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

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

**Agenda Item:** 7.2.5.7

**Source:** Moderator (LG Electronics)

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

**Document for:** Discussion and decision

# Introduction

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

[102-e-NR-L1enh-URLLC-IIoTenh-01] HARQ-ACK for SPS release and reception – Duckhyun (LG)

* Issues 3.1, 3.5, 4.4 from feature lead’s summary
* Discussion and agreement by 8/21 and TPs by 8/28

To address the identified issues from companies’ contributions related to the above email thread, the suggestions for the issues are provided in Section 2. [In Section 3, a few open issues identified are listed up so companies are encouraged to provide your input/feedback in the next meeting in order to facilitate the discussion]. In section [4], the outcome from [102-e-NR-L1enh-URLLC-IIoTenh-01] are provided including all the agreements and all the endorsed TPs.

# E-mail discussions in RAN1#102

* 1. (Issue 3.1): SPS PDSCH release and SPS PDSCH receptions

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

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

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

FFS:

* If the HARQ-ACK for the SPS release and the SPS reception mapping to different PUCCHs
  + Case 1: SPS release PDCCH is received before the end of the SPS PDSCH reception for the same SPS configuration corresponding to the SPS release PDCCH [6][7][8][10][13]
  + Case 2: SPS release PDCCH is received after the end of the SPS PDSCH for the same SPS configuration corresponding to the SPS release PDCCH [7][8][13][16]
  + Not support the case of the HARQ-ACK for the SPS release and the SPS reception in a slot mapping to different PUCCHs [9][12]

Based on the above, the majority of companies think it is possible to receive SPS release DCI in a slot where SPS PDSCH is received without timeline restriction if those are mapped to different PUCCH. If it is agreeable, remaining issue is whether to decode PDSCH in such cases. Based on companies’ contributions, all proponents of case 2 support separated HARQ-ACK generation for SPS PDSCH and SPS release. For case 1, three companies propose to generate only one HARQ-ACK for SPS PDSCH as like same PUCCH case and two companies think it is possible to generate both HARQ-ACKs for SPS PDSCH and SPS release. From those points of view, I would like to suggest following proposal.

FL’s recommendation:

**Proposal 1-1:**

**Support the case that SPS release PDCCH is received in a slot where SPS PDSCH is configured to be received for the same SPS configuration corresponding to the SPS release PDCCH if the HARQ-ACK for the SPS release and the SPS reception mapping to different PUCCHs**

* + **the UE receives the SPS PDSCH and generates HARQ-ACK information for the SPS release and the SPS reception if SPS release PDCCH is received after the end of the SPS PDSCH reception**
  + **FFS whether to receive SPS PDSCH if SPS release PDCCH is received before the end of the SPS PDSCH reception**

**Comment:**

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In addition, some companies raised their concern on other issues but also related to timeline between SPS release and SPS reception. Among those, following two are addressed in common.

* How to handle joint release [8][11][17].
* An issue with other SPS configuration not corresponding to SPS release PDCCH, e.g., the case that UE receives in the same slot a SPS release DCI and a SPS PDSCH belonging to different SPS configurations if the corresponding HARQ-ACK information are mapped to the same bit position in a PUCCH [5][7][8].

Regarding joint release, main concern is the scope of our previous agreement. When SPS release DCI is received in a slot where SPS PDSCH is configured to received, if the SPS release DCI is corresponding to multiple SPS configuration, it could be an issue which SPS PDSCH restricts the reception of SPS release DCI. Based on proposals in this meetings, I would like to suggest following proposal.

FL’s recommendation:

**Proposal 1-2:**

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

* **Option 1: a SPS release PDCCH in a slot can be received only if the SPS release reception meets the timeline condition between single SPS PDSCH release and single PDSCH reception with all of the SPS PDSCH receptions with the indicated SPS configurations in the slot.**
* **Option 2: a SPS release PDCCH in a slot can be received only if the SPS release reception meets the timeline condition between single SPS PDSCH release and single PDSCH reception with any of the SPS PDSCH receptions with the indicated SPS configurations in the slot.**
* **Option 3: a SPS release PDCCH in a slot can be received only if the SPS release reception meets the timeline condition between single SPS PDSCH release and single PDSCH reception with a SPS PDSCH reception required to be received with the indicated SPS configurations in the slot.**

