3GPP TSG-RAN WG1 Meeting #116bis Tdoc R1-24nnnnn

Changsha, Hunan Province, China, April 15th – 19th, 2024

Agenda Item: 7

Source: Moderator (Ericsson)

Title: Summary of NR Rel-15/16 maintenance discussion for aperiodic triggering support for SRS carrier switching

Document for: Discussion, Decision

# 1 Introduction

In this contribution, we summarize the continuation of the discussion in RAN1#116 on aperiodic triggering support for SRS carrier switching [1]. In RAN1#116, the following agreement and conclusions were reached for aperiodically triggered SRS carriers switching. How available slot operation is supported was concluded, as well as that the UE should not be scheduled with overlapping SRS transmissions from a same switching-from carrier. When the latter conclusion was reached, it was discussed that changes to 38.214 section 6.2.1.3 to support the conclusion on multiple DCIs are possible [1].

**Conclusion**

* Available slot operation can be used with SRS carrier switching triggered by DCI formats 1\_1, 1\_2, and 2\_3.
* It is an error case if DCI format 2\_3 is used with more than one entry in *availableSlotOffsetList* (no spec change needed).

**Conclusion**

The UE does not expect to receive multiple DCIs scheduling multiple SRS transmissions that overlap in time, including RF retuning time, in target carriers associated with the same source carrier.

Adding explicit support for DCI format 1\_3 was also discussed, motivated by the changes in RAN1#115 that identified support for DCI 1\_1 and 1\_2. While there was general agreement, full consensus was not reached and the moderator suggested to conclude on the DCI 1\_3 issue in RAN1#116bis, first addressing if new UE capability for DCI format 1\_3 with SRS carrier switching is needed [1].

Since DCI format 1\_3 is a Rel-18 feature, the Chair gave guidance that it should be treated under a Rel-18 agenda point. Therefore, this issue is expected to be treated in this meeting in the multicarrier enhancements discussions under agenda point 8.3. Consequently, in this contribution, we consider whether and how RAN1 specifications should be corrected to reflect the conclusion on overlapping SRS triggered by multiple DCIs.

Comments for the initial discussion are invited in section 2. Responses will be summarized after first round discussion in section 3.

# 2 Discussion

## 2.1 Multiple DCI

As introduced above, discussion on the need for new behavior to address where there are overlapping SRS carrier switching triggers by multiple DCIs continued in RAN1#116, resulting in the conclusion below.

**Conclusion**

The UE does not expect to receive multiple DCIs scheduling multiple SRS transmissions that overlap in time, including RF retuning time, in target carriers associated with the same source carrier.

As was discussed in RAN1#116, corresponding spec changes can still be proposed, and there is one proposal in this meeting to do so in [2]. The proposal is a subset of the changes proposed in [3], and is copied below.

38.214 section 6.2.1.3

|  |
| --- |
| For *~~n~~*~~-th (~~*~~n ≥~~* ~~1)~~ an aperiodic SRS transmission on a cell *c*, upon detection of a positive SRS request on a grant, the UE shall commence this SRS transmission on the configured symbol and slot provided  - it is no earlier than the summation of  - the maximum time duration between the two durations spanned by N OFDM symbols of the numerology of cell *c* and the cell carrying the grant respectively, and  - the UL or DL RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR,*  - it does not collide with any previous SRS transmissions, or interruption due to UL or DL RF retuning time, except if the previous SRS transmission is in the same cell *c* and the UE reports *stayOnTargetCC-SRS-CarrierSwitch* for the corresponding band combination.  otherwise, *~~n~~*~~-th~~ the SRS transmission is dropped, where N is the reported capability as the minimum time interval in unit of symbols, between the DCI triggering and aperiodic SRS transmission. |

The proposal above was motivated in [2] with the following interpretation of the timing. We repeat it here to see if this is the common understanding of the behavior. Figure 1 below shows an interpretation of the 38.214 text above where multiple DCIs are supported and two grants each trigger one SRS transmissions on a cell. Here ‘C1’ is a switching-from (or “source”) cell while C2 and C3 are switching-to (or “target”) cells. The PDCCH’s could be closely transmitted in time on one cell or on two different cells depending on which of DCI formats 1\_1/1\_2 or 2\_3 and if self-scheduling and/or cross-carrier scheduling is used. The transmissions must meet the two conditions in the text. Firstly, each must be no earlier than the summation of the minimum delay between SRS and PDCCH (determined according to the numerology of the cells) and the retuning time. Secondly, each SRS transmission must not collide with any previous SRS transmission, including the retuning time. As shown in the figure, the text constrains subsequent switches on the source cell to be delayed enough to allow switching time back to and away from the source cell. This constraint avoids where target cells overlap when switching from the source carrier, and so if the 38.214 text were to be interpreted as supporting multiple DCIs, the conclusion above is believed in [2] to be supported, i.e., the UE would not expect to receive multiple DCIs scheduling multiple SRS transmissions that overlap in time, including RF retuning time, in target carriers associated with the same source carrier.



Figure 1

The interpretation above assumes that the text applies to the multiple DCI case. However, the majority view in recent RAN1 discussions is that this text in 38.214 addresses where a single DCI triggers SRS transmissions based on “For *n*-th (*n ≥* 1) aperiodic SRS transmission on a cell *c*, upon detection of a positive SRS request on a grant”. If the text does not apply to multiple DCI, then it may be questioned how the RAN1#116 conclusion that when multiple DCIs schedule multiple SRS transmissions that overlap is actually an error case, since the timing would not be defined for the multiple DCI case. This leads to the main question, i.e. if timing is clear for multiple DCI triggering in the current specification such that the conclusion from RAN1#116 is sufficient.

