3GPP TSG RAN WG1 #108-e R1-2202833

e-Meeting, February 21 – March 3, 2022

**Agenda item: 7.1**

**Source: Moderator (Nokia)**

**Title: [108-e-NR-CRs-02] Issue#3 SPS PDSCH activation and PUCCH resource selection for the 1st SPS PDSCH**

**WI: NR\_newRAT-Core**

**Document for: Discussion and Decision**

# 1 Introduction

This document is a summary of the discussion related to the RAN1#108 AI 7.1 issue #2 handled in the following email thread:

[108-e-NR-CRs-02] Issue#3 SPS PDSCH activation and PUCCH resource selection for the 1st SPS PDSCH by March 1 – Karri (Nokia)

* Relevant tdocs: [R1-2201027](file:///C%3A%5CUsers%5CDocs%5CR1-2201027.zip), [R1-2201028](file:///C%3A%5CUsers%5CDocs%5CR1-2201028.zip), [R1-2201385](file:///C%3A%5CUsers%5CDocs%5CR1-2201385.zip), [R1-2202116](file:///C%3A%5CUsers%5CDocs%5CR1-2202116.zip), [R1-2201656](file:///C%3A%5CUsers%5CDocs%5CR1-2201656.zip)

The following Tdocs address the issue

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| **TDoc#** | **Tdoc title** | **Source** |
| [R1-2201027](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201027.zip) | SPS PDSCH activation and PUCCH resource selection for the 1st SPS PDSCH | Nokia, Nokia Shanghai Bell |
| [R1-2201028](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201028.zip) | Draft 38.213 CR on SPS PDSCH activation and PUCCH resource selection for the 1st SPS PDSCH | Nokia, Nokia Shanghai Bell |
| [R1-2201385](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201385.zip) | Clarification on PUCCH resource determination for the first SPS PDSCH | ZTE |
| [R1-2202116](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202116.zip) | Clarification on HARQ-ACK PUCCH resource for SPS PDSCH | Qualcomm Incorporated |
| [R1-2201656](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201656.zip) | Clarification on HARQ-ACK for SPS PDSCH (Originally submitted to AI 7.2.5) | Ericsson |

# 2 Summary of the issue raised in the Tdoc

Exact proposals of the documents:

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| **TDoc#** | **Proposal** |
| [R1-2201027](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201027.zip)[R1-2201028](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201028.zip) | **Proposal 1**: based on the above two observations, conclude that the 1st SPS-PDSCH after receiving the activation DCI is considered as SPS-PDSCH, and the PUCCH handling follows the *SPS-Config*. The PUCCH-related fields in the SPS-PDSCH activation DCI are ignored.**Proposal 2:** Agree to the following clarification to TS 38.213 v15.14.0 and v16.8.0. A corresponding draft CR to Rel-15 is provided in [R1-2201028]:If a UE transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by *n1PUCCH-AN*. A PDCCH carrying a DL SPS activation is not considered to correspond to any of the SPS PDSCHs. |
| [R1-2201385](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201385.zip) | Proposal 1: The PUCCH resource corresponding to the HARQ-ACK for the first SPS PDSCH associated with an activation DCI is determined by DCI. |
| [R1-2202116](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202116.zip) | *Proposal 1:* Capture the following as a conclusion in RAN1 Chairman’s notes* PUCCH resource indicated by PRI in activation DCI is used to feedback HARQ-ACK for the first SPS PDSCH activated by activation DCI
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| [R1-2201656](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201656.zip%22%20%5Ct%20%22_parent) | [Observation 1 For HARQ-ACK codebook construction and PUCCH resource determination of Case (A), there is no differentiation of first SPS PDSCH after activation DCI and subsequent SPS PDSCH.](file:///C%3A%5CUsers%5Ckrantaah%5CAppData%5CLocal%5CTemp%5C7zO8A612123%5CR1-2201656%20Clarification%20on%20HARQ-ACK%20for%20SPS%20PDSCH.docx#_Toc95486078)[Observation 2 For HARQ-ACK codebook construction and PUCCH resource determination of Case (B), there is no differentiation of first SPS PDSCH after activation DCI and subsequent SPS PDSCH.](file:///C%3A%5CUsers%5Ckrantaah%5CAppData%5CLocal%5CTemp%5C7zO8A612123%5CR1-2201656%20Clarification%20on%20HARQ-ACK%20for%20SPS%20PDSCH.docx#_Toc95486079)Correspondingly, we propose that RAN1 endorses the following conclusion for avoid future confusion.**Proposed Conclusion:** For HARQ-ACK codebook construction and PUCCH resource determination, there is no differentiation of first SPS PDSCH after activation DCI and subsequent SPS PDSCH, regardless of if there are HARQ-ACK bits for dynamically scheduled PDSCH in the same (sub-)slot. |

# 3 Discussion

## 3.1 Round 1

The issues raised by the documents illustrates the different understandings of the SPS-PDSCH activation DCI and whether it should be considered to correspond to the first SPS-PDSCH or not, i.e. is the 1st PDSCH after the DL SPS activation

* a “normal” dynamically granted PDSCH that was scheduled with the PDCCH carrying the DL SPS activation message, or
* an SPS-PDSCH like all the subsequent SPS-PDSCH, and has no corresponding PDCCH.

This defines the way the HARQ-ACK is transmitted for the 1st SPS-PDSCH.

**The issue:** should the PUCCH transmitting the HARQ-ACK in response to the first PDSCH triggered by an DL SPS activation DCI be considered as:

1. PUCCH corresponding to an SPS-PDSCH (following the RRC *SPS-Config*): 1027/1028, 1656
2. PUCCH corresponding to of a dynamically granted PDSCH (ignoring the RRC *SPS-Config)*: 1385, 2116

**Moderator proposes to take the discussion in two steps**

* Step 1: Agree on one of the interpretations:
* Step 2: Agree on the RAN1 action (A CR, a RAN1 conclusion)

**Please provide company comments to the table below**

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| **Company**  | **Comment** |
| Ericsson | We support moderator’s two-steps approach.For Step 1, our understanding of the specification is that the 1st DL SPS PDSCH and other DL SPS PDSCHs with respect to the corresponding HARQ-ACK, codebook construction and eventually PUCCH resource are treated the same (justifications available in our contribution).  |
| Fujitsu | The two-step approach proposed by the moderator looks good. Interpretation 1) is our understanding and support the justification in 1027 and 1656 |
| NTT DOCOMO | OK with the two-steps approach.Regarding interpretation, our interpretation is 2nd one; i.e. HARQ feedback for the initial SPS PDSCH is handled as one of dynamic scheduling, for PUCCH resource determination perspective.* a) Why spec editor uses the wording is for this interpretation.
* b) When activation DCI schedules corresponding PUCCH transmission as “the last DCI”, NW needs to consider the HARQ-ACK payload size. 2nd interpretation can allocate appropriate PUCCH resource, but 1st one cannot.
* c) From codebook construction perspective, there is no issue like b); thus the initial SPS PDSCH is handled as a normal SPS PDSCH.
* d) Misalignment to Rel-16 SPS should be discussed in Rel-16 URLLC WI after fixing this discussion. Here this is clarification for Rel-15 spec, so Rel-16 URLLC spec should not be considered in this discussion.
* e) The current Rel-15 spec text is the following. Clearly 2nd one is correct in our reading.

