**3GPP TSG RAN WG1 Meeting #98bis** **R1-1911181**
**Chongqing, China, Oct 14th – 20th, 2019**

**Agenda Item:** **7.2.6.6**
**Source:** **NTT DOCOMO, INC.**
**Title:** **Summary on URLLC enhanced configured grant transmission**
**Document for:** **Discussion and decision**

# 1 Introduction

This document summarizes the remaining issues related to configured grant (CG) transmission based on the contributions submitted to the agenda item 7.2.6.6. It is noticed that there is one email discussion [107#55] [NR_IIOT] in RAN2 on the remaining higher layer impacts for supporting multiple SPS/CG configurations including the HARQ ID determination, RRC signalling structure and parameters for multiple configurations, additional periodicity, confirmation MAC CE etc. Related RAN2 email summary can be found in R2-1913952. **Therefore, in this document, the focus is physical layer support for multiple CGs. The topics already covered by the RAN2 email discussion are not summarized.**

# 2 Offline discussions

**Proposal 1-1:**

- *Support DCI format 0-0, 0-1 and new DCI format scheduling PUSCH for Rel.16 Type 2 CG activation.*

**Proposal 1-2:**

- *Support DCI format 0-0 for Rel.16 Type 2 CG release.*
  - *FFS DCI format 0_1 and new DCI format.*

**Proposal 2-1:**

- *M (M<=4) least significant bits of HPN field in DCI format 0-0 with CRC scrambled by CS-RNTI is used to indicate which configuration is to be activated and which configuration(s) is/are to be released.*
- *M (M<=4) least significant bits of HPN field in DCI format 0-1 with CRC scrambled by CS-RNTI is used to indicate which configuration is to be activated.*
- *M (M<=4) least significant bits of HPN field in DCI format 0-1 with CRC scrambled by CS-RNTI is used to indicate which configuration is to be released if the DCI format 0-1 is agreed as release DCI.*
- *FFS whether M can be the same or different for activation and release DCI.*
- *FFS for new DCI format.*
- *FFS the impacts on the false alarm for activation/release DCI validation.*



APPLE 1045
Apple v. Apex Beam
IPR2025-00909

**Proposal 2-2:**

- *If the new UL DCI format with CRC scrambled by CS-RNTI is agreed to be used as activation and/or release DCI for Type 2 CG, at least HPN field in the new UL DCI format is used to indicate which configuration is to be activated and/or which configuration(s) is/are to be released.*
  - *FFS other field(s) if the number of bits for HPN field is smaller than M.*

**Proposal 3:**

- *New UL DCI format with CRC scrambled by CS-RNTI should be size-aligned with the new UL DCI format with CRC scrambled by C-RNTI.*

**Proposal 4:**

- *Retransmission of the PUSCH retransmission scheduled by a new UL DCI format with CRC scrambled by CS-RNTI with NDI=1 shall follow the same higher layer configuration defined for dynamic PUSCH transmission associated with the new UL DCI format.*

**Questions:**

**Q2: For the RRC parameters introduced in Rel.16 for dynamic grant PUSCH which are used to indicate the bit width of some fields in the new DCI format, are they also separately introduced for each configured grant configuration?**

| | |
|---|---|
| Nokia, NSB | I guess this very much depends on the assumptions for Type-2 activation (not just re-tx as in Q3 below). If the Rel-15 operation behaviour for activation is retained, then it would need to be Option 1 in case the new DCI format is to be used. Otherwise, there may not be a need for it.<br>We might need to discuss overall the activation & re-transmission, before we see how much additional configuration for each CG configuration may be needed. |
| ZTE | Rel-15 behavior can be applied here for simplicity, i.e., Option 1. |
| CATT | We may need more discussion on what RRC parameters are needed. But in general, we do not see the need to prevent to have separate configurations for each CG configuration. |
| vivo | Further discussion is needed on what and which fields are included in the activation and retransmission DCI in case of new DCI format. After there is clear picture about the DCI contents in the new DCI format, we can draw the conclusion. |

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| Huawei,HiSilicon | Agree with CATT. Basically we think at least for some of the RRC parameters, they may need to go to Option 1. |
| LG | It is up to the purpose of those parameters. If those parameter only define the number of bit for each field and do not change interpretation, we can go to option 1 since DCI structure would be same between configured grant and dynamic grant |
| Ericsson | No. When applying new DCI format for the activation, the CG follows the higher configurations for the new DCI, same interpretation as for dynamic PUSCH when applying the new DCI. It would be unnecessary to redefine all the parameters and do DCI field size alignment, mess up the specification with all those RRC parameters.<br><br>If different configurations are preferred as in release 15, non-fallback DCI format can be used. |

**Q3: If the answer is yes to the Question 2, how to fix the NDI, HPN, RV position of the new DCI format used for activation/release, scheduling the retransmissions among different CG configurations?**

| Company | View |
|---|---|
| Nokia, NSB | Structure of the DCI should be given by the new DCI format configuration (same for C-RNTI & CS-RNTI). |
| ZTE | Reuse Rel-15 behavior is preferred at current late stage. |
| CATT | We prefer to reuse Rel-15 rules. |
| vivo | See the answer to question 2. |
| Huawei,HiSilicon | For Question 3, we provided following two options in our contribution:<br>- **Option 1:** Insert a number of most significant bits with the value set to '0' if the bit width of a field is not equal to a maximum bit width. The maximum bit width is determined according to the higher layer parameter defined either for dynamic grant or for configured grant that requires the maximum bit width for the field.<br>- **Option 2:** Locate NDI field as well as HPN field in front of the fields with configurable bit width, and pad '0' bits to the end of the DCI if the size of the DCI is not equal to a maximum value. The maximum value of the DCI size is determined according to the higher layer configuration either for dynamic grant or configured grant that leads to the maximum DCI size.<br><br>Since Option 2 could have smaller DCI size and seems to have less complexity compared to Option 1, we prefer to adopt Option 2. |
| LGE | Re-use release 15 manners. No matter how many CGs are configured, if one anchor point; DCI with C-RNTI is used, all DCI structure for multiple CG |

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| | would be aligned. |

**Q3:**

- **For type 1 CG, how to determine the repetition scheme (either slot-based or mini-slot-based) for each CG configuration?**
- **For type 2 CG, how to determine the repetition scheme (either slot-based or mini-slot-based) for each CG configuration?**
  - **Same mechanism as for PUSCH scheduled by dynamic UL grant is used?**

| Company | View |
|---|---|
| | |

# 3 L1 signaling for activation/release of multiple CG configs

## 3.1 The number of indication bits in activation/release DCI

Based on achieved agreements so far, separate activation, separate release and joint release are supported for multiple CGs. In addition, one working assumption was made that for activation and release of UL CG, same field(s) is/are used for a DCI format. It is proposed by [HW, 0071], [Fujitsu, 0188], [Intel, 0665], [Nokia, 0869], [Panasonic, 0992], [DCM, 1180] to confirm the working assumption.

