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

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

**Agenda Item: 7.2.5.1**

**Source: Moderator (Huawei)**

**Title: Summary #1 of email discussion [102-e-NR-L1enh-URLLC-PDCCH enhancements-01] on remaining issues on DCI format** design

**Document for: Discussion and Decision**

# Introduction

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

[10**2**-e-NR-L1enh-URLLC-PDCCH enhancements-01] Email discussion/approval on remaining issues on DCI format design – Chengyan (Huawei)

* Issue A-1: Remaining issue on DCI size alignment in TS 38.212
* Issue A-2: Type2 HARQ-ACK codebook construction related to DAI bit width
* Discussion/Agreement by 8/21 and TPs by 8/28

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

# DCI format scheduling Rel-16 URLLC

Based on the contributions from companies, the following issues related to DCI format design are discussed.

## Issue A-1: Remaining issue on DCI size alignment due to the introduction of DCI format 0\_2/1\_2

In RAN1#101-e meeting, DCI size alignment was discussed and the following agreements were made:

**Agreement**

* A UE is not expected to monitor a first decoding candidate with DCI format 0\_0/1\_0 and a second candidate with DCI format 0\_2/1\_2, where the two decoding candidates are mapped to the same resource and the DCI formats 0\_0/1\_0 and 0\_2/1\_2 have the same size.
* A UE is not expected to monitor a first decoding candidate with DCI format 0\_1/1\_1 and a second candidate with DCI format 0\_2/1\_2, where the two decoding candidates are mapped to the same resource and the DCI formats 0\_1/1\_1 and 0\_2/1\_2 have the same size.

However, the specification is not complete for the above agreement, since there is no consensus on the following two bullets:

* *There is no need for gNB to ensure different DCI size for DCI format 0\_1 and DCI format 1\_2*
* *There is no need for gNB to ensure different DCI size for DCI format 1\_1 and DCI format 0\_2*

Some companies provide views on the above issue in the contribution and the position is summarized as below:

* + ***Support****: (i.e. there is no need for gNB to ensure different DCI size for DCI format 0\_1 and DCI format 1\_2, and there is no need for gNB to ensure different DCI size for DCI format 1\_1 and DCI format 0\_2)*
		- *Ericsson, Intel, ZTE, Huawei, HiSilicon, CATT*
	+ ***Reasons***
		- *The “Identifier for DCI formats” field in DCI formats can always be used to differentiate UL DCI format and DL DCI format, therefore no need for gNB to ensure different DCI size.*
		- *If we force different sizes for DL and UL, it will introduce draw backs like increasing the DCI size unnecessary, increasing more difficulty at gNB side to ensure different size unnecessary, etc.*
		- *The current agreement exactly means that the DCI size alignment is only performed between DL DCI formats or UL DCI formats. The text in the RAN1 agreement is consistent only if “0\_x/1\_x” is interpreted as “0\_x and 1\_x, respectively”, and not if interpreted as “x\_0 and x\_1”. This is because a decoding candidate cannot correspond to more than one DCI format, unless they are of the same size, and if they are of the same size, then it the issue is moot.*
	+ ***Note support****: any DCI format of 0\_1 and 1\_1 cannot be size-aligned with any DCI of 0\_2 and 1\_2*
		- *Qualcomm*
	+ ***Reasons***
		- *Simplifies the UE implementation, as it allows the UE to determine the DCI format (between 0\_1/1\_1 and 0\_2/1\_2) prior to decoding the PDCCH.*

**Feature lead view #1**: The above issue was discussed a lot last meeting, and there is very strong majority view. Therefore, it is recommended to go to the majority view.

In addition, Ericsson (R1-2005506) additionally pointed that if the CORESET and search space configurations do not lead to any PDCCH candidates of different DCI formats having the same CCE mapping, it is not necessary that the sizes of those DCI formats need to be different.

