**3GPP TSG-RAN WG1 #106bis-e R1-21xxxxx**

**e-Meeting, 11th – 29th October, 2021**

**Agenda item: 8.8.1.1**

**Source: Moderator (Sharp)**

**Title: FL Summary #3 on Enhancements on PUSCH repetition type A**

**Document for: Discussion and Decision**

# Introduction

For PUSCH enahancements the following objectives are described in the Coverage Enhancement WID.

* *Specification of PUSCH enhancements [RAN1, RAN4]*
  + *Specify the following mechanisms for enhancements on PUSCH repetition type A [RAN1]*
    - *Increasing the maximum number of repetitions up to a number to be determined during the course of the work.*
    - *The number of repetitions counted on the basis of available UL slots.*

This document is intended to facilitate view exchange and discussions on the enhancements on PUSCH repetition type A, for the following assigned email discussion.

[106bis-e-NR-R17-CovEnh-01] Email discussion regarding enhancements for PUSCH repetition type A – Toshi (Sharp)

* 1st check point: October 14
* Final check point: October 19

# Open Issues summary

## Increasing the maximum number of repetitions

For increasing of the maximum number of repetitions, the following agreements have been made.

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| **In RAN1#104-e**  Agreements:  The maximum number of repetitions for DG-PUSCH is also applicable to CG-PUSCH.  Agreements:  Rel-17 PUSCH repetition Type A supports the increase of maximum number of repetitions with repetition factors configured in a TDRA list with a row index indicated either by the configured grant configuration or by TDRA field in a DCI.   * FFS: increasing the maximum number of repetitions with repetition factor configured in *PUSCH-Config* and/or *ConfiguredGrantConfig*.   **In RAN1#105-e**  Agreement:   * Down-selection in RAN1#106-e: * Alt 1: The maximum number of repetitions supported by Rel-17 PUSCH repetition Type A is 32, irrespective of counting method, * Alt 2: The maximum number of repetitions supported by Rel-17 PUSCH repetition Type A is: 32 for the counting based on physical slots; and 16 (i.e. no change from Rel-16) for the counting based on available slots.   Agreement:  In addition to {1, 2, 3, 4, 7, 8, 12, 16} and {32}, the following additional value set for repetition factor is supported in Rel-17.   * {20, 24, 28}   **In RAN1#106e**  Agreement   * DCI format 0\_1 and DCI format 0\_2 support Rel-17 PUSCH repetition Type A with the increased maximum repetition numbers configured in TDRA lists.   Working Assumption  The maximum number of repetitions accounted for available slots supported by Rel-17 PUSCH repetition Type A is 32 |

At the same time, the following two remaining issues have been identified.

* Issue#1-1: Value of the maximum number of repetitions
* Issue#1-2: DCI formats and RRC paramters supporting the repetition factors indicated/configured via TDRA lists

### [Close] Issue#1-1: Value of the maximum number of repetitions

In Rel-15/16, RRC parameter *pusch-AggregationFactor* configures the number of repetitions for PUSCH, where the candidate value set of *pusch-AggregationFactor* = {2, 4, 8}. TDRA based dynamic repetition number indication introduced in Rel-16 is applied when configured, where the candidate value set of *numberOfRepetitions-r16* = {1, 2, 3, 4, 7, 8, 12, 16}. For CG-PUSCH, RRC parameter *repK* configures the number of repetitions, where the candidate value set of *repK* = {2, 4, 8}. For Type 2 configured PUSCH repetition, TDRA based dynamic repetition number indication with *numberOfRepetitions-r16* using activation DCI is also applicable.

In RAN1#105-e, it was agreed to down-select on of Alt 1 and Alt 2 in RAN1#106-e.

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| Agreement:   * Down-selection in RAN1#106-e: * Alt 1: The maximum number of repetitions supported by Rel-17 PUSCH repetition Type A is 32, irrespective of counting method, * Alt 2: The maximum number of repetitions supported by Rel-17 PUSCH repetition Type A is: 32 for the counting based on physical slots; and 16 (i.e. no change from Rel-16) for the counting based on available slots. |

Then, in RAN1#106-e, the following working assumption which is in line with Alt 1 was made. At that time, it was discussed that if RAN plenary would decide the combination of up to 32 repetitions and counting based on the available slots is out of WI scope, this issue may be revisited. However, in RAN#93-e, there was no such a discussion.

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| Working Assumption  The maximum number of repetitions accounted for available slots supported by Rel-17 PUSCH repetition Type A is 32 |

According companies’ contributions for RAN1#106bis-e, the following companies are proposing confirming the working assumption.

* Confirm the working assumption
  + Support: vivo [4], OPPO [5], CATT [6], CMCC [8], Xiaomi [9], Samsung [12], NTT DOCOMO [14], Nokia/Nokia Shanghai Bell [15], Sierra Wireless [16], Apple [18], InterDigital [21]

Based on the aforementioned situations, it is suggested confirming the working assumption.

1st round (Issue#1-1)

Companies are invited to provide their views to the following proposal.

FL proposal on Issue#1-1

Confirm the following working assumption:

Working Assumption

* The maximum number of repetitions accounted for available slots supported by Rel-17 PUSCH repetition Type A is 32

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| **Company** | **Comments** |
| Sharp | Support the proposal. |
| ZTE | Support |
| Apple | We support to confirm the working assumption. |
| InterDigital | Support |
| CMCC | Support to confirm the working assumption |
| QC | Support |
| Intel | We are fine to confirm the working assumption. |
| Lenovo, Motorola Mobility | Fine to confirm the WA |
| Samsung | Support |
| Panasonic | We support to confirm the working assumption. |
| Spreadtrum | Support |
| NTT DOCOMO | Support |
| Vivo | Support |
| CATT | Support. |
| OPPO | Support |
| Xiaomi | Support |
| FL | As the working assumption was confirmed in Oct-12 GTW2 session as the following, this issue is considered as closed.  Working Assumption is confirmed  Working Assumption  The maximum number of repetitions accounted for available slots supported by Rel-17 PUSCH repetition Type A is 32 |

### [Pending] Issue#1-2: DCI formats and RRC paramters supporting the repetition factors indicated/configured via TDRA lists

In RAN1#104-e, it was agreed that the increased maximum number of repetitions is supported by CG-PUSCH as well as DG-PUSCH.

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| Agreements:  The maximum number of repetitions for DG-PUSCH is also applicable to CG-PUSCH. |

In addition, it was also agreed that the maximum number of repetitions is supported by the repetition factors configured in a TDRA list. It still remains FFS whether or not the repetition factors not configured in a TDRA list but configured in *PUSCH-Config* and/or *ConfiguredGrantConfig* also support the maximum number of repetitions.

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| Agreements:  Rel-17 PUSCH repetition Type A supports the increase of maximum number of repetitions with repetition factors configured in a TDRA list with a row index indicated either by the configured grant configuration or by TDRA field in a DCI.  FFS: increasing the maximum number of repetitions with repetition factor configured in *PUSCH-Config* and/or *ConfiguredGrantConfig*. |

In RAN1#106-e, it was discussed whether DCI format 0\_0 supports the maximum increased number of repetitions configured via a TDRA list or not. Since Type-1 CG-PUSCH use the TDRA list of DCI format 0\_0 in Rel-16, it was also discussed whether Type-1 CG-PUSCH supports the maximum increased number of repetitions configured via a TDRA list or not. In addition, the discussions covered whether to support the maximum increased number of repetitions configured without using a TDRA list or not. There was no agreement on DCI format 0\_0, but the following agreements for DCI format 0\_1 and 0\_2 were made.

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| Agreement   * DCI format 0\_1 and DCI format 0\_2 support Rel-17 PUSCH repetition Type A with the increased maximum repetition numbers configured in TDRA lists. |

In RAN1#106-e, during the discussions on Type-1 CG-PUSCH with the maximum increased number of repetitions configured via a TDRA list, it was identified that companies had different interpretations on the RAN1#104-e’s agreement “Rel-17 PUSCH repetition Type A supports the increase of maximum number of repetitions with repetition factors configured in a TDRA list with a row index indicated either by the configured grant configuration or by TDRA field in a DCI.”. Some companies including FL had interpreted the above part as a row index of the TDRA list is indicated by an RRC parameter in the configured grant configuration, as in Type-1 CG-PUSCH repetition in Rel-16. Meanwhile, some other companies had the interpretation that the above underline part was saying that Type-2 CG-PUSCH repetition supports the maximum increased number of repetitions configured via a TDRA list. Although the language of the agreement had originally intended to support Type-1 CG-PUSCH with the maximum increased number of repetitions configured via a TDRA list, FL admits there is ambiguity on the wording and it does not explicitly mean Type-1 CG-PUSCH repetitions.

Therefore, it is suggested discussing all the yellow parts in the following table in terms of support of up to 32 repetitions.

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|  | Support of up to 32 repetitions | | |
| by Rel-17 *pusch-AggregationFactor* | by Rel-17 *repK* | by Rel-17 *numberOfRepetitions* |
| DG-PUSCH scheduled by DCI format 0\_0 | To be discussed | N/A | To be discussed |
| DG-PUSCH scheduled by DCI format 0\_1 | To be discussed | N/A | Supported (already agreed in RAN1#106-e.) |
| DG-PUSCH scheduled by DCI format 0\_2 | To be discussed | N/A | Supported (already agreed in RAN1#106-e.) |
| Type 2 CG-PUSCH activated by DCI format 0\_0 | N/A | To be discussed | To be discussed |
| Type 2 CG-PUSCH activated by DCI format 0\_1 | N/A | To be discussed | Supported (already agreed in RAN1#106-e.) |
| Type 2 CG-PUSCH activated by DCI format 0\_2 | N/A | To be discussed | Supported (already agreed in RAN1#106-e.) |
| Type 1 CG-PUSCH | N/A | To be discussed | To be discussed  If this is to be supported, also discuss:   * Alt 1 The TDRA list for DCI format 0\_0 is reused. (This implies DCI format 0\_0 supports up to 32 repetitions.) * Alt 2 The TDRA list for DCI format 0\_1 or 0\_2 is reused. * Alt 3 A new TDRA list for Type 1 CG-PUSCH is introduced. |

According to the contributions for RAN1#106bis, companies’ preferences are summarized as follows.

* DG-PUSCH scheduled by DCI format 0\_0 with up to 32 repetitions (configured by Rel-17 *pusch-AggregationFactor* or Rel-17 *numberOfRepetitions*)
  + Support:
  + Not support: Spreadtrum [3], CMCC [8], Xiaomi [9], Rakuten Mobile [10], Panasonic [11], Intel [13], Nokia/Nokia Shanghai Bell [15], Sharp [17], Qualcomm [22]
* Type 2 CG-PUSCH activated by DCI format 0\_0 with up to 32 repetitions (configured by Rel-17 *repK* or by Rel-17 *numberOfRepetitions*)
  + Support:
  + Not support: Spreadtrum [3], CMCC [8], Xiaomi [9], Rakuten Mobile [10], Panasonic [11], Intel [13], Nokia/Nokia Shanghai Bell [15], Sharp [17], Qualcomm [22]
* Type 1 CG-PUSCH with up to 32 repetitions configured by Rel-17 *numberOfRepetitions*
  + Support: ZTE [2] (either using DCI format 0\_0 TDRA Table or reusing Rel-16 rules for PUSCH repetition Type B, , Sharp [17] (using the TDRA list for DCI format 0\_1)
  + Not support: Panasonic [11]
* Increasing the maximum number of repetitions with repetition factor configured in PUSCH-Config and/or ConfiguredGrantConfig (i.e. by Rel-17 *pusch-AggregationFactor* and/or Rel-17 *repK*)
  + Support:
    - OPPO [5], Xiaomi [9], Samsung [12] (support 16 repetitions), Intel [13], Nokia/Nokia Shanghai Bell [15], LG Electronics [19], Lenovo/Motorola Mobility [23]
  + Not support:
    - ZTE [2], vivo [4], CATT [6], CMCC [8], NTT DOCOMO [14], Sierra Wireless [16], Sharp [17]
  + Support Type 1 CG-PUSCH with up to 32 repetitions configured by Rel-17 *repK*
    - Spreadtrum [3], Panasonic [11], Qualcomm [22]
* The number of rows of the TDRA table for configuring 32 repetitions configured by Rel-17 *numberOfRepetitions* remains unchanged from Rel-16
  + ZTE [2], Xiaomi [9], Samsung [12]
* Discuss whether the size of the Rel-17 parameter for number of repetitions for DCI format 0\_1/0\_2 is 8 or 12
  + Samsung [12]

Based on the above, the discussions can be categorized into the following four points:

* DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0
* Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2
* Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2
* Type 1 CG-PUSCH

1st round (Issue#1-2)

Companies are invited to provide their views to the following questions.

Q1: Do you agree to support up to 32 repetitions for DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0?

Q2: Do you agree to support up to 32 repetitions configured by Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2?

Q3: Do you agree to support up to 32 repetitions configured by Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2?

Q4: For support of up to 32 repetitions for Type 1 CG-PUSCH, which option do you prefer?

* Alt 1: Type 1 CG-PUSCH does not support up-to-32 repetitions.
* Alt 2: Type 1 CG-PUSCH supports up-to-32 repetitions configured by Rel-17 *repK*.
* Alt 3-a: Type 1 CG-PUSCH supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions*. The TDRA list for DCI format 0\_0 is reused. (This implies DCI format 0\_0 supports up to 32 repetitions.)
* Alt 3-b: Type 1 CG-PUSCH supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions*. The TDRA list for DCI format 0\_1 or 0\_2 is reused.
* Alt 3-c: Type 1 CG-PUSCH supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions*. A new TDRA list for Type 1 CG-PUSCH is introduced.

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| **Company** | **Comments** |
| Sharp | Q1: No. We do not see the need to support up to 32 repetitions for DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0.  Q2: No. For DG-PUSCH scheduled by DCI format 0\_1/0\_2, support of up to 32 repetitions configured by Rel-17 *numberOfRepetitions* is sufficient.  Q3: No. For Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2, support of up to 32 repetitions configured by Rel-17 *numberOfRepetitions* is sufficient.  Q4: Our 1st preference is Alt 3-b. If many companies have concern to reuse the TDRA list for DCI format 0\_1 or 0\_2, we can live with Alt 1 as well. |
| ZTE | Q1: This is related to Q4 regarding whether to adopt Alt 3-a. Prefer to first discuss Q4.  Q2: No. Using *numberOfRepetitions* in the TDRA table is sufficient.  Q3: No. Using *numberOfRepetitions* in the TDRA table is sufficient.  Q4: Fine with Alt 3-a or Alt 3-b, which is to reuse legacy PUSCH repetition type A procedure or legacy PUSCH repetition type B, as the spec texts copied below.  - **For Type 1 PUSCH transmissions** with a configured grant, the following parameters are given in *configuredGrantConfig* unless mentioned otherwise:  ...  - For PUSCH repetition type A, the selection of the time domain resource allocation table follows the rules for DCI format 0\_0 on UE specific search space, as defined in Clause 6.1.2.1.1.  - For PUSCH repetition type B, the selection of the time domain resource allocation table is as follows:  - If *pusch-RepTypeIndicatorDCI-0-1* in *pusch-Config* is configured and set to *‘*pusch-RepTypeB*’*, *pusch-TimeDomainResourceAllocationListDCI-0-1* in *pusch-Config* is used;  - Otherwise, *pusch-TimeDomainResourceAllocationListDCI-0-2* in *pusch-Config* is used.  - It is not expected that *pusch-RepTypeIndicator* in *rrc-ConfiguredUplinkGrant* is configured with *‘*pusch-RepTypeB*’* when none of *pusch-RepTypeIndicatorDCI-0-1* and *pusch-RepTypeIndicatorDCI-0-2* in *pusch-Config* is set to *‘*pusch-RepTypeB*’*. [6.1.2.3 of 38.214 ] |
| Apple | Q1: don’t support PUSCH repetitions scheduled by DCI format 0\_0.  Q2: don’t support 32 PUSCH repetition with parameter Rel-17 *pusch-AggregationFactor*  Q3: don’t support 32 PUSCH repetition with parameter Rel-17 *repK* for Type 2 CG-PUSCH  Q4: Alt3-a is preferred as first priority. Alt 1 is preferred in second priority. |
| CMCC | Q1:  No. The DCI format 0\_0 do not support DCI triggered repetitions. Then there is no need to enhance the repetition numbers for this fallback DCI.  Q2:  No. The DCI format 0\_1/0\_2 could be configured with repetition factors with maximum in the TDRA table. There is no need to further enhance *pusch-AggregationFactor*.  The question is a little misleading. Since there is no strong relationship between DCI format 0\_1/0\_2 and *pusch-AggregationFactor*. Without the DCI format 0\_1/0\_2, *pusch-AggregationFactor* could also be used.  Q3:  No. No need to enhance the *repK*, since the DCI format 0\_1/0\_2 can support maximum 32 repetitions through TDRA table.  Q4:  Alt 1 is preferred.  Since the type 1 CG-PUSCH could be transmitted without gNB’s permission, it cannot be controlled or the gNB have no idear about how much delay could be induced by the large repetition factors. Then we are very cautious to allow UE using such large repetition factors. Current Type 2 CG-PUSCH could fulfil the enhancements for the CG based transmission.  Do not support 3-a and 3-b. Alt 3-a is to support DCI 0\_0 with repetitions. For Alt 3-b, legacy Type 1 CG-PUSCH do not support to use *numberOfRepetitions.* |
| Qualcomm | Q1: No need to change behavior for DG-PUSCH (no repetitions supported). Support going up to 32 reps for CG-PUSCH by changing the config parameter ranges.  Q2: Not necessary  Q3: Not necessary  Q4: Prefer Alt 2. |
| Intel | Q1: No.  Q2: Yes, as defined in R15/16, when numberofrepetitions is not presented in the TDRA table and if pusch-AggregationFactor is configured in PUSCH-Config, the number of repetitions is determined based on pusch-AggregationFactor. We think we need to ensure that default mode should also support increased maximum number of repetitions.  Q3: Yes, similar reasons as mentioned above.  Q4: Alt 3-b. |
| Lenovo, Motorola Mobility | Q1: No, we don’t see the need to increase the number of PUSCH repetitions with DCI format 0\_0  Q2: Yes, we agree to support the indication of 32 PUSCH repetitions with Rel-17 *pusch-AggregationFactor*  Q3: Yes, we agree to support the indication of 32 PUSCH repetitions with Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2  Q4: Alt 3-b is our preferred option |
| Samsung | Q1: No need to introduce support of PUSCH repetitions scheduled by DCI format 0\_0.  Q2: Yes. Consistently with the agreed increase of numbers of repetitions for the parameter *numberOfRepetitions,* an additional larger value of repetitions in *pusch-AggregationFactor* should be introduced. In Rel-16 *pusch-AggregationFactor* can have values {n2, n4, n8}, in Rel-17 it can be added n16.  Q3: Yes, similar considerations as for Q2.  Q4: Alt 2. And the value can be 16 or 32. |
| Panasonic | Q1: No. Since the repetition is supported by only DCI format 0-1 and DCI format 0-2 in Rel.15/16, there is no need to support Rel.17 PUSCH repetition Type A with the increased maximum repetition numbers configured in TDRA lists by DCI format 0-0.  Q2: We are open to to support up to 32 repetitions configured by Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0-1/0-2.  Q3: We are open to support up to 32 repetitions configured by Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0-1/0-2.  Q4: We prefer Alt.2. |
| Spreadtrum | Q1: DG-PUSCH scheduled by DCI format 0\_0 Not support with up to 32 repetitions  Q2: Not support up to 32 repetitions configured by Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2. One method is enough to support up to 32 repetitions.  Q3: Not support up to 32 repetitions configured by Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2. Because we already agreed that Rel-17 *numberOfRepetitions* up to 32 repetitions can be applied to Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2. It is redundant to have the second method to support the same thing. Furthermore, there would be more problems when these two parameters are both exit, especially with different value.  Q4: Support Alt 2: Type 1 CG-PUSCH supports up-to-32 repetitions configured by Rel-17 *repK.* Because for Type 1 CG-PUSCH, when it is PUSCH repetition type A, the TDRA table follows the rules for DCI format 0\_0 on UE specific search space. So the new increased repetition number cannot used for these legacy TDRA tables. However, repK in Rel-17 can be extended to support the increased values, which is easier way to support this feature in Rel-17. According to Alt 3a/b/c, new definition or association of TDRA table used for Type 1 CG-PUSCH are needed. Comparing to Alt 2, they are more complex to support. |
| NTT DOCOMO | Q1 : No  Q2/Q3 : No, *numberOfRepetitions* is sufficient for configuring up to 32 repetitions.  Q4 : We prefer Alt3-b. |
| vivo | Q1: Not support.  Q2: Not support.  Q3: Not support.  Q4: Support Alt 3-b. |
| CATT | Q1: N  Q2: N. Rep=32 is already supported by numberOfRepetitions associated with DCI format 0\_1/0\_2.  Q3: N. Rep=32 is already supported by numberOfRepetitions associated with DCI format 0\_1/0\_2.  Q4: Can live with the baseline, i.e. Alt.1. |
| OPPO | Q1: Not need to increase the number of PUSCH repetitions with DCI format 0\_0.  Q2: Yes.  Q3: Yes.  Q4: Support Alt 2: Type 1 CG-PUSCH supports up-to-32 repetitions configured by Rel-17 *repK*. |
| Xiaomi | Q1: NO  Q2:Yes  Q3: Yes  Q4: prefer alt 3-b |
| Nokia/NSB | Q1: No. As discussed multiple times, the motivation of supporting DCI format 0\_0 is unclear.  Q2: Yes.  Q3: Yes.  Q4: We prefer Alt. 2, which is the simplest solution and requires minimum specification impacts. |
| Ericsson1 | In our understanding, R17 Type A PUSCH repetition enhancement based on R16 TDRA tables are enough, there’s no need to revisit R15 repetition schemes. Thus we have following answers:  Q1: No.  Q2: No. (Assuming “R17” in the question means “R15” as we have no agreement yet on introducing a R17 parameter for this)  Q3: No. (Assuming “R17” in the question means “R15” as we have no agreement yet on introducing a R17 parameter for this)  Q4: Alt1. |
| Huawei/HiSilicon | Q1:No  Q2:No  Q3:No  Q4: Alt 3-b. Please note that in Rel-16, maximum 16 repetition number has been supported for Type-1 CG-PUSCH, as the spec excerpt copied below. Therefore, it is quite straightforward to extend it to 32 in Rel-17. | |

1st round summary (Issue#1-2)

Companies’ inputs for the 1st round are summarized as follows.