Before confirming the working assumptions, [Spreadtrum, 0020] and [Nokia, 0869] have different views on whether to have the same number of bits for activation and release of UL CG. Since for activation DCI, the number of bits (for simplicity, call "M for activation") for indicating which CG is activated can be determined by the number of CGs configured by higher layer; while for release DCI, the number of bits (for simplicity, call "M for release") for indicating which CG(s) is/are released is not directly tied with the number of configured CGs. There are three options [Nokia, 0869], [DCM, 1180]:

- Opt.1: it depends on the number of configured grant(s) configured by higher layers
- Opt.2: the number of bits is configured by RRC but no more than 4 bits
- Opt.3: fixed as 4 bits

In addition, it is noted that the determination of the M also needs to take whether to support cross-carrier, cross-BWP activation/release of CG(s) into account. Different CCs/BWPs may configure different number of CGs.

Based on above, it is beneficial to first have some discussions to achieve common understanding for following:

- **Question 1:**

1-1: How to determine the value of M (M<=4) for release?

1-2: How to determine the value of M (M<=4) for activation?

1-3: Whether to have the same number of bits, i.e. M (M<=4) for activation and release of UL CG(s)?

| Company | View |
|---|---|
| Nokia, NSB | 1-3 – and based on gNB configuration (Option 1 above)<br><br>We think the same also apply for SPS activation / release – but the number of bits to be independently configured from CG.<br><br>For simplicity, we think the same number of bits should be applied (1-3) as we don't see any real difference otherwise. This does not affect the false alarm rate, as if less bits would be needed, still not all states would be required and the remaining states can be used for false-alarm prevention (as discussed during the last meeting) |
| ZTE | Q1-1: determined by the number of CG states for release configured by higher layer, and no larger than 4bits.<br><br>Q1-2: determined by the number of CG configurations configured by higher layer, and no larger than 4bits.<br><br>Q1-3: Based on answers to Q1-1 and Q1-2, the number of bits could be the different which depends on RRC configuration.<br><br>As noted by FL, we need to decide whether support cross-carrier, cross-BWP activation/release of CG(s). |
| Fujitsu | For 1-1,<br><br>we perfer the number of M for release depends on the number of CG configuration(s) configured by higher layers.<br><br>For 1-2,<br><br>we perfer the number of M for release depends on the number of:<br><br>• If CG states are configured, M for release depends on the number of CG state(s) configured by higher layers.<br><br>• If CG states are not configured, M for release depends on the number of CG configuration(s) configured by higher layers.<br><br>For 1-3,<br><br>No. Although we agreed to use the same field for the activation and the release of UL CG configuration(s), it does not mean that they always use the same number of bits for indication.<br><br>For example, assuming that 4 CG configuration(s) and 8 CG states are configured for a UE, the bitwidth of the field for the activation/release |

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| | indication is 3. For activation, only 2 bits are required and the left bit can be used for activation validation. |
| CATT | 1-1: How to determine the value of M (M<=4) for release?<br><br>If higher layer configured state(s) is configured, M is determined by the number of configured state(s). Otherwise, M is determined by the number of configured Type 2 CG configurations.<br><br>1-2: How to determine the value of M (M<=4) for activation?<br><br>M is determined by the number of configured Type 2 CG configurations.<br><br>1-3: Whether to have the same number of bits, i.e. M (M<=4) for activation and release of UL CG(s)?<br><br>M for activation and release of UL CG(s) may not be the same. |
| vivo | Regarding question 1-1, the value of M is dependent on the number of configured state(s) for release for configured grant(s) by higher layer.<br><br>Regarding question 1-2, the value of M is dependent on the number of configured grant(s) configured by higher layer.<br><br>Regarding question 1-3, whether the value of M for activation and release are the same or different is depending on the configuration for release or activation. |
| Huawei,HiSilicon | Firstly, we share a same view with Nokia that there is no motivation to have different fields or different numbers of bits for configuration index indication in activation and release DCI.<br><br>Secondly, we don't think it's necessary to introduce a new RRC parameter to configure the value of *M*. Instead, it can be determined implicitly according to the number *P* of Type 2 configurations and/or the maximum value *Q* of the higher layer configured state(s) for release, e.g., *M*=max( $\lceil log_2(P) \rceil$ , $\lceil log_2(Q) \rceil$ ), if we want to make it configurable. |
| LGE | Firstly, for question 1-3, we share similar view to Nokia, it is not necessary to have different bit length for activation and release.<br><br>For question 1-1 and 1-2, we prefer option 2 and option 3 which is explicit way. If we consider the number of configuration, configuration index previously configured can be exceed the range of M due to releasing configuration having smaller index. It may cause redundant re-configuration. |
| Panasonic | 1-1: The value of M depends on the number of configured states.<br>1-2: The value of M depends on the number of configured configurations. |

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|---|---|
| | 1-3: Based on 1-1 and 1-2, the value of M for release and activation are the same or different. But we think that to apply the same number of bits can also be possibility by using the method mentioned by Huawei. |
| Ericsson | Value of M for release is decided by the bit width of HPN of the DCI format. Same field is used for activation, retransmission and release. |

### 3.2 DCI format(s) for activation/release and scheduling re-transmission

In the RAN1#98 meeting, following was agreed:

**Agreements:**

- Introduce one new DCI format for DL scheduling and one new DCI format for UL scheduling with configurable sizes for some fields in Rel-16
- Support separate configurable number of bits (2 or 3 or 4 bits) for "HARQ process number" for new DCI formats for scheduling DL and UL.

Before discussing which field(s) can be used for indicating CG(s) activation/release. It is better to first discuss the DCI format(s) can be used as activation/release DCI. For simplicity, here we denote DCI format 0_a for the new DCI format in uplink scheduling and DCI format 1_b for the new DCI format in downlink scheduling. Companies' preference for activation and release DCI format(s) are summarized in following Table 1, 2 and 3 respectively based on contributions. **Companies are encouraged to input or correct their views for following.**

Table 1: Activation DCI format(s) for multiple CG(s)

| Company's view | DCI format 0_0 | DCI format 0_1 | DCI format 0_a |
|---|---|---|---|
| HW (0071) | Support | Support | FFS |
| ZTE (0105) | Support | Support | Support |
| Fujitsu (0188) | Support~~?~~ | Support~~?~~ | Support |
| Vivo (0226) | Support | Support | Support? |
| CATT (0346) | Support | Support | Support |
| Samsung (0488) | Support? | Support? | Support |
| Ericsson (0550) | Support | Support | Support |
| OPPO (0624) | Support | Support | FFS? |
| Intel (0665) | Support? | Support? | Support? |
| LG (0831) | Support? | Support? | Support |
| Nokia (0869) | Support | Support | Support |

| | | | |
|---|---|---|---|
| Panasonic (0992) | Support | Support | Support |
| DCM (1180) | Support | Support | Support |
| WILUS (1319) | Support | Support | Support |

