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

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

**Agenda Item: 7.2.2.2.3**

**Source: Moderator (Huawei)**

**Title: Feature lead summary#1 on email discussion 100b-e-NR-unlic-NRU-HARQ-03 (SPS)**

**Document for: Discussion and Decision**

# Introduction

This document provides updated proposals on issue A11. Companies are invited to provide their views on the two questions from the FL using the table in section 2.

[100b-e-NR-unlic-NRU-HARQ-03] Email discussion/approval on handling of SPS with enhanced dynamic codebook and with NNK1 by 4/24; if necessary, followed by endorsing the corresponding TPs by 4/30 – David (Huawei)

# Issue A11

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| A11 | SPS with enhanced dynamic codebook and with NNK1  Issue 1: Whether there is a problem with reusing the pseudo-code of section 9.1.3.1 because it will result in reporting 2 HARQ-ACK bits for SPS PDSCH in one PUCCH when HARQ-ACK feedback both PDSCH groups is reported?  Issue 2: Handling of case when an SPS configuration is activated with a DCI that indicates non-numerical K1. Interpretation of NFI, DAI, q in activated DCI for SPS PDSCH |

FL analysis: for issue 1, the problem seems to be that clause 9.1.3.3 asks the UE to follow the procedure of clause 9.1.3.3 twice when first and second HARQ information is generated, which means that UE will append HARQ-ACK bits for SPS PDSCH receptions twice (at the end of each group).

FL proposal: companies provide views on the following questions

* Q1: Can we simply clarify that the HARQ-ACK bits corresponding to SPS PDSCHs are appended to the end of a dynamic HARQ-ACK codebook for nrofHARQ-Processes configured for the SPS configuration, i.e. when the UE generates first and second HARQ-ACK information in 9.1.3.3 the following handling of HARQ-ACK bits for SPS PDSCH receptions in 9.1.3.1 is only done once after generating the first and second HARQ-ACK information?

Set 

while 

if a single SPS PDSCH reception is activated for a UE and the UE is configured to receive SPS PDSCH in a slot  for serving cell , where  is the PDSCH-to-HARQ-feedback timing value for SPS PDSCH on serving cell 



= HARQ-ACK information bit associated with the SPS PDSCH reception

end if

;

end while

* Q2: Can a DCI format 1\_1 indicate a NNK1 and activate a SPS configuration (CRC scrambled with CS-RNTI and NDI=0)?
* Q3: Can we clarify that in a DCI activating SPS PDSCH, the NFI, DAI, q fields are only interpreted for the PDSCH scheduled by the DCI, and are not interpreted for the SPS PDSCHs?

Please complete/revise/add your company’s view on the proposal in the table below.

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| **Company** | **Comments** |
| OPPO | Q1: support  Q2: Open, but slightly not preferred  Q3: yes, these fields should be reserved. |
| Nokia, NSB | Q1: We believe the best would be to add condition in 9.1.3.3 stating that SPS PDSCH CB is not appended for the triggered non-scheduled group.  Q2: We think that support for NN-K1 in DL SPS activation is a corner case, because UE activates DL SPS to avoid need for transmitting DCIs. There may be more issues than benefit from supporting it.  Q3: We have the same view as FL, but we think that the current spec is clear on this. Reporting HARQ-ACK for DL SPS activation in TYPE2 is business as usual and SPS PDSCH is appended to the CB. All clear. |
| ZTE | Q1: Fine with the proposal  Q2: No, we share the same view as Nokia  Q3: Yes |
| MediaTek | Q1: The issue only happens when the first and second HARQ-ACK information are multiplexed in a same PUCCH occupation (i.e., q = 1). One alternative to address this issue is stating that UE generates HARQ-ACK bits of SPS PDSCH receptions only for PDSCH group 1 (g = 1) when q = 1. Then, the HARQ-ACK bits for SPS will be naturally mapped at the end of enhanced HARQ-ACK codebook.    Q2: No  Q3: Agree with FL |
| Sharp | Q1: Fine with FL’s proposal.  Q2: No. The main purpose of NNK1 mechanism is to indicate the UE to report the corresponding HARQ-ACK information in the next COT. Since when the COT is obtained is unknown at the time of indicating NNK1, some SPS PDSCHs (if scheduled) probably fall out of the next COT.  Q3: Yes. We have the same view as FL and Nokia. The current spec has descriptions corresponding to SPS activation DCI and SPS PDSCH in 9.1.3.3 and 9.1.3.1, respectively. |
| Samsung | Q1: We’d like to ask for the clarification of “nrofHARQ-Processes configured for the SPS configuration”. Whether the *nrofHARQ-Processes* is determined by the number of SPS PDSCHs with in a slot , i.e. exactly the same as Rel-15 without HARQ-ACK retransmission of SPS PDSCHs? If yes, we support FL’s proposal.  Q2: No. Share the same view Nokia.  Q3: Share the same view with Nokia and FL. |
| LG | Q1: Support that the HARQ-ACK bits corresponding to SPS PDSCHs are appended to the end of a dynamic HARQ-ACK codebook. In case when only one group is requested, the HARQ-ACK bits for SPS PDSCHs start after that for the group. In case when both two groups are requested, the HARQ-ACK bits for SPS PDSCHs start after that for the second group 1.  Q2: Similar view with other companies by considering two concerning points below:  - The motivation to introduce NN-K1 was to address UE processing time for the PDSCH scheduled to the end of a COT, but periodic DCI-less SPS PDSCH doesn’t seem to be suitable with such motivation.  - The reception of SPS activation DCI by UE is currently confirmed to gNB by receiving the corresponding HARQ-ACK PUCCH from the UE, but there would be no confirmation from the UE if SPS activation DCI indicates NN-K1.  Q3: same view with other companies since the first PDSCH scheduled by SPS activation DCI is treated as a dynamic PDSCH with associated DCI. It seems the current spec is already clear, and thus no further clarification/correction would be necessary. |
| vivo | Q1: Basically support FL's proposal. The appended HARQ-ACK for SPS PDSCH can be only based on the PUCCH transmission occasion , so there is at most one bit, without regard to *nrofHARQ-Processes* configured for the SPS configuration.  Q2: Not supportive. This case may bring some issues, with ambiguous benefits.  Q3: Yes. |
| Ericsson | Q1: Yes  Q2: We slightly prefer this option. But OK since majority of companies are not supportive.  Q3: Yes |
| Lenovo, Motorola Mobility | Q1: We support placing HARQ-ACK information bit for SPS PDSCH at the end of the dynamic HARQ-ACK codebook regardless of one or two PDSCH groups requested for HARQ-ACK feedback.  Q2: NO.  Q3: Yes. |

