**3GPP TSG RAN WG1 #101 R1-2004035**

**e-Meeting, May 25th – June 5th, 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 can be found in Appendix.

# Summary and FL recommendation

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| Email thread | Title | Topics including |
| #1 | Text proposal for previous agreement | 3.1, 3.2, 3.5, 4.3 |
| #2 | SPS PDSCH release and SPS PDSCH reception | 3.4 |
| #3 | HARQ-ACK feedback related issues for SPS including PDSCH aggregation factor. | 3.3, 3.6 |
| #4 | Discussion on CG-CG/DG with same priorities drafting reply LS for R1-2003259 | 6.1 |
| Note: It is suggested to postpone discussion on the issues other than the above.Note: for the agreements from RAN1#100b-e without the corresponding TPs, draft TPs are to be prepared and endorsed separately, from email thread budget. |

# Remaining issues on email discussions in RAN1#101

* 1. Spec text in case of UE supporting 1 unicast PDSCH per slot

[Open issues to be discussed from [IIoTenh-01] in RAN1#100b-e]

For the paragraph in the specification on handling in case of UE supporting 1 unicast PDSCH per slot, there was a short discussion whether to remove or update this part. This part is relevant to what we’ve agreed for issue 2.1 in the email outcome. Due to lack of time, there was no enough comment to conclude whether the spec text needs to be removed or to be updated. The following options are provided for further consideration in the next meeting so **it is recommended for companies to provide your preference or any other suggestion on this aspect**.

**Option 1: Adopt the following text proposal for section 5.1 in TS 38.214:**

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| 5.1        UE procedure for receiving the physical downlink shared channel**<**Unchanged text is omitted>~~If a UE does not indicate a capability to receive more than one unicast PDSCH per slot, and if there is more than one PDSCH on a serving cell each without a corresponding PDCCH transmission in a slot, the UE is not required to receive a PDSCH among these PDSCHs other than one with the lowest configured~~ *~~sps-ConfigIndex~~* ~~on the serving cell.~~**<**Unchanged text is omitted> |

**Option 2: Adopt the following text proposal for section 5.1 in TS 38.214:**

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| 5.1        UE procedure for receiving the physical downlink shared channel**<**Unchanged text is omitted>If a UE does not indicate a capability to receive more than one unicast PDSCH per slot, and if there is more than one PDSCH on a serving cell each without a corresponding PDCCH transmission in a slot, after resolving overlapping with symbols in the slot indicated as uplink by *tdd-ULDL-ConfigurationCommon*, or by *tdd-UL-DL-ConfigurationDedicated,* the UE is not required to receive a PDSCH among ~~these~~ PDSCHs other than one with the lowest configured *sps-ConfigIndex* on the serving cell.**<**Unchanged text is omitted> |

**Option 3: Keep the paragraph (no spec change)**

This option would not work properly. At least the text should take into account the aspect on conflict with semi-static UL.

Companies shows preferences by contributions in this meetings:

* Option 1: vivo, CATT, Samsung, Spreadtrum, LG
	+ Reasons: Previous agreement already covers a UE incapable of the receiving more than one unicast PDSCH per slot
* Option 2: ZTE

**Comment:**

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| Company | Priority(High/Low) | Comment |
| LGE | High | This issue is essential to finalize previous discussion. Without conclusion, there would be a problem due to conflict with semi-static UL. |
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* 1. Text proposal for collision between dynamic PDSCH and multiple SPS PDSCHs

[Open issues to be discussed from [IIoTenh-01] in RAN1#100b-e]

In RAN1#100bis-e, the following agreement has been made. But TP has not been made yet.

**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.

**Comment:**

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| Company | Priority(High/Low) | Comment |
| LGE | High | The agreement needs to be captured in the specification; otherwise there can be ambiguity on which SPS PDSCH is the reference for handling of overriding when multiple SPS PDSCHs are overlapped with a DG PDSCH. |
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**<Samsung, [8]>**

***Proposal 2: Support to revise following text in TS 38.214.***

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| 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 earliest starting symbol of the PDSCH(s) with CS-RNTI without the corresponding DCI, in which case the UE shall decode the PDSCH scheduled with C-RNTI or MCS-C-RNTI. |

**<Nokia, [4]>**

**Proposal 1: If the 14-symbol timeline for overwriting SPS PDSCH with a dynamic PDSCH is not fulfilled for a first SPS PDSCH, but fulfilled for subsequent SPS PDSCH(s), the UE does not receive any of the SPS PDSCHs overlapping with the dynamic PDSCH.**

**<LG, [10]>**

Note that the red text in the below TP has been already endorsed in RAN1#100bis-e (R1-2003141).

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| 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 one or multiple PDSCHs 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 earliest PDSCH among these PDSCHs with CS-RNTI without the corresponding DCI, in which case the UE shall decode the PDSCH scheduled with C-RNTI or MCS-C-RNTI. |

* 1. Unnecessary restriction of at most 1 bit of HARQ-ACK feedback on a PUCCH for single SPS PDSCH configuration for type-2 codebook

[Open issues to be discussed from [IIoTenh-02] in RAN1#100b-e]

Even in case of single SPS configuration in a cell group, it is possible that multiple HARQ-ACK bits are to be transmitted in the same PUCCH considering mixed numerology case (e.g., DL SCS > UL SCS). Due to lack of time, there was no chance to discuss if such spec change is also needed for type-2 HARQ-ACK codebook, as raised by ZTE in the last e-meeting.

**Companies are encouraged to check if such change is necessary or not, and hopefully to provide your feedback/comment/TP (if deemed necessary) in the next meeting (regardless of whether or not such change is necessary).**

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| **TS 38.213 v16.1.0****9.1.3.2            Type-2 HARQ-ACK codebook in physical uplink shared channel****<**Unchanged text is omitted> for any Set  while if a single SPS PDSCH reception is activated for a UE and the UE is configured to receive SPS PDSCH in a slot  for serving cell , where  is the PDSCH-to-HARQ-feedback timing value for SPS PDSCH on serving cell = HARQ-ACK information bit associated with the SPS PDSCH receptionend if;end while |

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| Company | Priority(High/Low) | Comment |
| LGE | High | This issue identified in the last meeting as high, and the aspects on HARQ-ACK codebook need to be concluded. |
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For this issue, Following TP and proposals are provided by companies’ contributions.

**<ZTE, [1]>**

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| **TS 38.213 v16.1.0****9.1.3.1            Type-2 HARQ-ACK codebook in physical uplink control channel****<**Unchanged text is omitted> for any ~~Set~~ ~~while~~ ~~if a single SPS PDSCH reception is activated for a UE and the UE is configured to receive SPS PDSCH in a slot  for serving cell , where  is the PDSCH-to-HARQ-feedback timing value for SPS PDSCH on serving cell~~ ~~= HARQ-ACK information bit associated with the SPS PDSCH reception~~~~end if~~~~;~~~~end while~~If one or multiple SPS PDSCH receptions are activated for a UE and the UE multiplexes corresponding HARQ-ACK information in the PUCCH in slot $n$, the UE generates the HARQ-ACK information as described in Clause 9.1.2 and appends it to the  HARQ-ACK information bits.**<**Unchanged text is omitted> |

**<vivo, [2]>**

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| ================== Beginning of text proposal 2 ===================**TS 38.213 v16.1.0****9.1.3.1            Type-2 HARQ-ACK codebook in physical uplink control channel** **<**Unchanged text is omitted> for any Set  while if ~~a single SPS PDSCH reception is activated for a UE and~~ the UE is configured to receive a single SPS PDSCH in a slot  for serving cell , where  is the PDSCH-to-HARQ-feedback timing value for the SPS PDSCH on serving cell = HARQ-ACK information bit associated with the SPS PDSCH receptionend if;end whileIf multiple SPS PDSCH receptions are activated or there is more than one DL slot for SPS PDSCH receptions on a serving cell and the UE multiplexes corresponding HARQ-ACK information in the PUCCH in slot $n$, the UE generates the HARQ-ACK information as described in Clause 9.1.2 and appends it to the  HARQ-ACK information bits.**<**Unchanged text is omitted>================== End of text proposal 2 =================== |

***Proposal 2: Adopt above TP2 in TS 38.213 section 9.1.3.1.***

<Nokia, [4]>

**Proposal 2: Adopt the following text proposal to allow more than 1 bit of SPS PDSCH HARQ-ACK feedback in a Type-2 Codebook when a single SPS PDSCH reception is activated for a UE:**