Table 2: Release DCI format(s) for multiple CG(s)

| Company's view | DCI format 0_0 | DCI format 0_1 | DCI format 0_a |
|---|---|---|---|
| HW (0071) | Support | No? | FFS |
| ZTE (0105) | Support | Support | Support |
| Fujitsu (0188) | Support~~?~~ | No ~~Support?~~ | Support |
| Vivo (0226) | Support | Support | Support? |
| CATT (0346) | Support | ~~No?~~FFS (depends on whether to support cross-BWP/carrier activation/release) | ~~No?~~FFS (depends on whether to support cross-BWP/carrier activation/release) |
| Samsung (0488) | Support? | Support? | Support |
| Ericsson (0550) | Support | No? | Support |
| OPPO (0624) | Support | No? | FFS? |
| Intel (0665) | Support? | Support? | Support? |
| LG (0831) | Support? | Support? | Support |
| Nokia (0869) | Support | Support | Support |
| Panasonic (0992) | Support | Support | Support |
| DCM (1180) | Support | Support | Support |
| WILUS (1319) | Support | Support? | Support |

Based on above, following proposal is made:

Q1: should cross-carrier activation/release the Type 2 CG be supported?

Q2: should cross-BWP activation the Type 2 CG be supported?

**<u>Proposal 1:</u>**

- *Support DCI format 0-0, 0-1 and new DCI format scheduling PUSCH for Type 2 CG activation*
- *Support DCI format 0-0 and new DCI format scheduling PUSCH for Type 2 CG release*

- *FFS DCI format 0_1 for Type 2 CG release*

Any comments?

| Company | View |
|---|---|
| Nokia, NSB | We support this proposal – including the support the FFS (as this limits the x-scheduling operation) |
| ZTE | We think both non-fallback DCI and new DCI format can be supported for activation and release. While, for fallback DCI, it depends on the answer to Question 1. If the number of bits for activation/release is determined by RRC, the fallback DCI which should be independent from RRC configuration cannot be used for activation/release here. |
| Fujitsu | Support this proposal. |
| CATT | We support the activation. For release, if cross-BWP/carrier activation/release is not supported, only DCI format 0_0 for release is sufficient. Otherwise, both DCI format 0_1 and new DCI format for release can be supported. |
| vivo | Generally, we are fine with the proposal.<br>Regarding the DCI format 0_1 for release, we think it can be supported. |
| Huawei, HiSilicon | We are ok with the proposal even though we think the conclusion about new DCI format could be made after the whole picture of new DCI format is clear. |
| LG | We are fine with this proposal in terms of activation. For release, we don't need to use other DCI format since the release doesn't require to be performed immediately as like activation even for URLLC purpose. It can be discuss after new DCI format design and related PDCCH issue are resolved. |
| Panasonic | Support the proposal. We also support DCI format 0-1 for Type 2 CG release. |
| Ericsson | We are fine with activation proposal. Not sure if the cross carrier releasing with DCI 0-1 is needed. |

### 3.3 Field(s) for indicating CG(s) activation/release

Based on contributions, almost all companies prefer to re-use existing field(s) for indicating which CG(s) is/are activated/released.

- [HW, 0071], [CATT, 0346], [SS, 0488], [Ericsson, 0550], [OPPO, 0624], [Intel, 0665], [LG, 0831], [Panasonic, 0992] proposed to use the HPN field for both activation/release indication;

- [CATT, 0346], [SS, 0488] proposed gNB needs to ensure the bit-width of HPN field is no less than $\lceil \log_2 N \rceil$, where N is the configured number of UL CG configurations.

- [ZTE, 0105], [Fujitsu, 0188], [Nokia, 0869], [DCM, 1180], [WILUS, 1319] proposed to use HPN field when the number of bit of HPN field is equal or larger than M; otherwise, concatenate HPN field, RV and/or TPC field for indicating activation/release of CG(s).

The decision for the field(s) is related to the discussions on the DCI format(s) and value of M discussions. However, the proposal can be made considering the common aspects:

**Proposal 2-1:**

- *M (M<=4) least significant bits of HPN field in DCI format 0_0 and 0_1 with CRC scrambled by CS-RNTI is used to indicate which configuration is to be activated and which configuration(s) is/are to be released.*
  - *Note: M may or may not be different for activation and release DCI.*

Any comments?

| Company | View |
|---|---|
| Nokia, NSB | Support this proposal |
| ZTE | It seems this proposal assumes the number of bits for activation and release is the same, i.e., use a same value M. But it should be determined based on the discussion of Question 1 in section 2.1.<br><br>Whether fallback DCI, i.e., DCI format 0_0 can be applied here depends on the discussion of Proposal 1 in section 2.2 above. |
| Fujitsu | Support this proposal |
| CATT | Support this proposal with the understanding that M can be different for activation and release. |
| vivo | We share the similar view as ZTE. We suggest to separate the discussion for activation and release, as it is also related to the proposal listed above. |
| Huawei,HiSilicon | We support this proposal |
| LG | Support this proposal. |
| Panasonic | Support the proposal. |
| Ericsson | Support the proposal. |

**Proposal 2-2:**

- *If the new UL DCI format with CRC scrambled by CS-RNTI is agreed to be used as*

*activation and/or release DCI for Type 2 CG, at least HPN field in the new UL DCI format is used to indicate which configuration is to be activated and which configuration(s) is/are to be released.*

- *FFS other field(s) if the number of bits for HPN field is smaller than M.*

Any comments?

| Company | View |
|---|---|
| Nokia, NSB | Support this proposal.<br>As noted in our contribution, we might need to use some additional fields such as RV and/or TPC here. |
| ZTE | Support this proposal. |
| Fujitsu | Support this proposal. |
| CATT | Support this proposal. |
| Vivo | If new DCI format is supported for activation/release, we can support this proposal.<br><br>FFS whether there is restriction if new DCI format is used for activation or release. |
| Huawei,HiSilicon | We support to use HPN filed in new DCI format for configuration index indication, if the new DCI format is agreed to be used for Type 2 CG activation/release.<br><br>For the FFS part, we think it depends on how the gNB configures the bit width of HPN field. If gNB takes the Type 2 CG activation/release into consideration when determining the bit width of HPN field, then we think there is no need to use other field(s) for configurations index indication. |
| LG | We share similar view to Huawei,HiSilicon's view. Basically, the number of configuration should be not larger than the number of HARQ process. And if we consider re-transmission, DCI controlling CG configuration should have sufficient HARQ process number field on its DCI format. From this point of view, there seems no clear use cases that HPN field smaller than M. |
| Panasonic | Support the proposal. |
| Ericsson | Support this proposal. |

## 3.4 Necessity for defining additional field(s) for activation/release DCI validation

In Rel.15, following special fields are defined to validate and differentiate between activation and deactivation signalling in TS 38.213.

