**3GPP TSG RAN WG1 Meeting #109-e R1-220xxxx**

**E-Meeting, May 9 – May 20, 2022**

**Agenda Item: 7.2.5**

**Source: Moderator (Huawei, HiSilicon)**

**Title: Summary of [109-e-R16-URLLC-07] Issue#8: Remaining issues on UL prioritization cases related to SP-CSI**

**Document for: Discussion and Decision**

# Introduction

Following email thread is dedicated to discuss the remaining issues on UL prioritization cases related to SP-CSI’. This issue has been raised in R1-2204895 [1].

[109-e-R16-URLLC-07] Issue#8: Remaining issues on UL prioritization cases related to SP-CSI by May 13 – Thorsten (Huawei)

**Due to the short time available for discussion, please provide you input for the first round before May 10, 17:00 pm (UTC)**

**Background**

In Rel-16, for handling collision between a high priority UL channel and a low priority UL channel, the low priority UL channel will be canceled. In R1-2204895 [1], it is raised that according to the current specification some cases related to SP-CSI are missing and consequently, the UE behavior for these cases is not clear and may cause misunderstanding between gNB and UE.

The following was observed during the meeting preparation for RAN1#109-e:

“*In Rel-16, for handling collision between a high priority UL channel and low priority UL channel, some cases related to SP-CSI are missing. This issue has been raised in R1-2201627 last meeting, but was not treated last meeting. During the discussion for RAN1#108-e, 9 companies (Samsung, DCM, OPPO, Nokia/NSB, vivo, Sharp, New H3C, Huawei/HiSilicon, Ericsson) prefer or fine to discuss, while 3 companies (Qualcomm, Intel, ZTE) think it is not essential, since the collision is not in Rel-16 scope given prioritization between DG and CG PUSCH with different PHY priorities are not support in Rel-16. However, as further clarified in R1-2204895, according to the current specification it is not clear whether this kind of collision is supported or not, better to make it clearer in the spec. Note that the intention of the contribution is not to introduce enhancements to support this kind of collision*”.

# Discussion

## Round 1

**Initial moderator remark:**

During the scope setting of RAN1#108-e, this issue was brought up already and companies have had a different understanding. As outcome, this issue was not included in the discussion, but the different understandings remained. During this meeting we should target to get a common view, and if needed, clarify the specification to avoid misunderstanding between the gNB and UE.

In [1] it is raised that 4 cases are missing from the current spec for HP/LP PUSCH overlap where at least one channel has SP-CSI and the corresponding UE behaviour should be defined. These 4 cases are:

* LP PUSCH with DCI vs HP PUSCH with SP-CSI without DCI
* LP CG PUSCH vs HP PUSCH with SP-CSI without DCI
* LP PUSCH with SP-CSI without DCI vs HP PUSCH with SP-CSI without DCI
* LP PUSCH with SP-CSI without DCI vs HP PUSCH with DCI

In general and based on the comments given by companies prior to this discussion, there are 3 Options:

**Option 1:** PUSCH with SP-CSI follows the CG or DG rules

**Option 2:** PUSCH with SP-CSI is always cancelled by PUSCH with data (according to Section 5.2.5 in 38.214)

**Option 3:** The missing cases are error cases

For Option 1, in Rel-15 according to clause 5.2.5 in 38.214, if a PUSCH with SP-CSI overlaps with a PUSCH with data, the UE will always transmit the PUSCH with data. Thus, in Rel-15 PUSCH prioritization rules for SP-CSI vs data prioritization are defined. Independent from this, also CG vs DG prioritization rules are defined in 38.321 for Rel-15, but they focus only on PUSCH with data. Thus, according to the moderator’s understanding, a PUSCH with SP-CSI is not regarded as CG and not as DG either. For Option 1, before being able to apply the CG vs DG rules, a discussion and clarification would be needed whether PUSCH with SP-CSI shall be regarded as DG or CG (if any).

For option 2, in Rel-16, the question would be whether the priority rules for PUSCH with SP-CSI and PUSCH with data, as they are defined in 38.214, can also be applied to PUSCHs with different priorities. That means, should also in Rel-16 a PUSCH with data always override a PUSCH with SP-CSI regardless of their priorities? This seems not reasonable since it can result in that a LP PUSCH with data overrides a HP PUSCH with SP-CSI.

