**3GPP TSG RAN WG1 #106-e R1-210xxxx**

**e-Meeting, August 16th – 27th, 2021**

**Agenda Item:** 7.2.5

**Source:** LG Electronics

**Title:** Summary for email discussion [106-e-NR-L1enh-URLLC-11]

**Document for:** Discussion and decision

# Introduction

According to discussion at the preparation phase, the following email thread is allocated by Chairman for further discussion:

* [106-e-NR-L1enh-URLLC-11] Issue#17: SPS Release and SPS PDSCH Receptions with Slot Aggregation by August 20 - Duckhyun (LG)

This email discussion has been triggered by following contributions:

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| [**R1-2106676**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106676.zip) | SPS Release and SPS PDSCH Receptions with Slot Aggregation | Ericsson |
| [**R1-2106827**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106827.zip) | [Draft CR] Handling of HARQ-ACK feedback for SPS release | Nokia, Nokia Shanghai Bell |
| [**R1-2106862**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106862.zip) | Draft CR on SPS release with aggregation factor | Samsung |
| [**R1-2107557**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107557.zip) | Discussion on Nokia draft CRs on Rel-16 URLLC/IIoT Scheduling/HARQ and SPS enhancements | Nokia, Nokia Shanghai Bell |
| [**R1-2107983**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107983.zip) | Maintenance on SPS enhancements | vivo |

The issue of “SPS Release and SPS PDSCH Receptions with Slot Aggregation” had been discussed in the previous meetings. Related email discussion and progress can be found in R1-2106358.

# Summary of contributions and E-mail Discussion

Most of proposal and draft CR is to capture previous agreements and conclusions following:

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| Conclusion (RAN1#105-e)  For SPS PDSCH release and SPS PDSCH reception with slot-aggregation, if a UE is configured to receive SPS PDSCHs over multiple slots for a TB by SPS configurations that are indicated to be released by a DCI format, UE can receive the PDCCH providing the DCI format only before end of the first occasion of corresponding SPS receptions.   * Note: The UE stops the PDSCH decoding and does not generate HARQ-ACK feedback information for the SPS PDSCH reception as in current specification.   Conclusion (RAN1#104bis-e)  The following is not supported:   * The case that SPS release is received in a slot where SPS PDSCH is configured to be received for the SPS configuration corresponding to the SPS release if the HARQ-ACK for the SPS release and the SPS reception mapping to different PUCCHs.   Agreement (RAN1#101e)  It is not supported that a SPS release PDCCH in a slot is received after the end of the SPS PDSCH reception in the slot for the same SPS configuration corresponding to the SPS release PDCCH if HARQ-ACKs for the SPS release and the SPS reception would map to the same PUCCH.   * FFS: if HARQ-ACKs for the SPS release and the SPS reception mapping to different PUCCHs |

Followings are related proposals including draft CR in this meetings

From R1-2106676:

* Reason for change:
  + Previous agreements and conclusions have not been captured in the specification.
* Summary of change:
  + The agreements and conclusions are reflected. The texts take into account that: (a) the SPS release can be a group release of multiple SPS configurations; (b) multiple SPS configurations may have SPS PDSCHs in the same slot, and the SPS PDSCHs may overlap, in which case the UE is only expected to receive a subset of the SPS PDSCHs; (c) A SPS PDSCH may use slot aggregation.

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| **9.1 HARQ-ACK codebook determination**  <Unchanged parts are omitted>  In the remaining of this clause, reference is to one HARQ-ACK codebook and to DCI formats that schedule PDSCH reception, or indicate SPS PDSCH release, or indicate SCell dormancy without scheduling a PDSCH reception and are associated with the HARQ-ACK codebook.  If a UE is expected to receive SPS PDSCHs in a slot according to Clause 5.1 of [6] and Clause 11.1 for SPS PDSCH transmission occasions of TBs for SPS configurations that are indicated to be released by a DCI format, the UE is not expected to receive the DCI format in the slot if the end of the last symbol of the PDCCH reception is after the end of a last symbol of any of the SPS PDSCH transmission occasion(s) that are expected to be received.  If a UE is configured to receive SPS PDSCHs in a slot for SPS configurations that are indicated to be released by a DCI format, and if the UE receives the PDCCH providing the DCI format in the slot ~~where the end of a last symbol of the PDCCH reception is not after the end of a last symbol of any of the SPS PDSCH receptions,~~ and if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH receptions would be multiplexed in a same PUCCH, the UE does not expect to receive the SPS PDSCHs, does not generate HARQ-ACK information for the SPS PDSCH receptions, and generates a HARQ-ACK information bit for the SPS PDSCH release.  If a UE is configured to receive SPS PDSCH(s) in a slot for SPS configuration(s), the UE does not expect to receive a PDCCH providing a DCI format in the slot to indicate SPS PDSCH release of these SPS configuration(s), if HARQ-ACK information for the SPS PDSCH release and for the SPS PDSCH reception(s) would map to different PUCCHs.  <Unchanged parts are omitted> |

