**3GPP TSG-RAN WG1 #108-e R1-22xxxxx**

**e-Meeting, February 21st – March 3rd, 2022**

**Agenda item: 8.8.1.1**

**Source: Moderator (Sharp)**

**Title: FL Summary #4 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.

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

* 1st check point: February 25
* Final check point: March 3

# Discussion

## Remaining issues

For this meeting, the following remaining issues have been raised.

* Issue#1-1: Available slot counting for DG-PUSCH scheduled by DCI format 0\_0 with other RNTI than TC-RNTI
* Issue#1-2: Available slot counting for DG-PUSCH repetition Type A with K=1
* Issue#1-3: Available slot counting for CG-PUSCH repetition Type A with K=1
* Issue#1-4: The slot indicated by K2 offset for the available slot counting (DG-PUSCH with K=1)
* Issue#1-5: The slot indicated by K2 offset for the available slot counting (DG-PUSCH with K>1)
* Issue#1-6: The slot determined in 38.321 Section 5.8.2 for the available slot counting (CG-PUSCH with K=1)
* Issue#1-7: The slot determined in 38.321 Section 5.8.2 for the available slot counting (CG-PUSCH with K>1)
* Issue#1-8: Use of SSBs across multiple TRPs for the available slot determination
* Issue#1-9: Use of SSBs of other serving cells in half duplex CA operation for the available slot determination

### [Close] Issue#1-1: Available slot counting for DG-PUSCH scheduled by DCI format 0\_0 with other RNTI than TC-RNTI

So far, we have not made any agreement on whether available slot counting is applied to DG-PUSCH scheduled by DCI format 0\_0 with other RNTIs than TC-RNTI. In the current TS38.214 [5], the behaviors related to the available slot counting is specified for DCI format 0\_1 and 0\_2 but not for DCI format 0\_0. In RAN1#107bis-e, FL made the following proposal for a possible conclusion.

|  |
| --- |
| **FL proposal:**   * A slot for PUSCH scheduled by DCI format 0\_0 with C-RNTI / CS-RNTI with NDI=1 / MCS-C-RNTI is determined by physical slots (not available slots), irrespective of whether AvailableSlotCounting is enabled or not.   + No specification impact is expected. |

Although most of the companies accepted to make this clarification, a few companies raised the concern on the relationship between this proposed conclusion and the K2 timeline.

According to the contributions for RAN1#108-e, companies views are summarized as follows.

* A slot for PUSCH scheduled by DCI format 0\_0 with C-RNTI / CS-RNTI with NDI=1 / MCS-C-RNTI is determined by physical slots (not available slots), irrespective of whether AvailableSlotCounting is enabled or not.
  + Nokia/ Nokia Shanghai Bell [7], Apple [18], CMCC [19]

To address the concern on the K2 timeline raised in the last meeting, it is clarified that Issues #1-4 and #1-5 are about PUSCH scheduled by DCI format 0\_1 or 0\_2, and also a sub-bullet saying “Note: the same K2 timeline as Rel-15/16 is applied” is added in the following proposal.

**Proposed conclusion on Issue#1-1:**

* A slot for PUSCH scheduled by DCI format 0\_0 with C-RNTI / CS-RNTI with NDI=1 / MCS-C-RNTI is determined by physical slots (not available slots), irrespective of whether AvailableSlotCounting is enabled or not.
  + Note: No specification impact is expected.
  + Note: The same K2 timeline as in Rel-15/16 is applied.

1st round (Issue#1-1)

Do you agree on the proposed conclusion on Issue#1-1?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | Agree |
| ZTE | Ok with the proposed conclusion. |
| Panasonic | Agree |
| Apple | OK with the conclusion. So, this proposal implicitly means K=1 supported for available slot counting, as DCI format 0\_0 doesn’t repetition, i.e., only supports K=1. It’s a bit overlapped with issue#1-2. |
| InterDigital | Yes. It is also fine to not make any new conclusion since this is the current status. |
| Intel | Although we do not think this is needed as AvailableSlotCounting is only applied for PUSCH repetitions, we are fine with the proposed conclusion. |
| NTT DOCOMO | We are fine with the conclusion. |
| LG | Agree |
| vivo | Fine. |
| Samsung | It is not clear this conclusion is needed. Available slot counting is for counting repetitions. |
| CMCC | Support. DCI 0\_0 with other RNTI than TC-RNTI cannot schedule PUSCH repetitions. And the available slot counting is used for the PUSCH repetitions. Then the DCI format 0\_0 scheduled slot should be determined by physical slots. |
| TCL | Agree |
| OPPO | Agree |
| CATT | Agree. |
| Ericsson | Agree |
| Spreadtrum | Agree |
| Huawei, HiSilicon | It was a RAN1 conclusion that PUSCH repetition type A cannot be scheduled by DCI format 0\_0. RRC *AvailableSlotCounting* is only applicable to PUSCH repetition type A. Therefore, we don’t feel the proposal is necessary.  For Msg3 repetitions, its retransmission may be scheduled by DCI 0\_0, but it is a different UE feature from Rel-17 PUSCH repetition type A. We cannot assume a UE capable of Rel-17 PUSCH repetition type A can be scheduled by DCI 0\_0 for PUSCH repetition type A even the UE is capable of Msg3 repetitions. |
| Nokia/NSB | Agree with Huawei/HiSilicon |

1st round summary (Issue#1-1)

The 1st round inputs are summarized as follows:

* Agree on taking the proposed conclusion on Issue#1-1
  + QC, ZTE, Panasonic, Apple, InterDigital, Intel, NTT DOCOMO, LG, vivo, CMCC, TCL, OPPO, CATT, Ericsson, Spreadtrum
* No need to make the proposed conclusion
  + Samsung, Huawei/HiSilicon, Nokia/NSB

15 companies agree on the proposals, while 5 companies do not think the proposed conclusion is necessary. It should be noted that all the companies (including the 5 companies that do not support the proposal) have the understanding that the available slot counting is not applicable to the PUSCH scheduled by DCI format 0\_0 with C-RNTI / CS-RNTI with NDI=1 / MCS-C-RNTI. Based on the above, even without making the explicit conclusion, it is observed that all the companies have the common understanding on this point. Therefore, with this observation, FL would like to close this issue without making a formal conclusion.

### [Pending] Issue#1-2: Available slot counting for DG-PUSCH repetition Type A with K=1 scheduled by DCI format 0\_1 or 0\_2

So far, we have not explicitly made any agreement on whether available slot counting is applied to DG-PUSCH with K=1 scheduled by DCI format 0\_1 or 0\_2. In RAN1#107bis-e, it was discussed whether the physical slot counting or the available slot counting is used for the case of K=1 when AvailableSlotCounting is enabled

According to the contributions for RAN1#108-e, companies’ preferences are summarized as follows:

* The available slot counting is applied for PUSCH repetition type A with K=1 scheduled by DCI format 0\_1 or 0\_2, when *AvailableSlotCounting* is enabled.
  + Nokia/ Nokia Shanghai Bell [7], OPPO [10], CMCC [19], Ericsson (for DG-PUSCH) [20], Sharp [23]
* The physical slot counting is applied for PUSCH repetition type A with K=1 scheduled by DCI format 0\_1 or 0\_2, when *AvailableSlotCounting* is enabled.
  + CATT [11], Spreadtrum [15], InterDigital [16], Ericsson (for CG-PUSCH) [20], Qualcomm [22]

Even for the behaviour captured in the current version of RAN1 specifications, different companies have different interpretations. Nokia/Nokia Shanghai Bell [7] is saying that current specification allows available slot counting for PUSCH repetition type A with K=1 because the current specification does not specify any exception in terms of available slot counting. Meanwhile, argues that the available slot transmission procedure does not apply to K=1 case, but can only be used to K>1 case, because of the following descriptions in the current specification.

|  |
| --- |
| 6.1.2.1 Resource allocation in time domain  …  For PUSCH repetition Type A, in case *K>1:*  - If the PUSCH is scheduled by DCI format 0\_1 or 0\_2  - if *AvailableSlotCounting* is enabled, the same symbol allocation is applied across the slots determined for the PUSCH transmission and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the slots determined for the PUSCH transmission, applying the same symbol allocation in each slot. |

One thing that should be noted is that, for Msg3, the following TP has been agreed in AI 8.8.3 in RAN1#107bis-e. During the discussion on the TP, it was clarified that the value range of covers 1. This is the reason why “transmits” was replaced by “repeats”. Here, the following sentence says “the UE determines the slots as the first slots starting from slot where a repetition of the PUSCH transmission does not include a symbol indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or indicated as a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*” and this statement covers the case of =1. Therefore, according to the agreed TP, once the UE requests repetition of Msg3 PUSCH, the available slot counting is applied to Msg3 PUSCH even if K=1 is signaled by RAR UL grant. Note that Qualcomm []expresses their view that, for Msg3 transmission and retransmission, the use of available slot-based counting should be restricted only to the case when number of repetitions are greater than 1.

|  |
| --- |
| 8.3 PUSCH scheduled by RAR UL grant **<Unchanged parts are omitted>**  A UE can be provided in *RACH-ConfigCommon* a set of numbers of repetitions for a PUSCH transmission with PUSCH repetition Type A that is scheduled by a RAR UL grant or by a DCI format 0\_0 with CRC scrambled by a TC-RNTI. If the UE requests repetition of PUSCH scheduled by RAR UL grant [11, TS 38.321], ~~T~~the UE transmits ~~repeats~~ the PUSCH transmission over slots, where is indicated by the 2 MSBs of the MCS field in the RAR UL grant or in the DCI format 0\_0 with CRC scrambled by the TC-RNTI, and determines a redundancy version and RBs for each repetition as described in [6, TS 38.214]. For unpaired spectrum operation, the UE determines the slots as the first slots starting from slot where a repetition of the PUSCH transmission does not include a symbol indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or indicated as a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  **<Unchanged parts are omitted>** |

1st round (Issue#1-2)

Q1: Do you agree on the following FL’s observation?

* As there are two interpretations on the current specification in terms of the slot counting method for DG-PUSCH repetition Type A with K=1 scheduled by DCI format 0\_1 or 0\_2, RAN1 has to make a clear agreement/conclusion on whether the physical slot counting or the available slot counting is applied in this case. Otherwise, mis-aligned assumptions between the UE and the network may happen in the real field.

Q2: Do you think a unified slot counting method should be applied to the following two cases?

* PUSCH repetition type A with K=1 scheduled by RAR UL grant or by DCI format 0\_0 with TC-RNTI when the UE requested repetition of the PUSCH scheduled by RAR UL grant, and
* PUSCH repetition type A with K=1 scheduled by DCI format 0\_1 or 0\_2 when AvailableSlotCounting is enabled.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | Q1: Yes, we don’t think K=1 was ever clearly discussed or clarified. It doesn’t even seem to be within the scope of this sub-agenda. A clarification/conclusion on the desired behavior is necessary.  Q2: We prefer to retain legacy behavior for the case when K=1 for DCI 0\_1 and DCI 0\_2 irrespective of availableSlotCounting being enabled or not. We think this helps UE and gNB to not have to re-implement various checks for prioritization, out-of-order scheduling, overlap resolution, A-CSI multiplexing, etc. These procedures are currently tied to the value of K2 and if this does not hold anymore, this feature has a huge impact on existing implementations for both UE and gNB. It will significantly add to implementation and IODT overhead, while bringing no gains to coverage.  Here is an example of what could happen with OoO scheduling:    Here is an example of what could happen with checks for overlapped PUSCH transmissions    Each of these checks will need to be rewritten if we don’t preserve legacy behavior for K=1. The implementation burden does not seem justified. |
| ZTE | Q1: Agree clarification is needed.  Q2: Prefer to align the two cases. As it has concluded for Msg3 repetition to apply available slot counting also for K=1, the same can be applied to PUSCH repetition type A with K=1 scheduled by DCI format 0\_1 or 0\_2. In our view, this has no additional specification impact. |
| Panasonic | Q1: Agree  Q2: Yes |
| Apple | Q1: agree  Q2: Yes |
| InterDigital | Q1: In our understanding, the current specification applies “available slot counting” even for K=1. The part conditional to K>1 is only to specify that symbol allocation is the same between the repetitions. Nevertheless, RAN1 should make agreement/conclusion on this case.  Q2: Yes. Our preference is that legacy behaviour continues to apply in all cases when K=1 and TBoMS is not enabled (N=1). |
| Intel | Q1: agree  Q2: Yes |
| NTT DOCOMO | Q1: agree  Q2: Yes |
| LG | Q1: We agree on the FL’s observation, and clarification on the UE behavior seems necessary.  Q2: We prefer to apply the legacy behavior as a unified solution. |
| vivo | Q1: Agree. But for DG PUSCH, the first slot can be controlled by the network so that it can be always available in our view. And this should be up to implementation, there should be no issue in real field.  Q2: Yes. |
| Samsung | Q1: OK to clarify, but it is up to the network to choose a proper K2.  Q2: Preferable |
| CMCC | Q1: yes and no.  From our understanding, the previous agreement is clear that K=1 is included in the available slot counting. But the current TP is not fully aligned with the agreement without decriptions of K=1.  We support the clarify this issue at this meeting.  Q2: No.  We think the Msg 3 repetition is clear. And the issue here is to solve the K=1 in the available slot counting method. As we mentioned in Q1, the agreement of the available slot counting is clear. It is not necessary to introduce other elements for reference or considerations. |
| TCL | Q1: Agree  Q2: Yes |
| OPPO | Q1: Agree.  Q2: Yes. |
| FL | @vivo and Samsung: Some network vendor thinks such restriction is not necessary from not only specification perspective but also the real operation perspective. If no clarification is made, there is a possibility that the network sets K2 offset that indicates an invalid slot for UL, while the UE assumes that never happens. |
| CATT | (1) Yes and better to clarify. Although to us, it is clearly that current Rel-17 spec does not support K=1 case (only allow K>1 transmission with available slot counting). If no further agreements achieved, by default, K=1 with available slot counting is not supported in current spec, at least for DCI format 0\_1 or 0\_2.  (2) Prefer to follow legacy behavior as Qualcomm mentioned, i.e. unified method and K=1 can only use physical slot counting. Even in AI 8.8.3, companies have very few discussion on K=1 case, since it is no much difference than legacy behavior. |
| Ericsson | Q1: The current specification on determination of available slots for DG-PUSCH can be applied to K=1 and K>1. The quoted clause for K>1 for DG-PUSCH is only about the same symbol allocated across multiple slots. Therefore, K=1 for DG-PUSCH with available slot counting is already supported in 38.214 v17.0.0. Anyway, we are fine with an agreement/conclusion if it helps the interpretation.  Q2: Yes. |
| Spreadtrum | Q1: Agree.  Q2: Yes. |
| Huawei, HiSilicon | Q1: agree  Q2: for both cases, legacy UE behavior is preferred for K=1. |
| Nokia/NSB | Q1: agree with Samsung  Q2: Not necessarily. |

1st round summary (Issue#1-2)

|  |
| --- |
| Q1: Do you agree on the following FL’s observation?   * As there are two interpretations on the current specification in terms of the slot counting method for DG-PUSCH repetition Type A with K=1 scheduled by DCI format 0\_1 or 0\_2, RAN1 has to make a clear agreement/conclusion on whether the physical slot counting or the available slot counting is applied in this case. Otherwise, mis-aligned assumptions between the UE and the network may happen in the real field.   Q2: Do you think a unified slot counting method should be applied to the following two cases?   * PUSCH repetition type A with K=1 scheduled by RAR UL grant or by DCI format 0\_0 with TC-RNTI when the UE requested repetition of the PUSCH scheduled by RAR UL grant, and * PUSCH repetition type A with K=1 scheduled by DCI format 0\_1 or 0\_2 when AvailableSlotCounting is enabled. |

The 1st round inputs are summarized as follows:

* For Q1, all the companies agree to make a clear agreement/conclusion on whether the physical slot counting or the available slot counting is applied in the case of DG-PUSCH repetition Type A with K=1 scheduled by DCI format 0\_1 or 0\_2 when AvailableSlotCounting is enabled.
* For Q2,
  + A unified solution is preferred
    - (16 companies) QC, ZTE, Panasonic, Apple, InterDigital, Intel, NTT DOCOMO, LG, vivo, TCL, OPPO, CATT, Ericsson, Spreadtrum, Huawei/HiSilicon
  + Not necessarily
    - (3 companies) CMCC, Nokia/NSB

As all the companies agree to make a clear agreement/conclusion between the physical slot counting or the available slot counting, FL suggest trying down-select between them again under Issue#1-4.

### [Pending] Issue#1-3: Available slot counting for CG-PUSCH repetition Type A with K=1

Similar to DG-PUSCH with K=1, in RAN1#107bis-e, it was discussed whether the physical slot counting or the available slot counting is used for the case of CG-PUSCH with K=1 when AvailableSlotCounting is enabled.

According to the contributions for RAN1#108-e, companies’ views are summarized as follows:

* The available slot counting is applied for PUSCH repetition type A with K=1, when *AvailableSlotCounting* is enabled.
  + Nokia/ Nokia Shanghai Bell [7], OPPO [10], CMCC [19], Sharp [23]
* The physical slot counting is applied for PUSCH repetition type A with K=1, when *AvailableSlotCounting* is enabled.
  + CATT [11], Spreadtrum [15], InterDigital [16], Ericsson [20], Qualcomm [22]

Unlike DG-PUSCH, in FL’s understanding the interpretation of behaviours for CG-PUSCH with K=1 in the current specification is quite clear. The available slot counting for CG-PUSCH is defined only for K>1 and there is no available slot counting procedure for CG-PUSCH with K=1 in the current specification. Therefore, if no specification change is agreed, then that means the physical slot counting is applied for PUSCH repetition type A with K=1, no matter *AvailableSlotCounting* is enabled.

|  |
| --- |
| For both Type 1 and Type 2 PUSCH transmissions with a configured grant, when *K >* 1*,*  - For unpaired spectrum:  - If *AvailableSlotCounting* is enabled, the UE shall repeat the TB across the slots determined for the PUSCH transmission applying the same symbol allocation in each slot.  - A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  - Otherwise, the UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.  - For paired spectrum:  - Irrespective of whether *AvailableSlotCounting* is enabled or not, the UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.  - If *AvailableSlotCounting* is enabled, and in case of reduced capability half-duplex UE, a slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*. |

1st round (Issue#1-3)

Q1: Do you agree on the following FL’s observation?

* The available slot counting for CG-PUSCH is defined only for K>1 and there is no available slot counting procedure for CG-PUSCH with K=1 in the current specification. Therefore, if no specification change is agreed, then that means the physical slot counting is applied for PUSCH repetition type A with K=1, no matter AvailableSlotCounting is enabled.

Q2: Do you think a unified slot counting method should be applied to the following two cases?