To avoid a misunderstanding between the gNB and UE, and since both Option 1 and Option 2 would be complicated to discuss at this late stage or could also result in not reasonable behaviour, it is suggested in [1] to define the 4 missing cases as error cases and the following proposal is made:

***Proposal 1: For the overlap between LP PUSCH and HP PUSCH for the following cases, the UE is not expected to be scheduled and the TP from Appendix 1 in [1] is adopted for 38.213***

* + ***HP PUSCH with DCI and LP PUSCH with SP-CSI without DCI;***
  + ***HP PUSCH with SP-CSI without DCI and LP PUSCH with DCI;***
  + ***HP PUSCH with SP-CSI without DCI and LP CG PUSCH;***
  + ***HP PUSCH with SP-CSI without DCI and LP PUSCH with SP-CSI without DCI.***

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| **9 UE procedure for reporting control information**  <unchanged text omitted>  A UE does not expect that a PUCCH carrying SL HARQ-ACK reports overlaps with PUSCH with aperiodic or semi-persistent CSI reports.  A UE does not expect to be scheduled to transmit a PUCCH or a PUSCH with smaller priority index that would overlap in time with a PUCCH of larger priority index with HARQ-ACK information only in response to a PDSCH reception without a corresponding PDCCH. A UE does not expect to be scheduled to transmit a PUCCH/PUSCH of smaller priority index that would overlap in time with a PUSCH of larger priority index with SP-CSI report(s) without a corresponding PDCCH. A UE does not expect to be scheduled to transmit a PUSCH of smaller priority index with SP-CSI report(s) without a corresponding PDCCH that would overlap in time with a PUSCH of larger priority with DCI.  <unchanged text omitted> |

**Q1: Companies are encouraged to share their view on Proposal 1. If you don’t support it, please give also your reasons.**

