**3GPP TSG-RAN WG4 Meeting # 100-e R4-2115367**

**Electronic Meeting, August 16-27, 2021**

**Agenda item:** 9.21.2

**Source:** CATT

**Title:** WF on Rel-17 positioning enhancements RRM\_2

**Document for:** Approval

Topic #1: UE Rx/Tx and/or gNB Rx/Tx timing delay mitigation

### Sub-topic 1-1 Clarification on the denition of TEGs

**Issue 1-1-1 Framework of TEG**

Agreements:

Common understanding: TEG framework enables association information without limiting implementation to ensure that the timing error difference between measurements/transmissions associated to the same TEG are within a certain margin.

**Issue 1-1-2 Clarification about”DL measurement” in the definition of UE Rx TEGs.**

* Option 1: (Huawei)
  + “DL measurements” in the definition of Rx TEGs refers to TOA measurements
* Option 2: (CATT, vivo, Nokia)
  + “DL measurements” in the definition of Rx TEGs refers to RSTD measurements
* Option 3: (Ericsson)
  + Wait for RAN1 clarification.

*GTW agreements:*

* Tentative agreements:
  + Option 1: Send LS to RAN1 to clarify the TEG definition and whether the TEG is associated with DL TOA or RSTD measurements
  + Option 2: It is RAN4 understanding that “DL measurements” in the definition of Rx TEGs refers to TOA measurements (i.e., reference cell and target cell TOA measurements can be associated with different TEGs)
* Please vivo check if Option 2 is acceptable.

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| **Issue 1-1-2 Clarification about”DL measurement” in the definition of UE Rx TEGs.** | |
| **Company** | **Comments** |
| Qualcomm | We understand that the RAN1 agreement below is consistent with option 1. If needed, clarification could be requested in the LS reply to RAN1.  Agreement:   * Subject to UE capability, support a UE to include one UE Rx TEG ID for the RSTD reference time and one UE Rx TEG ID for each DL RSTD measurement (including each additional DL RSTD measurement), in a DL TDOA measurement report. These UE Rx TEG IDs can be the same or different. * Note: RSTD reference time is related to the DL\_PRS\_Reference\_Info IE |
| Ericsson | Same view as QC. Support option 2 of GTW tentative agreements. |
| Huawei | Our understanding is option 1, i.e. “DL measurements” in the definition of Rx TEGs refers to TOA measurements. If there is different interpretations we are also fine to clarify with RAN1. |
| Nokia | We are fine with option 2 of GTW tentative agreements. |

**Issue 1-1-3 On the absolute timing error**

Agreements:

It is not necessary to know the absolute timing error for UE Rx/Tx TEG.

### Sub-topic 1-2 Feasibility of TEG grouping

**Issue 1-2-1 Feasibility of TEGs for timing error mitigation mechanism**

*GTW agreements:*

* Agreements:
  + Confirm that the timing error mitigation mechanism defined by RAN1 is feasible for both UE Rx/Tx and gNB Rx/Tx.
  + UE/TRP may group the timing errors for UE/TRP Rx/Tx (e.g., based on RF chains and antenna panel) such that timing error difference in the same group is within a certain margin
  + FFS on RRM requirements for timing error mitigation mechanism, timing error grouping method, criteria and margin. FFS if any specific UE behavior will be defined.

**Issue 1-2-2 The values of timing error margins associated with TEGs.**

* Option 1: (Qualcomm, CATT, vivo, Ericsson)
  + It is within RAN4 scope to recommend a useful range of values for timing error margins associated with TEGs.
* Option 1a: (Qualcomm, Ericsson)
  + Configuring TEGs with different timing error margins, subject to UE capability, should be supported.
* Option 2: (Huawei, Intel, Nokia)
  + FFS