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| For a PUCCH transmission with HARQ-ACK information, a UE determines a PUCCH resource after determining a set of PUCCH resources for  HARQ-ACK information bits, as described in Clause 9.2.1. The PUCCH resource determination is based on a PUCCH resource indicator field [5, TS 38.212] in a last DCI format 1\_0 or DCI format 1\_1, among the DCI formats 1\_0 or DCI formats 1\_1 that have a value of a PDSCH-to-HARQ\_feedback timing indicator field indicating a same slot for the PUCCH transmission, that the UE detects and for which the UE transmits corresponding HARQ-ACK information in the PUCCH where, for PUCCH resource determination, detected DCI formats are first indexed in an ascending order across serving cells indexes for a same PDCCH monitoring occasion and are then indexed in an ascending order across PDCCH monitoring occasion indexes....If a UE transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by *n1PUCCH-AN*. |

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| Samsung | We are OK with the two-step approach. When *SPS-PUCCH-AN-List* is provided, clause 9.2.1 of 38.213 is clear and interpretation 1 applies – e.g. “If the UE is provided *SPS-PUCCH-AN-List* and transmits $O\_{UCI}$ UCI information bits that include only HARQ-ACK information bits in response to one or more SPS PDSCH receptions and SR, if any, the UE determines a PUCCH resource to be …”When *SPS-PUCCH-AN-List* is not provided, the argument for interpretation 2 is based on the “corresponding PDCCH” in following “If a UE is not provided *SPS-PUCCH-AN-List* and transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by *n1PUCCH-AN*” being applicable only to the first SPS PDSCH.We do not understand such logic. If so, why only the first SPS PDSCH and not all SPS PDSCHs (i.e. use the resource indicated by PRI, instead of *n1PUCCH-AN*, for all SPS PDSCHs)? Why is the “corresponding PDCCH” corresponding to the first SPS PDSCH and not to every SPS PDSCH since every SPS PDSCH is activated/scheduled by that “corresponding PDCCH”? It should be clear that the activation DCI is not a scheduling DCI (e.g. fields used to indicate activation do not provide scheduling information, the HARQ-ACK of all SPS PDSCHs is put together for the Type-2 HARQ-ACK codebook without considering DAI, …” and SPS PDSCH do not have a “corresponding PDCCH”. Also, as it was well captured in x1027 and x1656, interpretation 2 is not consistent with other Rel-15 specifications (would require NBC changes) while interpretation 1 is. To summarize, our understanding is interpretation 1 – i.e. there is no difference between the first SPS PDSCH and non-first SPS PDSCHs with respect to resource determination for PUCCH transmission with corresponding HARQ-ACK. |
| ZTE | OK with the two-step approach. For Step 1, our understanding is Interpretation 2. As summarized by DOCOMO, the Rel-15 specification clearly specifies that the PRI in a last DCI, regardless of whether it is an activation DCI or not, would be used for PUCCH resources determination. And *n1PUCCH-AN* is only used for SPS PDSCH without a corresponding DCI. In addition, when discussing rate-matching for SPS PDSCH in R1-2112403 in RAN1#107-e, companies had a common understanding that the current spec text ‘*a PDSCH scheduled by a PDCCH*’ covers the first SPS PDSCH with activation DCI. In other words, the first SPS PDSCH with activation DCI is regarded as a dynamic PDSCH in RAN1, and this should be kept the same for all related handling.  |
| Intel | We are fine with the two-step approach. For Step 1, our understanding is Interpretation 2. The first PDSCH scheduled by activation DCI should be considered as dynamically granted PDSCH. The PUCCH resource corresponding to the HARQ-ACK for the first SPS PDSCH associated with an activation DCI is determined by DCI, i.e., RPI.  |
| QC | We are fine with the two-step approach. For step 1, our understanding is Interpretation 2. From RAN1 Rel-15 spec point of view, what DOCOMO provided clearly indicate RAN1 spec does not differentiate SPS activation DCI with a scheduling DCI. They are just with different RNTI, and following just say last DCI format 1\_0 or 1\_1, which of course include both RNTIs. “….The PUCCH resource determination is based on a PUCCH resource indicator field [5, TS 38.212] in a last DCI format 1\_0 or DCI format 1\_1, among the DCI formats 1\_0 or DCI formats 1\_1 that have a value of a PDSCH-to-HARQ\_feedback timing indicator field indicating a same slot for the PUCCH transmission”Even from RAN2 spec point of view, RAN2 spec has this note “NOTE 3a: A PDCCH indicating activation of SPS or configured grant type 2 is considered to indicate a new transmission.” To me, this note at least infer SPS activation DCI schedule a new transmission. |
| LG | We are also fine with the two-step approach. For Step 1, our understanding is also Interpretation 2.As observed by above companies (DOCOMO, ZTE, Intel, QC) as well as based on our understanding, the first PDSCH is to be treated as a dynamic PDSCH in terms of determining PUCCH resource and generating HARQ-ACK codebook. |
| vivo | We are ok with the two-step approach.For step 1, our understanding for the current specification is the 1st SPS PDSCH activated by DCI and the corresponding HARQ-ACK are considered the same as dynamic grant scheduled PDSCH and PUCCH. |
| CATT | We are fine with the two-step approach.For Step 1, our understanding is Interpretation 2. |
| Sharp | We support the two-step approach.For step 1, our understanding is Interpretation 2. We share the same observation as by Docomo, ZTE and others. |
| Nokia, NSB | Our understanding is interpretation 1 and all the PDSCHs that are triggered by the DL SPS activation DCI are SPS PDSCHs, but what is more important to us is that there is one interpretation that we can clarify as a group, and base our implementation on, or else DL SPS activation would not work.@NTT DOCOMO, the specification text you quote (from the Qualcomm Tdoc?) leads to interpretation 2 only if you assume that the 1st SPS PDSCH is a DG-PUSCH that has a corresponding PDCCH, NOT an SPS PDSCH. This is reciting an assumption as proof and as such doesn’t help, when the problem lies in whether that assumption is the correct assumption to take.  |
| Spreadtrum | We support the two-step approach. Our understanding is interpretation 2.1. There is no ignore UE behaviour defined in the specification. So UE should treat PRI field as a valid field in the activation DCI.
2. The first CG-PUSCH after activation is treated as same as dynamic scheduled. So SPS PDSCH after activation can share the same rule as CG-PUSCH
3. The field of “PDSCH-to-HARQ\_feedback timing indicator” is valid in activation DCI. Thus the activation DCI belongs to the “DCI format 1\_0 or DCI format 1\_1 for scheduling PDSCH receptions” in the spec. It share the same HARQ-ACK feedback mechanism as dynamic PDSCH, which does not need any changes.
4. If interpretation 1 is used, a lot of changes needed to clarify the different operations of the activation DCI, such as ignore the PRI field, the special handling of DAI in the activation DCI, etc.
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| Apple | At RAN1 #91 (November 2017), there was an LS reply to RAN2 from RAN1 (R1-1721574):**….**RAN1 would like to thank RAN2 on the questions related to DL SPS and grant-free operation. RAN1 has concluded the followings according to the questions asked by RAN2.**Q1**: RAN2 would like to kindly ask RAN1 on the feasibility to support DL SPS-like operation for NR. From RAN2 point of view, it is possible to support DL SPS-like operation in NR similar to LTE DL SPS.**A1:** RAN1 believes that it is feasible to support DL SPS operation in NR. The NR DL SPS scheme has no significant differences compared with LTE DL SPS scheme.….….The highlighted text should be relevant to the discussion here. We don’t have time to dig out the exact agreement concerning SPS HARQ feedback in NR. However, if LTE can be used as reference, then interpretation 2 should be the right one (copied text is from 36.213 v8.8.0): |

### Summary after round #1

**The issue:** should the PUCCH transmitting the HARQ-ACK in response to the first PDSCH triggered by an DL SPS activation DCI be considered as:

1. PUCCH corresponding to an SPS-PDSCH (following the RRC *SPS-Config*): 1027/1028, 1656
2. PUCCH corresponding to of a dynamically granted PDSCH (ignoring the RRC *SPS-Config)*: 1385, 2116

**Interpretation 1 supported by:**

* Ericsson, Fujitsu, Samsung, Nokia/NSB (4)

**Interpretation 2 supported by:**

* NTT DOCOMO, ZTE, Intel, Qualcomm, LG, vivo, CATT, Sharp, Spreadtrum, Apple (10)

If there is a different understanding between the UE and the gNB, there is a high risk that the SPS activation consistently fails as the gNB never receives ACK for the activation even if the UE received it correctly. Hence a common interpretation is a necessity for DL SPS to be supported by the standard.

The proponents of interpretation 1 derive the justification from the lack of differentiation between the 1st SPS-PDSCH and other SPS-PDSCHs, differentiation that would be needed for interpretation 2 and point out that there may be further issues in RAN2 and in Rel-16 specs if RAN1 is going to clarify that the 1st PDSCH after the SPS activation is not SPS-PDSCH, but a DG-PDSCH for Rel-15.

The proponents of interpretation 2 derive the justification from the TS38.213 text implying that the DL SPS activation DCI schedules the 1st SPS PDSCH as the PDCCH carrying the activation DCI corresponds to the first SPS-PDSCH. Apple further makes a compelling argument on the similarity to LTE DL SPS, which with seems to match the reality on the field.

Both arguments are understandable and can be defended and there is no compelling technical argument why one interpretation must be the correct one and the other the wrong one – the problem lies in RAN1 failing to properly address this question at the time of Rel-15 specification. Apple reference to the earlier RAN1-RAN2 LS exchange and the corresponding LTE implementation on the field is an additional piece of evidence in favour of Alt2.

There is, however, a fairly clear majority in favour of Alt2. Hence an attempt to accept the majority view is the starting point of the 2nd round.

