**3GPP TSG RAN WG1 #106-e R1-210XXXX**

**e-Meeting, August 16th – 27th, 2021**

**Agenda item:** 7.2.5

**Source:** Moderator (Qualcomm)

**Title:** Summary of [106-e-NR-L1enh-URLLC-01]

**Document for:** Discussion and Decision

# Introduction

This document is created to facilitate the email discussion of “[106-e-NR-L1enh-URLLC-01] Issue#3: Correction on SRS resource configuration. This email thread is triggered by the following draft CR.

R1-2107318 Remaining issues on PDCCH enhancements for URLLC Qualcomm Incorporated

# Explanation of the problem

In the RAN1 #105\_e meeting, an agreement was made to restrict the RRCs parameters associated with the SRS resource set in *srs-ResourceSetToAddModListDCI-0-2* with usage equal to “*codebook*” or “*noncodebook*” to be the same as the RRC parameters associated with the SRS resource set configured in *srs-ResourceSetToAddModList* with the same usage. The purpose is to make sure that the SRS resource set configured by *srs-ResourceSetToAddModListDCI-0-2* only contain a subset of SRS resources that are configured by the SRS resources set in *srs-ResourceSetToAddModList*.

However, [1] argues that it is neither necessary nor correct to make all RRC parameters associated with the two SRS resource sets to be the same. For example, [1] suggests to remove the restrictions of same RRC configuration for the following parameters associated with an SRS resource set configuration.

* *srs-ResourceSetId*
* *srs-ResourceIdList*
* *aperiodicSRS-ResourceTrigger*
* *aperiodicSRS-ResourceTriggerList*

Furthermore, the following CR on TS 38.212 was proposed.

7.3.1.1.3 Format 0\_2

< Unchanged parts are omitted >

- SRS resource indicator –$ \left⌈log\_{2}\left(\sum\_{k=1}^{min\left\{L\_{max}, N\_{SRS,0\\_2}\right\}}\left(\begin{matrix}N\_{SRS,0\\_2}\\k\end{matrix}\right)\right)\right⌉ $or $\left⌈log\_{2}N\_{SRS, 0\\_2}\right⌉ $bits, where $N\_{SRS, 0\\_2}$ is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*', where the SRS resource set is composed of the first $N\_{SRS, 0\\_2}$ SRS resources together with other configurations in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModList*, if any, and associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*', respectively, except for the higher layer parameters *‘srs-ResourceSetId’, ‘srs-ResourceIdList’, ‘aperiodicSRS-ResourceTrigger’,* and *‘aperiodicSRS-ResourceTriggerList’*

- $\left⌈log\_{2}\left(\sum\_{k=1}^{min\left\{L\_{max}, N\_{SRS,0\\_2}\right\}}\left(\begin{matrix}N\_{SRS,0\\_2}\\k\end{matrix}\right)\right)\right⌉$ bits according to Tables 7.3.1.1.2-28/29/30/31 if the higher layer parameter *txConfig = nonCodebook*, where $N\_{SRS, 0\\_2}$ is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*nonCodeBook*', where the SRS resource set is composed of the first $N\_{SRS, 0\\_2}$ SRS resources together with other configurations in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModList*, if any, and associated with the higher layer parameter *usage* of value '*nonCodeBook*', except for the higher layer parameters *‘srs-ResourceSetId’, ‘srs-ResourceIdList’, ‘aperiodicSRS-ResourceTrigger’,* and *‘aperiodicSRS-ResourceTriggerList’,* and

- if UE supports operation with *maxMIMO-LayersDCI-0-2* and the higher layer parameter *maxMIMO-LayersDCI-0-2* of *PUSCH-ServingCellConfig* of the serving cell is configured, *Lmax* is given by that parameter

- otherwise, *Lmax* is given by the maximum number of layers for PUSCH supported by the UE for the serving cell for non-codebook based operation.

- $\left⌈log\_{2}N\_{SRS, 0\\_2}\right⌉ $bits according to Tables 7.3.1.1.2-32 if the higher layer parameter *txConfig = codebook*, where $N\_{SRS, 0\\_2}$ is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*codeBook*', where the SRS resource set is composed of the first $N\_{SRS, 0\\_2}$ SRS resources together with other configurations in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModList*, if any, and associated with the higher layer parameter *usage* of value '*codeBook*', except for the higher layer parameters *‘srs-ResourceSetId’, ‘srs-ResourceIdList’, ‘aperiodicSRS-ResourceTrigger’,* and *‘aperiodicSRS-ResourceTriggerList’*.

