**3GPP TSG RAN WG1 #102-e R1-200xxxx**

**e-Meeting, August 17th – 28th, 2020**

**Agenda Item:** 7.2.5.7

**Source:** Moderator (LG Electronics)

**Title:** Summary on maintenance of other aspects for URLLC/IIOT

**Document for:** Discussion and decision

# Introduction

This document summarizes the topics under AI 7.2.5.7 others based on the contributions submitted to this AI, and provides FL recommendation to organize the subsequent email discussions. The relevant agreements from previous meetings can be found in Appendix.

# Summary and FL recommendation

Reserved

# Remaining issues on email discussions in RAN1#101

Based on e-mail discussion in the last meeting, there are some issues not fully resolved [1-3]. In this section, proposal related those issue are summarized from contributions in this meeting.

* 1. SPS PDSCH release and SPS PDSCH receptions

In the RAN1#101-e, it was discussed to specify UE behavior when UE receives SPS PDSCH release in a slot having SPS PDSCH. As a result, following agreement was made:

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| **Agreement**   * At least, support the case that in a slot SPS release PDCCH is received before the end of the SPS PDSCH reception for the same SPS configuration corresponding to the SPS release PDCCH   + 1 bit HARQ-ACK is generated for SPS release and a UE does not expect to receive the SPS PDSCH if HARQ-ACKs for the SPS release and the SPS reception would map to the same PUCCH.   + FFS whether and how to support the HARQ-ACK for the SPS release and the SPS reception mapping to different PUCCHs * FFS whether and how to support the case that SPS release PDCCH is received after the end of the SPS PDSCH for the same SPS configuration   **Agreement**  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 |

From submitted contributions, companies provides their views on following FFS point of SPS PDSCH release and SPS PDSCH receptions.

FFS:

* If the HARQ-ACK for the SPS release and the SPS reception mapping to different PUCCHs
  + SPS release PDCCH is received before the end of the SPS PDSCH reception for the same SPS configuration corresponding to the SPS release PDCCH [6][7][8][10][13]
  + SPS release PDCCH is received after the end of the SPS PDSCH for the same SPS configuration corresponding to the SPS release PDCCH [7][8][13][16]
  + Not support the case of the HARQ-ACK for the SPS release and the SPS reception in a slot mapping to different PUCCHs [9][12]

In addition, some companies raised their concern on other issue but also related to timeline between SPS release and SPS reception.

* How to handle joint release [8][11][17].
* An issue with other SPS configuration not corresponding to SPS release PDCCH, e.g., the case that UE receives in the same slot a SPS release DCI and a SPS PDSCH belonging to different SPS configurations if the corresponding HARQ-ACK information are mapped to the same bit position in a PUCCH [5][7][8].
* Cross carrier issues
  + For type-1 HARQ-ACK codebook, a HARQ-ACK bit position for SPS release PDCCH is same as the last corresponding SPS PDSCH reception among the multiple SPS PDSCH receptions. [18]
  + For cross-carrier SPS release, the latest PDSCH slot which overlaps with the release PDCCH is used to determine if the SPS release is supported or not.[11]
* Another issue related to timeline
  + A UE does not expect to be scheduled with a dynamic PDSCH overlapping in time with a SPS PDSCH, where none of scheduling PDCCH nor the SPS release PDCCH end sooner than 14 symbols before the start of the SPS PDSCH.[17]
    - Question: (1) Does “end sooner” means “end before” or “end shorter”? (2) Depending on 1, this seems duplicated or contradictory to current 14 symbol restriction of overlapping DG PDSCH with SPS PDSCH. In addition, our previous agreement was basically for SPS release DCI and SPS PDSCH in same slot. Do we need additional restriction?
  + UE does not expect to receive a PDCCH that schedules a DG-PDSCH overlapping with SPS-PDSCH, and the PDCCH ends sooner than 14 symbols before the start of the SPS-PDSCH, and the PDCCH is received before the end of the expected transmission of HARQ-ACK for SPS release PDCCH. [17]
    - Question: (1) Does “end sooner” means “end before” or “end shorter”? (2) Depending on 1, this seems duplicated or contradictory to current 14 symbol restriction of overlapping DGPDSCH with SPS PDSCH? In addition, our previous agreement was basically for SPS release DCI and SPS PDSCH in same slot. Do we need additional restriction?
  + FL comment: It should be common understanding that gNB must not be optimistic. If gNB want to release SPS PDSCH and to utilize its resource, gNB should keep timeline restriction unless gNB verify SPS release at gNB perspective. It seems not necessary to specify as specification description.
* Clarify whether to generate NACK or omit HARQ-ACK bit in the case that in a slot SPS release PDCCH is received before the end of the SPS PDSCH reception for the same SPS configuration corresponding to the SPS release PDCCH [15]
  + FL comment: Based on current specification, HARQ-ACK PUCCH is constructed by two part; determining bit length and filling HARQ result. Our previous agreement is for latter one, so HARQ-ACK bit length shouldn’t change for my understanding. Please comment if you have different understanding.

**Comment:**

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| Company | Priority  (High/Low) | Comment |
| LGE | High | This issue started from two meetings ago since it is essential. It should be finalized in this meeting. |
| Qualcomm | High | Need to resolve the FFS left from the previous meetings, and related issues.  To FL’s questions, in both cases, “ends sooner than” means “ends shorter than” or “ends within 14 symbols…”. |
| Ericsson | High | We want to bring attention that multiple SPS release (i.e., group release) applicability to previous agreements (quoted above) should be discussed as well alongside with the current issue |
| Samsung | High |  |
| vivo | High | FFS and joint release need to be resolved. |
| HW/HiSi | High |  |
| Nokia / NSB | High | We should try to wrap this up this time. |

Proposals from contributions:

<ZTE, [5]>

***Proposal 3:*** *In a slot, if a release DCI is received, and an SPS configuration deactivated by the release DCI overlaps with other SPS PDSCH reception, while HARQ-ACKs for the release DCI and all the SPS PDSCH receptions would map to the same PUCCH, 1 bit HARQ-ACK will be generated for the release DCI and UE does not expect to receive the deactivated SPS PDSCH reception and other SPS PDSCH reception overlapping with the deactivated SPS configuration.*

<Ericsson, [6]>

Proposal 2 Multiple SPS release PDCCH and SPS PDSCH reception should be allowed within the same slot.

Proposal 3 Support the HARQ-ACK for the SPS release and the SPS reception mapping to different PUCCHs.

Proposal 4 1-bit HARQ-ACK is generated for SPS release and a UE does not expect to receive the SPS PDSCH if HARQ-ACKs for the SPS release and the SPS reception would map to the different PUCCHs.

Proposal 5 Do not allow SPS release PDCCH to be received after the end of the SPS PDSCH for the same SPS configuration within the same slot.

<Nokia, [7]>

**Proposal 1: In a slot, if SPS release PDCCH is received before the end of the SPS PDSCH reception for the same SPS configuration corresponding to the SPS release PDCCH, and if HARQ-ACK for the SPS release and the SPS reception would map to different PUCCHs:**

* + **The UE is not expected to receive the SPS PDSCH and separate HARQ-ACK bits (NACK for the SPS PDSCH and ACK for SPS release) are reported, unless the PUCCH for SPS reception would only contain feedback for the SPS PDSCH, in which case the PUCCH for SPS reception is not reported.**

**Proposal 2: In a slot, if SPS release PDCCH is received after the end of the SPS PDSCH reception for the same SPS configuration corresponding to the SPS release PDCCH, and if HARQ-ACK for the SPS release and the SPS reception would map to different PUCCHs, the UE receives the SPS PDSCH and generates HARQ-ACK information for the SPS release and the SPS reception**

**Proposal 3: For UEs with the capability to decode a single PDSCH per slot and Type-1 HARQ-ACK codebook, a UE is not expected to receive in the same slot a SPS release DCI and a SPS PDSCH belonging to different SPS configurations if the corresponding HARQ-ACK information are mapped to the same bit position in a PUCCH.**

<CATT, [8]>

Proposal 3: In a slot, if SPS release DCI is received before the end of the SPS PDSCH for the same SPS configuration, UE does not expect to receive the SPS PDSCH and does not generate HARQ-ACK information for the SPS PDSCH if HARQ-ACK for the SPS release and the SPS reception would map to different PUCCHs.

Proposal 4: In a slot, if SPS release DCI is received after the end of the SPS PDSCH for the same SPS configuration, separate HARQ-ACK bits would be generated when the HARQ-ACK for the SPS release and the SPS reception would map to different PUCCHs.

Proposal 5: A joint SPS release DCI can be received in a slot before the end of an SPS PDSCH other than the SPS PDSCH with the lowest configuration index released by the DCI.

Proposal 6: For the HARQ-ACKs for the release DCI and SPS PDSCH for a different configuration from the SPS configuration indicated in the release DCI, if they map to the same PUCCH when a UE is capable of receiving only one unicast PDSCH or their corresponding SLIVs belong to the same SLIV group even if the UE is capable of receiving more than one unicast PDSCH, down select from the following two alternatives:

*Alternative 1: UE does not expect to generate HARQ-ACK feedback for the SPS PDSCH and always generate HARQ-ACK feedback for the release DCI.*

*Alternative 2: UE does not expect to receive the release DCI in this case.*

*Otherwise, UE can receive the release DCI and the SPS PDSCH for different SPS configuration in the same slot and generate separate HARQ-ACK bits.*

Proposal7: SPS PDSCH cancellation due to SPS overlapping or overlapping with semi-static uplink symbols should be performed before handling the case of receiving release DCI and SPS PDSCH in the same slot.

<NEC, [9]>

***Proposal 1***: *Do not support mapping HARQ-ACK for the SPS release and the SPS PDSCH reception to different PUCCH.*

However, even if HARQ-ACK mapping to different PUCCHs is supported, symbol after the first symbol of SPS release PDCCH can be considered as the time when SPS PDSCH configuration is released.

