**3GPP TSG RAN WG1 #100bis R1-200xxxx**

**e-Meeting, April 20th – 30th, 2020**

Source: moderator (vivo)

Title: Feature lead summary NRU-CG-02

Agenda Item: 7.2.2.2.4

Document for: Discussion and Decision

1. Introduction

Following email thread is assigned:

[100b-e-NR-unlic-NRU-CG-02] Email discussion/approval on following issues by 4/24; if necessary, followed by endorsing the corresponding TPs by 4/29 – Rakesh (Vivo)

* PUSCH repetition transmission related issues for NRU configured grant
* RV determination for CG repetition

1. Discussion on topic#2
   1. Issue 2: The PUSCH repetition transmission related issues for NRU configured grant

### 2.2.1 TP1

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===================TP for 38.214 6.1.2.3.1================

6.1.2.3.1 Transport Block repetition for uplink transmissions of PUSCH repetition Type A with a configured grant

\*\*\* Unchanged text is omitted \*\*\*

For both Type 1 and Type 2 PUSCH transmissions with a configured grant, when the UE is configured with *repK >* 1*,* the UE shall repeat the TB across the *repK* consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots-r16* and *cg-nrofPUSCH-InSlot-r16*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration. For operation with shared spectrum channel access, where the UE is provided with higher layer parameters *cg-nrofSlots-r16* and *cg-nrofPUSCH-InSlot-r16*  and *repK>1,* the UE shall perform the transmission of the first repetition in the earliest transmission occasion for which the related channel procedure described in 37.213 is successful.A Type 1 or Type 2 PUSCH transmission with a configured grant in a slot is omitted according to the conditions in Subclause 11.1 of [6, TS38.213].

\*\*\* Unchanged text is omitted \*\*\*

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### 2.2.2 TP2

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For both Type 1 and Type 2 PUSCH transmissions with a configured grant, when *K >* 1*,* the UE shall repeat the TB across the *K* consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots-r16* and or *cg-nrofPUSCH-InSlot-r16*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration if the *repK* earliest consecutive transmission occasion candidates are within the same configuration period. If the *repK* earliest consecutive transmission occasion candidates are not within the same configuration period, the UE repeats the TB at least in the consecutive transmission occasion candidates within the same configuration period. A Type 1 or Type 2 PUSCH transmission with a configured grant in a slot is omitted according to the conditions in Subclause 11.1 of [6, TS38.213].

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### 2.2.3 TP3

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The higher layer parameter *repK-RV* defines the redundancy version pattern to be applied to the repetitions. For operation without shared spectrum channel access, ~~I~~if the parameter *repK-RV* is not provided in the *configuredGrantConfig*, the redundancy version for uplink transmissions with a configured grant shall be set to 0. Otherwise, for the *n*th transmission occasion among *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod(n-1,4)+1)th* value in the configured RV sequence. If a configured grant configuration is configured with *Configuredgrantconfig-StartingfromRV0* set to *‘off’*, the initial transmission of a transport block may only start at the first transmission occasion of the *K* repetitions. Otherwise, the initial transmission of a transport block may start at

- the first transmission occasion of the *K* repetitions if the configured RV sequence is {0,2,3,1},

- any of the transmission occasions of the *K* repetitions that are associated with RV=0 if the configured RV sequence is {0,3,0,3},

- any of the transmission occasions of the *K* repetitions if the configured RV sequence is {0,0,0,0}, except the last transmission occasion when *K≥8*.

For operation with shared spectrum channel access, the initial transmission of a transport block may start at any transmission occasion of the *K* repetitions with RV=0. If the parameter *repK-RV* is not provided in the *configuredGrantConfig*, the redundancy version for uplink transmission with a configured grant is determined by the UE. Otherwise, for the *n*th transmission among at most *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod(n-1,4)+1)th* value in the configured RV sequence.