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| **Text proposal to Section 9.1.3.1 in TS 38.213:**9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel**<**Unchanged text is omitted>if a single SPS PDSCH reception is activated for a UE:Set  while Set $N\_{c}^{DL}$ to the number of DL slots with a configured SPS PDSCH reception on serving cell $c$ with HARQ-ACK information multiplexed on the PUCCH Set $n\_{D}=0$ – slot index while $n\_{D}<N\_{c}^{DL}$~~if a single SPS PDSCH reception is activated for a UE and the UE is configured to receive SPS PDSCH in a slot  for serving cell , where  is the PDSCH-to-HARQ-feedback timing value for SPS PDSCH on serving cell~~ = HARQ-ACK information bit associated with the SPS PDSCH ~~reception~~ in slot $n\_{D}$ $$n\_{D}=n\_{D}+1$$~~end if~~end while;end whileend ifIf multiple SPS PDSCH receptions are activated for a UE and the UE multiplexes corresponding HARQ-ACK information in the PUCCH in slot $n$, the UE generates the HARQ-ACK information as described in Clause 9.1.2 and appends it to the  HARQ-ACK information bits.**<**Unchanged text is omitted> |

**<CATT [5]>**

***Proposal 2: Adopt the text proposal for Type 2 HARQ-ACK codebook generation.***

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| -------------------------------------------------- Start of text proposal ------------------------------------------------------9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel<unchanged text omitted>~~Set~~ ~~while~~ ~~if a single SPS PDSCH reception is activated for a UE and the UE is configured to receive SPS PDSCH in a slot  for serving cell , where  is the PDSCH-to-HARQ-feedback timing value for SPS PDSCH on serving cell~~ ~~= HARQ-ACK information bit associated with the SPS PDSCH reception~~~~end if~~~~;~~~~end while~~If a UE is configured to receive SPS PDSCH and the UE multiplexes HARQ-ACK information for a single SPS PDSCH reception in the PUCCH in slot $n$, the UE generates 1 bit HARQ-ACK information associated with the SPS PDSCH reception and appends it to the  HARQ-ACK information bits.If ~~multiple SPS PDSCH receptions are activated for a UE~~a UE is configured to receive SPS PDSCH and the UE multiplexes ~~corresponding~~ HARQ-ACK information for multiple SPS PDSCH receptions in the PUCCH in slot $n$, the UE generates the HARQ-ACK information as described in Clause 9.1.2 and appends it to the  HARQ-ACK information bits.<unchanged text omitted>----------------------------------------------------- End of text proposal ------------------------------------------------------ |

**<LG, [10]>**

From our understanding, it seems no need to change the specification as the pseudo code in Section 9.1.3.2 only covers the case for 1 bit HARQ-ACK (the case for multiple HARQ-ACK bits is covered by yellow

**<Huawei, HiSilicon, [17]>**

A simple method to overcome this is to revise the restriction and to allow M bits instead of 1 bit to be transmitted in the PUCCH, where M is equal to the number of slots used to transmit the SPS PDSCH.

***Proposal 1: Do not restrict to at most 1 bit of HARQ-ACK feedback on a PUCCH for single SPS PDSCH configuration for type-2 codebook in mixed numerology case.***

* 1. SPS PDSCH release and SPS PDSCH receptions

[Open issues to be discussed from [IIoTenh-02] in RAN1#100b-e]

It seems that the issue is how to handle the scenario where **SPS release DCI and SPS PDSCH for the same configuration are received in the same slot**. This scenario can happen at least if 1 slot periodicity is configured.

In this scenario, we will face the following cases:

* Case 1: In a slot, if SPS release DCI is received before the end of the SPS PDSCH for the same SPS configuration
	+ Case 1-1: A UE is not required to receive the SPS PDSCH if HARQ-ACK for the SPS release and the SPS reception would map to different PUCCHs
		- Expected consequence: separate HARQ-ACK bits but NACK for the SPS PDSCH?
	+ Case 1-2: A UE is not required to receive the SPS PDSCH if HARQ-ACK for the SPS release and the SPS reception would map to the same PUCCH
		- Expected consequence: only 1 bit for SPS release
* 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: SPS PDSCH is received if HARQ-ACK for the SPS release and the SPS reception would map to different PUCCHs
		- Expected consequence: Separate HARQ-ACK bits
	+ Case 2-2: A UE is not required to receive the SPS PDSCH if HARQ-ACK for the SPS release and the SPS reception would map to the same PUCCH
		- Expected consequence: only 1 bit for SPS release

Now the question would be which cases are to be allowed. In FL’s understanding, these cases need to be discussed for both UE having processing capability of a single unicast PDSCH reception per slot and UE having processing capability of more than one unicast PDSCH reception per slot (even though the final restriction/result may be different depending on UE type).

**Companies are encouraged to provide your views at least on the following questions by tdocs in the next meeting (and surely any other comments/suggestions would be highly appreciated).**

**Q1: Which cases are to be disallowed? For any case(s) disallowed, what is the expected UE behavior on HARQ-ACK feedback (especially please provide your feedback if you disagree with the above observation on the expected consequence).**

**Q2: Do you think how to handle the cases above should be differentiated between a UE having processing capability of a single unicast PDSCH reception per slot and a UE having processing capability of more than one unicast PDSCH reception per slot? If so, please provide your reason, and specific solution.**

For the above issues, most companies show their view and preference on Q1.

* Case 1: **ZTE, vivo, Ericsson, Nokia, NEC(1-2 only), Intel(1-2 only), Spreadtrum, LG(1-1 only), QC(1-2 only), Huawei,**
	+ Expected consequence of Case 1-1
		- separate HARQ-ACK bits
			* **Nokia, Spreadtrum, LG, Huawei,**
			* **Spreadtrum: NACK for SPS PDSCH**
			* **Nokia**: unless the PUCCH for SPS reception would only contain 1 bit of (NACK) feedback, in which case the PUCCH for SPS reception is not reported
		- only 1 bit for SPS release
			* **Vivo, Ericsson**
	+ Expected consequence of Case 1-2:
		- separate HARQ-ACK bits
		- only 1 bit for SPS release
			* **Vivo, Ericsson, Nokia, Spreadtrum, Huawei**
		- HARQ-ACK bit for SPS release and SPS PDSCH can be bundled as 1bit if the UE detects that the SPS PDSCH corresponding to the SPS release DCI is actually transmitted in the slot, otherwise, UE generates only the 1-bit HARQ-ACK for the SPS release.
			* **ZTE**
* Case 2: **Ericsson, Nokia(2-1 only), Spreadtrum, LG(1-1 only), Huawei,**
	+ Expected consequence of Case 2-1
		- separate HARQ-ACK bits
			* **Spreadtrum, Huawei**
		- only 1 bit for SPS release
			* **Ericsson**
	+ Expected consequence of Case 2-2:
		- separate HARQ-ACK bits
		- only 1 bit for SPS release
			* **Ericsson, Spreadtrum, Huawei**

For Q2, following are proposed by [1][2][5][7]

* ZTE[1]: No need to differentiate the lower processing capability of a single unicast PDSCH reception per slot and higher capability of more than one unicast PDSCH reception per slot. The key issue is the SPS release DCI and SPS PDSCH occur in one slot. The capability of processing whether one or more than one unicast PDSCH reception doesn’t affect the capability of DCI reception.
* Vivo[2]: For a UE having processing capability of a single unicast PDSCH reception per slot and a UE having processing capability of more than one unicast PDSCH reception per slot, a UE is not required to receive the SPS PDSCH if HARQ-ACK for the SPS release and the SPS reception would map to different PUCCHs or the same PUCCH. UE generates only 1-bit HARQ-ACK for SPS release.
* CATT[5]:
	+ ***For a UE* *not indicating a capability to receive more than one unicast PDSCH per slot,***
		- ***only HARQ-ACK corresponding to the SPS PDSCH release is transmitted and the HARQ-ACK corresponding to the SPS PDSCH is omitted.***
	+ ***For a UE indicating a capability to receive more than one unicast PDSCH per slot,***
		- ***If the HARQ-ACK bit location for the SPS PDSCH release collides with that for an SPS PDSCH, only HARQ-ACK corresponding to the SPS PDSCH release is transmitted and the HARQ-ACK corresponding to the SPS PDSCH is omitted.***
* Intel[7]: UE behavior can be generalized for both types of UEs. The context of Q1 (and Q2) is when release and PDSCH occasion are for/include the same configuration. Thus, the same case (Case 1-2 only) applies for both cases.
* LG[10]:
	+ For a UE not indicating a capability to receive more than one unicast PDSCH per slot
		- Case 2-1 (and 2-2) is not allowed
	+ For a UE indicating a capability to receive more than one unicast PDSCH per slot
		- Case 2-1 is allowed (no spec impact)

**Comment:**

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| Company | Priority(High/Low) | Comment |
| LGE | High | The issue is essential as identified in the last meeting. Considering proposals in companies’ contributions, there would be so many scenarios due to different UE capability and codebook type. I would like to suggest to discuss principle addressing the problem.  |
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For this issue, Following TP and proposals are provided by companies’ contributions.

**<Ericsson, [3]>**

Proposal 2: Modify the text as: The UE may receive SPS PDSCH release and unicast PDSCH in a same slot.

