: Intel, Apple*

**From feature view**: It seems there is some issue at least when search space sets are configured with 1-symbol CORESET(s). The TP from Intel can work. Alternatively, if people want to keep the current description as much as possible, the following potential update can be considered also.

|  |
| --- |
| < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0>  - per span 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 the starting symbol of any pair of overlapping spans are the same,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0> |

**Question C-2-1**: Which option do you prefer for the text proposal to correct the definition of “aligned spans” case?

* ***Option 1****: Adopt the following text proposal for section 10.1 in TS 38.213:*

|  |
| --- |
| < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0>  - per span on the active DL BWP(s) of all scheduling cell(s) from the downlink cells, if any pair of spans on the active DL BWP(s) of any two scheduling cells from the downlink cells are within a same set of up to consecutive symbols, or have their first symbols separated by at least symbols,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0> |

* ***Option 2****: Adopt the following text proposal for section 10.1 in TS 38.213:*

|  |
| --- |
| < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0>  - per span 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 the starting symbol of any pair of overlapping spans is the same,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0> |

**Please provide your views and your reasons on the above text proposals for “aligned spans” case**.

|  |  |
| --- | --- |
| *Company* | *View* |
| Feature lead | As discussed in RAN1#100b-e meeting, UE will first determine the combination (X, Y) on each serving cell, and then check whether the spans on the serving cell with the same combination (X, Y) is aligned or not. Therefore, if the first symbol of any pair of spans is different, then the ending symbol of the pair of spans is different either, since the span duration for all serving cells using combination (X, Y) is the same. Of course, it is possible that only some symbols in a span has PDCCH monitoring occasions, but these empty symbols should located at the end of a span, not at the start of a span. Therefore, it seems ok to only define the start symbol of a span as shown in option 2.  The following detailed procedure should be applied according to the current spec:   * **Step 1**: Determine the applicable combination (X, Y) to acquire the maximum number of non-overlapping CCEs and PDCCH candidates for each cell. This is done according to: “*If the 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 two or more of the multiple combinations , the UE is expected to monitor PDCCH on the cell according to the combination associated with the largest maximum number of and .”* * **Step 2**: For all cells that result into the same (X, Y) according to step 1, construct the union of all PDCCH monitoring occasions. Determine the applicable (X, Y) for the union of PDCCH monitoring occasions. If it is the same (X, Y) as for the single cells, the span configuration is considered as aligned. Otherwise, the spans are not aligned. |
| *Samsung* | *We consider the existing specifications as clear but open to discuss potential revisions.* |
| *Quectel* | I’m wondering why we still need “*the starting symbol of any pair of overlapping spans is the same*” here considering that “*the span duration is aligned among all the serving cells*” according to FL’s reply to **Update #1 for discussion**?  Chengyan> I was saying that span duration on all the serving cells are the same. |
| Qualcomm | With a 2-step procedure mentioned by the feature lead above, it is unclear why any change is needed. However, we are also fine to discuss further.  Regarding the example provided by Intel, given that we assume for the new PDCCH capability, similar to FG 3-5b, the PDCCH monitoring occasions of FG 3-1 should also be included, we are just wondering if the span pattern on the second carrier is valid.  Chengyan> CC2 may not have FG 3-1? |
| Intel | For the 2nd step of the 2-step procedure from the FL, determining the applicable (X, Y) for the union of PDCCH MOs across the cells with same (X,Y) would still result in (2,2) as the combination for the example we cited (originally from Ericsson) at least for 1-symbol CORESET cases. This can be addressed either using the first or second option captured above, and we are open to the 2nd option suggested by the FL as well to minimize spec-changes. |
| HW/HiSi | We are open to discuss further. The example from Intel should result into un-aligned spans, but according to current definition, it would be aligned spans. And update is needed.  We tend to prefer Option 2, it is simpler and the formulation “*and the starting symbol of any pair of overlapping spans is the same*” is solving the problem raised by Intel. |
| Ericsson | We agree with the understanding on the procedure (Step 1, Step 2). However, we disagree with the FL view that after Step 1, the span duration for all serving cells using combination (X, Y) is the same. The span duration for each serving cell is determined according to the span definition in Section 10.1, i.e., the duration of a span is , where is a maximum duration among durations of CORESETs that are configured to the UE and is a minimum value of in the combinations of that are reported by the UE. It could happen that in different serving cells, UE reports different combination of multiple (X,Y) and is configured with different CORESET durations (as shown in **Update #1 for discussion** above). In such case, the span duration may be different in the serving cells using the same combination (X, Y) for determining the CA limit scaling.  Chengyan> It is common understanding that for a combination (X, Y), then the duration can only go up to Y.  This is illustrated in the figure below where for CC2, when max CORESET duration is not more than 2 (e.g., 2), the span duration according to the span definition in the specification is equal to 2, i.e., . However, according to the specification, CC2 is considered as monitoring with the limit corresponding to (7,3) and therefore grouped together with CC1 for the purpose of CA limit scaling.    Figure: Example of different DL cells from the   downlink cells having different span durations. A UE repots (7,3) for CC1 and (2,2),(4,3),(7,3) for CC2. For each CC, spans pattern are determined according to the span definition in the specification where span duration = max(max CORESET duration, Ymin).  Hence, the term “per span” should at least be clarified. For example, it can refer to a “resulting span” derived from the union of PDCCH monitoring occasions which then includes all PDCCH monitoring occasions in the “aligned” spans across the DL cells.  *We propose Option 3:*  *--*  < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0>  - per span 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 , where the span here refers to the resulting span derived from the union of PDCCH monitoring occasions,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0>  *--* |
| Sharp | We are fine with either option 1 or option 2 since the span duration for all serving cells using combination (X, Y) is the same as per FL comment.  Just for confirmation, the below example should be considered as an unaligned span case.    Chengyan> That’s my understanding. |
| vivo | We prefer Option 2 as there is less spec change.  Regarding the example provided by Sharp, we think it is an unaligned span case, according to Option 2. |
| ZTE | We prefer Option 1.  Depending on Proposal 1, it is possible that the following case is valid if the UE reports both (2,2) and (4,3). But, option 2 precludes this. In this sense, Option 1 should be fine.    Chengyan> With TP2, the figure it not aligned case since the starting symbol of the first symbol is not the same. |
| CATT | No strong view as both work. Slightly prefer option 2 as it has less spec impact. |

#### Summary of the status for question C-2-1

* ***Based on the above views, the main question is to clarify the motivation of the TP. As long as which TP to take, people are fine and TP2 seems simpler.***
* ***Feature lead:*** *The TP is to preclude the following case considered as aligned span case, which will be considered as aligned span case according to the current specification. The configuration of CC2 may happen, e.g. for SCell without CSS.*



* ***Feature lead recommendation:*** *Take TP 2.*

### Issue C-3: Corrections on “unaligned spans” case

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

|  |
| --- |
| If a UE is configured only with downlink cells using Rel-16 PDCCH monitoring capability, and with of the downlink cells using combination for PDCCH monitoring, and having active DL BWPs using SCS configuration , 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 span 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 ,  - TBD, otherwise  Where is a number of configured cells using Rel-16 PDCCH monitoring capability with SCS configuration . If a UE is configured with downlink cells using both Rel-15 PDCCH monitoring capability and Rel-16 PDCCH monitoring capability, is replaced by |

As shown in the above text, the text for “unaligned spans” case is still TBD. Some companies provide views on this.

