**3GPP TSG RAN WG1 #110bis-e R1-221xxxx**

**e-Meeting, October 10th – 19th, 2022**

**Agenda item:** **8.1**

**Source: Moderator (ZTE)**

**Title: FL Summary on Rel-17 FeMIMO maintenance for SRS in Round 1**

**Document for:** **Discussion and Decision**

## Introduction

As per the discussion in preparation phase, issue#1 was approved to be discussed in RAN1#110bis-e meeting for alignment CR. Company’s comments in this round are highly expected **before 13th October 11 AM UTC.**

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| [110bis-e-R17-MIMO-09] Email discussion on remaining maintenance issues on SRS by October 14 – Yang (ZTE)-       For alignment CR: Correction on available slot offset ‘t’ without configuration and the transmission timeline of aperiodic SRS (R1-2208764) |

## Summary for maintenance issue

**Issue#1:** Draft CR on available slot offset ‘t’ without configuration and the transmission timeline of aperiodic SRS (R1-2208764)

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| ***Reason for change:*** | First, there is the following agreement in RAN1#106b

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| **Agreement**Bit width of SOI depends on the maximum number of “t” values configured for any of the aperiodic SRS resource sets* The SOI field is 0 bit if the maximum number of ‘t’ values is one
* If at least one resource set has “t” configured
	+ For the resource sets with “t” value configured, each of them is configured with K values of “t”, where 1<=K<=4
	+ t=0 applies for the resource set(s) without “t” configured in RRC
* If none of the resource sets is configured with “t” values, follow Rel-15 approach to determine slot offset
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But in current specification, t=0 applies for each SRS resource set when there is at least one SRS resource set without ‘t’ configured in RRC. It doesn’t match above agreement and may lead a useless configuration for ‘t’ for another SRS resource set. In addition, the wording ‘otherwise’ in the section about the case where none of the resource sets is configured with “t” values is controversial, because that there are two conditions before the ‘otherwise’. Then, from spec perspective, it is ambiguous about what is the exact condition corresponding to the ‘otherwise’, i.e., the case where at least one of the resource sets is configured with “t” values and/or the case where the UE is not configured with ca-SlotOffset for at least one of the triggered cell and triggering cell.Finally, some editorial issues are corrected accordingly.  |
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| ***Summary of change:*** | Clarify description for available slot offset and condition for AP-SRS timeline (i.e., in the case that the UE is not configured with *ca-SlotOffset* for both the triggered and triggering cell).  |
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| ***Consequences if not approved:*** | It may lead misalignement for AP-SRS timeline between gNB and UE sides. |

According to above, the following draft CR is provided in R1-2208764, where the update parts are highlighted in red:

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6.2.1 UE sounding procedure

**<Unchanged parts are omitted>**

For aperiodic SRS at least one state of the DCI field is used to select at least one out of the configured SRS resource set(s).

The following SRS parameters are semi-statically configurable by higher layer parameter *SRS-Resource* or *SRS-PosResource*.

- *srs-ResourceId* or *SRS-PosResourceId* determines SRS resource configuration identity.

- Number of SRS ports, as defined by the higher layer parameter *nrofSRS-Ports* and described in clause 6.4.1.4 of [4, TS 38.211]. If not configured, *nrofSRS-Ports* is 1.

*-* Time domain behaviour of SRS resource configuration as indicated by the higher layer parameter *resourceType*, which may be periodic, semi-persistent, aperiodic SRS transmission as defined in clause 6.4.1.4 of [4, TS 38.211].