< Unchanged parts are omitted >

For your reference, the RRC configuration for SRS resource set in Rel-16 is provided below.



# Company views

Companies are encouraged to provide comments on the following questions.

**Q1: Do you agree with the intention of the CR described in Section 2 that the RRC parameters associated with the SRS resource set configured in *srs-ResourceSetToAddModListDCI-0-2* and *srs-ResourceSetToAddModList* with the same usage can not all be configured the same? If not, any justifications?**

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| **Company** | **Yes or No** | **Comment** |
| HW/HiSi | [No] | Tentative no support. In our view it does not seem needed to configure the parameters separately since the SRS resource set of 0\_2 is intended to be a sub-set of 0\_1. The specification is not broken, and this CR would be an optimization in our view. But we would like to hear the views from others. |
| Apple | [No] | We have a similar understanding as Huawei.  |
| Nokia, NSB | No | We agree with Huawei/HiSi assessment there, this is regarded as some unnecessary optimization.  |
| Ericsson | No | Our understanding of the CRs made in RAN1#105e is similar to HW/HiSi/Apple/Nokia/NSB. The intention was that SRS resource set of DCI format 0\_2 is the subset of that of 0\_1, including the configurations. Before the CRs was made, it was stipulated that only a single SRS resource set can be configured for ‘codebook’, which was more restrictive. The same for ‘nonCodebook’.[1] argues that something is incorrect in current spec. But we fail to see the error case at the moment. If it is true that there is an error, we are open to correct. Maybe QC can explain better. |
| Vivo | No | We share similar views with Huawei/HiSi.Bit width of SRS request field in DCI format 0\_2 is configured by RRC parameter *srs-RequestDCI-0-2* instead of depending on *aperiodicSRS-ResourceTrigger* or *aperiodicSRS-ResourceTriggerList*. With a proper configuration, SRS resource sets can be triggered separately for different DCI formats. Different configurations on *aperiodicSRS-ResourceTrigger* or *aperiodicSRS-ResourceTriggerList* are an optimization issue.  |
| Qualcomm | Yes | At least it is incorrect to force the “*srs-ResourceSetId”* and “*srs-ResourceIdList”* to be always configured the same between the two SRS resource sets belonging to *srs-ResourceSetToAddModListDCI-0-2* and *srs-ResourceSetToAddModList.*  * For example, “*srs-ResourceSetId”* must be configured differently for the two SRS resource sets configured in the two SRS resource set lists*,* since this index will be used by the UE to determine which SRS resource set to use once triggered by DCI format 0\_1/1\_1/0\_2/1\_2. If the two SRS resource sets are configured with the same ID, e.g., ID=1, then both *srs-ResourceSetToAddModList* and *srs-ResourceSetToAddModList* will include SRS resource set with ID=1. In this case, how should the UE know which SRS resource set is triggered by DCI 0\_1/1\_1, and which SRS resource set is triggered by DCI 0\_2/1\_2?
* Similarly, it is not correct to enforce *srs-ResourceIdList* to be always the same for the two SRS resource sets with same usage. In a typical configuration, the SRS resource set associated with *srs-ResourceSetToAddModListDCI-0-2* should contain less SRS resources as the SRS resource set associated with *srs-ResourceSetToAddModList*  in order to achieve a smaller DCI size for DCI 0\_2 and 1\_2. If we always configure the same list of SRS resources across the two SRS resource sets, how can we achieve the goal of reducing the DCI size for DCI 0\_2 and 1\_2?