***Option 1:*** *Rel-15 slot-based PDCCH monitoring is applied for “unaligned spans”, i.e. if a configuration of search space sets in one or more cells would result to “unaligned” spans, the UE expects to be configured for Rel-15 PDCCH monitoring on those cells*

* *Support: Samsung*
* *Reasons*
  + *“Unaligned spans” is not a typical configuration*
  + *Maintain optional simplicity*
* *Cons*
  + *Revert the agreements*

|  |
| --- |
| If a UE is configured only with downlink cells using Rel-16 PDCCH monitoring capability, and with of the downlink cells using combination for PDCCH monitoring, and having active DL BWPs using SCS configuration , 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  - expects that the union of PDCCH monitoring occasions on all scheduling cells from the downlink cells results to PDCCH monitoring according to the combination , and  - is not required to monitor more than PDCCH candidates or more than non-overlapped CCEs per span on the active DL BWP(s) of all scheduling cell(s) from the downlink cells  where is a number of configured cells using Rel-16 PDCCH monitoring capability with SCS configuration . If a UE is configured with downlink cells using both Rel-15 PDCCH monitoring capability and Rel-16 PDCCH monitoring capability, is replaced by . |

***Option 2:*** *Adopt the following text proposal for section 10.1 in TS 38.213:*

|  |
| --- |
| < Unchanged parts omitted, TS 38.213, Subclause 10.1, Editor’s CR with changes accepted>  If a UE is configured only with downlink cells using Rel-16 PDCCH monitoring capability, and with of the downlink cells using combination for PDCCH monitoring, and having active DL BWPs using SCS configuration , 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 span 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 ,  - for the sum of the number PDCCH candidates and corresponding number of non-overlapped CCEs across any set of spans on the active DL BWP(s) of different scheduling cell(s) from the downlink cells, with at most one span per scheduling cell for each set of spans, otherwise  < Unchanged parts omitted, TS 38.213, Subclause 10.1, Editor’s CR with changes accepted> |

* *Support: Intel*

***Option 3 (original proposal in RAN1#100b-e):*** *Adopt the following text proposal for section 10.1 in TS 38.213:*

|  |
| --- |
| < Unchanged parts omitted, TS 38.213, Subclause 10.1, Editor’s CR with changes accepted>  If a UE is configured only with downlink cells using Rel-16 PDCCH monitoring capability, and with of the downlink cells using combination for PDCCH monitoring, and having active DL BWPs using SCS configuration , 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 span 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 ,  - 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 parts omitted, TS 38.213, Subclause 10.1, Editor’s CR with changes accepted> |

* *Support:*

**From feature view**: It seems we need more discussion on this issue. Firstly, it would be good for us not to revert the agreement if possible. Relying on gNB to ensure aligned span cases or if impossible then following Rel-15 as proposed by option 1 may be too restrictive, especially considering potential limitation on the periodicity and slot offset of CSS. Of course, if gNB can be able to configure it as span aligned case, I think gNB do that as much as possible. More views are needed before we can make any proposal here.

**Question C-3-1**: Which option do you prefer for defining “unaligned spans” case?

**Please provide your views and your reasons on the above question C-3-1 for “unaligned spans” case.**

|  |  |
| --- | --- |
| *Company* | *View* |
| *Samsung* | *Our proposal is to consider a cell that would result to unaligned spans as a cell with Rel-15 PDCCH monitoring. The motivations are (a) to not violate the agreement that the number of PDCCH candidates / non-overlapping CCEs per slot is not less than the Rel-15 ones and (b) to avoid such a cell penalizing PDCCH monitoring in remaining cells that would otherwise have aligned spans for (X, Y).* |
| *Quectel* | *Option 1 may force gNB to not configure Rel-16 PDCCH monitoring and unaligned spans simultaneously. It will largely restrict gNB span configuration as well as MO configuration. We are not sure whether the unaligned configuration can be considered a very corner case. We’d like to hear more companies’ view.* |
| Qualcomm | Option 3; however, it should be clarified further that the constraints should be satisfied for all valid sets of spans across the carriers.  Regarding (a) pointed out by Samsung, it should be noted that the total number of CCEs/BDs per slot is at least 2x of Rel. 15. Hence, the agreement is not violated. For (b), it is gNB’s choice how to configure the CORESETs and search spaces across different carriers. If a non-aligned scenario is undesirable, a gNB can simply avoid a configuration that leads to a non-aligned pattern. |
| Intel | We would be fine with either options 1, 2, or 3!  Options 2 and 3 are identical. The only difference is that Option 2 is spelling out what the limits are on. This was motivated by prior comments that “per set of spans across the active DL BWP(s)” was not very clear. So, now, if companies are fine with Option 3 text, we can accept it as well.  On Option 1, we had also suggested the same two meetings ago that with the agreed characterization of there is not a great deal of flexibility in any case beyond the “aligned span” cases. Thus, if agreeable to all, we can also accept Option 1. |
| HW/HiSi | A question for clarification to Samsung (“*Our proposal is to consider a cell that would result to unaligned spans as a cell with Rel-15 PDCCH monitoring)*  Do you mean that if the network would e.g. configure 2 cells that would result in (X, Y) = (4, 3) but which are not aligned, then the gNB should configure both cells with Rel-15 monitoring or just one of them?  Chengyan> In my understanding, just one of them. But good question is which one to choose if there is no any two cells are aligned. |
| Ericsson | We support Option 3. |
| Sharp | We support option 3. |
| vivo | We support option 3. |
| ZTE | No strong preference. |
| CATT | We support to keep the agreement as it is. The agreement has been debated extensively and is accepted to all companies. The agreement should not be reverted it is not totally wrong.  For option 2 and option 3, we don’t see big difference. We slightly prefer option 3 as is simpler and more align with the description of aligned span. |

#### Summary of the status for question C-3-1

***Option 1:*** *Consider a cell that would result to unaligned spans as a cell with Rel-15 PDCCH monitoring*

* *Support: Samsung, Intel (fine),*
* *Reasons*
  + *Not violate the agreement that the number of PDCCH candidates / non-overlapping CCEs per slot is not less than the Rel-15 ones*
  + *Avoid such a cell penalizing PDCCH monitoring in remaining cells that would otherwise have aligned spans for (X, Y)*
* ***Question 1****: Which cell to take as Rel-15 if there is no any two cells are aligned. The simple example is that if only configured two cells, and these two are not aligned.*
* ***Question 2****: If we really want to go to this direction, instead of considering this kind of cell as a Rel-15 cell, is it better to consider it as a separate group of the Rel-16 cell? For example, if there are 3 cells, CC1 and CC2 are aligned, while CC3 is not aligned with both CC1 and CC2, then is it better to calculate the limit for CC3 separately? Detailed solution as option 4.*

***Option 2:***

* *Support: Intel*

***Option 3:***

* *Support: Qualcomm, Intel (fine), Ericsson, Sharp, Vivo, CATT*
* *Reasons*
  + *gNB can avoid configuring non-aligned span case if it would result in much worse PDCCH monitoring*

***Option 4****: If a UE is configured with downlink cells with Rel-16 PDCCH monitoring capability with an associated combination (X, Y) and SCS configuration µ, where* , *the UE is not required to monitor more than* *non-overlapping CCEs per span on the active DL BWP(s) of scheduling cell(s) from the downlink cells if the spans on all downlink cells from the downlink cells are aligned, where*

* + *The is the number of cells from the cell set with same numerology , same associated combination (X, Y) and that are satisfying aligned-span condition.*
  + *is the number serving cells configured with Rel-16 PDCCH monitoring capability with SCS configuration j.*
  + *If a UE is configured with multiple carriers with a mix of Rel-15 and Rel-16 PDCCH monitoring capability, is replaced by .*
  + *The associated combination (X, Y) is the combination (X, Y) associated with largest maximum number of , if the UE indicates a capability to monitor PDCCH according to multiple (X, Y) combinations and a configuration of search space sets to the UE results in a separation of any two consecutive PDCCH monitoring spans that is equal to or larger than the value of X for two or more of the (X, Y) combinations.*
  + *Support:*
  + *Reasons*
    - *Remove the restriction among the carriers with aligned span cases*
    - *Simpler to implementation and more structured in specification compared to option 1.*

***Feature lead recommendation:*** *At this late stage, I would recommend to go to the majority view, i.e. option 3, and not prefer to re-open the discussion based our previous experience. Of course, if we can magically agree to either option 1 or option 4, for sure I would be ok to take it since it does provide more benefits.*

### Issue C-4: Enhanced PDCCH monitoring capability for cross-carrier scheduling

Huawei (R1-2003525), Intel (R1-2001998) and Quectel (R1-2003942) discusses Rel-16 PDCCH monitoring capability for cross-carrier scheduling case. Two alternatives were discussed in the contributions:

