**3GPP TSG RAN WG1 Meeting #101-e R1-200xxxx**

**E-Meeting, May 25 – June 5, 2020**

**Agenda Item: 6.2.3.1.1**

**Source: Moderator (Huawei)**

**Title: Feature summary #1 on LTE DL MIMO efficiency enhancement**

**Document for: Discussion and Decision**

# Introduction

Agreements and conclusions in previous meeting for the LTE DL MIMO efficiency enhancements (WI code LTE\_DL\_MIMO\_EE-Core; WID in RP-182901) are summarized in [1].

In this paper, the inputs from companies submitted to RAN1#100-e meeting ([2]-[9]) on remaining issues are summarized.

# Discussion

## Transmission pattern

Issue 1: Indexing of additional SRS symbols.

* As explained in [4], the parameter *l* in may be misleading as the range of the parameter is not defined. The interpretation that is OFDM symbol index within the subframe should be avoided.
* Proposal: Endorse the following text proposal to TS 36.211

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| Mapping to physical resources shall be done according to clause 5.5.3.2.1 with the following exceptions:- frequency hopping between OFDM symbols is supported and if a UE is configured by higher layer parameter *additionalSRS-GuardSymbolFH*, a guard symbol is added between every frequency hop;- where is the ~~index of the OFDM symbol number carrying~~ additional SRS transmission number within the subframe, where corresponds to the first OFDM symbol of SRS transmission ~~not counting guard symbol(s)~~ , and is the repetition factor given by the higher-layer parameter *additionalSRS-RepNum*; |

## Collision handling

Issue 2: Support of additional SRS for DC

 There are two options considering the support of DC:

* Option 1: As explained in [3][7][8], the additional SRS can be applied in DC cases.
	+ Proposal:
		- Legacy UE behavior related to dual connectivity power control mode 1 and 2, including simultaneous transmission of SRS in a cell group and PUCCH/PUSCH in the other cell group, SRS power scaling within a cell group, and dropping rules, should be inherited for additional SRS.
* In [3], the following is proposed:

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| =========================Start of text proposal 2 to 36.213===========================5.1.4.1 Dual connectivity power control Mode 1If the UE PUSCH/PUCCH transmission(s) in subframe  of CG1 overlap in time with PUSCH/PUCCH transmission(s) in more than one symbol of subframe of CG2 or if any symbol the UE PUSCH/PUCCH transmission(s) in subframe  of CG1 overlap in time with SRS transmission(s) of subframe , and <unchanged parts are omitted>-  is determined as follows- if the PUSCH/PUCCH is not transmitted in the last symbol of subframe  of CG1 and UE does not have a trigger type 2 SRS transmission in subframe of serving cell , or if the UE does not have an SRS transmission in subframe  of serving cell or if the UE drops SRS transmission in subframe  of serving cell  due to collision with PUCCH in subframe  of serving cell - ; - if the UE has an SRS transmission and does not have a PUCCH/PUSCH transmission in subframe  of serving cell - ;- if the UE has a trigger type 0/1 SRS transmission and has a PUCCH transmission, and does not have a PUSCH transmission in subframe  of serving cell - - if the UE has a trigger type 0/1 SRS transmission and has a PUSCH transmission, and does not have a PUCCH transmission in subframe  of serving cell - - if the UE has a trigger type 0/1 SRS transmission and has a PUSCH transmission and a PUCCH transmission in in subframe  of serving cell - <unchanged parts are omitted>5.1.4.2 Dual connectivity power control Mode 2<unchanged parts are omitted>-  is determined as follows- if the UE does not have an SRS transmission in subframe  of serving cell or if the UE drops the SRS transmission in subframe  of serving cell due to collision with a PUCCH/PUSCH transmission in subframe  of serving cell - ; - if the UE has an SRS transmission and does not have a PUCCH/PUSCH transmission in subframe  of serving cell  - ;- if the UE has a trigger type 0/1 SRS transmission and has a PUCCH transmission, and does not have a PUSCH transmission in subframe  of serving cell - - if the UE has a trigger type 0/1 SRS transmission and has a PUSCH transmission, and does not have a PUCCH transmission in subframe  of serving cell - - if the UE has a trigger type 0/1 SRS transmission and has a PUSCH transmission and a PUCCH transmission in subframe  of serving cell - where is the linear value of described in Subclause 5.1.3.1.<unchanged parts are omitted>=========================End of text proposal to 36.213=========================== |