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| Company | Comments |
| vivo | o HP PUSCH with DCI and LP PUSCH with SP-CSI without DCI;  o HP PUSCH with SP-CSI without DCI and LP PUSCH with DCI;  For the above two cases, considering that overlapping between DG PUSCH and CG PUSCH of different priorities is not supported in Rel-16, it is ok to be concluded as error case.  o HP PUSCH with SP-CSI without DCI and LP CG PUSCH;  o HP PUSCH with SP-CSI without DCI and LP PUSCH with SP-CSI without DCI.  For these two cases, considering the PUSCH with SP-CSI and CG PUSCH are both periodical, we are wondering whether these overlapping cases can be avoided from configuration perspective. If gNB venders have no concern on this limitation, we are fine to treat these as error cases.  [Moderator]: Thanks for your comment. Please see my thinking below in the “moderator comments” |
| CATT | In our view, the principle that a HP channel cancels a LP channel applies to SP-CSI without DCI as well.   * + ***HP PUSCH with DCI and LP PUSCH with SP-CSI without DCI;***   + ***HP PUSCH with SP-CSI without DCI and LP PUSCH with DCI;***   + ***HP PUSCH with SP-CSI without DCI and LP CG PUSCH;***   + ***HP PUSCH with SP-CSI without DCI and LP PUSCH with SP-CSI without DCI.***   Our views for the above four cases are as follows.  The 1st case is a valid case and the HP PUSCH with DCI cancels LP PUSCH with SP-CSI without DCI.  The 2nd case is an error case since it does not make sense for a gNB to schedule a LP PUSCH which is expected to be cancelled.  The 3rd and 4th cases are also valid cases where HP PUSCH cancels LP PUSCH.  [Moderator]: Thanks for your comment. Please see my thinking below in the “moderator comments” |
| Nokia/NSB | On the identified cases by the moderator, we are wondering if there is not actually **a 5th case** that would need to be considered, namely **LP PUSCH with SP-CSI without DCI and HP CG PUSCH?**  The only thing in the current specs were this may be interpreted is the following, overlapping CG & CG PUSCH – which unfortunately again in R16 v16.9.0 and R17 17.1.0 have a different notation there:  From v16.9.0:  - a configured grant PUSCH of larger priority index and a configured PUSCH of smaller priority index on a same serving cell  From v17.1.0:  - a configured grant PUSCH of larger priority index and a configured grant PUSCH of smaller priority index on a same serving cell  Overall, we think that we should define the same handling for all the cases (error case or HP PUSCH cancelling LP PUSCH), but not do a case by case specific selection at this rather late stage in the R16 maintenance.  [Moderator]: Thanks for your comment. Please see my thinking below in the “moderator comments” |
| DOCOMO | o HP PUSCH with DCI and LP PUSCH with SP-CSI without DCI;  o HP PUSCH with SP-CSI without DCI and LP PUSCH with DCI;  Share the same view as vivo. For the above two cases, it is ok to be concluded as error case as DG/CG PUSCH overlapping is not supported in Rel-16.  o HP PUSCH with SP-CSI without DCI and LP CG PUSCH;  o HP PUSCH with SP-CSI without DCI and LP PUSCH with SP-CSI without DCI.  For these two cases, we also have similar concern to vivo that it would lead to scheduling restriction considering the PUSCH with SP-CSI and CG PUSCH are both periodical. Assuming the two cases are similar to the overlapping case of HP CG PUSCH and LP CG PUSCH, it could be concluded that HP PUSCH is prioritized for the two cases. However, as we understand that such an optimization may not be preferrable for some companies at this late stage, we would be fine to conclude the two cases are also error cases.  [Moderator]: Thanks for your comment. Please see my thinking below in the “moderator comments” |
| Moderator | **@ vivo:** Thanks for your feedback. For the last two cases, if they are supposed to be avoided by NW configuration, then they also could be defined as an error case, this would make it safer. One gNB vendor (Nokia) has answered already, that it would be ok to treat all cases as error case. But we can wait for more feedback if any other gNB vendor would have a strong concern for that.  **@CATT:** The prioritization between DG/CG or between CG/CG with different PHY priorities is not supported in Rel-16. For case 1/3/4 above, the operation that HP PUSCH cancels LP PUSCH is only supported in Rel-17 but not Rel-16.  **@Nokia:** You have raised 2 issues i) whether there is a 5th case and ii) to treat all cases in a similar way.  For i), according to Rel-16 spec, as you pointed out, the HP CG PUSCH would be transmitted and the LP configured PUSCH is cancelled. Wouldn’t this be sufficient for here, since we are discussing Rel-16 maintenance only? Or do you mean that the LP configured PUSCH actually means a LP configured **grant** PUSCH (since this is how it will be captured in Rel17). If this is wrong in Rel-16, in that case, it is maybe a good opportunity to include it in the CR we are discussing here? So I think for this issue, we have 2 options. Either we have 4 cases and base this on the rel-16 wording you marked in blue in your comment, or we capture the 5th case you brought up as well, and then also correct the Rel-16 spec by inserting the word “grant” before PUSCH. What do you think?  For ii) I agree, that all 4 (or 5) cases should be treated in the same way. And both of your options are possible in theory. But treating them as error case is simpler and straight forward. Also, regarding the other option (cancel the LP) received some negative feedback during the preparation of last meeting, since it also could result in partial cancellation and would trigger further discussion  **@DOCOMO:** Thanks a lot for sharing your thoughts and your flexibility. |
| Nokia/NSB 3 | **@ Moderator:** Thanks for the reply. I personally think it should be at least aligned in both – Rel-16 & R-17 for the same functionality. And I guess the intention had been CG vs. CG PUSCH for both (captured in R17, but missing from R16). Otherwise the 5th case would only be in R17 based on the R16 functionalities, which is very weird. I guess we should prevent any divergence of R16 & R17 specs for clear R16 specifications (if not seen needed otherwise). |
| Qualcomm | We are fine to define prioritization rules for the above cases to reduce the impact on the URLLC scheduling latency (except for the 2nd one where the gNB should avoid scheduling the LP channel that would be cancelled. However, if the majority think that the optimizations should be avoided during maintenance, we could be fine to define these events as an error.  @Moderator: Do mean partial cancellation here? “The prioritization between DG/CG or between CG/CG with different PHY priorities is not supported in Rel-16.” If your comment is not about partial cancellation, then the cases you mentioned are supported in R16. |
| Samsung | NOT support.  As we commented in the prepare phase, we don’t think there is any difference for a PUSCH with or without SP CSI when resolving the overlapping PUCCHs/PUSCHs with different priorities. |
| Intel | Similar views as vivo and DCM that the following two are allowed while the other two are error cases. This is because “PUSCH with SP-CSI without DCI” is just a CG PUSCH, and should be treated as such. Then, with this interpretation, the rest follows from current specs, and we do not see any need to update specs.  Valid cases:   * + ***HP PUSCH with SP-CSI without DCI and LP CG PUSCH;***   + ***HP PUSCH with SP-CSI without DCI and LP PUSCH with SP-CSI without DCI.***   Error cases:   * + ***HP PUSCH with DCI and LP PUSCH with SP-CSI without DCI;***   + ***HP PUSCH with SP-CSI without DCI and LP PUSCH with DCI.*** |
| Moderator | **@Nokia:** I agree that it should be at least aligned in both – Rel-16 & R-17 for the same functionality.We can capture the 5th case you brought up as well, and then also correct the Rel-16 spec by inserting the word “grant” before PUSCH.  **@Qualcomm**: Thanks a lot for sharing your thoughts and your flexibility. By saying “The prioritization between DG/CG or between CG/CG with different PHY priorities is not supported in Rel-16.” I mean when CG and DG overlaps, DG always overrides CG in Rel-16, regardless of their priorities.  **@Intel:** If PUSCH with SP-CSI is treated as a CG PUSCH, how about the case “***HP PUSCH with SP-CSI without DCI and LP CG PUSCH***” ? If we follow the rule in 38.213, HP PUSCH with SP-CSI without DCI should be transmitted. And if we follow “5.2.5 Priority rules for CSI report” in 38.214, LP CG PUSCH should be transmitted.  Based on our understanding, PUSCH with SP-CSI is neither CG nor DG, that’s why we have the specific rules for the overlapping between PUSCH with SP-CSI and PUSCH with data in “5.2.5 Priority rules for CSI report” in 38.214 in Rel-15.  **@Samsung**: If there is no difference for a PUSCH with or without SP CSI, the PUSCH without SP CSI should be treated as DG or CG when resolving the overlapping. If it is treated as CG, the issue is raised in my reply to Intel. That means if we go this way, we need to clarify that PUSCH with SP-CSI is regarded as a CG, which is not obvious according to my initial remark. |