* DG-PUSCH repetition type A with K=1 scheduled by DCI format 0\_1 or 0\_2 when AvailableSlotCounting is enabled.
* CG-PUSCH repetition type A with K=1 when AvailableSlotCounting is enabled.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | Q1: Agree.  Q2: Yes, a uniform behavior is desirable. It makes it a lot easier for the gNB scheduler and also for UE implementation. We prefer to retain legacy behavior when K=1 for all cases. |
| ZTE | Q1: Agree clarification is needed.  Q2: Prefer to align the two cases. |
| Panasonic | Q1: Agree  Q2: Yes |
| Apple | Q1: we think the UE behaviour is not defined for K=1 with available slot-based counting. We need conclusion, such as physical slot counting is applied for for K=1 with available slot-based counting.  Q2: Yes |
| InterDigital | Q1: Agree. However, it also means that physical slot counting would be applied to TBoMS with K=1 and N>1, which may be against TBoMS agreement?  Q2: Yes, we prefer unified slot counting method between DG-PUSCH and CG-PUSCH. |
| Intel | Q1: Agree  Q2: it is good to have a unified solution for these two cases. |
| Panasonic | Q1: Agree  Q2: Yes |
| LG | Q1: We agree on the FL’s observation.  Q2: We prefer to apply a unified solution. |
| vivo | Q1: Yes  Q2: In our understanding, for DG PUSCH with K=1, it should be always available in a normal dynamic scheduling, meaning that one can say it’s based on either available slot or physical slot. There’s no need to align CG with DG with respect to available slot determination. |
| Samsung | Q1: Yes  Q2: ok to align, but not strictly necessary. |
| CMCC | Q1:  We are not sure the understanding is correct. We have following agreements in #107 meeting. Clearly, *repK-r17* is defined for Type 1 CG-PUSCH and Type 2 CG-PUSCH including repetition factor K=1. And *numberOfRepetitions* should also work for Type 2 CG-PUSCH. based on those agreements, the specification should be updated.  If there is any misunderstanding, please correct me.   |  | | --- | | Agreement   * Rel-17 does not support numberOfRepetitions-r17 for DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0. * *repK-r17*supporting up-to-32 repetitions is introduced and is applicable to Type 1 CG-PUSCH and Type 2 CG-PUSCH (irrespective of the activating DCI format).   + *Note: No RAN1 spec impact is expected.*   + *The possible values of repK-r17 includes 16 and 32. FFS: other values.* * *numberOfRepetitions-r17*is not applicable to Type 1 CG-PUSCH repetition type A.   Agreement   * 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#1-1   + Type-2 CG-PUSCH with Rel-17 repetition factor     Agreement   * For *repK-r17*,   + The value range of *repK-17* is {1, 2, 4, 8, 12, 16, 24, 32}.   + *repK-r17* is included in *ConfiguredGrantConfig*.   + When *repK-r17* is provided, the legacy *repK* is not provided. |   Q2: Yes, a unified behavior is desired. |
| TCL | Q1: Agree  Q2: Yes |
| OPPO | Q1: Agree.  Q2: Yes. |
| CATT | Q1: Agree.  Q2: Open to discuss. Slightly prefer unified design to make the situation simpler. |
| Ericsson | Q1: Agree  Q2: We prefer to keep the current specification. No need to align the counting method between DG-PUSCH and CG-PUSCH as they are configured/scheduled in different ways. |
| Spreadtrum | Q1: Agree.  Q2: Yes. |
| Huawei, HiSilicon | Q1: agree  Q2: for both cases, legacy UE behavior is preferred for K=1. |
| Nokia/NSB | Q1: Agree clarification is needed.  Q2: Ok to align but not strictly necessary. |
| Xiaomi | Q1: Agree  Q2: Yes |

1st round summary (Issue#1-3)

|  |
| --- |
| Q1: Do you agree on the following FL’s observation?   * The available slot counting for CG-PUSCH is defined only for K>1 and there is no available slot counting procedure for CG-PUSCH with K=1 in the current specification. Therefore, if no specification change is agreed, then that means the physical slot counting is applied for PUSCH repetition type A with K=1, no matter AvailableSlotCounting is enabled.   Q2: Do you think a unified slot counting method should be applied to the following two cases?   * DG-PUSCH repetition type A with K=1 scheduled by DCI format 0\_1 or 0\_2 when AvailableSlotCounting is enabled. * CG-PUSCH repetition type A with K=1 when AvailableSlotCounting is enabled. |

The 1st round inputs are summarized as follows:

* For Q1, almost all the companies agree on the FL’s observation.
* For Q2,
  + A unified solution is preferred
    - (15 companies) QC, ZTE, Panasonic, Apple, InterDigital, Intel, NTT DOCOMO, LG, CMCC, TCL, OPPO, CATT, Spreadtrum, Huawei/HiSilicon
  + Not necessarily
    - (5 companies) vivo, Samsung, Ericsson, Nokia/NSB

Similar to DG-PUSCH, FL suggest trying down-select for CG-PUSCH between the physical slot counting vs the available slot counting again under Issue#1-6.

### [Pending] Issue#1-4: The slot indicated by K2 offset for the available slot counting (DG-PUSCH with K=1 scheduled by DCI format 0\_1 or 0\_2)

In RAN1#107bis-e, it was discussed whether the slot indicated by K2 offset is by default an available slot or not. Companies have different views on whether the slot indicated by K2 offset shall be an available slot or not. Besides, several companies mentioned that whether the slot indicated by K2 offset shall be an available slot or not depends on whether K=1 or K>1. Furthermore, companies have different views on what behavior is captured in the current spec, e.g., some companies think it is precluded by the current spec language, some others think the current spec allows the slot to be an unavailable slot. The clarification on this point seems important, because different understanding on this point would cause mis-aligned assumptions between the UE and the network. In the last meeting, FL provided the several options for each of the combinations of DG-PUSCH/CG-PUSCH and K=1/K>1, to collect companies’ views.

In this meeting, FL assigns different issue indices for different combination of DG-PUSCH/CG-PUSCH and K=1/K>1. Under this section, we discuss the case of DG-PUSCH, when AvailableSlotCounting is enables, and for K=1.

According to the RAN1#108-e contributions, companies views are summarized as follow:

* For DG-PUSCH scheduled by DCI format 0\_1 or 0\_2, when AvailableSlotCounting is enables, and for K=1,
  + Option 1: A UE does not assume that PUSCH symbols overlap with DL symbol or SSB symbol in the slot indicated by K2 offset is the slot which is not counted in K available slot(s).
    - * CATT [11], China Telecom [13], Spreadtrum [15], Apple [18], TCL [24]
  + Option 2: A UE assumes that PUSCH symbols can overlap with DL symbol or SSB symbol in the slot indicated by K2 offset.
    - Option 2-1: When overlapping, the UE drops the PUSCH transmission in the slot indicated by K2 offset and does not perform the PUSCH transmission in later slots, either.
      * LG [25]
    - Option 2-2: When overlapping, the UE does not perform the PUSCH transmission in the slot indicated by K2 offset and performs the PUSCH transmission in the next available slot subject to PUSCH dropping rules.
      * Nokia/ Nokia Shanghai Bell [7], ZTE [9], OPPO [10], Panasonic [12], NTT DOCOMO [14], CMCC [19], Ericsson [20]

Related to this issue, Qualcomm [22] is raising an issue of Out-of-Order scheduling due to available slot counting. Considering a scenario where PDCCH received in Slot 0 schedules PUSCH in Slot 3 (using K2 offset of 3) and another PDCCH schedules a second PUSCH in Slot 4 (K2 offset of 3), this is a valid scheduling for Rel-15/16. For Rel-17, on the other hand, if Slot 3 is not an available slot for the first PUSCH transmission and the first PUSCH transmission gets deferred to Slot 4 with starting symbol later than that of the second PUSCH, then this leads to Out-of-Order.

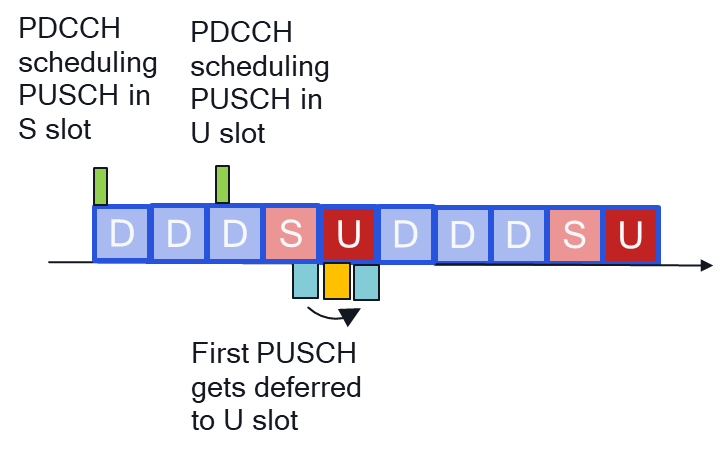


Figure 1 of R1-2202151 [22]

In the FL’s understanding, this Out-of-Order scheduling is prohibited by the following descriptions in TS38.214 [5], where in this context, the “symbol *j*” for the first PUSCH transmission is the starting symbol of PUSCH after the deferral due to the available slot counting.

|  |
| --- |
| A UE shall upon detection of a PDCCH with a configured DCI format 0\_0, 0\_1 or 0\_2 transmit the corresponding PUSCH as indicated by that DCI unless the UE does not generate a transport block as described in [10, TS38.321]. Upon detection of a DCI format 0\_1 or 0\_2 with '*UL-SCH indicator*' set to '0' and with a non-zero '*CSI request*' where the associated *reportQuantity* in *CSI-ReportConfig* set to '*none*' for all CSI report(s) triggered by '*CSI request*' in this DCI format 0\_1 or 0\_2, the UE ignores all fields in this DCI except the '*CSI request*' and the UE shall not transmit the corresponding PUSCH as indicated by this DCI format 0\_1 or 0\_2. When the UE is scheduled with multiple PUSCHs by a DCI, HARQ process ID indicated by this DCI applies to the first PUSCH not overlapping with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*, HARQ process ID is then incremented by 1 for each subsequent PUSCH(s) in the scheduled order, with modulo operation of *nrofHARQ-ProcessesForPUSCH* applied. HARQ process ID is not incremented for PUSCH(s) not transmitted if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*. For any HARQ process ID(s) in a given scheduled cell, the UE is not expected to transmit a PUSCH that overlaps in time with another PUSCH. Except for the case when a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet* for the active BWP of a serving cell and PDCCHs that schedule two non-overlapping in time domain PUSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* for any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start a first PUSCH transmission starting in symbol *j* by a PDCCH ending in symbol *i*, the UE is not expected to be scheduled to transmit a PUSCH starting earlier than the end of the first PUSCH by a PDCCH that ends later than symbol *i*. When the PDCCH candidates are associated with a search space set configured with *searchSpaceLinking*, for the purpose of determining the PDCCH ending in symbol *i*, the PDCCH candidate that ends later in time among the two configured PDCCH candidates is used. The UE is not expected to be scheduled to transmit another PUSCH by a DCI format 0\_0 with CRC scrambled by TC-RNTI, for a given HARQ process with the DCI received before the end of the expected transmission of the last PUSCH for that HARQ process if the latter is scheduled by a DCI format 0\_0 with CRC scrambled by TC-RNTI or by an UL grant in RA Response. The UE is not expected to be scheduled to transmit another PUSCH by DCI format 0\_0, 0\_1 or 0\_2 scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI for a given HARQ process with the DCI received before the end of the expected transmission of the last PUSCH for that HARQ process if the latter is scheduled by a DCI with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI. |

Spreadtrum [15] raised another interesting point that whether overlapping with DL is allowed when DCI format 2\_0 is monitored. In Rel-16, 38.213 clause 11.1.1 has the following restriction in terms of collision between DG-PUSCH and DL symbols indicated by SFI. For Rel-17, it may need to be clarified whether this restriction applies after the available slot determination or before the available slot determination. Normally, the DL symbols configured by *tdd-UL-DL-Configuration* are also indicated as DL symbols by SFI in DCI format 2\_0. Therefore, if the below restriction applies before the available slot determination, the UE does not expect the PUSCH in the slot indicated by K2 offset overlaps with DL symbols configured by *tdd-UL-DL-Configuration* when DCI format 2\_0 monitoring is configured. In contrast, if the restriction applies after the available slot determination, the UE assumes the PUSCH in the slot indicated by K2 offset can overlap with DL symbols configured by *tdd-UL-DL-Configuration*.

|  |
| --- |
| For a set of symbols of a slot, a UE does not expect to detect a DCI format 2\_0 with an SFI-index field value indicating the set of symbols in the slot as downlink and to detect a DCI format, a RAR UL grant, fallbackRAR UL grant, or successRAR indicating to the UE to transmit PUSCH, PUCCH, PRACH, or SRS in the set of symbols of the slot. |

1st round (Issue#1-4)

In the 1st round discussion, FL suggest firstly discussing the new aspects that we have not discussed yet, rather than discussing the listed options again.

Q1: Please provide your views on the above-described Out-of-Order scheduling issue.

Q2: Please provide your views on the collision handling between DG-PUSCH and DL symbols indicated by dynamic SFI.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | Q1: The above was just one example. Resolving overlapping PUSCH transmissions is another case. We believe more issues will surface as the features go through the rigors of implementation. We feel these ancillary aspects could significantly hamper this feature’s commercial deployment.  Q2: We don’t think a UE should be given such a conflicting configuration. This should remain as an error case with or without available slot counting. Any other option would require very detailed timeline discussions.  We prefer to avoid these issues by restricting the slot pointed to by K2 offset to be an available slot. We believe a vast majority of commercial BSs already adher to this principle and we prefer to formalize it. |
| ZTE | Q1: The order of order issue could be regarded as an error case.  Q2: Our understanding is the cited restriction for dynamic SFI is applied after the slot determination which is only based on semi-static configurations. |
| Panasonic | Q1: We agree to the above FL’s understanding. Second PUSCH transmission can only be scheduled after the end of the first PUSCH which includes the deferral due to the available slot counting.  Q2: The restriction should be applied after the available slot determination. |
| Apple | Q1: for the example case, we think it’s an error case, the slot for first transmission should be always available slot, which can be used for UL transmission. There is no reason that gNB schedules the first transmission on an invalid slot.  Q2: We believe this is an error case. The first dynamic grant transmission is always controllable by gNB, it doesn’t make sense to schedule the UE on invalid resources, then UE delay the transmission to next available sources which is still managed by gNB. |
| InterDigital | Q1: The signaling does not prevent potential out-of-order issue in R15/R16 either. It is up to the network to avoid this case.  Q2: Prefer to keep the same as legacy behaviour for K=1 and N=1. In our understanding this corresponds to Option 2-1. There is no need to identify this as an error case in the specs. |
| Intel | Q1: We think it depends on whether to consider the first slot indicated by K2 is available slot.  Q2: Our view is that dynamic SFI is applied after the available slot determination in the 2-step approach. |
| NTT DOCOMO | Q1: We agree to FL understanding. On the other hand if these issues (e.g. Q1/Q2) bring difficulty for UE implementation, we may understand they can be error cases. |
| LG | Q1: In our view, out-of-order issue may be avoided by the network, since available slots are determined based on semi-static configurations. However, it seems make the issue clear not to postpone the PUSCH transmission slot for K=1.  Q2: The restriction should be applied after the available slot determination. |
| vivo | The transmission of different PUSCH transmissions are up to network implementation to make sure the scheduling is in order as specified in NR Rel-15/16 specification in our understanding.  It seems not necessary to discuss the legacy collision rules to be applied for an actual PUSCH transmission here either. |
| Samsung | Q1: Scheduling issues can be avoided by the network.  Q2: This case is also a scheduling issue that the network can handle. |
| CMCC | Q1: the out of order scheduling issue should be an error case. As gNB has the full information of the available slot and the scheduling behind, it should not schedule any transmission which may induce an out of order scheduling. |
| TCL | Q1: We think the out-of-order issue can be avoided by gNB, anyway, the network could ensure the slot for the first transmission is available slot.  Q2: We think dynamic SFI is applied after the available slot determination. |
| OPPO | Q1: We agree to FL’s understanding, out-of-order issue may be avoided by the network.  Q2: The restriction should be applied after the available slot determination. |
| CATT | Q1: Considering that Rel-15/16 rules are based on physical slot counting, some clarification will help. We are OK if we can conclude that ‘the “symbol *j*” for the first PUSCH transmission is the starting symbol of PUSCH after the deferral due to the available slot counting’, so the out-of-order issue is resolved.  Q2: We think the current spec prohibits conflicted configuration between two dynamic signals (i.e. SFI and scheduling DCI). We are OK if we can conclude that the legacy rule is applied after available slot counting. So such collision is avoided. |
| Ericsson | Q1: The non-out-of-order rule applies to PUSCH repetition based on available slots. The actual PUSCH transmission is used to determine 'the end of the first PUSCH' if it is postponed.  Q2: FL provides interpretations regarding the restriction is applied before and after the first step.  We would like to clarify the impact of the restriction on step 2.  For DG-PUSCH with K=1, if the restriction applies after the available slot determination, does it apply before the second step? If so, it prevents the collision between a DL slot indicated by dynamic SFI and the determined available slot. In other words, the flexible symbols which are considered as an available slot in the first step should not be indicated as DL by dynamic SFI, if any.  To answer the question if the slot indicated by K2 offset is always an available slot, we also need to consider no dynamic SFI case. |
| Spreadtrum | Q1: We think it’s an error case and can be avoided by gNB.  Q2: We share the view with QC and Apple. We think it is an error case if PUSCH symbols overlapping with DL symbol or SSB. For DL symbol configured by tdd-UL-DL-ConfigurationCommon or tdd-UL-DL-ConfigurationDedicated, and these DL symbols cannot be scheduled to transmit DG-PUSCH. The gNB performs the first transmission on the time slot indicated by K2. |
| Nokia/NSB | Q1: In our view, PUSCH transmissions can be handled by the network to make sure the scheduling is in order and that the slot for first transmission is always an available slot.  Q2: This also seems a scheduling issue that network can handle. |

1st round summary (Issue#1-4)

|  |
| --- |
| Q1: Please provide your views on the above-described Out-of-Order scheduling issue.  Q2: Please provide your views on the collision handling between DG-PUSCH and DL symbols indicated by dynamic SFI. |

* For Q1, the large majority thinks that it should be assumed that the gNB schedules DG-PUSCHs such that Out-of-Order does not happen even with the available slot counting.
* For Q2, the large majority thinks that it should be assumed that the gNB schedules DG-PUSCHs such that it does not collide with DL symbols indicated by SFI even with the available slot counting. In addition, 7 companies (ZTE, Panasonic, Intel, LG, TCL, OPPO, CATT) agrees on that the restriction that no collision between DG-PUSCH and DL indicated by SFI is expected should be applied after the available slot determination. In fact, this aspect is not much related to K2 timeline discussion. FL suggests looking into a bit more details later for the case that DCI 2\_0 is monitored.

Based on the above, FL would like to make the following proposal.

**FL proposal on Issue#1-4:**

* It should be assumed that the gNB schedules DG-PUSCHs such that Out-of-Order does not happen even with the available slot counting.

2nd round (Issue#1-4)

Q1: Provide your comment only if you have a strong concern on the above FL proposal on Issue#1-4.