<OPPO, [10]>

***Proposal 1: Support PDSCH and SPS release in the same slot, including SPS release PDCCH is received before the end of the SPS PDSCH reception for the same SPS configuration and SPS release PDCCH is received after the end of the SPS PDSCH reception for the same SPS configuration, if their corresponding HARQ-ACK feedback are reported in different PUCCHs.***

<Samsung, [11]>

***Proposal 4: In case of joint SPS release, down select from the two options below.***

* ***Alt. 1 (behavior 1): It is not supported that a SPS release PDCCH in a slot is received after the end of any of the SPS PDSCH receptions with the indicated SPS configurations in the slot, if HARQ-ACKs for the SPS release PDCCH and the indicated SPS receptions in the slot would map to the same PUCCH***
* ***Alt. 2 (behavior 2): It is not supported that a SPS release PDCCH in a slot is received after the end of every SPS PDSCH reception with the indicated SPS configurations in the slot, if HARQ-ACKs for the SPS release and the indicated SPS receptions in the slot would map to the same PUCCH. UE is not expected to receive the indicated SPS PDSCHs ending later than release PDCCH.***

***Proposal 5: For cross-carrier SPS release, the latest PDSCH slot which overlaps with the release PDCCH is used to determine if the SPS release is supported or not.***

***Proposal 6: The following TP should be adopted for Proposal 4 (Alt 2), Proposal 5 for TS 38.213 V16.2.0 Section 9.1.***

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| **TS 38.213** 9.1 HARQ-ACK codebook determination …  UE is not expected to receive one or more SPS PDSCHs in a slot, if UE receives a PDCCH indicating a SPS PDSCH release corresponding to the SPS configurations of the SPS PDSCHs in the slot, where the slot is the slot which overlaps with the end of the ending symbol of the PDCCH, if   * The end of a last symbol of the PDCCH reception is after the end of a last symbol of all the indicated SPS PDSCH reception(s) in the slot, and * HARQ-ACK information for the SPS PDSCH release and the indicated SPS PDSCH receptions in the slot would be multiplexed in a same PUCCH   If a UE is configured to receive one or more SPS PDSCH(s) in a slot, and if the UE receives a PDCCH  indicating a SPS PDSCH release corresponding to one or more SPS configuration(s) in the slot where the end of a last symbol of the PDCCH reception is not after the end of a last symbol of all of the SPS PDSCH reception(s), and if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH reception(s) would be multiplexed in a same PUCCH, the UE does not expect to receive the SPS PDSCH(s) in the slot, which end after the end of the PDCCH, does not generate HARQ-ACK information for the SPS PDSCH reception(s), and generates a HARQ-ACK information bit for the SPS PDSCH release. … |

***Proposal 7: When the SPS PDSCH is configured with aggregation factor, for SPS release when HARQ-ACKs for the SPS release PDCCH and the SPS reception are mapped to the same PUCCH, down select from the following options.***

* ***Alt. 1 It is not supported that a SPS release PDCCH in a slot is received after the end of any of the SPS PDSCH receptions among the SPS PDSCH repetition period.***
* ***Alt. 2 It is not supported that a SPS release PDCCH in a slot is received after the end of the last SPS PDSCH reception among the SPS PDSCH repetition period. If release PDCCH is received before the last SPS PDSCH, then UE is not expected to receive the SPS PDSCH, and only HARQ-ACK for release PDCCH is reported.***

***Proposal 8: The following TP should be adopted for Proposal 7 (Alt 2) for TS 38.213 V16.2.0 Section 9.1***

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| **TS 38.213** 9.1 HARQ-ACK codebook determination …  If a UE is configured to receive a SPS PDSCH in a slot for a SPS configuration, and if the UE receives a PDCCH  indicating a SPS PDSCH release corresponding to the SPS configuration in the slot where the end of a last symbol of the PDCCH reception is not after the end of a last symbol of the SPS PDSCH reception in the slot or not after the end of a last symbol of the last occasion of the SPS PDSCH reception with aggregation factor, and if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH reception would be multiplexed in a same PUCCH, the UE does not expect to receive the SPS PDSCH, does not generate HARQ-ACK information for the SPS PDSCH reception, and generates a HARQ-ACK information bit for the SPS PDSCH release.  … |

<LG, [12]>

Proposal 2: It is not supported that a SPS release PDCCH is received in a slot where SPS PDSCH reception is configured for the same SPS configuration corresponding to the SPS release PDCCH if the HARQ-ACKs for the SPS release and the SPS reception mapping to different PUCCHs

<Huawei, Hisilicon, [13]>

***Proposal 3:******For the scenario where SPS release DCI and SPS PDSCH for the same configuration are received in the same slot, the following cases are supported in addition to the already agreed case 1-2:***

* ***Case 1-1: In a slot, if SPS release DCI is received before the end of the SPS PDSCH for the same SPS configuration*** 
  + ***Support the HARQ-ACK for the SPS release and the SPS reception mapping to different PUCCHs***
* ***Case 2: In a slot, if SPS release DCI is received after the end of the SPS PDSCH for the same SPS configuration*** 
  + ***Case 2-1: 1 bit HARQ-ACK is generated for SPS release and a UE does not expect to receive the SPS PDSCH if HARQ-ACKs for the SPS release and the SPS reception would map to the same PUCCH.***
  + ***Case 2-2: Support the HARQ-ACK for the SPS release and the SPS reception mapping to different PUCCHs***

< Asia Pacific Telecom, [15]>

**Proposal 1: Clarify in the case that in a slot SPS release PDCCH is received before the end of the SPS PDSCH reception for the same SPS configuration corresponding to the SPS release PDCCH, interpretation 1 or interpretation 2 is adopted.**

* **Interpretation 1: HARQ-ACK bit for the SPS PDSCH is included in a Type-2 HARQ-ACK codebook and it is set to NACK.**
* **Interpretation 2: HARQ-ACK bit for the SPS PDSCH is not included in a Type-2 HARQ-ACK codebook.**

<NTT DoCoMo, [16]>

**Proposal 1:**

* *It is not supported that a SPS release PDCCH in a slot is received before 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 different PUCCHs.*
* *It is 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 different PUCCHs.*
  + *HARQ-ACKs are generated for the SPS release and the SPS PDSCH*
* *Adopt following TP in TS 38.213 section 9.1*

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| 9.1 HARQ-ACK codebook determination  [….]  If a UE is configured to receive a SPS PDSCH in a slot for a SPS configuration, and if the UE receives a PDCCH  indicating a SPS PDSCH release corresponding to the SPS configuration in the slot where the end of a last symbol of the PDCCH reception is not after the end of a last symbol of the SPS PDSCH reception, and if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH reception would be multiplexed in a same PUCCH, the UE does not expect to receive the SPS PDSCH, does not generate HARQ-ACK information for the SPS PDSCH reception, and generates a HARQ-ACK information bit for the SPS PDSCH release.  If a UE is configured to receive a SPS PDSCH in a slot for a SPS configuration, and if the UE receives a PDCCH  indicating a SPS PDSCH release corresponding to the SPS configuration in the slot where the end of a last symbol of the PDCCH reception is after the end of a last symbol of the SPS PDSCH reception, and if HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH reception would be transmitted in different PUCCHs, the UE generates HARQ-ACK information for the SPS PDSCH release and the SPS PDSCH reception.  [….] |

< Qualcomm, [17]>

**Proposal 1: For the case that in a slot, a SPS release PDCCH is received before the end of the SPS PDSCH reception for the same SPS configuration, do not support the HARQ-ACK for the SPS release and the SPS reception mapping to different PUCCHs.**

**Proposal 2: 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 regardless of HARQ-ACKs for the SPS release and the SPS reception would map to the same PUCCH or to different PUCCHs.**

**Proposal 3: Support the case that in a slot, a SPS joint release PDCCH is received before the end of all SPS PDSCH receptions for the SPS configurations corresponding to the SPS joint release PDCCH**

* **A 1-bit HARQ-ACK is generated for joint SPS release and a UE does not expect to receive any of the SPS PDSCHs**

**Proposal 4: It is not supported that a SPS joint release PDCCH in a slot is received after the end of any of the SPS PDSCH receptions in the slot for the SPS configurations corresponding to the SPS release PDCCH.**

**Proposal 5: A UE does not expect to be scheduled with a dynamic PDSCH overlapping in time with a SPS PDSCH, where none of scheduling PDCCH nor the SPS release PDCCH end sooner than 14 symbols before the start of the SPS PDSCH.**

**Proposal 6: UE does not expect to receive a PDCCH that schedules a DG-PDSCH overlapping with SPS-PDSCH, and the PDCCH ends sooner than 14 symbols before the start of the SPS-PDSCH, and the PDCCH is received before the end of the expected transmission of HARQ-ACK for SPS release PDCCH.**

< WILUS Inc., [18]>

* + ***Proposal 1: For type-1 HARQ-ACK codebook, a HARQ-ACK bit position for SPS release PDCCH is same as the last corresponding SPS PDSCH reception among the multiple SPS PDSCH receptions.***
  + ***Proposal 2: Adopt the following text proposal for TS38.213***

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| 9.1.2.1 Type-1 HARQ-ACK codebook in physical uplink control channel  =============================Unchanged part is omitted===================================  For the set of slot timing values, the UE determines a set of  occasions for candidate PDSCH receptions or SPS PDSCH releases according to the following pseudo-code. A location in the Type-1 HARQ-ACK codebook for HARQ-ACK information corresponding to a single SPS PDSCH release is same as for ~~a~~the last corresponding SPS PDSCH reception. A location in the Type-1 HARQ-ACK codebook for HARQ-ACK information corresponding to multiple SPS PDSCH releases by a single DCI format is same as for ~~a~~the last corresponding SPS PDSCH reception with the lowest SPS configuration index among the multiple SPS PDSCH releases.  =============================Unchanged part is omitted=================================== |

* 1. Potential ambiguity between SPS PDSCH release and codebook for SPS PDSCH receptions

There is remaining issue on SPS release timeline and determination codebook for SPS PDSCH receptions. Currently, type-2 HARQ-ACK codebook is based on received PDCCH and activated SPS PDSCH configuration. It means type-2 HARQ-ACK codebook can be changed depending on when SPS PDSCH is released.

Based on companies contributions, some companies want to define timeline of SPS release when SPS PDSCH are release [5][9][15] and other companies think current specification can work properly [4][12][13]. Basically, SPS PDSCH release by MAC after PDCCH decoding. For our understanding, it is questionable that RAN1 defines timeline of SPS PDSCH release and PDCCH reception at this stage. Moreover, SPS PDSCH can be release by RRC configuration which is not possible to specify timeline. Even in that case, UE should be able to transmit HARQ-ACK PUCCH. In the FL’s perspective, the issue seems not inevitable and can be resolve by proper K1 selected by gNB.

**Comment:**

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| --- | --- | --- |
| Company | Priority  (High/Low) | Comment |
| LGE | Low | The issue seems not inevitable and can be resolve by proper K1 selected by gNB. |
| Ericsson | Low | Agree with FL that with proper K1, this won’t be an issue. |
| Samsung | High | We have the following agreements in the last meeting  **Agreement**   * At least, support the case that in a slot SPS release PDCCH is received before the end of the SPS PDSCH reception for the same SPS configuration corresponding to the SPS release PDCCH   + 1 bit HARQ-ACK is generated for SPS release and a UE does not expect to receive the SPS PDSCH if HARQ-ACKs for the SPS release and the SPS reception would map to the same PUCCH.   In our understanding, according to the agreements if UE receives the SPS release DCI, UE does not expect to receive the SPS PDSCH and the SPS PDSCH should be considered as released. If the release DCI is miss detected by UE, there will be ambiguity issue. gNB will consider the SPS PDSCH as released but UE considers it as activated. gNB and UE will have different understanding of the Type-2 HARQ-ACK codebook.  In Huawei’s contribution [13], it is pointed out that before the ACK is sent by the UE, the SPS PDSCH should not be released.  It seems different companies have different views on at what time the SPS PDSCH is released. We think this issue is essential and should be addressed. |
| Vivo | Low | For Type 2, even if the SPS release PDCCH is missed, there is total DAI, so the HARQ-ACK codebook size will not be misunderstood by gNB. The codebook size misalignment btw gNB and UE caused by miss-detection of PDCCH is not specific issue for SPS PDCCH release.  In addition, agree with FL, with proper K1, there is no problem. |
| Nokia, NSB | Low | Agree with FL, can be handled by proper K1 selection |

**Proposals from contributions:**

<Vivo, [4]>

**Proposal 2: There is no potential ambiguity between SPS PDSCH release and codebook for SPS PDSCH receptions.**

<ZTE, [5]>

***Proposal 2:*** *In order to avoid the ambiguity of HARQ-ACK codebook structure caused by release DCI, it is recommended that RAN1 consider the following methods:*

* *Alt1:RAN1 defines the timeline of release DCI taking effect.*
* *Alt2: Adopt that PUCCH for SPS release should be earlier than PUCCH for SPS PDSCH receptions including the SPS PDSCH to be released.*

<NEC, [9]>

***Proposal 2***: *SPS PDSCH configuration is released after the starting symbol of SPS PDSCH release PDCCH.*

<LG, [12]>

Proposal 4: it is not necessary to specify timeline of SPS release DCI reception and codebook for SPS PDSCH receptions.