Q1: Do you agree to support up to 32 repetitions for DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0?

* Agree: (0 company)
* Not agree: (20 companies) Sharp, Apple, CMCC, Qualcomm, Intel, Lenovo/Motorola Mobility, Samsung, Panasonic, Spreadtrum, NTT DOCOMO, vivo, CATT, OPPO, Xiaomi, Nokia/NSB, Ericsson, Huaweri/HiSilicon
* Discuss Q4 first: (1 company) ZTE

Q2: Do you agree to support up to 32 repetitions configured by Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2?

* Agree: (8 companies) Intel, Lenovo/Motorola Mobility, Samsung, OPPO, Xiaomi, Nokia/NSB
* Not agree: (12 companies) Sharp, ZTE, Apple, CMCC, Qualcomm, Spreadtrum, NTT DOCOMO, vivo, CATT, Ericsson, Huaweri/HiSilicon
* Open: (1 company) Panasonic

Q3: Do you agree to support up to 32 repetitions configured by Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2?

* Agree: (8 companies) Intel, Lenovo/Motorola Mobility, Samsung, OPPO, Xiaomi, Nokia/NSB
* Not agree: (12 companies) Sharp, ZTE, Apple, CMCC, Qualcomm, Spreadtrum, NTT DOCOMO, vivo, CATT, Ericsson, Huaweri/HiSilicon
* Open: (1 company) Panasonic

Q4: For support of up to 32 repetitions for Type 1 CG-PUSCH, which option do you prefer?

* Alt 1: Type 1 CG-PUSCH does not support up-to-32 repetitions.
  + Support: (5 companies) Sharp (2nd choice), Apple (2nd choice), CMCC, CATT, Ericsson
* Alt 2: Type 1 CG-PUSCH supports up-to-32 repetitions configured by Rel-17 *repK*.
  + Support: (11 companies) Qualcomm, Samsung, Panasonic, Spreadtrum, OPPO, Nokia/NSB, [Intel, Lenovo/Motorola Mobility, Xiaomi]
* Alt 3-a: Type 1 CG-PUSCH supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions*. The TDRA list for DCI format 0\_0 is reused. (This implies DCI format 0\_0 supports up to 32 repetitions.)
  + Support: (2 companies) ZTE, Apple (1st choice)
* Alt 3-b: Type 1 CG-PUSCH supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions*. The TDRA list for DCI format 0\_1 or 0\_2 is reused.
  + Support: (10 companies) Sharp (1st choice), ZTE, Intel, Lenovo/Motorola Mobility, NTT DOCOMO, vivo, Xiaomi, Huaweri/HiSilicon
* Alt 3-c: Type 1 CG-PUSCH supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions*. A new TDRA list for Type 1 CG-PUSCH is introduced.
  + Support: (0 company)

For Q1 “DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0”, the clear majority objected to support up to 32 repetitions.

For Q2 “Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2”, we have not made a consensus to support up-to-32 repetitions. Furthermore, DCI format 0\_1 and DCI format 0\_2 can support up-to-32 repetitions by using Rel-17 *numberOfRepetitions*, as agreed already.

As for Q3 “Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2”, 8 companies are in favor of it while slightly more companies do not think it’s necessary. There seems no consensus here. At the same time, it is also true that, if Rel-17 *repK* is to be introduced for Type 1 CG-PUSCH, there is no harm to use the same Rel-17 *repK* for Type 2 CG-PUSCH as well. Therefore, it is suggested that whether to support Rel-17 *repK* for Type 2 CG-PUSCH would follow the decision on Q4 below.

For Q4, 19 companies think Type 1 CG-PUSCH should support up-to-32 repetitions, although there are different views on how to support it. Alt 2 (11 companies) and Alt 3-b (10 companies) are supported by almost the same number of companies.

Based on the above, FL made a set of proposals, which may be a middle ground among all companies’ preferences. Therefore, companies are encouraged to consider if the following proposal is acceptable as a compromise.

FL proposal 1 to Issue#1-2:

* Rel-17 does not support up to 32 repetitions for DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0.
* Rel-17 does not support up to 32 repetitions configured by Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2.
* For Type 1 CG-PUSCH and Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2, select one from the following two alternatives:
  + Alt 2:
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *repK* for Type 1 CG-PUSCH. Rel-17 does not support up-to-32 repetitions configured by Rel-17 *numberOfRepetitions* for Type 1 CG-PUSCH.
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2.
  + Alt 3-b:
    - Rel-17 does not support up-to-32 repetitions configured by Rel-17 *repK* for Type 1 CG-PUSCH and for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2.
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions* for Type 1 CG-PUSCH, where the TDRA list for DCI format 0\_1 or 0\_2 is reused.

2nd round (Issue#1-2)

Companies are encouraged to consider if the following proposal is acceptable as a compromise. Only if any company has a strong concern on the above proposal, provide comments below.

FL proposal 1 to Issue#1-2:

* Rel-17 does not support up to 32 repetitions for DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0.
* Rel-17 does not support up to 32 repetitions configured by Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2.
* For Type 1 CG-PUSCH and Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2, select one from the following two alternatives:
  + Alt 2:
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *repK* for Type 1 CG-PUSCH. Rel-17 does not support up-to-32 repetitions configured by Rel-17 *numberOfRepetitions* for Type 1 CG-PUSCH.
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2.
  + Alt 3-b:
    - Rel-17 does not support up-to-32 repetitions configured by Rel-17 *repK* for Type 1 CG-PUSCH and for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2.
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions* for Type 1 CG-PUSCH, where the TDRA list for DCI format 0\_1 or 0\_2 is reused.

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| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | We are fine with the FL proposal and prefer Alt. 2 since Alt. 3 unnecessarily modifies the current behavior of determining number of repetitions for Type 1 CG and can be considered as out of scope. In addition, there may be some ambiguity in the wording “support/does not support up-to-32 repetitions” since this may mean that “support up to a value less than 32 but greater than 16 is still possible. However, if the common understanding here is “support/does not support increasing maximum number of repetitions” then we are fine with the FL’s wording as well. |
| Huawei, HiSilicon | Alt 3-b. As commented before, in in Rel-16, maximum 16 repetition number has been supported for Type-1 CG-PUSCH, as the spec excerpt copied below. Therefore, it is quite straightforward to extend it to 32 in Rel-17. The first bullet in Alt 2 causes unnecessary spec change and should not be an option. |
| Ericsson2 | We do not think we need to enhance the repetitions introduced in Rel-15. Enhancement of Rel-16 repetitions are enough in Rel-17.  Regarding the CG Type 1, the determined (using same rules as for DCI0-0 according to following text copied here) TDRA table has no repetition factors included, i.e. dynamic repetition is not supported for CG Type 1 when we introduce dynamic repetition Type A and Type B. This means that CG Type 1 repetition is still Rel-15 repetition.   |  | | --- | | 38.214:  For PUSCH repetition type A, the selection of the time domain resource allocation table follows the rules for DCI format 0\_0 on UE specific search space, as defined in Clause 6.1.2.1.1. | |
| QC | Using new TDRA tables for Type 1 is ruled out due to difference in the table sizes (**16 vs 64**). This will impact DCI format 0\_0 field bit widths and overall size. We strongly discourage companies from taking this approach (alt 3-b).  Alt 2 would be a very lightweight change. |
| Samsung | We prefer Alt 2. In our understanding with Alt 2, there is no change respect to R15/16 behaviour for DCI format 0\_0 and Type 1 CG with repetitions Type A.  The 2nd bullet is not our preference, but if the intention is to agree to this proposal as a package, we are fine with the proposal. |
| Sharp | OK with the proposal.  To QC’s comment, for alt 3-b, DCI format 0\_0 field bit widths should be kept as is. Instead, it needs some RAN1 spec update to switch DCI 0\_0 to DCI 0\_1/0\_2 in terms of the TDRA table association with Type-1 CG. |
| Spreadtrum | Support, and our preference is Alt 2.  Given by Type 1 CG-PUSCH, when it is PUSCH repetition type A, the TDRA table follows the rules for DCI format 0\_0 on UE specific search space. So the new increased repetition number cannot used for these legacy TDRA tables. However, repK in Rel-17 can be extended to support the increased values, which is easier way to support this feature in Rel-17. According to Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2, because we have agreed it can use Rel-17 numberOfRepetitions, an easier way is to say Rel-17 repK can be replaced by Rel-17 numberOfRepetitions if it exits. |
| CATT | OK for progress. |
| OPPO | We prefer Alt 2. |
| Xiaomi | OK with the proposal |

2nd round summary (Issue#1-2)

The 2nd round inputs are summarized below. It is suggested discussing this proposal in the GTW session to make a progress on this issue.

For the proposal as a package,

* OK: Nokia/NSB, Huawei/HiSilicon?, Qualcomm?, Samsung, Sharp, Spreadtrum, CATT, Xiaomi
* Not OK: Ericsson

For further down-selection on Type-1 CG-PUSCH,

* Alt 2: Nokia/NSB, Qualcomm, Samsung, Spreadrum, OPPO
* Alt 3-b: Huawei/HiSilicon

FL proposal 1 to Issue#1-2:

* Rel-17 does not support up to 32 repetitions for DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0.
* Rel-17 does not support up to 32 repetitions configured by Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2.
* For Type 1 CG-PUSCH and Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2, select one from the following two alternatives:
  + Alt 2:
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *repK* for Type 1 CG-PUSCH. Rel-17 does not support up-to-32 repetitions configured by Rel-17 *numberOfRepetitions* for Type 1 CG-PUSCH.
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2.
  + Alt 3-b:
    - Rel-17 does not support up-to-32 repetitions configured by Rel-17 *repK* for Type 1 CG-PUSCH and for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2.
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions* for Type 1 CG-PUSCH, where the TDRA list for DCI format 0\_1 or 0\_2 is reused.

3rd round (Issue#1-2)

FL proposal 1 to Issue#1-2:

* Rel-17 does not support up to 32 repetitions for DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0.
  + Note: DCI format 0\_0 field bit widths are kept unchanged.
* Rel-17 does not support up to 32 repetitions configured by Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2.
* For Type 1 CG-PUSCH and Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2, select one from the following two alternatives:
  + Alt 2:
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *repK* for Type 1 CG-PUSCH. Rel-17 does not support up-to-32 repetitions configured by Rel-17 *numberOfRepetitions* for Type 1 CG-PUSCH.
      * Note: The TDRA list for Type 1 CG-PUSCH is kept un changed (i.e., use the TDRA list for DCI format 0\_0).
      * Note: Need to introduce *repK-r17*.
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2.
  + Alt 3-b:
    - Rel-17 does not support up-to-32 repetitions configured by Rel-17 *repK* for Type 1 CG-PUSCH and for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2.
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions* for Type 1 CG-PUSCH, where the TDRA list for DCI format 0\_1 or 0\_2 is reused.
      * Note: Need a mechanism to change the TDRA list for Type 1 CG-PUSCH, from the one for DCI format 0\_0 to the one for DCI format 0\_1 or 0\_2.

To address the comments in the 2nd round, several notes are added. Before discussing this proposal in the GTW session, it is suggested resolving the clarification issues as much as possible. If companies would like more clarifications on the above package, please provide comments below.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | Support. |
| Intel | Sorry for joining the discussion late.  It is still not clear to us why we cannot support pusch-AggregationFactor up to 32 for PUSCH repetition type A enhancement. This is the default mode of operation if numberOfRepetitions is not configured as part of TDRA table.  We do not support the 2nd bullet   * Rel-17 does not support up to 32 repetitions configured by Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2. |
| Sierra Wireless | Support proposal.  The first two bullets regard “no support for” would be better as conclusions which emphasizes that there would be not spec impact. E.g. There is no consensus to support “bla bla” in rel 17.  Our preference is for Alt 2 as spec impacts would be lower but not a strong view. |
| Panasonic | We are fine with the proposal. Our preference is Alt.2 since Alt.2 has same rule as Rel.15/16 for CG PUSCH Type 1 in our understanding. |
| Spreadtrum | Support the proposal.  OK to down select next meeting. |
| CMCC | Support in general.  At least the 1st 2 bullets is acceptable to us.  The note under the 1st bullet needs clarification. Since if the new feature is not supported, why there is possibility to change the bit width.  For the 3rd bullet, the 2nd bullet under Alt 1, we do not see any needs to enhance the *repK* when the *numberofslot* has been supported for the DCI format 0\_1 and 0\_2. Then for the Alt 1 it is still not proper to support the *repK* only for Type 1 CG-PUSCH.  While Alt 3-b could solve all the issues by single parameter *numberofslot*. For the newly introduced behavior of Type 1 CG-PUSCH which may be different from the Rel-16, we have no problem. |
| Sharp | Support the proposal.  For the selection from Alt 2 and Alt 3-b, we slightly prefer Alt 3-b but can live with Alt 2 as well to seek the progress. |
| CATT | Support the proposal.  Alt3-b is our 1st preference. |
| QC | Support. Alt 2 is slightly preferred, but can go with Alt 3b as well if necessary. |
| Ericsson3 | Support the 1st 2 main bullets.  Do not support the 3rd main bullet. As we commented earlier, Rel-17 up to 32 repetitions supported in Rel-16 TDRA list when used by DCI 0-1 or 0-2 is enough. |

3rd round summary (Issue#1-2)

The 3rd round inputs are summarized below. It is suggested discussing this proposal in the GTW session to make a progress on this issue.

* OK with the following proposal: Nokia/NSB, Sierra Wireless, Panasonic, Spreadtrum, CMCC, Sharp, CATT, Qualcomm
  + For further selection between Alt 2 and Alt 3-b:
    - Alt 2 is preferred: Sierra Wireless, Panasonic, Sharp (2nd choice), Qualcomm (1st choice)
    - Alt 3-b is preferred: CMCC, Sharp (1st choice), CATT, Qualcomm (2nd choice),
* Not OK with the following proposal: Intel (has a concern on the 2nd bullet), Ericsson (has a concern on the 3rd bullet)

FL proposal 1 to Issue#1-2:

Agree the following as a package:

* Rel-17 does not support up to 32 repetitions for DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0.
* Rel-17 does not support up to 32 repetitions configured by Rel-17 *pusch-AggregationFactor* for DG-PUSCH scheduled by DCI format 0\_1/0\_2.
* For Type 1 CG-PUSCH and Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2, select one from the following two alternatives:
  + Alt 2:
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *repK* for Type 1 CG-PUSCH. Rel-17 does not support up-to-32 repetitions configured by Rel-17 *numberOfRepetitions* for Type 1 CG-PUSCH.
      * Note: The TDRA list for Type 1 CG-PUSCH is kept un changed (i.e., use the TDRA list for DCI format 0\_0).
      * Note: Need to introduce *repK-r17*.
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *repK* for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2.
  + Alt 3-b:
    - Rel-17 does not support up-to-32 repetitions configured by Rel-17 *repK* for Type 1 CG-PUSCH and for Type 2 CG-PUSCH activated by DCI format 0\_1/0\_2.
    - Rel-17 supports up-to-32 repetitions configured by Rel-17 *numberOfRepetitions* for Type 1 CG-PUSCH, where the TDRA list for DCI format 0\_1 or 0\_2 is reused.
      * Note: DCI format 0\_0 field bit widths are kept unchanged.
      * Note: Need a mechanism to change the TDRA list for Type 1 CG-PUSCH, from the one for DCI format 0\_0 to the one for DCI format 0\_1 or 0\_2.

## The number of repetitions counted on the basis of available UL slots

For the number of repetitions counted on the basis of available UL slots, the following agreements have been made.

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| **In RAN1#104-e**  Agreements:  Select one of the following alternatives, considering the aspect whether or not the determination of all the available slots should be done prior to the first actual transmission of the repetitions (other alternatives are not precluded)  -        Alt1: Whether or not a slot is determined as available for UL transmissions depends on RRC configurations (at least tdd\_ul\_dl configuration, FFS: other RRC configurations) and does not depend on dynamic signaling (at least SFI, FFS: other dynamic signaling e.g. CI, PUSCH priority for URLLC).  -        Alt2: Whether or not a slot is determined as available for UL transmissions depends on RRC configurations (at least tdd\_ul\_dl configuration, FFS: other RRC configurations) and also depends on dynamic signaling (at least SFI, FFS: other dynamic signaling e.g. CI, PUSCH priority for URLLC).  Agreements:  For defining available slots: a slot is determined as unavailable if at least one of the symbols indicated by TDRA for a PUSCH in the slot overlaps with the symbol not intended for UL transmissions   * FFS details   **Conclusion:**  Discuss further to select one of the following alternatives:   * Alt-a: The determination of all the available slots has to be done prior to the first actual transmission of the repetitions. * Alt-b: The determination of all the available slots does not have to be done prior to the first actual transmission of the repetitions. The timeline requirement is per repetition basis.   **In RAN1#105-e**  Agreement:   * RV cycling is based on available slot for the Type A PUSCH repetition enhancement with repetitions counted based on available slot in Rel-17   **Conclusion:**   * The following agreement in RAN1#104-e is applied to all slots including special slots.  |  | | --- | | Agreements:  For defining available slots: a slot is determined as unavailable if at least one of the symbols indicated by TDRA for a PUSCH in the slot overlaps with the symbol not intended for UL transmissions.   * FFS details |   Agreement:   * Each available slot identified by the UE is considered as a transmission occasion for PUSCH repetition.   + RV is cycled across transmission occasions, irrespective of whether PUSCH transmission in the transmission occasion is further omitted or not.   Agreement:   * If PUSCH symbol in a slot overlaps with flexible symbol(s) with SSB transmission, the slot is determined as not available during the counting of repetitions. As there is no PUSCH in the slot, no PUSCH omission applies to the slot.   Agreement:  Select one from the following (further refinement of the alternatives can be further discussed), for the procedure of Rel-17 PUSCH repetition Type A (other alternatives are not precluded)   * Alt 1-B consisting of two steps   + Step 1: Determine available slots for K repetitions based on RRC configuration(s) in addition to TDRA in the DCI scheduling the PUSCH, CG configuration or activation DCI   + Step 2: The UE determines whether to drop a PUSCH repetition or not according to Rel-15/16 PUSCH dropping rules, but the PUSCH repetition is still counted in the K repetitions. * Alt 1-B’ consisting of two steps   + Step 1: Determine K repetitions based on available slots, where the available slot is the UL slot and flexible slot indicated by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*.   + Step 2: The UE determines whether to drop a PUSCH repetition or not according to Rel-15/16 PUSCH dropping rules, but the PUSCH repetition is still counted in the K repetitions.   + FFS: handling of dynamic signaling (e.g. UL CI, DCI for high priority channel), e.g., UE without CI capability * Alt 2-A consisting of a single step   + Step 1: Determine available slots for K repetitions based on RRC configuration(s) and dynamic signaling (e.g. SFI, UL CI, DCI for high priority channel) in addition to TDRA in the DCI scheduling the PUSCH, CG configuration or activation DCI * Alt 2-B consisting of two steps   + Step 1: Determine available slots for K repetitions based on RRC configuration(s) and dynamic SFI in addition to TDRA in the DCI scheduling the PUSCH, CG configuration or activation DCI     - FFS timeline for the dynamic signalling   + Step 2: The UE determines whether to drop a PUSCH repetition or not according to Rel-15/16 PUSCH dropping rules, but the PUSCH repetition is still counted in the K repetitions.   **In RAN1#106e**  Agreement:   * For Rel-17 PUSCH repetition Type A without joint channel estimation, no new inter-slot frequency hopping mechanism is introduced.   Agreement  Take Option 1-B as an agreement for the procedure of Rel-17 PUSCH repetitions counted on the basis of available slots.   * Alt 1-B consisting of two steps * Step 1: Determine available slots for K repetitions based on RRC configuration(s) in addition to TDRA in the DCI scheduling the PUSCH, CG configuration or activation DCI * Step 2: The UE determines whether to drop a PUSCH repetition or not according to Rel-15/16 PUSCH dropping rules, but the PUSCH repetition is still counted in the K repetitions. * FFS: Rel-17 PUSCH dropping rules are also applied if introduced in other WI(s)   Agreement  For PUSCH repetition Type A for Rel-17 CG-PUSCH, semi-static flexible symbol is considered as available.  Agreement  For PUSCH repetition Type A for Rel-17 DG-PUSCH, semi-static flexible symbol is considered as available.  Note: The applicability for Msg 3 is to be discussed in 8.8.3  Agreement   * For DG-PUSCH with counting based on the available slots, count of available slots continues until satisfying the conditions defined for DG-PUSCH repetition Type A in Rel-16. |

At the same time, the following eleven remaining issues have been identified.