Q2: Do you agree on that, when checking A-CSI reference resource identification, the slot indicated by K2 offset needs to be valid for UL.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | Q1: While its good that companies assume that OoO issues should be handled by the gNBs, this doesn’t address the underlying concern. Not mandating that the slot indicated by K2 offset to be an available slot means that K2 can no longer be used to determine the start of a PUSCH transmission. Legacy UE (and gNB, we assume) implementations rely on K2 parameter to carry out checks for cancellation, prioritization, multiplexing, etc. This entire logic will now be impacted. The feature has a very large footprint on UE uplink operations as a consequence. We feel this will hamper commercializing this feature especially in TDD bands where it might be most useful.  While we are okay with the proposal, what we want is for the slot pointed to by K2 offset to be an available slot.  Q2: The point we were trying to make here is that CSI multiplexing requires looking back from the slot where PUSCH transmission occurs to figure out which CSI resource is to be used as a reference. K2 is used to determine this. If K2 points to an invalid slot, then once again this procedure too is impacted.  Also, as an aside, we see that for the case where we have A-CSI multiplexing on PUSCH without UL-SCH payload, the slot for transmission continues to be specified using K2 (See Section 6.1.2.1 in 38.214). Do we then assume that available slot counting does not apply to this case?  This then once again leads to divergent behavior depending on whether there is a transport block to transmit or not.  Not guaranteeing the slot pointed to by the K2 offset to be an available slot leads to unnecessary additional UE complexity, with no benefit to the network. We think such a configuration should be barred. |
| vivo2 | Q2: A-CSI multiplexing on PUSCH is performed first and collision handling is performed in a second step in our understanding, so A-CSI reference resource identification does not have to consider the validation. |
| CMCC | Share similar view as vivo. |
| LG | Q2: If the slot indicated by K2 cannot be available and the first slot of PUSCH transmission is postponed in that case, the slot for A-CSI reporting also should be postponed in our view. If this behavior causes other problems, it seems better to assume the slot indicated by K2 is available always. |
| Nokia/NSB | Q2: aligned with Vivo. |
| Intel | Q1: for FL proposal on Issue#1-4, our understanding is that even if the slot indicated by K2 is not available slot for whatever reason gNB decides to do so, we should still need to ensure that OOO handling is determined based on the slot indicated by K2 value. This would help ensure the same timeline checking at UE side without changing the implementation.  Q2: we share similar view as Vivo. |
| InterDigital | Q2: what Vivo suggests seems reasonable. However, there may specification impact in section 5.2.2.5 of 38.214 because the CSI reference resource there is referred to the uplink slot in which PUSCH transmission takes place. To avoid this impact, it may be ok to require that first slot is available for the DG case. |
| Ericsson | Q2: Agree with vivo. A-CSI reference resource identification doesn’t affect if the slot indicated by K2 offset is available or not. |
| Samsung | Q2: same understanding as vivo and others above. |
| Spreadtrum | Q1: We support the proposal. While if K =1, K2 can only be an available slot would be no problem for OoO.  Q2: Yes, it should be a valid slot. We do not agree with vivo. Because the determination of CSI reference resource is based on “a CSI reporting in uplink slot *n'*”, not the slot indicated by K2. So A-CSI multiplexing on PUSCH is performed later than determine the PUSCH slot. There is no problem if the slot indicated by K2 is an available slot.   |  | | --- | | 38214 clause 5.2.2.5 CSI reference resource definition  In the time domain, the CSI reference resource for a CSI reporting in uplink slot *n'* is defined by a single downlink slot *n*-*nCSI\_ref*, | |

2nd round summary (Issue#1-4)

|  |
| --- |
| Q1: Provide your comment only if you have a strong concern on the above FL proposal on Issue#1-4.  Q2: Do you agree on that, when checking A-CSI reference resource identification, the slot indicated by K2 offset needs to be valid for UL. |

The 2nd round inputs are summarized as follow:

* For Q1, there was no objection to the FL proposal on Issue#1-4. On the other hand, Intel raised another point that we should still need to ensure that OoO handling is determined based on the slot indicated by K2 value. If this is required and if the slot indicated by K2 offset can be unavailable for UL, then the scheduler has to take case of two different OoO handling – one is OoO handling before deferral and the other is OoO handling after deferral, and the UE also needs two different OoO checks.
* For Q2, 3 companies (QC, LG, Spreadtrum) see the issue for A-CSI reference resource identification from the UE complexity perspective, and 1 company (InterDigital) see some specification impact on CSI reference resource definition. Meanwhile, 7 companies (vivo, CMCC, Nokia/NSB, Intel, Ericsson, Samsung) do not see any issue for A-CSI reference resource identification.
* 1 company (QC) raised another point that which counting method is applied to PUSCH without UL-SCH when AvailableSlotCounting is enabled, and whether a unified counting method is applied to the PUSCH with UL-SCH with K=1 and the PUSCH without UL-SCH.

As several companies identified some UE complexity increase if the UE needs to handle the deferral of PUSCH transmission from the slot indicated by the K2 offset, FL would like to suggest taking the following proposal.

**Updated FL proposal on Issue#1-4:**

* For DG-PUSCH scheduled by DCI format 0\_1 or 0\_2, when AvailableSlotCounting is enabled, and for K=1,
  + The UE does not expect that the PUSCH symbols in the slot indicated by K2 offset overlap with DL symbol or SSB symbol.
    - FFS: Whether this restriction is captured in the specification.
    - Note: With this restriction, there is no difference between the physical slot counting and the available slot counting for DG-PUSCH with K=1.

FL suggests continuing the discussion under Section 2.1.10.

### [Pending] Issue#1-5: The slot indicated by K2 offset for the available slot counting (DG-PUSCH with K>1 scheduled by DCI format 0\_1 or 0\_2)

Under this section, we discuss the case of DG-PUSCH, when AvailableSlotCounting is enables, and for K>1.

According to the RAN1#108-e contributions, companies views are summarized as follow:

* For DG-PUSCH scheduled by DCI format 0\_1 or 0\_2, when AvailableSlotCounting is enables, and for K>1,
  + Option 1: A UE does not assume that the slot indicated by K2 offset is the slot which is not counted in K available slot(s).
    - * Spreadtrum [15], Apple [18], Qualcomm [22]
  + Option 2: A UE assumes that the slot indicated by K2 offset can be the slot which is not counted in K available slot(s).
    - * Nokia/ Nokia Shanghai Bell [7], ZTE [9], OPPO [10], Panasonic [12], China Telecom [13], NTT DOCOMO [14], CMCC [19], Ericsson [20], LG [25]

Samsung [21] expresses their view that the slot indicated by K2 is subject to the same conditions as any other slot when available slot counting is enabled, however a gNB would indicate a value of K2 so that the indicated slot is an available slot and the PUSCH transmission can be actually transmitted in that slot, similar to Rel-15/16.

Panasonic [12], Ericsson [20] and Sharp [23] have the understanding that, in Rel-15/16 PUSCH repetitions, there is no restriction that the slot indicated by K2 offset needs to be valid for the PUSCH transmission. On the contrary, TS38.213 Clause 11.1 [4] defines the collision handling rule between DG-PUSCH and DL/SSB symbols as the following.

|  |
| --- |
| For a set of symbols of a slot that are indicated to a UE as downlink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, the UE does not transmit PUSCH, PUCCH, PRACH, or SRS when the PUSCH, PUCCH, PRACH, or SRS overlaps, even partially, with the set of symbols of the slot.  For a set of symbols of a slot that are indicated to a UE as flexible by *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* if provided, the UE does not expect to receive both dedicated higher layer parameters configuring transmission from the UE in the set of symbols of the slot and dedicated higher layer parameters configuring reception by the UE in the set of symbols of the slot.  For operation on a single carrier in unpaired spectrum, for a set of symbols of a slot indicated to a UE by *ssb-PositionsInBurst* in *SIB1* or *ssb-PositionsInBurst* in *ServingCellConfigCommon*, for reception of SS/PBCH blocks, the UE does not transmit PUSCH, PUCCH, PRACH in the slot if a transmission would overlap with any symbol from the set of symbols and the UE does not transmit SRS in the set of symbols of the slot. The UE does not expect the set of symbols of the slot to be indicated as uplink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, when provided to the UE. |

1st round (Issue#1-5)

Q: Please provide your views on Rel-15/16 UE’s assumptions for Rel-15/16 DG-PUSCH with K>1.

* Assumption #1: Rel-15/16 UEs may consider the case of overlapping between PUSCH symbols in the slot indicated by K2 offset and DL symbols as an unspecified error case.
* Assumption #2: Rel-15/16 UEs need to assume that overlapping between PUSCH symbols in the slot indicated by K2 offset and DL symbols may occur.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | Not sure what “unspecified error case” means, but we would like the slot indicated by K2 to be an available slot. Without this, checks for OoO scheduling A-CSI reference resource identification, etc, will need to be discussed and re-implemented.  A question for companies suggesting that K2 offset could point to an unavailable slot, what is the benefit of this? Why is the base station not able to ensure such a thing does not occur? |
| ZTE | Assumption #2. Agree that the collision is allowed and dropping behavior is specified according to the cited spec texts.  Regarding QC’s question, our understanding is it depends on the available K2 values for scheduling. It is possible that gNB cannot find a proper K2 value to avoid collision for the first repetition in TDD, with also considering the available PDCCH transmission occasions. In addition, even gNB can avoid the collision for the first repetition in some cases with a proper K2, it may not be able to avoid collisions for the rest of repetitions. Possibly, it may cause more collisions due to ensure the first repetition is available. |
| Panasonic | Assumption #2 |
| Apple | Assumption#1. We are not so sure what is gNB intention to do so. The UL transmission is not delayed to next slot, only result is UE drop the scheduled UL transmission and the UL grant is wasted. |
| InterDigital | Assumption #2. For DG there is no reason why the network would do this, but for the CG case it may be a bit restrictive for the network to disallow it. We prefer same behaviour for CG and DG. |
| Intel | Assumption #2. This seems similar to the discussion for the first PUCCH repetition. |
| NTT DOCOMO | Assumption #2. |
| LG | Assumption #2. |
| vivo | Assumption #2. |
| Samsung | The network would indicate a K2 value that schedules a transmission in a slot where the transmission can actually be possible. |
| CMCC | Assumption #2. |
| TCL | Assumption #2. |
| OPPO | Assumption #2. |
| CATT | Although we agree that the spec does not limit K2 slot must be a valid one, we do feel it is natural for a gNB to indicate a valid slot to the UE as the starting position.  For PUCCH repetitions with K>1, as far as we know, Rel-16 clarifies that the 1st PUCCH can be in an unavailable slot (mainly due to it is already counted by available slot), but the group does not achieve common understanding whether it is also applied to Rel-15.  So literately, Assumption#2 is interpreted. Nevertheless, even if we cannot agree the legacy behavior in Rel-15/16, we still have a chance to take Assumption#2 for Rel-17 PUSCH available slot counting, right? |
| Ericsson | Assumption #2. |
| Spreadtrum | Assumption#1.There is no reason for gNB to schedule an unavailable slot for the slot indicated by K2 offset. Because, K2 range is large enough e.g. from 0 to 32, so it can find a suitable slot for the PUSCH transmission. Therefore, the slot indicated by K2 offset is an available slot on which DG-PUSCH symbols cannot overlap with DL symbols. |
| Nokia/NSB | Assumption #2. In general, it is reasonable to assume that network would indicate a K2 value that schedules a transmission in a slot where the transmission is possible. |

1st round summary (Issue#1-5)

The 1st round inputs on Rel-15/16 UE’s assumptions for Rel-15/16 DG-PUSCH with K>1 are summarized as follows:

* Assumption #1: Rel-15/16 UEs may consider the case of overlapping between PUSCH symbols in the slot indicated by K2 offset and DL symbols as an unspecified error case.
  + QC, Samsung, Spreadtrum
* Assumption #2: Rel-15/16 UEs need to assume that overlapping between PUSCH symbols in the slot indicated by K2 offset and DL symbols may occur.
  + ZTE, Panasonic, InterDigital, Intel, NTT DOCOMO, LG, vivo, CMCC, TCL, OPPO, CATT, Ericsson, Nokia/NSB

In terms of Rel-15/16 UE’s assumptions for Rel-15/16 DG-PUSCH with K>1, it seems the majority of the companies consider Assumption#2 while 3 companies have different understanding. QC raised the concern that, in order to check A-CSI reference resource identification, the slot indicated by K2 offset needs to be a valid slot for UL.

It also seems that the discussion point is the same as for Issue#1-4. Therefore, it is suggested having technical discussions (including A-CSI reference resource identification aspect) under Issue#1-4 to avoid duplicated discussions.

### [Pending] Issue#1-6: The slot determined in 38.321 Section 5.8.2 for the available slot counting (CG-PUSCH with K=1)

Under this section, we discuss the case of CG-PUSCH, when AvailableSlotCounting is enables, and for K=1.

According to the RAN1#108-e contributions, companies views are summarized as follow:

* For CG-PUSCH, when AvailableSlotCounting is enables, and for K=1,
  + Option 1: A UE does not assume that PUSCH symbols overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2.
  + Option 2: A UE assumes that PUSCH symbols can overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2.
    - Option 2-1: When overlapping, the UE drops the PUSCH transmission in the slot determined in 38.321 Section 5.8.2 and does not perform the PUSCH transmission in later slots, either.
      * China Telecom [13], Ericsson [20], TCL [24], LG [25]
    - Option 2-2: When overlapping, the UE does not perform the PUSCH transmission in the slot determined in 38.321 Section 5.8.2 and performs the PUSCH transmission in the next available slot subject to PUSCH dropping rules.
      * Nokia/ Nokia Shanghai Bell [7], ZTE [9], OPPO [10], Panasonic [12], NTT DOCOMO [14], CMCC [19], Sharp [23]

It seems all the companies that express their views on this issue in their contributions prefer taking Option 2. Therefore, FL made the following proposal. If this proposal is agreeable, then the remaining issue for CG-PUSCH with K=1 is the decision between Options 2-1 and 2-2, which is highly correlated with Issue#1-3.

**FL proposal on Issue#1-6:**

* For CG-PUSCH, when AvailableSlotCounting is enables, and for K=1, a UE assumes that PUSCH symbols can overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2.

1st round (Issue#1-6)

Do you agree on the above FL proposal on Issue#1-6?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Support |
| Panasonic | Agree |
| InterDigital | Agree. For K=1 and CG-PUSCH (and N=1) we prefer Option 2-1. |
| Intel | Just clarify: is there any spec impact for this? |
| NTT DOCOMO | Agree. |
| LG | Agree |
| vivo | Same comment as for issue 1-4. |
| QC | What is the benefit of such a configuration? Why cant the gNB point to an available slot in Section 5.8.2?  If we are relaxing this, there needs to be a strong justification. |
| CMCC | To FL should this proposal is for K=1 not K>1 ?  **FL proposal on Issue#1-6:**   * For CG-PUSCH, when AvailableSlotCounting is enables, and for K>1, a UE assumes that PUSCH symbols can overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2. |
| TCL | Agree. |
| OPPO | Agree. |
| FL | @CMCC and All:  I noticed a typo “K>1” in the proposal, which is corrected to be “K=1”. Thanks, CMCC, for spotting the typo!  @QC:  At least my understanding is that Rel-15/16 allows the network to configure CG-PUSCH with K=1 with CG period equal to 14 symbols (i.e., 1 slot) for any TDD configuration such as “DDSUU”. In this case, the slot determined in Section 5.8.2 is any slot including “D” slot, but the UE does not transmit CG-PUSCH in “D” slot, because of the rule defined in 38.213 Section 11.1. The consequence of this configuration is that the UE can start the CG-PUSCH transmission at any UL slot. |
| CATT | OK with K=1 CG-PUSCH case (with the typo corrected). |
| Ericsson | Agree the revised FL proposal |
| Spreadtrum | Agree |
| Huawei, HiSilicon | If a gNB would have to ensure all PUSCH symbols in CG configurations not to overlap with any DL symbol or SSB symbol, then it would have been not necessary to introduce the feature enabled by *AvailableSlotCounting* in the first place*.*  A clarification may be needed, whether the PUSCH symbols in the proposal refer to the symbols in the first configured slot of a CG periodicity. |
| Nokia/NSB | Agree. Option 2-2 as per above list is the best course of action in our view. |

1st round summary (Issue#1-6)

Almost all the companies accepted the following proposal. To move one-step forward (i.e., precluding Option 1), FL suggests taking the following proposal. As for the comment raised by Intel and vivo, spec impact can be discussed as part of down selection between Options 2-1 and 2-2. As for the clarification question by Huawei, “the slot determined in 38.321 Section 5.8.2” is the first configured slot in a CG period. More specifically, it means the slot which contains “the symbol” determined in 38.321 Section 5.8.2 (see the excerpt below).

|  |
| --- |
| 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. |

**FL proposal on Issue#1-6:**

* For CG-PUSCH, when AvailableSlotCounting is enables, and for K=1, a UE assumes that PUSCH symbols can overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2.

Note that the selection from Options 2-1 (i.e. the physical slot counting) and 2-2 (i.e. the available slot counting) is equivalent to Issue#1-3, therefore further down-selection will be discussed under Issue#1-3.

2nd round (Issue#1-6)

Q1: Provide your comment only if you have a strong concern on the above FL proposal on Issue#1-6.