- Slot level periodicity and slot level offset as defined by the higher layer parameters *periodicityAndOffset-p* or *periodicityAndOffset-sp* for an SRS resource of type periodic or semi-persistent. The UE is not expected to be configured with SRS resources in the same SRS resource set *SRS-ResourceSet* or *SRS-PosResourceSet* with different slot level periodicities. For an *SRS-ResourceSet* configured with higher layer parameter *resourceType* set to 'aperiodic', a slot level offset is defined by the higher layer parameter *slotOffset.* For an *SRS-ResourceSet* configured with higher layer parameter *resourceType* set to 'aperiodic', a list of zero or up to four different available slot offset values from the reference slot *n* + *k* to the slot where the aperiodic SRS resource set is transmitted where *n* is the slot with triggering DCI and *k* is *slotOffset* can be configured~~is defined~~ by the higher layer parameter *availableSlotOffsetList.* The parameter *availableSlotOffsetList* can be configured up to 4 different values*.* For an *SRS-PosResourceSet* configured with higher layer parameter r*esourceType* set to 'aperiodic', the slot level offset is defined by the higher layer parameter *slotOffset* for each SRS resource.

- Number of OFDM symbols in the SRS resource, starting OFDM symbol of the SRS resource within a slot including repetition factor R as defined by the higher layer parameter *resourceMapping* and described in clause 6.4.1.4 of [4, TS 38.211]. If *R* is not configured, then *R* is equal to the number of OFDM symbols in the SRS resource.

**<Unchanged parts are omitted>**

For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource* is set to 'aperiodic':

- the UE receives a configuration of SRS resource sets,

- the UE receives a downlink DCI, a group common DCI, or an uplink DCI based command where a codepoint of the DCI may trigger one or more SRS resource set(s). For SRS in a resource set with usage set to 'codebook' or 'antennaSwitching', the minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is *N2*  symbols and an additional time duration *Tswitch*. Otherwise, the minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is *N2* +14 symbols and an additional time duration *Tswitch*. The minimal time interval unit of OFDM symbol is counted based on the minimum subcarrier spacing given by min(*µPDCCH, µUL*) where *µUL* is given by min(*µUL,carrier1, µUL,carrier2, µSRS*) when the UE is configured with the higher layer parameter *uplinkTxSwitchingOption* set to 'dualUL' for uplink carrier aggregation, and by *µSRS*otherwise. *µSRS* and *µPDCCH*are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively.

- *Tswitch*, *µUL,carrier1* and *µUL,carrier2* are defined in clause 6.4.

- When UE reporting *[Triggering SRS* only in DCI 0\_1/0\_2*],* the UE can be indicated with DCI 0\_1 and 0\_2 to trigger aperiodic SRS without data and without CSI as described in clause 7.3.1.1 of TS38.212. Otherwise, except for DCI format 0\_1/0\_2 with CRC scrambled by SP-CSI-RNTI, a UE is not expected to receive a DCI format 0\_1/0\_2 with UL-SCH indicator of "0" and CSI request of all zero(s) as described in clause 7.3.1.1 of [5, TS 38.212].

- If the UE receives the DCI triggering aperiodic SRS in slot *n* and at least one resource set is configured with parameter *availableSlotOffset* across all configured BWPs in a component carrier except when SRS is configured with the higher layer parameter *SRS-PosResource*,

- If ca-*SlotOffset* is configured, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in the (*t* + 1)-th available slot counting from slot ,

- otherwise the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in the (*t* + 1)-th available slot counting from slot $\left⌊n⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{PDCCH}}}\right⌋+k$, where

*- k* is configured via higher layer parameter *slotOffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command, respectively;

*-* $N\_{slot, offset, PDCCH}^{CA}$ and $μ\_{offset,PDCCH}$ are the $N\_{slot, offset}^{CA}$ and the, respectively, which are determined by higher-layer configured *ca-SlotOffset* for the cell receiving the PDCCH, $N\_{slot, offset, SRS}^{CA}$ and $μ\_{offset,SRS}$ are the $N\_{slot, offset}^{CA}$ and the, respectively, which are determined by higher-layer configured *ca-SlotOffset* for the cell transmitting the SRS, as defined in [4, TS 38.211] clause 4.5.

- An available slot is a slot satisfying there are UL or flexible symbol(s) for the time-domain location(s) for all the SRS resources in the resource set and it satisfies UE capability on the minimum timing requirement between triggering PDCCH and all the SRS resources in the resource set. From the first symbol carrying the SRS request DCI to the last symbol of the triggered SRS resource set, UE does not expect to receive SFI indication, UL cancellation indication or dynamic scheduling of DL channel/signal(s) on flexible symbol(s) that may change the determination of available slot.