* Issue#2-1: The 1st Transmission occasion for CG-PUSCH repetitions
* Issue#2-2: Termination conditions for CG-PUSCH repetitions
* Issue#2-3: Aspect related to the gNB’s blind detections of CG-PUSCH transmissions
* Issue#2-4: Use of Type0-PDCCH CSS set configuration for the determination of available slots
* Issue#2-5: Use of Invalid UL symbol configuration for the determination of available slots
* Issue#2-6: Use of semi-static PUCCH repetition configuration for the determination of available slots
* Issue#2-7: Use of SMTC configuration for the determination of available slots
* Issue#2-8: Use of other RRC configurations for the determination of available slots
* Issue#2-9: Handling of a collision between PUSCH repetition and other UL channels/signals
* Issue#2-10: Applicability of available slot based counting method to paired spectrum

### [Open] Issue#2-1: The 1st Transmission occasion for CG-PUSCH repetitions

Sharp [17] raised the potential issue on the 1st transmission occasion determination for CG-PUSCH repetitions. In Rel-15/16, the timing of the 1st transmission occasion of DG-PUSCH is derived from K2 value, and the corresponding behavior is defined in RAN1 specification. On the other hand, the timing of the 1st transmission occasion for Type 1 / Type 2 CG-PUSCH is defined as the timing of uplink grant generation in RAN2 specification, as shown below.

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| **TS38.321 v16.5.0** 5.8.2 Uplink *[Omitted]*  After an uplink grant is configured for a configured grant Type 1, the MAC entity shall consider sequentially that the Nth (N >= 0) uplink grant occurs in the symbol for which:  [(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  (*timeReferenceSFN* × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* *+* *timeDomainOffset* × *numberOfSymbolsPerSlot* + *S* + N × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*).  After an uplink grant is configured for a configured grant Type 2, the MAC entity shall consider sequentially that the Nth (N >= 0) uplink grant occurs in the symbol for which:  [(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] = [(SFNstart time × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slotstart time × *numberOfSymbolsPerSlot* + symbolstart time) + N × *periodicity*] modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*).  Where SFNstart time, slotstart time, and symbolstart time are the SFN, slot, and symbol, respectively, of the first transmission opportunity of PUSCH where the configured uplink grant was (re-)initialised. |

Although it is likely to be commonly understood that all the transmission occasions for CG-PUSCH repetitions including the 1st transmission occasion are determined on the basis of available slots, it has not been explicitly agreed yet. Therefore, it is suggested confirming that all the transmission occasions for CG-PUSCH repetitions including the 1st transmission occasion are determined on the basis of available slots if configured. Moreover, if the answer to the above question is yes, it is suggested checking companies’ views on whether defining of the 1st transmission occasion timing based on the available slots is left to RAN2 or not.

1st round (Issue#2-1)

Companies are invited to provide their views to the following questions.

Q1: Do you agree that, for CG-PUSCH repetitions counted on the basis of available slots, all the K transmission occasions including the 1st transmission occasion are determined on the basis of available slots.

Q2: If the answer to Q1 is yes, do you also agree that new timing of the 1st transmission occasion (i.e., new timing of the 1st UL grant occurrence) is defined in RAN2 specification.

Q3: Do you agree that both Type-1 and Type-2 CG-PUSCHs with Type A repetitions support the counting based on the available slots?

Q4: Do you agree that the number of repetitions, K, in the Step 1 of the agreed Option 1-B is the value indicated/configured by *pusch-AggregationFactor*, *repK* or *numberOfRepetitions*, and no spec change is expected in terms of determination of the K in TS38.214, except for the support of increased maximum number of repetitions.

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| **Company** | **Comments** |
| Sharp | Q1: Yes.  Q2: Yes. We expect RAN2 would update the descriptions in TS38.321 such that the 1st UL grant occurs for an available slot. |
| ZTE | Q1: Yes  Q2: Not sure what’s the new timing would be. In our view, the first transmission occasion should be in the first available slot (based on the definition in RAN1) that derived by the equations in RAN2. This might require no RAN2 impact. |
| Apple | Q1: agree the transmission occasions should be determined based on available slot.  Q2: ok to determine transmission occasion for CG-PUSCH in RAN2. |
| CMCC | Q1: Yes  Q2: No sure what’s is the issue for the timing. The 1st transmission occasion should be the 1st available slot based on the current equations. |
| Qualcomm | Q1: Yes  Q2: Prefer to leave RAN2 spec unchanged. Transmissions occasions are derived based on available slots in the case of Type A repetitions. This should be clear based on the RAN1 spec. |
| Intel | Q1: Yes,  Q2: it is not clear to us whether the update in 321 is needed. |
| Lenovo, Motorola Mobility | Q1: Yes  Q2: It is up to RAN2 discussion to determine new timing based on first transmission occasion |
| Samsung | Q1: Yes  Q2: It is not clear that there is a need. Also, no need for RAN1 to discuss 321 specifications. |
| FL | The intention to ask Q2 is to identify what RAN1 specification should specify.  Regarding the definition of “available slot”, it should be specified in RAN1 specification, for sure.  As for the 1st transmission occasion, the one for DG-PUSCH is clearly defined by using K2 value in the current TS38.214. However, it does not have any definition of the 1st transmission occasion for CG-PUSCH, as the 1st transmission occasion is understood as a slot with the CG-PUSCH for which the 1st UL grant occur. Now, the CG-PUSCH repetitions should be counted on the basis of available slots. Do we define the 1st transmission occasion for CG-PUSCH in RAN1 specification? That creates the difference between the slot where PUSCH is transmitted and the slot for which MAC entity generates the UL grant, and that has some impact on MAC behavior. Therefore, it may be good to have some coordination with RAN2 to pick one of the the following options:   * Alt 1: RAN1 specification to define the 1st transmission occasion of CG-PUSCH, based on the definition of available slots and the symbol for which the UL grant occur according to the current TS38.321.   + Note 1: the definition of available slots to be defined in RAN1 specification.   + Note 2: Alt 1 results in the difference between the slot where the 1st CG-PUSCH is transmitted and the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH. * Alt 2: RAN2 specification TS38.321 to be updated such that the symbol for which the UL grant occur is based on the available slots.   + Note 1: the definition of available slots to be defined in RAN1 specification.   + Note 2: Similar to Rel-15/16, RAN1 specification does not need to define the 1st transmission occasion of CG-PUSCH.   + Note 3: With Alt 2, the slot where the 1st CG-PUSCH is transmitted is the same as the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH.   What do you think of? |
| Panasonic | Q1: Yes  Q2: Although it is up to RAN2 discussion to determine new timing based on first transmission occasion, our preference is Alt.1. |
| Spreadtrum | Q1: Yes  Q2: Alt 1. |
| vivo | Q1: Yes  Q2: No, no need to introduce new timing of 1st UL grant occurrence. According to the current agreements of the available slot determination based on semi-static configuration, it is not difficult for UL grant to guarantee the 1st PUSCH transmission occasion to be available prior to the first repetition and there is common understanding between gNB and UE on the available slot pattern. |
| FL | It seems we have a consensus on Q1. Therefore, I’d like to bring the following proposal to the coming GTW session.  FL proposal 1 to Issue#2-1:  For Type 1 and Type 2 CG-PUSCH repetitions counted on the basis of available slots, all the K transmission occasions including the 1st transmission occasion are determined on the basis of available slots. |
| CATT | Q1: Yes  Q2: It seems workable if 1st transmission occasion still reuses legacy definition, where proper configuration can guarantee that the 1st transmission occasion is an available slot. If this is the correct understanding, we do not think modification on specification is needed. |
| OPPO | Q1: Yes  Q2: The first transmission occasion should be in the first available slot. It is no need to introduce new timing of 1st UL grant occurrence. |
| Xiaomi | Q1:Yes  Q2: No need to introduce new timing of 1st UL grant occurrence. |
| WILUS | Q1: Yes  Q2: New timing for Rel-17 enhanced PUSCH repetition Type A is unnecessary. |
| FL | The latest form of the proposal during Oct-12 GTW2 session is as follows. Companies are asked to provide comment/suggestion to the possible agreement, if any.  Possible Agreement  For Type 1 and Type 2 CG-PUSCH repetitions counted on the basis of available slots, all the K transmission occasions including the 1st transmission occasion are determined on the basis of available slots.  Besides, I added Q3 and Q4, based on the comment in the GTW2 session. Companies are asked to provide their views on those questions as well. |
| Nokia/NSB | Q1: Yes.  Q2: This can be up to RAN2 to decide.  Q3: We are open to discuss if there is any limitation to CG type 1 as well. Answer to this question may depend on whether, in the end, both “increased maximum number of repetitions” and “counting on available slots” should be combined as a single feature or not. If these features are always combined, then supporting “counting on available slots” for CG type 1 also means supporting “increased maximum number of repetitions” for CG type 1, which depends on the outcome of Q4 for Issue #1-2. In contrast, if “increased maximum number of repetitions” and “counting on available slots” are decoupled into two separate features, then CG type 1 can support only “counting on available slots” with the legacy indication of number of repetitions (in case there is no consensus on how to support the “increased maximum number of repetitions” for CG type 1).  Q4: Yes.  With the above comment for Q3, we can leave CG type 1 in the above agreement as FFS and support CG type 2 first. |
| Ericsson1 | Q1: Yes.  Q2: No. In our understanding, the first transmission occasion determination doesn’t need to be changed as it would be up to network, legacy timing rules can be reused.  Q3: No. Semi-statically configured repetitions introduced in R15 doesn’t need to be supported with the counting based on available slot. R17 enhancement based on dynamically indicated repetitions introduced in Rel-16 is enough.  Q4: No. We do not see that enhancement of “*pusch-AggregationFactor*, *repK*” can be assumed based the agreed option Alt1-B. Alt1-B mainly tells that available slot will be determined by semi-static RRC configuration on top of TDRA, including the TDRA field in DCI/activation DCI and the periodicity configuration in CG configuration. It’s fine to agree on the enhancement of Rel-16 Type A PUSCH repetition with repetition factors dynamically signaled in TDRA list, but the enhancement of Rel-15 semi-statically configured repetition factors are not necessary. |
| Huawei/HiSilicon | Q3: Surely Yes although we feel it has been agreed by the previous agreement on Option 1-B. Please note that in Rel-16, maximum 16 repetition number has been supported for Type-1 CG-PUSCH, as the spec excerpt copied below. For Type 1 CG-PUSCH, the indexed row of TDRA table has been provided to a UE by RRC. Therefore, it is quite straightforward to extend it to 32 in Rel-17. | |
| Qualcomm2 | Q3: Yes.  Q4: Yes. | |
| Intel2 | Q3: Yes. based on existing agreements, both Type-1 and Type-2 CG-PUSCHs support counting based on available slots.  Q4: Yes. | |
| InterDigital | Q1 Yes  Q3 Yes  Q4 Yes | |
| Panasonic 2 | Q3 : Yes  Q4 : Yes | |

1st round summary (Issue#2-1)

For Q1 ” for CG-PUSCH repetitions counted on the basis of available slots, all the K transmission occasions including the 1st transmission occasion are determined on the basis of available slots”, no company has objected. At the same time, in the Oct-12 GTW session there was a comment that this is already covered by the previous agreement. Another comment in the session was that it is not clear if we have made any agreement saying that both Type 1 and Type 2 CG-PUSCH support the counting based on the available slots. In order to de-couple two different issues, the proposal was modified as the following.

Modified FL proposal 1 to Issue#2-1:

Take the following as a conclusion:

* For CG-PUSCH repetitions counted on the basis of available slots, all the K transmission occasions including the 1st transmission occasion are determined on the basis of available slots.

For Q2 “new timing of the 1st transmission occasion (i.e., new timing of the 1st UL grant occurrence) is defined in RAN2 specification”, most of the companies do not see the need to modify the timing of UL grant occurrence and think that RAN1 would define the 1st transmission occasion based on the definition of available slots. Therefore, FL made the following proposal.

Modified FL proposal 2 to Issue#2-1:

Take Alt 1 from the following alternatives:

* Alt 1: RAN1 specification to define the 1st transmission occasion of CG-PUSCH, based on the definition of available slots and the symbol for which the UL grant occur according to the current TS38.321.
  + Note 1: the definition of available slots to be defined in RAN1 specification.
  + Note 2: Alt 1 leads to the difference between the slot where the 1st CG-PUSCH is transmitted and the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH.
* Alt 2: RAN2 specification TS38.321 to be updated such that the symbol for which the UL grant occur is based on the available slots.
  + Note 1: the definition of available slots to be defined in RAN1 specification.
  + Note 2: Similar to Rel-15/16, RAN1 specification does not need to define the 1st transmission occasion of CG-PUSCH.
  + Note 3: With Alt 2, the slot where the 1st CG-PUSCH is transmitted is the same as the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH.

As for whether we have made any agreement saying that both Type 1 and Type 2 CG-PUSCH support the counting based on the available slots and how to determine ”K” value, it is suggested collecting companies views in the next round as well. As several companies have already provided their views on these questions, the provided views would be captured by FL in the next round.

2nd round (Issue#2-1)

Companies are invited to provide their views to the following questions.

Q1: Do you agree on the following proposal 1?

Modified FL proposal 1 to Issue#2-1:

Take the following as a conclusion:

* For CG-PUSCH repetitions counted on the basis of available slots, all the K transmission occasions including the 1st transmission occasion are determined on the basis of available slots.

Q2: Do you agree on the following proposal 2?

Modified FL proposal 2 to Issue#2-1:

Take Alt 1 from the following alternatives:

* Alt 1: RAN1 specification to define the 1st transmission occasion of CG-PUSCH, based on the definition of available slots and the symbol for which the UL grant occur according to the current TS38.321.
  + Note 1: the definition of available slots to be defined in RAN1 specification.
  + Note 2: Alt 1 leads to the difference between the slot where the 1st CG-PUSCH is transmitted and the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH.

Q3: Do you agree that, for both Type-1 and Type-2 CG-PUSCHs with Type A repetitions, support of the counting based on the available slots has been agreed by the previous agreement on Option 1-B?

* The 1st round inputs to the Q3 “Do you agree that both Type-1 and Type-2 CG-PUSCHs with Type A repetitions support the counting based on the available slots?” are as follows
  + Yes: Huawei/HiSilicon (the previous agreement covers), Qualcomm, Intel (the previous agreement covers), InterDigital, Panasonic
  + No: Ericsson
  + Open: Nokia/NSB

Q4: Do you agree that the number of repetitions, K, in the Step 1 of the agreed Option 1-B is the value indicated/configured by *pusch-AggregationFactor*, *repK* or *numberOfRepetitions*, and no spec change is expected in terms of determination of the K in TS38.214, except for the support of increased maximum number of repetitions.

* The 1st round inputs to the same question are as follows
  + Yes: Nokia/NSB, Qualcomm, Intel, InterDigital, Panasonic
  + No: Ericsson

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | Q1: Yes.  Q2: It is unclear to us how does RAN1 specification define transmission occasion based on RAN2 specs. Maybe some clarification on how to exactly do that in RAN1 is needed.  Q3: Our understanding on the agreement is that it at least cover CG type 2. Whether CG type 1 is covered or not depending on whether the legacy behavior of determining the number of repetitions is modified or not, for CG type 1.  Q4: Yes. |
| Huawei, HiSilicon | Regarding Q3, As commented before, in in Rel-16, maximum 16 repetition number has been supported for Type-1 CG-PUSCH, as the spec excerpt copied below. Therefore, it is quite straightforward to extend it to 32 in Rel-17, and it has been agreed by the previous agreement. |
| Ericsson2 | Q1: Looks fine.  Q2: Do we need to discuss this since we do not expect any specification changes in both RAN1 and RAN2 on the determination of transmission occasion for the first repetition? Or anything we missed here?  Q3/Q4: No.  In our understanding the “CG configuration” mentioned in step 1 in below agreement means that the **periodicity** of CG PUSCH in time domain will be configured and will also be considered for available slot determination.   |  | | --- | | Agreement  Take Option 1-B as an agreement for the procedure of Rel-17 PUSCH repetitions counted on the basis of available slots.   * Alt 1-B consisting of two steps * Step 1: Determine available slots for K repetitions based on RRC configuration(s) in addition to TDRA in the DCI scheduling the PUSCH, CG configuration or activation DCI * Step 2: The UE determines whether to drop a PUSCH repetition or not according to Rel-15/16 PUSCH dropping rules, but the PUSCH repetition is still counted in the K repetitions. * FFS: Rel-17 PUSCH dropping rules are also applied if introduced in other WI(s) |   In our view, only the K repetitions configured in TDRA list (introduced in Rel-16) are necessarily to be enhanced to be counted based on available slot or enhanced to be increased to be more than 16 repetitions and the semi-statically configured K repetitions introduced in Rel-15 doesn’t have to be enhanced.  Regarding the CG Type 1 repetition mechanism, see our earlier comments for issue 1-2. |
| QC | Q1 Agree  Q2 Agree in principle, but not entirely sure why this is being pointed out.  Q3 Yes, no doubt about it at all. Here is an agreement from R1-104e that reinforces this:  Agreements:  The maximum number of repetitions for DG-PUSCH is also applicable to CG-PUSCH.  Q4: Yes, no intention of changing the procedure using which K is determined. Legacy rules suffice. Suffices to change the range of the RRC parameters. |
| InterDigital | Q1 : Agree  Q3 : Agree  Q4 : Agree |
| Samsung | Q1: Yes  Q2: If the first transmission occasion indicated by the UL grant is in an unavailable slot, the position of the symbol of the slot where transmission starts would be the same. So no need to mention it.  Q3: It would be better to have a clear agreement rather than trying to interpret past agreements. In our opinion, available slot counting should be also applicable to CG-PUSCH with repetitions.  Q4: Yes. |
| Sharp | Q1: Yes.  Q2: Although we prefer Alt 2, we can live with Alt 1, considering the majority support it.  To Ericsson and Qualcomm:  The discussion point we raised in our contribution is as follows: In the current MAC procedure for CG-PUSCH, the MAC entity generates the 1st UL grant for a slot as shown in the TS38.321 descriptions that FL copied above. When the MAC entity delivers the 1st UL grant to HARQ process, the HARQ process instructs PHY to send PUSCH. On the other hand, the current TS38.214 is just saying “the K consecutive slots” but does not have any description of what is the start of “the K consecutive slots”. This implies the proper interpretation is that the start of “the K consecutive slots” is the slot for which the PHY is instructed to send the PUSCH corresponding to the 1st UL grant. But, now we are introducing available slot counting. This enhancement breaks such implication, because the slot for which the PHY is instructed to send the PUSCH corresponding to the 1st UL grant is not always an available slot. Therefore, in our view, if we go with Alt 1, TS38.214 has to clearly define the start of the K available slot for CG-PUSCH, e.g., some potential offset from the slot for which the 1st UL grant is generated.  Q3: Yes. The previous agreement captures the three cases, TDRA indicated in the DCI scheduling the PUSCH, TDRA indicated in CG configuration, and TDRA indicated in activation DCI. No doubt it covers all of DG-PUSCH, Type-1 CG-PUSCH and Type-2 CG-PUSCH. It is not possible to interpret it as not covering Type-1 CG-PUSCH. Having said that, to move forward, we are open to have the additional agreements saying “Both Type-1 CG-PUSCH and Type-2 CG-PUSCH support counting based on the available slots.”  Agreement  Take Option 1-B as an agreement for the procedure of Rel-17 PUSCH repetitions counted on the basis of available slots.   * Alt 1-B consisting of two steps * Step 1: Determine available slots for K repetitions based on RRC configuration(s) in addition to TDRA in the DCI scheduling the PUSCH, CG configuration or activation DCI * Step 2: The UE determines whether to drop a PUSCH repetition or not according to Rel-15/16 PUSCH dropping rules, but the PUSCH repetition is still counted in the K repetitions. * FFS: Rel-17 PUSCH dropping rules are also applied if introduced in other WI(s)   Q4: Yes. |
| Spreadtrum | Q1: Yes  Q2: support, Conclusion may be better.  Q3: support an agreement for CG-PUSCH. Actually, we think the K repetitions configured by TDRA can be same as K transmission in a period. Since there are up to K repetitions, can have up to K transmission occasions.  Q4: Yes. |
| CATT | Q1: Yes.  Q2: Yes. But for Note2, (1) Isn’t it possible that the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH, it is an available slot? (2) RAN2 may consider update the 38.321 part.  Q3: We think both Type1 and Type2 can support counting based on available slot.  Q4: Yes. |
| OPPO | Q1: Yes.  Q2: Yes.  Q3: Yes. CG-PUSCH can support counting based on available slot.  Q4: Yes. |
| Xiaomi | Q1:yes  Q4:YES |

2nd round summary (Issue#2-1)

The 2nd round inputs are summarized below.