Proposal 3: The UE reports positive HARQ-ACK only in response to SPS PDSCH release, where the UE is expected to receive SPS PDSCH release and SPS PDSCH in a same slot or sub-slot.

Proposal 4: The UE reports positive HARQ-ACK only in response to SPS PDSCH release which can be based on group SPS release where the UE is expected to receive SPS PDSCH release and SPS PDSCH in a same slot or sub-slot.

Proposal 6: The SPS PDSCH reception should be allowed if it is not entirely after the DCI carrying SPS release.

Proposal 7: The collision between HARQ-ACKs between SPS release and SPS PDSCH should be resolved according to the existing prioritization rules. In case of same priority, SPS release should takes the precedence if there is one bit for the HARQ-ACK in the codebook.

**<Nokia, [4]>**

**Proposal 5: For 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, [5]>**

***Proposal 5:***

***For same-carrier scheduling, if an SPS PDSCH release is received in a slot in which UE is configured to receive SPS PDSCH(s) and the HARQ-ACK corresponding to the SPS PDSCH release and SPS PDSCH(s) are to be transmitted in the same PUCCH, or***

***For cross-carrier scheduling, if* *UE is configured to receive SPS PDSCH(s) on scheduled cell in the last slot overlapping with* *an SPS PDSCH release on scheduling cell and the HARQ-ACKs for the SPS PDSCH release and the SPS PDSCH(s) on the scheduled cell are expected to be transmitted in the same PUCCH,***

* ***For a UE* *not indicating a capability to receive more than one unicast PDSCH per slot,***
	+ ***only HARQ-ACK corresponding to the SPS PDSCH release is transmitted and the HARQ-ACK corresponding to the SPS PDSCH is omitted.***
* ***For a UE indicating a capability to receive more than one unicast PDSCH per slot,***
	+ ***If the HARQ-ACK bit location for the SPS PDSCH release collides with that for an SPS PDSCH, only HARQ-ACK corresponding to the SPS PDSCH release is transmitted and the HARQ-ACK corresponding to the SPS PDSCH is omitted.***

**<NEC, [6]>**

***Proposal 3****: A UE is not expected to receive an SPS release DCI in the same slot as the SPS PDSCH for the same SPS configuration such that there is not enough time to at least cancel the HARQ-ACK feedback for the SPS PDSCH.*

***Proposal 4*:** *A gNB stops transmitting SPS PDSCH when it starts transmitting release DCI for the same SPS configuration.*

***Proposal 5:*** *A gNB does not send SPS PDSCH release in a slot if the SPS PDSCH for the same SPS configuration cannot be stopped by the gNB.*

<Intel, [7]>

Proposal 1

* For a UE not indicating a capability to receive more than one unicast PDSCH per slot, if a UE is configured to receive at least one SPS PDSCH in a slot on a serving cell, for same- or cross-carrier scheduling cases,
	+ if a PDCCH with SPS PDSCH release including an SPS configuration with the lowest configuration index among the SPS configuration(s) configured to be received in the slot is received in the slot, only HARQ-ACK corresponding to the PDCCH with SPS PDSCH release is generated.
		- The UE is not expected to receive the PDCCH with SPS PDSCH release such that the PDCCH ends after the last symbol of the SPS PDSCH of an SPS configuration with the lowest configuration index among the SPS configuration(s) configured to be received in the slot.
	+ The UE is not expected to receive a PDCCH with SPS PDSCH release which does not include an SPS configuration with the lowest configuration index among the SPS configuration(s) configured to be received in the slot.

Proposal 2

* For a UE indicating a capability to receive more than one unicast PDSCH per slot, if a UE is configured to receive at least one SPS PDSCH in a slot on a serving cell, for same- or cross-carrier scheduling cases,
	+ if a PDCCH with SPS PDSCH release, that includes an SPS configuration for which an SPS PDSCH is to be received in the slot after resolution of any overlapping SPS occasions, is received in the slot, only HARQ-ACK corresponding to the PDCCH with SPS PDSCH release is generated.
		- The UE is not expected to receive the PDCCH with SPS PDSCH release for an SPS configuration such that the PDCCH ends after the last symbol of the SPS PDSCH of the same SPS configuration.
	+ The UE is not expected to receive a PDCCH with SPS PDSCH release which does not include an SPS configuration with configuration index that is not among the SPS configuration(s) to be received in the slot after resolution of any overlapping SPS occasions

**<Samsung, [8]>**

***Proposal 6: UE does not expect to receive an SPS PDSCH starting after the starting symbol of the SPS release DCI indicating the same SPS PDSCH configuration.***

**<Spreadtrum, [9]>**

**Proposal 3. For a UE not indicating a capability to receive more than one unicast PDSCH per slot,**

* **Option 2: If a UE is configured to receive at least one SPS PDSCH in a slot on a serving cell, at least for same-carrier scheduling case,**
	+ **if a PDCCH with SPS PDSCH release including an SPS configuration with the lowest configuration index among the SPS configuration(s) configured to be received in the slot is received in the slot, only HARQ-ACK corresponding to the PDCCH with SPS PDSCH release is generated**
		- **The UE is not expected to receive the PDCCH with SPS PDSCH release such that the PDCCH ends after the last symbol of the SPS PDSCH of an SPS configuration with the lowest configuration index among the SPS configuration(s) configured to be received in the slot**
	+ **The UE is not expected to receive a PDCCH with SPS PDSCH release which does not include an SPS configuration with the lowest configuration index among the SPS configuration(s) configured to be received in the slot**

**Proposal 4. If a UE is configured to receive at least one SPS PDSCH in a slot on a serving cell, for cross-carrier scheduling case,**

* **if a PDCCH with SPS PDSCH release including an SPS configuration with the lowest configuration index among the SPS configuration(s) configured to be received in the slot for scheduled cell ends in the slot, only HARQ-ACK corresponding to the PDCCH with SPS PDSCH release is generated**
	+ **The UE is not expected to receive the PDCCH with SPS PDSCH release such that the PDCCH ends after the last symbol of the SPS PDSCH of an SPS configuration with the lowest configuration index among the SPS configuration(s) configured to be received in the slot**
* **The UE is not expected to receive a PDCCH with SPS PDSCH release which does not include an SPS configuration with the lowest configuration index among the SPS configuration(s) configured to be received in the slot**

**<LG, [10]>**

* Case 1-2 and 2-2 are not allowed
* For a UE not indicating a capability to receive more than one unicast PDSCH per slot
	+ Case 2-1 (and 2-2) is not allowed
	+ Case 1-1 is allowed but the UE is not required to receive the SPS PDSCH
* For a UE indicating a capability to receive more than one unicast PDSCH per slot
	+ Case 1-1 is allowed but the UE is not required to receive the SPS PDSCH
	+ Case 2-1 is allowed (no spec impact)

**Proposal 1:**

**A UE does not expect to receive SPS release DCI and SPS PDSCH for the same SPS configuration in a slot if HARQ-ACK for the SPS release and the SPS reception would map to the same PUCCH.**

**Proposal 2:**

**For a UE not indicating a capability to receive more than one unicast PDSCH per slot, the UE does not expect to receive SPS release DCI after the end of the SPS PDSCH for the same SPS configuration in a slot.**

**For a UE not indicating a capability to receive more than one unicast PDSCH per slot, if SPS release DCI is received before the end of the SPS PDSCH for the same SPS configuration, the UE is not required to receive the SPS PDSCH.**

**Proposal 3:**

**For a UE indicating a capability to receive more than one unicast PDSCH per slot, if SPS release DCI is received before the end of the SPS PDSCH for the same SPS configuration, the UE is not required to receive the SPS PDSCH.**

**<oppo, [11]>**

**A UE does not expect to receive an SPS PDSCH starting N symbols after the end of the SPS release DCI indicating the same SPS PDSCH configuration which N is SPS release processing time.**

**<** **NTT DOCOMO, INC., [15]>**

**Proposal 1:**

* *For a UE not indicating a capability to receive more than one unicast PDSCH per slot, if the UE is configured to receive at least one SPS PDSCH in a slot on a serving cell, at least for same-carrier scheduling case,*
	+ *Support to receive SPS PDSCH and SPS release in the same slot if their corresponding HARQ-ACK feedback are reported in different PUCCHs, regardless of if the SPS PDSCH and the SPS release share the same configuration index or not.*
		- *The UE is not required to receive SPS PDSCH of the SPS configuration that is released by a PDCCH ending no later than the ending of the SPS PDSCH.*
	+ *FFS cross-carrier scheduling case*

**<** **Qualcomm Incorporated, [16]>**

**Proposal 4: If Option 1 is adopted, SPS release PDCCH must end no later than the end of SPS PDSCH.**

**Proposal 5: If Option 1 is adopted, K1 for SPS release PDCCH and K1 for SPS PDSCH shall indicate the same (sub)slot for PUCCH and indicating the same bit location in HARQ-ACK codebook.**

**Proposal 6: If Option 1 is adopted, UE does not expect to receive a SPS PDSCH in a slot that SPS release PDCCH is detected.**

**Proposal 7: 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 8: 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.**

**< Huawei, HiSilicon, [17]>**

***Proposal 2:******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:***

* ***Case 1: In a slot, if SPS release DCI is received before the end of the SPS PDSCH for the same SPS configuration***
	+ ***Case 1-2: A UE is not required to receive the SPS PDSCH if HARQ-ACK for the SPS release and the SPS reception would map to the same PUCCH***
		- ***Expected consequence: only 1 bit for SPS release***
* ***Case 2: In a slot, if SPS release DCI is received after the end of the SPS PDSCH for the same SPS configuration***
	+ ***Case 2-2: A UE is not required to receive the SPS PDSCH if HARQ-ACK for the SPS release and the SPS reception would map to the same PUCCH***
		- ***Expected consequence: only 1 bit for SPS release***
	1. HARQ-ACK for SPS PDSCH cancelled by dynamic SFI/DCI

[Open issues to be discussed from [IIoTenh-02] in RAN1#100b-e]

Although we have made the agreement on this issue as below, due to lack of time, there was no chance to discuss the corresponding TP.