*- t* is configured via higher layer parameter *availableSlotOffsetList* with up to four different valuesof *AvailableSlotOffset* for each triggered SRS resources set and it is based on the subcarrier spacing of the triggered SRS transmission. When one or more SRS resource sets across all configured BWPs in a component carrier are configured, and at least one resource set is configured with *availableSlotOffsetList* parameter of more than one values, the indicated value of *t* is indicated by SOI field in DCI scheduling PUSCH/PDSCH and DCI 0\_1/0\_2 without data and without CSI request described in [5, TS 38.212]. The UE shall apply indicated value *t* specificallyfor those sets with configured *availableSlotOffsetList* parameter. When one or more SRS resource sets across all configured BWPs in a component carrier are configured and at least one resource set is configured with *availableSlotOffsetList* parameter, and the *availableSlotOffsetList* parameter for each SRS resource set has only one value, the UE shall apply the configured value specificallyfor those sets with configured *availableSlotOffsetList* parameter. For an SRS resource set configured with *availableSlotOffsetList* parameter, each of resource set is configured with *K* values of *AvailableSlotOffset*. For an SRS resource set configured without *availableSlotOffsetList* parameter, *t* = 0 is applied for the ~~each of~~ resource set.

- If the UE receives the DCI triggering aperiodic SRS in slot *n* and none of the resource sets is configured with parameter *availableSlotOffsetList* across all configured BWPs in a component carrier, and if the UE is configured with *ca-SlotOffset* for at least one of the triggered and triggering cell, except when SRS is configured with the higher layer parameter *SRS-PosResource*, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in slot , otherwise if the UE is not configured with *ca-SlotOffset* for both the triggered and triggering cell, the UE transmits aperiodic SRS in each of the triggered resource set(s) in slot $K\_{s}=\left⌊n⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{PDCCH}}}\right⌋+k+K\_{offset}⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{K\_{offset}}}}$, where $K\_{offset}$is a parameter configured by higher layer as specified in clause 4.2 of [6 TS 38.213], and where

*- k* is configured via higher layer parameter *slotOffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;

*-* $μ\_{K\_{offset}}$is the subcarrier spacing configuration for $K\_{offset}$ with a value of 0 for frequency range 1.

- $N\_{slot, offset, PDCCH}^{CA}$ and $μ\_{offset,PDCCH} $are the $ N\_{slot, offset}^{CA}$ and the, respectively, which are determined by higher-layer configured *ca-SlotOffset* for the cell receiving the PDCCH, $N\_{slot,offset,SRS}^{CA}$ and $μ\_{offset,SRS}$ are the  and the , respectively, which are determined by higher-layer configured *ca-SlotOffset* for the cell transmitting the SRS, as defined in [4, TS 38.211] clause 4.5.