<Huawei, Hisilicon, [13]>

In our view, there is no confusion. There will be one ACK feedback for the released DCI, so we think before the ACK is sent by the UE, the SPS PDSCH should not be released.

< Asia Pacific Telecom, [15]>

Proposal 2: A SPS PDSCH configuration is considered as released N symbols after the end of a SPS PDSCH release DCI indicating release of the corresponding SPS configuration.

* 1. Counting HARQ-ACKs for SPS PDSCH cancelled by dynamic SFI/DCI

In the last e-meeting, there is an issue raised and remains. According to current specification, PUCCH power control takes into account the number of information bit. However, if meaningful information bit for HARQ-ACK is zero, and if there is no other meaningful information bit, PUCCH power control offset becomes minus infinity. For example, if UE fills NACK information due to cancelled PDSCH, it occupies HARQ-ACK codebook but would not increase. Then for the PUCCH would be zero if all HARQ-ACK in a PUCCH is for cancelled PDSCH.

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| Agreements:   * HARQ-ACK feedback for a SPS PDSCH is included in the HARQ-ACK codebook when the SPS PDSCH is cancelled by DCI/dynamic SFI in which case NACK is generated for the SPS PDSCH.   Agreements: (updated)  **HARQ-ACK feedback for a SPS PDSCH is included in the HARQ-ACK codebook when the SPS PDSCH is cancelled by DCI/dynamic SFI in which case NACK is generated for the SPS PDSCH.**   * **For type-1 codebook, the main bullet is not applied if only a single HARQ-ACK bit, for an SPS PDSCH, is mapped on a PUCCH; otherwise, the main bullet is applied.** * **For type-2 codebook, the main bullet is applied.** |

Based on the contribution, there are some different view on this issue as followings:

* Specify to drop such PUCCH transmission [8][11]
* Count SPS PDSCH regardless of cancellation [5]
* Keep current specification [4][12][13]
  + Reasons:
    - This is corner case and, can be avoided/handled by gNB
    - Minus infinity power offset could mean that UE won’t transmit PUCCH

Based on the contributions, two companies want to specify additional UE ehaviour and one company want to change UE ehaviour as a solution. On the other hand, one companies think the issue can be avoided by gNB, and two companies think the minus infinity power offset could means no transmission without additional description. Though we have only few inputs for each views, what we see here is that some companies proposed a solution and the other companies thinks UE may work as proposed with current specification or work properly by gNB implementation. If it is, the issue seems not essential.

**Comment:**

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| --- | --- | --- |
| Company | Priority  (High/Low) | Comment |
| LGE | Low | The issue can be avoided by gNB and UE may work as proposed solution without additional spec description. |
| Qualcomm | Low |  |
| Ericsson | Medium | The definition of used in can be changed, indicating number of HARQ-ACK bits generated for SPS PDSCHs rather than PDSCH reception. |
| Samsung | Medium | This case can happen due to TSN period misalignment, gNB can cancel the transmission of empty SPS PDSCHs. There is an error in current spec, we think it needs to be fixed. |
| Vivo | Low | This can be avoided by gNB. |
| Nokia, NSB | Medium | Not all of it may be needed, but some of the clarifications (e.g. in [8] and [11]) could be maybe useful (and clearly don’t hurt) |

**Proposals from contributions:**

<Vivo, [4]>

**Proposal 1: The power issue of counting HARQ-ACKs for SPS PDSCH cancelled by dynamic SFI/DCI does not need to be handled.**

<ZTE, [5]>

***Proposal 1:*** *Endorse TP#1 for section 9.1.3.1 in TS 38.213.*

**TP# 1 for section 9.1.3.1 in TS 38.213**

|  |
| --- |
| 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel **…**  If a UE is not provided *PDSCH-CodeBlockGroupTransmission* for each of the  serving cells, or for PDSCH receptions scheduled by a DCI format that does not support CBG-based PDSCH receptions, or for SPS PDSCH reception, or for SPS PDSCH release, and if , the UE determines a number of HARQ-ACK information bits  for obtaining a transmission power for a PUCCH, as described in Clause 7.2.1, as    …  -  is the number of SPS PDSCH receptions, which are configured to receive, by the UE on serving cell  for which the UE transmits corresponding HARQ-ACK information in the same PUCCH as for HARQ-ACK information corresponding to PDSCH receptions within the  PDCCH monitoring occasions  .… |

<CATT, [8]>

Proposal 8: UE does not transmit a HARQ-ACK codebook if all the corresponding SPS PDSCH(s) are cancelled and there is no HARQ-ACK for a PDSCH scheduled by a DCI multiplexed in the same HARQ-ACK codebook.

<Samsung, [11]>

***Proposal 3: For a PUCCH transmission using PUCCH format 2 or PUCCH format 3 or PUCCH format 4 and for a number of UCI bits smaller than or equal to 11, if UCI only contains all known NACKs for the cancelled SPS PDSCHs in the HARQ-ACK codebook, UE does not transmit the PUCCH. The following TP should be adopted.***

|  |
| --- |
| **TS 38.213** 9.1.2.1 Type-1 HARQ-ACK codebook in physical uplink control channel **…**  If , the UE determines a number of HARQ-ACK information bits  for obtaining a transmission power for a PUCCH, as described in Clause 7.2.1, as  where  -  is the number of transport blocks the UE receives in PDSCH reception occasion  for serving cell  if *harq-ACK-SpatialBundlingPUCCH* and *PDSCH-CodeBlockGroupTransmission* are not provided, or the number of transport blocks the UE receives in PDSCH reception occasion  for serving cell  if *PDSCH-CodeBlockGroupTransmission* is provided and the PDSCH reception is scheduled by a DCI format 1\_0, or the number of PDSCH receptions if *harq-ACK-SpatialBundlingPUCCH* is provided or SPS PDSCH release in PDSCH reception occasion  for serving cell  and the UE reports corresponding HARQ-ACK information in the PUCCH.  -  is the number of CBGs the UE receives in a PDSCH reception occasion  for serving cell  if *PDSCH-CodeBlockGroupTransmission* is provided and the PDSCH reception is scheduled by a DCI format 1\_1 and the UE reports corresponding HARQ-ACK information in the PUCCH.  If, and UE does not transmit HARQ-ACK information in the PUCCH.  … 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel **…**  If a UE is not provided *PDSCH-CodeBlockGroupTransmission* for each of the  serving cells, or for PDSCH receptions scheduled by a DCI format that does not support CBG-based PDSCH receptions, or for SPS PDSCH reception, or for SPS PDSCH release, and if , the UE determines a number of HARQ-ACK information bits  for obtaining a transmission power for a PUCCH, as described in Clause 7.2.1, as    where  …  -  is the number of SPS PDSCH receptions by the UE on serving cell  for which the UE transmits corresponding HARQ-ACK information in the same PUCCH as for HARQ-ACK information corresponding to PDSCH receptions within the  PDCCH monitoring occasions.  If, and UE does not transmit HARQ-ACK information in the PUCCH.  … |

<LGE, [12]>

Proposal 1: no specification change is needed for counting HARQ-ACKs bits for cancelled SPS PDSCH by dynamic SFI/DCI

<Huawei, Hisilicon, [13]>

We think this may be a corner case and does not need to be addressed specifically, as it could be avoided by the gNB. However, if other companies regard this is a big problem, we think it can be solved by setting the PUCCH power control offset to 0 or by deleting the PUCCH transmission.

* 1. HARQ-ACK codebook for SPS PDSCH with PDSCH aggregation

For configured multiple aggregation factor, it was agreed to use maximum value to remove potential ambiguity of type-1 HARQ-ACK codebook construction. There was one FFS point on RRC parameter *RepNumR16*, which is for dynamic indication of number of repetition.

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority  (High/Low) | Comment |
| LGE | High | RRC parameter RepNumR16 has same issue with what we define as essential in the previous meeting. Based on the contribution, proposed solution also same as before so it wouldn’t take much time. |
| Qualcomm | Low | In our understanding, the parameter “RepNumR16” was introduced under the multi-TRP/eMIMO agenda, and it was concluded there that the current spec on Type 1 CB construction work well for this case. It is gNB’s responsibility to make sure that the last PDSCH of the RepNumR16 PDSCHs is not conflict with UL symbols. Therefore, no need to discuss this issue. |
| Ericsson | High | It’s important to consider RepNumR16 for proper CB construction |
| Samsung | High | Type-1 HARQ-ACK codebook issue is not only related to MIMO, but also related to IIOT. We think it can be handled here and similar solution should be used as for pdsch-AggregationFactor.  For Type-2 HARQ-ACK codebook PDCCH MO set determination, the new parameter “pdsch-AggregationFactor-r16” should be included as well. |
| Vivo | Low | Based on MIMO’s agreement, simultaneous configuration of pdsch-AggregationFactor in SPS-Config or PDSCH-Config and RepNum16 is not expected. No need to discuss the issue. |
| HW/HiSi | Medium | We have no strong view. There has been a discussion during the preparation phase whether this issue already had been addressed in MIMO. Whether this is the case or not, could make sense to conclude during the meeting phase. |
| Nokia, NSB | Low | As replied by email, we don’t see any remaining issue here. And if so, suggest to handle any needed changes with respect to RepNum16 in the MIMO WI (… the WI that introduced this feature should also take care of maintenance) |

Proposals from contributions:

<Ericsson, [6]>

Proposal 7 To determine a set of occasions for candidate PDSCH receptions for Type-1 HARQ-ACK codebook, the maximum value of pdsch-AggregationFactor is established by considering values in SPS-Config or PDSCH-Config and RepNum16 values if provided.