Q2: For CG-PUSCH, when AvailableSlotCounting is enables, and for K=1, select one from the following:

* Option 2-1 (physical slot counting with PUSCH dropping): When PUSCH symbols overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2, the UE drops the PUSCH transmission in the slot and does not perform the PUSCH transmission in later slots of the same CG period, either.
* Option 2-2 (available slot counting): When PUSCH symbols overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2, the UE does not perform the PUSCH transmission in the slot and performs the PUSCH transmission in the next available slot of the same CG period subject to PUSCH dropping rules.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Panasonic | Q2: Our preference is Option 2-2 and a unified slot counting method should be applied to “DG-PUSCH with K=1 when AvailableSlotCounting is enabled” and “CG-PUSCH with K=1 when AvailableSlotCounting is enabled”. |
| Xiaomi | Q1:agree FL proposal  Q2: prefer option 2-2. Because AvailableSlotCounting is enabled, so slot counting based on available slot should be performed when the original slot is unavailable. |
| QC | Q1: Why does a UE have to deal with such configurations? What is the benefit? This seems like a careless configuration by the gNB. We don’t see any benefit to such configurations.  Q2: We don’t think K=1 is within the scope of the WI. We prefer to go with Option 2-1. |
| vivo2 | Fine. |
| FL | @QC,  Let me echo my previous comment. Let’s assume DDSUU configuration. How can the R15 gNB fully utilize UL slots for CG-PUSCH with K=1? In order to achieve this, the R15 gNB can configure CG periodicity set to 1-slot length. This is not a careless configuration but an appropriate configuration which enables full use of the UL slots. Therefore, R15 UE capable of CG has to be able to deal with a collision between CG-PUSCH with K=1 and DL symbols. |
| CMCC | Q1: support  Q2: option 2-2. Following the agreements of the available slot counting, option 2-2 is correct understanding. |
| LG | Q2: We prefer Option 2-1.We’d like to apply the legacy rule for DG/CG-PUSCH for K=1. |
| CATT | Q1: OK.  Q2: Option 2-2 is slightly prefer. Can live with Option 2-1. |
| Nokia/NSB | Q1: agree with FL proposal. Please note that there is a typo similar to **FL proposal on Issue#1-7**, i.e., enables 🡪 enabled.  Q2: Option 2-2 is our preference. |
| Intel | Q1: we do not support the proposal.  Our understanding is that counting based on available slot is only applied for the case for PUSCH repetitions, i.e., K > 1. For single slot CG-PUSCH or DG-PUSCH transmission, we do not apply available slot counting, which is not aligned with the scope in the WID. |
| InterDigital | Q1: support proposal in principle. However, does the condition “K=1” include TBoMS with N>1? If this is intended to non-TBoMS case (N=1) this should be clarified.  Q2: prefer 2-1 to keep consistent behaviour with R15/R16 when K=1 and N=1. |
| FL | @Intel,  Thanks for the feedback on Q1. The proposal is not saying that the available slot counting is used for CG-PUSCH with K=1. Q1 is to ask whether to introduce the configuration restriction that the gNB has to configure CG resources and TDD configuration such that the CG resouce in any CG period does not overlap with DL symbols.  On the contrary, when the overlapping happens to CG-PUSCH with K=1, whether the physical slot counting (i.e., option 2-1) or the available slot counting (i.e., option 2-1) is applied would be the next discussion point.  Hope the above clarifies the intention.  @InterDigital,  Thanks. Yes, your understanding is correct. This discussion is not intended to cover TBoMS. The clarifications on TBoMS should be discussed under AI 8.8.1.2. |
| Ericsson | Q1: support FL proposal.  Q2: Option 2-1 is preferred. It is aligned with current specification. |
| Samsung | Q2: Option 2-1.  **FL proposal on Issue#1-6 +**Option 2-1 seems to be equivalent to not supporting available slot counting with K=1. Would it be better to simply agree whether or not to support available slot counting with no repetition (for DG-PUSCH/CG-PUSCH)? |
| Spreadtrum | Q1: Agree  Q2: Option 2-1. The Rel-17 specification doesn’t include available slot counting procedure for CG-PUSCH with K=1. We prefer Option 2-1 to reuse Rel-15/16 counting method based on physical slots. |
| OPPO | Q1: Support.  Q2: We prefer option 2-2. |

2nd round summary (Issue#1-6)

The 2nd round inputs are summarized as follows:

* For the FL proposal on Issue#1-6, only 2 companies (QC and Intel) expressed strong concerns.

FL proposal on Issue#1-6:

* + For CG-PUSCH, when AvailableSlotCounting is enables, and for K=1, a UE assumes that PUSCH symbols can overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2.
* As for further down-selection, the slight majority prefers Option 2-1, i.e., the physical slot counting, although the number of supporting companies are close to even.
  + Option 2-1 (physical slot counting with PUSCH dropping): When PUSCH symbols overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2, the UE drops the PUSCH transmission in the slot and does not perform the PUSCH transmission in later slots of the same CG period, either.
    - (8 companies) QC, LG, CATT (can live with), Intel(?), InterDigital, Ericsson, Samsung, Spreadtrum
  + Option 2-2 (available slot counting): When PUSCH symbols overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2, the UE does not perform the PUSCH transmission in the slot and performs the PUSCH transmission in the next available slot of the same CG period subject to PUSCH dropping rules.
    - (7 companies) Panasonic, Xiaomi, CMCC, CATT, Nokia/NSB, OPPO

For CG-PUSHC with K=1, considering the slight majority prefer the physical slot counting and also it is more aligned with what the current specification captures, FL’s recommendation is to take the physical slot counting. In addition, the physical slot counting is the legacy behavior, FL suggests reusing the legacy UE assumption and not having further discussions on whether or not the UE assumes that PUSCH symbols can overlap with DL symbol or SSB symbol in the slot determined in 38.321 Section 5.8.2.

**Updated FL proposal on Issue#1-6:**

* For CG-PUSCH with K=1, when AvailableSlotCounting is enabled, the legacy counting method (i.e., the physical slot counting) is applied.
  + Note: No RAN1 spec impact is expected.
  + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1.

FL suggests continuing the discussion under Section 2.1.10.

### [Pending] Issue#1-7: The slot determined in 38.321 Section 5.8.2 for the available slot counting (CG-PUSCH with K>1)

Under this section, we discuss the case of CG-PUSCH, when AvailableSlotCounting is enables, and for K=1.

According to the RAN1#108-e contributions, companies views are summarized as follow:

* For CG-PUSCH, when AvailableSlotCounting is enables, and for K>1,
  + Option 1: A UE does not assume that the slot determined in 38.321 Section 5.8.2 is the slot which is not counted in K available slot(s).
  + Option 2: A UE assumes that the slot determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slot(s).
    - * Nokia/ Nokia Shanghai Bell [7], ZTE [9], OPPO [10], Panasonic [12], China Telecom [13], NTT DOCOMO [14], CMCC [19], Ericsson [20], Sharp [23], LG [25]

It seems all the companies that express their views on this issue in their contributions prefer taking Option 2. Therefore, FL made the following proposal.

**FL proposal on Issue#1-7:**

* For CG-PUSCH, when AvailableSlotCounting is enables, and for K>1, a UE assumes that the slot determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slot(s).

1st round (Issue#1-7)

Do you agree on the above FL proposal on Issue#1-7?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Support |
| Panasonic | Agree |
| InterDigital | Agree |
| Intel | Just clarify: what is the difference between Issue 1-6 and 1-7? And what is the spec impact for this? |
| NTT DOCOMO | Agree. |
| LG | Agree |
| vivo | Fine. |
| QC | What is the benefit of such a configuration? Why can’t the gNB point to an available slot in Section 5.8.2?  If we are relaxing this, there needs to be a strong justification. |
| CMCC | Support. |
| TCL | Agree. |
| OPPO | Agree. |
| FL | @Intel:  Once we reach the consensus on the intended behavior, the next step would be the discussion on the spec impact.  @QC:  Let me raise another example. In Rel-15/16 38.214 Section 6.1.2.3.1 says that, for CG-PUSCH, the initial transmission of a transport block may start at any of the transmission occasions of the K repetitions if the configured RV sequence is {0,0,0,0}. Here the first transmission occasion corresponds to the slot determined in 38321 Section 5.8.2. In other words, even in Rel-15/16, the CG-PUSCH repetitions do not always start at the slot determined in 38321 Section 5.8.2, for example in the case when the collision occurs at the first slot. |
| CATT | OK. |
| Ericsson | Agree |
| Spreadtrum | Agree |
| Huawei, HiSilicon | Similar comment as to issue#1-6, the proposal may need some refinement. |
| Nokia/NSB | Agree. |

1st round summary (Issue#1-7)

Almost all the companies accepted the following proposal. Therefore, FL suggests taking the following proposal.

**FL proposal on Issue#1-7:**

* For CG-PUSCH, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slot(s).

2nd round (Issue#1-7)

Provide your comment only if you have a strong concern on the above FL proposal on Issue#1-7.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | What is the benefit to such a relaxation? Why is the gNB not able to configure the UE appropriately?  @FL to your comment directed at us: R15/R16 didn’t have the concept of deferral. A late start is not the issue here. I am trying to understand why the gNB is configuring the UE is such a way in the first place. Cant this be resolved at the gNB itself? |
| Vivo2 | Just one editorial comment:  **FL proposal on Issue#1-7:**   * For CG-PUSCH, when AvailableSlotCounting is enable~~s~~d, and for K>1, a UE assumes that the slot determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slot(s). |
| FL | @QC,  Thanks for the response. I’m glad to know that we have the same understanding that in R15/16 the late start was not the problem for CG-PUSCH. I guess that also means R15/16 gNB is allowed to configure in such a way the first configured slot in a CG period overlaps with a DL slot, and R15/16 UEs assume such configurations may happen.  In fact, I understand your concern on K2 timeline for DG-PUSCH, because R15/16 gNB normally set a suitable K2 value so that the scheduled PUSCH does not collide with DL. However, CG-PUSCH is a different story. R15/16 gNB does not have to always avoid collision between CG-PUSCH and DL by configurations. I’m wondering why we need to force R17 gNB to ensure no collision? We didn’t have such configuration restrictions in R15/16.  @vivo,  Thanks for spotting the typo! Now fixed. |
| Nokia/NSB | Agree |
| InterDigital | Agree in principle. One question is this should also apply to K=1, N>1 (TBoMS case without repetition)?  Agree with FL that it would be constraining to guarantee availability for CG-PUSCH. |
| Ericsson | Agree. One editorial comment is that since K>1, the brackets of ‘slot(s)’ can be removed. |
| Spreadtrum | We are fine to support the proposal. |

2nd round summary (Issue#1-7)

The 2nd round inputs are summarized as follows:

* For the FL proposal on Issue#1-7, only 1 company (QC) expressed a strong concern.

FL proposal on Issue#1-7:

* + For CG-PUSCH, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slots.

Given the large majority supports the FL proposal on Issue#1-7, FL would like to ask QC to be flexible to make a progress.

**FL proposal on Issue#1-7:**

* For CG-PUSCH, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot (i.e., the first configured slot in a CG period) determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slots.

FL suggests continuing the discussion under Section 2.1.10.

### [Pending] Issue#1-8: Use of SSBs across multiple TRPs for the available slot determination

In NR Rel-17 feMIMO WI, it was agreed to support different SSB sets with different PCIs transmitted from mTRPs in a same serving cell. In RAN1#107-e and RAN1#107bis-e, we discussed whether to consider more than one SSB sets for available slot counting for CovEnh. After several rounds of discussions during RAN1#107bis-e, the following conclusion was made, because most of the companies had the same understanding that the MIMO group did not have much discussions on the collision handling between UL channels/signals and multiple SSBs for inter-cell mTRPs and duplicated discussions in two different WIs should be avoided.

|  |
| --- |
| **Conclusion**   * The CovEnh discussion on the available slot counting for inter-cell mTRPs is deferred until further progress on the collision handling between UL channels/signals and multiple SSBs for inter-cell mTRPs is made in feMIMO session. |

For RAN1#108-e, vivo [8] is proposing having discussions to downselect from the following three options.

* Option 1: SSBs with PCI different from the serving cell PCI are only used for actual PUSCH repetition determination after the available slots are determined
* Option 2: Both SSBs with serving cell PCI and SSBs with PCI different from the serving cell PCI are used for the available slot determination
* Option 3: SSBs with the same PCI as the SSB used to determine the spatial relation of the PUSCH, are used to determine the available slots. Other set of SSBs are used for actual PUSCH repetition determination after the available slots are determined.

Also, Ericsson [20], Samsung [21] and WILUS [26] are proposing taking Option 2 above.

However, considering the conclusion that we made in the last meeting and feMIMO discussion status, FL would like to not discuss this issue in this meeting, unless any progress is made in feMIMO WI.

### [Close] Issue#1-9: Use of SSBs of other serving cells in half duplex CA operation for the available slot determination

For CA case, the collision handling is performed according to following text in the same section of 38.213 v17.0.0.

|  |
| --- |
| If a UE  - is configured with multiple serving cells and is provided with *directionalCollisionHandling-r16* = 'enabled' for a set of serving cell(s) among the multiple serving cells, and  - indicates support of *half-DuplexTDD-CA-SameSCS-r16* capability, and  - is not configured to monitor PDCCH for detection of DCI format 2\_0 on any of the multiple serving cells,  for a set of symbols of a slot that are indicated to the UE for reception of SS/PBCH blocks in a first cell of the multiple serving cells by *ssb-PositionsInBurst* in *SystemInformationBlockType1* or by *ssb-PositionsInBurst* in *ServingCellConfigCommon*, when provided to the UE, the UE does not transmit PUSCH, PUCCH, or PRACH in the slot if a transmission would overlap with any symbol from the set of symbols, and the UE does not transmit SRS in the set of symbols of the slot in  - any of the multiple serving cells if the UE is not capable of simultaneous transmission and reception as indicated by *simultaneousRxTxInterBandCA* among the multiple serving cells, and  - any one of the cells corresponding to the same band as the first cell, irrespective of any capability indicated by *simultaneousRxTxInterBandCA*. |

In RAN1#107bis-e, it was discussed whether SSBs in the other serving cells than the one where the PUSCH is transmitted is considered or not for available slot determination for the Type A PUSCH repetition transmissions. Since there was no company which propose changing the currently captured the available slot counting procedure, FL provided the following proposal for a possible conclusion.

|  |
| --- |
| **Proposed conclusion:**   * For half duplex CA operation, no additional spec impact is necessary in terms of consideration of SSB(s) for the available slot determination. |

The above conclusion was not taken in the last meeting, because one company did not think the conclusion is necessary. However, the large majority supported the proposed conclusion. Moreover, even the company who did not think making this conclusion is necessary also think that no additional spec impact is necessary.

In RAN1#108-e, vivo [8] is proposing making a conclusion that only the SSBs transmitted within the serving cell are considered for available slot determination for the Type A PUSCH transmissions if CA is configured.

However, based on the situation in the last meeting, without any conclusion, it seems to be commonly understood that the current specification already teaches that, for half duplex CA operation, only the SSBs transmitted within the serving cell are considered for available slot determination for the Type A PUSCH transmissions. Therefore, FL would like to suggest keeping this issue closed.

### [Open] Issues#1-2 to #1-7: Behaviors when AvailableSlotCounting is enabled

During the 1st and 2nd round discussions on Issues#1-2 to #1-7, we had very good discussions and clarifications in terms of the behaviors when AvailableSlotCounting is enabled. As described in the 2nd round summaries on Issue#1-4, Issue#1-6 and Issue#1-7, FL has made the following proposals, considering all the inputs during the 1st and 2nd rounds.

**Updated FL proposal on Issue#1-4:**

* For DG-PUSCH scheduled by DCI format 0\_1 or 0\_2, when AvailableSlotCounting is enabled, and for K=1,
  + The UE does not expect that the PUSCH symbols in the slot indicated by K2 offset overlap with DL symbol or SSB symbol.
    - FFS: Whether this restriction is captured in the specification.
    - Note: With this restriction, there is no difference between the physical slot counting and the available slot counting for DG-PUSCH with K=1.

**Updated FL proposal on Issue#1-6:**

* For CG-PUSCH with K=1, when AvailableSlotCounting is enabled, the legacy counting method (i.e., the physical slot counting) is applied.
  + Note: No RAN1 spec impact is expected.
  + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1.

**FL proposal on Issue#1-7:**

* For CG-PUSCH, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot (i.e., the first configured slot in a CG period) determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slots.

For each of the proposal, it may not be aligned with some company’s preference for the respective case. However, FL believes that all the above proposals as a package could be some level of middle-ground compromise among companies’ preferences. For example, the restriction on the overlapping between the first PUSCH repetition and DL/SSB symbols would apply to DG-PUSCH but not to CG-PUSCH. Therefore, FL would encourage companies to consider if the set of proposals as a package is acceptable. Note that this set of proposal also resolve Issue#1-2 and Issue#1-3 as well.

**FL proposal on Issues#1-2 to #1-7:**

* For DG-PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, when AvailableSlotCounting is enabled, and for K=1,
  + The UE does not expect that the PUSCH symbols in the slot indicated by K2 offset overlap with DL symbol or SSB symbol.
    - FFS: Whether this restriction is captured in the specification.
    - Note: With this restriction, there is no difference between the physical slot counting and the available slot counting for DG-PUSCH with K=1.
* For CG-PUSCH repetition Type A with K=1, when AvailableSlotCounting is enabled, the legacy counting method (i.e., the physical slot counting) is applied.
  + Note: No RAN1 spec impact is expected.
  + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1.
* For CG-PUSCH repetition Type A, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot (i.e., the first configured slot in a CG period) determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slots.

3rd round (Issues#1-2 to #1-7)