**<Unchanged parts are omitted>**

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| **Company** | **Comment (if any)** |
| CATT | Support in general. For the first change, we prefer to delete “zero”, i.e., change “a list of zero up to four different available slot offset values” to “a list of ~~zero~~ up to four different available slot offset values”.For the last change, we are ok to clarify what does “otherwise” mean, and prefer to change the wording to “otherwise if the UE is neither configured with *ca-SlotOffset* for the triggered cell nor for the triggering cell”. |
| Samsung | Support in principle. We would like to suggest some points.For the 1st change: we can live with CATT’s proposal, i.e., deleting ‘zero’.For the 2nd change (where *n* is the slot with triggering DCI and *k* is *slotOffset* can be configured~~is defined~~ by the higher layer parameter *availableSlotOffsetList.*): since “is defined” is used in several sentences in the same paragraph, we think this can be kept as is.For the 3rd change (For an SRS resource set configured without *availableSlotOffsetList* parameter, *t* = 0 is applied for the ~~each of~~ resource set.): we are fine.For the 4th change (otherwise …): we found that two bullets in the same section are used for the following cases, in order to distinguish two cases whether *ca-SlotOffset* is configured or not. **<Unchanged parts are omitted>**- If the UE receives the DCI triggering aperiodic SRS in slot *n* and at least one resource set is configured with parameter *availableSlotOffset* across all configured BWPs in a component carrier except when SRS is configured with the higher layer parameter *SRS-PosResource*, - If ca-*SlotOffset* is configured, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in the (*t* + 1)-th available slot counting from slot , - otherwise the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in the (*t* + 1)-th available slot counting from slot $\left⌊n⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{PDCCH}}}\right⌋+k$, where*- k* is configured via higher layer parameter *slotOffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command, respectively;**<Unchanged parts are omitted>**Hence, can we do similar thing for this as follows?**<Unchanged parts are omitted>**- If the UE receives the DCI triggering aperiodic SRS in slot *n* and none of the resource sets is configured with parameter *availableSlotOffsetList* across all configured BWPs in a component carrier, and * if the UE is configured with *ca-SlotOffset* for at least one of the triggered and triggering cell, except when SRS is configured with the higher layer parameter *SRS-PosResource*, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in slot ,
* otherwise ~~if the UE is not configured with~~ *~~ca-SlotOffset~~* ~~for both the triggered and triggering cell~~, the UE transmits aperiodic SRS in each of the triggered resource set(s) in slot $K\_{s}=\left⌊n⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{PDCCH}}}\right⌋+k+K\_{offset}⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{K\_{offset}}}}$, where $K\_{offset}$is a parameter configured by higher layer as specified in clause 4.2 of [6 TS 38.213], and where

*- k* is configured via higher layer parameter *slotOffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;**<Unchanged parts are omitted>** |
| QC | * For first editorial change ‘*zero or up to’*, we are okay with either CATT change or original CR
* For 2nd editorial change ‘*can be configured’*, we are okay
* For 3rd editorial change, we suggest the following to keep consistent with agreement and previous statement that used wording ‘each of the resource set’

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| **For an SRS resource set** configured with *availableSlotOffsetList* parameter, **each of resource set** is configured with *K* values of *AvailableSlotOffset*. **For an SRS resource set** configured without *availableSlotOffsetList* parameter, *t* = 0 is applied for **each ofresource set.** |

* For 4th editorial change, similar views as Samsung.
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| Apple | We think suggestion from Samsung is better |
| ZTE | For the first change, considering there is zero case, we lightly prefer to keep zero. If majority companies want to delete it, we are also fine to delete it. For the second change, we recommend to add comma ‘,’ before ‘can be configured’ to make it clearer/easily to read, otherwise it will be understand that k is configured/defined by *availableSlotOffsetList*. Although we prefer to use configured, but if majority companies prefer to use defined, we are also fine with defined. So the updated change is following

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|  a list of zero or up to four different available slot offset values from the reference slot *n* + *k* to the slot where the aperiodic SRS resource set is transmitted where *n* is the slot with triggering DCI and *k* is *slotOffset,* can be configured~~is defined~~ by the higher layer parameter *availableSlotOffsetList.*  |