* **Option 1**: Both the scheduling cell and scheduled cell for cross-carrier scheduling are restricted to be configured the same PDCCH monitoring capability (i.e., *Rel-15 PDCCH monitoring capability* or *Rel-16 PDCCH monitoring capability*), and provided the same combination (X, Y) when *Rel-16 PDCCH monitoring capability* is configured,
  + *Support: Huawei/HiSilicon, Spreadtrum, Ericsson, Sharp, Vivo*
  + *Reasons:*
    - *To simplify the PDCCH BD/CCE dimensioning and overall operation considering typical use cases*
* **Option 2**: There is no restriction on the PDCCH monitoring capabilities for scheduling cell and scheduled cell, but the calculations of and are based on the number of scheduled cells whose scheduling cells are configured with the same PDCCH monitoring capability and provided the same combination (X, Y) when *Rel-16 PDCCH monitoring capability* is configured.
  + *Support: Quectel*
  + *Reasons:*
    - *Does not prohibit the use of cross-carrier scheduling with different PDCCH monitoring capabilities or with different combinations and maintains the scheduling flexibility with limited specification efforts*

**From feature view**: More views are needed before making any proposal here.

**Please provide your preference between option 1 and option 2 for enhanced PDCCH monitoring capability for cross-carrier scheduling.**

|  |  |
| --- | --- |
| *Company* | *View* |
| *Samsung* | *No need to discuss.*  *TS 38.331 explicitly mentions there is no IE except for SS set in PDCCH config, and there is no IE except for #candidates in SS set config if they are for a scheduled cell in CCS, which is inherited from Rel-15. Basically, under the current structure in TS 38.331, the scheduling cell and scheduled cell cannot have different PDCCH monitoring behaviors.* |
| *Quectel* | Separate discussions may be needed for PDCCH monitoring capability and combination (X, Y) determination in case of cross-carrier scheduling.   * For PDCCH monitoring capability, as pointed out by our contribution (same understanding as Samsung above), no PDCCH monitoring capability indication will be contained by PDCCH-config for a scheduled cell. We think the ambiguities mainly arise from the current wording in 38.213. The default behavior for capability determination is defined as*”* *If the UE is not provided PDCCHMonitoringCapabilityConfig, the UE monitors PDCCH on the serving cell per slot.”* * To reflect agreements for Rel-16 CA enhancements that scheduling cell’s numerology is used instead of scheduled cell to group the scheduled cells, current 38.213 for Rel-15 PDCCH capability says “*If a UE is configured with downlink cells using Rel-15 PDCCH monitoring capability and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration* ”. According to current specification wordings, someone may mis-interpret that Rel-15 PDCCH monitoring capability is provided for the downlink cells while SCS configuration is used by their scheduling cell(s).   Chengyan> I missed the point here.   * For combination (X,Y) determination, if combination(X,Y) report is per FS or per FSPC, at least for inter-band CA, it cannot be ensured by a UE to report a same combination (X,Y) for a scheduled cell and its scheduling cell. Clarifications are needed, which may also have impacts to UE feature discussion.     We also need to discuss whether a same cell grouping principle as agreed by Rel-16 CA enhancement is supported/applied for span based monitoring (Rel-16 PDCCH monitoring), i.e., “ downlink cells” represents scheduled cells whose scheduling cell(s) using SCS configuration , or represents scheduled cells using SCS configuration . We think combination (X,Y) should follow SCS for cell grouping. |
| Intel | We are fine with clarifying the behavior as in Option 1 (we proposed this last meeting). However, we also see that it could be implicitly determined this way as pointed out by Samsung (the reason we did not propose it again this meeting 😊).  Perhaps a conclusion in RAN1 to clarify the intention in Option 1 may be sufficient? |
| *HW/HiSi* | Option 1 |
| Ericsson | We support Option 1. |
| *Sharp* | Option 1 |
| vivo | We support Option 1. |
| ZTE | Not critical as mentioned by Samsung and Intel. |
| CATT | Either Rel-15 PDCCH monitoring capability or Rel-16 PDCCH monitoring capability is associated with PDCCH monitoring. Once CCS is configured, a UE will only monitor its PDCCH on the scheduling cell. It doesn’t care what PDCCH monitoring capability on the scheduled cell at all. Even the scheduled cell can be a scheduling cell for another UE, e.g. UE2, UE1 doesn’t care. The PDCCH configuration can only follow the capability of scheduling CC. I don’t think it is an issue need to be fixed. |

#### Summary of the status for issue C-4

* ***Samsung & ZTE&CATT****: No need to discuss*
  + ***Reason***
    - *TS 38.331 explicitly mentions there is no IE except for SS set in PDCCH config, and there is no IE except for #candidates in SS set config if they are for a scheduled cell, which is inherited from Rel-15. Basically, under the current structure in TS 38.331, the scheduling cell and scheduled cell cannot have different PDCCH monitoring behaviors.*
  + ***Feature lead:*** *I noticed similar thing before also, but when I checked the current TS 38.213, there are a few places is not that clear, similar as some of the points pointed out by Quectel.*

* ***Clarification 1****: Is it clear that the text highlight in yellow below can show that the scheduled cell(s) will be included in also? e.g., if there is only one scheduling cell using combination (X, Y), but this scheduling cell will schedule 2 serving cells, then 2 will be used for ?*

***=================***

If a UE is configured only with downlink cells using Rel-16 PDCCH monitoring capability, and with of the downlink cells using combination for PDCCH monitoring, and having active DL BWPs using SCS configuration , 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

***=================***

* ***Clarification 2****: Is it allowed that the reported PDCCH monitoring capability by the UE is different for the scheduling cell and scheduled cell? e.g. scheduling cell with R16 PDCCH monitoring capability with scheduled cell not supporting Rel-16 capability according to the reported UE capability? E.g. scheduling cell with Rel-16 combination (2, 2) to schedule a cell with only (7, 3) reported?*
* ***Feature lead****: In my understanding, only the capability of the scheduling cell matters.*
* ***Clarification 2****: Is it clear that scheduled cell(s) can be considered as a serving cell provided with PDCCHMonitoringCapabilityConfig?*

***=================***

If a UE is provided *PDCCHMonitoringCapabilityConfig* for a serving cell, the UE obtains an indication to monitor PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs

- per slot, as in Tables 10.1-2 and 10.1-3, if *PDCCHMornitoringCapabilityConfig* = *R15 PDCCH monitoring capability*, or

- per span, as in Tables 10.1-2A and 10.1-3A, if *PDCCHMornitoringCapabilityConfig* = *R16 PDCCH monitoring capability*

If the UE is not provided *PDCCHMonitoringCapabilityConfig*, the UE monitors PDCCH on the serving cell per slot.

***=================***

* ***Feature lead****: My thinking is that the text is clear. Even PDCCHMonitoringCapabilityConfig is not configured directly on the scheduled cell, but it is configured on the scheduling cell, thus still can consider as “provided”.*

## Summary of the status and further discussion points

Please go back check the summary in section 2.1 also before going through here, because I also provided some reply to some of the comments above.

### Issue C-1: Corrections on span duration

Based on the summary of the status for issue C-1 in section 2.1, let’s further check the following:

* ***Common understanding from RAN1#100b-e***
  + *If a UE monitors PDCCH on a cell according to combination, then a CORESET with duration larger than Y is not allowed.*
  + *With the above understanding, then the example in the figure below is not allowed.*



**Please comment if you don’t agree the above understanding**.

|  |  |
| --- | --- |
| *Company* | *View* |
| Feature lead | Based on the inputs from the first round, Ericsson shared different understanding |
| Ericsson | We disagree with FL understanding. The claimed ‘common understanding’ above is incorrect since it contradicts with RAN1 agreements and current 38.213 spec text.  The example above is definitely allowed, according to the existing specification text cited below. The spec text is also in line with the definition in FG3-5b which is the common understanding since Rel-15.  For the figure, 𝑌min =2 and 𝑑CORESET,max =3 resulting in 𝑑span =3. This span pattern is valid with respect to (2,2) in terms of span gap, i.e., “minimum time separation of X symbols between the first symbol of two consecutive spans, including across slots”. Since UE reports both (2,2) and (4,3), the configuration should be valid as UE is capable of monitoring it according to its reported capabilities. Thus, we do not see the need to add any further restriction to the specification or change the existing definition since Rel-15 regarding monitoring span.  ------ TS 38.213 V16.1.0 -------  *A UE reports one or more combinations of (X, Y) number of symbols, where X ≥ Y, for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span is 𝑑span = 𝑚𝑎𝑥(𝑑CORESET,max, 𝑌min), where 𝑑CORESET,max is a maximum duration among durations of CORESETs that are configured to the UE and 𝑌min is a minimum value of Y in the combinations of (X, Y) that are reported by the UE. A last span in a slot can have a shorter duration than other spans in the slot.*  --------------------------------------- |

* ***Whether to determine the combination (X, Y) first or determine the span duration first based on the current specification, if UE reports the capability of supporting combination (2, 2) together with combination (4, 3) and/or (7, 3)?***

*=======================*

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 . If the 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 two or more of the multiple combinations , the UE is expected to monitor PDCCH on the cell according to the combination associated with the largest maximum number of and .

