**3GPP TSG-RAN WG4 Meeting # 100-e R4-2115412**

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

**Agenda item:** 9.21.2

**Source:** Moderator (CATT)

**Title:** Email discussion summary for [100-e][237] NR\_pos\_enh\_RRM\_2

**Document for:** Information

# Introduction

This email discussion summary contains agenda 9.21.2.2, 9.21.2.4 and 9.21.2.6 which include the following topics:

* Topic 1: UE Rx/Tx and/or gNB Rx/Tx timing delay mitigation
* Topic 2: Measurement in RRC\_INACTIVE state
* Topic 3: Enhancements of A-GNSS positioning

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2112000 | CATT | **Proposal 1: The absolute timing error cannot be provided and used to be grouped into different TEGs and we should consider other approaches for TEG grouping.** **Proposal 2: The TEG is not necessary to be time variant. The timing error range of each TEG should be constant in a certain scenario.** **Proposal 3: To support UE/TRP to provide the association information of measurements/transmissions with Rx/Tx TEGs, the timing error grouping and corresponding margin value of each group are needed.** **Proposal 4: It is possible that UE/TRP group the timing error (with or without calibration) based on RF chains and antenna panel such that timing errors in the same group are within certain margin.** **Proposal 5: The testability of this approach on mitigating TRP/UE Tx/Rx timing errors should be considered.** |
| R4-2112551 | vivo | ***Proposal 1: RAN4 confirms the timing error mitigation mechanism is feasible for both UE Rx/Tx and gNB Rx/Tx.******Proposal 2: The timing error grouping is UE implementation dependent and no specific UE behaviour is need to be specified.******Proposal 3: 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.******Proposal 4: It is not necessary to know the absolute timing error for UE Rx/Tx.*** ***Proposal 5: RAN4 is to further study whether RRM requirements for timing error mitigation are needed.*** |
| R4-2112598 | Nokia, Nokia Shanghai Bell | **Observation 1 :** this timing offset mitigation for positioning is a unique process, because it attempts to further mitigate residual timing error after calibrations. Basically, this work item argues nano second level timing error mitigation to achieve centi-meter location estimation accuracy. **Observation 2 :** Time variant nature of TEG depends on various parameters which can be static or semi-static. The examples of parameters affecting TEG can be categorized as follows:

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| Delay characteristic | Example of delay sources |
| Static | RU and DU connection cables |
| Semi-static | temperature, RF chain, frequency band, antenna array panel, baseband sampling rate and sampling offset |
| Dynamic | noise, interference |