For the trigger-sate *‘aperiodicSRS-ResourceTrigger’,* and *‘aperiodicSRS-ResourceTriggerList’,* there is no need to configure these to be the same across the two SRS resource sets associated with the two SRS resource set list discussed above, since these are just codepoints used by different DCI formats to trigger A-SRS transmission. But we do agree that this is an optimization for better network configuration flexibility, and the system could work without any change.  |
| Samsung | No | Agree with HW/HiSi. |
| Intel | No | Agree with HW-HiSi and others that this is not an essential correction. We do not see the apparent ambiguities cited by QC – the UE would know which DCI format it has received, and subsequently, the identify the correct SRS resource based on the existing configuration, e.g., for DCI 0\_2. |
| DOCOMO | No | Agree with HW/HiSi |

**Q2: If you answer to Q1 is yes, what are the RRC parameters that you think may or must be configured differently?**

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| **Company** | **Yes or No** | **Comment** |
| Qualcomm |  | As discussed above, we think that “*srs-ResourceSetId”* and “*srs-ResourceIdList”* need to be specified as exceptions as in the CR in Section 2, and *‘aperiodicSRS-ResourceTrigger’,* and *‘aperiodicSRS-ResourceTriggerList’* are nice to have if we anyways need to change the spec.  |
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**Q2: If you answer to Q1 is yes, any additional comments on the CR in Section 2?**

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| **Company** | **Yes or No** | **Comment** |
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## Round 2 discussion

Thanks for the input in the first round. Based on the companies’ input, most companies think that the CR is not necessary, whereas Qualcomm still thinks that some changes related to “*srs-ResourceSetId”* and “*srs-ResourceIdList”* are needed*.*

Based on the comments, the moderator would like to encourage the companies to provide inputs to the following questions to clarify the understanding of the SRS resource set configuration associated with DCI formats 0\_1/1\_1 and 0\_2/1\_2.

**Q1: Based on discussions in 105-e, the following CR was agreed in TS 38.214. Which of the following two interpretations do you agree?**

* **Interpretation 1: The UE can be configured with a first SRS resource set (denote by X) in *srs-ResourceSetToAddModList* and a second SRS resource set (denote by Y) in *srs-ResourceSetToAddModListDCI-0-2,* both with *usage=’codebook’,* where the second SRS resource set Y consists the first *N* SRS resources included in the first SRS resource set X.**
* **Interpretation 2: Only one SRS resource set with usage=“codebook” can be configured, denoted by SRS resource set X. For PUSCH scheduled with DCI format 0\_2, UE will take the first *N* SRS resources from SRS resource set X.**

Here’re the CR in TS 38.214.

“Only one SRS resource set can be configured in *srs-ResourceSetToAddModList* with higher layer parameter *usage* in *SRS-ResourceSet* set to ‘codebook’, and only one SRS resource set can be configured in *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to ‘codebook’.

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| **Company** | **Comment** |
| Qualcomm | **Interpretation 1**. In last meeting, companies think that Interpretation 2 is too restrictive, and agreed to allow gNB to configure two different SRS resource sets with usage=”codebook”. The restrictions introduced in TS 38.212 is to make sure that the SRS resources set associated with *srs-ResourceSetToAddModListDCI-0-2* contains only a subset of SRS resources in the SRS resource set associated with *srs-ResourceSetToAddModList.*Interpretation 2 will not work, since with Interpretation 2, there is no way to configure a smaller number of SRS resources for the SRS resource set associated with DCI format 0\_2. Therefore, there is no way for the gNB to configure a smaller SRI field in DCI format 0\_2 compared to DCI 0\_1, without introducing a new RRC parameter.  |
| Nokia/NSB | **In principle Interpretation 1**, but we don’t see that that the subset in *srs-ResourceSetToAddModListDCI-0-2* needs to be the first N entries of *srs-ResourceSetToAddModList.* So we think it should be:* **Interpretation 1: The UE can be configured with a first SRS resource set (denote by X) in *srs-ResourceSetToAddModList* and a second SRS resource set (denote by Y) in *srs-ResourceSetToAddModListDCI-0-2,* both with *usage=’codebook’,* where the second SRS resource set Y consists ~~the first~~ of *N* SRS resources included in the first SRS resource set X.**
 |
| Moderator | @Nokia. The requirement that the SRS resources in Y need to be the first N SRS resources in SRS resource set X is already captured in the 38.212 CR agreed in the previous meeting, copied below:“… where the SRS resource set is composed of the first $N\_{SRS, 0\\_2}$ SRS resources together with other configurations in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModList*, if any, and associated with the higher layer parameter *usage* of value '*nonCodeBook*' …”This restriction may indeed be a bit too restrictive, and could be removed if all companies agree to it.   |
| Vivo | **Interpretation 1.** |
| HW/HiSi | Interpretation 1. According to the agreement from last meeting (R1-2106364) it should be the first $N\_{SRS, 0\\_2}$ SRS resources. |
| Ericsson | Interpretation 1 |