*========================*

* + ***Understanding 1****: UE determines the span duration first, then determine the valid combination (X, Y)* 
    - ***Support****: Sharp, Vivo, ZTE, Huawei*
    - ***Reasons***
      * *From the text highlight in yellow in the spec, it looks more nature that* 
        + *UE will determine the span duration first,*
        + *then based on the span duration get the span separation,*
        + *then based on the span separation get the (X, Y) that with X smaller than the span separation,*
        + *then determine the used combination (X, Y) among the more than one (X, Y) combinations by checking which combination has the largest M and C*
  + ***Understanding 2****: UE determines the valid combination (X, Y) first, then determine the span duration* 
    - ***Support****: Samsung, Intel*
    - ***Reasons (guess from FL)***
      * *Check the candidate combinations (X, Y) directly first, by assuming when checking whether X=2 is valid or not automatically assuming span duration 2 is used, and when checking whether X=4 or X=7 is valid or not automatically assuming span duration 3;*
      * *then determine the used combination (X, Y) among the more than one (X, Y) combinations by checking which combination has the largest M and C*
    - ***Reasons (from Samsung)***
      * *If the UE determines the span duration first, the only way for the UE to end up with a (X, Y) other than (2, 2) would be for the gNB to configure a CORESET of 3 symbols for PDCCH monitoring. It should be clear that this is problematic – both for what the NW is mandated to do and for low scheduling latency requirements.*
  + ***Feature lead****: Both ways could work, as long as we achieve common understanding here. More views are needed.*

**Please indicate your preference between the above understanding** #1 **and understanding #2.**

|  |  |
| --- | --- |
| *Company* | *View* |
| Samsung | Understanding #2 |
| Quectel | In our view, the fundamental difference of these two understandings is which one, gNB or UE, should take the responsibility to ensure PDCCH correct reception. Prior to CSS CORESET setting, e.g., CORESET#0, the network may not know the UE’s capability, so our question is whether CSS CORESET duration is also considered here?  Chengyan> Yes |
| Intel | **Understanding #2.**  To rephrase the reasoning/description guessed by the FL, the UE simply evaluates the candidate combinations (X, Y) it supports for a given set of SS set configurations, and identifies which (X, Y) combinations are satisfied. Then, if multiple satisfy, then it picks the with the largest maximum number of and .  In this sense, to be precise, the “automatic assumption” mentioned under Understanding 2 is just part of the process of identifying candidate combinations that are satisfied by the provided configuration.  Agree with Samsung’s reasoning on the issue with Understanding #1. This was not an issue for R15, but becomes an issue due to the coupling of the determination of BD/CCE limits.  **Updated view (also reflected below in response to next and new questions):**  Based on some offline discussions, we realized that a further adjustment to TP2 would be necessary for Understanding #2. Specifically, our proposal would be TP2’ that states:  “If a UE monitors PDCCH on a cell according to combination *X,Y*, the duration of a span is no longer than *Y*.*”*  With the above change, effectively we have the following steps:   1. UE determines which (X,Y) is selected based on candidate (X,Y) values for provided SS Set configurations. 2. Then, for the identified span combination (X,Y), the UE determines the span duration for each of the spans corresponding to the actual MOs configured.   Thus, in step 1, UE determines the (X,Y) combination that should be assumed for a serving cell, for a given PDCCH monitoring via SS set configurations.  In step 2, the span durations depend on the exact SS set configurations and are contained within the spans corresponding to the identified (X,Y) combination (and both share same starting symbols). Note that the actual span duration can be different for different spans within the slot duration. |

**If your preference is understanding #1, then please also indicate whether you can accept TP 1 below. If your preference is understanding #2, then please also indicate whether you can accept TP 2 below.**

|  |  |
| --- | --- |
| *Company* | *View* |
| Samsung | TP 2 is unnecessary – specification of network misconfigurations should be avoided.  Chengyan> You mean TP1 here?  Aris> Yes |
| Quectel | May have relationship with whether CSS CORESET is considered for . |
| Intel | We support TP2.  **Updated view:**  A further adjustment to TP2 would be necessary for Understanding #2. Specifically, our proposal would be TP2’ that states:  “If a UE monitors PDCCH on a cell according to combination *X,Y*, the duration of a span is no longer than *Y*.*”* |
| Ericsson | Our understanding is according to understanding #1 which is following the current version of the specification and is also in line with the definition in FG3-5b.  We do not think either TP is needed. |

***TP 1****: Adopt the following text proposal for section 10 in TS 38.213:*

|  |
| --- |
| \*\*\* Unchanged text is omitted \*\*\*  A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span is , where is a maximum duration among durations of CORESETs that are configured to the UE and is a minimum value of in the combinations of that are reported by the UE. A last span in a slot can have a shorter duration than other spans in the slot. When is equal to 3, a UE is not expected to be configured with PDCCH monitoring occasions resulting into a separation of the first symbol of two consecutive spans that is smaller than 4.  \*\*\* Unchanged text is omitted \*\*\* |

***TP 2****: Adopt the following text proposal for section 10 in TS 38.213:*

|  |
| --- |
| A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. If a UE monitors PDCCH on a cell according to combination , the duration of a span is . A last span in a slot can have a shorter duration than other spans in the slot. |

Based on the above inputs, it seems most people prefer understanding 2, therefore I make the following proposal accordingly.

#### *Proposal C-1: Adopt the following text proposal for section 10 in TS 38.213:*

|  |
| --- |
| \*\*\* Unchanged text is omitted \*\*\*  A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. If a UE monitors PDCCH on a cell according to combination , the duration of a span is up to . A last span in a slot can have a shorter duration than other spans in the slot.  \*\*\* Unchanged text is omitted \*\*\* |

**Please comment if you don’t agree the above proposal**.

|  |  |
| --- | --- |
| *Company* | *View* |
| Intel | **Updated view on Proposal C-1**  Based on some offline discussions, we realized that a further adjustment to TP2 would be necessary for Understanding #2. Specifically, our proposal would be TP2’ that states:  “If a UE monitors PDCCH on a cell according to combination *X,Y*, the duration of a span is no longer than *Y*.*”*  With the above change, effectively we have the following steps:   1. UE determines which (X,Y) is selected based on candidate (X,Y) values for provided SS Set configurations. 2. Then, for the identified span combination (X,Y), the UE determines the span duration for each of the spans corresponding to the actual MOs configured.   Thus, in step 1, UE determines the (X,Y) combination that should be assumed for a serving cell, for a given PDCCH monitoring via SS set configurations.  In step 2, the span durations depend on the exact SS set configurations and are contained within the spans corresponding to the identified (X,Y) combination (and both share same starting symbols). Note that the actual span duration can be different for different spans within the slot duration.  Without the above change, ZTE’s example would still lead to unaligned spans, i.e. if span duration is fixed to Y (*courtesy of Xianghui, ZTE*):    instead of the following:    Chengyan> Seems we can change it to “up to Y” |
| Samsung | Fine with the latest update in proposal C-1.  Although this substantially removes a possibility of confusing what the UE procedure is, we may also discuss whether there is any need to capture in the specs the understanding of the two steps that was previously mentioned by the FL or above by Intel. If clear to everyone, of course no issue. May suffice to just put in the same (or adjacent) paragraph in 38.213 the current text that appears later and mentions how the UE determines (X, Y). |
| Ericsson | We agree with Intel and ZTE that the above picture in Intel response should be considered as “aligned spans”.  However, we do not support the change of span definition in the current specification which is based on FG 3-5b and is already the common understanding since Rel-15.  For the CA case, in order to achieve the goal of having a proper condition for the “aligned spans”, it is sufficient to modify the text in the “aligned spans” to the following.  ------------------------  < unchanged parts omitted, TS 38.213, Subclause 10.1, R1-2003276 CR>  - per span 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 , where the span refers to the resulting span derived from the union of PDCCH monitoring occasions across the downlink cells,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, R1-2003276 CR >  ---------------------------  In line with the agreement made in last meeting, it is sufficient to have a condition based on the gap and duration of PDCCH monitoring occasions which reflect actual PDCCH monitoring performed at the UE. Note that the last part of the text is added to clarify that the limits are applied to the resulting span across CCs, since individual span for each CC may be slightly different (for example, picture above in Intel response). |

**Question C-1-2**: Whether to keep “A last span in a slot can have a shorter duration than other spans in the slot. ”, and if yes whether any further clarification needed.