**Proposal 1: The effects of above time variant nature of above parameters on TEG association needs to be studied further in RAN4 for timing error grouping.****Proposal 2 : RAN4 conducts feasibility study on timing error mitigation/measurement, but no performance spec impact is expected.**  **- A new device requirement ( i.e. positioning reference unit ) is FFS up to RAN1/2 conclusion.****Proposal 3: Regarding TEG grouping approach, we support option-1 that UE/TRP may group the timing error based on RF chains and antenna panel, such that timing errors in the same group are within certain margin. Timing error grouping method and criterion with marigin need to be further discussed.****Proposal 4: Regarding Applicability of TEG with gNB/TRP, we support option-1 that TRP to provide association information of DL PRS resources with Tx and Rx TEG to LMF if TRP has multiple TEG .****Proposal 5: We support option-1 TEG is applicable for UEs with the same reason above.** RAN1 LS reply discussion **Observation 3 :** RAN1 has agreed to support TEG studies firstly for DL-TDOA measurement case. It is expected that RAN1 continues to discuss the time delay impacts for other time-based methods.**Observation 4 :** A goal of TEG study is to achieve cm-level positioning accuracy by mitigating this timing error. It may be related with RF margin in accuracy requirements.**Proposal 6 :** Propose possible replies as* RAN4 studies if TEG appears static or semi-static or dynamic in TX/RX scenarios with considering various front-end parameters and conditions (cable connection , antenna panel, RF chain, frequency, baseband sampling rate) for grouping.
* If timing error statically or semi-statically changes and it is deterministic by a device or an external device, it is possible to group timing error corresponding to a RF setting and condition.
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| R4-2113157 | Intel Corporation | **Observation 1: TX/RX timing error in gNB/UE can be introduced by multiple factors beside UE/gNB RX/TX antenna panel, which can be also dynamically changed for these from the same antenna panel.** **Observation 2: In order to avoid the over compensate timing error, LMF also needs to know whether such calibration error included in TEG.*****Proposal 1: The more investigations the more factors which can lead RX/TX timing error when UE measuring PRS resource is needed to conduct the feasibility of TEG reporting.*** |
| R4-2113874 | ZTE Corporation | **Observation 1:** Impacting factors of TE are at least the RF chains which are actually used for radio transmissions and the antenna panels. The property might be time-variant in an unanticipated way.Proposal 1: Further study how to consider the potential time-variant impacts on TE during the lifecycle of the UE or TRP. Proposal 2: UE/TRP may group the timing error (with or without calibration) based on RF chains and antenna panel, such that timing errors in the same group are within certain margin theoretically. However the UE/TRP may not be able to ensure that timing errors are within the same margin.**Observation 2:** Currently the tests in FR1 are conducted where the antenna panel used for actual transmission is removed in the test.Proposal 3: Further investigate the testability of the property of TE, especially in FR1.**Proposal 4: A reply LS shall be sent after RAN4 concludes on the open issues.** |
| R4-2114051 | Ericsson | 1. TEG enables association information without limiting implementation to ensure that the timing error difference between measurements/transmissions are within a certain margin delta
2. The absolute value of the residual timing error is irrelevant to TEG
3. Study behavior of residual timing error differences after calibration on static, semi-static of dynamic behavior and its implications to TEG association based on margin threshold
4. TEG reporting for gNB is not needed, since gNB RX/TX timing errors can be mitigated by defining each gNB antenna panel as a separate TRP with its own DL PRS transmissions and positioning measurements
5. Differentiation of antenna panels with certain distance in location/position is not in WID scope for Rel-17
6. TEG reporting for UEs is applicable
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| R4-2114198 | Qualcomm Incorporated | **Proposal 1: RAN4 needs further clarification about the definition of Rx TEGs before assessing impact on existing accuracy requirements and developing new requirements. Whether “DL measurements” in the definition of Rx TEGs refers to TOA measurements or RSTD measurements needs to be clarified.****Proposal 1b: RAN4 should support defining Rx TEGs based on grouping of DL TOA measurements.****Observation 1: TEGs provide a means for a UE/TRP to upper-bound relative timing uncertainty between measurements/signals without having to reveal proprietary/sensitive information about architecture and implementation, RF and baseband resource allocation, and other internal state.****Observation 2: The mapping of measurements/signals to TEGs may take into account any side-information that can be used to reduce the relative timing (delay) uncertainty between measurements/signals within a TEG.****Observation 3: The application/use of TEGs does not require exact knowledge of residual delay calibration errors. A statistical characterization of delay calibration errors should suffice.****Observation 4: 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.****Observation 5: 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.****Proposal 2: It is within RAN4 scope to recommend a useful range of values for timing error margins associated with TEGs.****Proposal 3: The following UE and TRP behaviors related to the application of TEGs need to be discussed and specified by RAN4:**1. **The maximum number of TEGs that a UE/TRP may configure at any given time.**
2. **Whether Rx TEGs and RxTx TEGs would be configured (including timing error margins) within a measurement report.**
3. **How to indicate the association of RS resource instances to Tx TEGs.**
4. **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.**
5. **How to report a measurement/resource that cannot be associated to any TEG.**
6. **Whether a measurement or RS resource could be mapped to multiple TEGs.**