* *RAN1#101e agreement covers the cases where* *a UE is not expected to monitor DCI formats with same size* ***only when the PDCCH candidates of corresponding DCI formats are mapped to the same resource****.*
	+ *Support: Ericsson*

**Feature lead view #2**: In theory it is true that there is no need to ensure different size when there is no overlap. However, it can be expected that more complexity will be increased at both gNB and UE sides. Therefore, it is recommended to keep what given in the current specification.

Based on the situation for the above two issues, it is recommended to go with the proposal below:

***Proposal 2-1****: Endorse the following text proposal in R1-2xxxxxx for TS 38.212 Section 7.3.1.0.*

|  |
| --- |
| 7.3.1.0 DCI size alignment**\*\*\* Unchanged text is omitted \*\*\***The UE is not expected to handle a configuration that, after applying the above steps, results in- the total number of different DCI sizes configured to monitor is more than 4 for the cell; or- the total number of different DCI sizes with C-RNTI configured to monitor is more than 3 for the cell; or- the size of DCI format 0\_0 in a UE-specific search space is equal to DCI format 0\_1 in another UE-specific search space; or- the size of DCI format 1\_0 in a UE-specific search space is equal to DCI format 1\_1 in another UE-specific search space; or- the size of DCI format 0\_0 in a UE-specific search space is equal to DCI format 0\_2 in another UE-specific search space; or- the size of DCI format 1\_0 in a UE-specific search space is equal to DCI format 1\_2 in another UE-specific search space ; or- the size of DCI format 0\_2 in a UE-specific search space is equal to DCI format 0\_1 in the same or another UE-specific search space; or- the size of DCI format 1\_2 in a UE-specific search space is equal to DCI format 1\_1 in the same or another UE-specific search space.**\*\*\* Unchanged text is omitted \*\*\*** |

|  |  |
| --- | --- |
| *Company* | *View* |
| *Samsung* | *OK with proposal 2-1 (also OK with Qualcomm’s proposal)* |
| WILUS | Support FL’s proposal 2-1 |
| CATT | Support FL’s proposal 2-1 |
| HW/HiSi | Support FL’s proposal 2-1 |
| DOCOMO | Support FL’s proposal 2-1 |
| Nokia, NSB | Support FL’s proposal 2-1 |
| Sharp | Support FL’s proposal 2-1 |
| Qualcomm | We are (still) not OK with Proposal 2-1, and would insist on adding the restriction that the size of DCI format 0\_1 can not be aligned with DCI format 1\_2 and size of DCI format 1\_1 can not be aligned with DCI format 0\_2. The WID for NR Rel-16 URLLC clearly states that the purpose of introducing a new DCI format is to have a smaller size, and should aim to have a max reduction of 10~16 bits compared to DCI format 0\_1/1\_0. What is the point of introducing a new DCI format that is size-aligned with the non-fallback DCI format in NR Rel-15, that typically has much larger size (e.g., typically 20 or more bits larger) even than the fallback DCI? Is there any use case of to allow aligned size between a DCI format 0\_1 and DCI format 1\_2 (and similarly between DCI format 1\_1 and 0\_2) beyond “flexibility”? **The purpose of the WID is NOT to introduce a new DCI format that is more flexible..** The purpose is to have a new DCI format that is more compact. * Specification of PDCCH enhancements [RAN1]
	+ DCI format(s) with configurable sizes for some fields, with a minimum DCI size targeting a reduction of 10~16 bits relative to Rel-15 DCI format 0\_0/1\_0 and a maximum DCI size that can be larger than Rel-15 DCI format 0\_0/1\_0, and provide the possibility to align with the size of the DCI format 0\_0/1\_0 (including possible zero padding if any)
 |
| Intel | Support FL’s proposal 2-1.@Qualcomm: There is no mandating of size-alignment. Thus, there is no forcing of large DCI format size with proposal 2-1. The proposal allows for cases wherein the size may not match and does not mandate having different sizes between DL and UL formats across x\_1 and x\_2. It was indeed the aim of this objective to introduce a DCI format that is more flexible (one may refer to relevant discussions during the SI phase). Accordingly, the key characteristics of the new DCI formats were defined in the objective via “configurable sizes”, and a range of size that can be smaller, same, or larger than the fallback formats. In fact, it is quite possible that size of (DL) DCI format 1\_2 (that may be smaller than DCI format 1\_1) matches with (UL) DCI format 0\_1. To elaborate further, it is quite typical to have larger size for the DCI format 1\_1 over 0\_1 (the gap could be 10+ bits in many example configurations, and one of the reasons DCI formats 1\_1 and 0\_1 are not size-aligned), and now, DCI format 1\_2 that could be about 10+ bits smaller than DCI format 1\_1, and end up same size as DCI format 0\_1. In such a case, formats 1\_2 and 0\_1 should not be forced to have different sizes (implying unnecessary increase in size for one of these formats). |
| ZTE | Support FL’s proposal 2-1 |
| Spreadtrum | Support FL’s proposal. |
| Ericsson | We support the spirit of proposal 2-1, but the TP has be updated to fully reflect the agreement.The agreement explicitly contains a condition that it is applied only when PDCCH candidates of the corresponding DCI formats are mapped to the same resource. The condition is part of the agreement and it should be captured. This condition does have impact on NW configuration and implementation, now that the burden is on the network to perform size alignment. **Agreement*** A UE is not expected to monitor a first decoding candidate with DCI format 0\_0/1\_0 and a second candidate with DCI format 0\_2/1\_2, where the two decoding candidates are mapped to the same resource and the DCI formats 0\_0/1\_0 and 0\_2/1\_2 have the same size.
* A UE is not expected to monitor a first decoding candidate with DCI format 0\_1/1\_1 and a second candidate with DCI format 0\_2/1\_2, where the two decoding candidates are mapped to the same resource and the DCI formats 0\_1/1\_1 and 0\_2/1\_2 have the same size.
 |
| MediaTek | Support FL’s proposal. |
| vivo | Support FL’s proposal. |