**Summary of the status for proposal 2 under issue C-1**

* ***Support****: Quectel, Huawei, Sharp, Vivo*
* ***Reasons***
  + *With the current spec, it is not clear what the exact duration is for the last span, because the current spec just say “has shorter duration…”. For example, if d\_span is 2, then whether 1 or 2 should be taken for the last span.*
  + ***Feature lead:*** *With the sentence “A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates”, it should be able to implicitly get whether the exact duration. Though I do agree no harm to make the spec clearer.*
* ***Not support****: Samsung, Qualcomm, Intel, Ericsson, ZTE, CATT* 
  + ***Qualcomm:*** *Not clear why the change is needed*
  + ***Feature lead:*** *With the current spec, it is not clear what the exact duration is for the last span, because the current spec just say “has shorter duration…”. For example, if d\_span is 2, then whether 1 or 2 should be taken for the last span.*
* ***Feature lead recommendation:*** *Since more companies think not necessary, I would suggest not to take the text proposal, though I do think no harm to make the spec clearer.*

In addition, Samsung raised a question that *how can both of the following be satisfied:* *(a) minimum separation of all PDCCH MOs in different spans is X symbols, including across slots, and (b) the span duration is less than Y symbols at the end of the slot.*

* ***Intel****: Don't see any contradiction*
* ***Feature lead:*** *Agree with Intel no contradiction. When there is a shorter span at the end of a slot, as long as the first span in the next slot doesn’t start at the beginning of the next slot with enough gap, the separation even across slots can be met also. Of course, if the first span in the next slot starts from the beginning, then gNB need to ensure there is no PDCCH monitoring occasions at the end of the slot to get a shorter span there.*

**Conclusion**: No any spec change for the last span in a slot

### Issue C-2: Corrections on “aligned spans” case

**Summary of the status for question C-2-1**

* ***Based on the above views, the main question is to clarify the motivation of the TP. As long as which TP to take, people are fine and TP2 seems simpler.***
* ***Feature lead:*** *The TP is to preclude the following case considered as aligned span case, which will be considered as aligned span case according to the current specification. The configuration of CC2 may happen, e.g. for SCell without CSS.*



* ***Feature lead recommendation:*** *Take TP 2.*

***Proposal 2.2-1****: Adopt the following text proposal for section 10.1 in TS 38.213:*

|  |
| --- |
| < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0>  - per span 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 the starting symbol of any pair of overlapping spans is the same,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0> |

**Please comment if you have strong concern with the above proposal.**

|  |  |
| --- | --- |
| *Company* | *View* |
| Samsung | If the span duration remains as , the proposal should also include “… the starting symbol or the ending symbol of any pair …”  Overall, the proposal is unnecessary.  Chengyan> Since we will only have the cell(s) with the same combination (X, Y), then if the starting symbol is the same then the ending symbol is the same also, therefore we only need to define the starting symbol here. My assumption is that even with formula d\_span here, the CORESET duration is smaller or equal to Y for a valid combination (X, Y). For example, if there is CORESET with 3-symbol is configured, then combination (2, 2) won’t be a valid combination. Not sure if I missed your point here.  [Aris2]: Yes, I agree – (2, 2) would be invalid if the UE is configured a CORESET of 3 symbols – no need for ‘ending symbol’. |
| Quectel | It is still not crystal clear for us whether span is defined per cell or cross cell if the texts are added. |
| Intel | Unfortunately, we cannot agree accept the proposal.  With the example case from ZTE, we realize that the above TP (based on Option 2), although it solves the issue with the earlier Ericsson example, is unnecessarily restrictive. This is not the case with Option 1.  There is no reason the following case should be considered as non-aligned:    **Thus, we propose to consider the TP based on Option 1** – although apparently a bit more verbose, it is the most accurate and unambiguous set of conditions to define aligned spans.  Chengyan> I kind of agree with you. I updated the proposal accordingly. Let’s see if any concern. |

***Revised Proposal 2.2-1****: Adopt the following text proposal for section 10.1 in TS 38.213:*

|  |
| --- |
| < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0>  - per span on the active DL BWP(s) of all scheduling cell(s) from the downlink cells, if any pair of spans on the active DL BWP(s) of any two scheduling cells from the downlink cells are within a same set of up to consecutive symbols, or have their first symbols separated by at least symbols,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0> |

**Please comment if you don’t agree the above proposal**.

|  |  |
| --- | --- |
| *Company* | *View* |
| Feature lead | The original proposal 2.2-1 may result in that the following case considered as “unaligned spans” based on the comments from Intel and ZTE. I think it would be good for us to take it as aligned spans case also.    **Updated feature lead view**:  Agree with Samsung and Intel, the original proposal with modification seems simpler. However, Ericsson may be not ok with that one also based on the comment below. We need more discussion. |
| Samsung | If the objective is to have as “aligned” spans such as the ones included in the “FL view” above, combined now with the change in C-1, it is better to go back to the previous text and add the text we had suggested (i.e. add “or ending symbol”) because it is now a better fix. For example, the following are not aligned under the current TP – the first symbols for ‘span1’ on CC2 and ‘span2’ on CC1 are not separated by X=4 (and are not within the same up to Y=3 symbols) - but they are aligned with the previous TP by adding “or the ending symbol”.  cid:image001.png@01D6358A.28BDBA90 |
| Ericsson | We do not support revised proposal 2.2-1 above.  As commented earlier, in order to achieve the goal of having a proper condition for the “aligned spans”, it is sufficient to modify the text in the “aligned spans” condition to the following without needing to change the span definition. In other words, the text in the “aligned spans” can be updated to:  < unchanged parts omitted, TS 38.213, Subclause 10.1, R1-2003276 CR>  - per span 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 , where the span refers to the resulting span derived from the union of PDCCH monitoring occasions across the downlink cells,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, R1-2003276 CR >  In line with the agreement made in last meeting, it is sufficient to have a condition based on the gap and duration of PDCCH monitoring occasions which reflect actual PDCCH monitoring performed at the UE. Note that the last part of the text is added to clarify that the limit is applied to the resulting span since now the actual duration of “aligned spans” across CCs can be different. |
|  |  |

#### *Further revised proposal 2.2-1: Adopt the following text proposal for section 10.1 in TS 38.213*

|  |
| --- |
| < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0>  - per span 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 the starting symbol or the ending symbol of any pair of overlapping spans is the same,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0> |

**Please comment if you have strong concern with the above recommendation.**

|  |  |
| --- | --- |
| *Company* | *View* |
| Apple | It seems so far we have not treated potential receive timing difference among different CCs. With interband CA, there can be up to 33 microseconds in receive timing between CCs. With 30 KHz SCS, that translates into one symbol’s offset as shown in the example below. It is necessary to clarify the aligned & un-aligned definitions is w.r.t. to the actual receive timing, then for inter-band CA, CCs with the same span pattern (e.g. (2,2), (4,3), …) should be considered un-aligned. For more details please see R1-2004874.  Image |
|  |  |

### Issue C-3: Corrections on “unaligned spans” case

#### Summary of the status for question C-3-1

***Option 1:*** *Consider a cell that would result to unaligned spans as a cell with Rel-15 PDCCH monitoring (i.e. not consider unaligned spans in Rel-16)*