## 3.2 Round 2

**Moderator proposal: Accept the majority view as identified in round #1; The 1st PDSCH after the reception of the activation DCI is considered as a PDSCH with a corresponding PDCCH, only the subsequent PDSCHs are PDSCHs without a corresponding PDCCH.**

* **The PUCCH resource for the HARQ-ACK of the 1st PDSCH follows the PRI on the DL SPS activation DCI**
* **The HARQ-ACK CB construction for that PDSCH follows the DG-PDSCH construction**

Companies in favour of Alt1 in round 1, please be mindful of whether you believe you have arguments that could realistically be seen as turning the majority the other way around.

**Please provide company comments to the table below**

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| **Company**  | **Comment** |
| ZTE | Support the proposal in principle. We suggest the following changes to make it a bit more accurate. **Moderator proposal: Accept the majority view as identified in round #1; The 1st SPS PDSCH after ~~the reception of~~ the SPS activation DCI is considered as a PDSCH with a corresponding PDCCH, only the subsequent SPS PDSCHs are PDSCHs without a corresponding PDCCH.*** **The PUCCH resource for the HARQ-ACK of the 1st SPS PDSCH follows the PRI on the DL SPS activation DCI**
* **The HARQ-ACK CB construction for ~~that~~ 1st SPS PDSCH follows the DG-PDSCH construction**
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| NTT DOCOMO | We support the direction. It seems that ZTE’s suggestion is preferred to avoid misunderstanding.One question: this is intended for both Rel-15/16 or only for Rel-16? |
| Samsung | We do not support the proposal because it is not according to specifications. Interactive discussion with Q&A is needed. In particular, we would like to ask proponents of the proposal the following questions.Q1: What is the scrambling ID of the DM-RS for the SPS PDSCH receptions? Is it same or different for the ‘first’ SPS PDSCH and for the ‘non-first’ SPS PDSCHs?Q2: Is there any ambiguity for the Rel-16 specifications when *SPS-PUCCH-AN-List* is provided? We think there is not and interpretation 1 is clearly stated. If so, do the proponents of interpretation 2 intend to change the Rel-16 38.213 specifications?Q3: TS 38.321 specifies that “after receiving the activation DCI, the UE follows the SPS-PDSCH configuration”. Do proponents of interpretation 2 intend to change the TS 38.321 specifications? Q4: For the Type-1 HARQ-ACK codebook fallback operation, all SPS PDSCHs are equivalent and different from DCI-scheduled PDSCHs. Do the proponents of interpretation 2 intend to change the Rel-15 fallback operation for Type-1 CB?Q5: The Type-2 HARQ-ACK codebook considers all SPS PDSCHs as not having “corresponding PDCCH”. Do the proponents of interpretation 2 intend to change the Rel-15 Type-2 CB construction?Q6: Proponents of interpretation 2 based their argument on the “PDSCH-to-HARQ\_feedback timing indicator”. That field applies to all SPS PDSCHs. Shouldn’t then the PRI apply to all SPS PDSCHs for the PUCCH resource determination?Q7: The main ambiguity seems to come from “If a UE is not provided *SPS-PUCCH-AN-List* and transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by *n1PUCCH-AN*” and the argument from proponents of interpretation 2 is that “corresponding PDCCH” is for the ‘first’ SPS PDSCH. If so, why doesn’t “corresponding PDCCH” apply for the ‘non-first’ SPS PDSCHs? Based on what DCI are those ‘non-first’ SPS PDSCHs received or have HARQ-ACK reported?Q8: What other fields from the activation DCI, other than k1 and PRI (for interpretation 2), are used? |
| Ericsson | We share the same view as Samsung and have the same questions. True that we are in minority, but we struggle to be comfortable with the logic. We appreciate if proponents of interpretation 2, provide their views to questions raised by Samsung.Some additional comments:* If interpretation 2 is adopted, definitely couple of CR is needed for at least CB construction as we point out in contribution. Which in turn, impacts the related functionalities and creates more work make different part of specifications flows nicely together.
* Also, referring to LTE and reusing the same procedure, would be an appealing argument if NR DL SPS would have been the same.
	+ We even mentioned in our contribution that either interpretation would not make a big difference for Rel-15, since DL SPS periodicity is 10 ms, which makes Rel-15 very similar to LTE.
	+ But, in Rel-16, DL SPS enhancements not only introduced simultaneous activation of multiple configurations, but also much smaller periodicities as compared to Rel-15 (and LTE). Here, it becomes complicated and with interpretation 2, we definitely need to have CR to ensure 1st and other DL SPS are treated differently.
* Another aspect is about configuration of PUCCH resources. There is no mention in specification that configuration of DL SPS, requires configuration of PUCCH resource set used for dynamic DG-PDSCH.
	+ Hence, from specification point of view, we have the case that multiple DL SPS are configured but dedicated PUCCH resource set is not configured. That leaves us to use the default PUCCH resources before dedicated RRC if we go we interpretation 2. Then, we need to address the cases that we can not support more than 3 DL SPS..
	+ The point we try to make is that with interpretation 2, for the specifications to work really for multiple DL SPS configuration, we have a lot of fixing to do.

So, therefore to us, not only logically is a bit strange, but also we see more troubles with respect to specifications if we go with interpretation 2, than the potential clarifications in spec for interpretation 1.  |
| QC | We support the proposal and prefer ZTE’s version. Regarding the question/concerns on codebook generation, if A/N for the first SPS PDSCH is treated as dynamic scheduled A/N, it just follows the part of the Pseudo code for dynamic A/N. We don’t see any problem.  |
| Fujitsu | It would not be good to just follow the majority for this case. As Samsung and Ericsson mentioned, we should discuss and clarify the consequence to approve the moderator’s proposal. Then we can choose less problematic one.  |
| Nokia, NSB | As stated by Samsung and Ericsson, taking the majority view and agreeing to the round #2 moderator proposal may have quite a few ramifications that would be avoided when dealing with all the SPS-PDSCHs the same way. That said, if we manage to agree that RAN1 understanding is that the first PDSCH after SPS activation is a DG-PDSCH, then we need to go and make the necessary clarifications as indicated by Fihitsu – it is more important to us to first agree on the behaviour, the ramifications of the agreement will have to be dealt with afterwards.DOCOMO’s question on the release, it seems evident that as of today we don’t have a functioning standard, so this would quality as an essential correction to Rel-15 either way. Not correcting Rel-15 would mean that we should be transparent and obsolete the feature in Rel-15, e.g. by stating in the Rel-15 UE capability specifications that the DL SPS capability is not supported in Rel-15.🡺 Nokia strongly feels that the technically correct, and more straight forward path here would be not to agree with the updated proposal, BUT we can reluctantly accept the majority view in order to have any chance of supporting DL SPS by the standard.We agree that the ZTE modifications make the proposal read better and can take that as well, even though it is somewhat secondary. We all understand what we are talking about and the next step on agreeing on a spec clarification would seem to be needed anyway. |
| NTT DOCOMO 2 | To Samsung’s question, we noticed that our understanding was a bit different from what FL proposed.Our view is that the terminology of “PDSCH with corresponding PDCCH” includes initial SPS PDSCH after SPS activation, and if there is no distinguish between activation DCI and dynamic DCI (e.g. no restriction of RNTI), the feature is applied to both. That’s all. If the terminology of “PDSCH with corresponding PDCCH” is used for some UE behavior, then the behavior is applied to the initial SPS PDSCH after SPS activation as well. If “PDSCH without corresponding PDCCH” is used, the behavior is not applied to the initial SPS PDSCH after SPS activation. But if we use “SPS PDSCH”, this still includes the initial SPS PDSCH after SPS activation as well.With this understanding,For Q1: “SPS PDSCH” terminology is used for DM-RS, right? Then DM-RS configuration for SPS is applied.[Samsung]: That would be against your argument as DM-RS is based on DCI. For Q2: the issue is Rel-16 URLLC. Our view is that they misunderstood Rel-15 behavior. And now we are discussing basic NR perspective since this issue is originally there from Rel-15 spec. If we conclude the current direction here, then Rel-16 URLLC guys should apply appropriate update. We do not think we need to care features introduced in Rel-16 or later here.[Samsung]: There was no misunderstanding. A Rel-16 CR to 38.213 will not be acceptable.For Q3, with the above understanding, we do not see any issue on 38.321. But we are fine with small update for the spec as well if necessary.[Samsung]: 38.321 is clear that the SPS configuration apply throughout. A Rel-15 CR to 38.321 will not be acceptable.For Q4/5, we guess the mentioned case uses “SPS PDSCH” terminology. No change is assumed.[Samsung]: That is incorrect at least based on the second sub-bullet of the moderator proposal. A Rel-15 CR to 38.213 will not be acceptable.For Q6, we agree that indicated k is used for any of SPS PDSCHs. There is no issue. And what we need to discuss is PRI as you mentioned. Then PRI in activation DCI is applied to the initial SPS PDSCH after activation, and n1PUCCH-AN is used for subsequent SPS PDSCHs since the terminology is “PDSCH without corresponding PDCCH”.[Samsung]: According to your interpretation, why isn’t the PRI apply to all SPS PDSCHs? Why then don’t the SPS PDSCHs, after the first one, have a “corresponding PDCCH”. Are they received based on some different signalling than the first PDCCH? For Q7, as commented for Q2, issue related to SPS-PUCCH-AN-List should be handled at Rel-16 URLLC guys in consideration of outcome of discussions in this thread, but we should not use this Rel-16 URLLC issue to discuss basic NR spec from Rel-15.[Samsung]: Please see comment to Q2 and Q6.For Q8, as we said, if the “PDSCH with corresponding PDCCH” terminology is used, or if there is no distinguish between activation DCI and dynamic DCI (e.g. no restriction of RNTI), other fields are used. This depends on the spec text for each feature.[Samsung]: What other fields do you think are used?With this understanding, we think the 2nd bullet of the proposal is not correct since we have both “PDSCH with/without corresponding PDCCH” and “SPS PDSCH”. The bullet should be removed. (Let me use ZTE’s version.)**Moderator proposal: Accept the majority view as identified in round #1; The 1st SPS PDSCH after ~~the reception of~~ the SPS activation DCI is considered as a PDSCH with a corresponding PDCCH, only the subsequent SPS PDSCHs are PDSCHs without a corresponding PDCCH.*** **The PUCCH resource for the HARQ-ACK of the 1st SPS PDSCH follows the PRI on the DL SPS activation DCI**
* **~~The HARQ-ACK CB construction for that 1~~~~st~~ ~~SPS PDSCH follows the DG-PDSCH construction~~**
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| Intel | We are fine with the proposal with ZTE’s modification.Our understanding is that regardless of which interpretation is selected, it is expected some issues need to be fixed in the spec, e.g., UCI multiplexing timeline in case when configured PUCCH resource for 1st SPS PDSCH overlapping with another PUCCH, etc.We suggest to fix this issue at least in Rel-16 given that the discussion in Rel-17 WIs including URLLC/CovEnh highly depends on the outcome of this issue. Regarding Samsung’s questions, here is our understanding:* Q1: it may not be relevant.