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TP1, TP2, TP3 are discussing similar issues, thus they are discussed together. Please provide your views/comments in the table below

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| Company/organization | comments |
| ZTE | We think TP1 is sufficient and we support it.  We do not see the need of TP2.  TP3 should be discussed together with Issue 12. And we prefer to adopt the TP in section 2.2 rather than this one. |
| Intel | 1. TP1: given that along the specification there is no specific text defining the way how the UE should map or handle the transmissions of multiple repetitions in case of LBT failure, we see the need of this text. 2. TP2: we think the current specification text is already quite clear. However, we believe that the “and”, should be replaced by “or” between parameters *cg-nrofSlots-r16* and *cg-nrofPUSCH-InSlot-r16* as proposed in this TP:   For both Type 1 and Type 2 PUSCH transmissions with a configured grant, when *K >* 1*,* the UE shall repeat the TB across the *K* consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots-r16* or *cg-nrofPUSCH-InSlot-r16*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.   1. TP3: We do not support this text. Also we believe that this TP lies in the same topic as that threated in Sec. 2.2, and we prefer the text in that section. |
| NTT DOCOMO | OK with TPs 1 and 2. TP3 should be discussed together with Issue #12. |
| LG | TP1 can be adopted to clarify the UE behavior for PUSCH repetition by CG resource but TP2 seems not necessary. We think that TP3 can be treated in section 2.2. |
| Huawei, HiSilicon | TP1: It is important to capture the channel access behavior with multiple transmission occasions, preferably in ‘TS37.213 consecutive UL’. Nevertheless, the conditions for the desired behavior in TP1 have been restated, i.e., “For operation with shared spectrum channel access, where the UE is provided with higher layer parameters *cg-nrofSlots-r16* and *cg-nrofPUSCH-InSlot-r16*  and *repK>1,* …”. It might lead to ambiguity as to whether or not the previous behavior “the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.” applies to “operation with shared spectrum access”. Some modification to the wording can be considered if agreed.  TP2: It targets a different behavior (termination) and could be adopted if the understanding of the group is that the following statement in a preceding paragraph of the same subclause 6.1.2.3.1 is not sufficient:  “For any RV sequence, the repetitions shall be terminated after transmitting *K* repetitions, or at the last transmission occasion among the *K* repetitions within the period *P*, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first.”  TP3: We think that it belongs to Issue 12 in Section 2.2 |
| Sony | We think TP1 is OK but TP2 is not necessary. TP3 should be discussed together with Issue #12. |
| Samsung | We are fine with TP1, but TP2 is unnecessary since the current specification is clear. We think TP3 should be discussed in Section 2.2. |
| Lenovo,  Motorola Mobility | TP1 is fine with us.  TP2: not needed.  TP3: Agree to discuss in Issue 12. |
| Nokia, NSB | TP1: this looks ok (need to clarify other repetitions)  TP2: this does not seem necessary  TP3: We agree this can be discussed together with Issue 12. |
| OPPO | TP1: We are fine to support this TP if the following modification is considered:  For operation with shared spectrum channel access, where the UE is provided with higher layer parameters *cg-nrofSlots-r16* and *cg-nrofPUSCH-InSlot-r16* and *repK>1,* the UE shall perform the transmission of the first repetition with RV=0 in the earliest transmission occasion for which the related channel procedure described in 37.213 is successful.  TP2: If we have modified TP1, TP2 is not needed.  TP3: It can be discussed in Issue 12. |

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Proposal:

* UE terminates the repetitions if an explicit feedback indicating ACK in the DFI is received for the HARQ process not only for CG-PUSCH but also for DG-PUSCH.

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Please provide your views/comments in the table below