**Q2: If your preference is Interpretation 1 above, then it means gNB will configure two identical SRS resource sets to the UE, where the two SRS resource sets have exactly the same RRC parameters, including the SRS resource set ID, and the same set of SRS resources.**

* **What is the benefit of having two SRS resource set configurations that have exactly the same parameters (i.e., same set ID, and same set of SRS resources)?**
* **More importantly, how should the UE determine the number of SRS resources contained in the SRS resource set associated with *srs-ResourceSetToAddModList-DCI-0-2,* which is needed to determine the bitwidth of SRI in DCI format 0\_2*?***

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| **Company** | **Comment** |
| Qualcomm | We think that it is necessary to configure different SRS resource set IDs for the SRS resource set X and SRS resource set Y, associated with *srs-ResourceSetToAddModListDCI-0-2* and *srs-ResourceSetToAddModList,* for the UE to distinguish these two SRS resource sets.Further, in order to allow the gNB configure different SRI bit width for DCI format 0\_1 and 0\_2, the two SRS resource set X and Y must be configured with different number of SRS resources (e.g., 4 SRS resources in SRS resource set X, and 2 SRS resources in SRS resource set Y, where the SRS resources in Y is the first 2 SRS resources contained in X). As such, it doesn’t work if we restrict the “*srs-ResourceIdList”* to be configured the same between SRS resource set X and SRS resource set Y*.* Hope it clarifies the intention of the proposal.  |
| Nokia / NSB | As commented in the first round, nothing is broken here. Clearly somebody may argue that this might be an overkill. We fail to see the issue raised by Qualcomm, gNB by configuration will take care that the configuration of the SRS resource set, SRS resource IDs and SRS resource ID lists are done to lead to the intended bitwidth in DCI format 0\_2 and having the resources to be a subset.  |
| Moderator | @Nokia, with the current spec in TS 38.212, the network can not configure different SRS resource set IDs and SRS resource ID lists in SRS resource set X and SRS resource set Y. For example, network will configure SRS resources as the following: **SRS resource set X** with set ID=0, SRS resource list ={a, b, c, d}; **SRS resource set Y** with set ID =0, SRS resource list ={a, b, c, d}.How could network configure different number of SRS resources in SRS resource set Y from SRS resources in SRS resource set X?  |
| Vivo | It has been agreed that SRS resource set configured for DCI format 0\_2 is composed of the first $N\_{SRS, 0\\_2}$ SRS resources in the SRS resource set configured for DCI format 0\_1. Considering the unique *‘srs-ResourceSetId’* in the context of the BWP, it is more reasonable to configure different *‘srs-ResourceSetId’*. *‘srs-ResourceIdList’* may be naturally different. |
| HW/HiSi | For the second question: “**how should the UE determine the number of SRS resources contained in the SRS resource set associated with *srs-ResourceSetToAddModList-DCI-0-2,* which is needed to determine the bitwidth of SRI in DCI format 0\_2*?”***According to our understanding, the number of SRS resources is obtained from the RRC parameter. And then how to use it to determine the number of bits for SRI is described in 38.212 for DCI 0\_2 according to the CR from last meeting. |
| Ericsson | Our understanding is that DCI format 0\_2 can use a reduced subset from 0\_1. Using the moderator’s notation, a typical example is:**SRS resource set X** with set ID=0, SRS resource list ={a, b, c, d}; **SRS resource set Y** with set ID =1, SRS resource list ={a, b}.Thus, we agree with moderator that: “*srs-ResourceSetId”* and “*srs-ResourceIdList”* need to be specified as exceptions as in CR [1]. |

**Q3: If your preference is Interpretation 2 above, how does the UE determine** $N\_{SRS,0\\_2}$ **in TS 38.212** **(see Section 2)**, **i.e., the number of SRS resources in the SRS resource sets associated with DCI format 0\_2, since there is no separate RRC parameter for** $N\_{SRS,0\\_2}$**?**

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| **Company** | **Comment** |
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## Round 3 discussion

**Summary for Round 2:**

Thanks all for the inputs and discussions in the 2nd round. Based on the companies’ input, all companies agree with **Interpretation 1** in **Q1**, that two different SRS resource sets (with a same usage=”codebook” or “noncodebook”) in *srs-ResourceSetToAddModList* and in *srs-ResourceSetToAddModListDCI-0-2,* respectively*.*And most companies agree that the “*srs-ResourceSetId”* and “*srs-ResourceIdList”* needs to be specified as exceptions in the CR in [1]*.*  Nokia has expressed concerns about the necessity of such CR in the beginning, but have not provided comments after the Moderator explains the issue, at the time this summary is provided.