* Option 2: As explained in [5], DC scheduling between MCG and SCG requires coordination over X2 interface. It would be difficult to deal with the collision between additional SRS and PUCCH/PUSCH in DC.
	+ Proposal:
		- Additional SRS is not applied to DC
		- Endorse the following TP

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| < Unchanged parts are omitted>5.1.4 Power allocation for EUTRA dual connectivityIf a UE is configured with multiple cell groups, the UE is not expected to be configured with SRS trigger type 2, and- if the UE supports synchronous dual connectivity but does not support asynchronous dual connectivity, or if the UE supports both synchronous dual connectivity and asynchronous dual connectivity and if the higher layer parameter *powerControlMode* indicates dual connectivity power control mode 1< Unchanged parts are omitted> |

Issue 3: Support of additional SRS for carrier based switching.

* As explained in [5][8], including the retuning time, the configured additional SRS may have impact the uplink transmission in the previous and/or next subframe.
	+ For collision of additional SRS in subframe N with uplink transmission in subframe N-1:
		- Option 1: The UE is not expected to be triggered to transmit type 2 SRS on a PUSCH-less CC in subframe N that overlaps (including the retuning time) with uplink subframe N-1 on a different CC.
		- Option 2: In addition to current dropping/puncturing rules defined for SRS carrier switching, UE may drop additional SRS transmission in the symbols of the first slot of the subframe
	+ For collision of additional SRS in subframe N with uplink transmission in subframe N+1:
		- In case a subset of the symbols for type 2 SRS transmission in subframe N on a PUSCH-less CC collide (including the retuning time) with a higher priority uplink transmission in subframe N+1 on a different CC, the UE shall drop the subset of type 2 SRS symbols.
		- Endorse the following TP

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| <TP1 for TS 36.213>8.2 UE sounding procedure< Unchanged parts are omitted>For a TDD serving cell *d* not configured for PUSCH/PUCCH transmission, denote as *s*0(*d*)the corresponding serving cell whose UL transmissions may be interrupted as signalled by *srs-SwitchFromServCellIndex*. Define the set *S*(*d*)*=* {*s*0(*d*)… *s*N-1(*d*)} as the set of serving cells that meet the all the following conditions:- {*s*0(*d*)… *s*N-1(*d*)} are in the same band as *s*0(*d*).- {*s*0(*d*)… *s*N-1(*d*)} have the same CP as *s*0(d).- {*s*0(*d*)… *s*N-1(*d*)} are in the same TAG as *s*0(d).The following prioritization rules shall be applied in case of collision between a transmission of SRS over serving cell *d* and transmission of a physical signal/channel over a serving cell in set *S(d)*:- If PUSCH/PUCCH transmission carrying HARQ-ACK/positive SR/RI/PTI/CRI/wideband PMI only (PUCCH reporting type 2a in Subclause 7.2.2) and/or PRACH on a serving cell in set *S(d)* overlaps in the same symbol with the SRS transmission (including any interruption due to uplink or downlink RF retuning time [10]) on serving cell *d*, then the UE shall not transmit type 0/1 SRS or drop the overlapped symbol(s) of type 2 SRS (including any interruption due to uplink or downlink RF retuning time [10]). Otherwise,- if PUSCH transmission carrying aperiodic CSI on a serving cell in set *S(d)* overlaps in the same symbol with the SRS transmission (including any interruption due to uplink or downlink RF retuning time [10]) in serving cell *d*, and if the SRS transmission is a type 0 SRS transmission, then the UE shall not transmit the type 0 SRS. Otherwise,- if PUSCH transmission on a serving cell in set *S(d)* overlaps in more than one symbol with the SRS transmission (including any interruption due to uplink or downlink RF retuning time [10]) in serving cell *d*, then the UE shall drop the PUSCH transmission. If PUCCH/type 0/1 SRS transmission on a serving cell in set *S(d)* overlaps in the same symbol with the SRS transmission (including any interruption due to uplink or downlink RF retuning time [10]) on serving cell *d*, the UE shall drop the PUCCH/type 0/1 SRS transmission. If a subset of symbol(s) for type 2 SRS transmission on a serving cell in set *S(d)* overlaps in with the SRS transmission (including any interruption due to uplink or downlink RF retuning time [10]) on serving cell *d*, the UE shall drop the subset of the symbol(s) for type 2 SRS on a serving cell in set *S(d)*.In case an SRS transmission in subframe N on serving cell *d* is dropped due to a collision with a higher priority transmission (as defined above) in subframe N+1, and there is a lower priority transmission (as defined above) in subframe N that would have been dropped had the transmission in subframe N+1 not occurred, the UE is not required to transmit the lower priority transmission in subframe N.The UE is not expected to be triggered to transmit type 2 SRS on serving cell *d* in subframe N that overlaps (including any interruption due to uplink or downlink RF retuning time [10]) with uplink subframe N-1 on a serving cell in set *S(d).*< Unchanged parts are omitted> |