Q1: Do you agree on the following proposal 1?

* Yes: Nokia/NSB, Ericsson, Qualcomm, InterDigital, Samsung, Sharp, Spreadtrum, OPPO, CATT
* No:

Modified FL proposal 1 to Issue#2-1:

Take the following as a conclusion:

* For CG-PUSCH repetitions counted on the basis of available slots, all the K transmission occasions including the 1st transmission occasion are determined on the basis of available slots.

Q2: Do you agree on the following proposal 2?

* OK,: Sharp, Spreadtrum, OPPO
* No need: Ericsson, Samsung
* More clarification needed: Nokia/NSB, Qualcomm, CATT

Modified FL proposal 2 to Issue#2-1:

Take Alt 1 from the following alternatives:

* Alt 1: RAN1 specification to define the 1st transmission occasion of CG-PUSCH, based on the definition of available slots and the symbol for which the UL grant occur according to the current TS38.321.
  + Note 1: the definition of available slots to be defined in RAN1 specification.
  + Note 2: Alt 1 leads to the difference between the slot where the 1st CG-PUSCH is transmitted and the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH.

Q3: Do you agree that, for both Type-1 and Type-2 CG-PUSCHs with Type A repetitions, support of the counting based on the available slots has been agreed by the previous agreement on Option 1-B?

* Yes: Huawei/HiSilicon, Qualcomm, InterDigital, Sharp, Spreadtrum, OPPO, CATT
* No: Nokia/NSB, Ericsson,
* Better to have clear agreement: Samsung

Q4: Do you agree that the number of repetitions, K, in the Step 1 of the agreed Option 1-B is the value indicated/configured by *pusch-AggregationFactor*, *repK* or *numberOfRepetitions*, and no spec change is expected in terms of determination of the K in TS38.214, except for the support of increased maximum number of repetitions.

* Yes: Nokia/NSB, Qualcomm, InterDigital, Samsung, Sharp, Spreadtrum, OPPO, CATT
* No: Ericsson,

As we have reached the consensus on Q1, the following FL proposal seems agreeable. It is suggested discussing the other questions further in the next round.

Modified FL proposal 1 to Issue#2-1:

Take the following as a conclusion:

* For CG-PUSCH repetitions counted on the basis of available slots, all the K transmission occasions including the 1st transmission occasion are determined on the basis of available slots.

The above proposal was taken as conclusion in Oct-14 GTW2 session.

3rd round (Issue#2-1)

Companies are invited to provide their answers to the following questions.

Q1: Do you agree on that all the following combinations support the counting based on available slots? If the answer is “no”, please indicate which combination does not support.

* DG-PUSCH with Rel-15 repetition factor
* Type-1 CG-PUSCH with Rel-15 repetition factor
* Type-2 CG-PUSCH with Rel-15 repetition factor
* DG-PUSCH with Rel-16 repetition factor
* Type-2 CG-PUSCH with Rel-16 repetition factor
* DG-PUSCH with Rel-17 repetition factor
* Type-1 CG-PUSCH with Rel-17 repetition factor, if supported in Issue#1-2
* Type-2 CG-PUSCH with Rel-17 repetition factor

Q2: If you do NOT agree on that the number of repetitions, K, in the Step 1 of the agreed Option 1-B is the value indicated/configured by *pusch-AggregationFactor*, *repK* or *numberOfRepetitions*, and no spec change is expected in terms of determination of the K in TS38.214, except for the support of increased maximum number of repetitions, please indicate what the expected spec impact is.

Q3: Would you like more clarifications on the following proposal? If any, please comment. For you reference, Sharp’s comments in the 2nd round are copied below. If there is any comment to their explanation, please also provide it.

Modified FL proposal 2 to Issue#2-1:

Take Alt 1 from the following alternatives:

* Alt 1: RAN1 specification to define the 1st transmission occasion of CG-PUSCH, based on the definition of available slots and the symbol for which the UL grant occur according to the current TS38.321.
  + Note 1: the definition of available slots to be defined in RAN1 specification.
  + Note 2: Alt 1 leads to the difference between the slot where the 1st CG-PUSCH is transmitted and the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH.
* Alt 2: RAN2 specification TS38.321 to be updated such that the symbol for which the UL grant occur is based on the available slots.
  + Note 1: the definition of available slots to be defined in RAN1 specification.
  + Note 2: Similar to Rel-15/16, RAN1 specification does not need to define the 1st transmission occasion of CG-PUSCH.
  + Note 3: With Alt 2, the slot where the 1st CG-PUSCH is transmitted is the same as the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH.

Sharp’s comments:

In the current MAC procedure for CG-PUSCH, the MAC entity generates the 1st UL grant for a slot as shown in the TS38.321 descriptions that FL copied above. When the MAC entity delivers the 1st UL grant to HARQ process, the HARQ process instructs PHY to send PUSCH. On the other hand, the current TS38.214 is just saying “the K consecutive slots” but does not have any description of what is the start of “the K consecutive slots”. This implies the proper interpretation is that the start of “the K consecutive slots” is the slot for which the PHY is instructed to send the PUSCH corresponding to the 1st UL grant. But, now we are introducing available slot counting. This enhancement breaks such implication, because the slot for which the PHY is instructed to send the PUSCH corresponding to the 1st UL grant is not always an available slot. Therefore, in our view, if we go with Alt 1, TS38.214 has to clearly define the start of the K available slot for CG-PUSCH, e.g., some potential offset from the slot for which the 1st UL grant is generated.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | Q1: Yes.  Q2: Any new concept of indicating the number of repetitions is out of scope.  Q3: We are fine with the FL’s proposal. We have one question for clarification. Isn’t it so that, with the legacy behavior, the start of the K consecutive slots may not be an available slot as well? In that case, PHY just needs to wait for the next available slot and the same logic then applies for counting on available slot? |
| Intel | Q1: Yes  Q2: no additional spec impact is needed.  Q3: It is not clear to us why we need to discuss the RAN2 impact in RAN1. If needed, we can send LS to RAN2 for clarification. But we do not need to make decision for RAN2. We do not think we need this proposal. |
| Sierra Wireless | Q1: Yes – but its unclear why we need this question as it is being discussed in issue 1-2.  Q2: Agree – no spec impact is needed  Q3: No questions but Alt2 is too specific for a RAN1 decision. The alternative should be more general e.g. RAN1 sends LS recommending RAN2 include “bla bla” functionality into their specifications. |
| FL | @Nokia,  With the legacy behavior, MAC instructs PUSCH transmission based on the generated UL grant and then PHY drops the PUSCH transmission if the slot is not available for UL. PHY does not postpone the PUSCH transmission to a later slot.  @Intel and Sierra Wireless,  Here, I’m trying to identify what PHY behavior RAN1 intends and what the potential RAN1 spec impact is. Hope the following modification clarifies the intention more. Or, do you think the decision should be done by RAN2?   |  | | --- | | Modified FL proposal 2 to Issue#2-1:  Take Alt 1 from the following alternatives:  For the counting based on available slots, the PHY behavior to determine the start of K repetitions for CG-PUSCH that RAN1 intends is:   * Alt 1: When MAC instructs PHY to transmit PUSCH, PHY waits for the earliest available slot and then transmit the instructed PUSCH subject to PUSCH dropping rules.   + FFS: details of RAN1 spec impact.   + Note 1: the definition of available slots to be defined in RAN1 specification.   + Note 2: Alt 1 leads to the difference between the slot where the 1st CG-PUSCH is transmitted and the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH. * Alt 2: MAC instructs PHY to transmit PUSCH for an available slot, PHY transmit the instructed PUSCH without waiting, subject to PUSCH dropping rules.   + Note 1: the definition of available slots to be defined in RAN1 specification.   + Note 2: Similar to Rel-15/16, RAN1 specification does not need to define the 1st transmission occasion of CG-PUSCH.   + Note 3: RAN1 expects RAN2 specification updates on the 1st UL grant occurrence. | |
| Panasonic | Q1: Yes  Q3: We are fine with the FL proposal. |
| Spreadtrum | Q1: Yes  Q2: We think it should be a RAN1 decision for available slot. According to RAN2 specification impact, we prefer to send a LS to RAN2, ask them to consider the potential issue. |
| Vivo | Q1: YES  Q2: no spec change is expected  Q3: Same question as Nokia. If the legacy behavior is UE drops the PUSCH transmission, we can also consider the transmission on 1st occasion is dropped for repetitions counting based on available slot, the ‘postpone’ behavior, mentioned by FL, is not explicitly defined when we have counting based on available slot mechanism. |
| FL | @vivo,  We should not mix dropping and postponing. Postponing I mentioned above is to determine K available slots in the Step 1. Dropping is done in the Step 2. In Step 2, the transmission opportunities may be reduced from K, while that does not happen in Step 1. The legacy behavior does not have Step 1, and as such, if the 1st occasion is dropped, the remaining occasion is K-1.  Regarding “the ‘postpone’ behavior, mentioned by FL, is not explicitly defined when we have counting based on available slot mechanism”, we just made the conclusion “For CG-PUSCH repetitions counted on the basis of available slots, all the K transmission occasions including the 1st transmission occasion are determined on the basis of available slots.” Without postponing, how can we ensure the 1st occasion is in an available slot with Alt1? |
| CMCC | Q1: Yes. No problem for all Rel-17 parameters. A little hesitate for Rel-16 and Rel-16.  Q3: fine with the proposal. A little confused, if the gNB (including MAC entity) and UE have a same understanding about the available slots, why should the starting point indication not on the 1st available slot ? |
| Sharp | Q1: Yes. All the combinations support the counting based on the available slots.  Q2: No spec change is expected  Q3: We can live with the proposal (i.e., Alt 1), though we prefer Alt 2. As for CMCC’s comment, in our understanding is that the whole point here is how to define the 1st available slot. So, we suggest agreeing on the followings:   * For DG-PUSCH, Step 1 of the previous agreements determines the *K* earliest available slots at/after the slot which is determined by the slot offset *K2*. * For CG-PUSCH, Step 1 of the previous agreements determines the *K* earliest available slots at/after the slot which is determined by *ConfiguredGrantConfig*. |
| CATT | Q1: Yes  Q2: No spec change on the determination of the K.  Q3: In our opinion, PHY determines the available slot(s) and the indices (for all transmission occasions), while the MAC shall indicate the PHY using the earliest available slot when CG-PUSCH is to be transmitted.  For down-selection, we slightly prefer Alt 1. But we think an LS noticing RAN2 the situation seems needed, no matter Alt.1 or Alt.2 is supported eventually. |
| QC | Q1: Yes  Q2: No spec change on the determination of the K. |
| Ericsson3 | Q1: No. Only 2 following repetition factors are supported to be configured as counting based on available slot.   * DG-PUSCH with Rel-17 repetition factor * Type-2 CG-PUSCH with Rel-17 repetition factor   Q2: It looks we’re repeating the discussions. Alt 1-B agreement only tells 2 steps are used for transmission of Rel-17 Type A PUSCH repetitions and the K repetitions are just the repetitions that would be enhanced in Rel-17. What they can be are being discussed separately. And we do not think Rel-15 repetitions need any enhancement, enhancement based on Rel-16 dynamic repetition factors are enough. If UE has coverage issue using Rel-15 techniques, it should be configured with Rel-16 repetitions, if UE needs further coverage enhancement, it can be further configured with Rel-17 enhanced repetitions based on Rel-16 repetitions.  Q3: Not sure what the question mean? Will gNB schedule a PUSCH on a slot not available based on SSB and semi-static RRC signaling? We do not think any discussions on the first transmission occasion needed here. |

3rd round summary (Issue#2-1)

The 3rd round inputs are summarized below.

Q1: Do you agree on that all the following combinations support the counting based on available slots? If the answer is “no”, please indicate which combination does not support.

* DG-PUSCH with Rel-15 repetition factor
* Type-1 CG-PUSCH with Rel-15 repetition factor
* Type-2 CG-PUSCH with Rel-15 repetition factor
* DG-PUSCH with Rel-16 repetition factor
* Type-2 CG-PUSCH with Rel-16 repetition factor
* DG-PUSCH with Rel-17 repetition factor
* Type-1 CG-PUSCH with Rel-17 repetition factor, if supported in Issue#1-2
* Type-2 CG-PUSCH with Rel-17 repetition factor

Companies’ views to Q1 are summarized as follows. The large majority thinks all the above combinations should support the counting based on available slots.

* All of them: Nokia/NSB, Intel, Sierra Wireless, Panasonic, Spreadtrum, vivo, Sharp, CATT, Qualcomm (10 companies)
* At least three (the ones with Rel-17 repetition factor): CMCC (1 company)
* Only two (DG-PUSCH with Rel-17 repetition factor and Type-2 CG-PUSCH with Rel-17 repetition factor): Ericsson (1 company)

Based on the above situation, the following FL proposal is made.

FL proposal 3 to Issue#2-1

All the following combinations support the counting based on available slots.

* DG-PUSCH with Rel-15 repetition factor
* Type-1 CG-PUSCH with Rel-15 repetition factor
* Type-2 CG-PUSCH with Rel-15 repetition factor
* DG-PUSCH with Rel-16 repetition factor
* Type-2 CG-PUSCH with Rel-16 repetition factor
* DG-PUSCH with Rel-17 repetition factor
* Type-1 CG-PUSCH with Rel-17 repetition factor, if supported in Issue#1-2
* Type-2 CG-PUSCH with Rel-17 repetition factor

Q2: If you do NOT agree on that the number of repetitions, K, in the Step 1 of the agreed Option 1-B is the value indicated/configured by *pusch-AggregationFactor*, *repK* or *numberOfRepetitions*, and no spec change is expected in terms of determination of the K in TS38.214, except for the support of increased maximum number of repetitions, please indicate what the expected spec impact is.

Companies’ views to Q2 are summarized as follows. The large majority agreed on the proposal.

* No spec impact is expected: Nokia/NSB, Intel, Sierra Wireless, vivo, Sharp, CATT, Qualcomm (8 companies)
* K is determined only by Rel-17 repetition factor: Ericsson (1 company)

FL proposal 4 to Issue#2-1

The number of repetitions, K, in the Step 1 of the agreed Option 1-B is the value indicated/configured by pusch-AggregationFactor, repK or numberOfRepetitions, and no spec change is expected in terms of determination of the K in TS38.214, except for the support of increased maximum number of repetitions.

Q3: Would you like more clarifications on the following proposal?

Modified FL proposal 2 to Issue#2-1:

Take Alt 1 from the following alternatives:

* Alt 1: RAN1 specification to define the 1st transmission occasion of CG-PUSCH, based on the definition of available slots and the symbol for which the UL grant occur according to the current TS38.321.
  + Note 1: the definition of available slots to be defined in RAN1 specification.
  + Note 2: Alt 1 leads to the difference between the slot where the 1st CG-PUSCH is transmitted and the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH.
* Alt 2: RAN2 specification TS38.321 to be updated such that the symbol for which the UL grant occur is based on the available slots.
  + Note 1: the definition of available slots to be defined in RAN1 specification.
  + Note 2: Similar to Rel-15/16, RAN1 specification does not need to define the 1st transmission occasion of CG-PUSCH.
  + Note 3: With Alt 2, the slot where the 1st CG-PUSCH is transmitted is the same as the slot for which MAC entity generates the 1st UL grant for the CG-PUSCH.

Companies’ views to Q3 are summarized as follows.

* OK with the proposal: Nokia/NSB, Panasonic, CMCC, Sharp
* Need more clarification: Nokia/NSB, Intel, vivo, CMCC
* Consider sending a LS to RAN2: Intel, Sierra Wireless, CATT
* No need of discussion: Ericsson
* Suggest agreeing on the followings: Sharp
  + For DG-PUSCH, Step 1 of the previous agreements determines the *K* earliest available slots at/after the slot which is determined by the slot offset *K2*.
  + For CG-PUSCH, Step 1 of the previous agreements determines the *K* earliest available slots at/after the slot which is determined by *ConfiguredGrantConfig*.

It seems that quite a few companies still need more clarifications on what the issue is. To identify the issue, it is suggested discussing what is the expected spec impact to capture the agreements we have (including the previously agreed Option 1-B), starting with whether the above proposals from Sharp are agreeable or not.

4th round (Issue#2-1)

Companies are invited to provide their answers to the following questions.

Q1: Do you agree on the following proposals?

FL proposal 5 to Issue#2-1

* For the *K* repetitions of DG-PUSCH, Step 1 of the previously agreed two-step procedure (i.e., Alt 1-B) determines the *K* earliest available slots no earlier than the slot which is determined by the slot offset *K2*.
* For the *K* repetitions of CG-PUSCH, Step 1 of the previously agreed two-step procedure (i.e., Alt 1-B) determines the *K* earliest available slots no earlier than the slot which is determined by *ConfiguredGrantConfig*.

Q2: If the answer to Q1 is yes, provide your views on whether and how RAN1 specs captures the above behaviors? Note that the current RAN1 specs have no description about “the slot which is determined by *ConfiguredGrantConfig*”.