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

* ***Support proposal 2-1****: Samsung, WILUS, CATT, Huawei/HiSilicon, DOCOMO, Nokia, Sharp, Intel, ZTE, Spreadtrum, MTK, Vivo*
	+ ***Reasons***
		- *The “Identifier for DCI formats” field in DCI formats can always be used to differentiate UL DCI format and DL DCI format, therefore no need for gNB to ensure different DCI size.*
		- *If we force different sizes for DL and UL, it will introduce draw backs like increasing the DCI size unnecessary, increasing more difficulty at gNB side to ensure different size unnecessary, etc.*
		- *The current agreement exactly means that the DCI size alignment is only performed between DL DCI formats or UL DCI formats. The text in the RAN1 agreement is consistent only if “0\_x/1\_x” is interpreted as “0\_x and 1\_x, respectively”, and not if interpreted as “x\_0 and x\_1”. This is because a decoding candidate cannot correspond to more than one DCI format, unless they are of the same size, and if they are of the same size, then it the issue is moot.*
* ***Note support****: Qualcomm*
	+ ***Reasons:***
		- * *The WID clearly states that introducing new DCI format to have a smaller size compared to 0\_0/1\_0. No point to introduce a new DCI format that is size-aligned with the non-fallback DCI.*
			* ***Feature lead****: 1) The objective for DCI format is to design a flexible DCI format, that can enable reducing the DCI format to a smaller size if needed, meanwhile can enable flexibility with larger DCI format also if needed. 2) The proposal here is not to do size-alignment always for UL DCI and DL DCI, it is to say if it is happened to be the same then it is ok, there is no need to ensure different size on purpose.*
	+ ***Proposal from Qualcomm***

========

-     the size of DCI format 0\_1 in a UE-specific search space is equal to DCI format 0\_2/1\_2 in the same or another UE-specific search space; or

-    the size of DCI format 1\_1 in a UE-specific search space is equal to DCI format 0\_2/1\_2 in the same or another search space