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| **Sub-topic 1-2 Feasibility of TEG grouping** | |
| **Company** | **Comments** |
|  | **Issue 1-2-1 Feasibility of TEGs for timing error mitigation mechanism**  **Issue 1-2-2 The values of timing error margins associated with TEGs.** |
| Qualcomm | **Issue 1-2-1 Feasibility of TEGs for timing error mitigation mechanism**  Option 3  **Issue 1-2-2 The values of timing error margins associated with TEGs.**  Options 1 and 1a. |
| ZTE | 1-2-1: Agreement is already made during GTW, why discuss it here?  1-2-2: Option 1. There should be a requirement on the margin defined in RAN4 or else the feature is useless. |
| Ericsson | 1-2-1: Follow GTW agreement  1-2-2: Options 1 and 1a. |
| Huawei | **Issue 1-2-2 The values of timing error margins associated with TEGs.**  Option 2, this is already included in the GTW agreements for 1-2-1. |
| Nokia | **Issue 1-2-2 The values of timing error margins associated with TEGs.**  Although we agree to discuss value range and configuration for further details of TEG, we think option-1 including timing error margins is within RAN4 scope, but option-2 seems not in RAN4 scope. |

### Sub-topic 1-3 Time variation of the TEGs

**Issue 1-3-1 Impact of the time variation of timing error on the TEGs**

* Option 1: (Qualcomm, Huawei)
  + Time variability of group delays may limit the time scope or useful life of TEGs or, conversely, it may limit the timing error margins that can be achieved if TEGs were to be applied over a prolonged time period.
* Option 2: (Nokia, ZTE, Ericsson, Huawei, vivo, Intel, CATT, OPPO)
  + Study behaviour of residual timing error differences after calibration on static, semi-static of dynamic behaviour and its implications to TEG association.

**Issue 1-3-2 Whether to define time variant (semi-static or dynamic) TEGs?**

* Option 1: No (vivo, CATT, Nokia, OPPO)
  + The timing error can be time variant but TEG is up to UE implementation, i.e., there is no need to consider time variant of TEG.
* Option 2: Yes (Qualcomm)
  + Semi-static or dynamic TEGs configured within the context of a given assistance data, location request, measurement report, or other suitable time period, would be preferable to static TEG configurations.
* Option 3: (Huawei)
  + Timing error is time varying and determination of TEG validity over time can be left to LMF implementation.
* Option 4: (Intel, Ericsson)
  + Depending on implementation and RAN1 outcome.

### Sub-topic 1-4 Applicability of TEG with gNB/TRP and UE

Tentative agreements:

RAN4 discussion is based on that TEG is applicable for both TRP and UE.

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| **Sub-topic 1-4 Applicability of TEG with gNB/TRP and UE** | |
| **Company** | **Comments** |
| Moderator | ‘gNB’ is removed since from RAN1 LS, the timing error is for UE/TRP Tx/Rx and there is nothing related to gNB. |
| ZTE | 1-3-2: Prefer not, which is Option 1. It might be hard to characterize. |
| Ericsson | 1-4: Ok with moderators’ update. |
| Huawei | Fine with the update from moderator. |
| Nokia | Fine with the tentative agreement. |

### Sub-topic 1-5 RRM requirements

**Issue 1-5-1 RRM requirements for verifying the timing error mitigation**

* Option 1: (CATT, ZTE, Qualcomm, OPPO)
  + The testability of this approach on mitigating TRP/UE Tx/Rx timing errors should be considered.
* Option 2: (vivo, Ericsson, Qualcomm, Nokia, OPPO)
  + RAN4 is to further study whether RRM requirements for timing error mitigation are needed.
* Option 3: (Huawei)
  + RAN4 concludes no impacts on core requirements from the TEG framework.
  + RAN4 to discuss whether and how to define new accuracy requirements for the TEG framework in the Performance part.

**Issue 1-5-2 UE and TRP behaviours that need to be discussed and specified in RAN4**

* Option 1: (Qualcomm)
  + The following UE and TRP behaviors related to the application of TEGs need to be discussed and specified by RAN4:
    - The maximum number of TEGs that a UE/TRP may configure at any given time.
    - Whether Rx TEGs and RxTx TEGs would be configured (including timing error margins) within a measurement report.
    - How to indicate the association of RS resource instances to Tx TEGs.
    - In general, specify the temporal scope or validity of TEG configurations, e.g. per measurement report, positioning session/request or as signaled by the UE/TRP.
    - How to report a measurement/resource that cannot be associated to any TEG.
    - Whether a measurement or RS resource could be mapped to multiple TEGs.

