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

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

**Agenda Item:** 7.2.5.7

**Source:** Moderator (LG Electronics)

**Title:** Summary#2 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.

# Collision handling related to SPS PDSCH(s)

* 1. SPS PDSCH collision handling

**[R1-2001606, Xiaomi]**

*Proposal 1:* *When UE is indicated a capability to receive n unicast PDSCH per slot, and in a slot with more than one SPS PDSCHs each without a corresponding PDCCH and no dynamic scheduled PDSCH and/or SPS PDSCH release, the SPS PDSCH with the lowest SPS configuration index within the slot can be identified as a first of the n SPS PDSCHs, a second SPS PDSCHs should be the one not overlapping with the first one and with the lowest SPS configuration index among the remaining SPS PDSCHs. This process can be repeated until the identified number of SPS PDSCHs is n, or all the SPS PDSCHs have been checked*

**[R1-2001617, ZTE]**

***Proposal 1:*** *gNB should try to avoid configuring more than one SPS PDSCH configurations on a serving cell which are partially or fully overlapping in time. Even such corner case happens, no further optimization is needed.*

**[R1-2001675, vivo], [R1-2001699, Nokia], [R1-2001790, Ericsson], [R1-2001925, LGE], [R1-2002088, CATT], [R1-2002135, Samsung], [R1-2002447, DCM], [R1-2002549, Qualcomm] (a bit preferred), [R1-2002584, Huawei]**

*Proposal 2: In case of collision in time domain among SPS PDSCHs each without a corresponding PDCCH,*

* + *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 received/decoded SPS PDSCH and any other SPS PDSCH(s) overlapping, even partially, the survivor SPS PDSCH 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*

**[R1-2001779, OPPO]**

***Proposal 1: A UE receives and decodes only one of SPS PDSCH with the lowest SPS configuration index within a group of overlapping SPS PDSCH one the same serving cell. A SPS PDSCH belongs to a group of overlapping SPS PDSCH once a SPS PDSCH overlaps with any SPS PDSCH in the group of overlapping SPS PDSCH group.***

**[R1-2001842, MediaTek]**

Option-2 could add value only in very limited conditions, i.e. the number of overlapped PDSCHs is larger than 2 where the low-priority SPS PDSCH (with higher index) is overlapping with two non-overlapped high priority SPS PDSCHs and these PDSCHs contain data in that slot.

There is no use-case for having large number of overlapped SPS PDSCHs

*Proposal 1: In case of collision in time domain among SPS PDSCHs each without a corresponding PDCCH, a UE receives and decodes only one of SPS PDSCHs with the lowest SPS configuration index within a group of overlapping SPS PDSCHs on the same serving cell.*

* *A SPS PDSCH belongs to a group of overlapping SPS PDSCHs*
	+ *If its SLIV is within the starting symbol of the first SPS PDSCH in that group, and the last symbol of the last SPS PDSCH in that group, and*
	+ *If this SPS PDSCH overlaps in time at least with another SPS PDSCH on the same serving cell in a slot, and*
	+ *If the starting and ending symbols of this SPS PDSCH overlaps in time at least with another SPS PDSCH on the same serving cell in a slot if the SPS PDSCH is neither the first nor the last SPS PDSCH in the group.*

**[R1-2002003, Intel]**

* *For UEs supporting multiple unicast PDSCH reception in a slot, Opt. 1 is followed to determine the set of SPS PDSCHs to be received in a slot*
	+ *In case of collision in time domain among SPS PDSCHs each without a corresponding PDCCH,*
		- *A UE receives and decodes only one of SPS PDSCHs with the lowest SPS configuration index within a group of overlapping SPS PDSCHs on the same serving cell.*
			* *A SPS PDSCH belongs to a group of overlapping SPS PDSCHs*
			* *If its SLIV is within the starting symbol of the first SPS PDSCH in that group, and the last symbol of the last SPS PDSCH in that group, and*
			* *If this SPS PDSCH overlaps in time at least with another SPS PDSCH on the same serving cell in a slot, and*
			* *If the starting and ending symbols of this SPS PDSCH overlaps in time at least with another SPS PDSCH on the same serving cell in a slot if the SPS PDSCH is neither the first nor the last SPS PDSCH in the group*

**[R1-2002088, CATT]**

Proposal 5: SPS PDSCH occasion colliding with at least one semi-statically configured uplink symbol should be excluded before handling the overlapping among a group of SPS PDSCHs and SPS PDSCH dropping due to limited receiving capability of unicast PDSCH in one slot.

