**3GPP TSG RAN WG1 #109-e R1-2205246**

**e-Meeting, May 9th – 20th, 2022**

**Title:** **DRAFT** LS response on TCI state signalling for SRS resource

**Response to:** R2-2206356

**Release:** Rel-17

**Work Item:** NR\_feMIMO-Core

**Source:** Moderator (OPPO)

**To:** RAN2

**Cc:** --

**Contact Person:**

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**Attachments:** None

# 1. Overall Description:

This is a reply LS to RAN2 to address the RAN2 questions on TCI state signalling for SRS resource in R2-2206356.

**2. Questions and answers**

**Question 1:**

For using unified TCI states with SRS resources, are there cases that are not addressed by current RRC specification (v17.0.0) and would require something to be specified in RAN2 (i.e., new RRC parameter or MAC CE based signalling)?

**Answer 1**:

The current RRC specifications covers the following case:

* SRS resource configured to follow the unified TCI state. This can be (1) aperiodic SRS for BM (2) Any time domain behaviour of SRS for CB/NCB/Ant Switching

***followUnifiedTCIstateSRS***

When set to enabled, for SRS resource Set, the UE applies the "indicated" Rel-17 DL only or joint TCI as specified in TS 38.214 clause 5.1.5. This parameter may be configured for aperiodic SRS for BM or SRS of any time-domain behavior for codebook, non-codebook, and antenna switching.

The following cases are not covered by current RRC specification:

* SRS resource not configured to follow the unified TCI state. The Rel-17 TCI state can be indicated by: (1) RRC configuration for periodic SRS (2) MAC CE for AP-SRS and SP-SRS
* P/SP-SRS for beam management. These don’t follow the unified TCI state. The Rel-17 TCI state can be indicated by: (1) RRC configuration for periodic SRS (2) MAC CE for SP-SRS

This follows the following RAN1 agreements:

**Agreement RAN1#106-e**

On Rel.17 unified TCI framework:

* Aperiodic SRS resources or resource sets for BM can share the same indicated Rel-17 TCI state as dynamic-grant/configured-grant based PUSCH, all or subset of dedicated PUCCH resources in a CC
	+ FFS: Discuss if/which restriction is necessary, e.g. only for aperiodic, apply to all resources in a set
	+ Note: This doesn’t imply that all time-domain behaviors are automatically supported

**Agreement RAN1#106b-e**

On Rel.17 unified TCI framework, for Rel-17 unified TCI, for DL or UL channels/signals that can share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH/PDCCH or dynamic-grant/configured-grant based PUSCH, all of dedicated PUCCH resources (via Rel-17 MAC-CE/DCI TCI state update):

* For DL: A non-UE dedicated PDCCH/PDSCH associated with the serving cell PCI or AP CSI-RS for BM or CSI (per previous agreements) sharing the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH/PDCCH (via Rel-17 MAC-CE/DCI TCI state update) is configured via RRC.
* For UL: An SRS for BM, for antenna switching, or for codebook/non-codebook based uplink transmission (per previous agreements) sharing the same indicated Rel-17 TCI state as dynamic-grant/configured-grant based PUSCH, all of dedicated PUCCH resources (via Rel-17 MAC-CE/DCI TCI state update) is configured via RRC.

Note: The details of this RRC configuration (e.g. whether via a new RRC parameter or other means) is up to RAN2. This does not imply that a new RRC parameter(s) is necessary from RAN1 point of view.

FFS: Relevant UE capability to be discussed under UE feature agenda item.

A possible implementation would be to include the field

 tciState-r17 CHOICE {

 tci-StateUnifiedId-r17 TCI-StateId,

 ul-TCIState-Id-r17 UL-TCIState-Id-r17

}

in the SRS-Resource IE.

For details on the MAC CE implementation, see the answer to question 3.

**Question 2:**

Is it sufficient to configure RRC parameter i.e. UL or joint TCI state for SRS Resource to address use of unified TCI state with SRS resources?

**Answer 2:** No, it is not sufficient. For a semi-persistent or aperiodic SRS resource that is not configured or cannot follow the unified TCI state, MAC-CE signalling is needed to provide a joint or UL TCI state for the SP/AP SRS resource.