**Proposal 4: Configuring TEGs with different timing error margins, subject to UE capability, should be supported.** |
| R4-2114310 | Huawei, HiSilicon | **Observation 1: TEG framework is to allow UE to provide association information to LMF where measurements with same or close timing error are associated to the same TEG.** **Observation 2: How to associate measurements to TEGs is up to UE implementation, and as minimum UE can associate measurements by different Rx paths to different TEGs.****Observation 3: Timing error is time varying and determination of TEG validity over time can be left to LMF implementation.****Observation 4: Applicability of multiple TEGs is an implementation issue, and there is no difference between TRP and UE from RAN4 perspective.****Proposal 1: RAN4 concludes no feasibility issue in the TEG framework defined by RAN1, and RAN4 could inform RAN1 about the time variation of timing error.****Proposal 2: RAN4 concludes no impacts on core requirements from the TEG framework.****Proposal 3: RAN4 to discuss whether and how to define new accuracy requirements for the TEG framework in the Performance part.** |

## Open issues summary

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

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

Proposals

* Option 1: (Ericsson)
	+ TEG enables association information without limiting implementation to ensure that the timing error difference between measurements/transmissions are within a certain margin delta.
* Option 2: (Qualcomm)
	+ TEGs provide a means for a UE/TRP to upper-bound relative timing uncertainty between measurements/signals without having to reveal proprietary/sensitive information about architecture and implementation, RF and baseband resource allocation, and other internal state.
* Option 3: (Huawei)
	+ TEG framework is to allow UE to provide association information to LMF where measurements with same or close timing error are associated to the same TEG.
* Recommended WF
	+ *Need more discussion*

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

Proposals

* Option 1: (Qualcomm)
	+ Whether “DL measurements” in the definition of Rx TEGs refers to TOA measurements or RSTD measurements needs to be clarified.
	+ RAN4 should support defining Rx TEGs based on grouping of DL TOA measurements.
* Recommended WF
	+ *Need more discussion*

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

Proposals

* Option 1: (CATT)
	+ The absolute timing error cannot be provided and used to be grouped into different TEGs and we should consider other approaches for TEG grouping.
* Option 2: (vivo, Ericsson, Qualcomm)
	+ It is not necessary to know the absolute timing error for UE Rx/Tx TEG.
* Recommended WF
	+ *Need more discussion*

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| **Sub-topic 1-1 Clarification on the denition of TEGs** |
| **Company** | **Comments** |
| XXX | **Issue 1-1-1:** **Issue 1-1-2:** **Issue 1-1-3:**  |
| Huawei | **Issue 1-1-1:** We understand all 3 options are similar, and they all seem to be companies’ understanding about TEG ramework. We are not sure if any agreement is needed. **Issue 1-1-2:** This is an RAN1 issue. Technically, we understand ”DL measurements” in the definition of Rx TEGs refers to TOA measurements. **Issue 1-1-3:** Option 2. How to associate measurements to TEGs is up to UE implementation, so we do not need to discuss any approach for TEG grouing in RAN4. |
| vivo | **Issue 1-1-1:** In our understanding, the 3 options are quite similar. A TEG is used for UE to group measurement results within certain timing error limit together. The measurement results grouping is up to UE implementation.**Issue 1-1-2:** According to RAN1 agreements below, whether UE Rx-Tx time difference measurement is supported for Rx TEG would depend on UE capability.For mitigating UE Tx/Rx timing errors for DL+UL positioning, a UE may support, up to UE capability, one or both of the following options:* Option 1: Reporting of UE RxTx TEG ID is supported by the UE
	+ FFS: Further details on how the RxTx TEG IDs are related/associated to Tx TEG IDs and/or Rx TEG IDs and to the Rx-Tx measurements.
* Option 2: Reporting of UE RxTx TEG ID is not supported by the UE; reporting of Rx TEG ID and Tx TEG ID is supported.