Please provide your views on whether the above FL proposal on Issues#1-2 to #1-7 as a package is acceptable. If you would like more clarification, please also provide your comment in the table below.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CMCC | Thanks for FL’s great efforts.  For the 1st sub-bullet under the 1st bullet, as we commented before, no matter the K=1 or K>1, the UE should assume the K2 indicated slot may overlapped with DL or SSB. For even legacy single slot PUSCH scheduling, there is no such assumption that UE will not expect the overlap between PUSCH and DL or SSB symbols. As mentioned in 38.213, UE will not transmit the PUSCH if overlapped. We are not sure it should be an assumption when even AvailableSlotCounting is enabled.  As we have the following agreements, the available slot should be the earliest K available slot no earlier than the slot indicated by K2 offset. Even the K2 indicated slot is conflict with DL or SSB, there would be PUSCH transmission according to current agreement.    For the 2nd bullet, we cannot understand how can we get such a conclusion. According to our understanding, the K factor of available slot for even CG-PUSCH contains K=1. Then all the slots should be determined based on the available slot determination. How can we use the physical slot counting ?  As we commented in the 1st round of issue #1-3, the agreements from #107e meeting are listed below, especially the highlighted part.  In the 2nd agreement, all the following combinations support the counting based on available slot. The combination includes DG-PUSCH, Type 1and Type 2 CG-PUSCH with Rel-17 repetition factors.  And in the 1st agreement, repK-r17 is applicable to both Type 1 and Type 2 CG-PUSCH. And in the 3rd agreement, repK-r17 contains K=1.  **We DO have the agreement that K=1 can be used for CG-PUSCH and the available slot is configured, although the TP does not capture it.**  Then what we should do is to follow the agreements and update the TP, Not reverse the agreement based on the in process TP.    We have no problem for the 3rd bullet.  Sorry for the long reply and if I mis-understand something. |
| Ericsson | Regarding the first bullet (updated FL proposal on Issue#1-4), we don’t think the restriction on slot indicated by K2 offset is necessary.  When a UE receives a DCI which triggers A-CSI report and schedules a PUSCH transmission with available slot counting enabled and K=1, the UE determines an available slot for the PUSCH transmission, which may be later than K2, and then identify the CSI-RS for CSI reporting in the available slot. The determination of available slot and CSI-RS identification is done immediately after UE receives the DCI. This timing relation has no impact on PUSCH preparation time or CSI computation time. For PUSCH based on available slots with K>1, CSI-RS identification is based on CSI reporting in the first determined available slot.  In addition, ‘the slot indicated by K2 offset can be the slot which is not counted in K available slots.’ has no RAN1 spec impact for both K=1 and K>1.  We are fine with the other two bullets, i.e., updated FL proposal on Issue#1-6 and FL proposal on Issue#1-7. |
| FL | @CMCC,  Thanks for the explanation. I understand your intention that K in the agreement should be considered to cover the value “1”. At the same time, there are some others who do not think the agreement intended to cover K=1. Please remember the 1st and 2nd round discussions. Their argument could be something like that the agreement said “K earliest available slots” which means K>1. I would say we should admit there are two interpretations of the agreement, though that is very unfortunate. When making the agreement, I should have made it clearer whether it covers K=1 or not. Sorry for that. But, again, there are now two parties which have different interpretations. This kind of situation always happens at the CR phase. In this situation, just repeating one interpretation is not so much constructive. Let’s focus on what behaviour would be more appropriate and/or what the specification impact is.  As for CG, the agreement you refer to says all the combination support the available slot counting. However, that does not mean those combinations shall always use the available slot counting. Now we are doing a kind of fine tuning, such as defining of exceptional cases.  Therefore, I’m sure that what we are discussing here does not revert the previous agreements.  @Ericsson,  Thanks for your view. Let me clarify a little bit more why I made this set of proposals as a package. In the 1st and 2nd round discussions, some companies said the configuration restriction should apply to both DG and CG, while some others argued no restriction is necessary for DG and CG. So, I was trying to find out some middle-ground compromise. When I think of more details, I observed the following:  - For DG with K=1, the proper gNB scheduler does not schedule a single-slot PUSCH such that it collides with DL. I know the spec does not have such a restriction, but I believe the actual scheduling is done in such a way. Therefore, that restriction would not lead to additional burden at the network side. On the other hand, for DG-PUSCH, the UE has to determine the slot for PUSCH after detecting DCI. Additional information for the determination would cause some level of increased burden from the processing point of view. Therefore, for DG, considering the restriction would help the UE processing and has no impact on the network.  - For CG, such a restriction would lead to additional difficulty to come up with proper configurations of CG periodicity and TDD/SSB at the network side. Meanwhile, the UE is provided all the necessary information (such as CG periodicity, TDD conf, SSB conf) by the network far prior to the CG period, irrespective of whether the restriction is adopted or not. Therefore, not adopting the restriction would help the gNB’s configurations and does not cause additional processing burden at the UE side. |
| vivo4 | First bullet, scheduling an unavailable slot for single repetition or for first repetition can be treated as an error case, and no specification impact is needed, it’s up to UE to decide whether read the dedicated signalling or not though this is not necessary.  2nd bullet, we’re basically fine with the proposed text, suggest removing “RAN1”, no spec. impact is expected in either RAN1 or RAN2 or other RAN groups.  3rd bullet, it’s enough to simply say that the determination is the same as NR Rel-16 and no spec. impact is expected, there’s no need to mention the details on whether the slot is available or whether it can be one not counted.  Given all the proposals have no spec. impact in our view, we would like to have an updated conclusion instead if all companies think such conclusion is necessary. We’re also fine to not have any conclusion on these proposals if companies cannot converge.   |  | | --- | | **FL ~~proposal~~ conclusion on Issues#1-2 to #1-7:**   * For DG-PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, when AvailableSlotCounting is enabled, and for K=1, network can schedule a PUSCH always available, it’s up to UE to decide whether to skip reading the *AvailableSlotCounting* signaling, no spec. impact is expected.   + ~~The UE does not expect that the PUSCH symbols in the slot indicated by K2 offset overlap with DL symbol or SSB symbol.~~     - ~~FFS: Whether this restriction is captured in the specification.~~     - ~~Note: With this restriction, there is no difference between the physical slot counting and the available slot counting for DG-PUSCH with K=1.~~ * For CG-PUSCH repetition Type A with K=1, when AvailableSlotCounting is enabled, the legacy counting method (i.e., the physical slot counting) is applied.   + Note: No ~~RAN1~~ spec. impact is expected.   + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1. * For CG-PUSCH repetition Type A, when AvailableSlotCounting is enabled, and for K>1, ~~a UE assumes that~~ the determination of a slot (i.e., the first configured slot in a CG period) ~~determined~~ in 38.321 Section 5.8.2 is the same as NR Rel-16, no spec impact is expected~~can be the slot~~ ~~which is not counted in K available slots~~. | |
| LG | We support the FL proposal on Issues#1-2 to #1-7. |
| CATT | Thanks FL for the great effort. Really appreciate.  As mentioned before, we think:   * Current Rel-17 spec has only specified *transmission* of available slot counting with *K>1* (although *determination* has no limit). * Available slot counting is aiming at improving coverage. Hence, K=1 is not its targeted case, at least not the main goal.   With this in mind, we support FL’s combined proposal. This is almost the safest choice there is no impact to the current Rel-17 spec (which only specifies K>1 case for transmission).  BTW, if there is a deadlock in clarifying Rel-15/16 behavior (i.e. whether Rel-15/16 behavior is (1) UE does not expect overlapping, or (2) overlapping may happen but the PUSCH is dropped), we may consider following update for the 1st bullet, borrowing the same spirit of 2nd bullet:   |  | | --- | | * For DG-PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, when AvailableSlotCounting is enabled, and for K=1, the legacy counting method (i.e., the physical slot counting) is applied,   + ~~The UE does not expect that the PUSCH symbols in the slot indicated by K2 offset overlap with DL symbol or SSB symbol.~~     - ~~FFS: Whether this restriction is captured in the specification.~~   + Note: With this restriction, there is no difference between the physical slot counting and the available slot counting for DG-PUSCH with K=1. |   All we need to know is that, there is no difference in Rel-17 for K=1.  If we can agree on ‘(1) UE does not expect overlapping is the correct understanding for Rel-15/16’, we are of course fine. |
| InterDigital | The FL proposal seems to be a reasonable compromise to us.  However, we need to specify that this is for non-TBoMS case only since the specification allows N>1 and K=1. Suggest the following addition. We could discuss later what happens if N>1.  At least for the case when TB is transmitted over a single slot (N=1):   * For DG-PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, when AvailableSlotCounting is enabled, and for K=1,   + The UE does not expect that the PUSCH symbols in the slot indicated by K2 offset overlap with DL symbol or SSB symbol.     - FFS: Whether this restriction is captured in the specification.     - Note: With this restriction, there is no difference between the physical slot counting and the available slot counting for DG-PUSCH with K=1. * For CG-PUSCH repetition Type A with K=1, when AvailableSlotCounting is enabled, the legacy counting method (i.e., the physical slot counting) is applied.   + Note: No RAN1 spec impact is expected.   + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1. * For CG-PUSCH repetition Type A, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot (i.e., the first configured slot in a CG period) determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slots. |
| Intel | Thanks FL for the great effort.  Our understanding is that we first need to decide whether AvailableSlotCounting is supported for single-slot PUSCH transmission with K = 1. As we mentioned previously, it is not clearly stated in the WID.  If we can agree this is supported, we think vivo’s update is aligned with our view. We do not intend to change Rel-15/16 behavior for DG/CG-PUSCH with K = 1, even when AvailableSlotCounting is enabled. For K > 1, there is no need to change the existing spec. |
| Spreadtrum | We agree with the FL's point of view. We are fine with the FL proposal on Issues#1-2 to #1-7.  For DG-PUSCH repetition Type A with K=1, the gNB can find a suitable slot for PUSCH transmission, which can be directly indicated to the UE by the K2 offset. However, for CG-PUSCH, it is configured periodically and the network cannot guarantee that PUSCH transmission will not collide with downlink symbols or SSB symbols. There is no need to impose restrictions on CG periodicity configurations. |
| QC | Thanks FL for trying to find common ground across companies.  We want to echo Intel’s comment to say that whether AvailableSlotCounting is applicable to the case when K=1 needs to be decided.  We think that restricting it to only apply to K > 1 is a reasonable choice --- this is a coverage enhancement WI, and the case where K=1 is not our primary focus. I think this is what CATT and a few other companies are proposing as well.  Therefore, we are okay to revise the first proposal to state that “For DG-PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, when K=1, physicalSlotCounting is applied.” (or any equivalent language).  We think a similar consideration can be applied to CG-PUSCH as well (this is how the spec is written currently anyway and the second bullet reinforces this).  On the question of K2 offset, and whether 38.321 Section 5.8.2 should point to an available slot, we are open to discuss further. We would really like to be able to have some guarantees at least for DG-PUSCH.  @Ericsson, our concern is not really about meeting timeline or not having enough time to compute CSI. Our concern is that every process in the spec that is currently tied to K2 requires a more careful handling. K2 is a rather fundamental parameter and is quite heavily used to apply various prioritization, collision handling and multiplexing rules. It leads to a lot of overhead before this feature can be commercialized. We prefer to have the new features self-contained to the largest extent possible so that their impact on legacy procedures is minimal. If K2 can point to invalid slots, then a lot of UE tx procedures will need revisions.  @FL: To summarize, we are okay to amend the first proposal to make it more acceptable to all companies, i.e., we restrict available slot counting to K >1 and not make a mention of K2 offset here.  Second proposal is okay to us.  On third proposal, we are okay to compromise, assuming that we will have a discussion on K2 offset when K > 1 for DG-PUSCH. |
| Samsung | Issue#1-4: The network will try to schedule the PUSCH transmission in a proper slot. We don’t see a need to constraint the K2 value in the specifications.  Issue#1-6: Support the proposal. Since it is equivalent to not supporting available slot counting with K=1, it may be reworded to clearly state that.  Issue#1-7: Support the proposal. As we understand it, there is no restriction for the first slot in each configured period being an available or unavailable slot, and it does not seem to require any specification change. |
| CMCC3 | @FL  It is unfortunate if FL feel that we are just repeating our interpretation and being not constructive. I posted the agreements for the first time just because we would like to remind the group we already had the agreements and the agreement is targeted for a behavior. Though it is not captured clearly in the spec. Normally we should fix the spec, because the agreements are the foundations of the specification.  But when we checked after the 1st round, there was literally NO response. And the 2nd round was pended where we posted our observations and other agendas are turned to other issues. However, it was still confusing us whether we, the group, have the same understanding about the agreements. That is why we posted it a second time. You may notice that there are still comments from companies that “whether AvailableSlotCounting is supported for single-slot PUSCH transmission with K = 1”.  Now it is more clear that the part not captured in the spec provides a chance for the group to remove/update some unwanted behavior. We have no problem if it seems a clear trend and if we have further agreements to amend this.  And Thanks to FL you finally provide some responses.  If we are on the same page, we have no problem with CATT’s updates for the 1st bullet. And we are also fine with the original 2nd bullet, as we proposed in the previous rounds a unified solution should be applied to CG and DG. |
| FL | @vivo,  Thanks for the suggestions. Regarding the spec impact on the 2nd bullet, we RAN1 should not make any decision on the other WG’s spec impact. Similarly, your suggested change on the 3rd bullet looks like talking about spec impact on RAN2 spec. For the FL perspective, that is not so appropriate.  @CMCC,  Thanks for the response. I saw some companies clearly mentioned that K=1 was not in the scope. Also, I stated, in the beginning of the section 2.1.2 in this document and also in the FL summary for the last meeting, “So far, we have not explicitly made any agreement on whether available slot counting is applied to DG-PUSCH with K=1 scheduled by DCI format 0\_1 or 0\_2.” So, I was assuming that obviously there had been the opinion that the previous agreement did not cover K=1 case. Probably, I should have clarified it as a response to CMCC’s input.  On the other hand, I would say “it is more clear that the part not captured in the spec provides a chance for the group to remove/update some unwanted behavior” in you comment is not correct. Any agreement that we have made has to be respected in terms of the spec updates. There could be some room for further discussions only if it is identified that there are multiple interpretations on the agreement or if some critical problem on the agreement is identified in the group.  @All,  Based on the feedback, I updated the proposal as the following. Your additional feedbacks are more than welcome.  **Updated FL proposal on Issues#1-2 to #1-7:**   * For DG-PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, when AvailableSlotCounting is enabled, and for K=1, the legacy counting method (i.e., the physical slot counting) is applied,   + Note: The legacy assumption on the K2 offset is applied, i.e., no RAN1 spec impact on the K2 offset is expected. * For CG-PUSCH repetition Type A with K=1, when AvailableSlotCounting is enabled, the legacy counting method (i.e., the physical slot counting) is applied.   + Note: No RAN1 spec impact is expected.   + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1. * For CG-PUSCH repetition Type A, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot (i.e., the first configured slot in a CG period) determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slots.   + Note: No RAN1 spec impact is expected.   + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1. |
| ZTE | We have sympathy with CMCC. The following agreements stated that available slot counting supports for **Rel-17 repetition factor** which includes K=1 according to other agreements. This should be clear. On the other hand, if the majority wants to revert previous agreement by reusing legacy behavior for K=1, we can also live with it to move forward, though it would imply dynamic switching between two counting method would be supported.  Agreement   * 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#1-1   + Type-2 CG-PUSCH with Rel-17 repetition factor |
| vivo5 | Thank for FL’s great effort and further clarifications.  If we reuse rules of Rel-15/16, we do not see any spec. impact is necessary, which is why we do not think it necessary to mislead RAN2 or any other groups and implicitly indicate that some RAN2 impacts may be still needed to optimize legacy UE behaviour on PUSCH transmissions based on available slot.  Some questions on the updated FL proposal:   1. For first bullet of FL updated proposal, is the intention to change the spec. to preclude K=1 case for available slot determination compared to v17.0.0? 2. For the 3rd bullet, is the intention to say that the first slot of CG PUSCH repetitions may be postponed?   If the answer is yes to above questions, we propose to have a simple conclusion instead, where to ease FL concern that we may be doing work for other RAN groups, I try to include “from RAN1 perspective”. In future, if companies do see some alignment CRs are needed for this conclusion, we can further discuss this later.  **Conclusion:**  NR Rel-16 UE behaviour is expected for first slot determination for PUSCH repetition transmissions based on available slot introduced in NR Rel-17, no spec. impact is expected from RAN1 perspective.  Based on discussions on several proposals and the combined proposal so far, it seems most of companies agree that no optimization is necessary for first repetition timing resource determination. Considering this is coverage enhancement topic, we should not focus too much effort on optimizations on single repetition or first repetition counting no matter whether it’s CG or DG and whether the repetition factor is 1 or >1. |
| Ericsson | Regarding the note of the first bullet ‘The legacy assumption on the K2 offset is applied’, it seems companies diverge on what the legacy assumption is. We would like to know if we will discuss DG-PUSCH with K>1 in terms of gNB scheduling restriction or the legacy assumption on K2 offset. |
| CATT | We are fine with the proposal. To Ericsson, we afraid that it is not an easy job to reach consensus here in a Rel-17 maintenance meeting, which seems more related to a Rel-15/16 CR. |
| FL | @ZTE,  Thank you for the feedback. “DG-PUSCH with Rel-17 repetition factor supports the available slot counting” does not necessarily mean “the available slot counting shall be used for every single case of DG-PUSCH with Rel-17 repetition factor”. Defining some exceptional case does not revert the previous agreement.  @vivo,  Thanks for the questions.  For the 1st question, according to the 1st round summary on Issue#1-2, all the companies see the need to make an agreement/conclusion on whether the physical slot counting or the available slot counting is applied to DG-PUSCH with K=1. The reason is that companies have different interpretations on the counting method for K=1 in the current version of the spec. In this sense, the conclusion you suggested above is not sufficient. Once we made a decision on the counting method for K=1, it would be more straightforward to capture what we agree on. But it depends on companies’ views. When we make a decision on the counting method, I will ask a question whether/how to capture it in the spec.  For the 2nd question, yes, your understanding is aligned with mine.  @Ericsson,  Thanks. I tend to agree with CATT. Although I have checked companies’ understanding on R15/16 during the 1st round on Issue#1-5, further discussion on R15/16 in this AI 8.8.1.1 would not be a good approach. |

3rd round summary (Issues#1-2 to #1-7)

The 3rd round discussion is summarized as follows:

* For the original proposal:
  + Support the proposal
    - * LG, Spreadtrum
  + Support the 2nd/3rd bullet points in principle
    - For the 1st bullet point, prefer clarifying the available slot counting is applied to DG-PUSCH with K=1, and no K2 timeline restriction is adopted
      * Ericsson
    - For the 1st bullet point, prefer clarifying the physical slot counting is applied to DG-PUSCH with K=1, and the legacy K2 timeline assumption is reused
      * CATT, Intel, QC
    - For the 1st bullet point, prefer clarifying no spec impact, since the gNB sets a proper K2 offset value
      * vivo, Samsung
  + For the DG-PUSCH with K=1, it’s up to UE to decide whether to skip reading the AvailableSlotCounting signaling
    - * vivo
  + Prefer clarifying differentiation from TBoMS
    - * InterDigital
  + The proposal on DG-PUSCH with K=1 is not in line with the previous agreements
    - CMCC, ZTE

4th round (Issues#1-2 to #1-7)

**Updated FL proposal on Issues#1-2 to #1-7:**

* For DG-PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, when AvailableSlotCounting is enabled, and for K=1, the legacy counting method (i.e., the physical slot counting) is applied,
  + Note: The legacy assumption on the K2 offset is applied, i.e., no RAN1 spec impact on the K2 offset is expected.
* For CG-PUSCH repetition Type A with K=1, when AvailableSlotCounting is enabled, the legacy counting method (i.e., the physical slot counting) is applied.
  + Note: No RAN1 spec impact is expected.
  + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1.
* For CG-PUSCH repetition Type A, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot (i.e., the first configured slot in a CG period) determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slots.
  + Note: No RAN1 spec impact is expected.
  + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1.

FL would like collect more views on the updated FL proposal on Issues#1-2 to #1-7. Please provide your comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | As we have mentioned in our Tdoc, further discussion on modifying K2 offset for available slot counting is not required in the current specification. We see ZTE concern on contradiction with previous agreements. In order to avoid any misunderstanding and creating any contradictions with previous agreements, the main focus has been on identifying available slot counting determination in DG-PUSCH when K=1, which basically is the same as for legacy method. For the sake of compromise, we can agree with the FL proposal with the following modifications:  For DG-PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, the legacy counting method applies when K=1, regardless of whether AvailableSlotCounting is enabled or not~~, and for K=1, the legacy counting method is applied,~~   * + Note: The legacy assumption on the K2 offset is applied, i.e., no RAN1 spec impact on the K2 offset is expected. * For CG-PUSCH repetition Type A, , the legacy counting method applies when K=1, regardless of whether AvailableSlotCounting is enabled or not ~~with K=1, when AvailableSlotCounting is enabled, the legacy counting method (i.e., the physical slot counting) is applied~~.   + Note: No RAN1 spec impact is expected.   + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1. * For CG-PUSCH repetition Type A, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot (i.e., the first configured slot in a CG period) determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slots.   + Note: No RAN1 spec impact is expected.   + Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1. |
| Intel | Although we still believe that AvailableSlotCounting is not applied for the case when K = 1 for both DG and CG-PUSCH, we can accept this to move forward. The update from Nokia is preferred.  For the last note, if this is for K = 1, it is not clear to us how this is related to the third bullet with K > 1. Suggest to delete it.   * For CG-PUSCH repetition Type A, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot (i.e., the first configured slot in a CG period) determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slots.   + Note: No RAN1 spec impact is expected.   ~~Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1.~~ |
| QC | Okay with edits proposed by Nokia and Intel. |
| Panasonic | Although 1st and 2nd bullet is not our preference, we can live with the proposal. The update from Nokia and Intel are fine. |
| LG | We support the proposal with Nokia’s modification. |

## Correction proposals

For this meeting, the following proposals for corrections on Rel-17 RAN1 specifications have been raised.