**[R1-2002638, WILUS]**

* ***Proposal 1: In case of collision in time domain among SPS PDSCHs each without a corresponding PDCCH, supports Option 1 with following update in red:***

Option 1: 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 only one of SPS PDSCHs with the lowest SPS configuration index within a group of overlapping SPS PDSCHs on the same serving cell in a slot.
		- A SPS PDSCH belongs to a group of overlapping SPS PDSCHs
			* If its SLIV is within the starting symbol of the first SPS PDSCH in that group, and the last symbol of the last SPS PDSCH in that group, and
			* If this SPS PDSCH overlaps in time at least with another SPS PDSCH on the same serving cell in a slot, and
			* If the starting and ending symbols of this SPS PDSCH overlaps in time at least with another SPS PDSCH on the same serving cell in a slot if the SPS PDSCH is neither the first nor the last SPS PDSCH in the group

**[R1-2002135, Samsung]**

Proposal 3: SPS PDSCHs overlapping handling should be done per slot when configured with pdsch-AggregationFactor.

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | This issue is essential; without conclusion, there would be ambiguity in the specification. It has been discussed several times, and should be concluded at this meeting.  |
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* 1. Collision between dynamic scheduled PDSCH and multiple SPS PDSCHs

**[R1-2001617, ZTE]**

***Proposal 2:*** *For the collision in the time domain between dynamic scheduled PDSCH and multiple SPS PDSCHs:*

* *If a DG PDSCH overlaps with one or more SPS PDSCHs in time, the UE shall receive the DG PDSCH when the Rel-15 timeline are satisfied, regardless of the priority indication, and drop the multiple SPS PDSCHs.*
* *The remaining SPS PDSCHs (if any) should be handled as the only SPS PDSCHs collision (if any).*

**[R1-2001675, vivo]**

*Proposal 3: For the collision between a group of SPS PDSCHs and dynamic PDSCH, it is handled in the same way as overlapping of SPS PDSCHs by assuming dynamic PDSCH as one SPS PDSCH with the lowest SPS configuration index.*

**[R1-2001699, Nokia]**



Proposal 3: 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 in a second step resolves overlapping between dynamic scheduled PDSCH and one or more remaining non-overlapping SPS PDSCHs from the first step.

**[R1-2001779, OPPO]**

*Proposal 2: Solve collision among overlapping SPS PDSCHs firstly. And then solve collision between dynamic PDSCH and SPS PDSCH with the lowest SPS configuration index.*

**[R1-2001790, Ericsson]**

Proposal 2 Separate collision handling between dynamic and a group of SPS PDSCHs.

**[R1-2001842, MediaTek], [R1-2002135, Samsung], [R1-2002584, Huawei]**

Proposal 2: In case of dynamically 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)

**[R1-2002003, Intel]**

**Proposal 3**

* *In case of overlap of one or more SPS PDSCHs and dynamically assigned PDSCH in a slot, the UE first selects the set of SPS PDSCHs to be received following Opt. 1, and then determines the final set of SPS PDSCHs by dropping those from the selected set that overlap with the dynamically assigned PDSCH.*

**[R1-2002088, CATT]**

Proposal 6: UE resolves overlapping among multiple SPS PDSCHs first and then resolves the cancelation due to dynamic PDSCH.

**[R1-2002335, Apple]**

Proposal 1: Resolve SPS PDSCH collision first, then resolve overlapping between SPS PDSCHs and DG PDSCHs;

**[R1-2002135, Samsung]**

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

**Comment:**

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| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | This issue is essential; without conclusion, there would be ambiguity in the specification. |
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* 1. Overwriting of SPS PDSCH with dynamic grant

**[R1-2001699, Nokia]**

Proposal 5: 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 UE procedure for receiving the physical downlink shared channel**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 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> |

**Comment:**

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| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | Seems optimization. Further discussion is needed on whether or not this relaxation/enhancement is essential. |
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# HARQ-ACK feedback related issues for SPS

* 1. SPS PDSCH release for UEs with single PDSCH decoding per slot capability

**[R1-2001606, Xiaomi]**

***Proposal 2: The issue of HARQ-ACK for SPS PDSCH reception and SPS PDSCH release for a UE with single PDSCH decoding per slot capability can be avoided by gNB implementation.***

**[R1-2001617, ZTE]**

***Proposal 5:*** *For Type-1 HARQ-ACK codebook in Rel-16, the same rule as in Rel-15 is applied (with no spec change) if the UE does not indicate a capability to receive more than one unicast PDSCH per slot.*

**[R1-2001675, vivo]**

***Proposal 4: For a UE not indicating a capability to receive more than one unicast PDSCH per slot, the UE does not expect to receive the PDCCH with SPS PDSCH release such that the PDCCH ends after the last symbol of the SPS PDSCH.***

**[R1-2001925, LGE]**

**Proposal 4: 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, 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**
* **FFS cross-carrier scheduling case**

**[R1-2002003, Intel]**

* *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.*

**[R1-2002088, CATT]**

***Proposal 7: At least for same-carrier scheduling case, 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,***

* ***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.***
* ***FFS cross-carrier scheduling case***

**[R1-2002135, Samsung]**

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

**[R1-2002549, Qualcomm]**

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

Proposal 2: 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 3: If Option 1 is adopted, UE does not expect to receive a SPS PDSCH in a slot that SPS release PDCCH is detected.