<OPPO, [10]>

***Proposal 2：If only dynamic indication of slot based PDSCH repetition (RepNumR16) is configured, the maximum value of RepNumR16 should be used to generating Type-1 HARQ-ACK codebook. If both pdsch-AggregationFactor and RepNumR16 are configured, the maximum value of pdsch-AggregationFactor and RepNumR16 should be used to generating Type-1 HARQ-ACK codebook.***

<Samsung, [11]>

***Proposal 1: For Type-1 HARQ-ACK codebook, the set of MA,c occasions for candidate PDSCH receptions should be determined based on the maximum value of RepNumR16, if provided. The following TP should be adopted.***

|  |
| --- |
| **TS 38.213** 9.1.2.1 Type-1 HARQ-ACK codebook determination …  If the UE is provided *pdsch-AggregationFactor* in *SPS-Config* or *PDSCH-Config* and no entry in *pdsch-TimeDomainAllocationList* includes *RepNumR16* in *PDSCH-TimeDomainResourceAllocation*, is a maximum value of *pdsch-AggregationFactor* in *SPS-Config* or *PDSCH-Config*; If the UE is provided at least oneentry in *pdsch-TimeDomainAllocationList* includes *RepNumR16* in *PDSCH-TimeDomainResourceAllocation*, is a maximum value of *RepNumR16*; otherwise . The UE reports HARQ-ACK information for a PDSCH reception  - from slot to slot , if is provided by *pdsch-AggregationFactor* [6, TS 38.214], or  - from slot to slot , if the Time domain resource assignment field in the DCI format scheduling the PDSCH reception indicates an entry in *pdsch-TimeDomainAllocationList* containing *RepNumR16,* or  - in slot , otherwise  only in a HARQ-ACK codebook that the UE includes in a PUCCH or PUSCH transmission in slot , where is a number of slots indicated by the PDSCH-to-HARQ\_feedback timing indicator field in a corresponding DCI format or provided by *dl-DataToUL-ACK* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in the DCI format. If the UE reports HARQ-ACK information for the PDSCH reception in a slot other than slot , the UE sets a value for each corresponding HARQ-ACK information bit to NACK.  … |

***Proposal 2: For Type-2 HARQ-ACK codebook, monitoring occasions for PDCCH on an active DL BWP of a serving cell should be determined by all the values of pdsch-AggregationFactor and/or pdsch-AggregationFactor-r16, when provided. The following TP should be adopted.***

|  |
| --- |
| **TS 38.213** 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel A UE determines monitoring occasions for PDCCH with DCI format scheduling PDSCH receptions or SPS PDSCH release on an active DL BWP of a serving cell , as described in Clause 10.1, and for which the UE transmits HARQ-ACK information in a same PUCCH in slot based on  - PDSCH-to-HARQ\_feedback timing indicator field values for PUCCH transmission with HARQ-ACK information in slot in response to PDSCH receptions or SPS PDSCH release  - slot offsets [6, TS 38.214] provided by time domain resource assignment field in a DCI format scheduling PDSCH receptions or SPS PDSCH release and by *pdsch-AggregationFactor* and/or *pdsch-AggregationFactor-r16* or *RepNumR16*, when provided.  … |

<LG, [12]>

Proposal 3: Down-select one of following options:

* Option 1: UE does not expect to be scheduled by a DCI format scheduling the PDSCH reception ending in slot n indicates an entry in *pdsch-TimeDomainAllocationList* containing *RepNumR16*, if at least one symbol from a set of symbols where the UE is scheduled PDSCH reception in slot n is an uplink symbol.
* Option 2: if *RepNumR16* is provided, is a maximum value among *pdsch-AggregationFactor* in *SPS-Config* or *PDSCH-Config* and *RepNumR16* in *PDSCH*-*TimeDomainResourceAllocation*
  1. HARQ-ACK codebook construction only for SPS PDSCH reception when the last SPS PDSCH occasion is omitted

In the current specification, there is the description for PUCCH carrying HARQ-ACK of SPS PDSCH only. However, the description hasn’t covered the case of SPS configuration with aggregation factor. As a result, UE would make codebook only based on the last SPS PDSCH occasion per period per configuration. Similar to issue in section 2.3, there would be a problem if the last SPS PDSCH occasion is cancelled by semi-static TDD configuration.

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority  (High/Low) | Comment |
| LGE | High | This issue is a part of the essential issue in the previous meeting. |
| Qualcomm | Medium |  |
| Ericsson |  | This issue exists in Rel-15 as well. This issue is not due to IIoT work. We propose to move it to Rel-15 maintenance agenda item, if companies agree that this issue should be addressed in the spec. |
| Samsung | High | This issue is related to multiple SPS, we think it is a Rel-16 issue and should be addressed here.  In addition to pdsch-AggregationFactor, MTRP scheme 3 and 4 should be considered as well. A unified solution is preferred. |
| vivo | High |  |
| HW/HiSi | High | This is part an essential issue that we started to discuss last meeting. This belongs to Rel-16, since in Rel-15 there is no HARQ-ACK codebook for SPS only. |
| Nokia, NSB | High | Essential issue from earlier discussions. |

Proposals from contributions:

<Vivo, [4]>

**Proposal 3: It is suggested to adopt the following text proposal to capture UE behavior for HARQ-ACK for SPS PDSCH correctly.**

----------------------------------------------------- Start of text proposal -----------------------------------------------------

9.1.2         Type-1 HARQ-ACK codebook determination

<unchanged text omitted>

Set to the number of serving cells configured to the UE

Set to the number of SPS PDSCH configuration configured to the UE for serving cell

Set to the number of DL slots for SPS PDSCH reception on serving cell with HARQ-ACK information multiplexed on the PUCCH

Set – HARQ-ACK information bit index

Set – serving cell index: lower indexes correspond to lower RRC indexes of corresponding cell

while

Set – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations

while

Set – slot index

while

if {

a UE is configured to receive a SPS PDSCH from~~in~~ slot to slot for SPS PDSCH configuration on serving cell , excluding SPS PDSCH that is not required to be received among overlapping SPS PDSCHs in any slots, if any according to [6, TS 38.214], or based on a UE capability for a number of PDSCH receptions in a slot according to [6, TS 38.214], or due to overlapping with a set of symbols indicated as uplink by *tdd-UL-DL-ConfigurationCommon* or by *tdd-UL-DL-ConfigurationDedicated*, and

HARQ-ACK information for the SPS PDSCH is associated with the PUCCH

}

----------------------------------------------------- End of text proposal -----------------------------------------------------

<Nokia, [7]>

**Proposal 5: For Type-1 HARQ-ACK codebook and in case of HARQ-ACK feedback for SPS PDSCH receptions only, the UE generates HARQ-ACK feedback for SPS PDSCH if at least one of the *pdsch-AggregationFactor* repetitions is received.**

Proposal 6: For Type-1 HARQ-ACK codebook and in case of HARQ-ACK feedback for SPS PDSCH and dynamic PDSCH or SPS release, and if *pdsch-AggregationFactor* > 1 is configured for a SPS configuration, the UE behaviour is undefined if it is scheduled with another decodable PDSCH that occupies the same bit position as the SPS PDSCH in a Type-1 HARQ-ACK codebook, and thus should be avoided by gNB implementation / scheduling.

<CATT, [8]>

Proposal 1: HARQ-ACK bit corresponding to an SPS PDSCH is included in the HARQ-ACK codebook corresponding to the last transmission slot as long as UE receives at least one SPS PDSCH among SPS PDSCH repetitions.

The following TP is proposed according to the above proposal:

-------------------------------------------------- Start of text proposal ------------------------------------------------------

9.1.2 Type-1 HARQ-ACK codebook determination

<unchanged text omitted>

Set – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations

while

Set – slot index

while

if {

a UE is configured to receive a SPS PDSCH from slot to slot for SPS PDSCH configuration on serving cell , excluding none of the SPS PDSCH(s) from slot to slot is ~~not~~ required to be received among overlapping SPS PDSCHs, if any according to [6, TS 38.214], or based on a UE capability for a number of PDSCH receptions in a slot according to [6, TS 38.214], or due to overlapping with a set of symbols indicated as uplink by *tdd-UL-DL-ConfigurationCommon*, or by *tdd-UL-DL-ConfigurationDedicated*, where *N* is provided by *pdsch-AggregationFactor* if configured, *N*=1 otherwise, and

HARQ-ACK information for the SPS PDSCH is associated with the PUCCH

}

= HARQ-ACK information bit for this SPS PDSCH reception

;

end if

<unchanged text omitted>

----------------------------------------------------- End of text proposal ------------------------------------------------------

Proposal 2: Adopt the text proposal for HARQ-ACK codebook generation in response to SPS PDSCH receptions.

<NEC, 9>

***Proposal 3****: HARQ-ACK feedback for an SPS PDSCH should be included in a HARQ-ACK codebook even if the last repetition is cancelled but others are received*.

<Samsung, [11]>

<LGE, [12]>

Proposal 5: Adopt following TP for TS 38.213.

Proposal 5: Adopt following TP for TS 38.213.

|  |
| --- |
| ----------------------------------------------------- Start of text proposal -----------------------------------------------------  9.1.2         Type-1 HARQ-ACK codebook determination  <unchanged text omitted>  Set – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations  while  Set – slot index  while  if {  a UE is configured to receive a SPS PDSCH in slot for a SPS PDSCH configuration on serving cell , and at least one ~~the~~ SPS PDSCH for the SPS PDSCH configuration is required to be received among overlapping SPS PDSCHs for each slot from slot  to slot  where N is provided by *pdsch-AggregationFactor*, in the SPS PDSCH configuration if configured or in *pdsch-config* otherwise, if any according to [6, TS 38.214], or based on a UE capability for a number of PDSCH receptions in a slot according to [6, TS 38.214], and  HARQ-ACK information for the SPS PDSCH is associated with the PUCCH  }  = HARQ-ACK information bit for this SPS PDSCH reception  ;  end if  <unchanged text omitted>  ----------------------------------------------------- End of text proposal ------------------------------------------------------ |

<Huawei, Hisilicon, [13]>

***Observation 1: According to the current specification, if the last repetition of a DL SPS PDSCH repetition is not received, the corresponding HARQ-A/N bit is not included in the codebook. This is the case even if an earlier repetition of the same DL SPS has been received. This is not in-line with the agreement that “For SPS PDSCH(s) with aggregation factor, UE generates A/N bits in the same way as in Rel-15 with pdsch- aggregation factor in Rel-15 with given set of MA,c occasions”.***

***Proposal 1: 1bit of HARQ-ACK feedback for a SPS PDSCH should also be included in the HARQ-ACK codebook for SPS only, if at least one SPS PDSCH repetition is not cancelled.***

In order to include the above proposal in the specification, we suggest the following TP could be found in the following.