* *Support: Samsung,*
* *Reasons*
  + *Not violate the agreement that the number of PDCCH candidates / non-overlapping CCEs per slot is not less than the Rel-15 ones*
  + *Avoid such a cell penalizing PDCCH monitoring in remaining cells that would otherwise have aligned spans for (X, Y)*
* ***Question 1****: Which cell to take as Rel-15 if there is no any two cells are aligned. The simple example is that if only configured two cells, and these two are not aligned.*
* ***Question 2****: If we really want to go to this direction, instead of considering this kind of cell as a Rel-15 cell, is it better to consider it as a separate group of the Rel-16 cell? For example, if there are 3 cells, CC1 and CC2 are aligned, while CC3 is not aligned with both CC1 and CC2, then is it better to calculate the limit for CC3 separately? Detailed solution as option 4, which also means no considering unaligned spans in Rel-16.*

***Option 2:*** *Details seen section 2.1*

* *Support: Intel*

***Option 3:*** *Details seen section 2.1*

* *Support: Qualcomm, Intel (fine), Ericsson, Sharp, Vivo, CATT*
* *Reasons*
  + *gNB can avoid configuring non-aligned span case if it would result in much worse PDCCH monitoring*

***Option 4****: If a UE is configured with downlink cells with Rel-16 PDCCH monitoring capability with an associated combination (X, Y) and SCS configuration µ, where* , *the UE is not required to monitor more than non-overlapping CCEs per span on the active DL BWP(s) of scheduling cell(s) from the downlink cells if the spans on all downlink cells from the downlink cells are aligned, where*

* + *The is the number of cells from the cell set with same numerology , same associated combination (X, Y) and that are satisfying aligned-span condition.*
  + *is the number serving cells configured with Rel-16 PDCCH monitoring capability with SCS configuration j.*
  + *If a UE is configured with multiple carriers with a mix of Rel-15 and Rel-16 PDCCH monitoring capability, is replaced by .*
  + *The associated combination (X, Y) is the combination (X, Y) associated with largest maximum number of , if the UE indicates a capability to monitor PDCCH according to multiple (X, Y) combinations and a configuration of search space sets to the UE results in a separation of any two consecutive PDCCH monitoring spans that is equal to or larger than the value of X for two or more of the (X, Y) combinations.*
* *Support: Intel*
  + *Reasons*
    - *Remove the restriction among the carriers with aligned span cases*
    - *Simpler to implementation and more structured in specification compared to option 1.*

***Feature lead recommendation:*** *At this late stage, I would recommend to go to the majority view, i.e. option 3, and not prefer to re-open the discussion based our previous experience. Of course, if we can magically agree to either option 1 or option 4, for sure I would be ok to take it since it does provide more benefits.*

##### Proposal 2.2-2: Adopt the following text proposal for section 10.1 in TS 38.213:

|  |
| --- |
| < Unchanged parts omitted, TS 38.213, Subclause 10.1, Editor’s CR with changes accepted>  If a UE is configured only with downlink cells using Rel-16 PDCCH monitoring capability, and with of the downlink cells using combination for PDCCH monitoring, and having active DL BWPs using SCS configuration , 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 span 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 ,  - 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 parts omitted, TS 38.213, Subclause 10.1, Editor’s CR with changes accepted> |

**Please comment if you have strong concern with the above proposal.**

|  |  |
| --- | --- |
| *Company* | *View* |
| Samsung | OK if proponents demonstrate how the above can always fulfill the agreement that a resulting number of PDCCH candidates/non-overlapping CCEs is not less than the Rel-15 per slot limits. Otherwise, do not specify “unaligned” spans.  Chengyan> The assumption here first is that the configured cells doesn’t exceed the CC limit. For example, for 2 cells as below, I think according to the current formula, it is still ok for gNB to configure 28 on each span each cell? Which means the total number is still more than that in Rel-15. Meanwhile, it can meet the condition that any set of spans not exceed 56, please note that for “any set of spans” only one span from each cell.    Above just my quick thinking, others may have better idea.  [Aris2]: I was thinking ‘unaligned’ by having a 3-symbol CORESET also for CC2 and shifting it by 1 symbol to the right in the above figure.  Then, the ‘set of spans’ is over the entire slot and the limit is 36 BDs, not 56 BDs. It is also unclear then what the “resulting span” is.  That is a concern with the ‘option 3’ and the proposed TP for ‘unaligned’ spans.  Chengyan2> You mean the following figure, right? In my understanding, even, for this case, the “per set of spans” limit is still 56. According to the “per set of spans” definition, only “one span” will be included in the set. That is there will be only 2 spans from different cells in the “set of spans” as shown in the figure below. I am not sure what do you mean “‘set of spans’ is over the entire slot and the limit is 36 BDs, not 56 BDs”.      [Aris3]: Yes, agree. OK with the proposal. Although it will be restrictive for the assignment/partition of PDCCH monitoring, no issue concluding it now given that the setup is unlikely in practice (on top of the unlikely use of CA for Rel-16 PDCCH monitoring) and, if supported, a NW can configure the UE for FG3-5b type monitoring. |
| Quectel | Share similar feeling as Samsung although we do not have strong view on it. It is too restrictive for the unaligned case which probably leading to very conservative scheduling by gNB. That may eventually make no difference from no specifying unaligned spans. |
| Intel | If we go ahead with specifying anything for unaligned spans, we are fine with **either Options 2 or 3**. We do not quite see any issue with satisfying the earlier RAN1 agreement, assuming this is translated to a sum-constraint across a set of serving cells with a given (X,Y) and SCS.  Alternatively, we simply not specify anything about “unaligned spans”.  In our earlier response we had somehow missed the part about treating certain cells as “Rel-15 ones” as part of Option 1.  We are not sure if such approach can work as is – e.g., if the UE supports only FG 3-1 for R15 monitoring, and R16 monitoring, then a cell (configured with R16 monitoring) that is not aligned with one or more other cells for a given numerology for any of the supported span combinations will now have to be treated as R15 cell possibly with multiple MOs in a slot while the BD/CCE limits may only be defined over slot (per R15) and not per span, etc. Thus, we do not prefer to pursue any path of supporting configurations with unaligned spans. Basically, “dropping unaligned spans” to us means “UE does not expect configurations leading to unaligned spans”.  In this regard, Option 4 does indeed seem as a reasonable alternative for the reasons already listed if Options 2 or 3 are not agreeable.  We have updated our views in the summary above accordingly. |
| Ericsson | We prefer to keep the agreement regarding the non-aligned spans.  While the non-aligned spans can be restrictive in ‘random’ span distribution among the cells, there are cases where the spans are fairly regular, although do not satisfy definition of ‘aligned span’. One example is below. For such span patterns, it is necessary to keep the agreement for non-aligned spans. |

### Issue C-4: Enhanced PDCCH monitoring capability for cross-carrier scheduling

**Summary of the status for issue C-4**

* ***Samsung & ZTE****: No need to discuss*
  + ***Reason***
    - *TS 38.331 explicitly mentions there is no IE except for SS set in PDCCH config, and there is no IE except for #candidates in SS set config if they are for a scheduled cell, which is inherited from Rel-15. Basically, under the current structure in TS 38.331, the scheduling cell and scheduled cell cannot have different PDCCH monitoring behaviors.*
  + ***Feature lead:*** *I noticed similar thing before also, but when I checked the current TS 38.213, there are a few places is not that clear, similar as some of the points pointed out by Quectel.*

* ***Clarification 1****: Is it clear that the text highlight in yellow below can show that the scheduled cell(s) will be included in also? e.g., if there is only one scheduling cell using combination (X, Y), but this scheduling cell will schedule 2 serving cells, then 2 will be used for ?*

***=================***

If a UE is configured only with downlink cells using Rel-16 PDCCH monitoring capability, and with of the downlink cells using combination for PDCCH monitoring, and having active DL BWPs using SCS configuration , 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

***=================***

**Please provide your views on the above clarification 1. If you feel some clarification needed in the spec, please also indicate how to make the change if possible.**