**Question 2.1.1: Please respond to either Alt A or B. If responding to Alt. A, indicate if you prefer Option 1 or 2. For Option 2, please identify the relevant specification text. If responding to Alt B, please complete the statement explaining gNB and UE knowledge of the timing constraints.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Alt A: There is, or should be, text in 38.214 or elsewhere that constrains the timing of SRS carrier switching triggered by multiple DCIs.**   * **Alt A.1: It is, or can be (given suitable corrections), in 38.214 section 6.2.1.3, “For n-th (n ≥ 1) aperiodic SRS transmission on a cell c, upon detection of a positive SRS request on a grant, …”** * **Alt A.2: It is, or can be (given suitable corrections), in some other text.**   **Alt B: There is no text constraining this timing. The gNB and UE know how close triggered switches given by multiple DCI from a same source cell can be because \_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | |
| **Company** | **Alt A**  **1 or 2** | **Alt B** | **Comments** |
| Qualcomm |  |  | We would be OK with having no specification change and keeping the previous conclusion as it is. As a 2nd option, we would prefer A.2 |
| MTK |  |  | Similar view as QC. Prefer no spec change followed by A.2. |
|  |  |  |  |

In case it is agreed that corrections are needed, and these are to the referenced text in 38.214, it may be useful to discuss details at this stage. The proposal from [2] given above is one possible approach, since two companies have supported it at least in part. However, given the concern in RAN1#116 that the error case would only apply where the DCIs have the same source CC, the proposal may need further clarification. One possibility could be to say that the SRS transmission does not collide with the interruption of a same source switching-from carrier, as updated below. This may clarify e.g. that if more than one switching-from carrier is configured, the timing constraints independently apply to each switching-from carrier.

38.214 section 6.2.1.3

|  |
| --- |
| For *~~n~~*~~-th (~~*~~n ≥~~* ~~1)~~ an aperiodic SRS transmission on a cell *c*, upon detection of a positive SRS request on a grant, the UE shall commence this SRS transmission on the configured symbol and slot provided  - it is no earlier than the summation of  - the maximum time duration between the two durations spanned by N OFDM symbols of the numerology of cell *c* and the cell carrying the grant respectively, and  - the UL or DL RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR,*  - it does not collide with any previous SRS transmissions, or interruption of a same switching from carrier due to UL or DL RF retuning time, except if the previous SRS transmission is in the same cell *c* and the UE reports *stayOnTargetCC-SRS-CarrierSwitch* for the corresponding band combination.  otherwise, *~~n~~*~~-th~~ the SRS transmission is dropped, where N is the reported capability as the minimum time interval in unit of symbols, between the DCI triggering and aperiodic SRS transmission. |

**Question 2.1.2: If you support Alt A in Question 2.1.1, please provide your view on the following proposal, indicating if you support each of the two sets of changes. Please also feel free to provide alternative solutions or improvements.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Correct the 38.214 section 6.2.1.3 text for aperiodic trigger timing such that it is clear how multiple DCI are supported by**   1. **Referring to ‘the aperiodic SRS transmission’ rather than the ‘nth aperiodic SRS transmission’, and by** 2. **Adding ‘of a same switching from carrier’,**   **as proposed above** | | | |
| **Company** | **Support a) Y/N** | **Support b) Y/N** | **Comments** |
| Qualcomm |  |  | In our view, it would be easier to just copy the conclusion we made in the previous meeting to the 214, if desired. |
| MTK |  |  | Similar view as QC. If majority wants to choose between a and b for revision, we slightly prefer b. |
|  |  |  |  |

# 3 Summary of discussion so far and way forward

## 3.1 First round summary

### 3.1.1 Multiple DCI:

TBD

## 3.2 First round outcome

TBD

# 4 Conclusion

TBD

# 5 References

1. R1-2401852, “Summary #3 of NR Rel-15/16 maintenance discussion for aperiodic triggering support for SRS carrier switching”, Moderator (Ericsson), 3GPP TSG RAN1#116, Athens, Greece, February 26th – March 1st, 2024.
2. R1-2403098, “Aperiodic SRS Carrier Switching”, Ericsson, 3GPP TSG RAN1#116bis, Changsha, Hunan Province, China, April 15th – 19th, 2024.
3. Huawei, HiSilicon, “R1-2312228, Discussion on DL DCI triggering for SRS carrier switching”, 3GPP TSG RAN1#115, Chicago, USA, November 13th – November 17th, 2023.

# 6 Contact info

Please provide your contact information below in order to facilitate offline discussion. I’ve taken the liberty of including the information provided in RAN1#116.

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| --- | --- | --- |
| Company name | Delegate name | Email address |
| Ericsson | Mark Harrison | mark.h.harrison@ericsson.com |
| Qualcomm | Alberto Rico | albertor@qti.qualcomm.com |
| TMUS | george cummings | george.cummings@t-mobile.com |
| Nokia | Karri Ranta-aho | Karri.Ranta-aho@nokia.com |
| Fujitsu | WANG Guotong (David) | wangguotong@fujitsu.com |
| ZTE | Bo Gao | gao.bo1@zte.com.cn |
| ZTE | Yang Zhang | Zhang.yang220@zte.com.cn |
| MTK | CH Hsieh | CH.Hsieh@mediatek.com |