**[R1-2001699, Nokia]**

**Proposal 1: For UEs capable of only receiving a single unicast PDSCH per slot, support PDSCH and SPS release in the same slot if their corresponding HARQ-ACK feedback are reported in different PUCCHs.
Adopt the following related text proposal/correction to Section 9.1.2 of TS 38.213 with changes are marked in red:**

|  |
| --- |
| **TP to TS 38.213, Sec. 9.1.2.1 Type-1 HARQ-ACK codebook in physical uplink control channel**9.1.2.1 Type-1 HARQ-ACK codebook in physical uplink control channel**<**Unchanged text is omitted>if the UE does not indicate a capability to receive more than one unicast PDSCH per slot and , ; ;If the UE indicates the capability of [*extendedSPS-Periodicities* or *multipleSPSconfig*], the UE does not expect to receive SPS PDSCH release and unicast PDSCH in a same slot associated with the same PUCCH; otherwise t~~T~~he UE does not expect to receive SPS PDSCH release and unicast PDSCH in a same slot;**<**Unchanged text is omitted> |

**[R1-2001790, Ericsson]**

**Proposal 3 Modify the text as: The UE may receive SPS PDSCH release and unicast PDSCH in a same slot.**

**Proposal 4 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.**

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | Without conclusion on this issue, short SPS periodicity would not be supported efficiently.  |
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* 1. HARQ-ACK codebook for SPS PDSCH
		1. HARQ-ACK for SPS PDSCH cancelled by SFI or dynamic UL grant

**[R1-2001699, Nokia]**

**Proposal 4: Confirm the current Rel-16 behavior according to TS 38.213 that for HARQ-ACK feedback in response to SPS PDSCH reception only (without associated DL assignment) and if there are more than one SPS PDSCH reception configured, the UE generates HARQ-ACK information for SPS PDSCH that is canceled due to UL-DL conflict or dynamic grant overwriting.**

**Adopt the following text proposal to ensure that Rel-15 behavior for single PDSCH reception is not changed. Changes are marked in red.**

|  |
| --- |
| **TP to TS 38.213, Sec. 9.1.2 Type-1 HARQ-ACK codebook determination** 9.1.2  Type-1 HARQ-ACK codebook determination<unnecessary part is omitted>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 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.<unnecessary part is omitted> |

**[R1-2001925, LGE]**

**Proposal 5: HARQ-ACK feedback for a SPS PDSCH should be included in the HARQ-ACK codebook when the SPS PDSCH is cancelled by DCI/SFI in which case NACK is generated for the SPS PDSCH.**

**[R1-2002088, CATT]**

Proposal 2: For an SPS PDSCH configured to be received, the HARQ-ACK feedback for the SPS PDSCH is generated even if such SPS PDSCH is cancelled by scheduled PDSCH, scheduled PUSCH or SFI and NACK should be generated if the SPS PDSCH is not received.

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

9.1.2 Type-1 HARQ-ACK codebook determination

< ---unchanged part is omitted--->

Set $N\_{cells}^{DL}$ to the number of serving cells configured to the UE

Set $N\_{c}^{SPS}$ 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 PUCCH

Set $j=0$ – HARQ-ACK information bit index

Set $c=0$ – serving cell index: lower indexes correspond to lower RRC indexes of corresponding cell

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 SPS PDSCH in slot $n\_{D}$ for SPS PDSCH configuration $s$ on serving cell $c$, and the HARQ-ACK for the SPS PDSCH would be transmitted on the PUCCH, 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 UE capability for the number of PDSCH receptions in a slot according to [6, TS 38.214]

$\tilde{o}\_{j}^{ACK}$ = 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

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

* + 1. Type-1 HARQ-ACK codebook for only a SPS PDSCH reception

**[R1-2001617, ZTE]**

***Proposal 3:*** *For the case of receiving only SPS PDSCH:*

* *For the case of receiving only a SPS PDSCH, the UE generates one HARQ-ACK information bit (reuse Rel-15).*
* *For the case of receiving only multiple SPS PDSCH, the UE generates a Type-1 HARQ-ACK codebook according to the case of only SPS PDSCHs (consistent with agreement).*
* *Adopt Text Proposal 1 for Section 9.1.2 in TS 38.213.*

**--------------------------------------------Text Proposal 1 for Section 9.1.2 in TS38.213vg10--------------------------------**

|  |
| --- |
| 9.1.2 Type-1 HARQ-ACK codebook determination<unchanged text omitted>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  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 reception 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.<unchanged text omitted> |

