**3GPP TSG RAN WG1 Meeting #100bis-e R1-200xxxx**

**E-Meeting, April 20 – 30, 2020**

**Agenda Item: 6.2.3.1.1**

**Source: Huawei**

**Title: TP on additional SRS and legacy SRS**

**Document for: Discussion and Decision**

# Introduction

This documents provides the text proposal as the outcome of following email discussion [1]:

[100b-e-LTE-LTE\_DL\_MIMO\_EE-02] Clarifications of transmission/configuration of legacy/additional SRS (Issues 2, 3 as described in R1-2002701) by 4/24 and corresponding TP (if any) by 4/30 – Yubo (Huawei)

# Discussion

**Reason for changes:**

The agreement that UE can transmit both the legacy and additional SRS symbol(s) in the same subframe has not been captured.

The configuration of FDD  and  should not be used for additional SRS.

The following restrictions should also be applied to additional SRS:

* A UE configured for type 1 triggered SRS transmission is not expected to receive type 1 SRS triggering events associated with different values of trigger type 1 SRS transmission parameters, as configured by higher layer signaling, for the same subframe and the same serving cell.
* A UE configured for type 1 or type 0 triggered SRS transmission and more than one TDD serving cell without PUSCH/PUCCH transmission is not expected to receive type 1 or type 0 SRS triggering events that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in the *UE-EUTRA-Capability*.

**Summary of changes:**

Capture the agreement that UE can transmit both the legacy and additional SRS symbol(s) in the same subframe has not been captured.

The configuration of FDD  and  is not used for additional SRS.

The following restrictions are also applied to additional SRS:

* A UE configured for type 1 triggered SRS transmission is not expected to receive type 1 SRS triggering events associated with different values of trigger type 1 SRS transmission parameters, as configured by higher layer signaling, for the same subframe and the same serving cell.
* A UE configured for type 1 or type 0 triggered SRS transmission and more than one TDD serving cell without PUSCH/PUCCH transmission is not expected to receive type 1 or type 0 SRS triggering events that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in the *UE-EUTRA-Capability*.

**Specs/sections impacted:**

Sections of 36.213: 8.2,

**Consequences if not approved:**

UE may not be able to transmit both the legacy and additional SRS symbol(s) in the same subframe when triggered.

UE configured with additional SRS may mistakenly apply configuration  and  to additional SRS symbol(s).

If the following restrictions are not applied to additional SRS, then there may be confusion on how to transmit type 2 SRS or indications beyond UE’s capability.

* A UE configured for type 1 triggered SRS transmission is not expected to receive type 1 SRS triggering events associated with different values of trigger type 1 SRS transmission parameters, as configured by higher layer signaling, for the same subframe and the same serving cell.
* A UE configured for type 1 or type 0 triggered SRS transmission and more than one TDD serving cell without PUSCH/PUCCH transmission is not expected to receive type 1 or type 0 SRS triggering events that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in the *UE-EUTRA-Capability*.

=======================Start of text proposal to TS 36.213============================

<Unchanged parts are omitted>

8.2 UE sounding procedure

If the UE is configured with a PUCCH-SCell, the UE shall apply the procedures described in this clause for both primary PUCCH group and secondary PUCCH group unless stated otherwise

* When the procedures are applied for the primary PUCCH group, the terms 'secondary cell', 'secondary cells', 'serving cell', and 'serving cells' in this clause refer to secondary cell, secondary cells, serving cell or serving cells belonging to the primary PUCCH group respectively unless stated otherwise.
* When the procedures are applied for secondary PUCCH group, the terms 'secondary cell', 'secondary cells', 'serving cell' and 'serving cells' in this clause refer to secondary cell, secondary cells (not including the PUCCH-SCell), serving cell, serving cells belonging to the secondary PUCCH group respectively unless stated otherwise. The term 'primary cell' in this clause refers to the PUCCH-SCell of the secondary PUCCH group.