* Issue#2-1: Corrections on frequency hopping
* Issue#2-2: Corrections on available slot counting for FDD
* Issue#2-3: Corrections on PUSCH repetition type A for multi-TRP operation

### [Open] Issue#2-1: Corrections on frequency hopping

In RAN1#107bis-e, the issue for TS38.214v17.0.0 [5] was raised, which was that, for PUSCH repetition type A frequency hopping, the current descriptions limit the PUSCH is scheduled by DCI format 0\_1 or 0\_2, RAR UL grant or DCI format 0\_0 with TC-RNTI. However, intra-slot frequency hopping is also applicable to a single slot PUSCH transmission, for example, the case when PUSCH is scheduled by DCI format 0\_0 with C-RNTI. After several rounds of discissions, the following three options were provided by FL [1].

Option 1: Adopt TP#1

|  |
| --- |
| **TP#1** 6.3.1 Frequency hopping for PUSCH repetition Type A and for TB processing over multiple slots For PUSCH repetition Type A scheduled by DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI, DCI format 0\_1 or 0\_2 and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *onfiguredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission. |

Option 2: Adopt TP#2

|  |
| --- |
| **TP#2** 6.3.1 Frequency hopping for PUSCH repetition Type A and for TB processing over multiple slots For PUSCH repetition Type A other than the PUSCH scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *onfiguredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission. |

Option 3: Adopt TP#3

|  |
| --- |
| **TP#3** 6.3.1 Frequency hopping for PUSCH repetition Type A and for TB processing over multiple slots For PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH) and for PUSCH scheduled by DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI, a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *onfiguredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission.  For operation with shared spectrum channel access, the UE does not expect that two hops of a PUSCH transmission are in different RB sets.  In case of resource allocation type 2, the UE transmits PUSCH without frequency hopping.  In case of resource allocation type 1, whether or not transform precoding is enabled for PUSCH transmission, the UE may perform PUSCH frequency hopping, if the frequency hopping field in a corresponding detected DCI format or in a random access response UL grant is set to 1, or if for a Type 1 PUSCH transmission with a configured grant the higher layer parameter *frequencyHoppingOffset* is provided, otherwise no PUSCH frequency hopping is performed. When frequency hopping is enabled for PUSCH, the RE mapping is defined in clause 6.3.1.6 of [4, TS 38.211].  For a PUSCH scheduled by RAR UL grant, fallbackRAR UL grant, or by DCI format 0\_0 with CRC scrambled by TC-RNTI, frequency offsets are obtained as described in clause 8.3 of [6, TS 38.213]. Otherwise, for a PUSCH scheduled by DCI format 0\_0/0\_1 or a PUSCH based on a Type2 configured UL grant activated by DCI format 0\_0/0\_1 and for resource allocation type 1, frequency offsets are configured by higher layer parameter *frequencyHoppingOffsetLists* in *pusch-Config*. For a PUSCH scheduled by DCI format 0\_2 or a PUSCH based on a Type2 configured UL grant activated by DCI format 0\_2 and for resource allocation type 1, frequency offsets are configured by higher layer parameter *frequencyHoppingOffsetListsDCI-0-2* in *pusch-Config*.  - When the size of the active BWP is less than 50 PRBs, one of two higher layer configured offsets is indicated in the UL grant.  - When the size of the active BWP is equal to or greater than 50 PRBs, one of four higher layer configured offsets is indicated in the UL grant. |

According to the contributions for RAN1#108-e, companies’ views are summarized as follows:

* No TP is necessary, which means that the “Frequency hopping flag” field in DCI format 0\_0 with C-RNTI is used to indicate whether ‘Intra-slot frequency hopping’ is enabled irrespective of the RRC parameter *frequencyHopping* in *pusch-Config*.
  + Huawei/HiSilicon [6]
* Discuss whether the RRC parameter *frequencyHopping* in *pusch-Config* is applied to the PUSCH scheduled by DCI format 0\_0 with C-RNTI
  + CMCC [19]
* Adopt TP#1
  + ZTE [9], CATT [11]
* Adopt TP#2
  + Vivo [8], Sharp [23]
* Adopt TP#3
  + Nokia/ Nokia Shanghai Bell [7], Intel [17], Apple [18], Samsung [21]

1st round (Issue#2-1)

Q: Please provide your views on which is Rel-15/16 FH behavior for the PUSCH scheduled by DCI format 0\_0 with C-RNTI.

* Behavior #1: When Rel-15/16 UEs determine whether to perform intra-slot frequency hopping, the UEs refer to the frequency hopping flag field value in the DCI format 0\_0 and ignore the RRC parameter *frequencyHopping* provided in *pusch-Config*.
* Behavior #2: When Rel-15/16 UEs determine whether to perform intra-slot frequency hopping, the UEs refer to both the RRC parameter *frequencyHopping* provided in *pusch-Config* and the frequency hopping flag field value in the DCI format 0\_0.
* Any other behaviors?

Note that, in any case, for the frequency hopping of the PUSCH scheduled by the DCI format 0\_0 with C-RNTI, the Rel-15/16 UEs refer to both the RRC parameter *frequencyHoppingOffsetLists* in *pusch-Config* and frequency domain resource assignment field value in the DCI format 0\_0 for the determination of frequency offsets.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Behavior #2  In Rel-16, the RRC parameter *frequencyHopping* also applies to DCI format 0\_0. Therefore, if it is configured by inter-slot FH, the UE would ignore the frequency hopping flag field in DCI. Otherwise, whether to perform intra-slot FH is based on the indication of frequency hopping flag field in DCI. |
| Panasonic | In RAN1#101e, there is the following conclusion.  [R1-2003594](file:///C:\Users\4035140\AppData\Local\Docs\R1-2003594.zip) was rejected for Rel-15.  **Conclusion**  Draft CR in [R1-2003594](file:///C:\Users\4035140\AppData\Local\Docs\R1-2003594.zip) is rejected for Rel-15 with the following understanding   1. For a PUSCH scheduled by a DCI format 0\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI or CS-RNTI, the frequency hopping field in the DCI format 0\_0 is not expected to be set to 1 if frequencyHopping in PUSCH-Config is not provided or set to interSlot. 2. For Type 2 CG PUSCH activated by DCI format 0\_0 with CRC scrambled by CS-RNTI, the frequency hopping field in the DCI format 0\_0 is not expected to be set to 1 if frequencyHopping in referredGrantConfig is not provided or set to interSlot.   It seems the Rel.15/16 FH behaviour for the PUSCH scheduled by DCI format 0-0 with C-RNTI is neither Behavior #1 nor Behavior #2. |
| Intel | Behavior #1. For PUSCH scheduled by DCI format 0\_0 with C-RNTI, only intra-slot frequency hopping is supported. In this case, *frequencyHopping* is not applied. UE only needs to check frequency hopping flag field value in the DCI format 0\_0 |
| vivo | Since there’s no repetition supported for PUSCH scheduled by DCI0-0 with C-RNTI which means only intra-slot FH can be applied in such case, it’s not necessary for UE to read FH type indication in *pusch-Config*.  So, behavior #1 seems enough. |
| CMCC | Behavior #2.  Our understanding is when UE initial access to the NW without RRC configurations, FH in DCI format 0\_0 should also work. When the RRC connection is established, the RRC parameter *frequencyHopping* in *pusch-Config* should not conflict with DCI 0\_0 scheduling. DCI 0\_0 can only scheduling PUSCH without repetition, then the inter-slot frequency hopping should not be configured.  TP#3 is our preference since it is more clear that PUSCH repetition cannot be scheduled by DCI 0\_0. |
| FL | Thanks, Panasonic, for digging out the past CR discussion! Looking at the conclusion in RAN1#101-e, indeed picking one option from Behaviors #1 and #2 does not seem a very good approach. I will bring another discussion point in the next round. |
| CATT | According to the information from Panasonic, it seems Behavior#1 is incorrect. But Behavior#2 is also incomplete. At least it should be conditional, i.e. the UE does not expect frequency hopping field in the DCI format 0\_0 indicates ‘on’ if *frequencyHopping* in *PUSCH-Config* is not provided. |
| Ericsson | Given the conclusion provided by Panasonic, we support TP#3 with an editorial change. The newly added words are better to be moved ahead of the brackets.  For PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 and for TB processing over multiple slots and for PUSCH scheduled by DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH) ~~and for PUSCH scheduled by DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI~~, a UE … |
| Huawei, HiSilicon | DCI format 0\_0 is a fallback DCI, which means its UE behavior is not supposed to depend on any UE dedicated RRC parameter. However, RRC parameter *frequencyHopping* is a UE dedicated parameter which is configured via *BWP-UplinkDedicated->PUSCH-Config-> frequencyHopping*.  Additionally, during initial access, a UE may be scheduled by DCI 0\_0 but no UE dedicated RRC including *frequencyHopping* has been configured to the UE. In this case, it is quite clear that the UE has to do intra-slot hopping if the DCI 0\_0 indicates so. Behavior#2 is not in line with this UE behavior.  Thirdly, in TS 38.212, there is always the “Frequency hopping flag” field in DCI format 0\_0.   |  | | --- | | Frequency hopping flag – 1 bit according to Table 7.3.1.1.1-3, as defined in Clause 6.3 of [6, TS 38.214] |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Table 7.3.1.1.1-3: Frequency hopping indication   |  |  | | --- | --- | | **Bit field mapped to index** | **PUSCH frequency hopping** | | 0 | Disabled | | 1 | Enabled | |   Therefore, Behavior#2 is incorrect at least for initial access. |

1st round summary (Issue#2-1)

Panasonic pointed out that there was the similar discussion in RAN1#101-e and the conclusion form the past discussion was as follows.

|  |
| --- |
| [R1-2003594](file:///C:\Users\4035140\AppData\Local\Docs\R1-2003594.zip) was rejected for Rel-15.  **Conclusion**  Draft CR in [R1-2003594](file:///C:\Users\4035140\AppData\Local\Docs\R1-2003594.zip) is rejected for Rel-15 with the following understanding   1. For a PUSCH scheduled by a DCI format 0\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI or CS-RNTI, the frequency hopping field in the DCI format 0\_0 is not expected to be set to 1 if frequencyHopping in PUSCH-Config is not provided or set to interSlot. 2. For Type 2 CG PUSCH activated by DCI format 0\_0 with CRC scrambled by CS-RNTI, the frequency hopping field in the DCI format 0\_0 is not expected to be set to 1 if frequencyHopping in referredGrantConfig is not provided or set to interSlot. |

Looking at the conclusion, for a PUSCH scheduled by a DCI format 0\_0 with CRC scrambled by C-RNTI, the conclusion does not require the UE to refer to frequencyHopping in PUSCH-Config and at the same time it does not preclude to refer to frequencyHopping in PUSCH-Config. Neither putting only DCI 0\_1 and 0\_2 nor putting all the DCI 0\_0, 0\_1 and 0\_2 in the concerned paragraph of 38.214 Section 6.3.1 may not resolve the issue, unfortunately.

A possible way forward is to go back to Rel-15/16 expressions (i.e., removing “DCI format 0\_1 or 0\_2”) and just adding “for TB processing over multiple slots” as the following TP.

|  |
| --- |
| TP#46.3.1 Frequency hopping for PUSCH repetition Type A and for TB processing over multiple slots For PUSCH repetition Type A and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *referredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot PUSCH transmission and and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission.  For operation with shared spectrum channel access, the UE does not expect that two hops of a PUSCH transmission are in different RB sets.  In case of resource allocation type 2, the UE transmits PUSCH without frequency hopping.  In case of resource allocation type 1, whether or not transform precoding is enabled for PUSCH transmission, the UE may perform PUSCH frequency hopping, if the frequency hopping field in a corresponding detected DCI format or in a random access response UL grant is set to 1, or if for a Type 1 PUSCH transmission with a configured grant the higher layer parameter *frequencyHoppingOffset* is provided, otherwise no PUSCH frequency hopping is performed. When frequency hopping is enabled for PUSCH, the RE mapping is defined in clause 6.3.1.6 of [4, TS 38.211].  For a PUSCH scheduled by RAR UL grant, fallbackRAR UL grant, or by DCI format 0\_0 with CRC scrambled by TC-RNTI, frequency offsets are obtained as described in clause 8.3 of [6, TS 38.213]. Otherwise, for a PUSCH scheduled by DCI format 0\_0/0\_1 or a PUSCH based on a Type2 configured UL grant activated by DCI format 0\_0/0\_1 and for resource allocation type 1, frequency offsets are configured by higher layer parameter *frequencyHoppingOffsetLists* in *pusch-Config*. For a PUSCH scheduled by DCI format 0\_2 or a PUSCH based on a Type2 configured UL grant activated by DCI format 0\_2 and for resource allocation type 1, frequency offsets are configured by higher layer parameter *frequencyHoppingOffsetListsDCI-0-2* in *pusch-Config*.  - When the size of the active BWP is less than 50 PRBs, one of two higher layer configured offsets is indicated in the UL grant.  - When the size of the active BWP is equal to or greater than 50 PRBs, one of four higher layer configured offsets is indicated in the UL grant. |

For your reference, Rel-16 descriptions are copied below.

|  |
| --- |
| 6.3.1 Frequency hopping for PUSCH repetition Type A For PUSCH repetition Type A (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *referredGrantConfig* for configured PUSCH transmission. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot PUSCH transmission and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission.  For operation with shared spectrum channel access, the UE does not expect that two hops of a PUSCH transmission are in different RB sets.  In case of resource allocation type 2, the UE transmits PUSCH without frequency hopping.  In case of resource allocation type 1, whether or not transform precoding is enabled for PUSCH transmission, the UE may perform PUSCH frequency hopping, if the frequency hopping field in a corresponding detected DCI format or in a random access response UL grant is set to 1, or if for a Type 1 PUSCH transmission with a configured grant the higher layer parameter *frequencyHoppingOffset* is provided, otherwise no PUSCH frequency hopping is performed. When frequency hopping is enabled for PUSCH, the RE mapping is defined in clause 6.3.1.6 of [4, TS 38.211].  For a PUSCH scheduled by RAR UL grant, fallbackRAR UL grant, or by DCI format 0\_0 with CRC scrambled by TC-RNTI, frequency offsets are obtained as described in clause 8.3 of [6, TS 38.213]. Otherwise, for a PUSCH scheduled by DCI format 0\_0/0\_1 or a PUSCH based on a Type2 configured UL grant activated by DCI format 0\_0/0\_1 and for resource allocation type 1, frequency offsets are configured by higher layer parameter *frequencyHoppingOffsetLists* in *pusch-Config*. For a PUSCH scheduled by DCI format 0\_2 or a PUSCH based on a Type2 configured UL grant activated by DCI format 0\_2 and for resource allocation type 1, frequency offsets are configured by higher layer parameter *frequencyHoppingOffsetListsDCI-0-2* in *pusch-Config*.  - When the size of the active BWP is less than 50 PRBs, one of two higher layer configured offsets is indicated in the UL grant.  - When the size of the active BWP is equal to or greater than 50 PRBs, one of four higher layer configured offsets is indicated in the UL grant. |

2nd round (Issue#2-1)

Please provide your views on the above TP#4.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Panasonic | We are fine with the above TP#4 with the following minor editorial correction.  Intra-slot frequency hopping, applicable to single slot and multi-slot PUSCH transmission ~~and~~ and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured. |
| Xiaomi | Fine with above TP#4 and Panasonic correction |
| vivo2 | TP #4 does not solve issue, as the original intention of the changes compared to Rel-16 spec. is to capture that Msg3 repetition is only allowed to perform inter-slot FH.  And in this case, UE does not need to read the dedicated signaling for FH of Msg3 when Msg3 is repeated.  So, TP#2 (simply exclude Type A Msg3 repetition case) is preferred from our side. |
| FL | @vivo,  Thanks for the feedback! My understanding is that UE does not need to read the dedicated signaling for FH of Msg3, irrespective of whether Msg3 is repeated or not. In this sense, Rel-17 UE behaviors related to reading of the dedicated signal (i.e., not read the the dedicated signal) for Msg3 is exactly the same as Rel-16 Msg3. That’s why I suggest going back to R16 descriptions. Do I miss something? |
| CMCC | General fine with the TP#4.  Removing the specific DCI format could solve some of the issues, such as single slot or multiple slot PUSCH is scheduled by certain DCI format or not. |
| CATT | Fine with it.  In our understanding, in the sub-bullet of TP#4, TboMS is included in ‘multi-slot PUSCH transmission’. |
| Nokia/NSB | We do not support TP#4 for the same reason explained by. If we remove the adjective “configured” before PUSCH in the first bullet, we include Msg3 repetitions which is wrong.  Maybe we could consider a variant of TP#3 as follows:   |  | | --- | | For PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *onfiguredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, and for PUSCH scheduled by DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission. | |
| Intel | We are fine with TP#4 with the update from Panasonic. |
| FL | @all,  The update provided by Panasonic is incorporated in the TP.  @vivo,  The conclusion in RAN1#101-e did not cover Msg3 PUSCH.  For the initial access, a UE transmits Msg3 PUSCH before acquiring the dedicated RRC signaling. There is no way to refer to it. For the Msg3 transmission after RRC establishment, the UE can refer to it, but the gNB cannot be aware of whether the UE which the RAR UL grant is intended for has the dedicated RRC signaling already or not. Therefore, even after RRC establishment, the UE does not refer to the dedicated RRC signaling for Msg3 PUSCH transmission. This is clarified by TS38.213 Sections 8.2 and 8.3. See Issue#17 of “[108-e-Prep-AI7.1] Rel-15 NR maintenance preparation phase” email discussion.  @Nokia,  Thanks for pointing out the issue due to removal of “configured”. Then, we can keep the “Intra-slot frequency hopping,…” bullet as is.   |  | | --- | | Updated TP#46.3.1 Frequency hopping for PUSCH repetition Type A and for TB processing over multiple slots For PUSCH repetition Type A and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *referredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission.  For operation with shared spectrum channel access, the UE does not expect that two hops of a PUSCH transmission are in different RB sets.  In case of resource allocation type 2, the UE transmits PUSCH without frequency hopping.  In case of resource allocation type 1, whether or not transform precoding is enabled for PUSCH transmission, the UE may perform PUSCH frequency hopping, if the frequency hopping field in a corresponding detected DCI format or in a random access response UL grant is set to 1, or if for a Type 1 PUSCH transmission with a configured grant the higher layer parameter *frequencyHoppingOffset* is provided, otherwise no PUSCH frequency hopping is performed. When frequency hopping is enabled for PUSCH, the RE mapping is defined in clause 6.3.1.6 of [4, TS 38.211].  For a PUSCH scheduled by RAR UL grant, fallbackRAR UL grant, or by DCI format 0\_0 with CRC scrambled by TC-RNTI, frequency offsets are obtained as described in clause 8.3 of [6, TS 38.213]. Otherwise, for a PUSCH scheduled by DCI format 0\_0/0\_1 or a PUSCH based on a Type2 configured UL grant activated by DCI format 0\_0/0\_1 and for resource allocation type 1, frequency offsets are configured by higher layer parameter *frequencyHoppingOffsetLists* in *pusch-Config*. For a PUSCH scheduled by DCI format 0\_2 or a PUSCH based on a Type2 configured UL grant activated by DCI format 0\_2 and for resource allocation type 1, frequency offsets are configured by higher layer parameter *frequencyHoppingOffsetListsDCI-0-2* in *pusch-Config*.  - When the size of the active BWP is less than 50 PRBs, one of two higher layer configured offsets is indicated in the UL grant.  - When the size of the active BWP is equal to or greater than 50 PRBs, one of four higher layer configured offsets is indicated in the UL grant. | |
| Spreadtrum | We are fine to support the updated TP#4. |
| Vivo3 | Thanks for FL’s clarification.  It seems the actual concern is that if we preclude Msg3, we should preclude not only Msg3 when repeated (Rel-17), but also for the Msg3 not repeated (Rel-16), while people are hesitant to change Rel-16 spec.  Actually, we proposed to preclude both repetition and non-repetition case for Msg3 in TP2 only for Rel-17. I try to put a table here to make sure that our understandings are aligned regarding whether reading dedicated FH type configuration signaling is needed for all possible transmissions. Is this correct understanding? If yes, it seems with TP2, there will be no other exceptions not precluded.   |  |  | | --- | --- | | Transmissions | Included by “PUSCH repetition Type A” in the first sentence of 6.3.1 of 38.213? i.e. reading the dedicated signaling is required? | | Msg3 PUSCH transmission/retransmission (repetition or not repetition) | No. | | Normal PUSCH (not Msg3) scheduled by fallback DCI or CG | Yes. (note that dedicated signaling may be not provide before RRC) | | TboMS | Yes. | | Normal PUSCH scheduled by non-fallback DCI | Yes. |   Hiding these facts in conclusions or 3GPP email discussions may trigger repeated discussions in future, be more misleading and worse for those working on products and not working in 3GPP.  To save time and move forward, we will let feature leader to decide whether to capture these in a TP for the first sentence in Rel-17.  We do not support **following changes** in TP4:   |  | | --- | | - Intra-slot frequency hopping, applicable to single slot and multi-slot PUSCH transmission and and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured. |   Is the intention to support intra-slot FH for Msg3 repetitions, which reverts RAN1 agreement? |
| OPPO | Fine to support the updated TP#4. |