Q3: If the answer to Q1 is no, provide your views on how the UE determines *K* available slots for the *K* repetitions?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XX | Q1:  Q2/Q3: |
| Lenovo, Motorola Mobility | Q1: Yes  Q2: We don’t think that RAN1 specs need to capture the behavior in terms of determining the earliest available slots. This should be implied based on the slot offset |
| Vivo | Q2: In section 6.1.2.3.1 of 38.214   |  | | --- | | ……If a configured grant configuration is configured with *startingFromRV0* set to *'off'*, the initial transmission of a transport block may only start at the first transmission occasion of the *K* repetitions. Otherwise, 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*. |   RAN1 spec already have above text which specifies the first transmission occasion. Rel-17 spec can further include how to determine the available slots, e.g. consider TDD UL/DL configure and SSB. While this part is common for determination of DG-PUSCH and CG-PUSCH transmission occasions. The determination of tx occasions for CG-PUSCH counted based on available slots would be clear. |
| FL | @ Lenovo, Motorola Mobility,  Thank you for the feedback. I’m wondering what “the slot offset” for CG-PUSCH in RAN1 specs you have in mind. If you can clarify it a bit more, that would be appreciated.  @vivo,  Thanks. We should not mix up “transmission occasion” and “initial transmission”. The restrictions you copied above are about “initial transmission”, which is the initial actual transmission after Step 2 of the previously agreed Alt 1-B. Now we are discussing how to determine “K transmission occasions” for the K repetitions in Step 1. The restrictions for “initial transmission” cannot affect the determination of “transmission occasions”. |
| Intel | Q1: We are fine with the proposals, but we think the main issue is the first available slot for DG/CG-PUSCH transmission.  Q2/Q3: Not sure whether RAN1 needs to capture this in the spec. For DG-PUSCH, it is up to gNB to ensure that all available slot after K2 value. For CG-PUSCH, as long as UE and gNB have similar understanding on the first transmission occasion of CG-PUSCH, we do not see the issue. |
| ZTE | Q1: Yes  Q2: May no need RAN1 impacts specifically for CG PUSCH. As commented, the transmission occasions for CG need to satisfy both 1) available slot defined in step 1 in RAN1, and 2) the restrictions defined by RAN2 equations. As long as these two conditions are satisfied, we don’t see any issues. There is no need to include RAN1 conditions into RAN2 or RAN2 conditions in RAN1. |
| Ericsson4 | Q1: We are fine with the understandings of the proposal.  Q2: We do not think this needs spec. changes in RAN1 either as long as the available slot definition itself is clearly specified. |
| CATT | Q1: Yes.  Q2: For DG-PUSCH, the gNB shall schedule the UE using a suitable K2. For CG-PUSCH, the transmission occasion can be implicitly deduced by (1) determination rule of available slot (Step 1 of Alt1-B) and (2) timeline restriction of upper layer. |
| Lenovo, Motorola Mobility (2) | *@Moderator (Thank you for the feedback. I’m wondering what “the slot offset” for CG-PUSCH in RAN1 specs you have in mind. If you can clarify it a bit more, that would be appreciated.)*  Our response:  I meant the slot offset value K2 |
| WILUS | Q1: We are fine in general. For the CG-PUSCH Type 2, the slot is determined by TDRA in activation DCI.  Q2: There are two aspects to consider, 1) starting slot via K2 value for DG-PUSCH/initial transmission occasion for CG-PUSCH and 2) how to count K available slots.  Regarding 1), nothing can be specified for DG-PUSCH since it depends on gNB handling. For CG-PUSCH, the legacy rule for determination of initial transmission occasion can be reused as vivo copied.  Regarding 2), ‘consecutive’ can be changed as ‘available’ in TS 38.214 Clause 6.1.2.1, which is applied commonly for both DG-PUSCH and CG-PUSCH:   |  | | --- | | For PUSCH repetition Type A, in case *K>1,* the same symbol allocation is applied across the *K* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *K* consecutive slots applying the same symbol allocation in each slot. | |
| CMCC | Q1: yes  Q2: not sure if there is necessity to capture this in the spec. |
| Xiaomi | Q1:yes  Q2: not sure if there is necessity to capture this in the spec. |
| Nokia/NSB | Q1: We are fine with the FL’s proposal in principle. We think that the following modification (in red) is needed for the second bullet to make it clearer, unless we misunderstood the intention.   * For the *K* repetitions of CG-PUSCH, Step 1 of the previously agreed two-step procedure (i.e., Alt 1-B) determines the *K* earliest available slots no earlier than the first slot which is determined by *ConfiguredGrantConfig*.   Q2: The need for specification changes is unclear to us. However, we are open to discuss if any. |
| Samsung | Q1: Yes.  Q2: What already in the specifications for the delay offset K2 is sufficient. We don’t think there is any need to add a description for the first available slot which can be the first physical slot or a subsequent slot. |

### [Pending] Issue#2-2: Termination conditions for CG-PUSCH repetitions

In RAN1#106-e, it was discussed whether limitation of overall duration of PUSCH repetitions needed to be introduced or not.

For DG-PUSCH, it was agreed that the existing limitation, i.e., not exceeding K, should be applied, as follows.

|  |
| --- |
| Agreement   * For DG-PUSCH with counting based on the available slots, count of available slots continues until satisfying the conditions defined for DG-PUSCH repetition Type A in Rel-16. |

On the other hands, for CG-PUSCH, companies had different views. There were two alternatives identified during the email discussions in RAN1#106-e, and the FL made the following proposal.

Modified FL proposal

For the CG-PUSCH with counting based on the available slots, select one of the following alternatives in RAN1#106bis-e:

* Alt 1
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion among the K repetitions within the period P, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, 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.
* Alt 2
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion within the period P, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first.
  + The UE is not expected to be configured with K larger than P/12 for 60kHz with ECP or P/14 otherwise.
    - FFS: The UE is not expected to be configured with K larger than the number of available slots within the period P.
    - FFS: whether/how to capture it in RAN1 spec.
* Note: For overriding by DG-PUSCH with the same HARQ process, if any update is made for Rel-16, it also applies to above alternatives.

For more clarifications on the above two alternatives, the differences between Alt. 1 and Alt. 2 in terms of relationship between K and P is that

* Alt. 1 : The UE cannot be configured with K larger than the number of available slots within the period P.
* Alt. 2 : The UE can be configured with K larger than the number of available slots within the period P.

As the result, for Alt. 2, the UE counts available slots until the end of the CG period if the UE cannot find all available slots during the CG period. Regarding “at the last transmission occasion within the period P” in Alt. 2, it is about counting available slots until the end of the CG period. In Alt 2, the number of available slots in some CG periods may be less than K. Meanwhile, for Alt. 1, every period P need to contain K available slots. In other words, there are restrictions with the value of K. K needs to be a small number so that K fits in any TDD configuration for every CG period. On the other hand, Alt 1 may not requires specification changes in terms of repetition termination rules, while Alt 2 needs some change.

According to the contributions for RAN1#106bis, companies’ preferences between the above two alternatives are summarized as follows.

* Alt 1
  + Spreadtrum [3], vivo [4], Intel [13], Nokia/Nokia Shanghai Bell [15], LG Electronics [19]
* Alt 2
  + Huawei/HiSilicon [1], Panasonic [11], InterDigital [21], Qualcomm? [22]

OPPO [5] is proposing the removal of the 2nd bullet from Alt 1, because the 2nd bullet will cause the limitation force K << P in DL heavy TDD configurations in order to ensure every CG period has K transmission occasions. However, FL’s understanding is that Alt 2 does not lead to such limitation to the gNB’s configurations, and that is the whole reason why Alt 2 has been raised.

Samsung [12] is proposing a relaxation of the condition “within the period P”. More specifically, the condition that PUSCH repetitions shall be terminated after P+N slots is added to the existing conditions, where the parameter N can be fixed or configured by gNB. The proposal from Samsung is listed as Alt 3 below for the 1st round discussion. From FL perspective, some clarification on Alt 3 may be necessary. The existing condition does not allow the available slots to exceed period P. It would be good to clarify how the additional condition “terminated after P+N slots” would change the UE behaviour.

Lenovo/Motorola Mobility [23] are proposing that for PUSCH type A repetition coverage enhancements in NR Rel-17, limitation of duration of PUSCH repetitions should be supported. However, they do not mention the limitation is applied to CG-PUSCH or both DG-PUSCH and CG-PUSCH. For, DG-PUSCH, it was agreed in RAN1#106-e that the count of available slots continues until satisfying the conditions defined for DG-PUSCH repetition Type A in Rel-16, which means no limitation except the repetition factor. If they think the limitation is applied only to CG-PUSCH, their intention looks very similar to Samsung’s proposal. Therefore, Lenovo/Motorola Mobility is merged into Alt 3 below.

Furthermore, Sharp [17] is proposing the following modification to Alt 2. With only the conditions currently captured in the above Alt 2, there may be the case where the number of actual repetitions does not exceed *K* (because of CG-PUSCH dropping), and the overall duration does not exceed the period *P* (because of long CG period), but the number of transmission occasions exceed *K*. However, that results in the available slots are determined after PUSCH dropping is performed, which is not in line with the previous agreement. The principle of Sharp’s proposal is incorporated to Alt 2 in the 1st round discussion (the exact wording is modified such that the change to the current specification wording is minimized).

* Alt 2 modified by Sharp
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion within the period P, or at the last transmission occasion among K repetitions, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first.
  + The UE is not expected to be configured with K larger than P/12 for 60kHz with ECP or P/14 otherwise.
    - FFS: The UE is not expected to be configured with K larger than the number of available slots within the period P.
    - FFS: whether/how to capture it in RAN1 spec.

1st round (Issue#2-2)

Companies are invited to provide their views to the following proposal.

FL proposal on Issue#2-2

Select one of the following alternatives in RAN1#106bis-e

* Alt 1
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion among the K repetitions within the period P, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, 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.
* Alt 2 (with the slight modification suggested by Sharp)
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion among the K repetitions and within the period P or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first.
  + The UE is not expected to be configured with K larger than P/12 for 60kHz with ECP or P/14 otherwise.
    - FFS: The UE is not expected to be configured with K larger than the number of available slots within the period P.
    - FFS: whether/how to capture it in RAN1 spec.
* Alt 3
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion among the K repetitions within the period P, or after P+N slots, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first.
    - N can be fixed or configured by gNB

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| --- | --- |
| **Company** | **Comments** |
| Sharp | Support the proposal. For down-selection, we prefer Alt 2, as it does not lead to unnecessary restrictions to the scheduling. For the 2nd bullet of Alt 2, although we agree with having the configuration restriction, we may not need to capture it in the specification. For Alt 3, the additional condition is always satisfied if the existing condition “or at the last transmission occasion among the K repetitions within the period P” is met. Therefore, the additional condition is not necessary. |
| ZTE | Alt 1 is slightly preferred. Because both available slots for K repetitions and period P are semi-statically determined. gNB can well know the situation to find a proper configuration. The additional flexibility of second bullet of Alt 2 could be minor.  For Alt 2, we don’t understand why ‘and’ should be added in the first bullet, even after reviewing the reason provided by the proponent. Shouldn’t the K repetitions be always within the period P? |
| Apple | Alt 1 is preferred, due to the performance of CG PUSCH repetition can be guaranteed. |
| InterDigital | The background for this discussion is based on the possibility that the number of available slots may be different for one CG period to another CG period. This means potentially, there could be a mismatch between the number of repetitions and number of available slots per CG period since TDD configurations are not aligned with number of repetitions (i.e., there is no guarantee that the same number of slots are available each CG period).  Therefore, if all PUSCH repetitions over available slots need to be guaranteed for CG PUSCH, a small number of K needs to be chosen and configured (e.g., K=1, K=2) which creates a bottleneck for coverage performance.  For the above reasons, we support the intention behind Alt. 2, “The UE can be configured with K larger than the number of available slots within the period P.”, as described in the FL’s summary. |
| CMCC | Alt 1 is good enough. In this case, the last transmission occasions within the period P could be used to stop the transmissions when the repetition number do not reach K. Then there is no need to add an “and” in the Alt 2. And the UE behavior should follow the Rel-15/16. No need to extend the transmission durations to P+N as in Alt 3. |
| QC | Alt 2 is preferred, but the second bullet seems unnecessary. Suggest dropping it. |
| Intel | We prefer Alt. 1. Existing behavior as defined in R15/16 should be reused for repetition based on available slots. |
| Lenovo, Motorola Mobility | We prefer Alt 3 as it provides additionally flexibility to configure N by network |
| Samsung | The scope of Alt 3 is to allow transmission of K repetitions (or of a number close to K) even when the overall duration of the PUSCH transmission would be larger than P. Alt 3 would be equivalent to Alt 1 with the removal of “within the period P” if all K repetitions were to be transmitted. But there should be a limit to the overall duration of the transmission, hence P+N is proposed. |
| FL | Let me clarify the reason why I added “and” to Alt 2. The current specification language “at the last transmission occasion among the K repetitions within the period P” can be interpreted as “the K repetitions have to be within the period P”. For Alt 1, this is not a problem, because of its second bullet. For Alt 2, the K repetitions are not necessarily within the period P, but the last transmission occasion should be within the period P. At the same time, the last transmission occasion should still be among K repetitions. |
| Panasonic | We are fine with FL proposal. Our preference is Alt.2. In our view, Alt.1 forces the scheduling to the restriction with the value of K, e.g., K needs to be a small number so that K fits in any TDD configuration for every CG period. It would cause that several CG resource cannot be used depending on the available slot counting. We are open to consider Alt.3. |
| Spreadtrum | We slightly prefer Alt 1. Since it is same as the conditions defined in Rel-15/Rel-16 CG-PUSCH. |
| NTT DOCOMO | We slightly prefer Alt.2 to help flexibility of NW configuration, though it would be handled by NW configuration with Alt.1. |
| vivo | We prefer Alt 1.  As FL’s description, the big difference is that in Alt 2, UE can be configured with K larger than the number of available slots within the period P, which may make the time duration of K repetitions to be larger than the time duration derived by the period P. However, gNB implementation to configure this kind K value. Furthermore, Alt 3 would bring in some spec impact. Thus, Alt 1 is preferred. |
| CATT | Either Alt1 or Alt2 is fine to us. |
| OPPO | Alt 1 is slightly preferred. |
| Xiaomi | We slightly prefer Alt 1 |
| Nokia/NSB | We support Alt. 1. We also notice that if the FFS in the second bullet of Alt.2 is agreed then there is no difference between Alt. 1 and Alt. 2. Therefore, clarification (e.g., removing the second bullet of Alt. 2 as suggested by Qualcomm) may be needed. |
| Ericsson1 | Alt1, and we assume no specification change is needed for this.  One more comment is that whether “DCI format 0\_0” scheduled PUSCH will be enhanced in Rel-17 is not agreed, so we propose to remove related text. |
| Huawei/HiSilicon | Alt2 is better.  For Alt 1, considering frame structure in different period could be different from each other, K value of repetitions is restricted to be the smallest number of available slots in all periods, which would cause resource waste and have influence on coverage performance. | |

1st round summary (Issue#2-2)

The companies’ inputs are summarized as follows.

* Alt 1
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion among the K repetitions within the period P, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, 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.
  + Support: (12 companies) ZTE, Apple, CMCC, Intel, Spreadtrum, vivo, CATT, OPPO, Xiaomi Nokia/NSB, Ericsson
* Alt 2 (with the slight modification suggested by Sharp)
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion among the K repetitions and within the period P or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first.
  + The UE is not expected to be configured with K larger than P/12 for 60kHz with ECP or P/14 otherwise.
    - FFS: The UE is not expected to be configured with K larger than the number of available slots within the period P.
    - FFS: whether/how to capture it in RAN1 spec.
  + Support: (8 companies) Sharp, InterDigital, Qualcomm, Panasonic, NTT DOCOMO, CATT, Huawei/HiSilicon
* Alt 3
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion among the K repetitions within the period P, or after P+N slots, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first.
    - N can be fixed or configured by gNB
  + Support: (3 companies) Lenovo/Motorola Mobility, Samsung

Although it is commonly understood that Alt 1 leads to some scheduling restrictions, the majority (12 companies) including several network vendors and operators expressed their views that the scheduling restrictions caused by Alt1 can be handled by the network. Therefore, FL made the following proposal. As for the comment on “DCI format 0\_0”, it is used just as a condition of CG-PUSCH termination, i.e., overriding by DG-PUSCH without repetition scheduled by DCI format 0\_0. So, it is kept as in the original proposal (also as in the current specification description).

Modified FL proposal on Issue#2-2

* For CG-PUSCH with repetition Type A counted on the basis of available slots,
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion among the K repetitions within the period P, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, 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.

2nd round (Issue#2-2)

Modified FL proposal on Issue#2-2

* For CG-PUSCH with repetition Type A counted on the basis of available slots,
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion among the K repetitions within the period P, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, 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.

Only if any company has a strong concern on the above proposal, provide comments below.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | We support the FL’s proposal. |
| Huawei, HiSilicon | Not OK with the FL proposal. It is quite clear that Alt 2 got supports of network vendors, chip vendors and operators. Alt 2 defines a clearer UE behavior, but Alt 1 is a network scheduling restriction. If any network vendors prefer Alt 1 the scheduling restriction, Alt 2 does not preclude their choice, they cannot implement such restriction anyway, but allow the other network vendors to be free from such restriction.  More importantly, If Alt 1 is selected, the performance of CG-PUSCH repetition type A with counting based on the available slots would be worse than the existing R15/R16 CG-PUSCH repetition type A with counting based on the physical slots. For example, in following figure, UE is configured with P = 5.  R15/R16 UE can repeat 3 times in the first period and 2 times in the second period, if K = 4.  Alt1 UE can only repeat 2 times in the first period and 2 times in the second period, because K is up to 2.  Alt2 UE can repeat 4 times in the first period and 3 times in the second period, if K = 4. |
| Ericsson2 | Looks fine. And thanks for the clarification for the DCI0-0 comment we made earlier. |
| QC | We will not object, but this debate has been quite bizarre --- gNB vendors arguing in favor of restrictions on gNB scheduling. |
| InterDigital | We also have a strong concern for the FL’s proposal. As we addressed in the earlier round, Alt. 1 restricts choice of K since the bottleneck will be created by the smallest number of available slots in the CG. Coverage performance will suffer from small number of K. So far there has not been any discussions about flaws in Alt. 2. Are there any critical flaws in Alt. 2? |
| Samsung | We suggest to remove the second sub-bullet to avoid capturing every possible gNB misconfiguration, or make it a conclusion/note. |
| Sharp | Huawei’s statement “the performance of CG-PUSCH repetition type A with counting based on the available slots would be worse than the existing R15/R16 CG-PUSCH repetition type A with counting based on the physical slots” is true for some combinations of CG period and TDD configuration. At the same time, for DG-PUSCH, available slot counting is always better than R15/16 counting. This is the reason why we proposed separate configurations of counting methods for DC-PUSCH and CG-PUSCH. However, in AI 8.8 RRC parameter discussion, such separate configurations have been excluded, unfortunately. Therefore, the performance degradation caused by Alt1 is not avoidable.  Having said that, we can live with Alt 1 if gNB vendors think it is workable.  @ Samsung: The 2nd bullet of Alt1 is already in the TS38.214. The point here is whether to update the TS38.214 description such that the current restriction applies to the legacy counting only. |
| Spreadtrum | Support. |
| CATT | OK. |
| OPPO | For the 2nd bullet of Alt1, it will force a smaller K to ensure every CG period has K actual repetitions. And “FFS: The UE is not expected to be configured with K larger than the number of available slots within the period P.” of Alt2 has the same restriction.  For Alt1, if the actual number of PUSCH repetitions is less than the configured number of the repetitions, does it mean “at the last transmission occasion among the K repetitions within the period P” is reached first? If this is right, the 2nd bullet may be not appropriate. |
| Xiaomi | OK |
| InterDigital | @OPPO  The difference between Alt. 1 and Alt. 2 (also shown in the FL’s summary above) is the following   * In Alt. 1, the UE **cannot be** configured with K larger than the number of available slots within the period P. * In Alt. 2, the UE **can be** configured with K larger than the number of available slots within the period P.   So there is a restriction on K for Alt.1 but under Alt. 2, there is no restriction on K. |

2nd round summary (Issue#2-2)

The 2nd round inputs on whether to accept to the following modified FL proposal are summarized below. As we do not reach the consensus, it is suggested discussing it further in the next round.

* OK: Nokia/NSB, Ericsson, Spreadtrum, Xiaomi, CATT
* Not OK: Huawei/HiSilicon, InterDigital, Samsung, OPPO

Modified FL proposal on Issue#2-2

* For CG-PUSCH with repetition Type A counted on the basis of available slots,
  + The repetitions shall be terminated after transmitting K repetitions, or at the last transmission occasion among the K repetitions within the period P, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, 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.

3rd round (Issue#2-1)

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| --- |
| **TS38.214**  6.1.2.3.1 Transport Block repetition for uplink transmissions of PUSCH repetition Type A with a configured grant  The procedures described in this clause apply to PUSCH transmissions of PUSCH repetition Type A with a Type 1 or Type 2 configured grant.  The higher layer parameter *repK-RV* defines the redundancy version pattern to be applied to the repetitions. If *cg-RetransmissionTimer* is provided, the redundancy version for uplink transmission with a configured grant is determined by the UE. If the parameter *repK-RV* is not provided in the *configuredGrantConfig* and *cg-RetransmissionTimer* is not provided, the redundancy version for uplink transmissions with a configured grant shall be set to 0. If the parameter *repK-RV* is provided in the *configuredGrantConfig* and *cg-RetransmissionTimer* is not provided, 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. If a configured grant configuration is configured with *startingFromRV0* set to *'off'*, the initial transmission of a transport block may only start at the first transmission occasion of the *K* repetitions. Otherwise, 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 from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first. In addition, the UE shall terminate the repetition of a transport block in a PUSCH transmission if the UE receives a DCI format 0\_1 with DFI flag provided and set to '1', and if in this DCI the UE detects ACK for the HARQ process corresponding to that transport block.  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*. If the UE determines that, for a transmission occasion, the number of symbols available for the PUSCH transmission in a slot is smaller than transmission duration *L*, the UE does not transmit the PUSCH in the transmission occasion. |

The formulation of the proposals in the 1st and 2nd rounds may be somehow confusing. In the round, the question is simplified. Companies are invited to provide their answer to the following question.

Q1: Select one of the following alternatives:

* Alt 1: The existing restriction (the blue part above) applies to both the counting based on physical slots and the counting based on available slots.
* Alt 2: The existing restriction (the blue part above) applies to the counting based on physical slots and does not apply to the counting based on available slots.