* As explained in [5], with *soundingRS-FlexibleTiming* configured, the legacy SRS can be postponed once to the next SRS occasion, which can be used to type 2 SRS.
	+ Proposal:
		- In case a subset of the symbols for type 2 SRS transmission on a PUSCH-less CC collide (including the retuning time) with HARQ-ACK transmission, the UE shall postpone the subset of the type 2 SRS symbol(s) once to next SRS occasion if the UE is configured with *soundingRS-FlexibleTiming*.
		- Endorse the following TP

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| <TP2 for TS 36.213>8.2 UE sounding procedure< Unchanged parts are omitted>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 type 1 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 type 1 SRS transmission in subframe *n + k + l*, where *l* = max( 5, ); if a subset of the symbols corresponding to the type 2 SRS transmission (including any interruption due to uplink or downlink RF retuning time [10]) in the first subframe , happen to overlap with a HARQ-ACK transmission for any serving cell, the UE shall commence the transmission of the subset of the type 2 SRS symbols in subframe , where .< Unchanged parts are omitted> |

## Other

Issue 4: Additional SRS for LAA, eMTC.

* As explained in [5][6][8],
	+ Due to limited bandwidth, the BL/CE UEs will use frequency hopping to achieve the frequency diversity gain, which requires RF retuning, which has not been discussed in RAN1.
	+ For LAA UEs, if additional SRS is triggered to be transmitted in the unlicensed band, there may be impact on the channel access before the additional SRS transmission, which has not been discussed in RAN1.
	+ The discussion is out of scope of R16 WID.
* Proposal: Additional SRS is not applied to LAA, eMTC, and endorse the following TP

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| < Unchanged parts are omitted>8.2 UE sounding procedure< Unchanged parts are omitted>A UE is not expected to be configured with SRS trigger type 0 and trigger type 2 on a LAA SCell.< Unchanged parts are omitted>- 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. A BL/CE UE is not expected to be configured with SRS parameters for trigger type 2. 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.< Unchanged parts are omitted> |

Issue 5: Term alignment between specs.

* As explained in [2][3][7][9], the term used in 36.211 is additional SRS symbol while in 36.213 it’s trigger type 2. But it is not specified that trigger type 2 SRS corresponds to additional SRS, and it should be clarified that trigger type 0 SRS and trigger type 1 SRS correspond to periodic SRS and aperiodic SRS of basic SRS respectively.
* Proposal: Endorse one of the following text proposal

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| Text proposal to 36.2138.2 UE sounding procedureIf 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/6-0A/6-1A 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*.

Trigger type 0 and type 1 SRS correspond to periodic SRS and aperiodic SRS of basic SRS respectively in Subclause 5.5.3 of [1]. Trigger type 2 SRS corresponds to additional SRS in Subclause 5.5.3 of [1]. |

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| Text proposal to 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: triggering of basic sounding reference signals as defined in subclause 5.5.3 of [3], by 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*  and the UE is configured for SRS triggering with *srs-DCI7-TriggeringConfig* . * trigger type 2: triggering of additional sounding reference signals as defined in subclause 5.5.3 of [3], by DCI formats 0/4/1A/6-0A/6-1A 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* and the UE is configured for SRS triggering with *srs-DCI7-TriggeringConfig*.