**Table 10.2-1: Special fields for DL SPS and UL grant Type 2 scheduling activation PDCCH validation**

| | DCI format 0_0/0_1 | DCI format 1_0 | DCI format 1_1 |
|---|---|---|---|
| HARQ process number | set to all '0's | set to all '0's | set to all '0's |
| Redundancy version | set to '00' | set to '00' | For the enabled transport block: set to '00' |

**Table 10.2-2: Special fields for DL SPS and UL grant Type 2 scheduling release PDCCH validation**

| | DCI format 0_0 | DCI format 1_0 |
|---|---|---|
| HARQ process number | set to all '0's | set to all '0's |
| Redundancy version | set to '00' | set to '00' |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '1's | set to all '1's |

Using HPN field to indicate which configuration(s) is/are activated/released will increase the false alarm rate on DCI monitored by CS-RNTI [CATT, 0346], [Ericsson, 0550], [Intel, 0665], [ZTE, 0150], [Nokia, 0869], [SS, 0488]. While, it is also observed by [ZTE, 0150] that in Rel.15 CG, the only difference between activation UL CG transmission and re-transmission of UL CG scheduled by dynamic DCI is NDI field, it means the false alarm of activation DCI can only depend on the CRC length and the 1-bit NDI. Therefore, further discussion is needed on whether to enhance the validation of activation and/or release DCI by setting defined values for additional field(s) that are less relevant for scheduling.

**<u>Proposal 3:</u>**

- *FFS whether it is necessary to set defined values for additional fields for activation and/or release DCI validation.*
  - *If necessary, FFS additional field(s)*

Any comments?

| Company | View |
|---|---|
| Nokia, NSB | We could for sure discuss this. But the discussion should be done with lower priority compared to other issues, as this is not absolutely needed to support URLLC CG. |
| ZTE | This could be discussed with low priority. |

| | |
|---|---|
| Fujitsu | From our perspective, adding new field(s) for DCI validation is unnecessary. Considering the potential use of the new DCI format, it is difficult to have a unify solution for different DCI formats. |
| CATT | We see the need to define additional field(s) for validation. Our understanding is that the false alarm is mainly between DCI for activation/release and dynamic scheduling. Give that based on proposal 2-1 and 2-2, HPN field is used to indicate the configuration index, additional field(s) is necessary for validation. |
| vivo | Discuss with low priority. |
| Huawei,HiSilicon | We agree with Nokia. |
| LG | Same view with Nokia. This issue can be discussed after other issues are resolved. |
| Panasonic | Discuss with low priority. |
| Ericsson | We think more fields for validation is needed. It is preferred to postpone the discussion when the functional DCI fields for activation/retransmission/release get decided. |

### 3.5 DCI size alignment

In NR Rel-15, there is a limit on the total number of DCI sizes UE should monitor for the cell, i.e., three different sizes for DCI with CRC scrambled by C-RNTI and one additional size for other RNTI to relax UE monitoring complexity.

In Rel.16, it was agreed to introduce one new DCI format (e.g. DCI format 0_a) for UL scheduling with configurable sizes for some fields. The DCI size for DCI format 0_a with CRC scrambled by C-RNTI is determined by the RRC parameters introduced in Rel.16 for dynamic grant, name it as pusch-config-r16 to differentiated from current pusch-config. In addition, multiple CGs and separate RRC parameters for different CGs configurations for a given BWP of a serving cell are supported. If Rel.16 DCI format 0_a is agreed to be used as activation/release DCI for CG, it is necessary to discuss following:

- DCI size for DCI format 0_a with CRC scrambled by CS-RNTI for different CG configurations
- DCI size between the DCI format 0_a with CRC scrambled by CS-RNTI and the DCI format 0_a with CRC scrambled by C-RNTI

Although it is expected/preferred the DCI size budget in Rel.16 can be relaxed compared to Rel.15, it is not possible and realistic to increase the DCI size budget up to 12, given at most 12 CGs can be supported for a BWP. Therefore, it is reasonable and simple to follow Rel.15 DCI size principle for DCI format 0_1 for the new DCI format 0_a [Ericsson, 0550], [Nokia, 0869], [LG, 0831]:

- New UL DCI format with CRC scrambled by CS-RNTI should be size-aligned with the new UL DCI format with CRC scrambled by C-RNTI.

**<u>Proposal 4:</u>**

- *New UL DCI format with CRC scrambled by CS-RNTI should be size-aligned with the new UL DCI format with CRC scrambled by C-RNTI.*

Any comments?

| Company | View |
|---|---|
| Nokia, NSB | Agree – we think the DCI structure should be given by the configuration of the DCI format 0_b. |
| ZTE | Support |
| Fujitsu | Support this proposal. |
| CATT | Support |
| vivo | If new DCI format is supported for activation, agree the proposal.<br><br>This proposal can be discussed after there are more details for new DCI format design. |
| Huawei,HiSilicon | If the new DCI format is agreed to be used for Type 2 CG activation/release, we also think the size should be aligned between the DCI with CRC scrambled by C-RNTI and the DCI with CRC scrambled by CS-RNTI. However, as discussed in our contribution, R15 principle for size alignment imposes unnecessary restrictions in terms of flexibility of higher configuration for CGs, especially when R16 supports multiple CG configurations for different services. |
| LG | Agree with this proposal. Related RRC parameters and RRC parameter used for interpretation need to be determined later. |
| Panasonic | Support the proposal. |
| Ericsson | Support the proposal. |

### 3.6 NDI/HPN and RV field(s) position alignment

As well summarized by [Nokia, 0869], at the end of Rel-15, there had been lengthy discussions in RAN1 on how to interpret DCI Format 0_1 considering the potential different configuration of certain parameters of *pusch-config* and *configuredGrantConfig*. Here, we briefly review the issues and the solutions agreed in Rel.15.

First, in Rel.15, RRC parameters related to dynamic grant are specified in the *PUSCH-Config*. RRC parameters related to configured grant are specified in the *ConfiguredGrantConfig*.

However, due to parallel discussions for NR different topics, some parameters defined in the *PUSCH-Config* are not specified in the *ConfiguredGrantConfig.* Therefore, it is proposed that the parameters which are not defined in the *ConfiguredGrantConfig* shall follow the parameters in the *PUSCH-Config.*

Second, for parameters defined in both *ConfiguredGrantConfig* and *PUSCH-Config*, when a UE receives a PDCCH scheduling a retransmission of a TB that was initially transmitted on a configured grant, which parameter to use (either the parameter in the *ConfiguredGrantConfig* or that in the *PUSCH-Config*) need to be defined. For this issue, two aspects need to be kept in minds:

(1) It is essential to fix the NDI field position in the DCI format 0_1 between activation DCI and re-transmission DCI, since the NDI field is used to distinguish whether the DCI format 0_1 is the activation DCI or the re-transmission DCI.

(2) it is essential to keep the total DCI format size between activation/re-transmission DCI for configured grant and scheduling DCI for dynamic grant.