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.

* 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.

For your convenience, the “tentative” TP can be provided as below so **companies are encouraged to check it out and to bring the TP for capturing RAN1 intention properly.**

Tentative TP proposal:

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

|  |
| --- |
| 9.1.2  Type-1 HARQ-ACK codebook determination<unnecessary part is omitted>within the cid:image002.png@01D61E3A.180D7580 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 cid:image002.png@01D61E3A.180D7580 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 more than one SPS PDSCH reception~~s~~ that the UE is configured to receive 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.**<**Unchanged text is omitted>while $c<N\_{cells}^{DL}$ Set $s=0$ – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations while $s<N\_{c}^{SPS}$Set $n\_{D}=0$ – slot index while $n\_{D}<N\_{c}^{DL}$if UE is configured to receive a SPS PDSCH in slot $n\_{D}$ for SPS PDSCH configuration $s$ on serving cell $c$, ~~and~~ except that the SPS PDSCH 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-ULDL-ConfigurationCommon*, or by *tdd-UL-DL-ConfigurationDedicated*$\tilde{o}\_{j}^{ACK}$ = HARQ-ACK information bit for this SPS PDSCH reception $j=j+1$;end if$n\_{D}=n\_{D}+1$;end while$s=s+1$;end while$c=c+1$;end while**<**Unchanged text is omitted> |

The first part makes the pseudo-code in 9.1.2 be applied to the case for multiple HARQ-ACK bits only for SPS PDSCHs (without DG PDSCH) on a PUCCH (and not to be applied to the case for single HARQ-ACK bit for an SPS PDSCH).

The second part is to include A/N bits for cancelled SPS PDSCH by dynamic SFI/DCI in the codebook for the case for multiple HARQ-ACK bits only for SPS PDSCHs without DG PDSCH on a PUCCH (for both type-1 and type-2 codebook).

The update of “or due to overlapping with a set of symbols indicated as uplink by *tdd-ULDL-ConfigurationCommon*, or by *tdd-UL-DL-ConfigurationDedicated*” comes from QC’s offline comment to make sure that A/N bit for the cancelled SPS PDSCH by semi-static UL is not included in the codebook as in Rel-15.

Except for the discussion on the TP, some companies raise issues such as PUCCH power control and order between SFI and SPS overlapping handling. In this issue, it is recommended to conclude TP first, and treat other issue after that.

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | The agreement needs to be captured in the specification. |
|  |  |  |
|  |  |  |

For this issue, Following TP and proposals are provided by companies’ contributions.

**<ZTE, [1]>**

|  |
| --- |
| 9.1.2 Type-1 HARQ-ACK codebook determination...If a UE reports HARQ-ACK information in a PUCCH only for - a SPS PDSCH release indicated by DCI format 1\_0 with counter DAI field value of 1, or- a PDSCH reception scheduled by DCI format 1\_0 with counter DAI field value of 1 on the PCell, or - SPS PDSCH reception~~s~~within the cid:image002.png@01D61E3A.180D7580 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~~ one SPS PDSCH reception~~s~~ according to corresponding cid:image002.png@01D61E3A.180D7580 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 more than one SPS PDSCH reception~~s~~ that the UE is configured to receive 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.**<**Unchanged text is omitted> |

**<Nokia, [4]>**

**Proposal 6: Adopt the following text proposal to capture the RAN1#100-bis-e agreement of “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.”**

**<Samsung, [8]>**

***Proposal 5: 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.***

***Proposal 7: For a Type-1 HARQ-ACK codebook, if a UE does not indicate the capability to receive more than one unicast PDSCH per slot, for an active BWP of a serving cell, following two alternatives can be considered,***

***Alt 1: it can be up to gNB’s implementation to ensure HARQ-ACK codebook construction.***

***Alt 2: when UE receives an SPS release DCI in a slot, UE will transmit HARQ-ACK for the release DCI and does not need to receive any SPS PDSCH in this slot.***

**<Spreadtrum, [9]>**

**Proposal 2: Choose one method for the processing order of DL SPS PDSCH overlapping handling and cancellation including due to TDD configuration/SFI/DCI**

**• Alt 1: DL SPS PDSCH overlapping handling first, and then TDD configuration/SFI/DCI.**

**• Alt 2: TDD configuration/SFI/DCI first, and then DL SPS PDSCH overlapping handling.**

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

[Open issues to be discussed from [IIoTenh-03] in RAN1#100b-e]

There were some proposals on HARQ-ACK codebook when PDSCH aggregation is configured for SPS. At least the following aspects are identified to be taken care of, so **companies are encouraged to take these aspects into account for preparing tdocs in the next meeting**.

* For SPS PDSCH with aggregation factor, A/N bit generation is per slot per occasion or within all *pdsch-AggregationFactor* occasions?
* How to assume *pdsch-AggregationFactor* when constructing HARQ-ACK codebook
* HARQ-ACK codebook construction depending on the reception of the last SPS PDSCH (e.g., when only the last SPS PDSCH is cancelled but others are received)

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | This issue is identified in the last meeting and a significant number of companies think it needs to be discussed.  |
|  |  |  |
|  |  |  |

For this issue, Following TP and proposals are provided by companies’ contributions.

**<vivo, [2]>**

***Proposal 5: For type 1 HARQ-ACK codebook, is the maximum of the values of pdsch-AggregationFactor values provided in SPS-Config and PDSCH-Config in the pseudo-code of determining occasions for candidate PDSCH receptions or SPS PDSCH releases.***

***Proposal 6:******Adopt TP3 in TS 38.213 section 9.1.2.1.***

***Proposal 7: For a SPS PDSCH reception ending in slot n, the UE transmits the PUCCH in slot n+k, where reception of the last SPS PDSCH is the PDSCH reception before cancellation.***

**<Ericsson, [3]>**

Proposal 5: For Type-1 codebook, the UE reports HARQ-N/ACK feedback on the placeholder corresponding to last actual transmitted repetition instead of a last configured repetition for a given SPS.

**<Nokia, [4]>**

**Proposal 8: For Type-1 HARQ-ACK codebook, adopt the following text proposal to Section 9.1.2 of TS 38.213 to allow PDSCH aggregation per DL SPS configuration (provided via RRC parameter *pdsch-AggregationFactor* in *sps-Config*).**

|  |
| --- |
| **TP to TS 38.213, Sec. 9.1.2** 9.1.2 Type-1 HARQ-ACK codebook determination<omitted text>For SPS PDSCH reception for which *pdsch-AggregationFactor* is provided in *sps-Config*, $N\_{PDSCH}^{repeat}$ is a value of *pdsch-AggregationFactor* in *sps-Config*. Otherwise, if the UE is provided *pdsch-AggregationFactor* in *pdsch-config* and no entry in *pdsch-TimeDomainAllocationList* includes *RepNumR16* in *PDSCH-TimeDomainResourceAllocation*, $N\_{PDSCH}^{repeat}$ is a value of *pdsch-AggregationFactor* in *pdsch-config*; otherwise $N\_{PDSCH}^{repeat}=1$. The UE reports HARQ-ACK information for a PDSCH reception* from slot $n-N\_{PDSCH}^{repeat}+1$ to slot $n$, if $N\_{PDSCH}^{repeat}>1$, or
* from slot $n-RepNumR16+1$ to slot $n$, 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 $n$, otherwise

only in a HARQ-ACK codebook that the UE includes in a PUCCH or PUSCH transmission in slot $n+k$, where $k$ 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 $n+k$, the UE sets a value for each corresponding HARQ-ACK information bit to NACK. <omitted text> |