From R1-2107557:

During the [105-e-NR-L1enh-URLLC-05] discussions, it was discussed that the TP shall consider the following aspects:

* Point 1: (By Huawei/HiSilicon) TP should address SPS occasions in multiple slots and UE is not expected to receive any release DCI during in a slot where UE is required to receive SPS occasion other than first SPS occasion.
* Point 2: (By Ericsson) TP should address TDD operation, to consider only valid SPS occasion.
* Point 3: (By Ericsson) It is desirable to consider SPS collision handling in Clause 5.1 in TS 38.214
* Point 4: (By Samsung) It should be clear whether it is allowed to transmit PDCCH in slot where SPS occasion is omitted.

A text proposal to TS 38.213, Sec. 9.1 was proposed by the FL in R1-2106358 Sec. 2.1.3 trying to address the above aspects. The most controversial part (i.e. first paragraph) is pasted below for convenience:

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| If a UE is required to receive SPS PDSCHs in a slot according to Clause 5.1 of [6] and Clause 11.1 for SPS PDSCH transmission occasions of TBs for SPS configurations that are indicated to be released by a DCI format, the UE is not expected to receive the DCI format in the slot if the end of the last symbol of the PDCCH reception is after the end of a last symbol of any of the SPS PDSCH transmission occasions that are required to be received of TBs. |

From the TP fragment above, we have little empathy with the wording “SPS PDSCH transmission occasions (…) of TBs” as it is not very clear that it relates to SPS PDSCH occasions due to *pdsch-AggregationFactor*, and such terminology is used only in TS 38.214 but not in TS 38.213 specifications. Also, how the TP addresses Point 1 raised by Huawei is also not very clear to us. With this in mind, we provide an alternative proposal below, based on the following logic:

* The second and third paragraphs are the same as found in the latest FL’s proposal in R1-2106358, which did not receive any objections during RAN#105-e discussions.
* For the first paragraph, blue highlight addresses Point 1 from Huawei in a clearer manner, green addresses Point 2 and 3 from Ericsson, and yellow addresses Point 4 from Samsung.

**The first paragraph:**

If a UE is required to receive SPS PDSCHs in a slot according to Clause 5.1 of [6] and Clause 11.1 for SPS configurations that are indicated to be released by a DCI format, the UE is not expected to receive the DCI format in the slot if the end of the last symbol of the PDCCH reception is after the end of a last symbol of any of the SPS PDSCH receptions. For SPS configurations subject to *pdsch-AggregationFactor*, the UE is not expected to receive the DCI format in a slot containing SPS PDSCH transmission occasions other than the first transmission occasion required to be received by the UE.

From R1-2106827:

* Reason for change:
  + Capture the corrections on the handling of HARQ-ACK feedback for SPS release with and without pdsch slot aggregation, in line with the conclusions/agreements reached in RAN1#101e ([101-e-NR-L1enh-URLLC-IIoTenh-02]), RAN1#104bis-e ([104b-e-NR-L1enh-URLLC-05]), RAN1#105-e ([105-e-NR-L1enh-URLLC-05]).
* Summary of change:
  + Clarify that
    - 1) UE does not expect to receive a SPS PDSCH and a corresponding SPS release DCI in the same slot if their HARQ-ACK feedback would map to different PUCCHs;
    - 2) UE does not expect to receive a SPS PDSCH and a corresponding SPS release DCI in the same slot, if the DCI is received after the end of the SPS PDSCH; and
    - 3) for releasing a PDSCH with slot-aggregation, the UE can receive the PDCCH providing the DCI format only before end of the first occasion of corresponding SPS receptions.