========

* ***Support in principle****: Ericsson*
	+ ***Reasons:***
		- *Ensuring different DCI size* ***only when the PDCCH candidates of corresponding DCI formats are mapped to the same resource***
		- ***Feature lead****: 1)* *In theory it is true that there is no need to ensure different size when there is no overlap. However, it can be expected that more complexity will be increased at both gNB and UE sides, since need to check if any overlapping for the potential PDCCH candidates in order to decide whether same DCI size or different DCI size is applied.*
	+ ***Proposed update from Ericsson***

========

-    the size of DCI format 0\_0 in a UE-specific search space is equal to DCI format 0\_2 in another UE-specific search space when at least one pair of the corresponding PDCCH candidates of DCI formats 0\_0 and 0\_2 are mapped to the same resource; or

-    the size of DCI format 1\_0 in a UE-specific search space is equal to DCI format 1\_2 in another UE-specific search space when at least one pair of the corresponding PDCCH candidates of DCI formats 1\_0 and 1\_2 are mapped to the same resource; or

-    the size of DCI format 0\_1 in a UE-specific search space is equal to DCI format 0\_2 in the same or another UE-specific search space when at least one pair of the corresponding PDCCH candidates of DCI formats 0\_1 and 0\_2 are mapped to the same resource; or

-    the size of DCI format 1\_1 in a UE-specific search space is equal to DCI format 1\_2 in the same or another UE-specific search space when at least one pair of the corresponding PDCCH candidates of DCI formats 1\_1 and 1\_2 are mapped to the same resource.

========

* ***Feature lead recommendation for issue A-1****: Go with the strong majority view and agree proposal 2-1 here.*

**Issue A-2**: Type2 HARQ-ACK codebook construction related to DAI bit width

In RAN1#101-e meeting, type 2 HARQ-ACK codebook construction related to DAI bit width was discussed under PDCCH enhancements, and the following agreement was achieved:

Agreement

If UE is configured to monitor DCI format 1\_2/0\_2, the HARQ-ACK codebook size for type-2 HARQ-ACK codebook is determined by



Further, the pseudo-code related to the agreement was also specified in section 9.1.3 of TS38.213 v16.2.0:

|  |
| --- |
| 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel […]If the UE transmits HARQ-ACK information in a PUCCH in slot and for any PUCCH format, the UE determines the , for a total number of HARQ-ACK information bits, according to the following pseudo-code:Set  – PDCCH with DCI format scheduling PDSCH reception or SPS PDSCH release monitoring occasion index: lower index corresponds to earlier PDCCH monitoring occasionSet Set Set Set Set  to the number of serving cells configured by higher layers for the UE[…]Set  to the number of PDCCH monitoring occasion(s)while […]end whileif end ifif *harq-ACK-SpatialBundlingPUCCH* is not provided to the UE and the UE is configured by *maxNrofCodeWordsScheduledByDCI* with reception of two transport blocks for at least one configured DL BWP of a serving cell,elseend if for any  |

However, Huawei (R1-2005790) and WILUS (R1-2006882) pointed out that some error exists with the pseudo highlight in yellow.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Huawei R1-2005790*Take the case shown in Table 1 as an example, where the gNB sends 3 DL DCIs with 1-bit counter DAI in three monitoring occasions and one UL grant with 2-bit UL DAI=3. If there is no missed DCI in the given example, then both gNB and the UE will have the same understanding about the codebook size, i.e. OAck = 3. However, if the DL DCI in MO#3 is missed, based on the value in Table 1 and the pseudo code highlighted in yellow above, the value of j is still equal to 0, which will result in OAck = 1 according to the equation for type 2 HARQ-ACK codebook construction. The reason for this problem is that the yellow-marked pseudo-code “” will not update the value of in this case, because is not smaller than in this case because of the different number of bits that are used for counter DAI and total DAI. Table 1 – Last DCI is missed (2-bits UL DAI and 1-bit counter DAI)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | MO#1 | MO#2 | MO#3 | UL grant |
|  | cDAI=1 | cDAI=2 | cDAI=1 | UL DAI=3 |
| Correct value of assuming no missed DCI  | 0 | 0 | **1** |  |
| Value of j according to the pseudo code in the spec if DCI in MO#3 is missed | 0 | **0** |  |  |