**<Unchanged parts are omitted>** |

Or

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| Text proposal to 36.211 **---- Unchanged parts are omitted ----**5.5.3 Sounding reference signal Two types of sounding reference signals can be configured:- basic sounding reference signal, supporting periodic or aperiodic transmission- **additional sounding reference signal**, supporting aperiodic transmission onlyBasic SRS corresponds to either SRS trigger type 0 or type 1 in 8.2 of [4]. Additional SRS corresponds to SRS trigger type 2 in 8.2 of [4]. **---- Unchanged parts are omitted ----** |

Or

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| -------------------------- Start of proposed TP1 for TS 36.211 ------------------------------------5.5.1.5 Determining virtual cell identity for sequence generationThe definition of  depends on the type of transmission.Transmissions associated with PUSCH:-  if no value for  is configured by higher layers or if the PUSCH transmission corresponds to a Random Access Response Grant or a retransmission of the same transport block as part of the contention based random access procedure, -  otherwise.Transmissions associated with SPUCCH/PUCCH:-  if no value for  is configured by higher layers, -  otherwise.~~Basic s~~Sounding reference signal~~s~~ transmissions of types 0 and 1 as defined in 8.2 of [4]:- if the higher-layer parameters *nSRS-Identity-Legacy* and *nSRS-Identity* both are configured, where equals the higher-layer parameter *nSRS-Identity*- otherwise.~~Additional s~~Sounding reference signal~~s~~ transmissions of type 2 as defined in 8.2 of [4]:- if no value for is configured by the higher-layer parameter *nSRS-Identity*- otherwise.----------------------------------------------- Unchanged text omitted -------------------------------------------5.5.3 Sounding reference signal Three types of sounding reference signals can be configured as defined in 8.2 of [4]: SRS trigger type 0, SRS trigger type 1, and SRS trigger type 2.~~Two types of sounding reference signals can be configured:~~~~- basic sounding reference signal, supporting periodic or aperiodic transmission~~~~- additional sounding reference signal, supporting aperiodic transmission only~~5.5.3.1 Sequence generation5.5.3.1.1 Sequence generation for SRS trigger types 0 and 1 ~~basic SRS~~The sounding reference signal sequence  is defined by clause 5.5.1, where  is the sequence-group number defined in clause 5.5.1.3,  is the base sequence number defined in clause 5.5.1.4, and . The cyclic shift  of the sounding reference signal is given as ,where  is configured separately for periodic and each configuration of aperiodic sounding by the higher-layer parameters *cyclicShift* and *cyclicShift-ap*, respectively, for each UE and  is the number of antenna ports used for sounding reference signal transmission. The parameter  if  , otherwise . The parameter  is given by the higher layer parameter *transmissionCombNum* if configured, otherwise .5.5.3.1.2 Sequence generation for SRS trigger type 2 ~~additional SRS~~The sounding reference signal is defined by clause 5.5.3.1.1 with the following exceptions- is given by the higher-layer parameter *additionalSRS-cyclicShift*- is given by the higher-layer parameter *additionalSRS-AntennaPort*- is given by the higher-layer parameter *additionalSRS-transmissionComb*- the function in clause 5.5.1.3 is given by where is the OFDM symbol index within the slot and is the number of OFDM symbols per slot- the function in clause 5.5.1.4 is given by5.5.3.2 Mapping to physical resources5.5.3.2.1 Mapping to physical resources for SRS trigger types 0 and 1 ~~basic SRS~~The sequence shall be multiplied with the amplitude scaling factor  in order to conform to the transmit power  specified in clause 5.1.3.1 in 3GPP TS 36.213 [4], and mapped in sequence starting with  to resource elements  on antenna port  according to----------------------------------------------- Unchanged text omitted -------------------------------------------5.5.3.2.2 Mapping to physical resources for SRS trigger type 2 ~~additional SRS~~An ~~additional~~ SRS of trigger type 2 spans one or more OFDM symbols in the time domain, where- the starting OFDM symbol within the subframe is given by the higher-layer parameter *additionalSRS-startPos*;- the duration in number of OFDM symbols, including potential guard symbols, is given by the higher-layer parameter *additionalSRS-duration*;Mapping to physical resources shall be done according to clause 5.5.3.2.1 with the following exceptions:- frequency hopping between OFDM symbols is supported and if a UE is configured by higher layer parameter *additionalSRS-GuardSymbolFH*, a guard symbol is added between every frequency hop;- where is the index of the OFDM symbol number carrying ~~additional~~ SRS of trigger type 2 within the subframe not counting guard symbol(s), and is the repetition factor given by the higher-layer parameter *additionalSRS-RepNum*;- is given by the higher-layer parameter *additionalSRS-Bandwidth*;- is given by the higher-layer parameter *additionalSRS-HoppingBandwidth*;- is the number of frequency hops for ~~additional~~ SRS of trigger type 2, derived from if antenna switching is not configured for ~~additional~~ SRS of trigger type 2, and from if antenna switching is configured for ~~additional~~ SRS of trigger type 2, where is the repetition factor given by the higher-layer parameter *additionalSRS-RepNum*, is the number of antenna switches for ~~additional~~ SRS of trigger type 2 defined in 8.2 of [4], is the guard-symbol configuration for antenna switching given by the higher-layer parameter *additionalSRS-GuardSymbolAS*, is the guard symbol configuration for frequency hopping given by the higher-layer parameter *additionalSRS-GuardSymbolFH*, and is given by the higher-layer parameter *additionalSRS-duration*;- is given by the higher-layer parameter *freqDomainPosition-additionalSRS*;- is given by the higher-layer parameter *additionalSRS-AntennaPort*;- is given by the higher-layer parameter *additionalSRS-cyclicShift*;- is given by the higher-layer parameter *additionalSRS-transmissionCombNum*;- is given by the higher-layer parameter *additionalSRS-transmissionComb*.------------------------------------------- End of proposed TP 1 ---------------------------------------------------- |