[Samsung]: An answer would be appreciated.* Q2: for multiple SPS PDSCH configurations as defined in Rel-16, the spec needs to be updated that the HARQ-ACK CB applies to SPS PDSCH except for the first PDSCH upon activation

[Samsung]: Please see response to Docomo.* Q3: We do not see the issue for 321. The first PDSCH still follows certain parameters as in the SPS-PDSCH Configuration.

[Samsung]: The text in TS 38.321 is clear – there is no differentiation/limitation to “certain parameters”* Q4: No, the first PDSCH just follows the pseudocode for dynamic PDCCH.

[Samsung]: There is no pseudocode for the fallback – there are rules that will need to be revised with a Rel-15 CR.* Q5: No, the first PDSCH just follows the pseudocode for dynamic PDCCH.

[Samsung]: That is incorrect based on current specs for the Type-2 construction – a Rel-15 CR will be needed.* Q6: the main critical point is that for the HARQ-Ack in response to the first PDSCH, the PUCCH can be dynamically indicated in the activation DCI. For the subsequent PDSCHs, the PUCCH cannot be dynamically indicated/changed from that in the activation DCI.
* Q7: same as Q6

[Samsung]: What causes the reception of the SPS PDSCHs after the first one? Why aren’t those SPS PDSCHs have a “corresponding PDCCH” according to interpretation 2?* Q8: At least resource assignment, MCS, etc., are indicated in activation DCI.

[Samsung]: What is indicated by the DCI and applies only to the first SPS PDSCH? |
| QC2 | Sharing our answers to the questions as below. Also added two more questions Q9 and Q10 to the list. @samsung, for the two camps to understand each others’ view better, if would be good if Samsung can share your answers to those questions as well. A1: This is irrelevant to this discussion. But to answer the question: Same DMRS SCID is used for the first and non-first PDSCH. SPS configuration does not provide SCID so UE follow what is indicated in DCI for the first and non-first PDSCH. Samsung: Yes, the point is that the DCI is applicable to all SPS PDSCHs (as for the k1 value, etc.). Interpretation 2 suggests making an exception between first/non-first SPS PDSCHs only for the PRI – such differentiation does not exist for any other field.QC: SPS configuration does not provide SCID. Of course SCID in DCI applies to the rest SPS PDSCH. Again, our interpretation of spec is that reception and A/N feedback of the first SPS PDSCH follow the activation DCI. For the rest SPS PDSCH reception and A/N feedback, if SPS configuration provided parameters, apply them. For those parameters not provided in SPS configuration, such as DMRS SCID, TDRA, FDRA, etc, follow the dynamic DCI. The same principle applies to PRI, which believe that is the LTE legacy as well. If Samsung think everything including A/N resource should follow SPS configuration, why SPS configuration does not include TDRA, FDRA, etc? A2: Rel-16 spec itself is conflicting. Yes, we admit the spec text may read as UE use SPS A/N resource. But isn’t the following Rel-16 spec clearly say using PRI, because apparently the SPS activation DCI has PDSCH-to-HARQ\_feedback timing indicator field. “The PUCCH resource determination is based on a PUCCH resource indicator field [5, TS 38.212], if present, in a last DCI format, among the DCI formats that have a value of a PDSCH-to-HARQ\_feedback timing indicator field, if present, or a value of dl-DataToUL-ACK, or dl-DataToUL-ACK-r16, or dl-DataToUL-ACKForDCIFormat1\_2, indicating a same slot for the PUCCH transmission”Samsung: Agree that the above can be a source for ambiguity. However, the following was to address SPS PDSCH and the issue then is the one currently under discussion – whether “corresponding PDCCH” applies for SPS PDSCH. It does not because of other spec text and because, even if it did, it is not a logical association to say that only the first SPS PDSCH has “corresponding PDCCH”.“If a UE is not provided *SPS-PUCCH-AN-List* and transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by *n1PUCCH-AN*.”QC: That is the conflicting I was talking about. The spec QC cited and Samsung cited are conflicting with each other. A3: Not sure if RAN2 spec should be used to regulate UE PHY layer behaviour. And we don’t see what is the problem in RAN2 spec. To us, the first PDSCH is like a dynamic scheduled PDSCH. n1PUCCH-AN does not apply to it. Samsung: Specifications are to be read jointly. One cannot say that TS ‘A’ is not clear about ‘XYZ’ but I choose to ignore TS ‘B’ that does and come up with my interpretation.QC: Indeed, because spec should be read jointly. We think even if 331 spec is not crystal clear. We think 213 spec Rel-15 version is clear. 213 spec Rel-16 version has confliction, as we pointed out in A2. A4: We are not sure what is the problem for SPS A/N fallback. If the SPS fallback is referring to the following, for the first SPS PDSCH, UE just follow the highlighted green textIf 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 on the PCell, or-    a PDSCH reception scheduled by DCI format 1\_0 with counter DAI field value of 1 on the PCell, or -    SPS PDSCH receptionSamsung: Let say the activation is by DCI format 1\_1. The specification says that if nothing else is received other than SPS PDSCH, fallback applies. Interpretation 2 considers DCI format 1\_1 as a scheduling DCI and fallback does not apply.QC: Our understanding is that the above is the text specify the fallback. Not sure what text in spec this “The specification says that if nothing else is received other than SPS PDSCH, fallback applies.” Refers to. Yes, in our understanding, activation DCI in format 1\_1 does not trigger fallback. A5: Same view as Intel for type 1 code book. Not sure what is the issue if the A/N of first SPS PDSCH follow dynamic A/N. Can Samsung please point to the Pseudo code to be more specific?Samsung: In clause 9.1.3.1, the following are stated for the Type-2 CB generation. The activation DCI is not a scheduling DCI and, even if it was, it would be a scheduling DCI for all SPS PDSCHs, not arbitrarily for only the first one. “*A UE determines monitoring occasions for PDCCH with DCI format scheduling PDSCH receptions, or having associated HARQ-ACK information without scheduling PDSCH reception,* …”QC: why activation DCI should not be viewed as scheduling DCI. It has TDRA, FDRA, PRI, PC command, etc. The only fields that are used differently than scheduling DCI are HARQ ID and RVID which is used for validation. Again, no one is interpreting activation DCI schedule all SPS PDSCHs. We hope we are not creating a 3rd interpretation here 😊Also, the following are not according to interpretation 2 and will need NBC CRs.“*If a UE is configured to receive SPS PDSCH and the UE multiplexes HARQ-ACK information for one activated SPS PDSCH reception in the PUCCH in slot* $n$*, the UE generates one HARQ-ACK information bit associated with the SPS PDSCH reception and appends it to the* $O^{ACK}$ *HARQ-ACK information bits.**If a UE is configured to receive SPS PDSCH and the UE multiplexes HARQ-ACK information for multiple activated SPS PDSCH receptions in the PUCCH in slot* $n$*, the UE generates the HARQ-ACK information as described in clause 9.1.2 and appends it to the* $O^{ACK}$ *HARQ-ACK information bits*.”QC: We don’t see NBC CR is needed. Again, in our understanding, the A/N for the first SPS PDSCH goes together with dynamic A/N, which is our understanding of the above text. A6: No, at least from QC point of view, we take interpretation 2 because of following highlighted text, not because of K1. The first red text does not exclude DCI with CS-RNTI so it is included. Second text clearly say without a corresponding PDCCH.