**Question 3:**

If answer to Q2 is "no" and MAC CE based solution is necessary for unified TCI states to work with SRS resource(set)s, please respond to below set of questions. Note that in order to have specification support for MAC operation the response needs to be detailed and clear enough for RAN2 to specify the needed support in RAN2#118:

1. What information is included for all the fields in the MAC CE (please indicate each parameter that should be included in MAC CE assuming a new MAC CE is designed from scratch) ?
2. How is such a MAC CE indication be used? Is it required to define activation/deactivation of concerned SRS resource (set)s with the associated TCI state (as same as SP SRS Activation/Deactivation MAC CE or enhanced SP/AP SRS Spatial Relation Indication MAC CE), or something else?
3. Does the MAC CE apply for one serving cell, or should we also apply for serving cells according to the simultaneous TCI state update list(s) configured for unified TCI state?

**Answer 3:**

A MAC CE should be designed for each of the following to signal a Rel-17 TCI state instead of the Rel-15/16 spatial relation.

1. SP SRS Activation/Deactivation MAC CE (TS 38.321 clause 6.1.3.17)
2. Enhanced SP/AP SRS Spatial Relation Indication MAC CE (TS 38.321 clause 6.1.3.26)
3. Serving Cell Set based SRS Spatial Relation Indication MAC CE (TS 38.321 clause 6.1.3.29)

For each of these, the resource ID which provides an identifier of the resource used for spatial relationship derivation is replaced by a Rel-17 TCI state that can be an UL TCI state or a Joint TCI state. Regarding the field F\_i in the corresponding MAC CE:

* In RAN,1 some companies think it can be used to indicate whether the indicated TCI state is an UL TCI state or a Joint TCI state.
* But other companies in RAN1 suggest that the using field F\_i to indicate TCI state type is not needed because UL TCI state and joint TCI state are configured according to the joint or separate TCI mode configured to the serving cell.

Other fields in the respective MAC CEs can remain the same.

The usage of the MAC CE is similar to the corresponding Rel-15/16 usage.

Similar to Rel-15/16, the MAC CE can apply to more than one serving cell. The serving cell ID for each resource ID is included in the MAC CE.

This is according to the following RAN1 agreement:

**Agreement RAN1#108-e**

On Rel-17 unified TCI framework, for any SRS resource or resource set that does not share the same indicated Rel-17 TCI state(s) as dynamic-grant/configured-grant based PUSCH and all of dedicated PUCCH resources, but can be configured as a target signal of a Rel-17 UL or, if applicable, joint TCI (hence the Rel-17 UL or, if applicable, joint TCI state pool), Rel-17 mechanism(s) which reuse mechanisms similar to the Rel-15/16 spatial relation info update signaling/configuration design(s) are used to update/configure such SRS (s) with Rel-17 UL or, if applicable, joint TCI state(s).

* Including inter-cell case, where SSB with PCI different from the serving cell can be used as a source RS in Rel-17 UL, or if applicable joint, TCI state for these SRS resources
* The UL PC parameter setting (including PL-RS) for the SRS resource set should be derived based on the setting associated with TCI indicated for the SRS resource with the lowest SRS-ResourceId in that SRS resource set
* The MAC-CE signaling for the Rel-17 mechanism(s) to update the spatial relation of the AP/SP-SRS not sharing the indicated Rel-17 TCI state shall provide an ID of Rel-17 UL or, if applicable, joint TCI state instead of an RS resource ID for each AP/SP-SRS resource
	+ Reuse other aspects of the MAC-CE for the Rel-15/16 spatial relation info update (including 'SP SRS Activation/Deactivation MAC CE', 'Enhanced SP/AP SRS Spatial Relation Indication MAC CE', and 'Serving Cell Set based SRS Spatial Relation Indication MAC CE')
		- Note:  The exact details are up to RAN2.
* Note: A Rel-17 UE is not required to support both this feature and optional Rel-16 features of SRS spatial relation info within the same band.

**2. Actions:**

**To RAN2 group:**

**ACTION:** RAN1 respectfully asks RAN2 to take the answers to the questions into account in your further work.

**3. Date of Next TSG-RAN WG1 Meetings:**

TSG-RAN WG1 Meeting #110 22 – 26 August 2022 Toulouse, France

TSG-RAN WG1 Meeting #110-bis-e 10 – 19 October 2022 Electronic Meeting