**[R1-2001699, Nokia]**

**Proposal 9: Adopt the following text proposal to clarify that HARQ-ACK codebook for SPS PDSCH should only include HARQ-ACK feedback of SPS PDSCH associated with the PUCCH. Changes are marked in red.**

|  |
| --- |
| **TP to TS 38.213, Sec. 9.1.2 to clarify that HARQ-ACK codebook for SPS PDSCH should only include HARQ-ACK feedback of SPS PDSCH associated with the PUCCH** 9.1.2  Type-1 HARQ-ACK codebook determination**<**Unchanged text is 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 $j=0$ – 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] and
		- 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$s=s+1$;end while$c=c+1$;end while**<**Unchanged text is omitted> |

**[R1-2002088, CATT]**



Proposal 1: HARQ-ACK codebook for SPS PDSCH should be generated based on SPS PDSCH with HARQ-ACK feedback in the same PUCCH.

* + 1. Type-1 HARQ-ACK codebook in PUSCH

**[R1-2001617, ZTE]**

***Proposal 4:*** *If a UE multiplexes HARQ-ACK information in a PUSCH transmission that is scheduled by DCI format 0\_1, and if*  *is in the DCI format 0\_1, and the UE receives only multiple SPS PDSCHs, then the UE generates a Type-1 HARQ-ACK codebook according to the case of only SPS PDSCHs.*

* *Adopt Text Proposal 2 for Section 9.1.2.2 in TS 38.213.*

**------------------------------------------Text Proposal 2 for Section 9.1.2.2 in TS38.213vg10 ------------------------------**

**9.1.2.2 Type-1 HARQ-ACK codebook in physical uplink shared channel**

If a UE would multiplex HARQ-ACK information in a PUSCH transmission that is not scheduled by a DCI format or is scheduled by DCI format 0\_0, then

- if the UE 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  occasions for candidate PDSCH receptions by DCI format 1\_0 or DCI format 1\_1 or SPS PDSCH on any serving cell , as described in Clause 9.1.2.1, the UE does not multiplex HARQ-ACK information 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 receives only a SPS PDSCH release, or only SPS PDSCH reception(s), or only a PDSCH that is scheduled by DCI format 1\_0 with a counter DAI field value of 1 on the PCell in the  occasions for candidate PDSCH receptions in which case the 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 within  symbols prior to a first symbol of a PUSCH transmission where the UE multiplexes HARQ-ACK information, where  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 field in DCI format 0\_1 is  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 when  unless the UE receives only a SPS PDSCH release, or only ~~a~~ SPS PDSCH(s), or only a PDSCH that is scheduled by DCI format 1\_0 with a counter DAI field value of 1 on the PCell in the  occasions for candidate PDSCH receptions in which case the UE generates HARQ-ACK information only for the SPS PDSCH release or only for the PDSCH reception as described in Clause 9.1.2.  if the DAI field in DCI format 0\_1 is set to '0'; otherwise, .

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

**[R1-2001699, Nokia]**

**Proposal 10: To allow multiple bits of HARQ-ACK feedback in a same PUCCH for a single SPS PDSCH configuration when SCS in DL is larger than the SCS in UL, remove the unnecessary restriction “*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*” from TS 38.213.**

**Adopt the related TP to Sec. 9.1 of TS 38.213 with changes are marked in red.**

|  |
| --- |
| **TP to TS 38.213, Sec. 9.1 to remove unnecessary restriction of at most 1 bit of HARQ-ACK feedback on a PUCCH for single SPS PDSCH configuration**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.~~ **<**Unchanged text is omitted> |

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | The aspects on HARQ-ACK codebook need to be concluded.  |
|  |  |  |
|  |  |  |

* 1. HARQ-ACK codebook with PDSCH aggregation

**[R1-2002135, Samsung]**

Proposal 4: 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.

|  |
| --- |
| 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 $\left⌊\left(n\_{U}-K\_{1,k}\right)∙2^{μ\_{DL}-μ\_{UL}}\right⌋+n\_{D}-N\_{PDSCH,max}^{repeat}+1$ 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… |

**[R1-2002549, Qualcomm]**



Proposal 5: $N\_{PDSCH}^{repeat}$ is always defined as 1 and A/N bit position for each PDSCH with repetitions is tied with the last actual PDSCH reception.

Proposal 6: 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.

**[R1-2002584, Huawei]**



Proposal 2: HARQ-ACK feedback for last SPS PDSCH repetition should also be included in the HARQ-ACK codebook, even if the last SPS PDSCH repetition is not be received among overlapping SPS PDSCHs without associated PDCCH, if other SPS PDSCH repetitions within same repetition are received.

**[R1-2002135, Samsung]**

**9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel**

A UE determines monitoring occasions for PDCCH with DCI format scheduling PDSCH receptions or SPS PDSCH release on an active DL BWP of a serving cell , as described in Clause 10.1, and for which the UE transmits HARQ-ACK information in a same PUCCH in slot  based on

- PDSCH-to-HARQ\_feedback timing indicator field values for PUCCH transmission with HARQ-ACK information in slot  in response to PDSCH receptions or SPS PDSCH release

- slot offsets  [6, TS 38.214] provided by time domain resource assignment field in a DCI format scheduling PDSCH receptions or SPS PDSCH release and by *pdsch-AggregationFactor*, when provided in *SPS-Config* or *PDSCH-Config*.