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| --- | --- |
| *Company* | *View* |
| Samsung | It will be good (and need) to align the above text and the corresponding one for Rel-15 (the TP was not aligned and an adjustment was missed in the draft CR). At least “scheduling cells” needs to be included. |
| Quectel | We agree with FL that for Rel-15, it is more of wording alignment issue.  For Rel-16, it may be not that straightforward. In Rel-16 CA enhancement WI, there was an agreement as shown below  **RAN1#96 (Feb/Mar 2019)**  Agreements**:**   * At least for the case of lower SCS PDCCH scheduling a higher SCS PDSCH the earliest possible starting point for the PDSCH is defined by the end of the PDCCH + Δ   + Δ>0. Detailed value(s) FFS   + FFS other factor(s) impacting Δ * The limit of BDs/CCEs (per slot in the scheduling CC) for the scheduled CC is determined based on the numerology of the scheduling CC.   + Change the definition of NcellsDL,μ to “the number of configured DL-CCs whose scheduling cell is with active DL BWP having SCS configuration μ” as in Section 10.1 of 38.213   The highlighted parts in the agreement resulted to the highlighted texts in the current spec:  *If a UE is configured with downlink cells using Rel-15 PDCCH monitoring capability and with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , where , a DL BWP of an activated cell is the active DL BWP of the activated cell,*  The problem is whether the CA agreement should be extended to Rel-16 PDCCH monitoring or not. That was why I asked for Rel-16 PDCCH monitoring spec “*If a UE is configured only with downlink cells using Rel-16 PDCCH monitoring capability, and with of the downlink cells using combination for PDCCH monitoring, and having active DL BWPs using SCS configuration ,”* does “ *downlink cells*” represents scheduled cells whose scheduling cell(s) using SCS configuration , or represents scheduled cells using SCS configuration .  In another word, is cross-carrier scheduling with different numerologies supported for Rel-16 PDCCH monitoring?  We presume the answer is yes, otherwise, it will be rather inconsistent for Rel-15 cell and Rel-16 cell, especially considering a UE may be simultaneously configured Rel-15 cells and Rel-16 cells.  As combination (X, Y) cannot be applied without a given numerology, if this is the case, we think it is natural that combination (X, Y) should follow numerology when determining whether a scheduled cell belongs to the *cells,* i.e. according to its scheduling cell’s numerology and combination.  Chengyan> My thinking is yes also. The only thing we need to do is to make the spec clear. My current thinking is to add the similar sentence to the Rel-16. Your suggestion are welcome also.  ***=================***  If a UE is configured only with downlink cells using Rel-16 PDCCH monitoring capability *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, and having active DL BWPs using SCS configuration , 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  ***=================*** |

#### *Proposal 2.2-3: Adopt the following text proposal for section 10.1 in TS 38.213:*

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| --- |
| < Unchanged parts omitted, TS 38.213, Subclause 10.1, Editor’s CR with changes accepted>  If a UE is configured only with downlink cells using Rel-16 PDCCH monitoring capability 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, ~~and having active DL BWPs using SCS configuration ,~~ 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 span 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 ,  < Unchanged parts omitted, TS 38.213, Subclause 10.1, Editor’s CR with changes accepted> |

**Please provide your views on the above proposal 2.2-3. If you have comments, please provide your suggested changes also.**

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| *Company* | *View* |
| Samsung | Fine with the principle and the intention. It will be good to align the text with similar text for Rel-15 PDCCH monitoring – no need to be different when they don’t have to. A copy-paste may apply (with the necessary changes in parameter names) – OK to proceed as suggested above and due some more fine tuning during the draft CR update or, better, next week as part of the TP updates. |
|  |  |

* ***Clarification 2****: Is it allowed that the reported PDCCH monitoring capability by the UE is different for the scheduling cell and scheduled cell? e.g. scheduling cell with R16 PDCCH monitoring capability with scheduled cell not supporting Rel-16 capability according to the reported UE capability? E.g. scheduling cell with Rel-16 combination (2, 2) to schedule a cell with only (7, 3) reported?*
* ***Feature lead****: In my understanding, only the capability of the scheduling cell matters.*

**Please provide your views on the above clarification 2.**

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| *Company* | *View* |
| Samsung | It should be clear that the scheduled cell does not matter – PDCCH is monitored on the scheduling cell. |
| Quectel | Agree with FL. However, the texts in current spec is ambiguous and even misleading. Even though scheduling cell is relevant, scheduled cell may also correspond to a combination according to per FS combination (X, Y) report. It is unclear in current spec which cell the combination (X, Y) is associated to for the BD/non-overlapped partition. |

* ***Clarification 3****: Is it clear that scheduled cell(s) can be considered as a serving cell provided with PDCCHMonitoringCapabilityConfig?*

***=================***

If a UE is provided *PDCCHMonitoringCapabilityConfig* for a serving cell, the UE obtains an indication to monitor PDCCH on the serving cell for a maximum number of PDCCH candidates and non-overlapping CCEs

- per slot, as in Tables 10.1-2 and 10.1-3, if *PDCCHMornitoringCapabilityConfig* = *R15 PDCCH monitoring capability*, or

- per span, as in Tables 10.1-2A and 10.1-3A, if *PDCCHMornitoringCapabilityConfig* = *R16 PDCCH monitoring capability*

If the UE is not provided *PDCCHMonitoringCapabilityConfig*, the UE monitors PDCCH on the serving cell per slot.

***=================***

* ***Feature lead****: My thinking is that the text is clear. Even PDCCHMonitoringCapabilityConfig is not configured directly on the scheduled cell, but it is configured on the scheduling cell, thus still can consider as “provided”.*

**Please provide your views on the above clarification 3. If you feel some clarification needed in the spec, please also indicate how to make the change if possible.**

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| *Company* | *View* |
| Samsung | The RAN1/RAN2 specs are clear. |
| Quectel | The texts quoted by FL are clear. However, in current 38.213 exactly following the texts quoted by FL, it also defines the default capability as *”* *If the UE is not provided PDCCHMonitoringCapabilityConfig, the UE monitors PDCCH on the serving cell per slot”.* The descriptions for the calculationofandfor the absence of *PDCCHMonitoringCapabilityConfig* are missing. |

## Summary of the status and further discussion points

### Issue C-1: Corrections on span duration

Based on the summary of the status for issue C-1 in section 2.1, let’s further check the following:

* ***Common understanding from RAN1#100b-e***
  + *If a UE monitors PDCCH on a cell according to combination, then a CORESET with duration larger than Y is not allowed.*
  + *With the above understanding, then the example in the figure below is not allowed.*



**Please comment if you don’t agree the above understanding**.

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| *Company* | *View* |
| Feature lead | Based on the inputs from the first round, Ericsson shared different understanding |
| Ericsson | We disagree with FL understanding. The claimed ‘common understanding’ above is incorrect since it contradicts with RAN1 agreements and current 38.213 spec text.  The example above is definitely allowed, according to the existing specification text cited below. The spec text is also in line with the definition in FG3-5b which is the common understanding since Rel-15.  For the figure, 𝑌min =2 and 𝑑CORESET,max =3 resulting in 𝑑span =3. This span pattern is valid with respect to (2,2) in terms of span gap, i.e., “minimum time separation of X symbols between the first symbol of two consecutive spans, including across slots”. Since UE reports both (2,2) and (4,3), the configuration should be valid as UE is capable of monitoring it according to its reported capabilities. Thus, we do not see the need to add any further restriction to the specification or change the existing definition since Rel-15 regarding monitoring span.  ------ TS 38.213 V16.1.0 -------  *A UE reports one or more combinations of (X, Y) number of symbols, where X ≥ Y, for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. The duration of a span is 𝑑span = 𝑚𝑎𝑥(𝑑CORESET,max, 𝑌min), where 𝑑CORESET,max is a maximum duration among durations of CORESETs that are configured to the UE and 𝑌min is a minimum value of Y in the combinations of (X, Y) that are reported by the UE. A last span in a slot can have a shorter duration than other spans in the slot.*  ---------------------------------------  Chengyan> We discussed this in RAN1#100b-e, in the end people tend to go to the above understanding. |

**Potential conclusion**: *If a UE monitors PDCCH on a cell according to combination, then a CORESET with duration larger than Y is not allowed.*

**Please comment if you don’t agree the above conclusion**.

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| *Company* | *View* |
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#### *Proposal C-1: Adopt the following text proposal in R1-20xxxxx for section 10 in TS 38.213:*

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| \*\*\* Unchanged text is omitted \*\*\*  A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. If a UE monitors PDCCH on a cell according to combination , the duration of a span is up to . A last span in a slot can have a shorter duration than other spans in the slot.  \*\*\* Unchanged text is omitted \*\*\* |