Summary of proposals from submitted Tdocs

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| **Company** | **Summary of proposals** |
| Vivo  (R1-2001654) | HARQ-ACK for SPS PDSCH, if any, is always placed at the end of enhanced HARQ-ACK codebook to be transmitted, no matter whether the transmitted HARQ-ACK codebook contains only the first HARQ-ACK information, or both the first HARQ-ACK information and the second HARQ-ACK information. |
| OPPO  (R1-2001761) | Appending the HARQ-ACK bit corresponding to SPS PDSCH to the group-based HARQ-ACK bits in enhanced type-2 HARQ-ACK codebook  Reuse Rel-15 mechanism for SPS PDSCH in Type-2 HARQ-ACK codebook as much as possible   * SPS PDSCH doesn’t have group ID. * If only the HARQ-ACK bit corresponding to SPS PDSCH is transmitted in slot n, PUCCH format 0/1 is used. Unless using one-shot HARQ-ACK feedback, HARQ-ACK only for SPS PDSCH cannot be retransmitted. * If other group-based HARQ-ACK bits collide with the HARQ-ACK bit corresponding to SPS PDSCH, all HARQ-ACK bits are multiplexing in one PUCCH, and the HARQ-ACK bit corresponding to SPS PDSCH is mapped to the end of HARQ-ACK codebook. Furthermore, if the multiplexed group-based HARQ-ACK is triggered for retransmission, the HARQ-ACK bit corresponding to SPS PDSCH should be simultaneously retransmitted. |
| Qualcomm  (R1-2002532) | When an SPS configuration is activated with a DCI that indicates non-numeric K1, the number of HARQ-Ack bits corresponding to SPS PDSCHs that are appended to the end of a dynamic HARQ-Ack codebook is nrofHARQ-Processes that is configured for the SPS configuration. |

# Conclusions

# References

1. R1-2001268 Feature lead summary#1 on NR-U phase 2 email discussion 100e-NR-unlic-NRU-HARQandULscheduling-02 (Type-3 HARQ-ACK codebook)
2. R1-2001269 Feature lead summary#1 on NR-U phase 2 email discussion 100e-NR-unlic-NRU-HARQandULscheduling-01 (enhanced Type-2 HARQ-ACK codebook)
3. R1-2001270 Feature lead summary of email discussion 100e-NR-unlic-NRU-HARQandULscheduling-03 (multi-PUSCH scheduling with DCI 0\_1)
4. R1-2002696 Feature lead summary#1 on NR-U HARQ, RAN1#100b-e
5. R1-2001536 Maintainance on HARQ-ACK enhancement Huawei, HiSilicon
6. R1-2001654 Remaining issues on HARQ operation for NR-U vivo
7. R1-2001707 Remaining issues on the HARQ for NR-U ZTE, Sanechips
8. R1-2001761 Discussion on the remaining issues of HARQ enhancements OPPO
9. R1-2001904 Remaining issues on HARQ operation for NR-U MediaTek Inc.
10. R1-2001937 Remaining issues of HARQ procedure for NR-U LG Electronics
11. R1-2001974 Remaining issues for HARQ enhancement for NR-U Lenovo, Motorola Mobility
12. R1-2001989 Enhancements to HARQ for NR-unlicensed Intel Corporation
13. R1-2002690 HARQ enhancement Ericsson
14. R1-2002119 HARQ enhancement for NR-U Samsung
15. R1-2002227 Remaining issues on NR-U HARQ scheduling and feedback Nokia, Nokia Shanghai Bell
16. R1-2002249 HARQ enhancement ETRI
17. R1-2002306 One shot HARQ ACK feedback InterDigital, Inc.
18. R1-2002384 Remaining issues and corrections on HARQ enhancement for NR-U Sharp
19. R1-2002532 TP for Enhancements to Scheduling and HARQ Operation for NR-U Qualcomm Incorporated
20. R1-2002631 Text proposal for enhanced dynamic HARQ procedures Google Inc.