**Proposal 9: For Type-1 HARQ-ACK codebook, the set of MA,c occasions for candidate PDSCH receptions should be determined based on the maximum of the values of *pdsch-AggregationFactor* values, if provided in *sps-Config* and/or *pdsch-Config*, and values of *RepNumR16*, if provided. Adopt the following text proposal to TS 38.213 Section 9.1.2.1:**

|  |
| --- |
| **TP to TS 38.213, Sec. 9.1.2.1** 9.1.2.1 Type-1 HARQ-ACK codebook in physical uplink control channelFor a serving cell , an active DL BWP, and an active UL BWP, as described in Clause 12, the UE determines a set of  occasions for candidate PDSCH receptions for which the UE can transmit corresponding HARQ-ACK information in a PUCCH in slot . If serving cell  is deactivated, the UE uses as the active DL BWP for determining the set of  occasions for candidate PDSCH receptions a DL BWP provided by *firstActiveDownlinkBWP-Id*. The determination is based:<omitted text>e) if *CA-slot-offset* is provided, on $N\_{slot,offset,c}^{DL} $and $μ\_{offset,DL,c}$ for serving cell $c$, or on$N\_{slot,offset}^{UL} $ and $μ\_{offsetUL}$for the cell of PUCCH transmission, as described in [4, TS 38.211].f) on $N\_{PDSCH, max}^{repeat}$, where $N\_{PDSCH, max}^{repeat}$ is the maximum of values of *pdsch-AggregationFactor* if provided in *sps-Config* and/or *pdsch-Config,* and values of *RepNumR16,* if provided.<omitted text>while if the UE is provided *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated* and, for each slot from slot $\left⌊\left(n\_{U}-K\_{1,k}\right)∙2^{μ\_{DL}-μ\_{UL}}\right⌋+n\_{D}-N\_{PDSCH,max}^{repeat}+1$ to slot , at least one symbol of the PDSCH time resource derived by row  is configured as ULwhere  is the *k*-th slot timing value in set , ;else; end ifend while<omitted text> |

**Proposal 10: When *pdsch-AggregationFactor* > 1 is configured for a SPS configuration, the UE is not expected to be scheduled with another decodable PDSCH that occupies the same bit position as the SPS PDSCH in a Type-1 HARQ-ACK codebook.**

**<CATT, [5]>**

|  |
| --- |
| -------------------------------------------------- Start of text proposal ------------------------------------------------------9.1.2 Type-1 HARQ-ACK codebook determination<unchanged text omitted>Set $N\_{cells}^{DL}$ to the number of serving cells configured to the UESet $N\_{c}^{SPS}$ to the number of SPS PDSCH configuration configured to the UE for serving cell $c$Set $N\_{c}^{DL}$ to the number of DL slots for SPS PDSCH reception on serving cell $c$ with HARQ-ACK information multiplexed on the PUCCHSet $N\_{PDSCH}^{repeat}$ to the number of slots for SPS PDSCH repetition.Set $j=0$ – HARQ-ACK information bit indexSet $c=0$ – serving cell index: lower indexes correspond to lower RRC indexes of corresponding cellwhile $c<N\_{cells}^{DL}$ Set $s=0$ – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations while $s<N\_{c}^{SPS}$Set $n\_{D}=0$ – slot index while $n\_{D}<N\_{c}^{DL}$if {a UE is configured to receive a SPS PDSCH in slot $n\_{D}$ for SPS PDSCH configuration $s$ on serving cell $c$, except that ~~and~~ the SPS PDSCH is not required to be received among overlapping SPS PDSCHs for each slot from slot $n\_{D}-N\_{PDSCH}^{repeat}+1$ to slot $n\_{D}$, 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], andHARQ-ACK information for the SPS PDSCH is associated with the PUCCH}$\tilde{o}\_{j}^{ACK}$ = HARQ-ACK information bit for this SPS PDSCH reception $j=j+1$;end if$n\_{D}=n\_{D}+1$;end while$s=s+1$;end while$c=c+1$;end while<unchanged text omitted>----------------------------------------------------- End of text proposal ------------------------------------------------------ |

***Proposal 4: Adopt the text proposal for HARQ-ACK codebook generation in response to SPS PDSCH receptions.***

**<NEC, [6]>**

***Proposal 6****: 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, [8]>**

***Proposal 3: For Type-1 HARQ-ACK codebook, the set of MA,c occasions for candidate PDSCH receptions should be determined based on the maximum of the values of pdsch-AggregationFactor values, if provided in SPS-Config and/or PDSCH-Config and values of RepNumR16, if provided. The following TP should be adopted.***

|  |
| --- |
| **TS 38.213**9.1.2.1 Type-1 HARQ-ACK codebook in physical uplink control channelFor a serving cell , an active DL BWP, and an active UL BWP, as described in Clause 12, the UE determines a set of  occasions for candidate PDSCH receptions for which the UE can transmit corresponding HARQ-ACK information in a PUCCH in slot . If serving cell  is deactivated, the UE uses as the active DL BWP for determining the set of  occasions for candidate PDSCH receptions a DL BWP provided by *firstActiveDownlinkBWP-Id*. The determination is based:a) on a set of slot timing values  associated with the active UL BWPa) If the UE is configured to monitor PDCCH for DCI format 1\_0 and is not configured to monitor PDCCH for DCI format 1\_1 on serving cell ,  is provided by the slot timing values {1, 2, 3, 4, 5, 6, 7, 8} for DCI format 1\_0b) If the UE is configured to monitor PDCCH for DCI format 1\_1 for serving cell ,  is provided by *dl-DataToUL-ACK* for DCI format 1\_1b) on a set of row indexes  of a table that is provided either by a first set of row indexes of a table that is provided by *pdsch-TimeDomainAllocationList* in *pdsch-ConfigCommon* or by Default PDSCH time domain resource allocation A [6, TS 38.214], or by the union of the first set of row indexes and a second set of row indexes, if provided by *pdsch-TimeDomainAllocationList* in *pdsch-Config*, associated with the active DL BWP and defining respective sets of slot offsets , start and length indicators *SLIV*, and PDSCH mapping types for PDSCH reception as described in [6, TS 38.214]c) on the ratio  between the downlink SCS configuration  and the uplink SCS configuration  provided by *subcarrierSpacing* in *BWP-Downlink* and *BWP-Uplink* for the active DL BWP and the active UL BWP, respectivelyd) if provided, on *tdd-UL-DL-ConfigurationCommon* and *tdd-UL-DL-ConfigurationDedicated* as described in Clause 11.1 e) if *CA-slot-offset* is provided, on $N\_{slot,offset,c}^{DL} $and $μ\_{offset,DL,c}$ for serving cell $c$, or on$N\_{slot,offset}^{UL} $ and $μ\_{offsetUL}$for the cell of PUCCH transmission, as described in [4, TS 38.211].f) on $N\_{PDSCH, max}^{repeat} $, where $N\_{PDSCH, max}^{repeat} $ is the maximum of values of *pdsch-AggregationFactor,* if provided in *SPS-Config* and/or *PDSCH-Config,* and values of *RepNumR16,* if provided.If a UE- is not provided *CORESETPoolIndex* or is provided *CORESETPoolIndex* with a value of 0 for first CORESETs on active DL BWPs of serving cells, and- is provided *CORESETPoolIndex* with a value of 1 for second CORESETs on active DL BWPs of the serving cells, and- is provided *ACKNACKFeedbackMode* = *JointFeedback*where - a serving cell is placed in a first set $S\_{0}$ of $N\_{cells}^{DL,0}$ serving cells if the serving cell includes a first CORESET, and- a serving cell is placed in a second set $S\_{1}$ of $N\_{cells}^{DL,1}$ serving cells if the serving cell includes a second CORESET, and- serving cells are placed in a set according to an ascending order of a serving cell indexthe UE generates a Type-1 HARQ-ACK codebook for the set $S\_{0}$ and the set $S\_{1}$ of serving cells separately by setting $N\_{cells}^{DL}=N\_{cells}^{DL,0}$ and $N\_{cells}^{DL}=N\_{cells}^{DL,1}$ in the following pseudo-code. The UE concatenates the HARQ-ACK codebook generated for the set $S\_{0}$ followed by the HARQ-ACK codebook generated for the set $S\_{1}$ to obtain a total number of  HARQ-ACK information bits..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 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 corresponding SPS PDSCH reception with the lowest SPS configuration index among the multiple SPS PDSCH releases.Set  - index of occasion for candidate PDSCH reception or SPS PDSCH releaseSet Set Set  to the cardinality of set Set *k* =0 – index of slot timing values , in descending order of the slot timing values, in set  for serving cell If a UE is not provided *CA-slot-offset* for any serving cell of PDSCH receptions and for the serving cell of corresponding PUCCH transmission with HARQ-ACK informationwhile  if  Set  – index of a DL slot within an UL slotwhile  Set  to the set of rowsSet  to the cardinality of Set  – index of row in set if slot  starts at a same time as or after a slot for an active DL BWP change on serving cell  or an active UL BWP change on the PCell and slot  is before the slot for the active DL BWP change on serving cell  or the active UL BWP change on the PCell $n\_{D}=n\_{D}+1$; else while if the UE is provided *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated* and, for each slot from slot $\left⌊\left(n\_{U}-K\_{1,k}\right)∙2^{μ\_{DL}-μ\_{UL}}\right⌋+n\_{D}-N\_{PDSCH}^{repeat}+1$ $\left⌊\left(n\_{U}-K\_{1,k}\right)∙2^{μ\_{DL}-μ\_{UL}}\right⌋+n\_{D}-N\_{PDSCH,max}^{repeat}+1$ to slot , at least one symbol of the PDSCH time resource derived by row  is configured as ULwhere  is the *k*-th slot timing value in set , ;else; end ifend while… |