### Sub-topic 1-6 LS reply

Agreements:

Send response LS to RAN1 based on RAN4 agreements.

Topic #2: Measurement in RRC\_INACTIVE state

### Sub-topic 2-1 General aspects

**Issue 2-1-1 The type of measurement requirements to be specified in RRC\_INACTIVE state**

Agreements:

At least UE RRM requirements for DL RSTD and DL PRS-RSRP measurements in RRC-INACTIVE state are specified.

**Issue 2-1-2 The requirements applicability in RRC\_INACTIVE state**

Tentative agreements:

RAN4 shall define inactive state positioning measurements for FR1 and FR2.

Further study the following applicability:

* Option 1: (Ericsson)
  + RAN4 to define periodic inactive state positioning measurements and reporting of positioning measurement which involves state transition to connected state from inactive state.
* Option 2: (Huawei, Intel)
  + Measurement requirements do not apply for a PRS resource if it has instances colliding with paging.

**Issue 2-1-3 The UE measurement capability**

* Option 1: (Ericsson, Huawei, vivo, CATT)
  + RAN4 to wait for RAN1 progress regarding UE measurement capability within DL RSTD and PRS-RSRP
* Option 2: (Qualcomm, Nokia)
  + A new UE capability would be required to support the feature.

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| **Sub-topic 2-1 General aspects** | |
| **Company** | **Comments** |
| Ericsson | **Issue 2-1-2 The requirements applicability in RRC\_INACTIVE state**  We can continue to investigate and comeback in next meeting.  **Issue 2-1-3 The UE measurement capability**  Our view is option 1. |
| Huawei | **Issue 2-1-2 The requirements applicability in RRC\_INACTIVE state**  Suggest to keep both options FFS as it may be too early to agree on such details  **Issue 2-1-3 The UE measurement capability**  Option 1 |
| Nokia | **Issue 2-1-2 The requirements applicability in RRC\_INACTIVE state**  There is no measurement requirements yet to this case of inactive state measurement, what requirements option-2 refers to? It is up to how to define new measurement behavior for this case in RAN4. We are open to further discuss like option-1.  **Issue 2-1-3 The UE measurement capability**  Opion-1 |
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### Sub-topic 2-2 Measurement requirements in RRC\_INACTIVE state

**Issue 2-2-1 The factors considered for the** **measurement requirements in RRC\_INACTIVE state**

Agreements:

MG is not to be considered in the measurement period requirements in RRC\_INACTIVE state.

Tentative agreements:

Further study the following factors and impacts for the measurement requirements in RRC\_INACTIVE state:

* Whether to use the reduced number of samples if it is agreed in Rel-17.
* Whether to use the summation-based approach for total frequency layers.
* The impact of paging periods.
* Analysis on PRS resource configuration, positioning measurement period and DRX behaviors in the UE RRC\_INACTIVE state.
* How to define the measurement interval Teffect.
* How to define the parameter Kcarrier.

Candidate options:

* Option 1: (vivo)
  + UE RRM requirements for DL PRS-RSRP measurements and DL RSTD measurements in RRC-INACTIVE state are specified based on reduced number of samples if it is agreed in Rel-17.
* Option 2: (vivo, Huawei)
  + UE RRM requirements for DL PRS-RSRP measurements and DL RSTD measurements in RRC-INACTIVE state are specified with summation-based approach for total frequency layers.
* Option 3: (Nokia, Intel)
  + RAN4 starts with analysis on PRS resource configuration, positioning measurement period and DRX behaviors in the UE RRC\_INACTIVE state. Consider following for minimum requirements.
    - A UE follows DRX cycle for paging to measure PRS. A UE completes PRS measurements during active DRX period for paging. A new measurement period requirement can be discussed.
    - Others procedure are not precluded for positioning measurements in inactive mode regarding power saving and measurement latency reduction.
* Option 4: (ZTE)
  + When defining core requirements for UE positioning under INACTIVE mode, the principle can be to replace the measurement gap related parameters with paging periods and re-use the R16 requirements for CONNECTED mode.
* Option 5: (Huawei, Intel)
  + The measurement interval Teffect should take DRX cycle but not MGRP into account.
  + The parameter Kcarrier should take one additional PFL into account.