…

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Medium (depending on the email budget) | This issue is identified by introduction of configuration for PDSCH aggregation factor per SPS configuration, and never been discussed yet. At least it would be helpful if an opportunity for discussion can be given. However at the same time, it can be envisioned that it may or may not be difficult to make a conclusion shortly. I would like to encourage companies to check the proposals in Section 3.3 quickly if agreeable and to let me know as soon as possible.  |
|  |  |  |
|  |  |  |

* 1. SPS PDSCH release and SPS PDSCH receptions

**[R1-2002135, Samsung]**

*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.*



**[R1-2002485, Asia Pacific Telecom]**

Proposal 1: If a SPS PDSCH starts N symbols after the end of a SPS PDSCH release DCI indicating release of the corresponding SPS configuration, the SPS PDSCH is considered as not received.

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | This issue seems essential but it would be better if a proposal can provide clearer picture about overall behavior (especially on HARQ-ACK feedback). Is it correct understanding that “not received” means no HARQ-ACK bit generation for the SPS PDSCH?  |
|  |  |  |
|  |  |  |

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

**[R1-2002485, Asia Pacific Telecom]**

Proposal 2: For the case where the HARQ-ACK bit location are the same for a SPS PDSCH of a first SPS PDSCH configuration and for a SPS PDSCH release DCI indicating release of a second SPS PDSCH configuration, the HARQ-ACK bit for the SPS PDSCH release DCI is transmitted.

**Comment:**

|  |  |  |
| --- | --- | --- |
| 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.  |
|  |  |  |
|  |  |  |

* 1. HARQ-ACK for SPS release by non-fallback DCI with CBG configuration

**[R1-2001699, Nokia]**

Proposal 8: If the SPS PDSCH release is indicated by non-fallback DCI and CBG operation is configured, the UE still generates 1 bit of HARQ-ACK information for the SPS PDSCH release (TB-level).

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | This topic was discussed in the last meeting. According to the comments from most companies, it was concluded that the current specification is already clear and no need for further discussion.  |
|  |  |  |
|  |  |  |

# Other issues related to SPS

* 1. Applicable parameters for SPS PDSCH due to separate RRC parameters for DCI format 1\_2

**[R1-2001699, Nokia]**

**Proposal 6: Clarify the applicable PDSCH parameters for SPS PDSCH when being activated by different DCI formats in Sec. 5.1 of TS 38.214 by adopting the following TP with changes in red:**

|  |
| --- |
| **TP to TS 38.214, Sec. 5.1 to correct clarify SPS PDSCH parameters when activated using different DCI formats**5.1 UE procedure for receiving the physical downlink shared channel**<**Unchanged text is omitted>If the UE is configured by higher layers to decode a PDCCH with its CRC scrambled by a CS-RNTI, the UE shall receive PDSCH transmissions without corresponding PDCCH transmissions using the higher-layer-provided PDSCH configuration for those PDSCHs. If not specified otherwise, the parameters of such 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. **<**Unchanged text is omitted> |

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | This needs to be clarified, and can be discussed under the assumption that it would not be that controversial.  |
|  |  |  |
|  |  |  |

* 1. Priority Indication by DCI

**[R1-2001790, Ericsson]**

--------------------------------- Text Proposal to TS 38.213 V16.0.0 ---------------------------------

9 UE procedure for reporting control information

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 for detection of DCI format 0\_1 and DCI format 0\_2 a priority index can be provided by a priority indicator field in DCI, except for Type 1 and Type 2 configured grant PUSCH, of which the priority is provided by higher layer. If in an active DL BWP a UE monitors PDCCH for detection of DCI format 1\_1 and DCI format 1\_2, a priority index can be provided by a priority indicator field in DCI, except for a HARQ-ACK in response to a SPS PDSCH and a PDCCH indicating a SPS PDSCH release, of which the priority is provided by higher layer.