A UE shall transmit Sounding Reference Symbol (SRS) on per serving cell SRS resources based on three trigger types:

- trigger type 0: higher layer signalling

- trigger type 1: DCI formats 0/0A/0B/4/4A/4B/1A/6-0A/6-1A for FDD, TDD, and frame structure type 3 and DCI formats 2B/2C/2D/3B for TDD, and frame structure type 3, and DCI format 7-0A/7-0B/7-1E/7-1F/7-1G for TDD if the UE is configured by higher layers for SRS triggering via DCI format 7-0A and has indicated the capability *srs-DCI7-Triggering-FS2-r15/ srs-DCI7-Triggering-FS2-r16* and the UE is configured for SRS triggering with *srs-DCI7-TriggeringConfig-r15/ srs-DCI7-Triggering-FS2-r16*.

* trigger type 2: DCI formats 0/4/1A for FDD and TDD, and DCI formats 2B/2C/2D/3B for TDD, and DCI format 7-0A/7-0B/7-1E/7-1F/7-1G for TDD if the UE is configured by higher layers for SRS triggering via DCI format 7-0A and has indicated the capability *srs-DCI7-Triggering-FS2-r16* and the UE is configured for SRS triggering with *srs-DCI7-TriggeringConfig-r16*.

A UE is not expected to be configured with SRS trigger type 0 on a LAA SCell.

In case both trigger type 0 and trigger type 1 SRS transmissions would occur in the same subframe in the same serving cell, the UE shall only transmit the trigger type 1 SRS transmission. This prioritization rule shall be applied before other prioritization rules defined in this subclause.

In case both trigger type 1 and trigger type 2 SRS transmissions would occur in the same subframe, the UE shall transmit both the trigger type1 and type 2 SRS transmissions.

In case both trigger type 0 and trigger type 2 SRS transmissions would occur in the same subframe, the UE shall transmit both the trigger type 0 and type 2 SRS transmissions.

If higher layer parameter *specialSubframePatterns-v1430* indicates *ssp10*, or if higher layer parameter *specialSubframePatterns-v1450* indicates *ssp10-CRS-LessDwPTS*, the UE shall assume for the purpose of determining $k\_{SRS}$ that the special subframe configuration is that signalled by *specialSubframePatterns* (without suffix)*.*

A UE may be configured with SRS parameters for trigger type 0 and trigger type 1/2 on each serving cell. A BL/CE UE configured with CEModeB is not expected to be configured with SRS parameters for trigger type 0 and trigger type 1. The following SRS parameters are serving cell specific and semi-statically configurable by higher layers for trigger type 0 and for trigger type 1/2.

- Number of combs  as defined in Subclause 5.5.3.2 of [3] for trigger type 0 and each configuration of trigger type 1/2, if configured

- srs-UpPtsAdd: two or four additional SC-FDMA symbols in UpPTS as defined in [11] for trigger type 0 and trigger type 1, if configured

- Transmission comb , as defined in Subclause 5.5.3.2 of [3] for trigger type 0 and each configuration of trigger type 1/2

- Starting physical resource block assignment , as defined in Subclause 5.5.3.2 of [3] for trigger type 0 and each configuration of trigger type 1/2 for a serving cell that is not a LAA SCell. For a serving cell that is a LAA SCell, .

*- duration*: single or indefinite (until disabled), as defined in [11] for trigger type 0

*- srs-ConfigIndex* ISRS for SRS periodicity  and SRS subframe offset , as defined in Table 8.2-1 and Table 8.2-2 for trigger type 0 and SRS periodicity  and SRS subframe offset , as defined in Table 8.2-4 for trigger type 1 and Table 8.2-5 for trigger type 1/2 for a serving cell that is not a LAA SCell

- SRS bandwidth , as defined in Subclause 5.5.3.2 of [3] for trigger type 0 and each configuration of trigger type 1/2 for a serving cell that is not a LAA SCell. For a serving cell that is a LAA SCell, .