2nd round summary (Issue#2-1)

The 2nd round inputs are summarized as follows:

* Fine with the updated TP#4
  + Panasonic, Xiaomi, CMCC, CATT, Intel
* Prefer TP#2
  + vivo
* Prefer a variant of TP#3
  + Nokia

Companies still have different views on which TP we should take. On the other hand, there was the very good discussions via RAN1 reflector about the 1st sentence of Clause 6.3.1 in TS 38.214, including what should be precluded from the sentence and what should not be touched in the sentence.

Some companies pointed out that the following changes should not be adopted. Otherwise, this bullet includes Msg3 repetitions, which is wrong. FL agrees on this argument.

|  |
| --- |
| - Intra-slot frequency hopping, applicable to single slot and multi-slot PUSCH transmission and and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured. |

As for the conclusion made in maintenance session in RAN1#101-e, FL’s understanding is that, if the frequency hopping field in the DCI format 0\_0 is set to 1, the UE can consider that frequencyHopping in PUSCH-Config is provided and set to intraSlot. This means that, for DCI format 0\_0 with C-RNTI, the UE is allowed to determine that intra-slot FH is enabled, by checking the frequency hopping field value only (without reading frequencyHopping in PUSCH-Config). At the same time, the conclusion does not preclude UE’s additional reading of frequencyHopping in PUSCH-Config. In other words, for DCI format 0\_0 with C-RNTI, whether to read frequencyHopping in PUSCH-Config is left to UE implementation. The descriptions in Section 6.3 of Rel-15 TS38.214 does not conflict with this conclusion.

|  |
| --- |
| [R1-2003594](file:///C:\Users\4035140\AppData\Local\Docs\R1-2003594.zip) was rejected for Rel-15.  **Conclusion**  Draft CR in [R1-2003594](file:///C:\Users\4035140\AppData\Local\Docs\R1-2003594.zip) is rejected for Rel-15 with the following understanding   1. For a PUSCH scheduled by a DCI format 0\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI or CS-RNTI, the frequency hopping field in the DCI format 0\_0 is not expected to be set to 1 if frequencyHopping in PUSCH-Config is not provided or set to interSlot. 2. For Type 2 CG PUSCH activated by DCI format 0\_0 with CRC scrambled by CS-RNTI, the frequency hopping field in the DCI format 0\_0 is not expected to be set to 1 if frequencyHopping in referredGrantConfig is not provided or set to interSlot. |

|  |
| --- |
| Rel-15 TS38.2146.3 UE PUSCH frequency hopping procedure A UE is configured for frequency hopping of scheduled or configured PUSCH transmission by the higher layer parameter *frequencyHopping* provided respectively in *pusch-Config* or in *referredGrantConfig*. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot PUSCH transmission.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission.  In case of resource allocation type 1, whether or not transform precoding is enabled for PUSCH transmission, the UE may perform PUSCH frequency hopping, if the frequency hopping field in a corresponding detected DCI format or in a random access response UL grant is set to 1, or if for a Type 1 PUSCH transmission with a configured grant the higher layer parameter *frequencyHoppingOffset* is provided, otherwise no PUSCH frequency hopping is performed. When frequency hopping is enabled for PUSCH, the RE mapping is defined in clause 6.3.1.6 of [4, TS 38.211]. |

Furthermore, The Spec editor already added the red part in Rel-17 spec, which was not in Rel-16 spec. FL believes the editor’s intention was to clarify that frequency hopping for Msg3 (with / without repetitions) is configured by “the frequency hopping flag information field” but not by “the higher layer parameter *frequencyHopping*”. FL thinks this would address vivo’s concern that, for Msg3, reading of frequencyHopping provided in pusch-Config should be precluded.

|  |
| --- |
| For PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *onfiguredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission. |

Lastly, in Rel-16 maintenance discussion [108-e-R16-URLLC-06], it has been discussed what the general “PUSCH repetition Type A” concept in Rel-16 covers, and it is observed that the common understanding is that PUSCH repetition Type A covers all cases that are not PUSCH repetition Type B, including a PUSCH scheduled by RAR UL grant, a PUSCH scheduled by fallbackRAR UL grant, a PUSCH scheduled by DCI format 0\_0 with TC-RNTI, a PUSCH scheduled by DCI format 0\_0 with C-RNTI.

Companies are again encouraged to check if the updated TP#4 is acceptable, taking all the aforementioned background information into account.

**FL proposal on Issue#2-1:**

Adopt the updated TP#4 to TS38.214.

|  |
| --- |
| Updated TP#46.3.1 Frequency hopping for PUSCH repetition Type A and for TB processing over multiple slots For PUSCH repetition Type A and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *referredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission.  For operation with shared spectrum channel access, the UE does not expect that two hops of a PUSCH transmission are in different RB sets.  In case of resource allocation type 2, the UE transmits PUSCH without frequency hopping.  In case of resource allocation type 1, whether or not transform precoding is enabled for PUSCH transmission, the UE may perform PUSCH frequency hopping, if the frequency hopping field in a corresponding detected DCI format or in a random access response UL grant is set to 1, or if for a Type 1 PUSCH transmission with a configured grant the higher layer parameter *frequencyHoppingOffset* is provided, otherwise no PUSCH frequency hopping is performed. When frequency hopping is enabled for PUSCH, the RE mapping is defined in clause 6.3.1.6 of [4, TS 38.211].  For a PUSCH scheduled by RAR UL grant, fallbackRAR UL grant, or by DCI format 0\_0 with CRC scrambled by TC-RNTI, frequency offsets are obtained as described in clause 8.3 of [6, TS 38.213]. Otherwise, for a PUSCH scheduled by DCI format 0\_0/0\_1 or a PUSCH based on a Type2 configured UL grant activated by DCI format 0\_0/0\_1 and for resource allocation type 1, frequency offsets are configured by higher layer parameter *frequencyHoppingOffsetLists* in *pusch-Config*. For a PUSCH scheduled by DCI format 0\_2 or a PUSCH based on a Type2 configured UL grant activated by DCI format 0\_2 and for resource allocation type 1, frequency offsets are configured by higher layer parameter *frequencyHoppingOffsetListsDCI-0-2* in *pusch-Config*.  - When the size of the active BWP is less than 50 PRBs, one of two higher layer configured offsets is indicated in the UL grant.  - When the size of the active BWP is equal to or greater than 50 PRBs, one of four higher layer configured offsets is indicated in the UL grant. |

3rd round (Issue#2-1)

During the 2nd round discussion, several alternatives were raised, each described below. It should be noted that FL took a liberty to make some updates to variants of TP#3.

Basically, each TP tries to fix the issue but still includes some kinds of imperfections. FL’s understanding is as follows:

* TP#2 intends to exclude only Msg3 PUSCH from the first sentence, as the dedicated signaling is not referred to for Msg3 PUSCH.
* Variant#1 of TP#3 intends to add the missing part which is how intra-slot FH is configured for PUSCH scheduled by DCI format 0\_0 other than Msg3.
* Variant#2 of TP#3 also intends to add the missing part which is how intra-slot FH is configured for PUSCH scheduled by DCI format 0\_0 other than Msg3, in a different way from Variant#1 of TP#3.
* Updated TP#4 intends not to clarify any exception for the first sentence.

|  |
| --- |
| TP#26.3.1 Frequency hopping for PUSCH repetition Type A and for TB processing over multiple slots For PUSCH repetition Type A other than the PUSCH scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *onfiguredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission. |

|  |
| --- |
| Variant#1 of TP#36.3.1 Frequency hopping for PUSCH repetition Type A and for TB processing over multiple slots For PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *onfiguredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, and for PUSCH scheduled by DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission. |

|  |
| --- |
| Variant#2 of TP#36.3.1 Frequency hopping for PUSCH repetition Type A and for TB processing over multiple slots For PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *onfiguredGrantConfig* for configured PUSCH transmission. For PUSCH scheduled by DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI, a UE is configured for frequency hopping by the higher layer *frequencyHopping* provided in *pusch-Config* set to ‘*intraSlot*’. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission. |

|  |
| --- |
| Updated TP#46.3.1 Frequency hopping for PUSCH repetition Type A and for TB processing over multiple slots For PUSCH repetition Type A and for TB processing over multiple slots (as determined according to procedures defined in Clause 6.1.2.1 for scheduled PUSCH, or Clause 6.1.2.3 for configured PUSCH), a UE is configured for frequency hopping by the higher layer parameter *frequencyHoppingDCI-0-2* in *pusch-Config* for PUSCH transmission scheduled by DCI format 0\_2, and by *frequencyHopping* provided in *pusch-Config* for PUSCH transmission scheduled by a DCI format other than 0\_2*,* and by *frequencyHopping* provided in *referredGrantConfig* for configured PUSCH transmission. For PUSCH repetition Type A scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, a UE is configured for frequency hopping by the frequency hopping flag information field of the RAR UL grant, and by the frequency hopping flag information field of DCI format 0\_0 with CRC scrambled by TC-RNTI, respectively. One of two frequency hopping modes can be configured:  - Intra-slot frequency hopping, applicable to single slot and multi-slot configured PUSCH transmission and multi-slot PUSCH transmission scheduled by DCI format 0\_1 or 0\_2 and each of multiple PUSCH transmissions scheduled by a DCI if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured.  - Inter-slot frequency hopping, applicable to multi-slot PUSCH transmission. |

Companies are encouraged to provide their views on which they think is the most suitable TP.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Variant#2 of TP#3 is preferred, where different kinds of PUSCH transmissions are put in parallel, without the concern that Msg3 repetition is a subset of PUSCH repetition Type A. |
| CMCC2 | Variant#1 of TP#3 is our fist preference.  As mentioned by other company in the last round, the 1st sentence of TP#4 (without any limitation to PUSCH repetition Type A) may overlap with the Msg 3 repetition (PUSCH repetition Type A scheduled by RAR UL grant), which is not referred. And still we prefer to have a clear description that DCI format 0\_0 cannot scheduling PUSCH repetitions. The variants of TP#3 is more preferable to us.  And for the variant #2, we are hesitating to agree because we are not sure it covers all the scenarios for DCI format 0\_0 with frequency hopping. Since the *push-Config* is a UE specific RRC configuration. But before the RRC setup, FH could work with DCI format 0\_0 and without RRC configurations. |
| Vivo4 | With the common understanding that the first sentence of the section 6.3.1 does not preclude Msg3 repetitions (actually all PUSCH transmissions except Type B PUSCH repetition are included as FL clarified) as we’ve discussed back and forth in email, although we prefer to preclude Msg3 for Rel-17 in the beginning, if all other companies are fine to let UE decide whether to read the dedicated signaling even if the spec. tells the signaling is configured for the transmissions, we’re also fine to go this way to move forward, i.e. **only** the text “ scheduled by DCI format 0\_1 or 0\_2” added by editor for precluding msg3 Type A PUSCH repetition in v17.0.0 is removed.  On the other hand, we’re also fine to not have any TP for section 6.3.1, meaning that UE does not have to read the dedicated signaling for any Type A PUSCH transmissions except for Type A PUSCH repetition scheduled DCI0\_1/2 , since it’s still up to UE to read it or not based on the FL understanding copied below:   |  | | --- | | [FL]As for the conclusion made in maintenance session in RAN1#101-e, FL’s understanding is that, if the frequency hopping field in the DCI format 0\_0 is set to 1, the UE can consider that frequencyHopping in PUSCH-Config is provided and set to intraSlot. This means that, for DCI format 0\_0 with C-RNTI, the UE is allowed to determine that intra-slot FH is enabled, by checking the frequency hopping field value only (without reading frequencyHopping in PUSCH-Config). At the same time, the conclusion does not preclude UE’s additional reading of frequencyHopping in PUSCH-Config. In other words, for DCI format 0\_0 with C-RNTI, whether to read frequencyHopping in PUSCH-Config is left to UE implementation. |   **As a conclusion,** we’re fine to have **no TP** or **TP#4**(only remove “ scheduled by DCI format 0\_1 or 0\_2”). No TP is a bit preferred, which makes it clearer with respect to when the FH type determination is necessary. |
| CATT | Variant#1 of TP#3 seems good to us. |
| Intel | We prefer Variant#1 of TP#3. The case for “PUSCH scheduled by DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI” is clearly covered.  TP#4 is not preferred. |
| Nokia/NSB | We prefer Variant#2 of TP#3, since it captures the conclusion  @CMCC2: you wrote: “But before the RRC setup, FH could work with DCI format 0\_0 and without RRC configurations”. However, is there any DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI, that can be received and properly understood by a UE which hasn’t already completed at least one RRC setup?  @Intel: can you elaborate on how we can demonstrate that Variant#1 of TP3 accounts for the conclusion made during RAN1 #101-e, please? We are ok with variant #1 of TP3 as well, if we can ensure that the conclusion is accounted for. |
| Samsung | Variant#2 of TP#3. Although also Variant#1 of TP#3 seems ok. |
| Huawei, HiSilicon | We prefer Variant#1 of TP#3. Because DCI 0\_0 as a fallback DCI does not rely on an RRC parameter.  @Nokia, regarding your question to CMCC, our understanding is yes. After Msg4 and contention resolution is successful, the TC-RNTI is assigned as C-RNTI, as TS 38.321 below, and the UE starts to monitor DCI scrambled with C-RNTI. At this moment, the UE may not be configured with UE-dedicated RRC pusch-Config yet. A gNB may schedule the UE with DCI 0\_0 to complete the remaining procedures until dedicated RRC parameter configuration is completed, e.g. UE capability inquisition.  TS 38.321, S5.1.5   |  | | --- | | 2> else if the CCCH SDU was included in Msg3 and the PDCCH transmission is addressed to its *TEMPORARY\_C-RNTI*:  3> if the MAC PDU is successfully decoded:  4> stop *ra-ContentionResolutionTimer*;  4> if the MAC PDU contains a UE Contention Resolution Identity MAC CE; and  4> if the UE Contention Resolution Identity in the MAC CE matches the CCCH SDU transmitted in Msg3:  5> consider this Contention Resolution successful and finish the disassembly and demultiplexing of the MAC PDU;  5> if this Random Access procedure was initiated for SI request:  6> indicate the reception of an acknowledgement for SI request to upper layers.  5> else:  6> set the C-RNTI to the value of the *TEMPORARY\_C-RNTI*;  5> discard the *TEMPORARY\_C-RNTI*;  5> consider this Random Access procedure successfully completed.  4> else:  5> discard the *TEMPORARY\_C-RNTI*;  5> consider this Contention Resolution not successful and discard the successfully decoded MAC PDU. | |
| FL | Thanks for the valuable inputs!  I should have clarified the discussion points a bit more. I believe that the intended behaviors about reading of “*frequencyHopping*” and “frequency hopping flag” are commonly understood. The points are how to capture them in the Rel-17 specifications, considering the background information raised in the 1st round discussion, in terms of:   * What needs to be captured in Rel-17 for the PUSCH scheduled by RAR UL grant or by DCI format 0\_0 with TC-RNTI, in addition to what was captured in Rel-16.   + What is affected by the support of Msg3 repetitions. * What needs to be captured in Rel-17 for the PUSCH scheduled by DCI format 0\_0 with C-RNTI, CS-RNTI or MCS-C-RNTI, in addition to what was captured in Rel-16.   + Whether to update Rel-17 spec, taking “the common understanding in the conclusion made in RAN1#101-e” into account.   My plan is to have the next round discussions on the above points. |
| ZTE | For Msg3 repetition, current specification has precluded for a UE to read RRC *frequencyHopping* for Msg3 repetition. So, we don’t see much need to further clarify on this point.  For DCI format 0\_0 with C-RNTI, CS-RNTI or MCS-C-RNTI, from procedure perspective, it seems not very appropriate to discuss whether to include it in Rel-17 discussion.  So, we are fine with no TP here. We can also fine with Variant#1 of TP#3 if the group prefers a TP for better clarity. |
| vivo5 | No TP is preferred according to the discussions rather divergent so far.  A FL conclusion may be helpful for companies to have common understanding on when UE is actually required to read the dedicated signaling though all Types of Type A PUSCH repetition are considered in the first sentence of section 6.3.1. |
| Ericsson | Regarding the first question, we think the current Rel-17 specification clearly states frequency hopping behaviour for Msg3 initial transmission and retransmission. No additional specification impact is needed for Msg3.  For the second question, with rounds of discussion, we think it is better to explicit the situation for PUSCH scheduled by DCI format 0\_0 with C-RNTI, CS-RNTI or MCS-C-RNTI. Variant#2 of TP3 (with the following change) is the best by reusing the legacy dependency on RRC configuration. Given the conclusion in Rel-15 CR discussion, though there should be no conflict between DCI and RRC configuration, if DCI indicates FH is enabled, a UE still has to refer to the corresponding RRC configuration, which is not mentioned in variant 1#TP3.  If there is no consensus on how to capture the frequency hopping for PUSCH scheduled by DCI format 0\_0 with C-RNTI, CS-RNTI or MCS-C-RNTI, updated TP#4 is acceptable as 2nd preference. We share the concern with vivo that PUSCH repetition Type A includes Msg3 PUSCH.  We have the following suggestion to Variant#2 of TP#3 to include that possibility that higher layer *frequencyHopping* is absent.   |  | | --- | | Variant#2 of TP#3 For PUSCH scheduled by DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI, a UE is configured for frequency hopping by the higher layer *frequencyHopping* provided in *pusch-Config* set to ‘*intraSlot*’, if the field is present. | |
| CATT | If Variant#1 of TP#3 is not wrong, prefer to adopt it to make everyone clear, and to avoid any debate in the future (see what’s going on in CR sections) |

3rd round summary (Issue#2-1)

The 3rd round discussion is summarized as follows:

* FL observed that there is common understanding on
  + For PUSCH scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, the UE is not required to read *frequencyHopping* in *pusch-Config* and is required to read the frequency hopping flag information field of the RAR UL grant or the DCI format 0\_0 with CRC scrambled by TC-RNTI, for the determination of whether the frequency hopping is configured for the PUSCH or not.
  + For PUSCH scheduled by DCI format 0\_0 with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI, the conclusion for R1-2003594 in RAN1#101-e is applied to Rel-17.
* On the other hand, as for the TP to achieve the above, companies have different views as the following:
  + No TP is necessary
    - vivo, ZTE
  + Adopt Variant#1 of TP#3
    - CMCC, CATT, Intel, Samsung (can live with), Huawei/HiSilicon, ZTE (can live with)
  + Adopt Variant#2 of TP#3
    - Ericsson, Nokia/NSB, Samsung

4th round (Issues#1-2 to #1-7)

Q1: Do you agree on the aforementioned FL observation on the common understanding?