## Round 2

**Due to the short time available for discussion, please provide you input for the first round before May 12, 08:00 am (UTC)**

It seems that companies have different preferences how to handle different cases. Below, I have listed the 4 original cases and the potential new case from Nokia is included as well:

* 1. ***HP PUSCH with DCI and LP PUSCH with SP-CSI without DCI;***
  2. ***HP PUSCH with SP-CSI without DCI and LP PUSCH with D*C*I.***
  3. ***HP PUSCH with SP-CSI without DCI and LP CG PUSCH;***
  4. ***HP PUSCH with SP-CSI without DCI and LP PUSCH with SP-CSI without DCI.***
  5. ***[LP PUSCH with SP-CSI without DCI and HP CG PUSCH] (proposed by Nokia)***

For further progress it seems beneficial to divide the 5 cases into 2 groups, group 1 where at least one channel is scheduled by DCI and group 2 where no channel is scheduled by DCI.

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| Group 1 | One PUSCH is scheduled by DCI  Here the gNB can avoid overlap by scheduling | ***Case 1: HP PUSCH with DCI and LP PUSCH with SP-CSI without DCI;***  ***Case 2:HP PUSCH with SP-CSI without DCI and LP PUSCH with DCI.*** |
| Group 2 | Both PUSCHs are without DCI | ***Case 3: HP PUSCH with SP-CSI without DCI and LP CG PUSCH;***  ***Case 4: HP PUSCH with SP-CSI without DCI and LP PUSCH with SP-CSI without DCI.***  ***Case 5: [LP PUSCH with SP-CSI without DCI and HP CG PUSCH] (proposed by Nokia)*** |

It seems also that a unified behaviour should be envisioned for all cases. But based on the comments received so far a unified behaviour for all 5 cases does not seem agreeable. Therefore I want to try with a unified behaviour for the cases within each group.