For the fourth change, we are fine for the suggestion from CATT. @Samsung, we want to confirm your suggestion, you want to also add the similar wording at the new place you mentioned, right? Because you add new wording with deleting mask, I am a little confused. We are fine if you want to add the similar wording both the original place and the new place. @QC, here the meaning of each is a little confused. Does it means each resources of the resource set? Please provide more clarification about the meaning of each. Thanks a lot.  |
| Samsung | @ZTE: Thank you. For other changes except the last one, we are fine either ZTE’s or our suggestions.For the last change, our intention is to change the structure of current wording to prevent ambiguity, as you suggested. We don’t want to add something in a new place, but modify original place’s structure. To be clear, I would like to show before and after as follows:Before:**<Unchanged parts are omitted>**- If the UE receives the DCI triggering aperiodic SRS in slot *n* and none of the resource sets is configured with parameter *availableSlotOffsetList* across all configured BWPs in a component carrier, and if the UE is configured with *ca-SlotOffset* for at least one of the triggered and triggering cell, except when SRS is configured with the higher layer parameter *SRS-PosResource*, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in slot , otherwise, the UE transmits aperiodic SRS in each of the triggered resource set(s) in slot $K\_{s}=\left⌊n⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{PDCCH}}}\right⌋+k+K\_{offset}⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{K\_{offset}}}}$, where $K\_{offset}$is a parameter configured by higher layer as specified in clause 4.2 of [6 TS 38.213], and where *- k* is configured via higher layer parameter *slotOffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;**<Unchanged parts are omitted>**After: **<Unchanged parts are omitted>**- If the UE receives the DCI triggering aperiodic SRS in slot *n* and none of the resource sets is configured with parameter *availableSlotOffsetList* across all configured BWPs in a component carrier, and * if the UE is configured with *ca-SlotOffset* for at least one of the triggered and triggering cell, except when SRS is configured with the higher layer parameter *SRS-PosResource*, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in slot ,
* otherwise, the UE transmits aperiodic SRS in each of the triggered resource set(s) in slot $K\_{s}=\left⌊n⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{PDCCH}}}\right⌋+k+K\_{offset}⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{K\_{offset}}}}$, where $K\_{offset}$is a parameter configured by higher layer as specified in clause 4.2 of [6 TS 38.213], and where

*- k* is configured via higher layer parameter *slotOffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;**<Unchanged parts are omitted>** |
| Intel | For the 1st change: Ok with CATT’s versionFor the 2nd change: The change seems not necessary. But if majority companies ok, then it’s fine.For the 3rd change: It’s fine.For the 4th change: In principle we are fine with Samsung’s suggestion to have the similar text style as the case that available slot is configured, in order to address the confusion caused by “otherwise”. But seems the modification is not correctly highlighted, which may have confusion to editor. Also, the text “*except when SRS is configured with the higher layer parameter SRS-PosResource*” should be included in the main bullet.Suggest the following:**<Unchanged parts are omitted>**- If the UE receives the DCI triggering aperiodic SRS in slot *n* and none of the resource sets is configured with parameter *availableSlotOffsetList* across all configured BWPs in a component carrier~~, and if the UE is configured with~~ *~~ca-SlotOffset~~* ~~for at least one of the triggered and triggering cell,~~ except when SRS is configured with the higher layer parameter *SRS-PosResource*~~, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in slot , otherwise, the UE transmits aperiodic SRS in each of the triggered resource set(s) in slot~~ $K\_{s}=\left⌊n⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{PDCCH}}}\right⌋+k+K\_{offset}⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{K\_{offset}}}}$~~, where~~ $K\_{offset}$~~is a parameter configured by higher layer as specified in clause 4.2 of [6 TS 38.213], and where~~ *-* if the UE is configured with *ca-SlotOffset* for at least one of the triggered and triggering cell, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in slot ,*-* otherwise, the UE transmits aperiodic SRS in each of the triggered resource set(s) in slot $K\_{s}=\left⌊n⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{PDCCH}}}\right⌋+k+K\_{offset}⋅\frac{2^{μ\_{SRS}}}{2^{μ\_{K\_{offset}}}}$, where $K\_{offset}$is a parameter configured by higher layer as specified in clause 4.2 of [6 TS 38.213], and where *- k* is configured via higher layer parameter *slotOffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;**<Unchanged parts are omitted>** |
| ZTE | **@Samsung** Thanks for your further explanation. We prefer to our version. To be honest, even the structure is changed, but because there is two if , the otherwise is not clear. But if major companies are fine with your version, we are also fine with your version considering we want to solve the same problem.  |
| Samsung | @ZTE, Intel: Thank you for the further discussion and explanation. For the last change, we are fine with Intel’s version which is much clearer for the part “except when SRS is configured with the higher layer parameter *SRS-PosResource*”. |

## Conclusion

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# References

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| 1 | R1-2208764 | Draft CR on SRS enhancement in TS 38.214 | ZTE |
| 2 | R1-2209691 | Draft CR on inter-set guard period for SRS enhancement | Samsung |
| 3 | R1-2210059 | Draft CR on UL SRS Inter-slot GP time location for the first and/or last resource | Nokia, Nokia Shanghai Bell |