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| For a PUCCH transmission with HARQ-ACK information, a UE determines a PUCCH resource after determining a set of PUCCH resources for  HARQ-ACK information bits, as described in Clause 9.2.1. The PUCCH resource determination is based on a PUCCH resource indicator field [5, TS 38.212] in a last DCI format 1\_0 or DCI format 1\_1, among the DCI formats 1\_0 or DCI formats 1\_1 that have a value of a PDSCH-to-HARQ\_feedback timing indicator field indicating a same slot for the PUCCH transmission, that the UE detects and for which the UE transmits corresponding HARQ-ACK information in the PUCCH where, for PUCCH resource determination, detected DCI formats are first indexed in an ascending order across serving cells indexes for a same PDCCH monitoring occasion and are then indexed in an ascending order across PDCCH monitoring occasion indexes....If a UE transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by *n1PUCCH-AN*. |

Samsung: Please see response to A2.A7: That will be interpretation 3, which is in lack of sufficient clarity regarding what "corresponding" means. So far, no one take that interpretation. Samsung: It is not interpretation 3 – it is just to show that interpretation 2 is arbitrary and lacks a logical basis. Why is it only the first SPS PDSCH that has ‘corresponding PDCCH’ and not, e.g., the second SPS PDSCH?QC: See our response to A5A8: HARQ process ID and RVID in activation DCI are used for SPS validation. Other fields are used for the first SPS PDSCH. Samsung: The DCI is explicitly mentioned throughout TSs as an “activation DCI”, not a “scheduling DCI”. All parameters for all SPS PDSCHs are either determined from the RRC configuration or from the DCI. There is no such case where the first SPS PDSCH has any different parameter value than the rest of the SPS PDSCHs. QC: The spec text we cited on DAI and PRI does not differentiate activation DCI from scheduling DCI.We also have a questions to proponents of interpretation 1. Q9: If go with interpretation 1, does it mean UE should ignore the DAI in activation DCI? Current spec does not differentiate DAI procedure between DCI with CS-RNTI and with C-RNTI. How do we expect to resolve this?Samsung: Yes, the DAI in the activation DCI is not processed based on current specs. Please see follow up to A5. QC: This is very different from our understanding. We are not sure that is even the common understanding among all companies supporting interpretation 1. Can proponents of interpretation 1 confirm DAI in the activation DCI is ignored, if following interpretation 1. If so, we think Rel-15 CR on DAI mechanism is needed, if take interpretation 1. Q10: If go with interpretation 1, in case there are multiple PDSCHs with HARQ-ACKs multiplexed on a PUCCH, and one of the PDSCHs is the first SPS PDSCH activated by a DCI, and the DCI activating the SPS PDSCH is the last DCI, which DCI used to determine the PUCCH resource for multiplexed HARQ-ACKs? The second last DCI? If so, A Rel-15 CR is needed. Samsung: The last DCI providing PRI. The “activation DCI” does not provide PRI (see also follow up to A2). A Rel-15 CR is not needed.QC: Spec does not say exclude DCI with CS-RNTI. Definitely Rel-15 CR is needed if we take interpretation 1. |
| ZTE | A1: It is irrelevant as DMRS scrambling ID is not configured in *SPS-Config* Samsung: Please see response to QC2 above.A2: We should focus on Rel-15 specification first and then decide whether any update to Rel-16 is needed. Samsung: Do not agree with “hiding things under the carpet”. NBC CRs will be needed for both Rel-15 and Rel-16 for interpretation 2.A3: We cannot read TS 38.321 only. Otherwise why don’t we use PRI and also several other bit fields for validation. In addition, the referred texts ‘after **receiving** the activation DCI’ instead of ‘after the activation DCI’’ is quite ambiguous about when it would take effect. Samsung: TSs must be read jointly. TS ‘A’ must be considered if any ambiguity in TS ‘B’.A4/A5: We don’t see any problem about current CB constructions by considering the first SPS PDSCH as a DG PDSCH.Samsung: Please see responses to QC2 above.A6: There is no HARQ feedback timing configuration in *SPS-Config,* while PUCCH resource is configured in *SPS-Config.* Samsung: The point is that there is no ‘first’ SPS PDSCH and ‘other’ SPS PDSCH. If SPS PDSCH had a “corresponding PDCCH” with a scheduling DCI for PUCCH resource determination, why shouldn’t it apply to all SPS PDSCHs (and then *n1PUCCH-AN* would be ignored)? Where exactly do you get the understanding that only the first SPS PDSCH is to be considered? A7: Similar as A6, *n1PUCCH-AN* is configured in *SPS-Config* and should be used for subsequent SPS PDSCHs. Samsung: Please see responses to QC2 above.A8: Except for the ones used for validation, all other fields are used for the first SPS PDSCH. Samsung: Please see responses to QC2 above. |

### Summary after round #2

All the 4 companies supporting interpretation 1 still indicated preference for that, but one of the companies indicated that they would be able to accept the majority view as a way forward if that allows RAN1 to clarify the spec so that DL SPS activation works. 4 out of the 10 companies supporting alternative 2 indicated they would be OK with the alternative 2. No other companies provided comments during round #2.

On the set of questions on the detailed implications of Alt.2 posed by Samsung, two companies provided responses, that were further responded by Samsung. However, it was not clear to the moderator if with Alt.2 the CB construction of the 1st SPS-PDSCH actually is supposed to follow DG-PDSCH or SPS-PDSCH construction.

Perhaps the correct interpretation of alt2 is that the 1st SPS-PDSCH after the activation is indeed an SPS-PDSCH, but with one exception – the PUCCH resource.

## 3.3 Round 3

**Survey 1 – most critical**

Please indicate your company’s preferred alternative (assume no changes to round 1 here, just for the record), and if you are able to accept the other alternative as well.

Please also indicate if you agree that the Alt.2 formulation is a correct one, or if e.g. the HARQ-ACK CB construction (or something else) should also follow the DG-PDSCH rule instead of SPS-PDSCH rule.