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| 9.1 HARQ-ACK codebook determination  < Unchanged parts are omitted >  In the remaining of this clause, reference is to one HARQ-ACK codebook and to DCI formats that schedule PDSCH reception, or indicate SPS PDSCH release, or indicate SCell dormancy without scheduling a PDSCH reception and are associated with the HARQ-ACK codebook.  If a UE is required to receive SPS PDSCHs in a slot according to Clause 5.1 of [6] and Clause 11.1 for SPS configurations that are indicated to be released by a DCI format, the UE is not expected to receive the DCI format in the slot if the end of the last symbol of the PDCCH reception is after the end of a last symbol of any of the SPS PDSCH receptions. For SPS configurations subject to *pdsch-AggregationFactor*, the UE is not expected to receive the DCI format in a slot containing SPS PDSCH transmission occasions other than the first transmission occasion required to be received by the UE.  If a UE is configured to receive SPS PDSCHs in a slot for SPS configurations that are indicated to be released by a DCI format, and if the UE receives the PDCCH providing the DCI format in the slot, and if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH receptions would be multiplexed in a same PUCCH, the UE does not expect to receive the SPS PDSCHs, does not generate HARQ-ACK information for the SPS PDSCH receptions, and generates a HARQ-ACK information bit for the SPS PDSCH release.  If a UE is configured to receive SPS PDSCH(s) in a slot for SPS configuration(s), the UE does not expect to receive a PDCCH providing a DCI format in the slot to indicate SPS PDSCH release of these SPS configuration(s), if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH reception(s) would map to different PUCCHs.  < Unchanged parts are omitted > |

From R1-2106862:

* Reason for change:
  +   
    The aforementioned agreement and conclusions have not yet been captured in the latest specification. To complete the definition of UE behaviour for SPS release PDCCH with SPS PDSCH configured with or without aggregation factor and same or different PUCCHs, the aforementioned agreement and conclusions should be captured in Spec.
* Summary of change:
  + To clarify UE behavior when the SPS release PDCCH indicates the release of a SPS PDSCH which is configured with aggregation factor and the ACK/NACK for the PDCCH and the SPS PDSCH would map to the same or different PUCCHs.

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| 9.1 HARQ-ACK codebook determination \*\*\* Unchanged text is omitted \*\*\*  If a UE is required to receive SPS PDSCHs in a slot according to Clause 5.1 of [6] and Clause 11.1 for SPS PDSCH transmission occasions of TBs for SPS configurations that are indicated to be released by a DCI format, the UE is not expected to receive the PDCCH providing the DCI format in the slot if the end of the PDCCH reception is after the end of a last symbol of any of the first SPS PDSCH transmission occasions that are required to be received of TBs.  If a UE is configured to receive SPS PDSCHs in a slot for SPS configurations that are indicated to be released by a DCI format, and if the UE receives the PDCCH providing the DCI format in the slot, and if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH receptions would be multiplexed in a same PUCCH, the UE does not expect to receive the SPS PDSCHs, does not generate HARQ-ACK information for the SPS PDSCH receptions, and generates a HARQ-ACK information bit for the SPS PDSCH release.  If a UE is configured to receive SPS PDSCH(s) in a slot for SPS configuration(s), the UE does not expect to receive a PDCCH providing a DCI format in the slot to indicate SPS PDSCH release of these SPS configuration(s), if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH reception(s) would map to different PUCCHs. |

From R1-2107983:

**Proposal 1: Adopt the following text proposal for SPS PDSCH release and SPS receptions.**

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| ---------------------------------Start of Text Proposal to TS 38.213 v16.6.0-----------------------  **9.1              HARQ-ACK codebook determination**  …  If a UE is required to receive SPS PDSCHs in a slot according to Clause 5.1 of [6] and Clause 11.1 for SPS PDSCH transmission occasions of TBs for SPS configurations that are indicated to be released by a DCI format, the UE is not expected to receive a PDCCH providing the DCI format in the slot if the end of the last symbol of the PDCCH reception is after the end of a last symbol of any of the SPS PDSCH transmission occasions that are required to be received of TBs.    If a UE is configured to receive SPS PDSCHs in a slot for SPS configurations that are indicated to be released by a DCI format, and if the UE receives the PDCCH providing the DCI format in the slot ~~where the end of a last symbol of the PDCCH reception is not after the end of a last symbol of any of the SPS PDSCH receptions~~, and if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH receptions would be multiplexed in a same PUCCH, the UE does not expect to receive the SPS PDSCHs, does not generate HARQ-ACK information for the SPS PDSCH receptions, and generates a HARQ-ACK information bit for the SPS PDSCH release.  < Unchanged parts are omitted >  If a UE is configured to receive SPS PDSCH(s) in a slot for SPS configuration(s), the UE does not expect to receive a PDCCH providing a DCI format in the slot to indicate SPS PDSCH release of these SPS configuration(s), if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH reception(s) would map to different PUCCHs.  < Unchanged parts are omitted >  --------------------------------- End of Text Proposal to TS 38.213 v16.6.0----------------------- |

# Round 1 discussion

Based on the companies’ contribution and draft CR, all of CR has three parts of changes and 2nd and 3rd part are identical. Thus, it would be good to discuss remaining part first.

first paragraphs of draft CRs look similar. But there are few terms which makes changes.