- Frequency hopping bandwidth, , as defined in Subclause 5.5.3.2 of [3] for trigger type 0 and each configuration of type 2

- Cyclic shift , as defined in Subclause 5.5.3.1 of [3] for trigger type 0 and each configuration of trigger type 1/2

- Number of antenna ports  for trigger type 0 and each configuration of trigger type 1/2

- SRS subframe for each configuration of trigger type 1 for a serving cell that is a LAA SCell and DCI format 4B

* Starting OFDM symbol $l\_{0}$ and duration $N$ and repetition number $R$ as defined in Subclause 5.5.3.2.2 of [3] for each configuration of SRS trigger type 2.

<Unchanged parts are omitted>

For TDD serving cell, and a UE configured for type 0 triggered SRS transmission in serving cell *c*, and the UE configured with the parameter *EIMTA-MainConfigServCell-r12* for serving cell *c*, if the UE does not detect an UL/DL configuration indication for radio frame *m* (as described in Subclause 13.1), the UE shall not transmit trigger type 0 SRS in a subframe of radio frame *m* that is indicated by the parameter *eimta-HARQ-ReferenceConfig-r12* as a downlink subframe unless the UE transmits PUSCH in the same subframe.

For a serving cell that is not a LAA SCell, trigger type 1 SRS configuration of a UE in a serving cell for SRS periodicity,, and SRS subframe offset,, is defined in Table 8.2-4 and Table 8.2-5, for FDD and TDD serving cell, respectively; and trigger type 2 SRS configuration of a UE in a serving cell for SRS periodicity,, and SRS subframe offset,, is defined in Table 8.2-5, for TDD serving cell. The periodicity  of the SRS transmission is serving cell specific and is selected from the set {2, 5, 10} ms or subframes.
For the SRS periodicity  of 2 ms in TDD serving cell configured for PUSCH and/or PUCCH transmission, two SRS resources are configured in a half frame containing UL subframe(s) of the given serving cell. For the SRS periodicity  of 2 ms in TDD serving cell not configured for PUSCH/PUCCH transmission, two or more SRS resources are configured in a half frame containing UL subframe(s) of the given serving cell.

For TDD serving cell configured for PUSCH and/or PUCCH transmission, and a UE configured for type 1/2 triggered SRS transmission in serving cell *c* and configured with the parameter *srs-UpPtsAdd*, the UE is not expected to receive trigger type 1/2 SRS configurations with SRS periodicity  of 2 ms.

A UE configured for type 1/2 triggered SRS transmission in serving cell *c* and not configured with a carrier indicator field shall transmit SRS on serving cell *c* upon detection of a positive SRS request in PDCCH/EPDCCH/MPDCCH/SPDCCH scheduling PUSCH/PDSCH on serving cell *c*.

A UE configured for type 1/2 triggered SRS transmission in serving cell *c* and configured with a carrier indicator field shall transmit SRS on serving cell *c* upon detection of a positive SRS request in PDCCH/EPDCCH/SPDCCH scheduling PUSCH/PDSCH with the value of carrier indicator field corresponding to serving cell *c*.

For a serving cell that is not a LAA SCell, a non-BL/CE UE configured for type 1/2 triggered SRS transmission on serving cell *c* upon detection of a positive SRS request in subframe *n*, slot *2n* or slot *2n+1* of serving cell *c* shall commence SRS transmission in the first subframe satisfying , and

-  if the positive SRS request in PDCCH/SPDCCH with DCI format 7-0A/7-1A is detected in slot *2n* or slot *2n+1,* for TDD

*- * if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI with DCI format other than DCI format 7-0A/7-0B/7-1E/7-1F/7-1G is in the UE-specific search space*,*

*- *otherwise, and

 for TDD serving cell *c* with  and for FDD serving cell *c*,

 for TDD serving cell *c* with 

where for FDD serving cell *c*  is the subframe index within the frame , for TDD serving cell *c*, if the UE is configured with the parameter *srs-UpPtsAdd* for trigger type 1,  is defined in Table 8.2-6; otherwise  is defined in Table 8.2-3. For a TDD serving cell not configured for PUSCH/PUCCH transmission and the positive SRS request detected in PDCCH/EPDCCH scheduling PDSCH and the UE configured with *soundingRS-FlexibleTiming-r14* by higher layer signalling, if the SRS transmission (including any interruption due to uplink or downlink RF retuning time [10]) in the first subframe  happens to overlap with a HARQ-ACK transmission for any serving cell, the UE shall commence SRS transmission in subframe *n + k + l*, where *l* = max( 5, ).