Q2: If not provided in the 3rd round yet, please provide your views on which TP you prefer and which TP you can live with.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia/NSB | Q1: Yes.  Q2: We still prefer Variant#2 of TP3. Ericsson’s modifications are acceptable. Variant 1#TP3 imposes a conflict between DCI and RRC configuration and if FH is enabled via DCI, where a UE still cannot refer the corresponding RRC configuration. We sympathize with Huawei’s observation, but it does not seem compatible with the conclusion mentioned above. |
| Intel | Q1: Yes.  Q2: we prefer Variant#1 of TP3. For Ericsson’s update, it may not cover the case when *frequencyHopping* provided in *pusch-Config* is not present or *pusch-Config* is not configured, e.g., before RRC setup.  We are also fine without TP as this is common understanding among companies. |
| Panasonic | Q1: Yes  Q2: We prefer Variant #1 of TP3 or TP#4. We are also fine without TP as there has been already clear conclusion in RAN1#101e. |

### [Close] Issue#2-2: Corrections on available slot counting for FDD

In RAN1#107bis-e, the issue for TS38.214v17.0.0 [5] was raised, which was an inconsistency between the main bullet and its sub-bullet, because main bullet says “ consecutive slots” but the sub-bullet implies “ slots” may be non-consecutive. After several rounds of discussions, FL provided two possible TPs as follows [1].

* Option 1: Adopt the updated TP#A

|  |
| --- |
| **TP#A**6.1.2.1 Resource allocation in time domain *[Omitted]*  For paired spectrum and SUL band:  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2, irrespective of whether *AvailableSlotCounting* is enabled or not.  - Except for the case of reduced capability half-duplex UEwith *AvailableSlotCounting* enabled, in which case a slot is not counted in the number of slots for a PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition Type A scheduled by RAR UL grant, based on the TDRA information field value in the RAR UL grant.  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_0 with CRC scrambled by TC-RNTI, based on the TDRA information field value in the DCI scheduling the PUSCH.  *[Omitted]* 6.1.2.3.1 Transport Block repetition for uplink transmissions of PUSCH repetition Type A with a configured grant *[Omitted]*  For both Type 1 and Type 2 PUSCH transmissions with a configured grant, when *K >* 1*,*  - For unpaired spectrum:  - If *AvailableSlotCounting* is enabled, the UE shall repeat the TB across the slots determined for the PUSCH transmission applying the same symbol allocation in each slot.  - A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  - Otherwise, the UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.  - For paired spectrum:  - Irrespective of whether *AvailableSlotCounting* is enabled or not, the UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.  - Except for the case of reduced capability half-duplex UE with *AvailableSlotCounting* enabled, in which case a slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*. |

* Option 2: Adopt the updated TP#B’

|  |
| --- |
| **TP#B’**6.1.2.1 Resource allocation in time domain *[Omitted]*  For paired spectrum and SUL band:  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.  - A reduced capability half-duplex UE with *AvailableSlotCounting* enabled determines slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2. A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition Type A scheduled by RAR UL grant, based on the TDRA information field value in the RAR UL grant.  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_0 with CRC scrambled by TC-RNTI, based on the TDRA information field value in the DCI scheduling the PUSCH.  *[Omitted]* 6.1.2.3.1 Transport Block repetition for uplink transmissions of PUSCH repetition Type A with a configured grant *[Omitted]*  For both Type 1 and Type 2 PUSCH transmissions with a configured grant, when *K >* 1*,*  - For unpaired spectrum:  - If *AvailableSlotCounting* is enabled, the UE shall repeat the TB across the slots determined for the PUSCH transmission applying the same symbol allocation in each slot.  - A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  - Otherwise, the UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.  - For paired spectrum:  - The UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.  - If *AvailableSlotCounting* is enabled, and in case of reduced capability half-duplex UE, the UE shall repeat the TB across the slots applying the same symbol allocation in each slot. A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*. |

According to the contributions for RAN1#108-e, companies’ preferences are summarized as follow:

* Adopt TP#B’
  + OPPO [10], Intel (with a slight update on the wording) [17], Samsung [21], Qualcomm [22], Sharp [23]

1st round (Issue#2-2)

Do you agree to adopt TP#B’?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Yes |
| Intel | Agree. Suggest to update the first part starting with the following, which is aligned with the CG-PUSCH.  For the case of a reduced capability half-duplex UE, and when *AvailableSlotCounting* is enabled, the UE determines … |
| LG | Agree |
| Vivo | Fine. |
| QC | Yes |
| OPPO | Agree. |
| CATT | Fine. |
| Ericsson | Yes. |
| Nokia/NSB | Ok |

1st round summary (Issue#2-2)

All the companies accepted the TP#B’. Therefore, FL suggests taking the following proposal. Note that it reflects small wording modification suggested by Intel.

**FL proposal on Issue#2-2:**

Adopt the following TP#B’’ to TS38.214.

|  |  |
| --- | --- |
| **TP#B’’**6.1.2.1 Resource allocation in time domain *[Omitted]*  For paired spectrum and SUL band:  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.  - For the case of a reduced capability half-duplex UE, and when *AvailableSlotCounting* is enabled, the UE determines slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2. A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition Type A scheduled by RAR UL grant, based on the TDRA information field value in the RAR UL grant.  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_0 with CRC scrambled by TC-RNTI, based on the TDRA information field value in the DCI scheduling the PUSCH.  *[Omitted]* 6.1.2.3.1 Transport Block repetition for uplink transmissions of PUSCH repetition Type A with a configured grant *[Omitted]*  For both Type 1 and Type 2 PUSCH transmissions with a configured grant, when *K >* 1*,*  - For unpaired spectrum:  - If *AvailableSlotCounting* is enabled, the UE shall repeat the TB across the slots determined for the PUSCH transmission applying the same symbol allocation in each slot.  - A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  - Otherwise, the UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.  - For paired spectrum:  - The UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.  - If *AvailableSlotCounting* is enabled, and in case of reduced capability half-duplex UE, the UE shall repeat the TB across the slots applying the same symbol allocation in each slot. A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*. |  |

2nd round (Issue#2-2)

Provide your comment only if you have a strong concern on the above FL proposal on Issue#2-2.

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

2nd round summary (Issue#2-2)

The above FL proposal on Issue#2-2 has been stable for more than 40 hours. Therefore, FL would like to suggest it for an email approval.

As the FL proposal on Issue#2-2 was agreed by email approval, this issue is now closed.

|  |
| --- |
| Agreement  The following TP#B’’ to TS38.214 (same as TP#B’’ in R1-2202567) is endorsed. |

### [Pending] Issue#2-3: Corrections on PUSCH repetition type A for multi-TRP operation

For TS38.214v17.0.0 [5], Intel [17] is pointing out that the current description for PUSCH repetition type A for multi-TRP operation is not accurately captured in Section 6.1.2.1, because, for Rel-17 PUSCH repetition type A enhancement with counting based on available slots, same symbol allocation can be applied across non-consecutive slots. To address this issue, Intel [17] is proposing the following TP.

**TP in R1-2201708 [17]**

|  |
| --- |
| **------------------------------ TP for TS 38.214-----------------------------------** 6.1.2.1 Resource allocation in time domain **< Unchanged text omitted >**  When two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' or 'noncodebook', for PUSCH repetition Type A, when *AvailableSlotCounting* is disabled, 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, and the association of the first and second SRS resource set in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* toeach slot is determined as follows:  **< Unchanged text omitted >** |

1st round (Issue#2-3)

Do you agree to adopt the above TP in R1-2201708?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Fine with the TP. |
| Intel | Agree. |
| LG | Fine with the TP. |
| vivo | We can understand the concern raised in the TP, but it seems also fine to consider the consecutive “slot” as consecutive “**available** slot” when available slot counting is enabled.  Another question is:  Is the intention of the TP to preclude the support of mTRP when PUSCH repetition is based on available slot? |
| QC | Similar question as Vivo. What about the case when available slot counting is enabled? |
| CATT | Understand the motivation, but we have similar confusion as vivo and QC. The case of ‘available slot counting’ + ‘mTRP’ is missing. |
| Ericsson | Same question with vivo. It would be better to refer to determination of available slot in the same section. |
| Nokia/NSB | We are not sure about the need for this TP. This aspect was never discussed in AI 8.8.1.1 and we should not introduce new functionalities at such at late stage. |

1st round summary (Issue#2-3)

The 1st round inputs are summarized as follows:

* Fine with the TP in R1-2201708
  + ZTE, Intel, LG
* Need clarification for the case with mTRPs when available slot counting is enabled
  + Vivo, QC, CATT, Ericsson
* No need to adopt the TP
  + Nokia/NSB

We have made the following conclusion in the last meeting. As stated in the conclusion, after feMIMO discussion, the CovEnh discussion on the available slot counting for inter-cell mTRPs would take place, if necessary. Until then, we cannot specify the behaviors for the case with mTRPs and with available slot counting.

|  |
| --- |
| **Conclusion**   * The CovEnh discussion on the available slot counting for inter-cell mTRPs is deferred until further progress on the collision handling between UL channels/signals and multiple SSBs for inter-cell mTRPs is made in feMIMO session. |

Intel’s intention is understandable, since feMIMO people have been assuming the inter-cell mTRPs procedure is applicable to the physical slot counting for sure. Having said that, it is also true that at this moment it is not clear if the condition “when AvailableSlotCounting is disabled” is necessary, because no one knows the behaviors for the case with mTRPs and with available slot counting. Therefore, FL suggests discussing this issue as part of “the CovEnh discussion on the available slot counting for inter-cell mTRPs” in the previous conclusion.

# References

1. R1-2200789 FL Summary #4 on Enhancements on PUSCH repetition type A Moderator (Sharp)
2. 3GPP TS38.211V17.0.0, December 2021
3. 3GPP TS38.212V17.0.0, December 2021
4. 3GPP TS38.213V17.0.0, December 2021
5. 3GPP TS38.214V17.0.0, December 2021
6. R1-2200966 Discussion on coverage enhancements for PUSCH repetition type A Huawei, HiSilicon
7. R1-2201012 Enhancements on PUSCH repetition type A Nokia, Nokia Shanghai Bell
8. R1-2201104 Remaining issues on enhancement for PUSCH repetition type A vivo
9. R1-2201164 Discussion on remaining issues for enhanced PUSCH repetition type A ZTE
10. R1-2201283 Enhancements on PUSCH repetition type A OPPO
11. R1-2201373 Remaining issues on enhancements on PUSCH repetition type A CATT
12. R1-2201380 Discussion on enhancements on PUSCH repetition Type A Panasonic Corporation
13. R1-2201442 Remaining issues on PUSCH repetition type A enhancements China Telecom
14. R1-2201487 Remaining issues on enhancements on PUSCH repetition type A NTT DOCOMO, INC.
15. R1-2201554 Discussion on enhancements for PUSCH repetition Type A Spreadtrum Communications
16. R1-2201657 Type-A PUSCH repetition for coverage enhancement InterDigital, Inc.
17. R1-2201708 Remaining details of enhancements on PUSCH repetition type A Intel Corporation
18. R1-2201780 Remaining issues on PUSCH repetition type A enhancement Apple
19. R1-2201868 Remaining issues on PUSCH repetition type A enhancement CMCC
20. R1-2201961 Remaining Issues for PUSCH Repetition Type A Enhancement Ericsson
21. R1-2202026 Enhancements on PUSCH repetition type A Samsung
22. R1-2202151 Enhancements on PUSCH Repetition Type A Qualcomm Incorporated
23. R1-2202196 Enhancements on PUSCH repetition type A Sharp
24. R1-2202239 Discussion on PUSCH repetition type A enhancement TCL Communication Ltd.
25. R1-2202299 Discussions on PUSCH repetition type A enhancements LG Electronics
26. R1-2202486 Remaining issues on enhancements for PUSCH repetition Type A WILUS Inc.

# 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.

Agreement

* 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*.
  + No RAN1 spec impact is expected in terms of the relation with the slot which is determined by the slot offset *K2*.
  + Note: The available slot determination is to be specified.
* 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 at least *ConfiguredGrantConfig*.
  + No RAN1 spec impact is expected in terms of the relation with the first slot which is determined by at least *ConfiguredGrantConfig*.
  + Note: The available slot determination is to be specified.

Agreement

* 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.

Agreement

* 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 for any instance of a CG period.

## Agreements in RAN1#107-e

Agreement

* The counting based on available slots is applicable to unpaired spectrum, paired spectrum and SUL
  + For paired spectrum and SUL except HD-FDD, all slots are considered as available slots in the first step of determining the available slots.

Agreement

* For HD-FDD RedCap Ues supporting the counting based on available slots.
  + For CG-PUSCH, *ssb-PositionsInBurst* is used in the first step of determining of available slots.
    - A slot is not counted in the number of available slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a symbol of an SS/PBCH block with index provided by ssb-PositionInBurst.
  + FFS: For DG-PUSCH
  + Note: Neither *tdd-UL-DL-ConfigurationCommon* nor *tdd-UL-DL-ConfigurationDedicated* is configured for FDD.

Agreement

* Rel-17 does not support numberOfRepetitions-r17 for DG-PUSCH scheduled by DCI format 0\_0 and for Type 2 CG-PUSCH activated by DCI format 0\_0.
* *repK-r17*supporting up-to-32 repetitions is introduced and is applicable to Type 1 CG-PUSCH and Type 2 CG-PUSCH (irrespective of the activating DCI format).
  + *Note: No RAN1 spec impact is expected.*
  + *The possible values of repK-r17 includes 16 and 32. FFS: other values.*
* *numberOfRepetitions-r17*is not applicable to Type 1 CG-PUSCH repetition type A.

Agreement

* 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#1-1
  + Type-2 CG-PUSCH with Rel-17 repetition factor

Conclusion

* + Rel-17 PUSCH repetition Type A with K>1 does not support PUSCH transmission without UL-SCH.

Agreement

  For *repK-r17*,

  The value range of *repK-17* is {1, 2, 4, 8, 12, 16, 24, 32}.

  *repK-r17* is included in *ConfiguredGrantConfig*.

  When *repK-r17* is provided, the legacy *repK* is not provided.

Agreement

  For HD-FDD RedCap Ues supporting the counting based on available slots.

  For DG-PUSCH, *ssb-PositionsInBurst* is used in the first step of determining of available slots.

  A slot is not counted in the number of available slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a symbol of an SS/PBCH block with index provided by ssb-PositionInBurst.

  Note: Neither *tdd-UL-DL-ConfigurationCommon* nor *tdd-UL-DL-ConfigurationDedicated* is configured for FDD.

## Agreements in RAN1#107bis-e

**Conclusion:**

No consensus to introduce *pusch-AggregationFactor-r17*.

**Agreement**

* Remove the notes from “Per (UE, cell, TRP, …)” and “Comment” columns of the existing *AvailableSlotCounting* in the consolidated RRC parameter list.
* If separate FGs are defined for DG-PUSCH and CG-PUSCH, add another *AvailableSlotCounting* to the consolidated RRC parameter list, with the following contents.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **WI code** | **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parant 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 |  |  |  |  | *AvailableSlotCounting* | new |  | Enabling PUSCH repetitions counted on the basis of available slots | ENUMERATED {enabled, disable } |  | in ConfiguredGrantConf | 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. |

**Conclusion:**

* The cancellation of LP PUSCH (introduced in Rel-17 eIIoT/URLLC WI) is applied in Step 2 of the previously agreed 2-step procedure of Rel-17 PUSCH repetitions counted on the basis of available slots (i.e., Option 1-B).
  + No specification impact is expected.

**Conclusion**

* The CovEnh discussion on the available slot counting for inter-cell mTRPs is deferred until further progress on the collision handling between UL channels/signals and multiple SSBs for inter-cell mTRPs is made in feMIMO session.

## Agreements in RAN1#108-e

Agreement

The following TP#B’’ to TS38.214 (same as TP#B’’ in R1-2202567) is endorsed

|  |  |
| --- | --- |
| TP#B’’6.1.2.1 Resource allocation in time domain *[Omitted]*  For paired spectrum and SUL band:  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.  - For the case of a reduced capability half-duplex UE, and when *AvailableSlotCounting* is enabled, the UE determines slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2. A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition Type A scheduled by RAR UL grant, based on the TDRA information field value in the RAR UL grant.  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_0 with CRC scrambled by TC-RNTI, based on the TDRA information field value in the DCI scheduling the PUSCH.  *[Omitted]* 6.1.2.3.1 Transport Block repetition for uplink transmissions of PUSCH repetition Type A with a configured grant *[Omitted]*  For both Type 1 and Type 2 PUSCH transmissions with a configured grant, when *K >* 1*,*  - For unpaired spectrum:  - If *AvailableSlotCounting* is enabled, the UE shall repeat the TB across the slots determined for the PUSCH transmission applying the same symbol allocation in each slot.  - A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  - Otherwise, the UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.  - For paired spectrum:  - The UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.  - If *AvailableSlotCounting* is enabled, and in case of reduced capability half-duplex UE, the UE shall repeat the TB across the slots applying the same symbol allocation in each slot. A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*. |  |