RSTD is supported for UE Rx TEGs.**Issue 1-1-3:** Option 2. |
| Ericsson | **Issue 1-1-1:** All options listed are somewhat aligned.**Issue 1-1-2:** We agree with option 1 and should wait for RAN1 clarification on that issue.**Issue 1-1-3:** Option 2. |
| Qualcomm | **Issue 1-1-1:**All three options are in close agreement.**Issue 1-1-2:** We understand that RAN1 has discussed this issue in their on-going meeting and reached the following agreement: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

**Issue 1-1-3:** Option 2. The definition of TEG is not based on absolute timing error, rather it has to do with relative timing error between measurements. In addition, as we argued in our paper TEGs should be based on a statistical characterization of the relative timing error. |
| CATT | **Issue 1-1-1:** We agree that the three options are similar, and the issue is to align the understanding on TEG definition in RAN4 group. Actuallly we see some ambiguity on the TEG definition. Because in RAN1’s definition TEG is associated with one or more measurements which have the Rx timing error within a certain margin (refer to LS R4-2104111). But in RAN4’s understanding, the absolute timing error is unknown to UE/gNB, so we can just ensure the timing error difference between measurements associated to the same TEG is within a certain margin. Maybe this should also be included in the reply LS to RAN1. Can we agree it as a common understanding in the WF and include it in the reply LS?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:** This definition is in RAN1 group, but same as issue 1-1-1 we should align the understanding in RAN4. According to the RAN1 agreement provided by QC, we think the DL measurements in RAN1 refer to RSTD measurements. **Issue 1-1-3:** If the TEG is about the timing error difference between measurements, we are fine with option 2. Our proposal option 1 is to clarify the absolute residual timing error is unknown and cannot be grouped. Because generally if we want to know the timing error difference between two measurements, we need to know the timing error of each measurement. If this is not possible, then we can find other approaches to ensure the rough difference, for example the difference can be regarded smaller than a certain value in a certain case.  |

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| Nokia | **Issue 1-1-1:** The listed options are aligned. We support the framework of TEG, but how to capture the requirements needs more discussion. **Issue 1-1-2:** This is about if TEB needs absolute TE measurement (ToA) or relative TE measurement (RSTD). All time measurements need reference point, so it is assumed to be relative. If it is absolute, reporting GNSS time stamp can be considered, however it is skeptical to practically measure.**Issue 1-1-3:** Option-2 with comments on 1-1-2  |

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| OPPO | **Issue 1-1-1:** **Fine with CATT’s proposal marked as yellow.****Issue 1-1-3:** **Option 2.** |

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

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

Proposals

* Option 1: (CATT, Nokia, ZTE)
	+ UE/TRP may group the timing error based on RF chains and antenna panel, such that timing errors in the same group are within certain margin. Timing error grouping method and criterion with margin need to be further discussed.
* Option 2: (vivo, Huawei)
	+ RAN4 confirms the timing error mitigation mechanism defined by RAN1is feasible for both UE Rx/Tx and gNB Rx/Tx.
* Option 2a: (vivo)
	+ The timing error grouping is UE implementation dependent and no specific UE behaviour is need to be specified.
* Option 3: (Intel)
	+ The more investigations the more factors which can lead RX/TX timing error when UE measuring PRS resource is needed to conduct the feasibility of TEG reporting.
* Recommended WF
	+ *Need more discussion*

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

Proposals

* Option 1: (Qualcomm, CATT)
	+ It is within RAN4 scope to recommend a useful range of values for timing error margins associated with TEGs.
* Option 1a: (Qualcomm)
	+ Configuring TEGs with different timing error margins, subject to UE capability, should be supported.
* Recommended WF
	+ *Need more discussion*