**[R1-2002447, DCM]**

|  |
| --- |
| 9 UE procedure for reporting control information […] 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 except for a HARQ-ACK in response to a SPS PDSCH and a PDCCH indicating a SPS PDSCH release, of which the priority is provided by higher layer. 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 PUCCH of larger priority index, a PUSCH or a second PUCCH of smaller priority index, and a transmission of the first PUCCH would overlap in time with a transmission of the PUSCH or the second PUCCH, the UE does not transmit the PUSCH or the second PUCCH- a PUSCH of larger priority index, a PUCCH of smaller priority index, and a transmission of the PUSCH would overlap in time with a transmission of the PUCCH, the UE does not transmit the PUCCH - 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 In the remaining of this Clause, a UE multiplexes UCIs with same priority index in a PUCCH or a PUSCH. A PUCCH or a PUSCH is assumed to have a same priority index as a priority index of UCIs a UE multiplexes in the PUCCH or the PUSCH.[…] |

|  |
| --- |
| 9.1 HARQ-ACK codebook determinationIf a UE is provided *pdsch-HARQ-ACK-Codebook-*List, the UE can be indicated by *pdsch-HARQ-ACK-Codebook-List* to generate one or two HARQ-ACK codebooks. If the UE is indicated to generate two HARQ-ACK codebooks- a first HARQ-ACK codebook is associated with a PUCCH of priority index 0 and a second HARQ-ACK codebook is associated with a PUCCH of priority index 1- the UE is provided first and second for each of {*PUCCH-Config*, *UCI-OnPUSCH*, *PDSCH*-*codeBlockGroupTransmission*} by {*PUCCHConfigurationList*, *UCI-OnPUSCH-List*, *PDSCH-CodeBlockGroupTransmission-List*}, respectively, for use with the first and second HARQ-ACK codebooks, respectivelyIf a UE receives a PDSCH without receiving a corresponding PDCCH, or if the UE receives a PDCCH indicating a SPS PDSCH release, the UE generates one corresponding HARQ-ACK information bit. If the UE generates two HARQ-ACK codebooks, the UE is indicated by *harq-CodebookID*, per SPS PDSCH configuration, a HARQ-ACK codebook index for multiplexing the corresponding HARQ-ACK information bit with same priority. The priority index is 0 for HARQ-ACK for SPS PDSCH or a SPS PDSCH release if the associated HARQ-ACK codebook configured with the *harq-CodebookID* value 1. The priority index is 1 for HARQ-ACK for SPS PDSCH or a SPS PDSCH release if the associated HARQ-ACK codebook configured with the *harq-CodebookID* value 2. UE doesn’t expect a multiple SPS PDSCH release by a single DCI format to release multiple SPS configuration with different *harq-CodebookID* values.[…] |

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | The intention is clear, and better to fix it.  |
|  |  |  |
|  |  |  |

* 1. MCS table selection for DL SPS

**[R1-2001925, LGE]**

Proposal 1: If mcs-Table is not configured in *SPS-Config*, and if *mcs-Table-ForDCIFormat1\_2* given by PDSCH-Config is set to 'qam256', then for the PDSCH with SPS activated by DCI format 1\_2 scheduled without corresponding PDCCH, the UE uses 256QAM table.

Proposal 2: Further discuss on the case where either *mcs-Table-ForDCIFormat1\_2* or *mcs-Table* given by PDSCH-Config is set to 'qam64LowSE'.

|  |  |  |
| --- | --- | --- |
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| --- |
| **Modified subclause (5.1.3.1 of TS38.214 v16.0.0)** |

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', - 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 or 1\_0 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.endThe UE is not expected to decode a PDSCH scheduled with P-RNTI, RA-RNTI, SI-RNTI and *Qm* > 2

|  |
| --- |
| **End of modifications** |

 |

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | To prevent undesirable operation, this issue should be addressed. |
|  |  |  |
|  |  |  |

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

**[R1-2001779, OPPO]**

--------------------------------------------------Text proposal for TS38.214--------------------------------------------------

5.1 UE procedure for receiving the physical downlink shared channel

For downlink, a maximum of 16 HARQ processes per cell is supported by the UE. The number of processes the UE may assume will at most be used for the downlink is configured to the UE for each cell separately by higher layer parameter *nrofHARQ-ProcessesForPDSCH*, and when no configuration is provided the UE may assume a default number of 8 processes.

A UE shall upon detection of a PDCCH with a configured DCI format 1\_0 or 1\_1 decode the corresponding PDSCHs as indicated by that DCI. For any HARQ process ID(s) in a given scheduled cell, the UE is not expected to receive a PDSCH that overlaps in time with another PDSCH. The UE is not expected to receive another PDSCH for a given HARQ process until after the end of the expected transmission of HARQ-ACK for that HARQ process, where the timing is given by Subclause 9.2.3 of [6]. In a given scheduled cell, the UE is not expected to receive a first PDSCH or SPS PDSCH release in slot *i*, with the corresponding HARQ-ACK assigned to be transmitted in slot *j*, and a second PDSCH or SPS PDSCH release starting later than the first PDSCH or SPS PDSCH release with its corresponding HARQ-ACK assigned to be transmitted in a slot before slot *j*. For any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start receiving a first PDSCH starting in symbol *j* by a PDCCH ending in symbol *i*, the UE is not expected to be scheduled to receive a PDSCH starting earlier than the end of the first PDSCH with a PDCCH that ends later than symbol *i*. In a given scheduled cell, for any PDSCH corresponding to SI-RNTI, the UE is not expected to decode a re-transmission of an earlier PDSCH with a starting symbol less than *N* symbols after the last symbol of that PDSCH, where the value of *N* depends on the PDSCH subcarrier spacing configuration *μ,* with *N*=13 for *μ*=0, *N*=13 for *μ*=1, *N*=20 for *μ*=2, and *N*=24 for *μ*=3.