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| Company/organization | comments |
| ZTE | The proposal itself is not that clear.  By reading the contribution [2435], we understanding the intention is to terminate the slot aggregation for DG-PUSCH if the DFI includes an ACK indication for that HARQ process.  As DFI is introduced mainly for CG-PUSCH, We are not sure if this optimization for DG-PUSCH is necessary. |
| Intel | We do not support this TP, and we believe this is an optimization which is not needed for the essential operation of the design. Also this type of operation would require additional discussions to distinguish the case when a GB-PUSCH is TB or per CBG based, given that the DFI provides feedback information at the TB level. |
| NTT DOCOMO | As the timeline (i.e., minimum duration, D) between DG-PUSCH repetitions and valid ACK/NACK in CG-DFI has been agreed as well as CG-PUSCH repetitions, we think the termination of DG-PUSCH repetitions by CG-DFI should be supported as well as CG-PUSCH. We proposed corresponding TP in our contribution (R1-2002435) as below:  TS38.214  == Start ==  6.1.2.1 Resource allocation in time domain  <omitted text>  For PUSCH repetition Type A, in case *K>1,* the same symbol allocation is applied across the *K* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *K* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, … *K*-1, is determined according to table 6.1.2.1-2. The UE shall terminate the repetition of a transport block in a PUSCH transmission if the UE receives a DCI format 0\_1 with DFI flag provided and set to '1', and if in this DCI the UE detects ACK for the HARQ process corresponding to that transport block.  <omitted text>  For PUSCH repetition Type B, after determining the invalid symbol(s) for PUSCH repetition type B transmission for each of the *K* nominal repetitions, the remaining symbols are considered as potentially valid symbols for PUSCH repetition Type B transmission. If the number of potentially valid symbols for PUSCH repetition type B transmission is greater than zero for a nominal repetition, the nominal repetition consists of one or more actual repetitions, where each actual repetition consists of a consecutive set of potentially valid symbols that can be used for PUSCH repetition Type B transmission within a slot. An actual repetition with a single symbol is omitted except for the case of *L*=1. An actual repetition is omitted according to the conditions in Clause 11.1 of [6, TS38.213]. The redundancy version to be applied on the *n*th actual repetition (with the counting including the actual repetitions that are omitted) is determined according to table 6.1.2.1-2. The UE shall terminate the repetition of a transport block in a PUSCH transmission if the UE receives a DCI format 0\_1 with DFI flag provided and set to '1', and if in this DCI the UE detects ACK for the HARQ process corresponding to that transport block.  <omitted text>  == End ==  Even if this is not supported, Section 6.1 in 38.214 as shown below should be modified so that an ACK/NACK in CG-DFI is used to terminate a TB repetition in a CG-PUSCH only.  If a UE receives an ACK for a given HARQ process in CG-DFI in a PDCCH ending in symbol *i* to terminate a transport block repetition in a PUSCH transmission on a given serving cell with the same HARQ process after symbol *i*, the UE is expected to terminate the repetition of the transport block in a PUSCH transmission starting from a symbol *j* if the gap between the end of PDCCH of symbol *i* and the start of the PUSCH transmission in symbol *j* is equal to or more than *N2* symbols. The value *N2* in symbols is determined according to the UE processing capability defined in Clause 6.4, and *N2* and the symbol duration are based on the minimum of the subcarrier spacing corresponding to the PUSCH and the subcarrier spacing of the PDCCH indicating CG-DFI. |
| LG | The proposal is not necessary. Because the purpose of HARQ-ACK for DG-PUSCH in CG-DFI is mainly the UL CWS adjustment, it seems an optimization issue rather than essential. |
| Huawei, HiSilicon | Agree with LG. Furthermore, unlike the CG repetitions which may be transmitted on non-contiguous consecutive transmission occasions, the slot-aggregated PUSCHs are always contiguous in time. Given the requirement of cg-minDFIdelay-r16 symbols from the end of the PUSCH before determining a valid ACK, such an early termination enhancement for slot aggregation is not a priority.  For the spec quoted by NTT DOCOMO from Section 6.1 in 38.214, if the understanding of the group is that it applies to both CG-PUSCH and DG-PUSCH, then the proposed enhancement is already supported. |
| Sony | We think this proposal is not necessary since it seems optimization. |
| Samsung | As commented by other companies, it is an optimization functionality, so we don’t think this proposal is necessary. |
| Nokia, NSB | The functionality does not seem crucial |
| OPPO | Agree with LG |

* 1. Issue 12: RV determination for CG repetition (Editorial/clarification)

### 2.12.1 TP1

TP for 38.214

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6.1.2.3.1 Transport Block repetition for uplink transmissions of PUSCH repetition Type A with a configured grant

The procedures described in this clause apply to PUSCH transmissions of PUSCH repetition Type A with a Type 1 or Type 2 configured grant.

The higher layer parameter *repK-RV* defines the redundancy version pattern to be applied to the repetitions. If the parameter *repK-RV* is not provided in the *configuredGrantConfig* and cg-RetransmissionTimer is not provided, the redundancy version for uplink transmissions with a configured grant shall be set to 0. If cg-RetransmissionTimer is provided, the redundancy version for uplink transmission with a configured grant is determined by the UE. If the parameter repK-RV is provided in the configuredGrantConfig and cg-RetransmissionTimer is not provided. ~~Otherwise~~, for the *n*th transmission occasion among *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod(n-1,4)+1)th* value in the configured RV sequence. If a configured grant configuration is configured with *Configuredgrantconfig-StartingfromRV0* set to *'off'*, the initial transmission of a transport block may only start at the first transmission occasion of the *K* repetitions. Otherwise, the initial transmission of a transport block may start at

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Please provide your views/comments in the table below