***Proposal 2: Endorse the following TP to ensure that HARQ-A/N feedback for DL SPS PDSCH is included in the HARQ-ACK codebook for SPS only if at least one repetition of the DL SPS has been received.***

----------------------------------Start of text proposal for 38.213 V16.2.0--------------------------------------------

9.1.2 Type-1 HARQ-ACK codebook determination

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

Set – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations

while

Set – slot index

while

if {

a UE is configured to receive a SPS PDSCH in slot for SPS PDSCH configuration on serving cell , excluding SPS PDSCH that is not required to be received for each slot from slot to slot , among overlapping SPS PDSCHs, if any according to [6, TS 38.214], or based on a UE capability for a number of PDSCH receptions in a slot according to [6, TS 38.214], or due to overlapping with a set of symbols indicated as uplink by *tdd-UL-DL-ConfigurationCommon* or by *tdd-UL-DL-ConfigurationDedicated*, and

HARQ-ACK information for the SPS PDSCH is associated with the PUCCH

}

= HARQ-ACK information bit for this SPS PDSCH reception

;

end if

---------------------------------------------End of text proposal--------------------------------------------------------

# Other issues in RAN1#102-e

In this section, Other issues identified are listed from submitted contribution.

* 1. Text Proposal for HARQ-ACK information in a PUCCH

The issue is identified in [6] by Ericsson

Proposal 1 A SPS PDSCH release can be indicated with any DCI format, and therefore adopt the following text proposal to TS 38.213 Section 9.1.2.

Hence, we propose a change in the above text in 38.213 to the following Text:

If a UE reports HARQ-ACK information in a PUCCH only for

- a single or multiple SPS PDSCH release indicated by a DCI format with counter DAI field value of 1, if counter DAI field is configured, or

- a PDSCH reception scheduled by DCI format 1\_0 with counter DAI field value of 1 on the PCell, or

- SPS PDSCH receptions

within the  occasions for candidate PDSCH receptions as determined in Clause 9.1.2.1, the UE determines a HARQ-ACK codebook only for the SPS PDSCH release or only for the PDSCH reception or only for the SPS PDSCH receptions according to corresponding  occasion(s) on respective serving cell(s), where the value of counter DAI in DCI format 1\_0 is according to Table 9.1.3-1 and HARQ-ACK information bits in response to SPS PDSCH receptions are ordered according to the following pseudo-code; otherwise, the procedures in Clause 9.1.2.1 and Clause 9.1.2.2 for a HARQ-ACK codebook determination apply

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority  (High/Low) | Comment |
| LGE | Low | This issue has been discussed in the preparation phase in the last meeting. It was defined as non-essential issue since it is not necessary to expand fallback UE behavior to all DL DCI format only because SPS PDSCH release can be indicated with any DCI format. |
| Qualcomm | Low | We share the same view as the FL. |
| Ericsson | High | We do not understand why the change is not necessary. Clearly, it is possible to have: (a) SPS release is via a group release DCI; (b) the DCI is not DCI format 1\_0 (current spec is limited to format 1\_0). When (a) and/or (b) occurs, the pseudo-code for generating HARQ-ACK codebook for SPS should still be applied. This is the intention of the TP. |
| Samsung | Low | Agree with FL |
| vivo | Low | We are ok with FL suggestion. |
| Nokia, NSB | Low | Agree with FL |

* 1. HARQ-ACK PUCCH determination with different SCSs in UL and DL

The issue is identified in [6] by Ericsson

In Section 9.1.2, TS 38.213, it is mentioned that the UE reports HARQ-ACK information for a PDSCH reception

*-     from slot to slot , if is provided by pdsch-AggregationFactor [6, TS 38.214], or*

*-     from slot to slot , if the Time domain resource assignment field in the DCI format scheduling the PDSCH reception indicates an entry in pdsch-TimeDomainAllocationList containing RepNumR16, or*

and so on. In this slot n corresponds to last PDSCH reception (with or without repetition) which mapped to UL slot size. However, the quantity (aggregation factor) RepNum16 or is measured in DL slot size and therefore the the combination *slot*  or *slot*  is not correctly presented in the specification. To correct this, the quantity (aggregation factor) RepNum16 or should be mapped to UL slot size.

Proposal 6

To determine HARQ-ACK information for the PDSCH reception in the PUCCH in slot , the PDSCH reception should be considered from slot or .

Below is Tesxt proposal reflecting above proposal.

|  |
| --- |
| Section 9.1.2, TS 38.213  If the UE is provided *pdsch-AggregationFactor* in *SPS-Config* or *PDSCH-Config* and no entry in *pdsch-TimeDomainAllocationList* includes *RepNumR16* in *PDSCH-TimeDomainResourceAllocation*, is a maximum value of *pdsch-AggregationFactor* in *SPS-Config* or *PDSCH-Config*; otherwise . The UE reports HARQ-ACK information for a PDSCH reception  -     from slot  to slot , if is provided by *pdsch-AggregationFactor* [6, TS 38.214], or  -     from slot to slot , if the Time domain resource assignment field in the DCI format scheduling the PDSCH reception indicates an entry in *pdsch-TimeDomainAllocationList* containing *RepNumR16,* or  -     in slot , otherwise  only in a HARQ-ACK codebook that the UE includes in a PUCCH or PUSCH transmission in slot , where is a number of slots indicated by the PDSCH-to-HARQ\_feedback timing indicator field in a corresponding DCI format or provided by *dl-DataToUL-ACK* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in the DCI format. If the UE reports HARQ-ACK information for the PDSCH reception in a slot other than slot , the UE sets a value for each corresponding HARQ-ACK information bit to NACK. |

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority  (High/Low) | Comment |
| LGE | Low | Based on the contribution, proposed changed is related to Rel-15 as well as Rel-16. In this case, it would be better to change Rel-15 first. |
| Qualcomm | Low | Agree with FL. The “issue” already exists in Rel-15. |
| Ericsson | High | We are OK to address the issue in another AI. However, it should be recognized as an issue that requires spec change, and FL formally recommend the Chairman to move it to AI7.1. Otherwise, this issue may not be addressed properly.  The same procedure (i.e., FL recommend the move to Chairman) applies to other issues in the same situation. |
| Samsung | Low | Not necessary. It is the common understanding that the slot is DL slot. |
| vivo | Low | Agree to be corrected in Rel.15 first. |
| Nokia, NSB | Low | Should be correct in Rel-15 first. |

* 1. Overwriting of SPS PDSCH with dynamic grant

The issue is identified in [7] by Nokia

**Proposal 4: For Rel-16, reduce the time between the end of a PDCCH scheduling a dynamic grant and an overlapping SPS PDSCH to *Tproc,1/2*, where *Tproc,1* is the PDSCH processing time of the corresponding capability (38.214, Sec. 5.3) assuming *d1,1*=0. Adopt the following text proposal/correction to Section 5.1 of TS 38.214 with changes marked in red:**

|  |
| --- |
| **TP to TS 38.214, Sec. 5.1 to reduce the time between the end of a PDCCH scheduling a dynamic grant and an overlapping SPS PDSCH** 5.1 UE procedure for receiving the physical downlink shared channel **<**Unchanged text is omitted>  The UE is not expected to decode a PDSCH in a serving cell scheduled by a PDCCH with C-RNTI, CS-RNTI or MCSC-RNTI and one or multiple PDSCH(s) required to be received according to this Clause in the same serving cell without a corresponding PDCCH transmission if the PDSCHs partially or fully overlap in time except if the PDCCH scheduling the PDSCH ends at least *T*~~14 symbols~~ before the earliest starting symbol of the PDSCH(s) without the corresponding PDCCH transmission, in which case the UE shall decode the PDSCH scheduled by the PDCCH. The value of *T* equals *Tproc,1*/2, where *Tproc,1* is the PDSCH processing time of the corresponding capability according to Subclause 5.3 assuming *d1,1*=0 if the UE indicates [fast\_SPS\_PDSCH\_overwriting] capability, otherwise *T*=14 symbols.  **<**Unchanged text is omitted> |

Similar issue is also identified in [11] by Samsung

***Proposal 9: Dynamic scheduled PDSCH can cancel non-overlapping SPS PDSCH when the number of received unicast PDSCHs exceeds UE’s capability. The following TP should be adopted.***

|  |
| --- |
| **TS 38.214**  5.1 UE procedure for receiving the physical downlink shared channel  …  The UE is not expected to decode a PDSCH in a serving cell scheduled by a PDCCH with C-RNTI, CS-RNTI or MCS-C-RNTI and one or multiple PDSCH(s) required to be received according to this Subclause in the same serving cell without a corresponding PDCCH transmission if the PDSCHs partially or fully overlap in time except if the PDCCH scheduling the PDSCH ends at least 14 symbols before the earliest starting symbol of the PDSCH(s) without the corresponding PDCCH transmission, in which case the UE shall decode the PDSCH scheduled by the PDCCH.  The UE is not expected to decode a PDSCH in a serving cell scheduled by a PDCCH with C-RNTI, CS-RNTI or MCS-C-RNTI and one or multiple PDSCH(s) required to be received according to this Subclause in the same serving cell without a corresponding PDCCH transmission if the number of PDSCHs without the corresponding PDCCH transmission is equal to the number of unicast PDSCHs in a slot supported by the UE and the PDSCHs are not overlapped in time except if the PDCCH scheduling the PDSCH ends at least 14 symbols before the earliest starting symbol of the PDSCH with the largest SPS configuration index, in which case the UE shall decode the PDSCH scheduled by the PDCCH and the UE is not required to receive the PDSCH with the largest SPS configuration index.  … |

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority  (High/Low) | Comment |
| LGE | Low | Reduced scheduling timeline is definitely good to have but seems not essential. Similarly, canceling SPS PDSCH by non-overlapped DG PDSCH also seems for corner case based on the contributions. |
| Qualcomm | Low | For the first issue identified by Nokia, we think it is non-essential. For the second issue identified by Samsung, in our view, there is no requirement in the spec for the UE to drop SPS PDSCH due to non-overlapping DG PDSCH that would exceeds UE capability. As a consequence, it is the gNB’s responsibility to guarantee that a DG is not scheduled in a slot (irrespective of timeline), if the number of SPS PDSCHs in the slot may be at or above the UE’s capability. |
| Ericsson | Low | We support the intention of the proposal. However, we admit this change is not essential given the late stage of Rel-16 maintenance. |
| Samsung | Medium |  |
| vivo | Low | The issue is not essential. |
| Nokia, NSB | High | We are a bit disappointed that we are discussing URLLC here, but we are still stuck with the last minute loose overriding timeline from Rel-15 still in Rel-16. |

* 1. PUCCH resource determination for SPS PDSCH receptions

The issue is identified in [14] by Sharp

**Proposal 1:** Adopt the following TP for section 9.2.1 in TS 38.213 to accurately describe the PUCCH resource determination for SPS PDSCH receptions.