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| **Company**  | **Alt.1**The 1st SPS-PDSCH and the subsequent SPS-PDSCHs all follow the *SPS-Config* | **Alt.2**The 1st SPS-PDSCH and the subsequent SPS-PDSCHs all follow the *SPS-Config,* except thatthe 1st SPS-PDSCH HARQ-ACK is sent on the PUCCH resource indicated by the activation DCI |
| Example row | Preferred choice | Acceptable compromiseAlt.2 description is incorrect. The HARQ-ACK CB and PDSCH DMRS sequence should be derived from the activation DCI as well for the 1st SPS-PDSCH |
| NTT DOCOMO |  | Support.After re-reading 9.1.3.2 of 213, we understand that if interpretation2’s logic is used then there are a lot of issues on type-2 HARQ-ACK CB. Meanwhile at least PUCCH resource determination perspective should use interpretation 2 from the following reason. Thus we think Alt 2 is what we should take.* Why PRI is used for initial SPS PDSCH after activation is to schedule a PUCCH with sufficient amount of resources to multiplex the HARQ-ACK and other HARQ-ACKs for dynamic scheduling (“last DCI” concept). Why the PRI is not used for subsequent SPS PDSCHs is that the PRI is appropriate one for the HARQ-ACK of the initial SPS PDSCH, but it would not be appropriate one for the HARQ-ACK of subsequent SPS PDSCHs.
 |
| QC | We fully agree with Nokia that the most important thing is to draw a conclusion which interpretation should RAN1 take, otherwise NR cannot support DL SPS, which will be a joke .So, we can accept Alt 1 to resolve this issue in this meeting, but **ONLY** in this meeting. If this issue is delayed to next meeting due to no consensus, we then will **NOT** have the flexibility to accept Alt 1. Alt 2 will be the only option we can accept in next/future meetings.  | Support this Alternative 2 (wording of the proposal maybe can be fine-tuned later)@Samsung, sorry we are a little late to get back to your questions. We just shared our answers to A1-A8 in the table above. We also added two more questions Q9 and Q10 to the list. For the two camps to understand each others’ view better, it would be good if Samsung can share your answers to A1-A10 questions as well.  |
| OPPO | We prefer the Alt1 as there are many other places reflect the 1st SPS-PDSCH is not set with PUCCH by the activation DCI. One additional thing is the 9.2.3 also mention “If the UE detects a DCI format 1\_1 that does not include a PDSCH-to-HARQ-timing-indicator field and schedules a PDSCH reception or activates a SPS PDSCH reception ending in slot , the UE provides corresponding HARQ-ACK information in a PUCCH transmission within slot  where  is provided by dl-DataToUL-ACK.” This means the k1 field should be ignored if it going to activates SPS. Then the PUCCH resource field should also be not used.In that sense, we also slight prefer interpretation 1. | This issue for us would be only one choice to make sure same understanding in gNB/UE, the Rel-15 be correct interpreted. We have to down to one option. |
| ZTE |  | SupportThere are only 4 RRC parameters in *SPS-Config.* Except for *n1PUCCH-AN,* it’s clear that all other parameters cannot be further indicated by a non-validation field in activation DCI and therefore should be applied for all SPS PDSCHs including the first SPS. We also provided our answers to the questions from Samsung above.  |
| Fujitsu | Preferred choice | Not preferred, but can compromise for the sake of progress (Fully support the statement by Nokia) |
| Samsung | Support | Object |
| Nokia, NSB | Support | Can accept the behaviour where PRI from DCI is used for the PUCCH resource of the 1st SPS-PDSCH, but all other operations (including HARQ-ACK CB generation) follow the same log as all SPS-PDSCHs. However, this seems both illogical and causes some difficulties in rEl-16.  |
| Spreadtrum | Not align with our understanding. But OK to discuss.  | Support  |
| vivo | We share the same feeling that the most important thing is to align the understanding and make a conclusion in RAN1 on this issue. Although Alt.1 is not aligned with our understanding for current spec. if majority is to take Alt.1, we are also fine with it. | Support |
| LG | We share similar view/understanding with QC’s analysis in the Survey 2 below. It seems more changes/impacts are needed with this Alt 1. | Support.With Alt 2, the PRI in DCI is used for the first PDSCH, and given that, it is consistent that the corresponding HARQ-ACK is generated same as dynamic PDSCH. |

**Survey 2**

* Do you agree that a Rel-15 38.213 CR is needed regardless of which of the alternatives is adopted?
* If Alt.2 is adopted, what other actions are needed, if any, for example. (note that the list below is just a set of examples that one could think of, not necessarily a correct or complete list)
	+ Is a Rel-15 CR to 38.213 needed for the 1st SPS-PDSCH HARQ ACK CB type 2 construction?
	+ Is a Rel-15 38.321 CR needed to clarify that the activation DCI schedules a TB?
	+ Is a Rel-16 CR needed to correct the SPS enhancements?
	+ …?