Issue 6: Aligning the higher layer parameters for virtual cell ID.

* As explained in [2], high layer parameters *srs-VirtualCellID* and *srs-VirtualCellID-AllSRS* are introduced, which are not aligned with the name of *nSRS-Identity* and *nSRS-Identity-Legacy* in TS 36.211
* Proposal: *nSRS-Identity* and *nSRS-Identity-Legacy* in TS 36.211 should be replaced with *srs-VirtualCellID* and *srs-VirtualCellID-AllSRS.*

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| 5.5.1.5 Determining virtual cell identity for sequence generationThe definition of  depends on the type of transmission.Transmissions associated with PUSCH:-  if no value for  is configured by higher layers or if the PUSCH transmission corresponds to a Random Access Response Grant or a retransmission of the same transport block as part of the contention based random access procedure, -  otherwise.Transmissions associated with SPUCCH/PUCCH:-  if no value for  is configured by higher layers, -  otherwise.Basic sounding reference signals:- if the value of higher-layer parameter *srs-VirtualCellID-AllSRS* is TRUE and *srs-VirtualCellID* is configured, where equals the higher-layer parameter *srs-VirtualCellID*- otherwise.Additional sounding reference signals:- if no value for is configured by the higher-layer parameter *srs-VirtualCellID*- otherwise. |

Issue 7: Typos for power control in 36.213.

* As explained in [7], there are several typos in 36.213 for power control.
* Proposal: Endorse the following text proposal to TS 36.213

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| Text proposal to 36.213**---- Unchanged parts are omitted ----**5.1.3 Sounding Reference Symbol (SRS)5.1.3.1 UE behaviourThe setting of the UE Transmit power for the SRS transmitted on subframe *i* for serving cell is defined by: for SRS transmission given trigger type 2 or for serving cell with frame structure type 2, and not configured for PUSCH/PUCCH transmission [dBm]otherwise [dBm]where - is the configured UE transmit power defined in [6] in subframe *i* for serving cell .- is semi-statically configured by higher layers for *m=0* and *m=1* for serving cell . For SRS transmission given trigger type 0 then *m=0* and for SRS transmission given trigger type 1 then *m=1*. - is the bandwidth of the SRS transmission in subframe *i* for serving cell expressed in number of resource blocks.- is the current PUSCH power control adjustment state for serving cell , see Subclause 5.1.1.1.- and are parameters as defined in Subclause 5.1.1.1 for subframe , where .- is the higher layer parameter *alpha-SRS* for SRS transmission given trigger type 0, 1, or is the higher layer parameter *alpha-additionalSRS* for SRS transmission given trigger type 2, configured by higher layers for serving cell .- is a parameter composed of the sum of a component which is *p0-Nominal-PeriodicSRS,* *p0-Nominal-AperiodicSRS*, or *p0\_Nominal\_AdditionalSRS* provided from higher layers for *m=0,* *1* or *2* respectively, and a component which is *p0-UE-PeriodicSRS,* *p0-UE-AperiodicSRS*, or *p0-Nominal-AdditionalSRS* provided by higher layers for *m=0,* *1* or *2* respectively, for serving cell . For SRS transmission given trigger type 0 then *m=0* and for SRS transmission given trigger type 1 then *m=1* and for SRS transmission given trigger type 2 then *m=2*. **---- Unchanged parts are omitted ----** |