**Issue 2-2-2 The PRS-RSRP measurement requirements in RRC\_INACTIVE state**

Tentative agreements:

Use the framework or formula of Rel-16 PRS\_RSRP measurement period as a baseline to derive the inactive state PRS-RSRP measurement period.

**Issue 2-2-3 The RSTD measurement requirements in RRC\_INACTIVE state**

Tentative agreements:

Use the framework or formula of Rel-16 RSTD measurement period as a baseline to derive the inactive state RSTD measurement period.

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| **Sub-topic 2-1 General aspects** | |
| **Company** | **Comments** |
|  | **Issue 2-2-1 The factors considered for the measurement requirements in RRC\_INACTIVE state**  **Issue 2-2-2 The PRS-RSRP measurement requirements in RRC\_INACTIVE state**  **Issue 2-2-3 The RSTD measurement requirements in RRC\_INACTIVE state** |
| Qualcomm | **Issue 2-2-2 The PRS-RSRP measurement requirements in RRC\_INACTIVE state**  We’re OK to use the framework from Re-16 as baseline (starting point) with the understanding that changes are not precluded.  **Issue 2-2-3 The RSTD measurement requirements in RRC\_INACTIVE state**  We’re OK to use the framework from Re-16 as baseline (starting point) with the understanding that changes are not precluded. |
| Ericsson | **Issue 2-2-1 The factors considered for the measurement requirements in RRC\_INACTIVE state**  We think it is early to agree anything in this meeting. It can be FFS for now.  **Issue 2-2-2 The PRS-RSRP measurement requirements in RRC\_INACTIVE state**  Tentative agreement is ok.  **Issue 2-2-3 The RSTD measurement requirements in RRC\_INACTIVE state**  Tentative agreement is ok. |
| Huawei | **Issue 2-2-1 The factors considered for the measurement requirements in RRC\_INACTIVE state**  Fine with the recommneded WF, but we understadnd the list is not limiting.  **Issue 2-2-2 The PRS-RSRP measurement requirements in RRC\_INACTIVE state**  Fine with the recommneded WF  **Issue 2-2-3 The RSTD measurement requirements in RRC\_INACTIVE state**  Fine with the recommneded WF |
| Nokia | **Issue 2-2-1 The factors considered for the measurement requirements in RRC\_INACTIVE state**  The tentative agreements listed too many thing. We want to leave it yellow in this meeting. RAN4 can further discuss item by item in the next meetings.  **Issue 2-2-2 The PRS-RSRP measurement requirements in RRC\_INACTIVE state**  We are fine to take the framework from Rel-16 as baseline.  **Issue 2-2-3 The RSTD measurement requirements in RRC\_INACTIVE state**  We are fine to take the framework from Rel-16 as baseline. |

### Sub-topic 2-3 Performance requirements in RRC\_INACTIVE state

Agreements:

FFS: RAN4 to take connected mode measurement performance requirements for DL RSTD and PRS-RSRP as baseline for inactive state measurement performance requirements.

### Sub-topic 2-4 Reporting requirements in RRC\_INACTIVE state

Agreements:

RAN4 wait for the outcomes of other WGs and define the reporting requirements based on the conclusions.

### Sub-topic 2-5 Impact on inactive state functions

Agreements:

RAN4 to discuss impact of positioning measurements on RRC INACTIVE state functions.

Topic #3: Enhancements of A-GNSS positioning

### Sub-topic 3-1 Specification release update

Agreement:

It is not needed to update TS 36.171, 37.171 and 38.171 to release 17 at this stage.

### Sub-topic 3-2 RAN4 requirements for A-GNSS enhancements

Tentative agreements:

RAN4 define requirements for additional BDS signals and NavIC after RAN2 has introduced the signaling support.

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| **Sub-topic 3-2 RAN4 requirements for A-GNSS enhancements** | |
| **Company** | **Comments** |
| Huawei | Fine with the recommneded WF |
| Nokia | We are fine with the tentative agreement. |
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