|  |  |
| --- | --- |
| **Company**  | **Comment** |
| Example row | Agree that Rel-15 CR is needed to clarify the correct behaviourThink a 38.300 CR is needed to make sure DL SPS is well described in that spec |
| NTT DOCOMO | OK with Rel-15 CR if agreeable. Otherwise, Rel-16 CR is needed.In our understanding, Alt 2’s intention is that in PUCCH resource determination in 9.2.3 of 38.213, PRI in activation DCI is used for PUCCH TX of the HARQ-ACK for the initial SPS PDSCH (and not used for subsequent SPS PDSCHs), and in type-1/2 HARQ-ACK CB construction under 9.1 of 38.213 (or any other feature), the initial SPS PDSCH is treated as a SPS PDSCH. Then at least clarification text for the PUCCH resource determination perspective would be needed. For the other part, we are fine with either way.Then corresponding to the outcome here, Rel-16 CR for SPS enh. is probably necessary. The CR should be discussed under 7.2.5. |
| QC | Rel-15 spec is aligned with interpretation 2. If we take interpretation 2. No Rel-15 CR is needed for neither 38.213 nor 38.321. A Rel-16 CR maybe needed to fix the conflicting text in Rel-16 spec 38.213, as we commented in 2nd round. If we take interpretation 1, Rel-15 CR to 38.213 is needed. Rel-16 CR to 38.213 is also needed. |
| OPPO | CR can be considered, TP of R1-2201027 would be acceptable. |
| ZTE | If Alt 2 is adopted, we may only need to correct the SPS enhancements. But we are also open for a Rel-15 CR if some companies think some part of the spec is not critical clear.  |
| Fujitsu | It is clear from the discussion here that the specifications are not crystal clear, and CR would be useful. For alt.1, we are OK with the CR in 1028 and no other CR would be needed.  |
| Samsung | The answer to the first question is ‘no’ in case of interpretation 1 - there is no need for any Rel-15 CR, for any TS. Rel-15/16 specifications are consistent with interpretation 1.In addition to requiring several NBC CRs for mandatory (and deployed) functionalities, interpretation 2 lacks the required logic in order to be a valid interpretation. |
| Nokia, NSB | 1. In our view, a Rel-15 CR to clarify the issue is a necessity. We would not have this discussion if there was no issue with the spec. We can accept delaying the solution to Rel-16 and essentially acknowledge that Rel-15 does not support DL SPS.
2. We don’t see the need for other RAN1 CRs for Rel-15 but clarification of which PUCCH resource (PRI-indicated or configured by *SPS-Config­*) is used for the 1st SPS-PDSCH HARQ-ACK regardless of which alternative is selected
3. Whether a MAC CR is needed can be left to RAN2 to determine. No need for an LS to RAN2, companies can provide their input directly to RAN2 if they see the need
4. There maybe a need for a Rel-16 CR for SPS enhancements with Alt.2. That can be left up to the companies to contribute to the future RAN1 meetings
 |
| Spreadtrum | * Q1: we think no CR for interpretation 2 applies, we are open for some small clarifications. And CR of Type 2 HARQ-ACK CB generation is needed if interpretation 1 applies.
* If Alt.2 is adopted,
	+ Q1: No, it is clear.
	+ Q2: up to RAN2, we are open for clarify.
	+ Q3: Yes, at least for two places quoted by Samsung in Round 1.
 |
| QC2 | Please see our Reply to Samsung on Q1 and Q8 in above table. Reading Samsung’s answer to Q9 and Q10 makes us worried more whether RAN1 can achieve a consensus on this. **It seems there are deeply different understanding of current Rel-15 spec**, **not just on PRI, but also on DAI mechanism. Can FL please organize a discussion on DAI as well? The divergence between two camps seems larger than what we originally assumed.** Q9: If go with interpretation 1, does it mean UE should ignore the DAI in activation DCI? Current spec does not differentiate DAI procedure between DCI with CS-RNTI and with C-RNTI. How do we expect to resolve this?Samsung: Yes, the DAI in the activation DCI is not processed based on current specs. Please see follow up to A5. QC: The following Rel-15 spec only defines DAI based on DCI formats. It clearly does not say DCI with CS-RNTI should be discarded. We scanned the spec and did not find any spec text that exclude DCI with CS-RNTI should be excluded. ---Samsung2: The specifications have the following – it should be clear. “If a UE is configured to receive SPS PDSCH and the UE multiplexes HARQ-ACK information for one activated SPS PDSCH reception in the PUCCH in slot $n$, the UE generates one HARQ-ACK information bit associated with the SPS PDSCH reception and appends it to the $O^{ACK}$ HARQ-ACK information bits.”---A value of the counter downlink assignment indicator (DAI) field in DCI format 1\_0 or DCI format 1\_1 denotes the accumulative number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH reception(s) or SPS PDSCH release associated with DCI format 1\_0 or DCI format 1\_1 is present, up to the current serving cell and current PDCCH monitoring occasion, first in ascending order of serving cell index and then in ascending order of PDCCH monitoring occasion index , where . The value of the total DAI, when present [5, TS 38.212], in DCI format 1\_1 denotes the total number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH reception(s) or SPS PDSCH release associated with DCI format 1\_0 or DCI format 1\_1 is present, up to the current PDCCH monitoring occasion  and is updated from PDCCH monitoring occasion to PDCCH monitoring occasion. Q10: If go with interpretation 1, in case there are multiple PDSCHs with HARQ-ACKs multiplexed on a PUCCH, and one of the PDSCHs is the first SPS PDSCH activated by a DCI, and the DCI activating the SPS PDSCH is the last DCI, which DCI used to determine the PUCCH resource for multiplexed HARQ-ACKs? The second last DCI? If so, A Rel-15 CR is needed. Samsung: The last DCI providing PRI. The “activation DCI” does not provide PRI (see also follow up to A2). A Rel-15 CR is not needed.QC: It seems Samsung’s view is that current spec can be read as the “last” DCI actually excluding the activation DCI? However, the spec does not say that. Spec just say DCI format 1\_0 or 1\_1. We don’t see how/why the activation DCI is excluded as in DCI format 1\_0 and 1\_1? Samsung2: This goes back to the question whether the activation DCI provides PRI as we have been discussing so far. With interpretation 1, it does not and Q10 is a non-issue.Regarding the TPs below, they are very inadequate for interpretation 2 and a number of NBC CRs will be needed. None is needed with interpretation 1.For a PUCCH transmission with HARQ-ACK information, a UE determines a PUCCH resource after determining a set of PUCCH resources for  HARQ-ACK information bits, as described in Clause 9.2.1. The PUCCH resource determination is based on a PUCCH resource indicator field [5, TS 38.212] in a last DCI format 1\_0 or DCI format 1\_1, among the DCI formats 1\_0 or DCI formats 1\_1 that have a value of a PDSCH-to-HARQ\_feedback timing indicator field indicating a same slot for the PUCCH transmission, that the UE detects and for which the UE transmits corresponding HARQ-ACK information in the PUCCH where, for PUCCH resource determination, detected DCI formats are first indexed in an ascending order across serving cells indexes for a same PDCCH monitoring occasion and are then indexed in an ascending order across PDCCH monitoring occasion indexes.**Again, our view is that achieving a conclusion in this meeting is more important than arguing which interpretation is correct, as either interpretation will work. To help convergence, we have the following proposal for FL and the group to consider.** **Proposal:** **For Rel-15, no CR or conclusion is needed.** **For Rel-16, if interpretation 2 is adopted as a conclusion in RAN1 chair’s notes, adopt the following TP for Rel-16**If the UE is provided *SPS-PUCCH-AN-List* and transmits $O\_{UCI}$ UCI information bits that include only HARQ-ACK information bits in response to one or more SPS PDSCH receptions excluding the ones associated with the corresponding activation DCI and SR, if any, the UE determines a PUCCH resource to be**We don’t think any other TP is needed for interpretation 2, as we think the Type 1/2 codebook generation has no ambiguity by treating the A/N of the first SPS PDSCH go with dynamic A/N. Other companies please propose TP if you think TP is needed for taking interpretation 2 for codebook generation.** **For Rel-16, if interpretation 1 is adopted as a conclusion in RAN1 chair’s notes, adopt the following TPs for Rel-16.** **Rel-16 TP1:** If a UE is not provided SPS-PUCCH-AN-List and transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH which includes the first SPS PDSCH reception associated with the corresponding activation DCI, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by n1PUCCH-AN.**Rel-16 TP2:** If the UE is provided *SPS-PUCCH-AN-List* and transmits $O\_{UCI}$ UCI information bits that include only HARQ-ACK information bits in response to one or more SPS PDSCH receptions including the ones associated with the corresponding activation DCI and SR, if any, the UE determines a PUCCH resource to be…**Rel-16 TP3:**For a PUCCH transmission with HARQ-ACK information, a UE determines a PUCCH resource after determining a set of PUCCH resources for  HARQ-ACK information bits, as described in Clause 9.2.1. The PUCCH resource determination is based on a PUCCH resource indicator field [5, TS 38.212], if present, in a last DCI format excluding the DCI format with CRC scrambled with CS-RNTI, among the DCI formats that have a value of a PDSCH-to-HARQ\_feedback timing indicator field, if present, or a value of dl-DataToUL-ACK, or dl-DataToUL-ACK-r16, or dl-DataToUL-ACKForDCIFormat1\_2, indicating a same slot for the PUCCH transmission, that the UE detects and for which the UE transmits corresponding HARQ-ACK information in the PUCCH where, for PUCCH resource determination, detected DCI formats are first indexed in an ascending order across serving cells indexes for a same PDCCH monitoring occasion and are then indexed in an ascending order across PDCCH monitoring occasion indexes. **Rel-16 TP4:**A value of the counter downlink assignment indicator (DAI) field in DCI formats denotes the accumulative number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH reception(s), SPS PDSCH release or SCell dormancy indication associated with the DCI formats excluding the DCI format with CRC scrambled with CS-RNTI is present up to the current serving cell and current PDCCH monitoring occasionThe value of the total DAI, when present [5, TS 38.212], in a DCI format denotes the total number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH reception(s), SPS PDSCH release or SCell dormancy indication associated with DCI formats excluding the DCI format with CRC scrambled with CS-RNTI is present, up to the current PDCCH monitoring occasion $m$ and is updated from PDCCH monitoring occasion to PDCCH monitoring occasion. If, for an active DL BWP of a serving cell, the UE is not provided coresetPoolIndex or is provided coresetPoolIndex with value 0 for one or more first CORESETs and is provided coresetPoolIndex with value 1 for one or more second CORESETs, and is provided ackNackFeedbackMode = joint, the total DAI value counts the {serving cell, PDCCH monitoring occasion}-pair(s) for both the first CORESETs and the second CORESETs. |
| vivo | If Alt. 2 is adopted, we don’t think a CR for Rel-15 is needed.For Rel-16, at least a CR for SPS enhancement to reflect Alt. 2 is needed. We are open to further discuss. |
| LG | Similar view/understanding with QC’s analysis in above and other companies.We don’t think Rel-15 CR is needed for Alt 2.We are open to further discuss on potential Rel-16 CR for SPS enhancement. |

### Summary after round #3

**Survey 1**

Not all the companies taking part in the 1st round provided their comments, but as an overall summary the company positions on the supported choice haven’t really changed. Fairly broad sentiment appears to be that both interpretations can lead to a functional system, but there is no consensus on which of the two interpretations should be confirmed as the correct one. Following summarises the company positions as provided in the round #3 survey 1.

|  |  |
| --- | --- |
| **Alt.1**The 1st SPS-PDSCH and the subsequent SPS-PDSCHs all follow the *SPS-Config* | **Alt.2**The 1st SPS-PDSCH and the subsequent SPS-PDSCHs all follow the *SPS-Config,* except that the 1st SPS-PDSCH HARQ-ACK is sent on the PUCCH resource indicated by the activation DCI |
| Support: Oppo, Fujitsu, Samsung, Nokia/NSB, Can accept/Open to discuss: Qualcomm, Spreadtrum, vivo | Support: NTT DOCOMO, Qualcomm, ZTE, Spreadtrum, vivo, LG Can accept/open to discuss: Oppo, Fujitsu, NokiaObject: Samsung |

**Survey 2**

Quite a number of companies think that Rel-15 specification is clear, but from the answers the clarity is in the eye of the reader, when the interpretations appear to differ.

* Rel-15 spec is defining Alt1, no Rel-15 CR needed: Samsung
	+ Rel-16 SPS enhancement CR not needed either
* Rel-15 spec is defining Alt2, no Rel-15 CR needed: Qualcomm, ZTE, Spreadtrum, vivo, LG
	+ Rel-16 SPS enhancement CR maybe needed regardless of which alt is agreed
* Rel-15 spec is ambiguous, a clarification is needed regardless of which Alt is agreed: DOCOMO, Oppo, Fujitsu, Nokia/NSB
* Rel-16 SPS enhancements CR need
	+ Many companies seem to think that at least with Alt.2, but possibly regardless of which Alt is agreed on, a Rel-16 SPS enhancement CR maybe needed.

## 3.4 Round 4

From the discussion in the earlier rounds, even though a number of companies believe that the specification is clear, the discussion seems to underline the fact that the specification is open to more than one interpretation, the textbook definition for the word “ambiguous”. The critical question of which alternative to adopt, as there can be only one is still hanging and the discussions are not converging. The discussions related to Rel-16 SPS Enhancements needing a CR depending on which alternative would seem to be debatable, but clearly it was not producing compelling argumentation why one or the other alternative must be adopted.