Issue 8: UL SC-FDMA symbol for additional SRS.

* As explained in [7], a SC-FDMA symbol instead of an OFDM symbol is used for a UL symbol.
* Proposal: Endorse the following text proposal to TS 36.211 and 36.213

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| Text proposal to 36.211< Unchanged parts are omitted>5.5.3.1.2 Sequence generation for additional SRSThe sounding reference signal is defined by clause 5.5.3.1.1 with the following exceptions- is given by the higher-layer parameter *additionalSRS-cyclicShift*- is given by the higher-layer parameter *additionalSRS-AntennaPort*- is given by the higher-layer parameter *additionalSRS-transmissionComb*- the function in clause 5.5.1.3 is given by where is the SC-FDMA symbol index within the slot and is the number of SC-FDMA symbols per slot- the function in clause 5.5.1.4 is given by< Unchanged parts are omitted>5.5.3.2.2 Mapping to physical resources for additional SRSAn additional SRS spans one or more SC-FDMA symbols in the time domain, where- the starting SC-FDMA symbol within the subframe is given by the higher-layer parameter *additionalSRS-startPos*;- the duration in number of SC-FDMA symbols, including potential guard symbols, is given by the higher-layer parameter *additionalSRS-duration*;Mapping to physical resources shall be done according to clause 5.5.3.2.1 with the following exceptions:- frequency hopping between SC-FDMA symbols is supported and if a UE is configured by higher layer parameter *additionalSRS-GuardSymbolFH*, a guard symbol is added between every frequency hop;- antenna switching within a subframe is supported and if a UE is configured by higher layer parameter *additionalSRS-GuardSymbolAS*, a guard symbol is added between every antenna switching;- where is the index of the SC-FDMA symbol number carrying additional SRS within the subframe not counting guard symbol(s), and is the repetition factor given by the higher-layer parameter *additionalSRS-RepNum*;< Unchanged parts are omitted> |

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| Text proposal to 36.2138.2 UE sounding procedure< Unchanged parts are omitted>- SRS subframe for each configuration of trigger type 1 for a serving cell that is a LAA SCell and DCI format 4B * Starting SC-FDMAsymbol and duration and repetition number as defined in Subclause 5.5.3.2.2 of [3] for each configuration of SRS trigger type 2.

< Unchanged parts are omitted> |

# Summary

FL’s view on the issues that are prioritized for discussion in this e-meeting are as following:

* Support of additional SRS for carrier based switching and dual connectivity
	+ - Issues 2, 3
* Indexing of additional SRS symbols
	+ - Issues 1
* Support of additional SRS to LAA/eMTC
	+ - Issue 4
* Alignment/correction of terms, higher layer parameters, typos
	+ - Issues 5, 6, 7, 8

# References

1. R1-1913596, “RAN1 agreements for DL MIMO efficiency enhancements for LTE”, Huawei, Reno, USA, November 2019.
2. R1-2003466 Maintenance of additional SRS symbols ZTE
3. R1-2003541 Corrections on additional SRS symbols Huawei, HiSilicon
4. R1-2003723 Corrections to additional SRS Intel Corporation
5. R1-2003784 Additional SRS symbols Qualcomm Incorporated
6. R1-2003818 Additional SRS symbols Lenovo, Motorola Mobility
7. R1-2003925 Text proposals on additional SRS symbols LG Electronics
8. R1-2003937 Remaining details of additional SRS symbols Nokia, Nokia Shanghai Bell
9. R1-2004431 Maintenance on additional SRS symbols Ericsson