***Proposal 4: 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, when provided in both SPS-Config and PDSCH-Config. The following TP should be adopted.***

|  |
| --- |
| **TS 38.213**9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channelA 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 values of *pdsch-AggregationFactor*, when provided in *SPS-Config* and *PDSCH-Config*. … |

**<Spreadtrum, [9]>**

**Proposal 7. For SPS PDSCH with aggregation factor, A/N bit generation is within all pdsch-AggregationFactor occasions.**

**Proposal 8. When constructing HARQ-ACK codebook, pdsch-AggregationFactor is the maximum value among the values of pdsch-AggregationFactor from PDSCH-config and SPS-config which SPS PDSCH reception with HARQ-ACK information multiplexed on the PUCCH**

**Proposal 9. When at least one SPS PDSCH is received, the HARQ-ACK can be in the HARQ-ACK codebook.**

**<oppo, [10]>**

**Proposal 3: A/N bit generation is per periodicity.**

**Proposal 4: Maximum value of *pdsch-AggregationFactor* for multiple SPS configurations with the same priority is applied for Type 1 HARQ-ACK codebook construction.**

**Proposal 5: The slot/sub-slot to transmit HARQ-ACK depends on the reception of the last SPS PDSCH repetition after semi-static cancellation of SPS PDSCH repetition.**

**< NTT DOCOMO, INC., [15]>**

**Proposal 2:**

* *If a UE is provided multiple PDSCH aggregation factor values by pdsch-AggregationFactor in SPS-Config and/or PDSCH-Config, the Type-1 HARQ-ACK codebook is determined based on the maximum of the multiple PDSCH aggregation factor values.*

**<** **Qualcomm Incorporated, [16]>**

**Proposal 9:** $N\_{PDSCH}^{repeat}$ **is always defined as 1 and A/N bit position for each PDSCH with repetitions is tied with the last actual PDSCH reception.**

**Proposal 10: If Proposal 5 is adopted, UE does not expect to be configured with a set of slot timing values K1 that for a given PDSCH with *pdsch-AggregationFactor* >1, none of actual receptions is received within the set of *nD* slots.**

**< Huawei, HiSilicon, [17]>**

***Proposal 3:******HARQ-ACK feedback for a SPS PDSCH should also be included in the HARQ-ACK codebook, if the last SPS PDSCH repetition is not received but other SPS PDSCH repetitions within same repetition are received****.*

# HARQ-ACK feedback related issues for SPS

* 1. HARQ-ACK codebook size determination for type1 HARQ-ACK codebook

In [1], ZTE raises a concern on codebook construction if HARQ-ACK information bits generation is based on the configured SPS PDSCHs but not activated SPS PDSCH. ZTE provides TP and proposals as below[1].

|  |
| --- |
| Set $N\_{cells}^{DL}$ to the number of serving cells configured to the UESet $N\_{c}^{SPS}$ to the number of SPS PDSCH configuration configured to the UE for serving cell $c$Set $N\_{c}^{DL}$ to the number of DL slots n-k1 which k1 is from the k1 set for SPS PDSCH reception on serving cell $c$ with HARQ-ACK information multiplexed on the PUCCH in slot nSet $j=0$ – HARQ-ACK information bit indexSet $c=0$ – serving cell index: lower indexes correspond to lower RRC indexes of corresponding cellwhile $c<N\_{cells}^{DL}$ Set $s=0$ – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations while $s<N\_{c}^{SPS}$Set $n\_{D}=0$ – slot index while $n\_{D}<N\_{c}^{DL}$if UE is configured to receive a SPS PDSCH in slot $n\_{D}$ for SPS PDSCH configuration $s$ on serving cell $c$, 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] , andHARQ-ACK information for the SPS PDSCH is associated with the PUCCH$\tilde{o}\_{j}^{ACK}$ = HARQ-ACK information bit for this SPS PDSCH reception $j=j+1$;end if$n\_{D}=n\_{D}+1$;end while$s=s+1$;end while$c=c+1$;end while |

*Proposal 4: The above TP is proposed for type-1 HARQ-ACK codebook size determination.*

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | Above TP is to assign a HARQ-ACK bit for SPS configuration not activated yet. For my understanding, $N\_{c}^{DL}$ will not change number of HARQ-ACK bit. $N\_{c}^{DL}$ is used only for gathering results of SPS PDSCH reception. Thus, if a SPS configuration is not activated, it is not necessary to include that SPS configuration to HARQ-ACK codebook as in Rel-15.Moreover, current description already says “the SPS PDSCH is required to be received” which means activated SPS PDSCH. We think the sentence can address the problem. |
|  |  |  |
|  |  |  |

* 1. [moved] HARQ-ACK bit collision between SPS release and SPS PDSCH

<Ericsson, [3]>

Proposal 7: The collision between HARQ-ACKs between SPS release and SPS PDSCH should be resolved according to the existing prioritization rules. In case of same priority, SPS release should takes the precedence if there is one bit for the HARQ-ACK in the codebook.

**Comment before the email discussion:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | Considering this case can be mostly avoided by gNB implementation, this issue could be low priority for discussion.  |
|  |  |  |
|  |  |  |

According to the email discussion, this issue is included issue 3.4.

* 1. PUCCH resource selection for SPS HARQ-ACK and SR

**<Samsung, [8]>**

**Proposal 9: Capture multiplexing of SR with HARQ-ACK from multiple SPS PDSCH by adding a reference to clause 9.2.1 as follows.**

|  |
| --- |
| 9.2.5.1 UE procedure for multiplexing HARQ-ACK or CSI and SR in a PUCCH\*\*\* Unchanged text is omitted \*\*\*If a UE would transmit a PUCCH with  HARQ-ACK information bits in a resource using PUCCH format 2 or PUCCH format 3 or PUCCH format 4 in a slot, as described in Clauses 9.2.1 and 9.2.3,  bits representing a negative or positive SR, in ascending order of the values of *schedulingRequestResourceId* and *schedulingRequestIDForBFR*, are appended to the HARQ-ACK information bits and the UE transmits the combined  UCI bits in a PUCCH using a resource with PUCCH format 2 or PUCCH format 3 or PUCCH format 4 that the UE determines as described in Clauses 9.2.1 and 9.2.3. If one of the SRs is a positive LRR, the value of the  bits indicates the positive LRR. An all-zero value for the  bits represents a negative SR value across all  SRs. \*\*\* Unchanged text is omitted \*\*\* |

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | The proposal seems concrete and necessary. At the same time, it could be fixed by editor even without agreement. |
|  |  |  |
|  |  |  |

# Other issues related to SPS

* 1. SPS PDSCH collision handling

<Ericsson, [3]>

Proposal 1: To correctly decode SPS PDSCH in an overlapping scenario, the SPS PDSCHs over uplink symbols must be excluded due to dynamic slot configuration and dynamic uplink scheduling.

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | In an overlapping scenario, we discussed with an assumption that collision handling would be performed in semi-static manner after SPS PDSCH configuration. It seems not essential and could bring additional issues such as time line between cancelation and collision handling. |
|  |  |  |
|  |  |  |

* 1. Overwriting of SPS PDSCH(s) with dynamic grant

**<Nokia, [4]>**

**Proposal 7: 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 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 *T*~~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. 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> |

**<Samsung, [8]>**

***Proposal 8: Dynamic scheduled PDSCH can cancel non-overlapping SPS PDSCH when the number of received unicast PDSCHs exceeds UE’s capability***

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | For changing timeline for overwriting, it seems optimization. Further discussion is needed on whether or not this relaxation/enhancement is essential.For UE capability handling, it seems not essential and not aligned with UL CI cancelation behavior.  |
|  |  |  |
|  |  |  |

* 1. DL SPS skipping

<vivo, [2]>

***Proposal 8: gNB may skip the DL SPS PDSCH transmission and UE can perform DMRS detection in a PDSCH occasion and decode the PDSCH only when the corresponding DMRS is detected.***

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | It seems optimization and can be discussed with low priority.  |
|  |  |  |
|  |  |  |

* 1. Out-of-order for SPS release and PDSCH transmission

<Ericsson, [3]>

Proposal 8: The out-of-order HARQ-ACK restriction should not be applied between SPS release and PDSCH transmission.