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| **Sub-topic 1-2 Feasibility of TEG grouping** |
| **Company** | **Comments** |
| XXX | **Issue 1-2-1:** **Issue 1-2-2:**  |
| ZTE | 1-2-1: Actually our proposal also has a second part, which is “However the UE/TRP may not be able to ensure that timing errors are within the same margin.” We think that such TEG can be formulated, but it might be more theoretical rather than practical. |
| Huawei | **Issue 1-2-1:** Option 2 and 2a. How to associate measurements to TEGs is up to UE implementation.On option 1, we do not see the need to disucss timing error grouping method and criterion with margin. Omn option 3, we do not see the need to investigate factors which can lead RX/TX timing error.**Issue 1-2-2:** FFSOn option 1, we think more inputs from other WGs are needed. For example, if LMF would only configure UE to report TEG information, RAN4 may not need to recommend the range of values for the margin. On option 1a, is the scenario that LMF could configure multiple values for the margin, and UE would report multiple sets of TEG information accordingly? If so, could proponent clarify the motivation to support this scenario? |
| vivo | **Issue 1-2-1:** Option 2. For UE Rx/Tx, the timing error for different measurement results may be from different antenna panels and/or RF chains, or on different frequency layers, or with different baseband sampling rate, or with different SRS antenna due to SRS antenna switching etc. From UE measurement perspective, all these factors, which may lead to different TEGs, are known to UE when PRS measurements are performed. So, the timing error mitigation mechanism defined by RAN1is feasible.**Issue 1-2-2:** Option 1. RAN4 may need to study the timing error margins within one TEG. |
| Intel | **Issue 1-2-1:** Our proposal is for issue 1-3-1 indeed. **Issue 1-2-2:** The reasonable margin shall be FFS |
| Ericsson | **Issue 1-2-1:** On option 1, we think it needs to be rephrased such that ”[...]such that timing error differences in the same group are within certain margin.”, since the TEG shall comprise information of the timing difference of “one or more measurements”. The absolute timing error should be irrelevant as discussed in other issues.**Issue 1-2-2:** Agree with option 1 and 1a. |
| Qualcomm | **Issue 1-2-1:** Option 2. Association of TEGs with measurements/signals should be left up to implementation.**Issue 1-2-2:** Support option 1 and 1a.Regarding Huawei’s question, the intention is to allow the UE to configure TEGs semi-statically or dynamically, including the associated error margin. The error margin for each TEC would be configured from a set of supported values in the specification. We think RAN4 should provide input about the useful range of the error margin (option 1). |
| CATT | **Issue 1-2-1:** We think some feasibility of grouping is needed. If there is no any principle to group the timing error, then how UE can say the timing error or timing error difference is within a certain margin as itself has no idea on the exact value. Maybe option 1 can be some example when confirming the feasibility of TEG framework to RAN1. **Issue 1-2-2:** Option 1. RAN4 need to study the possible value of the timing error difference margin for each TEG. But we agree this is for the case that UE/gNB provide the TEG information. If the TEG ID and the margin range within each TEG are provided by LMF, whether RAN4 work is needed can be FFS. For option 1a, according to the discussion in issue 1-1-1, we would like to clarify the TEG is configured with timing error margin or timing error difference margin.  |
| Nokia | **Issue 1-2-1:** Support option-1. In option-2, what mechanism does “the timing error mitigation mechanism defined by RAN” refer to? If it means mitigation using TEG, we think option-1 and option-2 lookvery similar.**Issue 1-2-2:** “The range of values” means a range of TEG itself or timing error margins? If it is the first one, it would be RAN1 discussion domain. If it is the latter one, the upper limit of margin can be considered. |

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

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

Proposals

* Option 1: (Qualcomm)
	+ 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 2a: (Nokia)
	+ The effects of above time variant nature of above parameters on TEG association needs to be studied further in RAN4 for timing error grouping.
		- Cable delay, Antenna array, Baseband sampling rate and offset, Circuit delay in RF chains,etc
* Option 2b: (ZTE)
	+ Further study how to consider the potential time-variant impacts on TE during the lifecycle of the UE or TRP.
* Option 2c: (Ericsson)
	+ Study ehaviour of residual timing error differences after calibration on static, semi-static of dynamic ehaviour and its implications to TEG association based on margin threshold
* Recommended WF
	+ *Need more discussion*

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

Proposals

* Option 1: No (vivo, CATT)
	+ 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.
* Recommended WF
	+ *Need more discussion*

