**3GPP TSG RAN WG1 Meeting #104-e R1-2102247**

**e-Meeting, January 25th – February 5th, 2021**

**Title: DRAFT** LS on TCI State Update for L1/L2-Centric Inter-Cell Mobility

**Response to:**

**Release:** Rel-17

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

**Source:** Samsung

**To:** RAN2, RAN3, RAN4

**Cc:** RAN

**Contact Person:**

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**1. Overall Description:**

RAN1 discussed the support of L1/L2-centric inter-cell mobility and made the following agreement.

**Agreement**

On Rel.17 enhancements for L1/L2-centric inter-cell mobility,

* Discuss whether to support at least the source RS types already agreed for intra-cell mobility for the purpose of referencing to non-serving cell(s). Note: This implies the following source RS(s):
  + CSI-RS for BM configured for non-serving cell(s) for DL QCL and UL TX spatial references
  + CSI-RS for tracking (TRS) configured for non-serving cell(s) for DL QCL and UL TX spatial references
  + SSB configured for non-serving cell(s) for UL TX spatial references
  + SRS for BM configured for non-serving cell(s) for UL TX spatial references
  + FFS: whether to support CSI-RS for mobility
  + FFS: whether to support other source RS(s) potentially agreed later for intra-cell mobility
  + FFS: whether to support CSI-RS for BM and tracking configured for non-serving cell(s) and without non-serving cell SSB as QCL-TypeD source
* Send an LS to RAN2 on TCI state update (beam indication) using source RS configured for non-serving cell(s) for DL reception and UL transmission. The following topics are considered for the LS:
  + RRC configuration issues
  + Serving cell issues
  + C-RNTI issues
  + Issues related to CU-DU split
  + Inter-band CA issues
  + Inter-frequency issues

As a part of the Rel-17 NR\_FeMIMO WID wherein the group is tasked to “identify and specify features to facilitate more efficient (lower latency and overhead) DL/UL beam management to support higher intra- and L1/L2-centric inter-cell mobility” as well as “QCL/TCI-related enhancements to enable inter-cell multi-TRP operations”, RAN1 is currently investigating TCI state update (beam indication) for DL reception from and UL transmission to non-serving cell(s) – at least on UE-dedicated PDSCH, PDCCH, PUSCH, and PUCCH. In this case, the TCI can be associated with source RS(s) configured for the non-serving cell(s), if supported. It is noted that a non-serving cell is differentiated from the serving cell by PCI.

For the aforementioned purpose (in the context of L1/L2-centric inter-cell mobility and inter-cell multi-TRP operations), RAN1 seeks a few answers from RAN2 on the following questions in order to proceed further.

**Question 1**: In regard of serving cell,

1. Is there a need for a UE to change a serving cell for DL reception from or UL transmission to another (non-serving) cell, at least on UE-dedicated PDSCH, PDCCH, PUSCH, and PUCCH?
2. If so, how can the addition, release or change of a non-serving cell for DL reception and/or UL transmission be done? For example, would any of such actions require L3 handover and/or selection/activation among pre-configured candidate cells from RAN2 perspective?
3. If so, how can the TCI states associated with the previous serving cell be handled?
4. If so, what is the impact on the system information reception by the UE?
5. If so, what is the impact on the RACH and PUCCH-related procedures and configurations?
6. If not, what is the impact on the applicable use cases? That is, in what scenarios can the UE be configured for DL reception from or UL transmission to another (non-serving) cell, at least on UE-dedicated PDSCH, PDCCH, PUSCH, and PUCCH, if the serving cell does not change?

**Question 2**: In regard of RRC configuration, RAN1 is discussing whether to allow a UE to be configured for DL reception from or UL transmission to a non-serving cell on UE-dedicated PDSCH, PDCCH, PUSCH, and PUCCH. From RAN2 perspective

1. Depending on the answer to question 1-1, what would be the impact of allowing the UE to transmit and/or receive on some or all of those channels and which RRC parameter(s) would need to be reconfigured for the UE?
2. Is it feasible to update some of the above RRC parameter(s) via dynamic signaling (e.g. MAC CE and/or DCI, potentially selecting pre-configured values) without any additional RRC reconfiguration signaling?

**Question 3**: In regard of C-RNTI:

1. Is there a need to assign a UE a separate C-RNTI for DL reception from and UL transmission to a non-serving cell, or can the same C-RNTI from the serving cell be reused, at least for transmission and reception on UE-dedicated PDSCH, PDCCH, PUSCH, and PUCCH?
2. In restricting the use of the same C-RNTI for serving and non-serving cells, what would be the impact in applicable use cases and/or required specification support, if any?
3. If separate C-RNTIs are considered necessary in some cases, for serving and non-serving cells, how would this be configured for UE, i.e. is RRC reconfiguration signaling or some other (dynamic) signaling needed for configuring the separate C-RNTI(s)?

**Question 4**: In regard of CU-DU split, from RAN2/3 perspective, is there any difference between supporting intra-DU only and supporting inter- in addition to intra-DU, in terms of the following?

1. The associated RAN2 specification impact,
2. Applicable use cases (e.g. deployment scenarios), and
3. Network inter-operability (e.g. across different gNB vendors)

**Question 5**: In regard of CA issues, RAN1 is discussing whether the operation is supported only for intra-band CA scenario (i.e. UE is configured to operate with serving and non-serving cells that belong to the same frequency band) or for both intra-band CA and inter-band CA scenarios. Note that one common TCI state ID associated with a non-serving cell, if supported, may be optionally applied for CCs in a band.

1. Are there specific RAN2/4 issues (including higher-layer impact) that need to be considered for deciding between the two alternatives?

**Question 6**: In regard of inter-frequency issues, from RAN2/4 perspective, what would be the higher-layer and RRM impact assuming inter-frequency scenarios as opposed to intra-frequency scenarios? For intra-frequency scenario, it is assumed that SSBs of non-serving cells have the same center frequency and SCS as the SSBs of the serving cell.

* Note: RAN1 has agreed to support intra-frequency scenarios, whereas the support for inter-frequency scenarios is still for further study.

**2. Actions:**

**To: RAN2, RAN3, RAN4**

**ACTION:** RAN1 respectfully asks RAN2 to provide answers for the above questions related to signalling or connection control procedures (questions 1 to 6) with additional details that RAN1 shall further consider. It is noted that question 4 (related to CU-DU split) can also benefit from additional answers from RAN3. It is also noted that questions 5 and 6 (related to frequency band and CA) can also benefit from additional answers from RAN4.

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

TSG RAN WG1 Meeting #104bis-e 12th – 20th April, 2021 E-meeting