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| **Common part of draft CRs:**  If a UE is required to receive SPS PDSCHs in a slot according to Clause 5.1 of [6] and Clause 11.1 [ (1) ] for SPS configurations that are indicated to be released by a DCI format, the UE is not expected to receive a PDCCH providing the DCI format in the slot if the end of the last symbol of the PDCCH reception is after [ (2) ]. |

For (1), most of companies suggest to use “for SPS PDSCH transmission occasions of TBs” in order to include the case where slot-aggregation is configured. Meanwhile, Nokia has concern that “SPS PDSCH transmission occasions” since this expression relates to SPS PDSCH occasions due to pdsch-AggregationFactor, and such terminology is used only in TS 38.214 but not in TS 38.213 specifications.

Since all draft CR using the terminology of “SPS PDSCH transmission occasion” at least for part (2), it may not be a problem to use “for SPS PDSCH transmission occasions of TBs”. Also, it would be also OK to remove that text if text has clear expression for slot-aggregation case.

Based on majority of views, moderator brings following Question for part (1):

Question 1 in Round 1:

Is it acceptable to add “for one or more SPS PDSCH transmission occasions of TBs” to (1)? Please indicates your view in the table below. It is highly appreciated to provide reasons in detail.

*Please share your view on* Question *1.*

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| Company name | Comments |
| CATT | Before discussing the text proposals, we realized that the previous agreement is not clear in case of cross-carrier SPS PDSCH release with different numerologies. To be more specific, it is not clear whether the slot in the following agreement is a slot with reference to numerology of release DCI or SPS PDSCH to be released.  Agreement (RAN1#101e)  It is not supported that a SPS release PDCCH in a slot is received after the end of the SPS PDSCH reception in the slot for the same SPS configuration corresponding to the SPS release PDCCH if HARQ-ACKs for the SPS release and the SPS reception would map to the same PUCCH.   * FFS: if HARQ-ACKs for the SPS release and the SPS reception mapping to different PUCCHs   In RAN1#100b-e meeting, the following conclusion was made for HARQ-ACK feedback for release DCI in case of cross-carrier release with different numerologies.  **Conclusion:**   * Type-1 HARQ-ACK Codebook for cross-carrier SPS release association: The codebook is associated with the last slot (on SPS PDSCH carrier) overlapping with the PDCCH providing SPS release. * The bit location of the SPS release in type-1 codebook is determined by the SLIV of the SPS PDSCH. * FFS whether spec update is needed or not.   We would like to clarify whether the release DCI as shown in the following figure is allowed to be transmitted or not. |
| HW/HiSi | It is ok. |
| vivo | Fine to add it. |
| Nokia / NSB | In the first occasion, this could be fine. |
| Ericsson | Support |
| Qualcomm | Ok to add. |

For (2), there are few kind of expression for previous conclusion in RAN1#105-e.

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| Conclusion (RAN1#105-e)  For SPS PDSCH release and SPS PDSCH reception with slot-aggregation, if a UE is configured to receive SPS PDSCHs over multiple slots for a TB by SPS configurations that are indicated to be released by a DCI format, UE can receive the PDCCH providing the DCI format only before end of the first occasion of corresponding SPS receptions.   * Note: The UE stops the PDSCH decoding and does not generate HARQ-ACK feedback information for the SPS PDSCH reception as in current specification. |

From Nokia’s contributions, following UE behavier seems not aligned with the conclusion. UE should be allowed to receive the SPS release DCI in the same slot if SPS PDSCH transmission occasion in the slot is not fully received yet. Please comment if there are some missing.

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| […]  For SPS configurations subject to pdsch-AggregationFactor, the UE is not expected to receive the DCI format in a slot containing SPS PDSCH transmission occasions other than the first transmission occasion required to be received by the UE.  […] |

From draft CRs, the moderator brings two options for part (2)

* Option 1: before the end of a last symbol of any of the SPS PDSCH transmission occasions that are required to be received of TBs.
* Option 2: before the end of a last symbol of any of the first SPS PDSCH transmission occasions that are required to be received of TBs.

Option 1 addresses “before … any of the SPS PDSCH…” to indicate first transmission occasion indirectly. It is more aligned with current specification for SPS PDSCH without slot-aggregation.

Option 2 address “before … first SPS PDSCH …” to indicate previous conclusion explicitly.

Both options are technically identical and bring same result. The moderator thinks these options are in realm of preferences. From those point of views, the moderator brings following question.

Question 2 in Round 1:

Please indicates your preference on Options above. It is highly appreciated to provide reasons in detail.