**Please comment if you don’t agree the above proposal**.

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| *Company* | *View* |
| Intel | **Updated view on Proposal C-1**  Based on some offline discussions, we realized that a further adjustment to TP2 would be necessary for Understanding #2. Specifically, our proposal would be TP2’ that states:  “If a UE monitors PDCCH on a cell according to combination *X,Y*, the duration of a span is no longer than *Y*.*”*  With the above change, effectively we have the following steps:   1. UE determines which (X,Y) is selected based on candidate (X,Y) values for provided SS Set configurations. 2. Then, for the identified span combination (X,Y), the UE determines the span duration for each of the spans corresponding to the actual MOs configured.   Thus, in step 1, UE determines the (X,Y) combination that should be assumed for a serving cell, for a given PDCCH monitoring via SS set configurations.  In step 2, the span durations depend on the exact SS set configurations and are contained within the spans corresponding to the identified (X,Y) combination (and both share same starting symbols). Note that the actual span duration can be different for different spans within the slot duration.  Without the above change, ZTE’s example would still lead to unaligned spans, i.e. if span duration is fixed to Y (*courtesy of Xianghui, ZTE*):    instead of the following:    Chengyan> Seems we can change it to “up to Y” |
| Samsung | Fine with the latest update in proposal C-1.  Although this substantially removes a possibility of confusing what the UE procedure is, we may also discuss whether there is any need to capture in the specs the understanding of the two steps that was previously mentioned by the FL or above by Intel. If clear to everyone, of course no issue. May suffice to just put in the same (or adjacent) paragraph in 38.213 the current text that appears later and mentions how the UE determines (X, Y). |
| Ericsson | We agree with Intel and ZTE that the above picture in Intel response should be considered as “aligned spans”.  However, we do not support the change of span definition in the current specification which is based on FG 3-5b and is already the common understanding since Rel-15.  For the CA case, in order to achieve the goal of having a proper condition for the “aligned spans”, it is sufficient to modify the text in the “aligned spans” to the following.  ------------------------  < unchanged parts omitted, TS 38.213, Subclause 10.1, R1-2003276 CR>  - per span 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 , where the span refers to the resulting span derived from the union of PDCCH monitoring occasions across the downlink cells,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, R1-2003276 CR >  ---------------------------  In line with the agreement made in last meeting, it is sufficient to have a condition based on the gap and duration of PDCCH monitoring occasions which reflect actual PDCCH monitoring performed at the UE. Note that the last part of the text is added to clarify that the limits are applied to the resulting span across CCs, since individual span for each CC may be slightly different (for example, picture above in Intel response). |
| Qualcomm | Fine with the TP; however, we think it should be clarified that Y >= CORESET duration. Is that the case?  Regarding the 2-step procedure proposed by Intel, we think that the span determination remains the same as was the case for FG 3-5b; in particular, the UE will place a 1 on the symbols associated with the occasions of the monitoring occasions. Once, the bitmap is formed, the UE can decide which reported (X,Y) patterns are valid, and will take the one with the largest CCE/BD limits per span. I am not sure if the two approaches are actually aligned. So, some further discussions would be helpful. |
| Intel2 | To respond to the above questions from Qualcomm:   * Yes, for both any given (X, Y), CORESET duration <= Y. * The span determination based on bitmap construction remains the same.   + The UE constructs the bitmap as described by Qualcomm above, and determines the selected (X,Y) of those reported by the UE as supported based on largest BD/CCE limits (e.g., the result is (4, 3) in example from ZTE). This is step 1 above.   + The UE uses the same bitmap to identify the actual span configuration (this is such that each of the actual spans is a proper subset of the corresponding span according to the (X,Y) determined in step 1. This actual span configuration (e.g., “span2” in the example from ZTE) is what the UE uses to determine if spans across cells are aligned or not. |

#### *Revised Proposal C-1: Adopt the following text proposal in R1-20xxxxx for section 10 in TS 38.213:*

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| --- |
| \*\*\* Unchanged text is omitted \*\*\*  A UE reports one or more combinations of number of symbols, where , for PDCCH monitoring. The UE determines the combination (X, Y) used for PDCCH monitoring on a cell from the one or more combinations of (X, Y) as defined in Clause 10.1. A span is a set of consecutive symbols in a slot in which the UE is configured to monitor PDCCH candidates. 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. If a UE monitors PDCCH on a cell according to combination , the duration of a span is up to . A last span in a slot can have a shorter duration than other spans in the slot.  \*\*\* Unchanged text is omitted \*\*\* |

**Please provide your views on the above revised proposal C-1**.

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| *Company* | *View* |
| Feature lead | The intention of the new added sentence “The UE determines the combination (X, Y) used for PDCCH monitoring on a cell from the one or more combinations of (X, Y) as defined in Clause 10.1” is to define that UE will determine the combination (X, Y) first, then UE will determine the span duration. Please check if it can achieve the intention.  As to “Y >= CORESET duration”, I think the sentence “If a UE monitors PDCCH on a cell according to combination , the duration of a span is up to ” already clarify it. However, it is also ok to have some conclusion to make it clearer, which is actually corresponding to the common understanding above, thus I added a conclusion there. |
| Nokia, NSB | We support the revised proposal C-1. |

### Issue C-2: Corrections on “aligned spans” case

**Summary of the status for question C-2-1**

* ***Based on the above views, the main question is to clarify the motivation of the TP. As long as which TP to take, people are fine and TP2 seems simpler.***
* ***Feature lead:*** *The TP is to preclude the following case considered as aligned span case, which will be considered as aligned span case according to the current specification. The configuration of CC2 may happen, e.g. for SCell without CSS.*



#### *Revised proposal 2.2-1: Adopt the following text proposal for section 10.1 in TS 38.213*

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| < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0>  - per span 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 the starting symbol or the ending symbol of any pair of overlapping spans is the same,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, v16.2.0> |

**Please comment if you have strong concern with the above recommendation.**

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| --- | --- |
| *Company* | *View* |
| Feature lead | *The TP is to preclude the following case considered as aligned span case, which will be considered as aligned span case according to the current specification. The configuration of CC2 may happen, e.g. for SCell without CSS.*    Meanwhile, the updated proposal here is to ensure the following figure as aligned spans case assuming span duration is up to Y symbol. |
| Ericsson | We do not support revised proposal 2.2-1 above.  As commented earlier, in order to achieve the goal of having a proper condition for the “aligned spans”, it is sufficient to modify the text in the “aligned spans” condition to the following without needing to change the span definition. In other words, the text in the “aligned spans” can be updated to:  < unchanged parts omitted, TS 38.213, Subclause 10.1, R1-2003276 CR>  - per span 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 , where the span refers to the resulting span derived from the union of PDCCH monitoring occasions across the downlink cells,  - TBD, otherwise  < unchanged parts omitted, TS 38.213, Subclause 10.1, R1-2003276 CR >  In line with the agreement made in last meeting, it is sufficient to have a condition based on the gap and duration of PDCCH monitoring occasions which reflect actual PDCCH monitoring performed at the UE. Note that the last part of the text is added to clarify that the limit is applied to the resulting span since now the actual duration of “aligned spans” across CCs can be different. |
| Apple | It seems so far we have not treated potential receive timing difference among different CCs. With interband CA, there can be up to 33 microseconds in receive timing between CCs. With 30 KHz SCS, that translates into one symbol’s offset as shown in the example below. It is necessary to clarify the aligned & un-aligned definitions is w.r.t. to the actual receive timing, then for inter-band CA, CCs with the same span pattern (e.g. (2,2), (4,3), …) should be considered un-aligned. For more details please see R1-2004874.  Image  Chengyan> We discussed this in RAN1#100b-e, you can find details in R1-2003048 question 3 under issue C-1. Based on the inputs, almost all companies think we don’t need to consider timing difference and the following conclusion was observed:  *It seems common understanding that timing difference of received signaling from different Cells is not considered for defining aligned span and non-aligned span case* |
| Nokia, NSB | We support the revised proposal 2.2-1. |

# Agreements made from RAN1#101-e

**Agreement**

The following text proposals in R1-200XXXX are endorsed for the editor’s CR on TS38.213.

* Text proposal in section 2.2 of feature lead’s summary (revised proposal 2.2-2, 2.2-3)