--------------------------------------------------Text proposal for TS38.214--------------------------------------------------

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | High | It seems straightforward.  |
|  |  |  |
|  |  |  |

* 1. SPS release validation when configured with ‘dynamicSwitch’ for FDRA

**[R1-2001699, Nokia]**

**Proposal 7: Clarify the applicable FDRA validation for SPS release for ‘*dynamicSwitch*’ in Sec. 10.2 of TS 38.213 by adopting the following TP with changes in red:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TP to TS 38.213, Sec. 10.2 to clarify the format of the FDRA bit field for SPS release validation when UE is configured with ‘dynamicSwitch’**10.2 PDCCH validation for DL SPS and UL grant Type 2**<**Unchanged text is omitted>Table 10.2-1: Special fields for single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2  | DCI format 1\_0/1\_2 | DCI format 1\_1 |
| HARQ process number | set to all '0's~~/0\_2~~ | set to all '0's | set to all '0's |
| Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |

Table 10.2-2: Special fields for single DL SPS or single UL grant Type 2 scheduling release PDCCH validation

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2  | DCI format 1\_0/1\_1/1\_2 |
| HARQ process number | set to all '0's | set to all '0's |
| Redundancy version | set to all '0's | set to all '0's |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '0's for FDRA Type 0 or for FDRA Type 2 with $μ=1$,set to all '1's for FDRA Type 1 or for FDRA Type 2 with $μ=0$ | set to all '0's for FDRA Type 0 or for ‘dynamicSwitch’ set to all '1's for FDRA Type 1 |

Table 10.2-3: Special fields for a single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2  | DCI format 1\_0/1\_2 | DCI format 1\_1 |
| Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |

Table 10.2-4: Special fields for multiple DL SPS and UL grant Type 2 scheduling release PDCCH validation

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2  | DCI format 1\_0/1\_1/1\_2 |
| Redundancy version | set to all '0's | set to all '0's |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '0's for FDRA Type 0 or for FDRA Type 2 with $μ=1$,set to all '1's for FDRA Type 1 or for FDRA Type 2 with $μ=0$ | set to all '0's for FDRA Type 0 or for ‘dynamicSwitch’set to all '1's for FDRA Type 1 |

**<**Unchanged text is omitted> |

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | It seems optimization. Unclear whether this is really needed.  |
|  |  |  |
|  |  |  |

* 1. DL SPS skipping

**[R1-2001675, vivo]**

Proposal 1: 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.  |
|  |  |  |
|  |  |  |

# Intra-UE UL collision related issues

* 1. PHR reporting in case of intra-UE collision

**[R1-2001790, Ericsson]**

Proposal 5 The PHR reporting inconsistency due to intra-UE collision can be resolved with gNB’s implementation. Thus, there is a no need to specify explicit behavior.

**[R1-2002135, Samsung]**



Figure 4: PHR calculation of Case 1



Figure 5: PHR calculation of Case 2

Case 1: The higher-priority DG PUSCH and lower-priority CG PUSCH are all meeting time requirement, the higher-priority DG PUSCH is used to calculate PHR as shown in Figure 4.

Case 2: The higher-priority DG PUSCH does not meet time requirement for PHR calculation and the lower-priority CG PUSCH meets time requirement for PHR calculation, the lower-priority PUSCH is used to calculate PHR as shown in Figure 5.

**Comment:**

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

* 1. Intra-UE prioritization without UL-SCH

**[R1-2001790, Ericsson]**

In the case involving high priority dynamic PUSCH and low priority CG PUSCH, if the higher layer did not deliver a transport block to transmit on this dynamic PUSCH, the UE shall not transmit anything on the dynamic PUSCH if the higher layers did not deliver a transport block and the UE shall instead transmit the low priority CG PUSCH.

Proposal 6 The UE shall not transmit anything on the dynamic PUSCH if the higher layers did not deliver a transport block.

**Comment:**

|  |  |  |
| --- | --- | --- |
| Company | Priority(High/Low) | Comment |
| LGE | Low | Not sure if there is any discussion point from PHY perspective. |
|  |  |  |
|  |  |  |

* 1. Collision handling between CG PUSCHs

**[R1-2001779, OPPO]**

*Proposal 4: If RAN2 solution is supported, then it can be applied to solve collision among CGs with the same priority. Otherwise, it is not expected that CG and CG with the same priority collide.*

**[R1-2002088, CATT]**



Proposal 8: 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.