*Please share your view on above options.*

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| Company name | Comments |
| HW/HiSi | Option 1.  We think that word “before” could be removed from Option1. Isn’t the intention to replace the “2” below by either Option 1or Option 2?  *“….the UE is not expected to receive a PDCCH providing the DCI format in the slot if the end of the last symbol of the PDCCH reception is after [ (2) ].”*  So, if we append Option 1 to the text above, it would become:  *“the UE is not expected to receive a PDCCH providing the DCI format in the slot if the end of the last symbol of the PDCCH reception is after ~~Before~~ the end of a last symbol of any of the SPS PDSCH transmission occasions that are required to be received of TBs.”?* |
| vivo | Option 1 with HW’s update. |
| Nokia, NSB | First of all, we respectfully disagree with the moderator to dismiss our proposal. It seems the moderator forgot the conclusion from RAN1#105-e here – especially the yellow part:   |  | | --- | | **Conclusion (RAN1#105-e)**  For SPS PDSCH release and SPS PDSCH reception with slot-aggregation, if a UE is configured to receive SPS PDSCHs over multiple slots for a TB by SPS configurations that are indicated to be released by a DCI format, UE can receive the PDCCH providing the DCI format only before end of the first occasion of corresponding SPS receptions.   * Note: The UE stops the PDSCH decoding and does not generate HARQ-ACK feedback information for the SPS PDSCH reception as in current specification. |   So the point is not just, that the DCI needs to come the end of the slot, but based on the RAN1#105-e agreement, there is another restriction that the UE does expect to receive the release DCI in a slot of any other than the first SPS PDSCH repetition.  It seems this is fully missed in the discussion here and this was our reason to include the specific additional restriction for SPS with slot-based repetition.  So in this respect, neither Option 1 not Option 2 takes into account, that in a slot where a SPS PDSCH repetition other than the initial transmission is received, the release DCI cannot be received. Clearly Option 1 with ‘any’ does not take that into account. But also for Option 2, as our assumption is we talk about the same SPS PDSCH occasions from the beginning of the sentence (i.e. one or more), but then then one or more is associated with different SPS configurations, but we need the restriction of the first repetition / SPS repetition of a single SPS configuration .  **So neither of this options work!** |
| Ericsson | Option 1, with ‘before’ deleted as shown by Huawei.  Regarding Nokia comment, an additional sentence like below can address it:  “If a SPS configuration is configured with repetition, and the UE is expected to receive the corresponding SPS PDSCH in a slot, the UE is not expected to receive the DCI format in the slot if this is not the first slot that SPS PDSCH transmission occasions of a TB is expected to be received.” |
| Qualcomm | Option 1 with HW’s update. |

**(placeholder) Draft CR based on Q1 and Q2:**

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| 9.1 HARQ-ACK codebook determination \*\*\* Unchanged text is omitted \*\*\*  If a UE is required to receive SPS PDSCHs in a slot according to Clause 5.1 of [6] and Clause 11.1 for [ one or more SPS PDSCH transmission occasions of TBs] for SPS configurations that are indicated to be released by a DCI format, the UE is not expected to receive the PDCCH providing the DCI format in the slot if the end of the PDCCH reception is after [the end of a last symbol of any of the first SPS PDSCH transmission occasions that are required to be received of TBs.]  If a UE is configured to receive SPS PDSCHs in a slot for SPS configurations that are indicated to be released by a DCI format, and if the UE receives the PDCCH providing the DCI format in the slot, and if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH receptions would be multiplexed in a same PUCCH, the UE does not expect to receive the SPS PDSCHs, does not generate HARQ-ACK information for the SPS PDSCH receptions, and generates a HARQ-ACK information bit for the SPS PDSCH release.  If a UE is configured to receive SPS PDSCH(s) in a slot for SPS configuration(s), the UE does not expect to receive a PDCCH providing a DCI format in the slot to indicate SPS PDSCH release of these SPS configuration(s), if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH reception(s) would map to different PUCCHs. |

# References

1. R1-2106676, SPS Release and SPS PDSCH Receptions with Slot Aggregation, Ericsson
2. R1-2106827, [Draft CR] Handling of HARQ-ACK feedback for SPS release, Nokia, Nokia Shanghai Bell
3. R1-2106862, Draft CR on SPS release with aggregation factor, Samsung
4. R1-2107557, Discussion on Nokia draft CRs on Rel-16 URLLC/IIoT Scheduling/HARQ and SPS enhancements, Nokia, Nokia Shanghai Bell
5. R1-2107983, Maintenance on SPS enhancements, vivo