Note that when no DCI is missed or one DCI but not the last one is missed, then there is no problem as shown in table 2 below.Table 2 – No DCI or one DCI but not the last one is missed (2-bits UL DAI and 1-bit counter DAI)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | MO#1 | MO#2 | MO#3 | UL grant |
|  | cDAI=1 | cDAI=2 | cDAI=1 | UL DAI=3 |
| Correct value of assuming no missed DCI | 0 | 0 | **1** |  |
| Value of j according to pseudo code in the spec if DCI in MO#1 is missed |  | 0 | **1** |  |
| Value of j according to pseudo code in the spec if DCI in MO#2 is missed | 0 |  | **1** |  |

To solve this issue, we propose to change the yellow pseudo-code to “”. Then the value of will be updated correctly even if the DCI in MO#3 is missed.***Proposal 3: Change the pseudo-code “” to “” in section 9.1.3.1 of 38.213. Endorse the TP below.***

|  |
| --- |
| 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel**\*\*\*Unchanged text is omitted\*\*\***if end if**\*\*\*Unchanged text is omitted\*\*\*** |
|  |

 |

|  |
| --- |
| *WILUS R1-2006882*In the revised pseudo-code, the type-2 HARQ-ACK codebook size is determined based on *Vtemp2* as well as the value of *j*. Also, the value of *j* is incremented when *Vtemp2* is less than *Vtemp* (as shown in the yellow part in the pseudo-code). Note that *Vtemp2* is coming from UL DAI value, which is one of {1, 2, 3, 4}, and *Vtemp* is the last counter-DAI value, which is one of {1, 2, … }, among counter-DAI values included in received PDCCHs. The range of two values such as *Vtemp* and *Vtemp2* is not aligned due to configurable counter-DAI field size, *TD*. Therefore, it is necessary to align the range of two values by comparing the two values in the pseudo-code. Similarly, as in the modifications by the agreement at RAN1#101-e meeting, since the range of *Vtemp2* can be re-interpreted to that of *Vtemp*, the comparison should be performed by the re-interpreted value of *Vtemp2*, i.e., *.** + ***Proposal 1: In case of HARQ-ACK multiplexing on PUSCH, the value of j is determined by comparing between the re-interpreted value of*** *Vtemp2****, i.e.,, and*** *Vtemp****.***
	+ ***Proposal 2: Adopt the following text proposal for TS38.213***
 |

**Feature lead view**: The issue does exist and needs to be addressed. The proposal from Huawei and WILUS looks reasonable.

***Proposal 2-2****: Endorse the text proposal in R1-2xxxxxx for TS 38.213 Section 9.1.3.1.*

|  |
| --- |
| 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel**\*\*\*Unchanged text is omitted\*\*\***if end if**\*\*\*Unchanged text is omitted\*\*\*** |