**[R1-2002584, Huawei]**

--------------------------------------------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--------------------------------------------------------

**Comment:**

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

# Summary and FL recommendation

During to the discussions at the preparation phase, one of the main discussions was about whether or not to discuss CG-CG collision handling. It should be noted that the discrepancy between RAN1 and RAN2 decisions has been recognized, so RAN2 is being discussed in order to resolve it (more specifically, RAN2 has been thinking about two options: one is to change RAN1 behavior whereas another is to change RAN2 behavior). In this context, it is likely to be risky if RAN1 starts to work under the assumption of “if RAN2 would make a certain decision”. Based on the observation, it is recommended not to discuss the issue in this e-meeting.

Another comment was made by multiple companies on discussion for issue 3.3, so it has been added into both options. However, for option 1, given the time budget, remaining issues and expected workload during the meeting, issue 3.3 may be able to discussed only if time is permitted (i.e., only if other issues are concluded rapidly enough). If 3 email threads are allowed as option 2, then issue 3.3 can be discussed under the email thread#3.

In summary, it is recommended for Chairman to choose one of the following two options as the scope of this e-meeting.

**Option 1**: If 2 email threads are allowed for AI 7.2.5.7

|  |  |  |
| --- | --- | --- |
| Email thread | Title | Topics including |
| #1 | SPS PDSCH collision handling | Sections 2.1, 2.2Section 3.3 if time is permitted |
| #2 | HARQ-ACK feedback related issues for SPS | Sections 3.1, 3.2, 3.4 |
| Note: It is suggested to postpone discussion on the issues other than the above.Note: The topics in section 4.2 and 4.5 will be handled in eCG discussions. |

**Option 2**: If 3 email threads are allowed for AI 7.2.5.7

|  |  |  |
| --- | --- | --- |
| Email thread | Title | Topics including |
| #1 | SPS PDSCH collision handling | Sections 2.1, 2.2 |
| #2 | HARQ-ACK feedback related issues for SPS | Sections 3.1, 3.2, 3.4 |
| #3 | Other remaining issues | Sections 4.1, 4.3, 3.3 |
| Note: It is suggested to postpone discussion on the issues other than the above.Note: The topics in section 4.2 and 4.5 will be handled in eCG discussions. |

# References

1. R1-2001606 Discussion on remaining issues on DL SPS enhancement for URLLC Beijing Xiaomi Mobile Software
2. R1-2001617 Remaining issues on SPS enhancements ZTE
3. R1-2001675 Other issues for URLLC vivo
4. R1-2001699 Maintenance of Rel-16 URLLC/IIoT SPS enhancements Nokia, Nokia Shanghai Bell
5. R1-2001779 DL SPS enhancement and Intra-UE multiplexing/prioritization OPPO
6. R1-2001790 Remaining Issue of DL SPS Enhancements for NR URLLC Ericsson
7. R1-2001842 Remaining issues on multiple SPS configurations MediaTek Inc.
8. R1-2001925 Remaining issues of other aspects for URLLC/IIOT LG Electronics
9. R1-2002003 Remaining issues on enhanced DL SPS for IIoT Intel Corporation
10. R1-2002088 Remaining issues on IIoT CATT
11. R1-2002135 Remaining issues for DL SPS and PHR Samsung
12. R1-2002335 Remaining Issues in SPS enhancements Apple
13. R1-2002447 Remaining issues for SPS enhancement for Rel-16 URLLC NTT DOCOMO, INC.
14. R1-2002485 Remaining issues on DL SPS enhancements Asia Pacific Telecom co. Ltd
15. R1-2002549 Remaining issues on DL SPS for URLLC Qualcomm Incorporated
16. R1-2002584 Corrections on other aspects for URLLC/IIOT enhancements Huawei, HiSilicon
17. R1-2002638 Remaining issues on DL SPS for NR URLLC WILUS Inc.

# Appendix: Previous relevant agreements

#  RAN1#96

**Conclusion**:

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

Agreements:

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

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

RAN2#105

Agreements in RAN2

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

#  RAN1#96bis

Agreements**:**

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

#  RAN1#97

Agreements:

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

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

**Conclusion**:

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

#  RAN1#98

Agreements**:**

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

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

**Conclusion:**

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

**Conclusion:**

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

Working assumption:

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

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

#  RAN1#98bis

Agreements**:**

Confirm the following working assumption:

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

Agreements**:**

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

Agreements**:**

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

Agreements:

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

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

Agreements:

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

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

Agreements**:**

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

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

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

Agreements**:**

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

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

RAN2#107bis

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

#  RAN1#99

Agreements:

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

Agreements:

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

Agreements:

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

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

Agreements:

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

Agreements:

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

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

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

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

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

Agreement

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

Agreement

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

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

Working assumption:

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

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

Agreement

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

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

Agreement

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

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

#  RAN1#100e

Agreements:

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

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

Agreements:

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

Agreements:

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

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

Agreements:

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