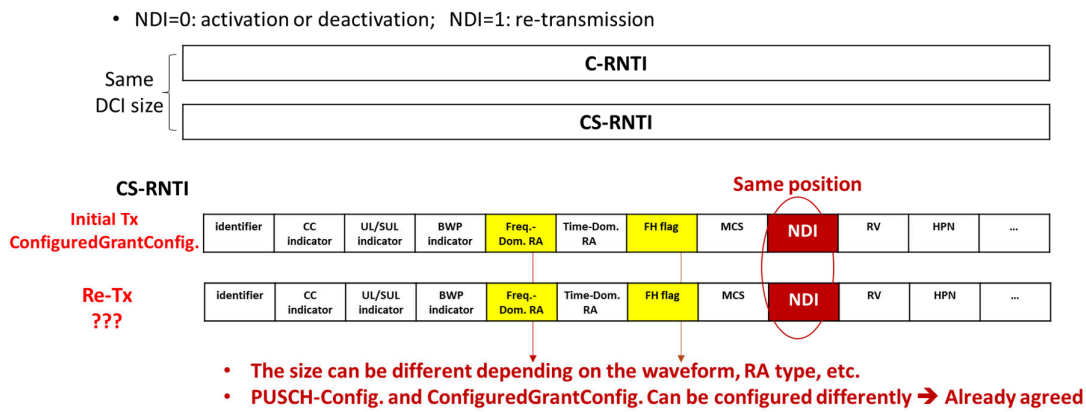


Figure 1: illustration of the issue for configured grant re-transmission

During the CR phase the following behaviors were agreed to solve above issues [Nokia, 0869]:

- <u>Behavior 1:</u> The UE does not expect the bit width of a field given by *configuredGrantConfig* to be larger than given by *pusch-config* (which defines the size for DCI format 0_1 scrambled by C-RNTI and CS-RNTI, see end of Sec. 7.3.1.1.2 of 38.212)
- <u>Behavior 2:</u> PUSCH according to configured grant apply the parameters given by *configuredGrantConfig* (with some exceptions, see Sec. 6 of TS 38.214)
- <u>Behavior 3:</u> PUSCH re-transmissions of a CG transmission apply the parameters given by *pusch-config* (with some exceptions, see Sec. 6 of TS 38.214)

In Rel.16, multiple CGs and separate RRC parameters for different CGs configurations for a given BWP of a serving cell are supported. The issue on how to fix the NDI/HPN, RV position need to be discussed.

- [SS, 0488], [LG, 0831] proposed to re-apply Rel.15 principle, above Behavior 1, 2 and 3;
- [HW, 0071] proposed to re-apply above behavior 2 and 3; For behavior 1, it was proposed to locate NDI field as well as HPN field in front of the fields with configurable bit width, and pad '0' bits to the end of the DCI if the size of the DCI is not equal to a maximum value. The maximum value of the DCI size is determined according to the higher layer configuration either for dynamic grant or configured grant that leads to the maximum DCI size.

- [Ericsson, 0550] proposed to re-apply behavior 3; For Behavior 1 and 2, it was proposed that the CG associated with new DCI format shall ignore the parameters configured in *ConfiguredGrantConfig* IE and instead follow the higher layer parameters configured for the dynamic PUSCH associated with new DCI format.
- [Nokia, 0869] proposed to re-apply behavior 2 and 3; For Behavior 1, it was proposed following:
  - New UL DCI Format 0_a can be used for activation of a Type 2 CG configuration, if the bitfield width of each field given by *configuredGrantConfig* of the Type 2 CG configuration is not larger than given by configuration of DCI Format 0_a. Otherwise, the new UL DCI format 0_a cannot be used for Type 2 activation and legacy formats 0_0 & 0_1 need to be used for Type 2 activation.
  - DCI Format 0_b can be used for release signalling of any Type 2 CG configuration.

Based on above, one proposal can be made which seems common preference.

**Proposal 5:**

- *Retransmission of the PUSCH retransmission scheduled by a new UL DCI format with CRC scrambled by CS-RNTI with NDI=1 shall follow the same higher layer configuration defined for dynamic PUSCH transmission associated with the new UL DCI format.*

Any comments?

| Company | View |
|---|---|
| Nokia, NSB | Support. |
| ZTE | Support |
| CATT | Support |
| vivo | This proposal can be discussed after there are more details for new DCI format design. |
| Huawei,HiSilicon | Support. |
| LG | Support. |
| Ericsson | Support the proposal. |

For other aspects, companies are encouraged to share your views for the following questions.

- **Question 2: For the RRC parameters introduced in Rel.16 for dynamic grant PUSCH which are used to indicate the bit width of some fields in the new DCI format, are they also separately introduced for each configured grant configuration?**
  - Option 1: Yes
  - Option 2: No

| Company | View |
|---|---|
| Nokia, NSB | I guess this very much depends on the assumptions for Type-2 activation (not just re-tx as in Q3 below). If the Rel-15 operation behaviour for activation is retained, then it would need to be Option 1 in case the new DCI format is to be used. Otherwise, there may not be a need for it.<br>We might need to discuss overall the activation & re-transmission, before we see how much additional configuration for each CG configuration may be needed. |
| ZTE | Rel-15 behavior can be applied here for simplicity, i.e., Option 1. |
| CATT | We may need more discussion on what RRC parameters are needed. But in general, we do not see the need to prevent to have separate configurations for each CG configuration. |
| vivo | Further discussion is needed on what and which fields are included in the activation and retransmission DCI in case of new DCI format. After there is clear picture about the DCI contents in the new DCI format, we can draw the conclusion. |
| Huawei,HiSilicon | Agree with CATT. Basically we think at least for some of the RRC parameters, they may need to go to Option 1. |
| LG | It is up to the purpose of those parameters. If those parameter only define the number of bit for each field and do not change interpretation, we can go to option 1 since DCI structure would be same between configured grant and dynamic grant |
| Ericsson | No. When applying new DCI format for the activation, the CG follows the higher configurations for the new DCI, same interpretation as for dynamic PUSCH when applying the new DCI. It would be unnecessary to redefine all the parameters and do DCI field size alignment, mess up the specification with all those RRC parameters.<br>If different configurations are preferred as in release 15, non-fallback DCI format can be used. |

- **Question 3: If the answer is yes to the Question 2, how to fix the NDI, HPN, RV position of the new DCI format used for activation/release, scheduling the retransmissions among different CG configurations?**

| Company | View |
|---|---|
| Nokia, NSB | Structure of the DCI should be given by the new DCI format configuration (same for C-RNTI & CS-RNTI). |
| ZTE | Reuse Rel-15 behavior is preferred at current late stage. |

| | |
|---|---|
| CATT | We prefer to reuse Rel-15 rules. |
| vivo | See the answer to question 2. |
| Huawei,HiSilicon | For Question 3, we provided following two options in our contribution:<br>- **Option 1:** Insert a number of most significant bits with the value set to '0' if the bit width of a field is not equal to a maximum bit width. The maximum bit width is determined according to the higher layer parameter defined either for dynamic grant or for configured grant that requires the maximum bit width for the field.<br>- **Option 2:** Locate NDI field as well as HPN field in front of the fields with configurable bit width, and pad '0' bits to the end of the DCI if the size of the DCI is not equal to a maximum value. The maximum value of the DCI size is determined according to the higher layer configuration either for dynamic grant or configured grant that leads to the maximum DCI size.<br>Since Option 2 could have smaller DCI size and seems to have less complexity compared to Option 1, we prefer to adopt Option 2. |
| LGE | Re-use release 15 manners. No matter how many CGs are configured, if one anchor point; DCI with C-RNTI is used, all DCI structure for multiple CG would be aligned. |