|  |
| --- |
| TP  TS 38.213 V16.2.0 (2020-06)  9.2.1 PUCCH Resource Sets  < Unchanged parts are omitted >  If the UE is provided *SPS-PUCCH-AN-List-r16* and transmits UCI information bits that include only HARQ-ACK information bits in response to one or more SPS PDSCH receptions, the UE determines a PUCCH resource to be  - a PUCCH resource indicated by *sps-PUCCH-AN-ResourceID* obtained from the first entry in *sps-PUCCH-AN-List-r16* if , or  - a PUCCH resource indicated by *sps-PUCCH-AN-ResourceID* obtained from the second entry in *sps-PUCCH-AN-List-r16*, if provided, if where is either provided by *maxPayloadSize* obtained from the second entry in *sps-PUCCH-AN-List-r16* or is otherwise equal to 1706, or  - a PUCCH resource indicated by *sps-PUCCH-AN-ResourceID* obtained from the third entry in *sps-PUCCH-AN-List-r16*, if provided, if where is either provided by *maxPayloadSize* obtained from the third entry in *sps-PUCCH-AN-List-r16* or is otherwise equal to 1706, or  - a PUCCH resource indicated by *sps-PUCCH-AN-ResourceID* obtained from the forth entry in *sps-PUCCH-AN-List-r16*, if provided, if where is equal to 1706.  < Unchanged parts are omitted > |

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority  (High/Low) | Comment |
| LGE | Low | gNB may be able to configure sps-PUCCH-AN-ResourceID in range of [0,1,2,3] by proper configuration. There seems no reason to have other values for sps-PUCCH-AN-ResourceID. |
| Qualcomm | Low | It is not clear to us what’s the motivation of the change. |
| Ericsson | Low | Not essential change. |
| Samsung | Medium | We think it is a valid issue, whether it should be handled in this meeting depends on the number of topics in the email thread. |
| vivo | Medium | Share same view with Samsung. |
| Nokia, NSB | High | Valid issue that needs to be solved. Just using the first 4 IDs results in very restricted operation. |

# References

1. R1-2004974, Summary of [101-e-NR-L1enh-URLLC-IIoTenh-02], RAN1#101e, Moderator (LG Electronics)
2. R1-2004974, Summary of [101-e-NR-L1enh-URLLC-IIoTenh-02], RAN1#101e, Moderator (LG Electronics)
3. R1-2004974, Summary of [101-e-NR-L1enh-URLLC-IIoTenh-02], RAN1#101e, Moderator (LG Electronics)
4. R1-2005352, Other issues for URLLC, vivo
5. R1-2005419, Remaining issues on SPS enhancements, ZTE
6. R1-2005512, Remaining Issue of Other Enhancements for NR URLLC/IIoT, Ericsson
7. R1-2005551, Maintenance of Rel-16 URLLC/IIoT SPS enhancements, Nokia, Nokia Shanghai Bell
8. R1-2005678, Remaining issues on SPS enhancements, CATT
9. R1-2005775, Remaining issues on DL SPS enhancement for URLLC, NEC
10. R1-2006057, DL SPS enhancement, OPPO
11. R1-2006114, Maintenance on IIoT SPS enhancements, Samsung
12. R1-2006295, Remaining issues of other aspects for URLLC/IIOT, LG Electronics
13. R1-2006390, Corrections on other aspects for URLLC/IIOT enhancements, Huawei, HiSilicon
14. R1-2006564, PUCCH resource determination for SPS PDSCH receptions for NR URLLC, Sharp
15. R1-2006634, Remaining issues on DL SPS enhancements, Asia Pacific Telecom co. Ltd
16. R1-2006699, Maintainance for SPS enhancement for Rel-16 URLLC, NTT DOCOMO, INC.
17. R1-2006779, Remaining issues on uplink collision handling and SPS for URLLC, Qualcomm Incorporated
18. R1-2006884, Remaining Issues on SPS PDSCH for NR URLLC, WILUS Inc.

# Appendix: Previous relevant agreements

RAN1#96

**Conclusion**:

* It is recommended to support the handling of scenario 1 as listed in R1-1814342 in the Rel-16 WI.
* It is recommended to allow the prioritization of configured grant over dynamic grant under some conditions in case of collision in scenario 2 as listed in R1-1814342 in the Rel-16 WI.
* It is recommended to support the handling of scenario 3 as listed in R1-1814342 in the Rel-16 WI.
* It is recommended to support enhancements for scenario 4 and 5 as listed in R1-1814342 in the Rel-16 WI.

Agreements:

For scenario 2 as listed in R1-1814342, in case the collision between configured grant and dynamic grant occurs in physical layer, options to determine the prioritization between configured grant and dynamic grant include at least – to be further investigated during the WI phase:

* Priority at PHY is determined by MAC layer for the purpose of PHY prioritization.
  + Note: this may or may not have any RAN1 impact
* Priority at PHY is determined via using PHY channel(s)/signal(s)/parameters for the purpose of PHY prioritization.
* It is configurable as part of the configured grant configuration whether it should have higher priority than dynamic grant in case of conflict.
* Other options are not precluded.

RAN2#105

Agreements in RAN2

|  |
| --- |
| * R2 assumes that the maximum number of active SPS configurations for a given BWP of a serving cell in the specification is 8 or 16 (FFS). * R2 assumes short SPS/CG periodicities and/or multiple SPS/CG configurations and/or combination thereof could be used to mitigate the periodicity misalignment between the TSN periodicity and CG/SPS periodicity. Other solutions not precluded, e.g. to address resource consumption. * Will support “short” SPS periodicities, at least down to 0.5ms * Ask R1 on feasibility, and additionally the feasibility to go down to even lower values, e.g. 2 symb. * R2 assumes that activation/deactivation is done by DCI. * RAN1 should address activation/deactivation DCIs related with configured grant Type 2 and SPS in the case of multiple configurations * When multiple UL CG or DL SPS configurations is configured, an offset for each configuration is needed for the calculation of the HARQ process ID |

RAN1#96bis

Agreements**:**

* Support separate activation for different DL SPS configurations for a given BWP of a serving cell.
  + FFS whether or not to support joint activation in a DCI for two or more DL SPS configurations
* Support separate release for different DL SPS configurations for a given BWP of a serving cell.
  + FFS whether or not to support joint release in a DCI for two or more DL SPS configurations

RAN1#97

Agreements:

Regarding Q2 in LS from RAN2, the following is captured:

* RAN1 discussed the feasibility of support of shorter periodicities for DL SPS, it is feasible to support periodicity down to 1 slot for all SCSs and single SPS configuration with certain constraints related to HARQ-ACK feedback and combinations of DL & UL SCSs

**Conclusion**:

* RAN1 will continue to further investigate whether or not it is feasible to support periodicities shorter than 1 slot for SPS.

RAN1#98

Agreements**:**

For cases where only HARQ-ACK feedback for SPS PDSCHs shall be reported (i.e. no dynamic PDSCH HARQ-ACK), support more than one bit of HARQ-ACK feedback for SPS PDSCH without an associated grant in a PUCCH resource

* FFS applicability to all PUCCH formats
* FFS the number of bits, e.g., the # of configured/activated SPS configurations, etc.
* FFS how to construct both type-1 and type-2 HARQ-ACK codebook for cases where HARQ-ACK feedback for SPS PDSCH is multiplexed with dynamic PDSCH HARQ-ACK

**Conclusion:**

* There is no consensus to support joint activation in a DCI for two or more SPS configurations for a given BWP of a serving cell in rel-16.

**Conclusion:**

There is no consensus on support of DL SPS periodicity shorter than 1 slot in Rel-16.

Working assumption:

Support joint release in a DCI for two or more SPS configurations for a given BWP of a serving cell

* Reusing the joint release mechanism as that defined for UL type 2 CG

RAN1#98bis

Agreements**:**

Confirm the following working assumption:

|  |
| --- |
| Working assumption:  Support joint release in a DCI for two or more SPS configurations for a given BWP of a serving cell   * Reusing the joint release mechanism as that defined for UL type 2 CG |

Agreements**:**

For cases where only HARQ-ACK feedback for SPS PDSCHs shall be reported (i.e. no dynamic PDSCH HARQ-ACK), PUCCH formats 2/3/4 are applicable in addition to PUCCH formats 0/1.

Agreements**:**

For cases where HARQ-ACK feedback for SPS PDSCH is multiplexed with HARQ-ACK feedback for dynamic scheduled PDSCH, the PUCCH resource to be used is determined by reusing rel-15 mechanism.

Agreements:

For cases where only HARQ-ACK feedback for SPS PDSCHs shall be reported (i.e. no dynamic PDSCH HARQ-ACK), RAN1 down-selects the following options:

* Option 1: Multiple PUCCH resources are configured common for all SPS configurations (similar to *multi-CSI-PUCCH-ResourceList*) per HARQ-ACK codebook. The actual PUCCH resource to be used among PUCCH resources is determined based on HARQ-ACK payload size
  + FFS: Number of maximum PUCCH resources
  + FFS details (threshold for determining PUCCH resource)
* Option 2: Multiple PUCCH resource sets are configured common for all SPS configurations per HARQ-ACK codebook. The PUCCH resource set to be used is determined based on HARQ-ACK payload size.
  + FFS whether or not to configure PUCCH resource sets separately from PUCCH resource set for dynamic-scheduled PDSCH
  + FFS whether to configure separate payload range
  + The actual PUCCH resource to be used among PUCCH resources in the chosen PUCCH resource set is determined by reusing rel-15 HARQ-ACK PUCCH resource determination mechanism for dynamic PDSCH based on the latest activation DCI

Agreements:

For cases where only HARQ-ACK feedback for SPS PDSCHs without associated DL assignment shall be reported (i.e. no dynamic PDSCH HARQ-ACK),

* Multiple PUCCH resources are configured common for all SPS configurations per HARQ-ACK codebook. The actual PUCCH resource to be used among PUCCH resources is determined based on HARQ-ACK payload size
  + Number of PUCCH resources is up to 4
  + FFS details (e.g., threshold for determining PUCCH resource)

Agreements**:**

For cases where only HARQ-ACK feedback for SPS PDSCHs without associated DL assignment shall be reported (i.e. no dynamic PDSCH HARQ-ACK), PUCCH resource *i* is selected if HARQ-ACK payload size (not including CRC) is in the range of {*Ni,min*, …, *Ni,max*} bits, where the number of PUCCH resources in the selection is from 0 up to 3.

* *N0,min*=1*, N0,max*=2
* For *i*≠0
  + *Ni,max* is configured by RRC; if not configured, *Ni,max* is 1706.
  + *Ni,min* is equal to *Ni-1,max*+1

Note: The above mechanism is equivalent to rel-15 procedure when a single PUCCH resource is configured per PUCCH resource set.

Agreements**:**

For cases where only HARQ-ACK feedback for SPS PDSCHs without associated DL assignment shall be reported (i.e. no dynamic PDSCH HARQ-ACK), the number of PRBs for the PUCCH transmission is determined by reusing rel-15 mechanism in Subclause 9.2.3 (UE procedure for reporting HARQ-ACK) of 38.213.