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | In the previous meeting, the issue raised by oppo was removed as this topic was also suggested to be discussed in Rel-15 CR. I would like to suggest to follow same principle in this meeting as well. |
|  |  |  |
|  |  |  |

* 1. Correction for HARQ-ACK information in a PUCCH

<Ericsson, [3]>

In Release-16, SPS release DCI can be single or multiple DL SPS release. In addition, in Release-16 all DCI formats can be used for SPS PDSCH release, 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

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | Seems true. Solution is also straightforward.  |
|  |  |  |
|  |  |  |

# Intra-UE UL collision related issues

* 1. Collision between CG and CG/DG (including LS R1-2003259)

In this meeting, there is incoming LS from RAN2 (R1-2003259), regarding intra-UE prioritization cases with uplink grants overlapping in time. According to the LS, some undesirable behavior could occur due to inconsistent conflict handing between RAN1/RAN2. To resolve this inconsistency, two options which are specified by RAN2 as following.

1. RAN2 changes MAC specification to accommodate current PHY behaviour. With this option, MAC will avoid providing second MAC PDU with the same L1 priority to PHY, meaning that PHY would transmit the packet with lower LCH priority data.
2. RAN1 changes PHY specification to accommodate current MAC behaviour of prioritizing the second MAC PDU provided from MAC.

In [21-25], some companies provide drafts of reply LS.

In order to reply the LS, we would like to collect companies’ preference on those options.

* Option 1
	+ Support: ZTE[1,21], Ericsson[3], Samsung[8], LG[10], MTK[12], Qualcomm[16,20], vivo[17,22 ], Nokia[19,24](no change RAN1 spec.)
* Option 2
	+ Support: CATT[5,23] (only if no UCI multiplexing), Huawei[17], Sony[13] (for UE supporting or configured with L1 priority), oppo[25]

Main discussion point would be a feasibility of the cancellation via second MAC PDU. Here is companies’ view on the feasibility

* The reason of infeasibility
	+ Timeline won’t guaranteed
	+ A moment when MAC PDU delivered cannot be specified
	+ It needs to redesign entire UCI multiplexing/prioritization behavior at the very late CR phase.
		- Especially, it may potentially produce the unintended dropping of a high-priority HARQ multiplexed onto the deprioritized PUSCH.
	+ It will lead to unnecessary increase in gNB complexity, DL control load, reduced DL & UL system efficiency, reduced inter-UE CG PUSCH multiplexing capabilities

As an additional discussion point, vivo[17] suggest to ask RAN2 how to handle the collision case in MAC layer if MAC layer intra-UE prioritization is not supported or not configured, i.e., LCH-based prioritization is not configured

Separately from LS, there were offline discussion and proposals on support of between CG and DG/CG with different priority. It should be note that the above options in LS can be applied to either same or different priority. So our suggestion is to focus drafting reply LS first.

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | At least, reply LS should be prepared. |
|  |  |  |
|  |  |  |

Proposals from contributions:

**<Ericsson, [3]>**

Proposal 9: Add clarification to TS38.214 that when high priority CG PUSCH overlaps with low priority DG PUSCH, the DG PUSCH is cancelled only if MAC has generated a TB to be carried by the CG PSUCH transmission.

Proposal 10: Add clarification to TS38.214 that for both CG-PUSCH and DG-PUSCH, the PUSCH participates in the intra-UE multiplexing/prioritization procedure only if the PUSCH contains a TB from MAC. Otherwise, an empty PUSCH is automatically dropped.

Observation 3: Rel-16 already supports collision handling of DG-PUSCH vs CG-PUSCH, or CG-PUSCH vs CG-PUSCH.

<CATT, [5]>

***Proposal 6: Only if there is no UCI multiplexing on the first PUSCH or PUCCH with SR, the PUSCH or PUCCH with SR can be interrupted by a second PUSCH/SR with same PHY priority.***

***Proposal 7: Adopt the text proposal provided below for UL overlapping in 38.213 section 9.***

|  |
| --- |
| If a UE is configured with *lch-BasedPrioritization-r16* and[*phy-LayerPrioritization*], if the UE determines to transmit a first SR or PUSCH of a priority index and a second SR or PUSCH of the same priority index triggered by MAC layer with higher logical channel priority, and a transmission of the first SR or PUSCH would overlap in time with a transmission of the second SR or PUSCH, the UE does not transmit the first SR or PUSCH unless there is UCI multiplexed on the first PUSCH with uplink transmission or PUCCH with SR. |

**<Intel, [7]>**

**Proposal 5**

* ***RAN1 to confirm that intra-UE prioritization for the following cases are supported in Rel-16***
	+ ***Time domain overlaps between two CG PUSCH occasions with different priorities***
	+ ***Time domain overlaps between a CG PUSCH occasion and a DG PUSCH with different priorities.***

**<Samsung, [8]>**

***Proposal 10: No need to preclude CG-PUSCH vs. CG-PUSCH collision and DG-PUSCH vs. CG-PUSCH collision.***

***Proposal 11: It is preferable to conclude first option (change RAN2 specification) to resolve RAN1-RAN2 mismatch issue of RAN2 LS (R1-2003259).***

**<** **MediaTek Inc., [12]>**

***Proposal 1: RAN1 should address the agreements made on CG-CG, DG-CG and ULSCH-SR conflict in RAN2#108 and the following observation noted in RAN2#109: “according to current R2 agreements: In case that two MAC PDUs with the same L1 priority (i.e. high-high or low-low) are delivered by MAC, the second PDU has priority from RAN2 perspective (based on LCH priority).”***

***Proposal 2: RAN1 should propose to RAN2 to change MAC specification to accommodate current PHY behavior. (Option 1 in R2 LS R2-2004121). With this option the MAC does not deliver a second PDU to L1 once a PDU has been passed to L1 and would conflict with the transmission of the second PDU and the respective colliding grants have equal L1 priority levels.***

**<Sony, [13]>**

**Proposal 1: If UE does not support intra-UE prioritization, UE follows Rel-15 behaviour and prioritises DG-PUSCH over CG-PUSCH when they collide.**

**Proposal 2: If UE supports intra-UE prioritization, when a DG-PUSCH and a CG-PUSCH of the same L1 priority collide, the later arriving PUSCH is transmitted.**

**<Apple, [14]>**

**Observation 2: To be consistent in RAN1, other overlapping PUSCH cases such as CG vs DG and CG vs CG cause the same challenge in UE implementation as DG vs DG cases, hence they should not be supported in Rel-16 just as the overlapping PUSCHs with DG vs DG.**

**Proposal 1: In Rel-16, a UE is not expected to handle overlapping PUSCHs with CG vs DG at physical layer.**

**Proposal 2: the tentative text in brackets in Clause 6.1 of TS 38.214 is removed.**

**<** **Qualcomm Incorporated, [16]>**

**Observation 1: RAN1 did not discuss the CGCG and CGDG collision handling during the WI phase. The agreements made for prioritization under the UCI enhancement AI do not cover these new scenarios.**

**Proposal 2: For handling CGCG PUSCH collision with different priorities, the UE’s MAC can avoid the over-the-air collision. Hence, no impact to the PHY specification is expected.**

**Proposal 3: For handling DGCG collision with different priorities, the Rel. 15 timelines for overriding a CG occasion using a dynamically granted PUSCH should remain unchanged.**

**<Huawei, HiSilicon, [17]>**

***Proposal 4: Adopt the following TP for 38.213:***

|  |
| --- |
| --------------------------------------------Start of text proposal--------------------------------------------------------9 UE procedure for reporting control information\*\*\* Unchanged text is omitted \*\*\*A PUSCH or a PUCCH, including repetitions if any, can be of priority index 0 or of priority index 1. If a priority index is not provided for a PUSCH or a PUCCH, the priority index is 0. If in an active DL BWP a UE monitors PDCCH either for detection of DCI format 0\_1 and DCI format 1\_1 or for detection of DCI format 0\_2 and DCI format 1\_2, a priority index can be provided by a priority indicator field. If a UE indicates a capability to monitor, in an active DL BWP, PDCCH for detection of DCI format 0\_1 and DCI format 1\_1 and for detection of DCI format 0\_2 and DCI format 1\_2, a DCI format 0\_1 or a DCI format 0\_2 can schedule a PUSCH transmission of any priority and a DCI format 1\_1 or a DCI format 1\_2 can schedule a PDSCH reception and trigger a PUCCH transmission with corresponding HARQ-ACK information of any priority. If, after resolving overlapping for PUCCH and/or PUSCH transmissions of a same priority index, a UE determines to transmit- […]- a first PUSCH of larger priority index on a serving cell, a second PUSCH of smaller priority index on the serving cell, and a transmission of the first PUSCH would overlap in time with a transmission of the second PUSCH, the UE does not transmit the second PUSCH, where at least one of the two PUSCH is not scheduled by a DCI format. - a first PUSCH on a serving cell, a second PUSCH of the same priority index on the serving cell, and the data from MAC layer of the second PUSCH is received later than that of the first PUSCH, and a transmission of the first PUSCH would overlap in time with a transmission of the second PUSCH, the UE does not transmit the first PUSCH, where at least one of the two PUSCH is not scheduled by a DCI format.---------------------------------------------End of text proposal-------------------------------------------------------- |