# 4 Start for the initial transmission of a TB with *K* repetitions

In Rel.15, only one CG configuration can be allowed for one carrier. The initial transmission of a TB UE can start depends on the configured RV sequence and repetition factor K as defined in TS 38.214. In summary,

- For RV sequence {0, 2, 3, 1}, the initial transmission of a TB shall start at the first transmission occasion (TO) of the K repetitions.
- For RV sequence {0, 3, 0, 3}, the initial transmission of a TB can start at any of the transmission occasions of the K repetitions that are associated with RV=0.
- For RV sequence {0, 0, 0, 0},
  - the initial transmission of a TB can start at any of the transmission occasions of the K repetitions when K=1, 2 or 4;
  - the initial transmission of a TB can start at any of the transmission occasions of the K repetitions, except the last transmission occasion when K=8.

In Rel.16, multiple active CG configurations for a BWP is supported. Reducing the initial transmission delay and ensure K repetition without cross the periodicity boundary can be achieved by multiple CG configurations, which have different starting positions. Therefore, [SS, 0488], [Intel, 0665] and [Nokia, 0869] proposed to introduce one RRC signalling to enable/disable the feature of starting from any RV0 occasion for RV cyclic sequences {0,0,0,0} and {0,3,0,3}; [HW, 0071] proposed to re-sue Rel.15 mechanism, i.e., when RV sequence {0, 2, 3, 1} is configured, repetitions only start from the first TO in a resource period; when RV

sequence {0, 0, 0, 0} or {0, 3, 0, 3} is configured, repetitions can start from TOs associated with RV0.

Therefore, further discussion is needed on whether to introduce the RRC signalling to enable/disable the feature of starting from any RV0 occasion for RV cyclic sequences {0,0,0,0} and {0,3,0,3}.

**Proposal 6:**

- *FFS whether to introduce the RRC signalling to enable/disable the feature of starting from any RV0 occasion for RV cyclic sequences {0,0,0,0} and {0,3,0,3}.*

Any comments?

| Company | View |
|---|---|
| Nokia, NSB | We support not just the FFS – but think we should agree to this proposal directly.<br>Agreeing to this proposal does not mean, that the Rel-15 behavior would not be supported anymore (as HW is requesting), but based on RRC config you have the Rel-15 operation retained (suggested by HW) or the not having the flexible start (as suggested by some others). |
| ZTE | From gNB point of view, limiting the transmission can only start at the first transmission occasion is beneficial for blind detection. On the other hand, it is only applicable when the number of CGs is equal or larger than the number of repetitions, otherwise it could cause additional latency if the UE misses the first occasion. We are fine with discussing this with low priority. |
| CATT | The necessity of introducing the RRC parameter is not so clear to us. Further discussion is needed. |
| vivo | We don't see the necessity to additionally support this proposal. Rel.15 mechanism is sufficient. If gNB desires to start an initial transmission at the first transmission occasion, then RV = {0 2 3 1} can be configured. |
| Huawei,HiSilicon | We don't support this proposal.<br><br>R15 already supports the enabling and disabling of flexible start by configuring different RV sequences, i.e., RV sequence {0231} to disable flexible start and RV sequences {0000} or {0303} to enable flexible start. We don't see any clear motivation or benefit to change the rule in R16. |
| LG | The purpose of introducing {0000} and {0303} was originally to support flexible starting point. If we have multiple configuration for flexible starting point, there seems no clear use case to configure {0000} and {0303}. |

| | |
|---|---|
| Panasonic | Agree with vivo. |
| Ericsson | We would like to postpone the discussion as it is also related to PUSCH enhancement. |

# 5 Solutions to reduce the transmission alignment delay and ensure the reliability

Based on the contributions, for reducing the transmission alignment delay and ensuring the reliability, in general, there are three options.

[MTK 1083] and [Ericsson, 0550] proposed to support single UL CG configuration to reduce the transmission alignment delay and ensure the reliability. [ZTE, 0105], [vivo, 0226], [SS, 0488], [Nokia, 0869], [QC, 1123] proposed to only support multiple CGs for this purpose. Considering the limited WI time, it is proposed to prioritize to finalize the feature of multiple CGs for different traffic support and for transmission alignment delay reduction without scarifying the reliability support.

Any comments on above?

| Company | View |
|---|---|
| Nokia, NSB | We think that transmission occasion should not cross the periodicity boundary as in Rel-15. |
| ZTE | Supporting single CG is an additional minor optimization on top of multiple CGs. So, we prefer only supporting multiple CGs for reduction of alignment delay and ensuring the reliability. |
| CATT | We are fine to deprioritize single UL CG configuration in Rel-16. |
| Vivo | Agree with FL comment. |
| LG | Agree with FL comment. |
| Panasonic | Agree with the proposal from FL. |
| | |

# 6 Other enhancements

Other potential enhancements proposed by some companies are summarized below.

**<u>For repetition factor,</u>**

- [Ericsson, 0550] proposed to increase maximum possible repetition factor to 16 considering the impact of UL-DL pattern on reliability. This point should also apply to PUSCH transmission with dynamic grant. So, it can be discussed together with PUSCH enhancements.

**For enhancement of multiple Type 1 configurations**,

- [Nokia, 0869] proposed to support a dynamic CG profile/configuration change for Type 1 CG through UE pre-configuration of multiple CG Type 1 configurations by RRC signalling, which can be dynamically exchanged/selected by DCI signalling, since for Type 1 CG, the parameter change can only rely on RRC reconfiguration which results in long delay and undefined UE behaviour during RRC reconfiguration ambiguity.