For a type 1/2 SRS triggered for more than one TDD serving cell in DCI format 3B and UE configured with more than 5 TDD serving cells without PUSCH/PUCCH transmission, the order of the triggered SRS transmission on the serving cells follow the order of the serving cells in the indicated set of serving cells configured by higher layers. For a type 1/2 SRS triggered for more than one TDD serving cell in DCI format 3B and UE configured with no more than 5 TDD serving cells without PUSCH/PUCCH transmission, the order of the triggered SRS transmission on the serving cells follow the order of the serving cells with type 1/2 SRS triggered in the DCI. The SRS resource for the *n*-th (*n*>=2) SRS transmission is determined such that it is the first SRS resource on or after the SRS resource for the (*n*-1)-th SRS transmission provided it does not collide with any previous SRS transmission triggered in the DCI format 3B, or interruption due to UL or DL RF retuning time [10].

For a serving cell *c* that is a LAA SCell, a UE configured for type 1 triggered SRS transmission on serving cell *c* upon detection of a positive SRS request in subframe *n* of serving cell *c* shall commence SRS transmission, conditioned on the channel access procedures described in subclause 4.2.1 of [13], in subframe , where

* corresponds to the scheduled PUSCH subframe determined in Subclause 8.0 if SRS is triggered in DCI format 0A/4A,
* is determined from Table 8.2-0A and the corresponding scheduled PUSCH subframe determined in Subclause 8.0 if SRS is triggered in DCI format 0B,
*  where the value of *l* is determined from SRS subframe parameter for the indicated SRS parameter set in Table 8.1, is determined from the first scheduled PUSCH subframe determined in Subclause 8.0 and *N* is determined by the procedure in Subclause 8.0 if SRS is triggered in DCI format 4B,
* where the value of *l* is determined by the SRS timing offset field in the corresponding DCI if SRS is triggered in DCI format 1A/2B/2C/2D according to Table 8.2-0B.

**Table 8.2-0B:  for SRS trigger type 1/2 in DCI format 1A/2B/2C/2D**

|  |  |
| --- | --- |
| **Value of SRS timing offset field** |  |
| '000' |  No type 1/2 SRS trigger |
| '001' | 1 |
| '010' | 2 |
| '011' | 3 |
| '100' | 4 |
| '101' | 5 |
| '110' | 6 |
| '111' | 7 |

A BL/CE UE configured for type 1 triggered SRS transmission on serving cell *c* upon detection of a positive SRS request of serving cell *c* shall commence SRS transmission in the first subframe satisfying , where subframe *n* is the last subframe in which the DCI format 6-0A/6-1A with the positive SRS request is transmitted, and

 for TDD serving cell *c* with  and for FDD serving cell *c*,

 for TDD serving cell *c* with  where for FDD serving cell *c*  is the subframe index within the frame , for TDD serving cell *c* , if the UE is configured with the parameter *srs-UpPtsAdd* for trigger type 1,  is defined in Table 8.2-6; otherwise  is defined in Table 8.2-3.

A UE configured for type 1/2 triggered SRS transmission is not expected to receive type 1/2 SRS triggering events associated with different values of trigger type 1/2 SRS transmission parameters, as configured by higher layer signalling, for the same subframe and the same serving cell.

For a serving cell that is a LAA SCell, a UE configured for type 1 triggered SRS transmission is not expected to receive type 1 SRS triggering event in DCI format 0B associated with a subframe that is not scheduled for PUSCH transmission for the same serving cell.

For a serving cell that is an LAA SCell, if the uplink transmission in a subframe is ending in the end of symbol #3 or in the end of symbol #6, the UE shall not transmit SRS in that subframe.

A UE configured for type 2, type 1 or type 0 triggered SRS transmission and more than one TDD serving cell without PUSCH/PUCCH transmission is not expected to receive type 2, type 1 or type 0 SRS triggering events that can result in uplink transmissions beyond the UE's indicated uplink carrier aggregation capability included in the *UE-EUTRA-Capability* [12].