***<vivo, [18]>***

***Proposal 1: it is necessary to ask RAN2 how to handle the collision case in MAC layer if MAC layer intra-UE prioritization is not supported or not configured, i.e., LCH-based prioritization is not configured. Form RAN1’s understanding, only one MAC PDU is generated for the collision case.***

***Proposal 2:***

* ***UE should not expect to be configured with MAC layer intra-UE prioritization alone***
* ***Intra-UE prioritization for PHY layer should be the prerequisite UE feature for the intra-UE prioritization for MAC layer***

***Proposal 3: following two options are suggested from RAN1 to RAN2:***

* ***Option 1: RAN2 changes MAC specification to accommodate current PHY behavior, that is MAC will avoid providing second MAC PDU with the same L1 priority to PHY.***
* ***Option 2: RAN2 does not need to change MAC specification that is MAC can generate the two MAC PDUs with the same L1 priority to PHY, but DG always override CG in PHY. In such case, the CG is dropped in PHY and the corresponding MAC PDU is discarded.***

***Proposal 4: for CG vs. CG, RAN1 strive for the solution to accommodate current MAC behaviour of prioritizing the second MAC PDU provided from MAC. If no consensus in RAN1, leave it to UE implementation.***

**<Nokia, [19]>**

* ***Observation: Changing the PHY behavior as suggested by RAN2, will lead to unnecessary increase in gNB complexity, DL control load, reduced DL & UL system efficiency, reduced inter-UE CG PUSCH multiplexing capabilities and especially unintended (uncontrollable) HARQ-ACK dropping affecting the DL URLLC performance.***
* ***Proposal: RAN1 does not change the agreed intra-UE UL multiplexing behavior in PHY for UL transmissions of the same PHY priority and inform RAN2 about this decision.***

***<Qualcomm[20]>***

**Proposal: In response to the RAN2 LS [1], RAN1 should ask RAN2 to follow the first option, i.e., to ask RAN2 to change the MAC specification to accommodate the current PHY behavior for handling CGCG collision with the same RRC priority.**

* 1. Correction on Intra-UE prioritization timeline

In the last meeting, it was agreed to specify timeline for inter-UE prioritization. There were two timeline, one is M for cancellation of LP UL transmission, and the other is N for extending processing time for HP transmission. Intel raised a concern that LP transmission cannot be cancelled properly when HP transmission starts earlier than cancellation point, which means M>N.

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Medium | The issue seems true, however, following two needs to be identified* Whether the case M>N is valid
* Whether Intra-UE prioritization timeline can be discussed in the agenda

I would like to encourage companies to check the proposals in Section 6.2 quickly in above aspect. |
|  |  |  |
|  |  |  |

**Based on the email discussion, this issue will be handled in AI 7.2.5.4**

**<Intel, [7]>**

**Proposal 3**

* *When a high-priority UL transmission overlaps with a low-priority UL transmission in a slot,*
	+ *The UE does not expect to be scheduled with a high-priority UL transmission that starts before the earliest symbol in which the low-priority UL transmission may be canceled.*

**Proposal 4**

* *Capture the below text proposal regarding collision handling of DG and CG PUSCH and update section 6.1 in TS 38.214.*

|  |
| --- |
| -------------------------- **Text proposal starts for TS 38.214, Section 6.1** ----------------------------------------If [a UE reports the capability of intra-UE prioritization], and if a PUSCH corresponding to a configured grant and a PUSCH scheduled by a PDCCH on a serving cell are partially or fully overlapping in time,*-* If the PUSCH corresponding to the configured grant has *priority* in *configuredGrantConfig* set to 1 (i.e., high priority), and the PUSCH scheduled by the PDCCH is indicated as low priority by having the [priority indicator] field in the scheduling DCI set to 0 or by not having the [priority indicator] field present in the scheduling DCI, the UE is expected to transmit the PUSCH corresponding to the configured grant, and cancel the PUSCH transmission scheduled by the PDCCH at latest starting at the first symbol of the PUSCH corresponding to the configured grant.Otherwise, the UE shall cancel the PUSCH transmission corresponding to the configured grant at latest starting *M* symbols after the end of the last symbol of the PDCCH carrying the DCI scheduling the PUSCH, and transmit the PUSCH scheduled by the PDCCH, where- *M = Tproc,2 +d1, where Tproc,2* is given by clause 6.4 for the corresponding PUSCH timing capability assuming *d2,1*= 0 and *d1* is determined by the reported UE capability [XXXXX],- In this case, the UE is not expected to be scheduled for the PUSCH by the PDCCH where the PUSCH starts earlier than *max (M, N)* symbols after the end of the last symbol of the PDCCH, where- *N = Tproc,2* + *d2*, where *Tproc,2* is the PUSCH preparation time of the PUSCH scheduled by the PDCCH using the associated PUSCH timing capability according to clause 6.4 and *d2* is determined by the reported UE capability [YYYYY].*-* In case of PUSCH repetitions, the overlapping handling is performed for each PUSCH repetition separately.*-* The UE is not expected to be scheduled for another PUSCH by a PDCCH where this PUSCH starts no earlier than the end of the prioritized transmitted PUSCH and before the end of the time domain allocation of the cancelled PUSCH.]---------------------------- **Text proposal ends for TS 38.214, Section 6. 1**---------------------------------------- |

# References

1. R1-2003323, Remaining issues on SPS enhancements, ZTE
2. R1-2003393, Other issues for URLLC, vivo
3. R1-2003445, Remaining Issue of Other Enhancements for NR URLLC/IIoT, Ericsson
4. R1-2003582, Maintenance of Rel-16 URLLC/IIoT SPS enhancements, Nokia, Nokia Shanghai Bell
5. R1-2003625, Remaining issues on IIoT, CATT
6. R1-2003710, Remaining issues on DL SPS enhancement for URLLC, NEC
7. R1-2003741, Corrections for DL SPS and intra-UE prioritization involving CG PUSCH, Intel Corporation
8. R1-2003869, Remaining issues for Others, Samsung
9. R1-2003982, Remaining issues on enhanced DL SPS for IIoT, Spreadtrum Communications
10. R1-2004034, Remaining issues of other aspects for URLLC/IIOT, LG Electronics
11. R1-2004120, DL SPS enhancement, OPPO
12. R1-2004125, Remaining issues on intra-UE prioritization for URLLC, MediaTek Inc.
13. R1-2004184, Discussion on RAN2 LS on Intra-UE Prioritization, Sony
14. R1-2004227, Remaining Issues in eURLLC/IIoT, Apple
15. R1-2004394, Remaining issues for SPS enhancement for Rel-16 URLLC, NTT DOCOMO, INC
16. R1-2004461, Remaining issues on uplink collision handling and SPS for URLLC, Qualcomm Incorporated
17. R1-2004611, Corrections on other aspects for URLLC/IIOT enhancements, Huawei, HiSilicon
18. R1-2003347, Discussion on Intra-UE Prioritization, vivo
19. R1-2003583, Discussion on RAN2 LS on Intra-UE Prioritization, Nokia, Nokia Shanghai Bell
20. R1-2004433, Discussion on Intra-UE prioritization, Qualcomm Incorporated
21. R1-2003345, Draft reply LS on Intra-UE Prioritization, ZTE
22. R1-2003348, Draft reply LS on Intra-UE Prioritization, vivo
23. R1-2003584, [Draft] Reply LS on Intra-UE Prioritization, Nokia
24. R1-2003589, Draft LS reply on Intra-UE Prioritization, CATT
25. R1-2004124, [Draft] Rely LS on Intra UE prioritization, OPPO

# 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 channelIf 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:**

|  |
| --- |
| **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:**

|  |
| --- |
| while $n\_{D}<N\_{c}^{DL}$if UE is configured to receive a SPS PDSCH in slot $n\_{D}$ for SPS PDSCH configuration*s* on serving cell$c$, 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$\tilde{o}\_{j}^{ACK}$ = HARQ-ACK information bit for this SPS PDSCH reception $j=j+1$;end if$n\_{D}=n\_{D}+1$;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:

|  |
| --- |
| 5.1.3.1             Modulation order and target code rate determinationFor 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 |