Q2: If your answer to Q1 is Alt1, please indicate your interpretation on “the time duration for the transmission of K repetitions”

* Alt 1-a: The time duration between the start of the 1st slot of the K repetitions and the end of the last slot of the K repetitions.
* Alt 1-b: The sum total of the slot lengths of the K available slots.
* Alt 1-c: Other interpretations.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | Alt. 1 |
| InterDigital | @FL  Thank you very much for the proposal.  We are not sure how these alternatives relate to the discussion for Issue #2-2. Could you clarify? For example, is the intention to check companies’ understanding on what “the time duration for the transmission of *K* repetitions*”* means, i.e., whether “time duration” = number of available slots? |
| Sierra Wireless | Alt 1. |
| FL | @InterDigital  The previous Alt 2 included two aspects: whether to apply the existing restriction for the Rel-17 counting, i.e., equivalent to this 3rd round question, and whether to introduce a new restriction for the Rel-17 counting. Companies commented on different aspects. So, I’m trying to focus on the single aspect in this round. Hope this answers your question. |
| Panasonic | Our preference is Alt.2 We share the same concern as Huawei and InterDigital in the 2nd round discussion. However, we understand that Alt.1 can work with some scheduling restriction. Therefore, we can live with Alt.1 if gNB vendors think Alt.1 is acceptable. |
| Spreadtrum | Alt 1. |
| vivo | Alt.1 |
| InterDigital | Thank you very much for clarification. We realized that there was a typo in our previous response so we made a correction (it does not affect intention of our question). Our view is similar to Alt 2. |
| FL | @InterDigital,  Thank you for the follow-up. Now I understand the intention of your previous comment. I added “Q2” accordingly. |
| CMCC | Alt 1. |
| Sharp | Q1: Share the same view as Panasonic. Our preference is Alt 2 but can live with Alt 1 if gNB vendors think Alt 1 is acceptable.  Q2: Alt 1-a. |
| CATT | Q1: Alt.1. This is the baseline, and if no consensus to extend the definition of ending rule due to introducing available slot, this shall be followed.  Q2: Alt 1-a. Currently, P is counting based on physical slot (or say absolute number of symbols, e.g. sym1x14, sym10x14, sym16x14, sym80x14). It is more suitable to do judge ‘exceed or not’ using the same metric. |
| QC | Q1: Alt 2 first preference, but can be okay with Alt 1 as well if gNB vendors don’t care for Alt 2.  Q2: Alt 1a. |
| Nokia/NSB2 | Q1: Alt. 1  Q2: Alt. 1a |
| Ericsson3 | Alt1. and 1a. |

3rd round summary (Issue#2-2)

The 3rd round inputs are summarized below.

Q1: Select one of the following alternatives:

* Alt 1: The existing restriction (the blue part above) applies to both the counting based on physical slots and the counting based on available slots.
  + Support: Nokia/NSB, Sierra Wireless, Spreadtrum, vivo, CMCC, CATT, Ericsson
  + Can live with: Panasonic, Sharp, Qualcomm
* Alt 2: The existing restriction (the blue part above) applies to the counting based on physical slots and does not apply to the counting based on available slots.
  + Support: Panasonic, InterDigital, Sharp, Qualcomm

Q2: If your answer to Q1 is Alt1, please indicate your interpretation on “the time duration for the transmission of K repetitions”

* Alt 1-a: The time duration between the start of the 1st slot of the K repetitions and the end of the last slot of the K repetitions.
  + Sharp, CATT, Qualcomm, Nokia/NSB, Ericsson
* Alt 1-b: The sum total of the slot lengths of the K available slots.
* Alt 1-c: Other interpretations.

Based on the above situation, the following FL proposal is made.

FL proposal 2 on Issue#2-2:

* The existing restriction “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*” applies to both the counting based on physical slots and the counting based on available slots.
  + The above “the time duration for the transmission of *K* repetitions” means the time duration between the start of the 1st slot of the K repetitions and the end of the last slot of the K repetitions.

### [Pending] Issue#2-3: Aspect related to the Gnb’s blind detections of CG-PUSCH transmissions

Panasonic [11] is raising the issue about the gNB’s blind detections of CG-PUSCH transmissions. Deterministic number of slots are necessary to judge whether UE transmits CG transmission or not. gNB accumulates DMRS symbols of the slot which may contain PUSCH. If the actual number of PUSCH repetitions is less than the required number of repetitions for gNB to enable to judge whether UE transmits CG transmission or not, gNB will not detect the CG PUSCH transmission. Therefore, they are proposing that, for CG-PUSCH repetition Type A in CovEnh scenario, if the actual number of PUSCH repetitions is less than the configured number of the repetitions (i.e., required number of repetitions for gNB to judge whether CG transmission is carried out or not), UE can drop the remaining part of the repetition.

Sharp [17] is raising another issue related to the gNB’s blind detections of CG-PUSCH transmissions. In Rel-15/16 CG-PUSCH with repetitions, the following restrictions on an initial transmission have been specified in oder to help gNB’s blind detections of CG-PUSCH. Sharp raised a question, whether the existing restrictions are also applied to CG-PUSCH repetitions counted on the basis of available slots or not. It is suggested collecting companies’s views on this aspect.

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| --- |
| **Clause 6.1.2.3.1 of TS38.214**  If a configured grant configuration is configured with *startingFromRV0* set to *‘off’*, the initial transmission of a transport block may only start at the first transmission occasion of the *K* repetitions. Otherwise, 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*. |

1st round (Issue#2-3)

Companies are invited to provide their views to the following question2.

Q1: Do you agree that, for CG-PUSCH with the counting based on available slots, if the actual number of PUSCH repetitions is less than the configured number of the repetitions (i.e., required number of repetitions for gNB to judge whether CG transmission is carried out or not), UE drops the rest of the repetitions.

Q2: Do you agree that, for CG-PUSCH with the counting based on available slots, the above restrictions on the initial transmission of a transport block are applied, assuming the K repetitions are determined on the basis of the available slots.

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| **Company** | **Comments** |
| Sharp | Q1: With the Rel-16 restrictions on the 1st transmission, the gNB can use DMRSs from at least two repetitions, for the detection of the presence of CG-PUSCH with K>=8. If two sets of DMRS is not sufficient for the blind detection, we prefer considering more restrictions on the 1st transmission, rather than allowing Ues to drop the rest of the repetitions.  Q2: Yes. Some restrictions on the 1st transmission should apply. |
| ZTE | Q1: No. In Rel-16, the number of actual CG transmission may be less than the configured one, e.g., due to the restrictions in Q2. While UE still transmissions those repetitions.  Q2: Yes. |
| Apple | Q1: UE just counts the available slots according to the RRC signaling, whether the transmission is dropped or not is according to dropping rule, which is related to gNB scheduling. No new dropping rule is required.  Q2: In general, we are ok with the same handling as repetition based on physical slot. |
| QC | Q1: No. Even if some repetitions are dropped UE transmits the remaining repetitions.  Q2: Yes, existing conditions on when a CG-PUSCH transmission can start can be applied even when repetitions are counted on the basis on available slots. |
| Intel | Q1: No, actual number of CG-PUSCH repetitions may be less than configured number of repetitions due to some dynamic ignaling in the 2nd step, e.g., dynamic SFI, UL CI, etc. No new dropping rule is needed.  Q2: Yes |
| Lenovo, Motorola Mobility | Q1: Similar view as Apple and no new dropping rule is required  Q2: Yes |
| Samsung | Q1: No new dropping rules seem to be necessary.  Q2: Yes. Same existing conditions for the initial transmission of a transport block can be applied when the counting of repetitions is based on available slots. |
| Panasonic | Q1: In our view, to transmit the remaining part of repetitions may not be meaningful if the actual number of PUSCH repetitions is less than the configured number of the repetitions (i.e., required number of repetitions for gNB to judge whether CG transmission is carried out or not). On the other hand, we are OK not to introduce new dropping rule if majority considers it is not necessary.  Q2: Yes. |
| Spreadtrum | Q1: We don’t think it is necessary to drop the rest of repetitions when less than K. This case exits in Rel-15/Rel-16, nothing is defined for it. The current is enough, no extra dropping is needed.  Q2: support. |
| Vivo | Q1: Whether DMRS can be detected by NW depends on many factors, including DMRS density, UE transmission power, etc., it is not easy to determine the number of repetitions required for NW to judge whether transmission is actually performed. Besides, for the cases CG-PUSCH can start at any occasions in the K repetitions, transmission of enough repetitions is not always required in current mechanism.  Q2: Yes. There is alignment between gNB and UE on the available slots pattern. And we have agreed the RV cycling based on available slots. |
| FL | It seems we have a consensus on Q2. Therefore, I’d like to bring the following proposal to the coming GTW session.  FL proposal 1 to Issue#2-3:  For CG-PUSCH with the counting based on available slots, the existing restrictions on the initial transmission of a transport block are applied, assuming the K repetitions are determined on the basis of the available slots. |
| CATT | Q1: It is highly related to gNB implementation on CG-PUSCH detection. We think there is no need to introduce such additional termination rule.  Q2: Agree. |
| OPPO | Q1: No need to introduce new dropping rules.  Q2: Agree. |
| Xiaomi | Q1: No need to introduce new dropping rules  Q2:Yes |
| FL | Regarding Q2, the following agreement was made in Oct-12 GTW2 session. Therefore, the discussion on Q2 is now closed. If there is further 1st round input on Q1, please do so in this table.  Agreement  For CG-PUSCH repetition Type A with the counting based on available slots, the R16 existing restrictions as defined in Clause 6.1.2.3.1 of TS38.214 at least on the initial transmission of a transport block are applied, assuming the K repetitions of R17 determined based the rule of counting available slots. |
| Nokia/NSB | Q1: No, otherwise this will contradict the whole purpose of the agreement on counting on available slots using the 2-step approach. |
| Ericsson1 | Q1: We share same view as most of the companies, i.e. no new rules are necessary specifically for enhanced Type A PUSCH repetitions when scheduled with configured grant. |
| Huawei/HiSilicon | Q1: No. It is not necessary to drop the rest of repetitions when less than K.  Q2: Yes | |

1st round summary (Issue#2-3)

For Q1 ”for CG-PUSCH with the counting based on available slots, if the actual number of PUSCH repetitions is less than the configured number of the repetitions (i.e., required number of repetitions for gNB to judge whether CG transmission is carried out or not), UE drops the rest of the repetitions”, the large majority prefer not to support such a dropping rule. Panasonic also accepted not to introduce a new dropping rule.

FL proposal 2 to Issue#2-3:

Take the following as a conclusion:

* The following dropping rule is not supported in Rel-17
  + For CG-PUSCH with the counting based on available slots, if the actual number of PUSCH repetitions is less than the configured number of the repetitions (i.e., required number of repetitions for gNB to judge whether CG transmission is carried out or not), UE drops the rest of the repetitions.

### [Pending] Issue#2-4: Use of Type0-PDCCH CSS set configuration for the determination of available slots

Regardless of whether dynamic signaling is used for the determination of available slots or not, at least of some RRC configurations need to be used for the determination. According to the following agreement in RAN1#104-e, it was agreed to use at lease tdd\_ul\_dl configuration (i.e. *tdd-UL-DL-ConfigurationCommon* and *tdd-UL-DL-ConfigurationDedicated*) for the available slot determination for both Alt 1 and Alt 2.

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| Agreements:  Select one of the following alternatives, considering the aspect whether or not the determination of all the available slots should be done prior to the first actual transmission of the repetitions (other alternatives are not precluded)  -        Alt1: Whether or not a slot is determined as available for UL transmissions depends on RRC configurations (at least tdd\_ul\_dl configuration, FFS: other RRC configurations) and does not depend on dynamic signaling (at least SFI, FFS: other dynamic signaling e.g. CI, PUSCH priority for URLLC).  -        Alt2: Whether or not a slot is determined as available for UL transmissions depends on RRC configurations (at least tdd\_ul\_dl configuration, FFS: other RRC configurations) and also depends on dynamic signaling (at least SFI, FFS: other dynamic signaling e.g. CI, PUSCH priority for URLLC). |

In addition, the following agreement was made in RAN1#105-e, which means that SSB configuration (i.e. *ssb-PositionsInBurst*) is also referred to for the determination of available slots.

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| --- |
| Agreement:   * If PUSCH symbol in a slot overlaps with flexible symbol(s) with SSB transmission, the slot is determined as not available during the counting of repetitions. As there is no PUSCH in the slot, no PUSCH omission applies to the slot. |

In RAN1#106-e, companies exchanged their views on what is the consequence from not using Type0-PDCCH CSS set configuration for the determination of available slots or not. For this point, it was commonly understood that no use of CORESET0 with Type0-PDCCH CSS for the available slot determination would force the Rel-17 gNB scheduler to always schedule PUSCH repetitions with the available slot based counting such that the PUSCH repetitions never overlap with PDCCH transmissions in CORESET0 with Type0-PDCCH CSS. However, the majority was still thinking the gNB scheduler can handle it.

According to the contributions for RAN1#106bis, companies’ preferences are summarized as follows.

* Use of Type0-PDCCH CSS set configuration for the determination of available slots
  + Support: Xiaomi [9], Intel [13], WILUS [24]
  + Not support: Spreadtrum [3], CATT [6], China Telecom [7], Panasonic [11], Sharp [17], Apple [18], LG Electronics [19], Qualcomm [22]
  + Introduce either all of RRC configurations or none of them for available slot determination: ZTE [2]

Looking at the companies’ views, the majority companies do not see the necessity and there is no consensus to support the use of Type0-PDCCH CSS set configuration for the determination of available slots.

1st round (Issue#2-4)

FL Observation to Issue#2-4

* There is no consensus to support the use of Type0-PDCCH CSS set configuration for the determination of available slots.

Only if any company has a strong concern on the above observation, provide comments below.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Ok with this observation. |
| CMCC | Support. We do not see a motivation to use Type0-PDCCH CSS set to determine the available slot for PUSCH. If there is conflicts, the PUSCH could be dropped based on some rule. |
| Intel | We still think it is beneficial to consider Type0-PDCCH CSS set configuration for the determination of available slots. Otherwise, this may pose certain scheduling restriction at gNB side. For each slot configured with flexible symbols, gNB needs to ensure there is no collision between flexible symbols and CORESET0 with Type0-PDCCH CSS set, which may not be desirable from scheduling perspective. |
| WILUS | Agree with Intel. Since PUSCH repetition can be deferred behind quite a number of slots in some TDD configurations (e.g., DL heavy slots). In this case, gNB complexity would be increased. |
| Ericsson1 | Fine with the proposal, there’s no need to consider other downlink broadcasting signals for available slot determination as we’ve discussed a lot earlier.  Similar to Msg3 repetition, available slot determination based on TDD UL/DL configuration and the SSB positions are enough, all other potential collisions can be handled in the 2nd step for actual Type A PUSCH repetition transmission determination with legacy collision handling rules. |

1st round summary (Issue#2-4)

Thanks to Intel and WILUS for the feedbacks. The arguments are collect, not considering Type0-PDCCH CSS set configuration for the determination of available slots leads to scheduling restriction at gNB side. However, that drawback was already identified in the last meeting and was well understood by companies including the network vendors and operators, and they still do not see the necessity. Therefore, FL would like to make the following proposal.

FL proposal on Issue#2-4

* Type0-PDCCH CSS set configuration is not considered for the determination of available slots.

### [Pending] Issue#2-5: Use of Invalid UL symbol configuration for the determination of available slots

Similar to CORESET0 with Type0-PDCCH CSS set, in Rel-16, invalid UL symbol configuration is used to determine time domain resource allocation for PUSCH repetition Type B. On the other hand, any clear behaviour (including PUSCH dropping rule) has not been specified for the case PUSCH repetition Type A overlaps with the invalid UL symbols.

In RAN1#106-e, it was discussed whether or not the invalid UL symbol configuration for the determination of available slots is used for the determination of available slots. The majority companies’ views were that Rel-16 invalid UL symbol configuration should not be re-purposed for the Rel-17 PUSCH repetition Type A with counting based on the available slots.

According to the contributions for RAN1#106bis, companies’ preferences are summarized as follows.

* Use of Invalid UL symbol configuration for the determination of available slots
  + Support: Xiaomi [9], Panasonic [11], Intel [13]
  + Not support: Spreadtrum [3], CATT [6], China Telecom [7], Sharp [17], Apple [18], LG Electronics [19], Qualcomm [22]
  + Introduce either all of RRC configurations or none of them for available slot determination: ZTE [2]

Looking at the companies’ views, the majority companies do not see the necessity and there is no consensus to support the use of Invalid UL symbol configuration for the determination of available slots.

1st round (Issue#2-5)

FL Observation to Issue#2-5

* There is no consensus to support the use of Invalid UL symbol configuration for the determination of available slots.

Only if any company has a strong concern on the above observation, provide comments below.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Ok with this observation. |
| Intel | Same reason as above. we still think it is beneficial to consider invalid UL symbol configuration for the determination of available slots. |
| Panasonic | We are OK to the FL observation. |
| Ericsson1 | Fine with the proposal, same comment as for issue #2-4. |

1st round summary (Issue#2-5)

Thanks to Intel for the feedbacks. Similar to the Issue#2-4, although the arguments are collect, such drawback was already identified in the last meeting and was well understood by companies including the network vendors and operators, and they still do not see the necessity. Therefore, FL would like to make the following proposal.

FL proposal on Issue#2-5

* Invalid UL symbol configuration is not considered for the determination of available slots.

### [Pending] Issue#2-6: Use of semi-static PUCCH repetition configuration for the determination of available slots

Rel-16 defines the PUSCH dropping rule that PUSCH repetitions are dropped in the slots where semi-static PUCCH repetitions with periodic CSI reporting overlap the PUSCH repetitions. Whether PUSCH resources collide with semi-static PUCCH repetitions with periodic CSI reporting or not is known by the UE prior to the start of PUSCH repetitions.

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| **TS38.213 v16.6.0**  9.2.6 PUCCH repetition procedure  *[Omitted]*  If a UE would transmit a PUCCH over a first number of slots and the UE would transmit a PUSCH with repetition Type A over a second number of slots, and the PUCCH transmission would overlap with the PUSCH transmission in one or more slots, and the conditions in clause 9.2.5 for multiplexing the UCI in the PUSCH are satisfied in the overlapping slots, the UE transmits the PUCCH and does not transmit the PUSCH in the overlapping slots. |

In RAN1#106-e, it was discussed whether to use semi-static PUCCH repetition configuration for the determination of available slots. The result was that the large majority did not think it as necessary.

According to the contributions for RAN1#106bis, companies’ preferences are summarized as follows.

* Use of semi-static PUCCH repetition configuration for the determination of available slots
  + Support:
  + Not support: Spreadtrum [3], CATT [6], China Telecom [7], Panasonic [11], Sharp [17], Apple [18], LG Electronics [19], Qualcomm [22]
  + Introduce either all of RRC configurations or none of them for available slot determination: ZTE [2]

Looking at the companies’ views, no company thinks the use of semi-static PUCCH repetition configuration for the determination of available slots is essential.

1st round (Issue#2-6)

FL Observation to Issue#2-6

* No company thinks the use of semi-static PUCCH repetition configuration for the determination of available slots is essential.

Only if any company has a strong concern on the above observation, provide comments below.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Ok with this observation. |
|  |  |

1st round summary (Issue#2-6)

As there is no company which objected the above FL Obsercation, FL would like to make the following proposal.

FL proposal on Issue#2-6

* Semi-static PUCCH repetition configuration is not considered for the determination of available slots.

### [Pending] Issue#2-7: Use of SMTC configuration for the determination of available slots

vivo [4] has been proposing that SSB based measurement by SMTC configuration should be handling in the available slot determination step, based on the following descriptions in RAN4 specification.

|  |
| --- |
| **TS38.133**  9.2.5.3 Scheduling availability of UE during intra-frequency measurements  UE shall be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same serving carrier which can be merged[2], if it is configured; otherwise, all *L* SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.  9.2.5.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1  When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement  - The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*  When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRQ measurement  - The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.* |

In RAN1#106-e, we discussed this issue, but there was no consensus to apply the same behaviors as for the SSB configured by *ssb-PositionsInBurst*.to theSSB measurement configured by SMTC

According to the contributions for RAN1#106bis, companies’ preferences are summarized as follows.

* Use of SMTC configuration for the determination of available slots
  + Support: vivo [4], Panasonic [11]
  + Not support: Spreadtrum [3], CATT [6], China Telecom [7], Sharp [17], Apple [18], LG Electronics [19], Qualcomm [22]
  + Introduce either all of RRC configurations or none of them for available slot determination: ZTE [2]

Looking at the companies’ views, the majority companies do not see the necessity and there is no consensus to support the use of SMTC configuration for the determination of available slots.

On the other hand, vivo [4] provides the information regarding RAN4 specifications, which is some interactions between RAN1 and RAN4 on UL transmission within SMTC window.