* The maximum code rate per PUCCH format is reused from the parameter associated with the identified HARQ-ACK codebook for SPS PDSCH

RAN2#107bis

* R2 assumes to support 8 as the maximum number of simultaneously activated SPS configurations per BWP per serving cell.
* Introduce SPS/CG index to identify each SPS/CG among multiple SPS/CG configurations, i.e., as in Rel-15 LTE.
* The association between “state” (used in the joint release DCI) and the CG configuration(s) for type-2 CG is configured via RRC message.
* Each CG configuration is always configured independently, as in Rel-15 LTE.
* The association between “state” (used in the joint release DCI) and the SPS configuration(s) is configured via RRC message, if RAN1 working assumption for joint release for multiple SPS configuration is confirmed.
* Each SPS configuration is always configured independently, as in Rel-15 LTE.
* Support simultaneous Type 1 & 2 CG configurations in a BWP.
* CG periodicities of any integer-multiple of one slot (FFS if we go even lower, e.g. 2 symb, 7 symb) below a maximum value should be supported. FFS on the maximum value of integer N.
* SPS periodicities of any integer-multiple of one slot below a maximum value should be supported in Rel-16. FFS on the maximum value of integer N.
* R2 assumes that HARQ offset parameter is explicitly configured by the network for each CG/SPS configuration.
* For CG, HARQ Process ID = [floor(CURRENT\_symbol/periodicity)] modulo nrofHARQ-Processes + harq-procID-offset.
* FFS (for checking) if For SPS, HARQ Process ID = [floor(CURRENT\_slot/periodicity)] modulo nrofHARQ-Processes + harq-ProcID-offset, Where CURRENT\_slot = [(SFN × numberOfSlotsPerFrame) + slot number in the frame].
* Introduce a new confirmation MAC CE format in Rel-16, which reflects the confirmation of multiple configured grant configurations

RAN1#99

Agreements:

In Rel-16, multiple DL SPS configurations can be configured on different serving cells in a cell group.

Agreements:

Support DCI format 1-0, 1-1 and 1\_2 for Rel-16 SPS activation and for Rel-16 SPS release.

Agreements:

HPN field in the applicable DL DCI formats with CRC scrambled by CS-RNTI and NDI=0 is used to indicate which SPS configuration is to be activated and which SPS configuration(s) is/are to be released

* M LSB HPN bits is used to indicate which configuration is to be activated and which configuration(s) is/are to be released.
* M is determined by the bit length for HPN field for each DCI format for activation and release of SPS configuration(s)

Agreements:

For both type-1 and type-2 HARQ-ACK codebook construction, one HARQ-ACK bit is generated for SPS PDSCH release with a joint release DCI

Agreements:

If the UE is configured with more than one SPS PDSCH configurations, and for type-1 HARQ-ACK codebook construction,

* For cases where HARQ-ACK feedback for one or more SPS PDSCH receptions without a corresponding PDCCH is multiplexed with HARQ-ACK feedback for dynamic scheduled PDSCH and/or for SPS PDSCH release, or
* For cases where HARQ-ACK feedback for SPS PDSCH release is multiplexed with HARQ-ACK feedback for dynamic scheduled PDSCH, or
* For cases where only HARQ-ACK feedback for SPS PDSCH release shall be reported,
  + HARQ-ACK bit location for SPS PDSCH reception is derived by reusing Rel-15 mechanism (i.e., based on the TDRA table row index and K1 indicated in the activation DCI)
  + HARQ-ACK bit location for SPS PDSCH release with a separate release DCI is derived by reusing Rel-15 mechanism (i.e., based on the TDRA table row index indicated in the activation DCI and K1 indicated in the release DCI)
  + HARQ-ACK bit location for SPS PDSCH release with a joint release DCI is derived based on the TDRA table row index indicated in the activation DCI for SPS PDSCH with the lowest SPS configuration index among the jointly released configurations and K1 indicated in the release DCI

Note: There is no change on the number of HARQ-ACK bits for a PUCCH transmission regardless whether a joint release DCI is present or not.

In Rel-16, when the SPS configurations are released by a joint release DCI,

* Multiple SPS configurations to be released by the joint release DCI should have the same priority

Agreement

For a rel-16 UE provided by *SPS-PUCCH-AN-List* a set of PUCCH resources, in case of collision between HARQ-ACK for SPS PDSCH without a corresponding PDCCH and SR for the same priority, reuse Rel-15 rule for collision between HARQ-ACK for dynamic scheduled PDSCH and SR in order to determine the PUCCH resource

Agreement

For a given SPS configuration activated by DCI format 1\_2, the MCS table is determined by reusing Rel-15 mechanism for a SPS configuration activated by DCI format 1\_1.

* No new RRC parameter for *mcs-Table* is introduced for DCI format 1\_2

Working assumption:

In case of collision only between more than one SPS PDSCHs each without a corresponding PDCCH, a UE is not required to decode SPS PDSCHs other than the SPS PDSCH with the lowest SPS configuration index among collided SPS PDSCHs.

* The UE shall report HARQ-ACK feedback only for the SPS PDSCH with the lowest SPS configuration index among collided SPS PDSCHs

Agreement

If the UE is configured with more than one SPS PDSCH configurations, for cases where only HARQ-ACK feedback for one or more SPS PDSCH receptions without a corresponding PDCCH shall be reported (i.e. no HARQ-ACK feedback for dynamic scheduled PDSCH and/or for SPS PDSCH release

* HARQ-ACK bit order for SPS PDSCH reception without a corresponding PDCCH is determined
  + In ascending order of DL slot per {SPS configuration index, serving cell index}, and then in ascending order of SPS configuration index per {serving cell index}, and then in ascending order of serving cell index

Agreement

If the UE is configured with more than one SPS PDSCH configurations, and for type-2 HARQ-ACK codebook construction,

* HARQ-ACK bit order for SPS PDSCH release with a separate/joint release DCI is derived by reusing rel-15 mechanism (i.e., based on DAI and K1 indicated in the release DCI)
* HARQ-ACK bit order for SPS PDSCH with associated PDCCH is derived by reusing rel-15 mechanism (i.e., based on DAI and K1 indicated in the activation DCI)
* For cases where HARQ-ACK feedback for one or more SPS PDSCH receptions without a corresponding PDCCH is multiplexed with HARQ-ACK feedback for dynamic scheduled PDSCH and/or for SPS PDSCH release,
  + HARQ-ACK for one or more SPS PDSCH receptions without a corresponding PDCCH is appended after HARQ-ACK bits for dynamic scheduled PDSCHs and/or for SPS PDSCH release
    - In ascending order of DL slot per {SPS configuration index, serving cell index}, and then in ascending order of SPS configuration index per {serving cell index}, and then in ascending order of serving cell index

RAN1#100e

Agreements:

For a UE not indicating a capability to receive more than one unicast PDSCH per slot, in a slot with more than one SPS PDSCHs each without a corresponding PDCCH and no dynamic scheduled PDSCH and/or ~~for~~ SPS PDSCH release, a UE is not required to receive SPS PDSCHs other than the SPS PDSCH with the lowest SPS configuration index among SPS PDSCHs in a slot (regardless of whether SPS PDSCHs are overlapped or not).

* The UE shall report HARQ-ACK feedback only for the SPS PDSCH with the lowest SPS configuration index among SPS PDSCHs in the slot.

Agreements:

* In a slot with more than one SPS PDSCHs each without a corresponding PDCCH, ~~for Type-1 HARQ-ACK codebook~~ ~~and without HARQ-ACK feedback for dynamic scheduled PDSCH and/or for SPS PDSCH release in the slot, or for Type-2 HARQ-ACK codebook~~, HARQ-ACK feedback for a SPS PDSCH should not be included in the HARQ-ACK codebook if the SPS PDSCH would not be received among overlapping SPS PDSCHs without associated PDCCH.
* For HARQ-ACK of SPS PDSCH (without dynamic scheduled PDSCH), the PUCCH resource is determined based on *SPS-PUCCH-AN-List* once it is configured, regardless of the number of active SPS configurations.

Agreements:

Introduce configuration of PDSCH aggregation factor (*pdsch-AggregationFactor*) per DL SPS configuration with the value range of {1,2,4,8} [RRC impact]

* For PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, or PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled with CS-RNTI with NDI=0
  + PDSCH aggregation factor signaled in *sps-Config*(newly introduced RRC parameter) is applied if configured; otherwise, PDSCH aggregation factor signaled in *pdsch-Config* is applied
* For PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled with CS-RNTI with NDI=1
  + PDSCH aggregation factor signaled in *pdsch-Config* is applied

Agreements:

For PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled by CS-RNTI with NDI=0, or PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, the UE is not expected to be configured with the time duration for the reception of *pdsch-AggregationFactor* repetitions in *sps-Config* (if configured) or in *pdsch-config* (otherwise) larger than the time duration derived by the periodicity P obtained from the corresponding *sps-Config*.

RAN1#100bis-e

Agreements:

* In case dynamic scheduled PDSCH and multiple SPS PDSCHs are overlapped in time domain,
  + At first, the UE resolves overlapped multiple SPS PDSCHs (first step) and then resolves overlapping between dynamic scheduled PDSCH and one or multiple SPS PDSCHs to be selected to decode from first step (second step).

Agreements:

In case of collision in time domain among SPS PDSCHs each without a corresponding PDCCH after excluding SPS PDSCHs overlapping semi-static UL symbols,

* A UE receives and decodes one or more of SPS PDSCHs within a group of overlapping SPS PDSCHs on the same serving cell according to the following procedure.
  + - Step 0: set j=0-number of selected PDSCH for decoding. Set Q to set of activated SPS PDSCHs within a slot
    - Step 1: A UE receives and decodes one of SPS PDSCHs with the lowest SPS configuration index within Q, set j=j+1. Designate the received SPS PDSCH as survivor SPS PDSCH.
    - Step 2: The survivor SPS PDSCH in step 1 and any other SPS PDSCH(s) overlapping (even partially) with the survivor SPS PDSCH in step 1 are excluded from Q.
    - Step 3: Repeat step 1 and 2 until the group is empty or j≥N, where N is the number of unicast PDSCHs in a slot supported by the UE

Agreements:

* Adopt the following text proposal for section 5.1 in TS 38.214:

|  |
| --- |
| **<**Unchanged text is omitted>  If more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are partially or fully overlapping in time in a slot, a UE is not required to receive a PDSCH among these PDSCHs other than one with the lowest configured *sps-ConfigIndex* in the slot. |

Note: This TP was superseded by other TP in the email thread [100b-e-NR-L1enh-URLLC-IIoTenh-01].