**I tried to summarize the feedback I have received below, please let me know if I got something wrong.**

* For group 1 treating the cases in group as error case, it seems that only Samsung and CATT have a concern. The rest of the companies prefers Group 1 as an error case or can live with it.
* For group 2, HW/HiSi prefers to have it as an error case, but the majority of companies wants to support these cases.

For Group 1 and for Group 2 it is therefore suggested to follow the clear majority view for each group and at least to define a unified behaviour within the group. I hope that the two proposals below can be an acceptable compromise for the companies.

**(@Samsung and CATT,** I acknowledge that you also want the cases 1 and 2 to be supported, but please see my explanation in the Moderator comment and the majority view. Supporting these cases would complicate the discussion further, since it needs to be decided whether a HP PUSCH with SP-CSI shall be considered as CG or DG. I hope you can accept this compromise solution.)

**Proposal 1: Following cases are treated as error cases**

* **Case 1 (HP PUSCH with DCI and LP PUSCH with SP-CSI without DCI)**
* **Case 2 (HP PUSCH with SP-CSI without DCI and LP PUSCH with DCI).**

**Please indicate if you have a strong concern with Proposal 1:**

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| Company | Comments |
| Moderator | @Samsung, : you commented “*we don’t think there is any difference for a PUSCH with or without SP CSI when resolving the overlapping PUCCHs/PUSCHs with different priorities*”  If there is no difference, since for PUSCH we only have CG/DG prioritization defined in Rel-16, it must be decided/clarified whether a PUSCH with SP-CSI is DG or CG (so that the DG/CG rules can be applied). But (please see my initial remark) is not obvious. If you have a strong concern on this proposal, please clarify how to categorize the PUSCH with SP-CSI? Or please correct my understanding if I got it wrong ☺  [Samsung] 38.214 5.2.5 follows the same rule of Rel-15, same priority should be considered only. If there is confusion, we are fine to make a conclusion for 214 to clarify 5.2.5 is for the same priority.  @CATT: Given my explanation above, can you live with the proposal 1? |
| CATT | We are fine to define Case 2 as error case as we commented earlier.  For the following comments from moderator that in Rel-16 DG always overrides CG regardless of PHY priority, it is not true when *lch-basedPrioritization* is enabled.  **@CATT:** The prioritization between DG/CG or between CG/CG with different PHY priorities is not supported in Rel-16. For case 1/3/4 above, the operation that HP PUSCH cancels LP PUSCH is only supported in Rel-17 but not Rel-16.  **@Qualcomm**: Thanks a lot for sharing your thoughts and your flexibility. By saying “The prioritization between DG/CG or between CG/CG with different PHY priorities is not supported in Rel-16.” I mean when CG and DG overlaps, DG always overrides CG in Rel-16, regardless of their priorities.  We are not clear yet why Case 1 cannot be supported. |
| Samsung | We have strong concern. Same comment as in first round. 38.214 5.2.5 only consider the case of same priority. |
| Qualcomm | Thanks for the response.  That is not the case as also pointed out by CATT. |
| CATT2 | Supporting these cases would complicate the discussion further, since it needs to be decided whether a HP PUSCH with SP-CSI shall be considered as CG or DG.  @moderator, maybe I missed something, but for your above reason to not support Case 1, why is it needed to decide whether a HP PUSCH with SP-CSI shall be considered as CG or DG. Can’t we just conclude that HP transmission cancels LP transmission as for the case 3-5?  In Rel-15, PUSCH with data can cancel PUSCH with SP-CSI. It is very strange to us that HP PUSCH cannot cancel LP PUSCH with SP-CSI in Rel-16. |
| vivo | Ok. Regarding CATT’s question, we think in Rel-16, HP DG PUSCH can’’t partially cancel LP CG either. |

For cases 3, 4 and 5 it seems that the majority wants them to be supported. I make a corresponding proposal for a unified handling of Group 2.