As brought up by HW, there is one issue related to the RRC parameters, so better to discuss it:

Question:

- *For type 1, how to determine the repetition scheme (either slot-based or mini-slot-based) for each CG configuration?*
- *For type 2, how to determine the repetition scheme (either slot-based or mini-slot-based) for each CG configuration?*
  - *Same mechanism as for PUSCH scheduled by dynamic PUSCH.*

**Proposal 7:**

- *Discuss above enhancements during the meeting.*

Any others?

| Company | View |
|---|---|
| Nokia, NSB | Yes |
| Huawei,HiSilicon | Another issue that is also needed to be discuss under 7.2.6.6 is how to determine the repetition scheme (either slot-based or mini-slot-based) for each CG configuration, as this may have impact on RRC parameters. |
| Ericsson | We would like to discuss range of repetition factor. For the repetition scheme, we may discuss this after the repetition scheme/parameters in PUSCH enhancement get decided. |
| | |

# 7 Proposal summary

Based on the survey and above discussions. All proposals are summarized as following:

**Proposal 1:**

- *Support DCI format 0-0, 0-1 and new DCI format scheduling PUSCH for Type 2 CG activation*
- *Support DCI format 0-0 and new DCI format scheduling PUSCH for Type 2 CG release*
  - *FFS DCI format 0_1 for Type 2 CG release*

**Proposal 2-1:**

- *M least significant bits of HPN field in DCI format 0_0 and 0_1 with CRC scrambled by CS-RNTI is used to indicate which configuration is to be activated and which configuration(s) is/are to be released.*

**Proposal 2-2:**

- *For new UL DCI format with CRC scrambled by CS-RNTI, at least HPN field is used to indicate which configuration is to be activated and which configuration(s) is/are to be released.*
  - *FFS other field(s) if the number of bits for HPN field is smaller than M.*

**Proposal 3:**

- *FFS whether and how to set defined values for additional fields for activation and/or release DCI validation.*

**Proposal 4:**

- *New UL DCI format with CRC scrambled by CS-RNTI should be size-aligned with the new UL DCI format with CRC scrambled by C-RNTI.*

**Proposal 5:**

- *Retransmission of the PUSCH retransmission scheduled by a new UL DCI format with CRC scrambled by CS-RNTI with NDI=1 shall follow the same higher layer configuration defined for dynamic PUSCH transmission associated with the new UL DCI format.*

**Proposal 6:**

- *FFS whether to introduce the RRC signalling to enable/disable the feature of starting from any RV0 occasion for RV cyclic sequences {0,0,0,0} and {0,3,0,3}.*

# 8 References


R1-1910020 Discussion on UL grant-free transmission enhancements for URLLC Spreadtrum Communications

R1-1910071 Enhanced UL configured grant transmission Huawei, HiSilicon

R1-1910105 Enhancements for UL configured grant transmission ZTE

R1-1910188 UL configured grant transmission enhancements for URLLC Fujitsu

R1-1910226 Enhanced UL configured grant transmissions for URLLC vivo

R1-1910346 Discussion on enhanced UL configured grant transmission CATT
R1-1910488 UL configured grants for eURLLC Samsung
R1-1910550 Enhancements to UL Configured Grant Transmission for NR URLLC Ericsson
R1-1910624 Configured grant enhancements for URLLC OPPO
R1-1910665 Enhancements to UL configured grant transmission Intel Corporation
R1-1910773 Enhanced UL configured grant transmission for URLLC Sony
R1-1910831 Enhanced UL configured grant transmission for NR URLLC LG Electronics
R1-1910869 On Enhanced UL Configured Grant Transmission for NR URLLC and activation/release of multiple SPS configurations Nokia, Nokia Shanghai Bell
R1-1910992 Discussion on URLLC enhancements for grant-free transmission Panasonic Corporation
R1-1911083 Enhancements for NR configured-grant MediaTek Inc.
R1-1911123 Enhanced Grant-Free Transmissions for eURLLC Qualcomm Incorporated
R1-1911180 Remaining issues for enhanced configured grant transmission NTT DOCOMO, INC.
R1-1911319 Discussion on UL configured grant enhancements for NR URLLC WILUS Inc.
R1-1911328 Consideration on enhanced UL configured grant transmissions for URLLC CAICT

# 9 Previous agreements

#94

**Agreements:**

- Study further whether/how multiple active configured grants for a BWP of a serving cell.
  - Identify potential specification impacts and options for both type 1 and type 2
    - At least Activation/deactivation mechanism for Type2
      - E.g., whether each configuration is activated/deactivated or multiple configurations are activated/deactivated
    - Study how to support repetitions with multiple configurations for a BWP of a serving cell
    - FFS HARQ process ID determination for both type 1 and type 2
    - FFS other specification impacts for both type 1 and type 2
  - Study the performance impacts

**Agreements:**

- Study further whether/how on ensuring K repetitions.
- Study further on PUSCH repetitions within a slot for configured grant.

#94bis

**Agreements:**

- One PUSCH transmission instance is not allowed to cross the slot boundary at least for grant-based PUSCH.

**Agreements:**

- To study further from at least the following:
  - Option 1: multiple active configured grant configurations for a BWP of a serving cell
  - Option 2: repetition(s) across the boundary of a period P
  - Option 3: one transmission cross boundary of a period P

- FFS the UE behavior when repetitions are collided with the resource which are not available for UL transmissions
- Note: Switch grant free to grant based retransmission which is available in Rel.15

#95

**Agreements:**

- Multiple active configured grant configurations for a given BWP of a serving cell should be supported at least for different services/traffic types and/or for enhancing reliability and reducing latency
  - FFS details
  - Note: it is understood that the above may be related to RAN2-led work on intra-UE multiplexing

Agreement:

- One PUSCH transmission instance is not allowed to cross the slot boundary for UL configured grant

Agreements:

- For whether to support explicit HARQ-ACK for configured grant for UL, at least study further gNB's missed detection performance of the PUSCH under configured grant
  - Study how to resolve gNB's missed detection if it is an issue
  - Study should take at least following into account:
    - Companies report the false alarm target
    - Companies report the DMRS configuration assumptions
    - The number of UEs sharing the time/frequency-domain grant free resource: 1 is the baseline, larger than 1 can also be considered

#AH 1901

Agreements:

- In Rel-16, for both Type 1 and Type 2 configured grant and when multiple active configurations are configured in a BWP, transmission of a TB based on the configured grant is associated with a single active configuration, even if the transmission is repeated

Observations:

- PUSCH miss detection performance highly depends on the PUSCH configurations such as DMRS configuration, resource allocation, and false-alarm target setting.
  - If a configured grant PUSCH resource is not shared by multiple UEs,
    - 7 companies observed that if the reliability requirement is to be met by a single transmission, all the results show that PUSCH miss detection probability is lower than the PUSCH target BLER under the respective evaluation assumptions (e.g., MCS levels, etc.).
- If the overall PUSCH BLER target requirement is to be met by uplink grant based HARQ re-transmission for the configured grant PUSCH, the BLER of the configured grant PUSCH transmission can be higher than the overall PUSCH BLER target such that the residual BLER after the re-transmission achieves the overall PUSCH BLER target; even in this case, miss detection probability for configured grant PUSCH should not be higher than the overall PUSCH BLER target.

#96

**Conclusion:**

- There is no consensus on the necessity of explicit HARQ-ACK for configured grant PUSCH for this SI.