* In R1-1810008, RAN1 informed RAN4 of RAN1’s working assumption that, in frequency range 1 unpaired spectrum, UE is not required to perform intra-frequency neighbour cell RRM measurement over SSB or CSI-RS for mobility when UE detects a DCI format 0\_0, DCI format 0\_1, DCI format 1\_0, DCI format 1\_1, or DCI format 2\_3 triggering the UE to transmit in UL in at least one of the symbols where the SSB or CSI-RS for RRM measurement on neighbour cell is transmitted.
* In R4-1904682, RAN4 replied to RAN1 that RAN4 was planning to technically endorse the CR capturing that, in case of frequency range 1 unpaired spectrum, for SSB based measurements, UE is not required to perform UL transmission on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.
* In R1-1905880, RAN1 sent RAN4 the reply saying that RAN1 respects RAN4 conclusions, and RAN1 does not expect any changes to Rel-15 RAN1 specification due to RAN4 conclusion.

Based on the above interactions, RAN1 and RAN4 both assumed the collision could happen between UL transmission and SSB for RRM, and RAN1 accepted RAN4’s conclusion.

It is suggested reviewing the past discussions on collision between UL transmission and SSB for RRM and check if any company changes their position on this issue.

1st round (Issue#2-7)

Companies are asked to review the aforementioned past interactions between RAN1 and RAN4 and to check if it affects their positions for the use of SMTC configuration for the determination of available slots.

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| **Company** | **Comments** |
| Sharp | We still see no need to use SMTC configuration for the determination of available slots. Considering Rel-15/16 PUCCH repetitions refer to only *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationDedicated* and *ssb-PositionsInBurst*, use of the same set as PUCCH for PUSCH would simplify the scheduling. |
| vivo | In addition to the summary provided by FL. We would like to further provide following comments.  1, Although R4-1904682 only mention scheduling restriction on FR1, the scheduling restiction is also applied to FR2, as captured in section 9.2.5.3.3 in 38.133. Hence, the situation is same for FR1 and FR2.  2, The SSB symbols configured by SMTC is not available for PUSCH transmission early in Rel-15, same as SSB indicated by ssbPositionsInBurst. And in initial RAN1 conclusion, UL transmission is prioritized over RRM. Hence, for available slots for PUCCH repetition, No need to consider SSB configured by SMTC on flexible symbols. However, the RAN1 conclusion is reverted by RAN4. Then, the symbols overlapping with SSBs by SMTC is counted as available but not actually available for PUCCH transmission. For PUSCH repetition counted on available slots, it is does not take too much effort to consider these resources as not available if repetitions are counted based on available slots. |
| WILUS | We share the similar view with Sharp. PUSCH transmission can be dropped in step 2 if symbols overlap with SSB by SMTC. |

1st round summary (Issue#2-7)

It seems no company except vivo has strong concern to no use of SMTC configuration. At the same time, as vivo kindly provided additional information in the 1st round, it is suggested having the next round to check whether any company changes their position based on the information provided by vivo.

2nd round (Issue#2-7)

Companies are invited to review the vivo’s comment in the 1st round and to check if they would keep/change their position on the use of SMTC configuration for the determination of available slots. Only if any company changes their position, please provide their comment below.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XX |  |
|  |  |

2nd round summary (Issue#2-7)

During the 2nd round, no company provided views, which means that no company has change their position on this issue.

After the email discussion after 1st round. The following single proposal was made, which covers all of the Issues #2-4, #2-5, #2-6, #2-7 and #2-8. It is suggested confirming the proposal is acceptable for everyone.

FL proposal on Issue#2-4 to #2-8

* Only *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationDedicated* and *ssb-PositionsInBurst* are considered for the determination of available slots.
  + Any other RRC configuration is not considered for the determination of available slots.

### [Pending] Issue#2-8: Use of other RRC configurations for the determination of available slots

In RAN1#106-e, it was discussed whether to use any other RRC configurations than the one discussed above, for the determination of available slots. The result was that the large majority did not think it as necessary.

According to the contributions for RAN1#106bis, companies’ preferences are summarized as follows.

* Use of the other RRC configurations configuration for the determination of available slots
  + Support:
  + Not support: Spreadtrum [3], CATT [6], China Telecom [7], Sharp [17], Apple [18], LG Electronics [19], Qualcomm [22]
  + Introduce either all of RRC configurations or none of them for available slot determination: ZTE [2]

Looking at the companies’ views, no company has raised any other RRC configuration for the determination of available slots.

1st round (Issue#2-8)

FL Observation to Issue#2-8

* No company thinks the use of any other RRC parameter for the determination of available slots is essential.

Only if any company has a strong concern on the above observation, provide comments below.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | OK with this observation. |
|  |  |

1st round summary (Issue#2-8)

As there is no company which objected the above FL Obsercation, FL would like to make the following proposal.

FL proposal on Issue#2-8

* Other RRC configuration is not considered for the determination of available slots, except for
  + *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationDedicated* and *ssb-PositionsInBurst* and
  + the ones that are discussed under Issue#2-4 to #2-7

### [Pending] Issue#2-9: Handling of a collision between PUSCH repetition and other UL channels/signals

In RAN1#105-e, Huawei proposed studying the case when PUSCH repetition Type A overlaps with SRS. In Rel-15/16, the specifications are not specifing any special handling of collisions between PUSCH and SRS, except for the case of overlaping between high priorirty PUSCH and low priority SRS. The reason is because the gNB can schedule PUSCH and SRS such that any collision between them does not happen. Huawei expressed their views that such a strict TDRA limitation leads to more resource waste of UL symbols when the PUSCH is repeated across more slots, and proposed the following option in order to avoid the wast of uplink resources.

* If symbols in the slot indicated by TDRA for a PUSCH repetition overlaps with the symbols still intended for other UL transmission ( but not for this PUSCH transmission), such as higher priority URLLC signal or periodic SRS or cancellation indication, non-overlapped UL symbols within the overlapped UL slot can be used for one PUSCH repetition to make a full utilization of uplink resources.

During the discussions in RAN1#105-e, the large majority expressed their views that this proposal (i.e. partial dropping of PUSCH) violates PUSCH repetition Type A nature, i.e. the same symbol allocation for all the repetitions. This issue was discussed in the GTW session in RAN1#105-e, but no agreement/conclusion was made. Mr. chairman suggested revisiting this issue in RAN1#106-e.

This issue was also discussed in the GTW session in RAN1#106-e, and there was no consensus to support partial PUSCH transmisssion due to overlapping with A-SRS for Rel-17 PUSCH repetition Type A.

For RAN1#106bis, there are several contributions which discuss the collisions between PUSCH repetitions and other UL channels/signals, though they are not much related to the above “partial-dropping” proposal.

* SRS is dropped in the case of collision between PUSCH repetition and A-SRS, i.e., no specification change is necessary.
  + Panasonic [11]
* For the case that one particular slot is determined as an available slot for multiple time-overlapping UL channels or signals (type A PUSCH repetition enhancement option 2, A-SRS, or SPS HARQ-ACK), RAN1 is to define the priority of the multiple time-overlapping UL transmissions. The UE only transmits the channel or signal with the highest priority in overlapping symbols in the slot.
  + Ericsson [20]
* For any special handling related to Release 17 changes in other work items in terms of collision between enhanced Type A PUSCH repetitions and other UL channels/signals, it should be handled within the scope of that work item.
  + Qualcomm [22]

FL’s understanding on this issue is as follows:

* In RAN1#104-e, it was agreed that, for defining available slots, a slot is determined as unavailable if at least one of the symbols indicated by TDRA for a PUSCH in the slot overlaps with the symbol not intended for UL transmissions. As for the components to determine “the symbol not intended for UL transmissions”, only the TDD UL/DL configuration (i.e. *tdd-UL-DL-ConfigurationCommon* and *tdd-UL-DL-ConfigurationDedicated*) and the SSB configuration (i.e. *ssb-PositionsInBurst*) have been agreed so far. If there is no other agreed component, whether a slot is considered as available or not available would be determined only by the comparison of the TDRA for the PUSCH in the slot and the TDD UL/DL configuration plus the SSB configuration.
* In RAN1#106-e, we agreed to take Option 1-B for the procedure of PUSCH repetition Type A counted on the basis of available slots. The agreed Option 1-B has an FFS bullet saying that “FFS: Rel-17 PUSCH dropping rules are also applied if introduced in other WI(s)”. This FFS bullet was added so as to address the concern that we are not aware of Rel-17 PUSCH dropping rules introduced in other WI(s). The discussions on the FFS point can take place only after finalizing the PUSCH dropping rules in other WI(s). At the same time, in RAN#93-e, it was concluded that all types of UEs are included in the scope of Rel-17 CovEnh WI. Therefore, whether Rel-17 PUSCH dropping rules introduced in other WI(s) are also applied or not can be discussed later under AI 8.8.1.1 if necessary.

### [Close] Issue#2-10: Applicability of available slot based counting method to paired spectrum

In RAN1#106-e, the following agreement was made in AI 8.8.1.2. Currently, only available slot based counting has been agreed for TBoMS. Given that the use of TBoMS is not limited to unpaired spectrum, the following agreement should be applicable to paired spectrum as well.

|  |
| --- |
| Agreement  The number of slots allocated for TBoMS is counted based on the available slots for UL transmission.   * The determination of available slots for PUSCH repetition type A, as defined in AI 8.8.1.1, is reused.   Note: Available slots for FDD or SUL could be revisited according to discussion in AI 8.8.1.1 |

In addition, in RAN$93-e there was the discussion on whether CovEnh WI should cover HD FDD RedCap or not. The conclusion was any UE type including HD FDD RedCap should be within the scope.

Therefore, it is suggested keeping both unpaired spectrum and paired spectrum for the use of the counting based on available slots for now.

According to the contributions for RAN1#106bis, companies’ preferences are summarized as follows.

* The use of available slot counting is not limited to unpaired spectrum
  + ZTE [2], vivo [4] (at least for HD-FDD RedCap UEs), Panasonic [11] (if TDD configuration is just applied without difference between TDD and FDD) , Sharp [17], Qualcomm [22] (for HD-FDD)
* For PUSCH Type A repetitions, counting based on available slots is NOT applicable to paired spectrum.
  + Sierra Wireless [16], LG Electronics [19] (for FD-FDD)
* Discuss applicability of Rel-17 PUSCH enhancements to HD-FDD RedCap UEs.
  + Samsung [12] (discuss in RAN1#107-e) , LG Electronics [19]

Based on the companies’ views in their contributions, there seems to be no need to discuss this issue under AI 8.8.1.1 in this meeting.

1st round (Issue#2-10)

Companies are invited to provide their views to the following question.

Q: Do you agree that there is no need to discuss whether or not the counting based on available slots is applicable only to unpaired spectrum under AI 8.8.1.1 in RAN1#106bis-e.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Sharp | Agree. |
| ZTE | We suggest to first agree on ‘The use of available slot counting is also applicable to paired spectrum’ in this meeting. Regarding details on how to support for HD-FDD UEs, it could defer to the next meeting. |
| Apple | The use case available slot for paired spectrum is for RedCap UE, according to RAN plenary instruction, we can wait for RedCap WI outcome to determine any addtional works are required for coverage enhancement WI. |
| CMCC | We support that the available slot could be used for both paired and unpaired spectrum.  And for the HD-FDD Redcap UE, I think RAN plenary had a discussion and clear conclusion that,  ***conclusion: endorsed:***  ***− All types of UEs are included in the scope of Rel-17 CovEnh WI.***  ***− Collision handling between PUSCH and SSB for HD-FDD UE in Rel-17 CovEnh WI depends on the outcome of Rel-17 RedCap WI. The parallel discussion between Rel-17 CovEnh WI and Rel-17 RedCap WI should be avoided.*** |
| QC | We suggest that a discussed focused on HD-FDD UEs take place under 8.8.1.1. Our preference would be to extend counting based on available slots to HD-FDD UEs as well. This is more in our domain than Redcap WI. |
| Intel | Agree. |
| Lenovo, Motorola Mobility | Yes, we agree that in this meeting at least, there is no need to discuss the applicability of counting method only to unpaired or paired spectrum |
| Samsung | Discussion of applicability of counting of available slot to HD-FDD RedCap UEs can be discussed in this AI in next meeting. |
| Panasonic | We agree to the FL suggestion. |
| Spreadtrum | At least available slot can be defined for HD-FDD. |
| NTT DOCOMO | Support. |
| vivo | We are fine to wait until the RedCap WI has some further clear conclusion. Based on the current agreements in RedCap WI, we can observe that at least for CG-PUSCH repetition type A, counting based on available slots could be applicable for HD-FDD RedCap UEs. |
| CATT | Currently, the concept of ‘available slot’ is used in PUSCH repetition Type A.  We are open to adopt ‘available slot’ for HD-FDD UE transmitting Type A PUSCH repetition, where only SSB symbols shall be considered as RRC parameters (not considering TDD configurations).  But we would like to confirm that this does not aim to extend the use of ‘available slot’ to other cases, e.g. Repetition type B. |
| OPPO | Agree. |
| Xiaomi | agree |
| WILUS | Agree |
| Nokia/NSB | Agree. In addition, as mentioned by other companies, we can discuss whether/how to support HD-FDD RedCap UEs in this AI. |
| Ericsson1 | Agree.  Available slot determination rules agreed so far are clear and enough, there’s no need to introduce additional rules for unpaired or paired spectrum. HD-FDD specific rules can be applied in the 2nd step when determining the actual transmission of a enhanced Type A PUSCH repetition. |
| Huawei/HiSilicon | Agree. The RAN1 design for PUSCH repetition type A is band agnostic since Rel-15, applicable to paired spectrum, unpaired spectrum and SUL band. | |

1st round summary (Issue#2-10)

The companies’ inputs are summarized as follows.

Q: Do you agree that there is no need to discuss whether or not the counting based on available slots is applicable only to unpaired spectrum under AI 8.8.1.1 in RAN1#106bis-e.

* OK with not discussing it in this meeting: Sharp, Apple, Intel, Lenovo/Motorola Mobility, Samsung, Panasonic, NTT DOCOMO, vivo, OPPO, Xiaomi, WILUS, Nokia/NSB, Ericsson, Huawei/HiSilicon
* First agree on ‘The use of available slot counting is also applicable to paired spectrum’: ZTE
* Discuss how to support HD-FDD: CMCC, Qualcomm, CATT (only for PUSCH repetition Type A)

As shown above, the large majority accepted not to discuss this isse in thie meeting. Therefore, FL made the following proposal.

FL proposal on Issue#2-10:

Take the following as a conclusion:

* Whether or not the counting based on available slots is applicable only to unpaired spectrum is not discussed under AI 8.8.1.1 in RAN1#106bis-e. Discussions on how HD-FDD RedCap UEs support the available slot counting may take place in AI 8.8.1.1 in RAN1#107-e, depending on the progress of RedCap WI discussions.

The above proposal was taken as observation in Oct-14 GTW2 session.

## RRC parameters for PUSCH repetition Type A

During the email discussion [Post-106-e-Rel17-RRC-08], it was actively discussed what RRC parameters would be necessary for PUSCH repetition Type A, and the summary was provided in R1-2108673. In this section, the RRC parameter related proposals described in the companies’ contributions for AI 8.8.1.1 are summarized, though the discussion will take place in [106bis-e-R17-RRC-CovEnh] under AI 8.8.

### [Discuss under AI8.8] Issue#3-1: Necessity of *PUSCH-TimeDomainResourceAllocation-r17*

During the email discussion [Post-106-e-Rel17-RRC-08], it was actively discussed whether the following parameters are necessary for PUSCH repetition Type A with increased maximum number of repetitions.

|  |  |  |  |
| --- | --- | --- | --- |
| **RAN2 Parent IE** | **Parameter name in the spec** | **Description** | **Value range** |
| [PUSCH-TimeDomainResourceAllocationList] | *numberOfRepetitions-17* | Support the increased maximum number of repetitions | 1, 2, 3, 4, 7, 8, 12, 16, 20, 24, 28, 32 |
| [PUSCH-Config] | *pusch-TimeDomainAllocationListDCI-0-1-r17* | Configuration for TDRA list for DCI format 0\_1 to support up to 32 repetitions, defined in the same way as for pusch-TimeDomainAllocationListDCI-0-1-r16 | SetupRelease { PUSCH-TimeDomainResourceAllocationList-r17 } |
| [PUSCH-Config] | *pusch-TimeDomainAllocationListDCI-0-2-r17* | Configuration for TDRA list for DCI format 0\_2 to support up to 32 repetitions, defined in the same way as for pusch-TimeDomainAllocationListDCI-0-2-r16 | SetupRelease { PUSCH-TimeDomainResourceAllocationList-r17 } |
| [pusch-TimeDomainAllocationListDCI-0-1-r17 and pusch-TimeDomainAllocationListDCI-0-2-r17] | [*PUSCH-TimeDomainResourceAllocationList-r17*] | Configuration for TDRA listto support up to 32 repetitions, defined in the same way as for pusch-TimeDomainResourceAllocationList-r16 | SEQUENCE (SIZE(1..maxNrofUL-Allocations-r17)) OF PUSCH-TimeDomainResourceAllocation-r17 |
|  | ~~[~~*~~maxNrofUL-Allocations-r17~~*~~]~~ | ~~Maximum number of PUSCH time domain resource allocations~~ | ~~64~~ |
| [PUSCH-TimeDomainResourceAllocationList] | [*PUSCH-TimeDomainResourceAllocation-r17*] | Configuration for TDRA list entries to support up to 32 repetitions [, defined in the same way as for PUSCH-TimeDomainResourceAllocation-r16] | SEQUENCE {k2, startSymbolAndLength-r17, numberOfRepetitions-r17, ...} [SEQUENCE { PUSCH-Allocation-r17 … }] |
| [PUSCH-TimeDomainResourceAllocation-r17] | [*PUSCH-Allocation-r17*] | Configuration for TDRA of each TDRA list entry to include numberOfRepetitions-17, defined in the same way as for PUSCH-Allocation-r16 | SEQUENCE { startSymbolAndLength-r17 numberOfRepetitions-r17 … } |

One major discussion point is whether *PUSCH-TimeDomainResourceAllocation-r16* is reused for up to 32 repetitions or not. Rel-16 RRC parameter *PUSCH-TimeDomainResourceAllocation-r16* includes not only 16-repetition function but also multiple PUSCH scheduling function for NR-U. There are two possible directions. Considering that NR-U multiple PUSCH scheduling does not need to be supported with CovEnh functions, creating a new structure would be the simpler and cleaner option.

* Alt 1: Reuse *PUSCH-TimeDomainResourceAllocation-r16* structure with adding *numberOfRepetitions-r17* to *PUSCH-Allocation-r16*
* Alt 2: Create a new structure by inserting *numberOfRepetitions-r17* to Rel-15 *PUSCH-TimeDomainResourceAllocation* structure

|  |
| --- |
| **Rel-16 *PUSCH-TimeDomainResourceAllocation-r16* structure in TS38.331v16.5.0**  PUSCH-TimeDomainResourceAllocation-r16 ::=　SEQUENCE { 　　k2-r16　　　　　　　　　　　INTEGER(0..32)　　　　　　　 OPTIONAL,　 -- Need S 　　puschAllocationList-r16　　 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16, 　　　　... }  PUSCH-Allocation-r16 ::=　SEQUENCE { 　　mappingType-r16　　　　　　 ENUMERATED {typeA, typeB}　　　　　　　　　　 OPTIONAL,　 -- Cond NotFormat01-02-Or-TypeA 　　startSymbolAndLength-r16　　INTEGER (0..127)　　　　　　 OPTIONAL,　 -- Cond NotFormat01-02-Or-TypeA 　　startSymbol-r16　　　　　　 INTEGER (0..13)　　　　　　　OPTIONAL,　 -- Cond RepTypeB 　　length-r16　　　　　　　　　INTEGER (1..14)　　　　　　　OPTIONAL,　 -- Cond RepTypeB 　　numberOfRepetitions-r16　　 ENUMERATED {n1, n2, n3, n4, n7, n8, n12, n16} OPTIONAL,　 -- Cond Format01-02 　　... } |

|  |
| --- |
| **Rel-15 *PUSCH-TimeDomainResourceAllocation* structure in TS38.331v16.5.0**  PUSCH-TimeDomainResourceAllocation ::=　SEQUENCE { 　　k2　　　　　　　　　　　　　INTEGER(0..32)　　　　　　　 OPTIONAL,　 -- Need S 　　mappingType　　　　　　　　 ENUMERATED {typeA, typeB}, 　　startSymbolAndLength　　　　INTEGER (0..127) } |

According to the contributions for RAN1#106bis, companies’ preferences are summarized as follows.