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| --- | --- |
| Company/organization | comments |
| ZTE | We think the three TPs are with the same meaning, and we are fine to adopt either of them.  For TP1, there is an extra full stop which should be removed, i.e. “is not provided~~.~~” |
| Intel | All the three TPs within this section are equivalent, and we have a slight preference in supporting TP2, but any of them would work OK. |
| NTT DOCOMO | OK with either of TPs 1,2,3 |
| LG | Since all three TPs address the same issue, we are fine with any of them, but TP2 is slightly preferred. |
| Huawei, HiSilicon | TP1, TP2 and TP3 in this section aim at capturing the same RV behavior which is important to be captured. However, it is not clear why all of the 3 TPs rely on providing the parameter *cg-RetransmissionTimer* to distinguish the NR-U case whereas the same subclause has already used other NR-U parameters such as *cg-nrofSlots-r16* and *cg-nrofPUSCH-InSlot-r16* to make such a distinction, which actually seem to be more relevant in that context than the *cg-RetransmissionTimer.* Why is it necessary to introduce such inconsistency in the same subclause?  It is also worth noting that TP3 in Section 2.1 of this summary captures the same behavior without inserting multiple if statements conditioned upon any the above parameters. |
| Sony | Although all three TPs can work, TP2 is preferable. |
| Samsung | We are fine with TP1, TP2, and TP3 since they clarify the same issue well. But, we have similar view with Huawei regarding *cg-RetransmissionTimer*. We hope to be clarified why the *cg-RetransmissionTimer* is used for these TPs. |
| Lenovo,  Motorola Mobility | Yes, we share same concern with Huawei. Relying on cg-Retransmission Timer is not clear to us. |
| Nokia, NSB | All TPs are somewhat similar. TP2 is slight preferred due to clarity. |
| OPPO | TP1, TP2 and TP3 in this section address RV behavior in NR-U. In our view, the RV determination behavior in unlicensed spectrum is different from licensed spectrum, so we prefer to address RV determination behavior separately.  For CG repetition transmission in NR-U, generally the parameter *repK-RV* is not expected to be configured and the RV can be determined by UE. However, if the UE is configured with the parameter *repK-RV*, it is preferred that the UE shall follow the configuration to determine RV for repetition transmissions. So we have the following proposal:  For operation with shared spectrum channel access, if the parameter *repK-RV* is not provided in the *configuredGrantConfig*, the redundancy version for uplink transmission with a configured grant is determined by the UE. Otherwise, for the *n*th transmission among at most *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod(n-1,4)+1)th* value in the configured RV sequence. |

### 2.12.2 TP2

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The procedures described in this clause apply to PUSCH transmissions of PUSCH repetition Type A with a Type 1 or Type 2 configured grant.

If *cg-RetransmissionTimer* is provided, the redundancy version for uplink transmission with a configured grant is determined by the UE.

The higher layer parameter *repK-RV* defines the redundancy version pattern to be applied to the repetitions. If the parameter *repK-RV* is not provided in the *configuredGrantConfig* and *cg-RetransmissionTimer* is not provided, the redundancy version for uplink transmissions with a configured grant shall be set to 0. ~~Otherwise~~ If the parameter *repK-RV* is provided in the *configuredGrantConfig* and *cg-RetransmissionTimer* is not provided, for the *n*th transmission occasion among *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod(n-1,4)+1)th* value in the configured RV sequence. If a configured grant configuration is configured with *Configuredgrantconfig-StartingfromRV0* set to *‘off’*, the initial transmission of a transport block may only start at the first transmission occasion of the *K* repetitions. Otherwise, the initial transmission of a transport block may start at

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| ZTE | We think the three TPs are with the same meaning, and we are fine to adopt either of them. |
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| NTT DOCOMO | OK with either of TPs 1,2,3 |
| LG | Since all three TPs address the same issue, we are fine with any of them, but TP2 is slightly preferred. |
| Huawei, HiSilicon | TP1, TP2 and TP3 in this section aim at capturing the same RV behavior which is important to be captured. However, it is not clear why all of the 3 TPs rely on providing the parameter *cg-RetransmissionTimer* to distinguish the NR-U case whereas the same subclause has already used other NR-U parameters such as *cg-nrofSlots-r16* and *cg-nrofPUSCH-InSlot-r16* to make such a distinction, which actually seem to be more relevant in that context than the *cg-RetransmissionTimer.* Why is it necessary to introduce such inconsistency in the same subclause?  It is also worth noting that TP3 in Section 2.1 of this summary captures the same behavior without inserting multiple if statements conditioned upon any the above parameters. |
| Sony | Although all three TPs can work, TP2 is preferable. |
| Samsung | We are fine with TP1, TP2, and TP3 since they clarify the same issue well. But, we have similar view with Huawei regarding *cg-RetransmissionTimer*. We hope to be clarified why the *cg-RetransmissionTimer* is used for these TPs. |
| Lenovo,  Motorola Mobility | Yes, we share same concern with Huawei. Relying on cg-Retransmission Timer is not clear to us. |
| Nokia, NSB | All TPs are somewhat similar. TP2 is slight preferred due to clarity. |
| OPPO | TP1, TP2 and TP3 in this section address RV behavior in NR-U. In our view, the RV determination behavior in unlicensed spectrum is different from licensed spectrum, so we prefer to address RV determination behavior separately.  For CG repetition transmission in NR-U, generally the parameter *repK-RV* is not expected to be configured and the RV can be determined by UE. However, if the UE is configured with the parameter *repK-RV*, it is preferred that the UE shall follow the configuration to determine RV for repetition transmissions. So we have the following proposal:  For operation with shared spectrum channel access, if the parameter *repK-RV* is not provided in the *configuredGrantConfig*, the redundancy version for uplink transmission with a configured grant is determined by the UE. Otherwise, for the *n*th transmission among at most *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod(n-1,4)+1)th* value in the configured RV sequence. |