**Please provide your views on proposal 2-2.**

|  |  |
| --- | --- |
| *Company* | *View* |
| *Samsung* | *Disagree with proposal 2-2.* *The issue is similar to the one for the counter DAI where it was agreed that a UE does not expect to multiplex in a same codebook HARQ-ACK that is in response to detection of DCI formats with different number of bits for the counter DAI. The consistent conclusion would be that this also applies to the total DAI (and the UL DAI – which is effectively the total DAI) and there is no mixture of different DAI sizes (not meaningful).**In principle, nothing is needed – it would be a network misconfiguration or a situation that is up to NW to handle and the specifications should not be capturing “UE does not expect …” for misconfigurations. However, also OK to add total/UL DAI in the existing text for the counter DAI (i.e. UE expects DAIs of same sizes for a given codebook).* |
| WILUS | Support FL’s proposal 2-2. This problem to be addressed in this proposal come from different size of counter DAI and UL DAI. As specified in TS38.212, the counter DAI can be 0, 1, or 2 bits in DCI format 1\_2, but UL DAI can be 0 or 2 bits in case of dynamic HARQ-ACK codebook. Thus, there are potential misalignments between counter DAI and UL DAI in terms of bit-size. For example, 1-bit counter-DAI vs 2-bit UL DAI. It should be corrected in the pseudocode. Regard Samsung’s suggestion (*UE expects DAIs of same sizes for a given codebook*), since UL DAI cannot be configured with 1 bit in case of dynamic HARQ-ACK codebook, so not sure how to multiplex dynamic HARQ-ACK codebook with 1-bit counter DAI in PUSCH scheduled by a PDCCH with 2-bit UL DAI. If intention is not to multiplex the dynamic HARQ-ACK codebook with 1-bit counter DAI in the PUSCH, it seems too restrictive to gNB scheduling. |
| CATT | Agree with FL’s proposal |
| HW/HiSi | We support the FL proposal since it resolves the identified problem with the current specification.We disagree with the comment from Samsung. This issue here is not the same as the different size of counter DAI field in DCI format 1\_2 and 1\_0/1\_1. The issue here is about the case that the counter DAI is 1 bit in DCI format 1\_2 but the total DAI is 2 bits in DCI format 0\_2. In Rel-16 a one-bit total DCI field has not been introduced.Please note that in the last meeting, the following agreement was made also because of this case, and it is already captured in the spec. Therefore, we do not think it is a valid argument to refer to a network misconfiguration.

|  |
| --- |
| Agreement If UE is configured to monitor DCI format 1\_2/0\_2, the HARQ-ACK codebook size for type-2 HARQ-ACK codebook is determined by |

In this case the problem is that the gNB and the UE may not have the same understanding about the value of “j” in the above equation if the last DCI is missed. |
| DOCOMO | Support FL’s proposal. The issue is valid and the proposal correctly updates “j” to acquire correct HARQ-ACK information bit size in case different C-DAI in DCI format 1\_2 and T-DAI in DCI format 0\_2. |
| Nokia, NSB | Support FL’s proposal.  |
| Sharp | Support FL’s proposal. |
| Intel | Support FL’s proposal 2-2. |
| ZTE | Support FL’s proposal. |
| Spreadtrum | Support FL’s proposal. |
| Ericsson | Support proposal 2-2. |
| MediaTek | Support FL’s proposal. |
| vivo | Support FL’s proposal. |

#### Summary of the status for issue A-2

* ***Support proposal 2-2****: WILUS, CATT, Huawei/HiSilicon, DOCOMO, Nokia, Sharp, Intel, ZTE, Spreadtrum, Ericsson, MTK, Vivo*
	+ ***Reasons***
		- *For 2-bit counter DAI and 1 bit counter DAI, the current pseudo will result in some error based on the current specification.*
		- *Simple correction.*
* ***Not support****: Samsung*
	+ ***Reasons***
		- *The issue is similar to the one for the counter DAI where it was agreed that a UE does not expect to multiplex in a same codebook HARQ-ACK that is in response to detection of DCI formats with different number of bits for the counter DAI.*
		- ***Feature lead****: The issue is different from the case we discussed in last meeting for different number of bits for counter DAI. Here the issue is for different number of bits for counter DAI in DL DCI format and total DAI in UL DCI format. For counter DAI,*
		- *It would be a network misconfiguration or a situation that is up to NW to handle.*
		- ***Feature lead****: Total DAI in UL DCI is always 2 bits for type 2 HARQ-ACK codebook, while counter DAI can go down to 1 bit. If we always rely on gNB to avoid, that means 1 bit DAI will never be used.*
* ***Feature lead recommendation****: Go with the strong majority view and agree proposal 2-2 here.*