#96bis

Agreements:

- Support separate RRC parameters for different configured grant configurations (for both type 1 and type 2 configured grants) for a given BWP of a serving cell.
    - FFS whether or not some parameters can be common among different configured grant configurations

Agreements:

- Support separate activation for different configured grant Type 2 configurations for a given BWP of a serving cell.
    - FFS whether or not to support joint activation in a DCI for two or more configured grant Type 2 configurations
- Support separate release for different configured grant Type 2 configurations for a given BWP of a serving cell.
    - FFS whether or not to support joint release in a DCI for two or more configured grant Type 2 configurations

**Conclusion:**

RAN1 believes that it is feasible from physical layer perspective to support multiple active configured grant configurations with different Types for a given BWP of a serving cell. However, there is no conclusion in RAN1 whether or not to support it.

No further action in RAN1 until RAN2 has made progress on this topic (whether or not to support, use cases, etc.)

#97

Agreements:

- For the maximum number of UL CG configurations per BWP of a serving cell:
    - 12

Agreements:

- Regarding Q1 in the LS in R1-1905940:
    - Although RAN1 has not completely analysed the potential impact of supporting up to 16 SPS configurations for a given BWP of a serving cell, RAN1 has the understanding that 8 SPS configurations for a given BWP of a serving cell is sufficient in Rel-16

Agreements**:**

- Support joint release in a DCI for two or more configured grant Type 2 configurations for a given BWP of a serving cell if the bit-length for indication which configurations released is no more than 4 bits and DCI size is not impacted by adopting joint release.
    - FFS details.

#98

Agreements**:**

- M<=4 bits indication in the Release DCI is used for indicating which CG configuration(s) is/are released, where the association between each state indicated by the indication and the CG configuration(s) is
    - Up to 2^M states are higher layer configurable, where each of the state can be mapped to a single or multiple CG configurations to be released
    - In case of no higher layer configured state(s), separate release is used where the release corresponds to the CG configuration index indicated by the indication

**Conclusion:**

- No support of joint activation in a DCI for two or more configured grant Type 2 configurations in Rel-16

Working assumption:

- For activation and release of UL CG, same field(s) is/are used for a DCI format

Agreements made in RAN2 #105bis

⇒ **R2 assumes that the maximum number of active SPS configurations for a given BWP of a serving cell in the specification is 8 or 16 (FFS).**

⇒ **R2 assumes short SPS/CG periodicities and/or multiple SPS/CG configurations and/or combination thereof could be used to mitigate the periodicity misalignment between the TSN periodicity and CG/SPS periodicity. Other solutions not precluded, e.g. to address resource consumption.**

⇒ **Will support "short" SPS periodicities, at least down to 0.5ms**

⇒ **Ask R1 on feasibility, and additionally the feasibility to go down to even lower values, e.g. 2 symb.**

⇒ **R2 assumes that activation/deactivation is done by DCI.**

⇒ **RAN1 should address activation/deactivation DCIs related with configured grant Type 2 and SPS in the case of multiple configurations**

⇒ **When multiple UL CG or DL SPS configurations is configured, an offset for each configuration is needed for the calculation of the HARQ process ID**

Rel.15 mechanism for performing repetitions

In Rel.15, repetitions for a configured grant transmission is following:

- For the $n^{th}$ transmission occasion among $K$ repetitions, $n$=1, 2, …, $K$, it is associated with $(mod(n-1,4)+1)^{th}$ value in the configured RV sequence.
- The initial transmission of a transport block may start at
    - the first transmission occasion of the $K$ repetitions if the configured RV sequence is {0,2,3,1},
    - any of the transmission occasions of the $K$ repetitions that are associated with RV=0 if the configured RV sequence is {0,3,0,3},
    - any of the transmission occasions of the $K$ repetitions if the configured RV sequence is {0,0,0,0}, except the last transmission occasion when $K$=8.
- For any RV sequence, the repetitions shall be terminated after transmitting $K$ repetitions, or

at the last transmission occasion among the *K* repetitions within the period *P*, or when a UL grant for scheduling the same TB is received within the period *P*, whichever is reached first.

- The UE is not expected to be configured with the time duration for the transmission of K repetitions larger than the time duration derived by the periodicity P.

From the above, it is understood that K repetitions can be ensured by RV sequence {0, 2, 3, 1} for K=2, 4, 8, and RV sequence {0, 3, 0, 3} for K=2, while with RV sequence {0, 3, 0, 3} for K=4, 8 or RV sequence {0, 0, 0, 0} for K=2, 4, 8, repetitions may be less than the value of K, according to the start timing of the repetitions.

### 38.214, 6.1 UE procedure for transmitting the physical uplink shared channel

PUSCH transmission(s) can be dynamically scheduled by an UL grant in a DCI, or the transmission can correspond to a configured grant Type 1 or Type 2. The configured grant Type 1 PUSCH transmission is semi-statically configured to operate upon the reception of higher layer parameter of *configuredGrantConfig* including *rrc-ConfiguredUplinkGrant* without the detection of an UL grant in a DCI. The configured grant Type 2 PUSCH transmission is semi-persistently scheduled by an UL grant in a valid activation DCI according to Subclause 10.2 of [6, TS 38.213] after the reception of higher layer parameter *configuredGrantConfig* not including *rrc-ConfiguredUplinkGrant*.

For the PUSCH transmission corresponding to a configured grant, the parameters applied for the transmission are provided by *configuredGrantConfig* except for *dataScramblingIdentityPUSCH*, *txConfig*, *codebookSubset*, *maxRank*, *scaling* of *UCI-OnPUSCH,* which are provided by *pusch-Config*. If the UE is provided with *transformPrecoder* in *configuredGrantConfig*, the UE applies the higher layer parameter *tp-pi2BPSK*, if provided in *pusch-Config*, according to the procedure described in Subclause 6.1.4 for the PUSCH transmission corresponding to a configured grant.

For the PUSCH retransmission scheduled by a PDCCH with CRC scrambled by CS-RNTI with NDI=1, the parameters in *pusch-Config* are applied for the PUSCH transmission except for *p0-NominalWithoutGrant, p0-PUSCH-Alpha, powerControlLoopToUse, pathlossReferenceIndex* described in Subclause 7.1 of [6, TS 38.213], *mcs-Table, mcs-TableTransformPrecoder* described in Subclause 6.1.4.1 and *transformPrecoder* described in Subclause 6.1.3.

#### 38.212, 7.3.1.1.2 Format 0_1

A UE does not expect that the bit width of a field in DCI format 0_1 with CRC scrambled by CS-RNTI is larger than corresponding bit width of same field in DCI format 0_1 with CRC scrambled by C-RNTI for the same serving cell. If the bit width of a field in the DCI format 0_1 with CRC scrambled by CS-RNTI is not equal to that of the corresponding field in the DCI format 0_1 with CRC scrambled by C-RNTI for the same serving cell, a number of most significant bits with value set to '0' are inserted to the field in DCI format 0_1 with CRC scrambled by CS-RNTI until the bit width equals that of the corresponding field in the DCI format 0_1 with CRC scrambled by C-RNTI for the same serving cell.