Agreements:

* Note: this supersedes the agreed TP to Sec. 5.1 in TS 38.214 from Email discussion [100b-e-NR-L1enh-URLLC-IIoTenh-03]
* Adopt the following text proposal for section 5.1 in TS 38.214:

|  |
| --- |
| 5.1        UE procedure for receiving the physical downlink shared channel  **<**Unchanged text is omitted>  If more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot, ~~partially or fully overlapping in time, a UE is not required to receive a PDSCH among these PDSCHs other than one with the lowest configured~~ *~~sps-ConfigIndex~~*~~.~~ after resolving overlapping with symbols in the slot indicated as uplink by *tdd-ULDL-ConfigurationCommon*, or by *tdd-UL-DL-ConfigurationDedicated*, a UE receives one or more PDSCHs without corresponding PDCCH transmissions in the slot as specified below.  ‒         Step 0: set *j*=0-number of selected PDSCH for decoding. Set *Q* to set of activated PDSCHs without corresponding PDCCH transmissions within the slot  ‒         Step 1: A UE receives one PDSCH with the lowest configured *sps-ConfigIndex* within *Q*, set *j*=*j*+1. Designate the received PDSCH as survivor PDSCH.  ‒        Step 2: The survivor PDSCH in step 1 and any other PDSCH(s) overlapping (even partially) with the survivor PDSCH in step 1 are excluded from *Q*.  ‒        Step 3: Repeat step 1 and 2 until *Q* is empty or *j* is equal to the number of unicast PDSCHs in a slot supported by the UE  **<**Unchanged text is omitted> |

Agreements:

* Adopt the following text proposal for section 5.1 in TS 38.214:

|  |
| --- |
| 5.1        UE procedure for receiving the physical downlink shared channel  **<**Unchanged text is omitted>  The UE is not expected to decode a PDSCH scheduled in a serving cell with C-RNTI or MCS-C-RNTI and another PDSCH scheduled in the same serving cell with CS-RNTI if the PDSCHs partially or fully overlap in time after resolving overlapping for PDSCHs without corresponding PDCCH transmissions except if the PDCCH scheduling the PDSCH with C-RNTI or MCS-C-RNTI ends at least 14 symbols before the start of the PDSCH with CS-RNTI without the corresponding DCI, in which case the UE shall decode the PDSCH scheduled with C-RNTI or MCS-C-RNTI.  **<**Unchanged text is omitted> |

**Agreements:**

If dynamic scheduled PDSCH is overlapped with multiple SPS PDSCHs after resolving overlapping for SPS PDSCHs, the reference SPS PDSCH for the 14 symbols is an SPS PDSCH having the earliest starting symbol among SPS PDSCHs overlapped with dynamic scheduled PDSCH after resolving overlapping for SPS PDSCHs.

Agreements:

* Latest proposals 2-2-1a/2-2-3a/2-2-4 are agreement (see summary R1-2003001)

Agreements

HARQ-ACK feedback for a SPS PDSCH is included in the HARQ-ACK codebook when the SPS PDSCH is cancelled by DCI/dynamic SFI in which case NACK is generated for the SPS PDSCH.

Agreements**:**

Adopt the following text proposal for section 9.1.2.2 in TS 38.213:

|  |
| --- |
| 9.1.2.2 Type-1 HARQ-ACK codebook in physical uplink shared channel  If a UE would multiplex HARQ-ACK information in a PUSCH transmission that is not scheduled by a DCI format or is scheduled by DCI format 0\_0, then  -     if theUE has not received any PDSCH or SPS PDSCH release that the UE transmits corresponding HARQ-ACK information in the PUSCH, based on a value of a respective PDSCH-to-HARQ\_feedback timing indicator field in a DCI format scheduling the PDSCH reception or the SPS PDSCH release or on the value of*dl-DataToUL-ACK* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in the DCI format, in any of the cid:image001.png@01D61ACE.3C904000 occasions for candidate PDSCH receptions by DCI format 1\_0 or DCI format 1\_1 or SPS PDSCH on any serving cell cid:image002.png@01D61ACE.3C904000, as described in Clause 9.1.2.1,the UE does not multiplex HARQ-ACKinformation in the PUSCH transmission;  -     else the UE generates the HARQ-ACK codebook as described in Clause 9.1.2.1, except that *harq-ACK-SpatialBundlingPUCCH* is replaced by*harq-ACK-SpatialBundlingPUSCH*, unless the UE receivesonly a SPS PDSCH release,or only SPS PDSCH reception, or only a PDSCHthat is scheduled by DCI format 1\_0 with acounter DAI fieldvalue of 1 on the PCell in the cid:image001.png@01D61ACE.3C904000 occasions for candidate PDSCH receptions in which casethe UE generates HARQ-ACK information only for the SPS PDSCH release or only for the PDSCH reception as described in Clause 9.1.2.  A UE sets to NACK value in the HARQ-ACK codebook any HARQ-ACK information corresponding to PDSCH reception or SPS PDSCH release that the UE detects in a PDCCH monitoring occasion that starts after a PDCCH monitoring occasion where the UE detects a DCI format 0\_0 or a DCI format 0\_1 scheduling the PUSCH transmission.  A UE does not expect to detect a DCI format switching a DL BWP withincid:image003.png@01D61ACE.3C904000 symbols prior to a first symbol of a PUSCH transmission where the UE multiplexes HARQ-ACK information, where cid:image003.png@01D61ACE.3C904000 is defined in [6, TS 38.214].  If a UE multiplexes HARQ-ACK information in a PUSCH transmission that is scheduled by DCI format 0\_1, the UE generates the HARQ-ACK codebook as described in Clause 9.1.2.1 when a value of the DAI fieldin DCI format0\_1 is cid:image004.png@01D61ACE.3C904000 except that *harq-ACK-SpatialBundlingPUCCH* is replaced by*harq-ACK-SpatialBundlingPUSCH*. The UE does not generate a HARQ-ACK codebook for multiplexing in the PUSCH transmission whencid:image005.png@01D61ACE.3C904000 unless the UE receives only a SPS PDSCH release,or only ~~a~~ SPS PDSCH(s), or only a PDSCHthat is scheduled by DCI format 1\_0 with acounter DAI fieldvalue of 1 on the PCell in the cid:image001.png@01D61ACE.3C904000 occasions for candidate PDSCH receptions in which casethe UE generates HARQ-ACK information only for the SPS PDSCH release or only for the PDSCH reception as described in Clause 9.1.2.cid:image006.png@01D61ACE.3C904000 if the DAI field in DCI format 0\_1 is set to '0'; otherwise,cid:image007.png@01D61ACE.3C904000. |

Agreements**:**

**Adopt the following text proposal for section 9.1 in TS 38.213:**

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| **9.1      HARQ-ACK codebook determination**  **<**Unchanged text is omitted>  ~~A UE does not expect to be indicated to transmit HARQ-ACK information for more than one SPS PDSCH reception in a same PUCCH if the UE is provided a single SPS PDSCH configuration in a cell group.~~ |

**Conclusion:**

* For type-1 codebook, Rel-15 behavior is not to include a HARQ-ACK bit for the SPS PDSCH if the SPS PDSCH is cancelled by dynamic SFI/DCI if only one HARQ-ACK bit for the SPS PDSCH is to be transmitted on a PUCCH.
* For type-2 codebook, Rel-15 behavior is to include a HARQ-ACK bit for SPS PDSCH if the SPS PDSCH is cancelled by dynamic SFI/DCI.

Agreements:

Update previous agreements by:

HARQ-ACK feedback for a SPS PDSCH is included in the HARQ-ACK codebook when the SPS PDSCH is cancelled by DCI/dynamic SFI in which case NACK is generated for the SPS PDSCH.

* For type-1 codebook, the main bullet is not applied if only a single HARQ-ACK bit, for an SPS PDSCH, is mapped on a PUCCH; otherwise, the main bullet is applied.
* For type-2 codebook, the main bullet is applied.

Agreements:

**Adopt the following text proposal for section 9.1.2 in TS 38.213:**

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| while  if UE is configured to receive a SPS PDSCH in slot for SPS PDSCH configuration*s* on serving cell, and the SPS PDSCH is required to be received among overlapping SPS PDSCHs, if any according to [6, TS 38.214], or based on a UE capability for a number of PDSCH receptions in a slot according to [6, TS 38.214]  and if HARQ-ACK for the SPS PDSCH is associated with the PUCCH  = HARQ-ACK information bit for this SPS PDSCH reception  ;  end if  ;  end while |

**Conclusion**

It is RAN1’s understanding, that the parameters of PDSCH transmissions without corresponding PDCCH transmissions follow the parameters of a PDSCH scheduled by the DCI format used to activate the PDSCH transmissions without corresponding PDCCH transmissions.

Agreements:

In case of collision in time domain among SPS PDSCHs each without a corresponding PDCCH, when a UE is configured with *pdsch-AggregationFactor*, SPS PDSCH overlapping handling is performed per slot.

* FFS: Type-1 and Type-2 HARQ-ACK codebook construction when UE is configured with (multiple) *pdsch-AggregationFactor*

Agreements:

Adopt the following text proposal for section 5.1.3.1 in TS 38.214:

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| 5.1.3.1             Modulation order and target code rate determination  For the PDSCH scheduled by a PDCCH with DCI format 1\_0, format 1\_1 or format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, SI-RNTI, RA-RNTI, MsgB-RNTI, or P-RNTI, or for the PDSCH scheduled without corresponding PDCCH transmissions using the higher-layer-provided PDSCH configuration *SPS-Config*,  if the higher layer parameter *mcs-Table-ForDCIFormat1\_2* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with DCI format 1\_2 with CRC scrambled by C-RNTI  -     the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.  elseif the UE is not configured with MCS-C-RNTI, the higher layer parameter *mcs-Table-ForDCIFormat1\_2* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled by a PDCCH with DCI format 1\_2 scrambled by C-RNTI  -     the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.  elseif the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with DCI format 1\_1 with CRC scrambled by C-RNTI  -     the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.  elseif the UE is not configured with MCS-C-RNTI, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled by a PDCCH with a DCI format other than DCI format 1\_2 in a UE-specific search space with CRC scrambled by C-RNTI  -     the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.  elseif the UE is configured with MCS-C-RNTI, and the PDSCH is scheduled by a PDCCH with CRC scrambled by MCS-C-RNTI  -     the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.  elseif the UE is not configured with the higher layer parameter *mcs-Table* given by *SPS-config*, the higher layer parameter *mcs-Table-ForDCIFormat1\_2* given by *PDSCH-Config* is set to 'qam256', ~~and the PDSCH is scheduled by a PDCCH with DCI format 1\_2 with CRC scrambled by CS-RNTI~~  -     if the PDSCH is scheduled by a PDCCH with DCI format 1\_2 with CRC scrambled by CS-RNTI or  -     if the PDSCH with SPS activated by DCI format 1\_2 is scheduled without corresponding PDCCH transmission using *SPS-Config*,  -     the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.  elseif the UE is not configured with the higher layer parameter *mcs-Table* given by *SPS-Config*, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256',  -     if the PDSCH is scheduled by a PDCCH with DCI format 1\_1 with CRC scrambled by CS-RNTI or  -     if the PDSCH with SPS activated by DCI format 1\_1 is scheduled without corresponding PDCCH transmission using *SPS-Config*,  -     the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.  elseif the UE is configured with the higher layer parameter *mcs-Table* given by *SPS-Config* set to 'qam64LowSE'  -     if the PDSCH is scheduled by a PDCCH with CRC scrambled by CS-RNTI or  -     if the PDSCH is scheduled without corresponding PDCCH transmission using *SPS-Config*,  -     the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.  else  -     the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.  end |