Based on the discussions, the moderator would like to encourage the companies to express any concerns on the following modified CR

**Q 2-1: Do you have any concern about the CR in TS 38.213 below?**

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| **Company** | **Comment** |
| Moderator | @Huawei, for your comment “**According to our understanding, the number of SRS resources is obtained from the RRC parameter,**” I guess you meant the RRC parameter “*srs-ResourceIdList*” associated with a given SRS resource set, since there is no other parameters that indicates the number of SRS resources in a SRS resource set. So, I assume you are OK with including “*srs-ResourceIdList*” in the exception. Please comment if the above understanding is not correct.  |
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7.3.1.1.3 Format 0\_2

< Unchanged parts are omitted >

- SRS resource indicator –$ \left⌈log\_{2}\left(\sum\_{k=1}^{min\left\{L\_{max}, N\_{SRS,0\\_2}\right\}}\left(\begin{matrix}N\_{SRS,0\\_2}\\k\end{matrix}\right)\right)\right⌉ $or $\left⌈log\_{2}N\_{SRS, 0\\_2}\right⌉ $bits, where $N\_{SRS, 0\\_2}$ is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*', where the SRS resource set is composed of the first $N\_{SRS, 0\\_2}$ SRS resources together with other configurations in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModList*, if any, and associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*', respectively, except for the higher layer parameters *‘srs-ResourceSetId’, and ‘srs-ResourceIdList’~~, ‘aperiodicSRS-ResourceTrigger’,~~* ~~and~~ *~~‘aperiodicSRS-ResourceTriggerList’~~*

- $\left⌈log\_{2}\left(\sum\_{k=1}^{min\left\{L\_{max}, N\_{SRS,0\\_2}\right\}}\left(\begin{matrix}N\_{SRS,0\\_2}\\k\end{matrix}\right)\right)\right⌉$ bits according to Tables 7.3.1.1.2-28/29/30/31 if the higher layer parameter *txConfig = nonCodebook*, where $N\_{SRS, 0\\_2}$ is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*nonCodeBook*', where the SRS resource set is composed of the first $N\_{SRS, 0\\_2}$ SRS resources together with other configurations in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModList*, if any, and associated with the higher layer parameter *usage* of value '*nonCodeBook*', except for the higher layer parameters *‘srs-ResourceSetId’ and ‘srs-ResourceIdList’, ~~‘aperiodicSRS-ResourceTrigger’,~~* ~~and~~ *~~‘aperiodicSRS-ResourceTriggerList’~~,* and

- if UE supports operation with *maxMIMO-LayersDCI-0-2* and the higher layer parameter *maxMIMO-LayersDCI-0-2* of *PUSCH-ServingCellConfig* of the serving cell is configured, *Lmax* is given by that parameter

- otherwise, *Lmax* is given by the maximum number of layers for PUSCH supported by the UE for the serving cell for non-codebook based operation.

- $\left⌈log\_{2}N\_{SRS, 0\\_2}\right⌉ $bits according to Tables 7.3.1.1.2-32 if the higher layer parameter *txConfig = codebook*, where $N\_{SRS, 0\\_2}$ is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*codeBook*', where the SRS resource set is composed of the first $N\_{SRS, 0\\_2}$ SRS resources together with other configurations in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModList*, if any, and associated with the higher layer parameter *usage* of value '*codeBook*', except for the higher layer parameters *‘srs-ResourceSetId’ and ‘srs-ResourceIdList’~~, ‘aperiodicSRS-ResourceTrigger’,~~* ~~and~~ *~~‘aperiodicSRS-ResourceTriggerList’~~*.

< Unchanged parts are omitted >

# Conclusion

To be added after the discussion.

# References

1. R1-2107318, Remaining issues on PDCCH enhancements for URLLC, Qualcomm, 3GPP WG1 106-e, Aug 16-27, 2021.