* Alt 1: Reuse *PUSCH-TimeDomainResourceAllocation-r16* structure with adding *numberOfRepetitions-r17* to *PUSCH-Allocation-r16*
  + Ericssin [20] (*pusch-TimeDomainAllocationListDCI-0-1-r17* overrides *pusch-TimeDomainAllocationListDCI-0-1-r16*, if both are configured)
* Alt 2: Create a new structure by inserting *numberOfRepetitions-r17* to Rel-15 *PUSCH-TimeDomainResourceAllocation* structure
  + vivo [4], Sharp [17]

It is suggested discussing the following proposal under [106bis-e-R17-RRC-CovEnh].

Select one of the following:

* Alt 1: Reuse *PUSCH-TimeDomainResourceAllocation-r16* structure with adding *numberOfRepetitions-r17* to *PUSCH-Allocation-r16*
* Alt 2: Create a new structure by inserting *numberOfRepetitions-r17* to Rel-15 *PUSCH-TimeDomainResourceAllocation* structure

### [Discuss under AI8.8] Issue#3-2: Necessity of separate *AvailableSlotCounting* parameters for DG-PUSCH and CG-PUSCH

During the email discussion [Post-106-e-Rel17-RRC-08], the following parameter for PUSCH repetition Type A with counting based on the available slots was discussed.

|  |  |  |  |
| --- | --- | --- | --- |
| **RAN2 Parent IE** | **Parameter name in the spec** | **Description** | **Value range** |
| [PUSCH-Config] | *~~RepetitionCountingType-R17~~* [*AvailableSlotCounting*] | Enabling PUSCH repetitions counted on the basis of available slots | ENUMERATED {enabled, disable } |

Sharp is proposing introducing two different RRC parameters for enabling the counting based on available slots, one is for DG-PUSCH and the other is for CG-PUSCH.

* Alt 1: A single RRC paramter *AvailableSlotCounting* that applies to both DG-PUSCH and CG-PUSCH is introduced.
* Alt 2: Two different RRC paramters, *AvailableSlotCounting#1* for DG-PUSCH and *AvailableSlotCounting#2* for CG-PUSCH, are introduced.

It is suggested discussing the following proposal under [106bis-e-R17-RRC-CovEnh].

Select one of the following:

* Alt 1: A single RRC paramter *AvailableSlotCounting* that applies to both DG-PUSCH and CG-PUSCH is introduced.
* Alt 2: Two different RRC paramters, *AvailableSlotCounting#1* for DG-PUSCH and *AvailableSlotCounting#2* for CG-PUSCH, are introduced.

### [Discuss under AI8.8] Issue#3-3: Configurations enabling CovEnh functions

As for the configuration of two enhancements, i.e., the increased maximum number of repetitions and the repetitions counted on the basis of available slots, the discussion has been deferred until concluding what repetition factor is supported with the counting based on the available slots. In RAN1#106-e, support of up to 32 repetitions with counting based on the available slots was taken as a working assumption, as the following. Therefore, it is the time to revisit this issue.

|  |
| --- |
| Working Assumption  The maximum number of repetitions accounted for available slots supported by Rel-17 PUSCH repetition Type A is 32 |

According to the contributions for RAN1#106bis, companies’ preferences are summarized as follows.

* Alt1: For Rel-17 PUSCH repetition Type A, the two features can be configured independently/separately.
  + “The counting based on available slots” is enabled via RRC signaling. If not enabled, the Rel-17 UE uses “the counting based on physical slots” (i.e. the same repetition counting as in Rel15/16).
  + Rel-17 RRC parameter(s) relating to “the increased maximum number of repetitions” is provided via RRC signaling to a UE which performs PUSCH repetitions with “the increased maximum number of repetitions”. If not provided, the repetition factor for the PUSCH repetitions is subject to Rel-15/16 configuration.
  + Support: ZTE [2], Spreadtrum [3], OPPO [5], China Telecom [7], NTT DOCOMO [14]
* Alt2: A single Rel-17 RRC parameter is used to enable both of the following functions:
  + Counting based on available slots is enabled via a RRC signaling.
  + Repetition number up to 32.
  + Support: CATT [6], Panasonic [11], Lenovo/Motorola Mobility [23]
* Alt.3 A single Rel-17 RRC parameter indicating one of the following three combinations is introduced.
  + "The counting based on physical slots" and "the existing maximum number of repetitions"
  + "The counting based on physical slots" and "the increased maximum number of repetitions"
  + "The counting based on available slots" and "the increased maximum number of repetitions"
  + Panasonic [11]
* Alt.4 A single Rel-17 RRC parameter indicating one of the following three combinations is introduced.
  + "The counting based on physical slots" and "the existing maximum number of repetitions"
  + "The counting based on physical slots" and "the increased maximum number of repetitions"
  + "The counting based on available slots" and "the existing maximum number of repetitions"
  + Ericsson [20]
  + FL’s comment: This alternative is not in line with the Working assumption from RAN1#106-e, i.e., “The maximum number of repetitions accounted for available slots supported by Rel-17 PUSCH repetition Type A is 32”.

The above alternatives are re-formulated as below so as to be more aligned with RRC parameter discussions.

It is suggested discussing the following proposal under [106bis-e-R17-RRC-CovEnh].

In addition to *numberOfRepetitions-r17*, a new Rel-17 RRC parameter for enabling the counting based on available slots is introduced. For the associated behaviours, select one of the following alternatives:

* Alt1: Two enhancements are configured separately (simultaneous configurations allowed).
  + If the new Rel-17 RRC parameter set to “enabled” is configured, *numberOfRepetitions-r17* may or may not be configured and the counting based on available slots is used.
  + Otherwise, *numberOfRepetitions-r17* may or may not be configured and the counting based on physical slots is used.
* Alt2: The configurations of two enhancements are always tied to each other.
  + If the new Rel-17 RRC parameter set to “enabled” is configured, *numberOfRepetitions-r17* has to be also configured and the counting based on available slots is used.
  + Otherwise, *numberOfRepetitions-r17* cannot be configured and the counting based on physical slots is used.
* Alt.3: One of three combinations of two enhancements is selectively configured.
  + If the new Rel-17 RRC parameter set to “enabled” is configured, *numberOfRepetitions-r17* has to be configured and the counting based on available slots is used,
  + If the above parameter set to “disabled” is configured, *numberOfRepetitions-r17* has to be configured and the counting based on physical slots is used,
  + If the above parameter is not configured, *numberOfRepetitions-r17* cannot be configured and the counting based on physical slots is used,

# References

1. R1-2108738 Discussion on coverage enhancements for PUSCH repetition type A Huawei, HiSilicon
2. R1-2108845 Discussion on enhanced PUSCH repetition type A ZTE
3. R1-2108919 Discussion on enhancements for PUSCH repetition Type A Spreadtrum Communications
4. R1-2108989 Discussion on enhancement for PUSCH repetition type A vivo
5. R1-2109088 Enhancements on PUSCH repetition type A OPPO
6. R1-2109240 Discussion on enhancements on PUSCH repetition type A CATT
7. R1-2109247 Remaining issues on PUSCH repetition type A enhancements China Telecom
8. R1-2109295 Discussion on enhancements on PUSCH repetition type A CMCC
9. R1-2109424 Enhancements on PUSCH repetition type A Xiaomi
10. R1-2109452 Discussion on enhancements on PUSCH repetition type A Rakuten Mobile, Inc
11. R1-2109455 Discussion on enhancements on PUSCH repetition Type A Panasonic Corporation
12. R1-2109504 Enhancements on PUSCH repetition type A Samsung
13. R1-2109624 Enhancements on PUSCH repetition type A Intel Corporation
14. R1-2109692 Enhancements on PUSCH repetition type A NTT DOCOMO, INC.
15. R1-2109886 Enhancements on PUSCH repetition type A Nokia, Nokia Shanghai Bell
16. R1-2109990 Design considerations for PUSCH repetition Type A Enhancements Sierra Wireless. S.A.
17. R1-2110000 Enhancements on PUSCH repetition type A Sharp
18. R1-2110046 Discussion on PUSCH repetition type A enhancement Apple
19. R1-2110096 Discussions on PUSCH repetition type A enhancements LG Electronics
20. R1-2110122 PUSCH Repetition Type A Enhancement Ericsson
21. R1-2110152 Type-A PUSCH repetition for coverage enhancement InterDigital, Inc.
22. R1-2110201 Enhancements on PUSCH Repetition Type A Qualcomm Incorporated
23. R1-2110237 Enhancements on PUSCH repetition type A Lenovo, Motorola Mobility
24. R1-2110327 Discussion on enhancements on PUSCH repetition type A WILUS Inc.

# RRC parameters listed in R1-2108673

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **WI code** | **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parent IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| NR\_cov\_enh-Core | Enhancement on PUSCH repetition Type A |  |  | [PUSCH-TimeDomainResourceAllocationList] |  | *numberOfRepetitions-17* | ~~new~~ existing |  | Support the increased maximum number of repetitions | 1, 2, 3, 4, 7, 8, 12, 16, 20, 24, 28, 32 |  |  | [UE-specific] | 38.331 | Agreements: Rel-17 PUSCH repetition Type A supports the increase of maximum number of repetitions with repetition factors configured in a TDRA list with a row index indicated either by the configured grant configuration or by TDRA field in a DCI.  Agreement: In addition to {1, 2, 3, 4, 7, 8, 12, 16} and {32}, the following additional value set for repetition factor is supported in Rel-17. • {20, 24, 28}  Agreement DCI format 0\_1 and DCI format 0\_2 support Rel-17 PUSCH repetition Type A with the increased maximum repetition numbers configured in TDRA lists.  [For PUSCH-Allocation-r17, only the field numberOfRepetitions-r16 is changed to numberOfRepetitions-r17. Other fields (mappingType, startSymbolAndLength, startSymbol, length) would be same as in Rel-16.] |
| NR\_cov\_enh-Core | Enhancement on PUSCH repetition Type A |  |  | [PUSCH-Config] |  | *pusch-TimeDomainAllocationListDCI-0-1-r17* | ~~new~~ existing |  | Configuration for TDRA list for DCI format 0\_1 to support up to 32 repetitions, defined in the same way as for pusch-TimeDomainAllocationListDCI-0-1-r16 | SetupRelease { PUSCH-TimeDomainResourceAllocationList-r17 } |  |  | [UE-specific] | 38.331 |
| NR\_cov\_enh-Core | Enhancement on PUSCH repetition Type A |  |  | [PUSCH-Config] |  | *pusch-TimeDomainAllocationListDCI-0-2-r17* | ~~new~~ existing |  | Configuration for TDRA list for DCI format 0\_2 to support up to 32 repetitions, defined in the same way as for pusch-TimeDomainAllocationListDCI-0-2-r16 | SetupRelease { PUSCH-TimeDomainResourceAllocationList-r17 } |  |  | [UE-specific] | 38.331 |
| NR\_cov\_enh-Core | Enhancement on PUSCH repetition Type A |  |  | [pusch-TimeDomainAllocationListDCI-0-1-r17 and pusch-TimeDomainAllocationListDCI-0-2-r17] |  | [*PUSCH-TimeDomainResourceAllocationList-r17*] | ~~new~~ existing |  | Configuration for TDRA listto support up to 32 repetitions, defined in the same way as for pusch-TimeDomainResourceAllocationList-r16 | SEQUENCE (SIZE(1..maxNrofUL-Allocations-r17)) OF PUSCH-TimeDomainResourceAllocation-r17 |  |  | [UE-specific] | 38.331 |
| ~~NR\_cov\_enh-Core~~ | ~~Enhancement on PUSCH repetition Type A~~ |  |  |  |  | ~~[~~*~~maxNrofUL-Allocations-r17~~*~~]~~ | ~~existing~~ |  | ~~Maximum number of PUSCH time domain resource allocations~~ | ~~64~~ |  |  | ~~[UE-specific]~~ | ~~38.331~~ |
| NR\_cov\_enh-Core | Enhancement on PUSCH repetition Type A |  |  | [PUSCH-TimeDomainResourceAllocationList] |  | [*PUSCH-TimeDomainResourceAllocation-r17*] | ~~new~~ existing |  | Configuration for TDRA list entries to support up to 32 repetitions [, defined in the same way as for PUSCH-TimeDomainResourceAllocation-r16] | SEQUENCE {k2, startSymbolAndLength-r17, numberOfRepetitions-r17, ...} [SEQUENCE { PUSCH-Allocation-r17 … }] |  |  | [UE-specific] | 38.331 |
| NR\_cov\_enh-Core | Enhancement on PUSCH repetition Type A |  |  | [PUSCH-TimeDomainResourceAllocation-r17] |  | [*PUSCH-Allocation-r17*] | ~~new~~ existing |  | Configuration for TDRA of each TDRA list entry to include numberOfRepetitions-17, defined in the same way as for PUSCH-Allocation-r16 | SEQUENCE { startSymbolAndLength-r17 numberOfRepetitions-r17 … } |  |  | [UE-specific] | 38.331 |
| NR\_cov\_enh-Core | Enhancement on PUSCH repetition Type A |  |  | [PUSCH-Config] |  | *~~RepetitionCountingType-R17~~* [*AvailableSlotCounting*] | new |  | Enabling PUSCH repetitions counted on the basis of available slots | ENUMERATED {enabled, disable } |  |  | [UE-specific] | 38.331 | Agreement: • Each available slot identified by the UE is considered as a transmission occasion for PUSCH repetition. o RV is cycled across transmission occasions, irrespective of whether PUSCH transmission in the transmission occasion is further omitted or not. |

# List of agreements

## Agreements in RAN1#104-e

Agreements:

Select one of the following alternatives, considering the aspect whether or not the determination of all the available slots should be done prior to the first actual transmission of the repetitions (other alternatives are not precluded)

-        Alt1: Whether or not a slot is determined as available for UL transmissions depends on RRC configurations (at least tdd\_ul\_dl configuration, FFS: other RRC configurations) and does not depend on dynamic signaling (at least SFI, FFS: other dynamic signaling e.g. CI, PUSCH priority for URLLC).

-        Alt2: Whether or not a slot is determined as available for UL transmissions depends on RRC configurations (at least tdd\_ul\_dl configuration, FFS: other RRC configurations) and also depends on dynamic signaling (at least SFI, FFS: other dynamic signaling e.g. CI, PUSCH priority for URLLC).

Agreements:

The maximum number of repetitions for DG-PUSCH is also applicable to CG-PUSCH.

Agreements:

For defining available slots: a slot is determined as unavailable if at least one of the symbols indicated by TDRA for a PUSCH in the slot overlaps with the symbol not intended for UL transmissions

* FFS details

Agreements:

Rel-17 PUSCH repetition Type A supports the increase of maximum number of repetitions with repetition factors configured in a TDRA list with a row index indicated either by the configured grant configuration or by TDRA field in a DCI.

* FFS: increasing the maximum number of repetitions with repetition factor configured in *PUSCH-Config* and/or *ConfiguredGrantConfig*.

**Conclusion:**

Discuss further to select one of the following alternatives:

* Alt-a: The determination of all the available slots has to be done prior to the first actual transmission of the repetitions.
* Alt-b: The determination of all the available slots does not have to be done prior to the first actual transmission of the repetitions. The timeline requirement is per repetition basis.

## Agreements in RAN1#105-e

Agreement:

* RV cycling is based on available slot for the Type A PUSCH repetition enhancement with repetitions counted based on available slot in Rel-17

Agreement:

* Down-selection in RAN1#106-e:
* Alt 1: The maximum number of repetitions supported by Rel-17 PUSCH repetition Type A is 32, irrespective of counting method,
* Alt 2: The maximum number of repetitions supported by Rel-17 PUSCH repetition Type A is: 32 for the counting based on physical slots; and 16 (i.e. no change from Rel-16) for the counting based on available slots.

**Conclusion:**

* The following agreement in RAN1#104-e is applied to all slots including special slots.

|  |
| --- |
| Agreements:  For defining available slots: a slot is determined as unavailable if at least one of the symbols indicated by TDRA for a PUSCH in the slot overlaps with the symbol not intended for UL transmissions.   * FFS details |

Agreement:

In addition to {1, 2, 3, 4, 7, 8, 12, 16} and {32}, the following additional value set for repetition factor is supported in Rel-17.

* {20, 24, 28}

Agreement:

* Each available slot identified by the UE is considered as a transmission occasion for PUSCH repetition.
  + RV is cycled across transmission occasions, irrespective of whether PUSCH transmission in the transmission occasion is further omitted or not.

Agreement:

* If PUSCH symbol in a slot overlaps with flexible symbol(s) with SSB transmission, the slot is determined as not available during the counting of repetitions. As there is no PUSCH in the slot, no PUSCH omission applies to the slot.

Agreement:

Select one from the following (further refinement of the alternatives can be further discussed), for the procedure of Rel-17 PUSCH repetition Type A (other alternatives are not precluded)

* Alt 1-B consisting of two steps
  + Step 1: Determine available slots for K repetitions based on RRC configuration(s) in addition to TDRA in the DCI scheduling the PUSCH, CG configuration or activation DCI
  + Step 2: The UE determines whether to drop a PUSCH repetition or not according to Rel-15/16 PUSCH dropping rules, but the PUSCH repetition is still counted in the K repetitions.
* Alt 1-B’ consisting of two steps
  + Step 1: Determine K repetitions based on available slots, where the available slot is the UL slot and flexible slot indicated by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*.
  + Step 2: The UE determines whether to drop a PUSCH repetition or not according to Rel-15/16 PUSCH dropping rules, but the PUSCH repetition is still counted in the K repetitions.
  + FFS: handling of dynamic signaling (e.g. UL CI, DCI for high priority channel), e.g., UE without CI capability
* Alt 2-A consisting of a single step
  + Step 1: Determine available slots for K repetitions based on RRC configuration(s) and dynamic signaling (e.g. SFI, UL CI, DCI for high priority channel) in addition to TDRA in the DCI scheduling the PUSCH, CG configuration or activation DCI
* Alt 2-B consisting of two steps
  + Step 1: Determine available slots for K repetitions based on RRC configuration(s) and dynamic SFI in addition to TDRA in the DCI scheduling the PUSCH, CG configuration or activation DCI
    - FFS timeline for the dynamic signalling
  + Step 2: The UE determines whether to drop a PUSCH repetition or not according to Rel-15/16 PUSCH dropping rules, but the PUSCH repetition is still counted in the K repetitions.

## Agreements in RAN1#106-e

Agreement:

* For Rel-17 PUSCH repetition Type A without joint channel estimation, no new inter-slot frequency hopping mechanism is introduced.

Agreement

Take Option 1-B as an agreement for the procedure of Rel-17 PUSCH repetitions counted on the basis of available slots.

* Alt 1-B consisting of two steps
* Step 1: Determine available slots for K repetitions based on RRC configuration(s) in addition to TDRA in the DCI scheduling the PUSCH, CG configuration or activation DCI
* Step 2: The UE determines whether to drop a PUSCH repetition or not according to Rel-15/16 PUSCH dropping rules, but the PUSCH repetition is still counted in the K repetitions.
* FFS: Rel-17 PUSCH dropping rules are also applied if introduced in other WI(s)

Agreement

For PUSCH repetition Type A for Rel-17 CG-PUSCH, semi-static flexible symbol is considered as available.

Agreement

For PUSCH repetition Type A for Rel-17 DG-PUSCH, semi-static flexible symbol is considered as available.

Note: The applicability for Msg 3 is to be discussed in 8.8.3

Agreement

* DCI format 0\_1 and DCI format 0\_2 support Rel-17 PUSCH repetition Type A with the increased maximum repetition numbers configured in TDRA lists.

Agreement

* For DG-PUSCH with counting based on the available slots, count of available slots continues until satisfying the conditions defined for DG-PUSCH repetition Type A in Rel-16.

Working Assumption

The maximum number of repetitions accounted for available slots supported by Rel-17 PUSCH repetition Type A is 32

## Agreements in RAN1#106bis-e

Working Assumption is confirmed

Working Assumption

The maximum number of repetitions accounted for available slots supported by Rel-17 PUSCH repetition Type A is 32

Conclusion:

For CG-PUSCH repetitions counted on the basis of available slots, all the K transmission occasions including the 1st transmission occasion are determined on the basis of available slots.

Agreement

For CG-PUSCH repetition Type A with the counting based on available slots, the R16 existing restrictions as defined in Clause 6.1.2.3.1 of TS38.214 at least on the initial transmission of a transport block are applied, assuming the K repetitions of R17 determined based the rule of counting available slots.

Observation

* Whether or not the counting based on available slots is applicable only to unpaired spectrum is not discussed under AI 8.8.1.1 in RAN1#106bis-e. Discussions on how HD-FDD RedCap UEs support the available slot counting may take place in AI 8.8.1.1 in RAN1#107-e, depending on the progress of RedCap WI discussions.