**Comment:**

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Regarding the issue on other SPS PDSCH having same SLIV, it would be good to look up following description in 38.213

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| If the UE indicates a capability to receive more than one PDSCH per slot, for occasions of candidate PDSCH receptions corresponding to rows of associated with a same value of , where , the UE does not expect to receive more than one PDSCH in a same DL slot. |

Basically, UE doesn’t expect to receive more than one PDSCH corresponding to same HARQ-ACK bit. Though we already allowed to receive SPS release DCI mapped to same PUCCH with corresponding SPS PDSCH, it seems not necessary to allow those case for different configuration as proponents mentioned in [7][8].

FL’s recommendation:

**Proposal 1-3:**

**For a UE configured with type-1 HARQ-ACK codebook, the UE does not expect to receive both a SPS release DCI and a SPS PDSCH which are corresponding to different configurations in a same DL slot if the SPS release DCI and SPS PDSCH are associated to a same HARQ-ACK bit position (i.e., same value of ) in a HARQ-ACK codebook.**

**Comment:**

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| Company | Comment |
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* 1. (Issue 3.5): HARQ-ACK codebook construction only for SPS PDSCH reception when the last SPS PDSCH occasion is omitted

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

A lot of TP are provided by companies’ contributions for resolving above issue. All TP have similar changes on spec. I tried to combine those TP to have least changes and ambiguities.

FL’s recommendation:

**Proposal 2-1:**

**Adopt the following text proposal for section 9.1.2 in TS 38.213 to capture UE behavior for HARQ-ACK for SPS PDSCH correctly.**

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

9.1.2         Type-1 HARQ-ACK codebook determination

<unchanged text omitted>

Set to the number of serving cells configured to the UE

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

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

Set – HARQ-ACK information bit index

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

while

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

while

Set – slot index

while

if {

a UE is configured to receive ~~a~~at least one SPS PDSCH from~~in~~ slot to slot for SPS PDSCH configuration on serving cell , excluding SPS PDSCH that is not required to be received among overlapping SPS PDSCHs in any slots, if any according to [6, TS 38.214], or based on a UE capability for a number of PDSCH receptions in a slot according to [6, TS 38.214], or due to overlapping with a set of symbols indicated as uplink by *tdd-UL-DL-ConfigurationCommon* or by *tdd-UL-DL-ConfigurationDedicated*, where is provided by *pdsch-AggregationFactor* if configured, =1 otherwise, and

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

}

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

**Comment:**

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| Company | Comment |
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* 1. (Issue 4.4): PUCCH resource determination for SPS PDSCH receptions

Based on previous discussion in the last meeting, each PUCCH resource ID is unique per UL BWP. In other words, configured PUCCH resource ID for two codebooks are should be different. For SPS PUCCH configuration, currently PUCCH resource having ID {0,1,2,3} is used for SPS only HARQ-ACK codebook for both priority index. It is not possible to support two HARQ-ACK codebook and not aligned with current RRC parameter structure TS 38.331.

Based on the TP in [14] by Sharp, I tried to change some sentence to align with other parts of 38.213.

FL’s recommendation:

**Proposal 3-1:**

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

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

**Comment:**

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| Company | Comment |
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# Open issues to be discussed

For section 3, it is recommended for companies to take into account the issues carefully and to come back with sufficiently specific options/preference/suggestions to the next meeting so that we can complete RAN1 works on the relevant functionalities with respect to specification.

# Final outcome from [102-e-NR-L1enh-URLLC-IIoTenh-01]

Reserved

# References

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

# Appendix: Previous relevant agreements

RAN1#96

**Conclusion**:

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

Agreements:

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

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

RAN2#105

Agreements in RAN2

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| * 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:

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| --- |
| 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*.

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Agreements:

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

Agreements:

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

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

Agreements:

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

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

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

Agreements:

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

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

Agreements:

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

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

**Agreements:**

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

Agreements:

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

Agreements

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

Agreements**:**

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

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

Agreements**:**

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

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

**Conclusion:**

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

Agreements:

Update previous agreements by:

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

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

Agreements:

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

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

**Conclusion**

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

Agreements:

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

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

Agreements:

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

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