For TDD serving cell *c*, and a UE configured with *EIMTA-MainConfigServCell-r12* for a serving cell *c*, the UE shall not transmit SRS in a subframe of a radio frame that is indicated by the corresponding eIMTA-UL/DL-configuration as a downlink subframe.

A UE shall not transmit SRS whenever SRS and a PUSCH transmission corresponding to a Random Access Response Grant or a retransmission of the same transport block as part of the contention based random access procedure coincide in the same subframe.

A UE not configured with higher layer parameter *ul-STTI-Length* is not expected to be triggered with trigger type 2 SRS transmission in the same symbols as a PUSCH/PUCCH.

**Table 8.2-1: UE Specific SRS Periodicity  and Subframe Offset Configuration 
 for trigger type 0, FDD**

|  |  |  |
| --- | --- | --- |
| **SRS Configuration Index ISRS** | **SRS Periodicity  (ms)** | **SRS Subframe Offset**  |
| 0 – 1 | 2 | ISRS |
| 2 – 6 | 5 | ISRS – 2 |
| 7 – 16 | 10 | ISRS – 7 |
| 17 – 36 | 20 | ISRS – 17 |
| 37 – 76 | 40 | ISRS – 37 |
| 77 – 156 | 80 | ISRS – 77 |
| 157 – 316 | 160 | ISRS – 157 |
| 317 – 636 | 320 | ISRS – 317 |
| 637 – 1023 | reserved | reserved |

**Table 8.2-2: UE Specific SRS Periodicity  and Subframe Offset Configuration 
 for trigger type 0, TDD**

|  |  |  |
| --- | --- | --- |
| **SRS Configuration Index** **ISRS** | **SRS Periodicity** **(ms)** | **SRS Subframe Offset** |
| 0 | 2 | 0, 1 |
| 1 | 2 | 0, 2 |
| 2 | 2 | 1, 2 |
| 3 | 2 | 0, 3 |
| 4 | 2 | 1, 3 |
| 5 | 2 | 0, 4 |
| 6 | 2 | 1, 4 |
| 7 | 2 | 2, 3 |
| 8 | 2 | 2, 4 |
| 9 | 2 | 3, 4 |
| 10 – 14 | 5 | ISRS – 10 |
| 15 – 24 | 10 | ISRS – 15 |
| 25 – 44 | 20 | ISRS – 25 |
| 45 – 84 | 40 | ISRS – 45 |
| 85 – 164 | 80 | ISRS – 85 |
| 165 – 324 | 160 | ISRS – 165 |
| 325 – 644 | 320 | ISRS – 325 |
| 645 – 1023 | reserved | reserved |

**Table 8.2-3:  for TDD**

|  |  |
| --- | --- |
|  | **subframe index *n*** |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1st symbol of UpPTS** | **2nd symbol of UpPTS** | **1st symbol of UpPTS** | **2nd symbol of UpPTS** |
|  **in case UpPTS length of 2 symbols** |  | 0 | 1 | 2 | 3 | 4 |  | 5 | 6 | 7 | 8 | 9 |
|  **in case UpPTS length of 1 symbol** |  | 1 |  | 2 | 3 | 4 |  | 6 |  | 7 | 8 | 9 |

**Table 8.2-4: UE Specific SRS Periodicity  and Subframe Offset Configuration 
 for trigger type 1, FDD**

|  |  |  |
| --- | --- | --- |
| **SRS Configuration Index ISRS** | **SRS Periodicity  (ms)** | **SRS Subframe Offset**  |
| 0 – 1 | 2 | ISRS |
| 2 – 6 | 5 | ISRS – 2 |
| 7 – 16 | 10 | ISRS – 7 |
| 17 – 31 | reserved | reserved |

=======================End of text proposal to TS 36.213============================

# References

1. R1-200xxxx Feature summary on #1 100b-e-LTE-LTE\_DL\_MIMO\_EE-02 Moderator(Huawei)