**Proposal 2: For following cases, the HP transmission cancels the LP transmission**

* **Case 3: HP PUSCH with SP-CSI without DCI and LP CG PUSCH;**
* **Case 4: HP PUSCH with SP-CSI without DCI and LP PUSCH with SP-CSI without DCI.**
* **Case 5: LP PUSCH with SP-CSI without DCI and HP CG PUSCH**

**Please indicate if you have a strong concern with Proposal 2:**

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| Company | Comments |
| CATT | We support the proposal. |
| Samsung | We have strong concern. Same comment as in first round. 38.214 5.2.5 only consider the case of same priority. |
| Qualcomm | We do have some questions on this proposal. Supporting these cases means that collision handling is done in the same way as CGCG collision handling? (at least for case 3 and 5). What are the timeline considerations? Should the DCI triggering the SP-CSI report still be N2 before the start of the overlapping CG occasion? The same question on Case 4 and the relation between the second triggering DCI and the SP-CSI reporting occasions of the first triggered reporting.  On a separate note, for case 3-5, isn’t it that we are assuming that the PUSCH  carrying SP-CSI without DCI is a CG-PUSCH? If so, can’t the same  assumption be made for the first two cases? |
| vivo | Fine with the proposal. for the timeline issue, we think for Rel-15, when HP channel is without DCI, there is no timeline requirement. |

## Round 3

**Due to the short time available for discussion, please provide you input for the first round before May 13, 10:00 am (UTC)**

The discussion so far has us not brought to a conclusion. A critical issue has been identified, though. That is that companies have a different understanding what overlap scenarios already are defined in Rel-16. It would be good to get an overview, so that we get the whole picture and based on this, we can decide how to move if (if needed to move on)

***Question: For the 5 cases, could you please fill in your view if a case is already supported in Rel-16 (and if yes, what is the behaviour according to your understanding) or if the case currently is missing and how it should be handled.***

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| Case 1 | ***HP PUSCH with DCI and LP PUSCH with SP-CSI without DCI*** | | | | |
| Already supported in Rel-16 | | Currently missing in Rel-16 | | Comments |
| Company | Yes/No | Behaviour | Yes/No | How to define behaviour |
| HW/HiSi | No | n.a. | Yes | Error case |  |
| vivo | No | n.a. | Yes | Error case |  |
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| Case 2 | ***HP PUSCH with SP-CSI without DCI and LP PUSCH with D*C*I*** | | | | |
| Already supported in Rel-16 | | Currently missing in Rel-16 | | Comments |
| Company | Yes/No | Behaviour | Yes/No | How to define behaviour |
| HW/HiSi | No | n.a. | Yes | Error case |  |
| vivo | No | n.a. | Yes | Error case | Wrong scheduling |
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| Case 3 | ***HP PUSCH with SP-CSI without DCI and LP CG PUSCH*** | | | | |
| Already supported in Rel-16 | | Currently missing in Rel-16 | | Comments |
| Company | Yes/No | Behaviour | Yes/No | How to define behaviour |
| HW/HiSi | No | n.a. | Yes | Error case |  |
| vivo | No | n.a. | Yes | Fine to support |  |
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| Case 4 | ***HP PUSCH with SP-CSI without DCI and LP PUSCH with SP-CSI without DCI*** | | | | |
| Already supported in Rel-16 | | Currently missing in Rel-16 | | Comments |
| Company | Yes/No | Behaviour | Yes/No | How to define behaviour |
| HW/HiSi | No | n.a. | Yes | Error case |  |
| vivo | No | n.a. | Yes | Fine to support |  |
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| Case 5 | ***LP PUSCH with SP-CSI without DCI and HP CG PUSCH*** | | | | |
| Already supported in Rel-16 | | Currently missing in Rel-16 | | Comments |
| Company | Yes/No | Behaviour | Yes/No | How to define behaviour |
| HW/HiSi | No | n.a. | Yes | Error case |  |
| vivo | No | n.a. | Yes | Fine to support |  |
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# Outcome

TBD.

# References

1. R1-2204895 “Remaining issues on UL prioritization cases related to SP-CSI”, RAN1#109-e, e-Meeting, May 9-20, 2022, Huawei, HiSilicon