### 2.12.3 TP3

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The procedures described in this clause apply to PUSCH transmissions of PUSCH repetition Type A with a Type 1 or Type 2 configured grant.

If *cg-RetransmissionTimer* is provided, the redundancy version for uplink transmission with a configured grant is determined by the UE. Otherwise, the higher layer parameter *repK-RV* defines the redundancy version pattern to be applied to the repetitions when the *cg-RetransmissionTimer* is not configured, for the *n*th transmission occasion among *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod(n-1,4)+1)th* value in the configured RV sequence. If the parameter repK-RV is not provided in the configuredGrantConfig and cg-RetransmissionTimer is not provided, the redundancy version for uplink transmissions with a configured grant shall be set to 0. If a configured grant configuration is configured with *Configuredgrantconfig-StartingfromRV0* set to *'off'*, the initial transmission of a transport block may only start at the first transmission occasion of the *K* repetitions. Otherwise, the initial transmission of a transport block may start at

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| NTT DOCOMO | OK with either of TPs 1,2,3 |
| LG | Since all three TPs address the same issue, we are fine with any of them, but TP2 is slightly preferred. |
| Huawei, HiSilicon | TP1, TP2 and TP3 in this section aim at capturing the same RV behavior which is important to be captured. However, it is not clear why all of the 3 TPs rely on providing the parameter *cg-RetransmissionTimer* to distinguish the NR-U case whereas the same subclause has already used other NR-U parameters such as *cg-nrofSlots-r16* and *cg-nrofPUSCH-InSlot-r16* to make such a distinction, which actually seem to be more relevant in that context than the *cg-RetransmissionTimer.* Why is it necessary to introduce such inconsistency in the same subclause?  It is also worth noting that TP3 in Section 2.1 of this summary captures the same behavior without inserting multiple if statements conditioned upon any the above parameters. |
| Sony | Although all three TPs can work, TP2 is preferable. |
| Samsung | We are fine with TP1, TP2, and TP3 since they clarify the same issue well. But, we have similar view with Huawei regarding *cg-RetransmissionTimer*. We hope to be clarified why the *cg-RetransmissionTimer* is used for these TPs. |
| Lenovo,  Motorola Mobility | Yes, we share same concern with Huawei. Relying on cg-Retransmission Timer is not clear to us. |
| Nokia, NSB | All TPs are somewhat similar. TP2 is slight preferred due to clarity. |
| OPPO | TP1, TP2 and TP3 in this section address RV behavior in NR-U. In our view, the RV determination behavior in unlicensed spectrum is different from licensed spectrum, so we prefer to address RV determination behavior separately.  For CG repetition transmission in NR-U, generally the parameter *repK-RV* is not expected to be configured and the RV can be determined by UE. However, if the UE is configured with the parameter *repK-RV*, it is preferred that the UE shall follow the configuration to determine RV for repetition transmissions. So we have the following proposal:  For operation with shared spectrum channel access, if the parameter *repK-RV* is not provided in the *configuredGrantConfig*, the redundancy version for uplink transmission with a configured grant is determined by the UE. Otherwise, for the *n*th transmission among at most *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod(n-1,4)+1)th* value in the configured RV sequence. |

# References

[1] R1-2002737, Feature lead summary#2 on NRU configured grant enhancement, RAN1#100b-e

[2] R1-2002745, Summary of prep email discussion on NRU-CG, RAN1#100b-e