# Proposal for Wednesday conference call

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

## Issue A-1: Remaining issue on DCI size alignment due to the introduction of DCI format 0\_2/1\_2

***Proposal 2-2****: Endorse the following text proposal in R1-2xxxxxx for TS 38.212 Section 7.3.1.0.*

|  |
| --- |
| 7.3.1.0 DCI size alignment**\*\*\* Unchanged text is omitted \*\*\***The UE is not expected to handle a configuration that, after applying the above steps, results in- the total number of different DCI sizes configured to monitor is more than 4 for the cell; or- the total number of different DCI sizes with C-RNTI configured to monitor is more than 3 for the cell; or- the size of DCI format 0\_0 in a UE-specific search space is equal to DCI format 0\_1 in another UE-specific search space; or- the size of DCI format 1\_0 in a UE-specific search space is equal to DCI format 1\_1 in another UE-specific search space; or- the size of DCI format 0\_0 in a UE-specific search space is equal to DCI format 0\_2 in another UE-specific search space; or- the size of DCI format 1\_0 in a UE-specific search space is equal to DCI format 1\_2 in another UE-specific search space ; or- the size of DCI format 0\_2 in a UE-specific search space is equal to DCI format 0\_1 in the same or another UE-specific search space; or- the size of DCI format 1\_2 in a UE-specific search space is equal to DCI format 1\_1 in the same or another UE-specific search space.**\*\*\* Unchanged text is omitted \*\*\*** |

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

* ***Support proposal 2-1****: Samsung, WILUS, CATT, Huawei/HiSilicon, DOCOMO, Nokia, Sharp, Intel, ZTE, Spreadtrum, MTK, Vivo*
	+ ***Reasons***
		- *The “Identifier for DCI formats” field in DCI formats can always be used to differentiate UL DCI format and DL DCI format, therefore no need for gNB to ensure different DCI size.*
		- *If we force different sizes for DL and UL, it will introduce draw backs like increasing the DCI size unnecessary, increasing more difficulty at gNB side to ensure different size unnecessary, etc.*
		- *The current agreement exactly means that the DCI size alignment is only performed between DL DCI formats or UL DCI formats. The text in the RAN1 agreement is consistent only if “0\_x/1\_x” is interpreted as “0\_x and 1\_x, respectively”, and not if interpreted as “x\_0 and x\_1”. This is because a decoding candidate cannot correspond to more than one DCI format, unless they are of the same size, and if they are of the same size, then it the issue is moot.*
* ***Note support****: Qualcomm*
	+ ***Reasons:***
		- * *The WID clearly states that introducing new DCI format to have a smaller size compared to 0\_0/1\_0. No point to introduce a new DCI format that is size-aligned with the non-fallback DCI.*
			* ***Feature lead****: 1) The objective for DCI format is to design a flexible DCI format, that can enable reducing the DCI format to a smaller size if needed, meanwhile can enable flexibility with larger DCI format also if needed. 2) The proposal here is not to do size-alignment always for UL DCI and DL DCI, it is to say if it is happened to be the same then it is ok, there is no need to ensure different size on purpose.*
	+ ***Proposal from Qualcomm***

========

-     the size of DCI format 0\_1 in a UE-specific search space is equal to DCI format 0\_2/1\_2 in the same or another UE-specific search space; or

-    the size of DCI format 1\_1 in a UE-specific search space is equal to DCI format 0\_2/1\_2 in the same or another search space

========

* ***Support in principle****: Ericsson*
	+ ***Reasons:***
		- *Ensuring different DCI size* ***only when the PDCCH candidates of corresponding DCI formats are mapped to the same resource***
		- ***Feature lead****: 1)* *In theory it is true that there is no need to ensure different size when there is no overlap. However, it can be expected that more complexity will be increased at both gNB and UE sides, since need to check if any overlapping for the potential PDCCH candidates in order to decide whether same DCI size or different DCI size is applied.*
	+ ***Proposed update from Ericsson***

========

-    the size of DCI format 0\_0 in a UE-specific search space is equal to DCI format 0\_2 in another UE-specific search space when at least one pair of the corresponding PDCCH candidates of DCI formats 0\_0 and 0\_2 are mapped to the same resource; or

-    the size of DCI format 1\_0 in a UE-specific search space is equal to DCI format 1\_2 in another UE-specific search space when at least one pair of the corresponding PDCCH candidates of DCI formats 1\_0 and 1\_2 are mapped to the same resource; or

-    the size of DCI format 0\_1 in a UE-specific search space is equal to DCI format 0\_2 in the same or another UE-specific search space when at least one pair of the corresponding PDCCH candidates of DCI formats 0\_1 and 0\_2 are mapped to the same resource; or

-    the size of DCI format 1\_1 in a UE-specific search space is equal to DCI format 1\_2 in the same or another UE-specific search space when at least one pair of the corresponding PDCCH candidates of DCI formats 1\_1 and 1\_2 are mapped to the same resource.