A possible conclusion could along the lines below.

**Moderator Proposal: Adopt alternative [1 or 2]**

* **Rel-15, either**
	1. **no CR needed, or**
	2. **agree to a clarification CR corresponding to the alternative adopted possible options (for reference, not for agreement at this stage) below.**
		+ **Decide whether to take the CR to Rel-15 or from Rel-16 onwards.**
* **Rel-16 CR for SPS-Enhancements to adapt the specification to the agreed alternative – to be discussed further in RAN1#109 AI 7.2.5**

|  |  |
| --- | --- |
| **Alt.** | **a draft candidate Rel-15 TP for TS38.213 subclause 9.2.3** |
| Alt1 | If a UE transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by *n1PUCCH-AN*. A PDCCH carrying a DL SPS activation is not considered to correspond to any of the SPS PDSCHs. |
| Alt2 | If a UE transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by *n1PUCCH-AN*. A PDCCH carrying a DL SPS activation is considered to correspond to the 1st SPS PDSCH only. |

Still, the most important question is which of the alternatives to choose. The company positions have not shifted much, but there are several companies in both camps that indicate willingness to compromise, which is promising. Given that there has consistently been a majority on the alt.2 side, it still looks to the moderator as the path of broader support and lesser resistance.

**Moderator Proposal: Adopt Alt.2**

**Please provide comments on the two proposals above**

|  |  |
| --- | --- |
| **Company**  | **Comment** |
| Ericsson | Although we share the view that interpretation 1 in previous round is the way to go, the situation is that “for some reasons” this view is not shared. Therefore, we are fine with Alt-1 proposed by Moderator.Since we missed providing comments in previous round (sorry for that), when it comes to proposing TPs, we should really aim for TPs that are needed, and not increasing the list of TPs unnecessarily.For the TPs proposed for interpretation 1 by proponents of interpretation 2, we see the TPs are repetitive. That is not the spec is written. When there is a clear statement that exclude a case, that is applicable to the rest of the specifications. Therefore, we think for interpretation 1, the clarification by Alt 1 proposed by Moderator is enough. For Alt 2, another TP is needed because for codebook construction, DL SPS is used, and by a TP, 1st and other Dl SPSs should be distinguished.  |

### Summary after round #4

Most of the Round#4 discussion took place over the reflector, After Samsung objection to Alt2. Moderator put forward the following proposal.

**Proposed way forward**

* Agree on alternative 1, I know this is not an easy pick, but if we can agree on how this is to be taken into account in the specs we can get there.
* Agree on the following set of TPs
	+ On Rel-15 functionality (this could be a Rel-15 or a Rel-16 CR), clarify that the PDCCH with the activation DCI does not correspond to the 1st SPS-PDSCH, along the lines of Nokia R1-2201028 (**Rel-15 TP** below)
		1. take possible further Rel-15 clarifications based on company contributions in future meetings based on company contributions
	+ On Rel-16 functionality
		1. the Rel-16 clarifications stands (**Rel-16 TP1** that is compatible with the Rel-15 TP)
		2. HARQ-ACK information multiplexing (**Rel-16 TP2**)
		3. PUCCH resource determination (**Rel-16 TP3**)
		4. DAI handling (**Rel-16 TP4**)
		5. take possible further Rel-16 clarifications based on company contributions in future meetings based on company contributions
	+ On Rel-17 functionality: possible implications to Rel-17, to be handled in the Rel-17 maintenance

**Rel-15 TP:**

If a UE transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH, which includes the first SPS PDSCH reception associated with the corresponding activation DCI, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by *n1PUCCH-AN*.

**Rel-16 TP1:**

If a UE is not provided *SPS-PUCCH-AN-List* and transmits HARQ-ACK information corresponding only to a PDSCH reception without a corresponding PDCCH, which includes the first SPS PDSCH reception associated with the corresponding activation DCI, a PUCCH resource for corresponding PUCCH transmission with HARQ-ACK information is provided by *n1PUCCH-AN*.

**Rel-16 TP2:**

If a UE is configured to receive SPS PDSCH and the UE multiplexes HARQ-ACK information for one activated SPS PDSCH reception including the ones associated with the corresponding activation DCI in the PUCCH in slot n, the UE generates one HARQ-ACK information bit associated with the SPS PDSCH reception and appends it to the OACK HARQ-ACK information bits.

**Rel-16 TP3:**

For a PUCCH transmission with HARQ-ACK information, a UE determines a PUCCH resource after determining a set of PUCCH resources for  HARQ-ACK information bits, as described in Clause 9.2.1. The PUCCH resource determination is based on a PUCCH resource indicator field [5, TS 38.212], if present, in a last DCI format excluding the SPS activation DCI, among the DCI formats that have a value of a PDSCH-to-HARQ\_feedback timing indicator field, if present, or a value of *dl-DataToUL-ACK*, or *dl-DataToUL-ACK-r16,* or *dl-DataToUL-ACKForDCIFormat1\_2*, indicating a same slot for the PUCCH transmission, that the UE detects and for which the UE transmits corresponding HARQ-ACK information in the PUCCH where, for PUCCH resource determination, detected DCI formats are first indexed in an ascending order across serving cells indexes for a same PDCCH monitoring occasion and are then indexed in an ascending order across PDCCH monitoring occasion indexes.

**Rel-16 TP4:**

A value of the counter downlink assignment indicator (DAI) field in DCI formats denotes the accumulative number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH reception(s), SPS PDSCH release or SCell dormancy indication associated with the DCI formats excluding the SPS activation DCI is present up to the current serving cell and current PDCCH monitoring occasion

The value of the total DAI, when present [5, TS 38.212], in a DCI format denotes the total number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH reception(s), SPS PDSCH release or SCell dormancy indication associated with DCI formats excluding the SPS activation DCI is present, up to the current PDCCH monitoring occasion $m$ and is updated from PDCCH monitoring occasion to PDCCH monitoring occasion. If, for an active DL BWP of a serving cell, the UE is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with value 0 for one or more first CORESETs and is provided *coresetPoolIndex* with value 1 for one or more second CORESETs, and is provided *ackNackFeedbackMode* = joint, the total DAI value counts the {serving cell, PDCCH monitoring occasion}-pair(s) for both the first CORESETs and the second CORESETs.

This proposal was in the end agreed with the following modifications

* Rel-15 CR was not created
* Rel-16 TP2 was missing a second instance of essentially the same text and that was added
* The following note was recorded:
* Note: Qualcomm, LG, NTT DOCOMO, Spreadtrum and Apple concern that the above proposal removes the functionality of PRI and DAI of DL SPS activation DCI. But Qualcomm, LG, NTT DOCOMO, Spreadtrum and Apple can accept the proposal for the sake of RAN1 progress, to avoid the consequence of losing the functionality of DL SPS in NR, given this proposal is the only solution due to other company's objection to other proposal(s).

# 4 Conclusion

Alternative 1 was agreed from Rel-16 onwards in the following CRs:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| R1-2202898 | Clarification of the SPS PDSCH activation and HARQ-ACK transmission for the 1st SPS PDSCH | Moderator (Nokia) | [**Rel-16**](https://portal.3gpp.org/desktopmodules/Release/ReleaseDetails.aspx?releaseId=191) | [**38.213**](https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3215) | 16.8.0 | [**NR\_L1enh\_URLLC-Core**](https://portal.3gpp.org/desktopmodules/WorkItem/WorkItemDetails.aspx?workitemId=830174) | 0286 | F |
| R1-2202899 | Clarification of the SPS PDSCH activation and HARQ-ACK transmission for the 1st SPS PDSCH | Moderator (Nokia) | [**Rel-17**](https://portal.3gpp.org/desktopmodules/Release/ReleaseDetails.aspx?releaseId=192) | [**38.213**](https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3215) | 17.0.0 | [**NR\_L1enh\_URLLC-Core**](https://portal.3gpp.org/desktopmodules/WorkItem/WorkItemDetails.aspx?workitemId=830174) | 0287 | A |

Note: Qualcomm, LG, NTT DOCOMO, Spreadtrum and Apple concern that the above proposal removes the functionality of PRI and DAI of DL SPS activation DCI. But Qualcomm, LG, NTT DOCOMO, Spreadtrum and Apple can accept the proposal for the sake of RAN1 progress, to avoid the consequence of losing the functionality of DL SPS in NR, given this proposal is the only solution due to other company's objection to other proposal(s).