========

* ***Feature lead recommendation for issue A-1****: Go with the strong majority view and agree proposal 2-1 here.*

**Issue A-2**: Type2 HARQ-ACK codebook construction related to DAI bit width

***Proposal 2-2****: Endorse the text proposal in R1-2xxxxxx for TS 38.213 Section 9.1.3.1.*

|  |
| --- |
| 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel**\*\*\*Unchanged text is omitted\*\*\***if end if**\*\*\*Unchanged text is omitted\*\*\*** |

#### Summary of the status for issue A-2

* ***Support proposal 2-2****: WILUS, CATT, Huawei/HiSilicon, DOCOMO, Nokia, Sharp, Intel, ZTE, Spreadtrum, Ericsson, MTK, Vivo*
	+ ***Reasons***
		- *For 2-bit counter DAI and 1 bit counter DAI, the current pseudo will result in some error based on the current specification.*
		- *Simple correction.*
* ***Not support****: Samsung*
	+ ***Reasons***
		- *The issue is similar to the one for the counter DAI where it was agreed that a UE does not expect to multiplex in a same codebook HARQ-ACK that is in response to detection of DCI formats with different number of bits for the counter DAI.*
		- ***Feature lead****: The issue is different from the case we discussed in last meeting for different number of bits for counter DAI. Here the issue is for different number of bits for counter DAI in DL DCI format and total DAI in UL DCI format. For counter DAI,*
		- *It would be a network misconfiguration or a situation that is up to NW to handle.*
		- ***Feature lead****: Total DAI in UL DCI is always 2 bits for type 2 HARQ-ACK codebook, while counter DAI can go down to 1 bit. If we always rely on gNB to avoid, that means 1 bit DAI will never be used.*
* ***Feature lead recommendation****: Go with the strong majority view and agree proposal 2-2 here.*

# References

1. R1-2005347 PDCCH enhancements for URLLC vivo
2. [R1-2005413](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2005413.zip) Remaining issues on PDCCH enhancements for NR URLLC ZTE
3. [R1-2005506](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2005506.zip) Remaining Issue of PDCCH Enhancements for NR URLLC Ericsson
4. [R1-2005672](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2005672.zip) Remaining issues on PDCCH enhancements CATT
5. [R1-2005790](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2005790.zip) Corrections on PDCCH enhancement for URLLC Huawei, HiSilicon
6. [R1-2005850](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2005850.zip) Remaining corrections for PDCCH enhancements for URLLC Intel Corporation
7. [R1-2006051](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2006051.zip) PDCCH enhancements for URLLC OPPO
8. [R1-2006109](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2006109.zip) Maintenance on PDCCH enhancements Samsung
9. [R1-2006278](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2006278.zip) Remaining issues of PDCCH enhancements for URLLC Spreadtrum Communications
10. [R1-2006487](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2006487.zip) Remaining issues on PDCCH enhancements Apple
11. [R1-2006549](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2006549.zip) Remaining Issues on PDCCH Enhancements for Rel-16 URLLC Quectel
12. [R1-2006563](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2006563.zip) Remaining issues on PDCCH enhancements for NR URLLC Sharp
13. [R1-2006774](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2006774.zip) Remaining issues on PDCCH Enhancements for URLLC Qualcomm Incorporated
14. [R1-2006865](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2006865.zip) Remaining issue for TCI field ASUSTeK
15. [R1-2006882](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_102%5CDocs%5CR1-2006882.zip) Remaining issues on PDCCH for NR URLLC WILUS Inc.