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| **Sub-topic 1-3 Time variant of the TEG** |
| **Company** | **Comments** |
| XXX | **Issue 1-3-1:** **Issue 1-3-2:** |
| ZTE | 1-3-1: Support Option 2a, 2b and 2c. This needs to be FFS. |
| Huawei | **Issue 1-3-1:** We agree with the observation in option 1, and we are fine to further study the its implications to TEG association as suggested in option 2c.**Issue 1-3-2:**Option 3.With the time variation nature of the timing error, the time validity of TEG association information should be considered, i.e. LMF cannot assume the timing errors of two measurements in the same TEG are same or close if the two measurements are taken far apart in time. We suggest that determination of TEG validity over time can be left to LMF implementation.On option 2, it is not clear to us what is meant by ”semi-static or dynamic TEG configuration”, could proponent help to clarify? |
| Vivo | **Issue 1-3-1:** In general, impact of the time variation of timing error on the TEGs can be further studied, e.g. if a TEG would be only valid for a certain period of time.**Issue 1-3-2:**It would be up to UE implementation how to handle time variant of TEG. We are not expecting dynamic TEGs as it would limit the use case of timing error mitigation. |
| Intel  | Issue 1-3-1:We support Option 2c as we mentioned in our Tdoc* + ” The more investigations the more factors which can lead RX/TX timing error when UE measuring PRS resource is needed to conduct the feasibility of TEG reporting.

“**Issue 1-3-2:**In our views, the dynamic TEG reporting is more helpful to improve the measurement accuracy. But from RAN1’s agreement below, it seems the static TEG (e.g. pannel index assocation) is expeced. We need to FFS on this.  |
| Ericsson | **Issue 1-3-1:** Options 2. The impact of time variation of timing error (differences) on the lifecycle of a TEG association can at least be studied and should be taken into account when the margin values for TEGs are discussed, based on issue 1-2-2.**Issue 1-3-2:**Timing error and timing error differences associated within the same TEG can be time variant. Whether or not to leave it up to implementation, also depends on the outcome of RAN1 discussion on “updating of Rx/Tx/RxTx TEGs”.  |
| Qualcomm | **Issue 1-3-1:** We agree that RAN4 can study this issue further. However, it is already recognized that impairments such as clock frequency drift lead to degraded timing accuracy over increasing time periods. Accordingly, option 1 anticipates that in practice TEGs will have a limited time scope or useful life.**Issue 1-3-2:**We support option 2. We do not support option 3. The time scope of a TEG should be indicated by the entity (UE or gNB) that configures the TEG. The LMF may not have the information required to make that determination.To vivo: Yes it can be up to UE implementation. The point is that semi-static or dynamic TEG configuration should be supported. i.e. the UE needs to be able to inform the LMF how TEGs are configured during a given period of time. |
| CATT | **Issue 1-3-1:** We are fine to further study the time variant of the TEG. And we would like to share our understanding on the time variant of TE (timing error) and time variant of TEG (timing error group). Firstly we think we all have the same understanding that the timing error is time variant due to clock frequency drift, temperature or other factors. But this doesnot mean the TEG need to be time variant. Because we think the TEG is a constant value group (such as [0,10]ns forTEG ID1 which means the timing error difference between measurements is smaller that 10ns). Since the association information is provided to LMF for each measurement report, if the timing error changes, the reported TEG ID can be different, but the TEG itself should be static. **Issue 1-3-2:**Option 1. As discussed in issue 1-3-1, we are not sure what the implementation of semi-static and dynamic TEG is.  |
| Nokia | **Issue 1-3-1:** Support Option 2a, and option-2b is also fine. We wonder what is “margin threshold” mentioned in option-2c.**Issue 1-3-2:**Support option-1. Regarding the dynamic TEG in option-2, we need to identify what are the sources of the error first. If it is just noise, it is not meaningful to include in TEG. If it has specific characteristic, then we may can consider. |
| OPPO | **Issue 1-3-1:** **Option 2b or 2c. This issus needs to be further studied.****Issue 1-3-2:****Our preference is option1. But since the time variant feature is not clear now, we are also open to time variant TEGs.** |

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

Proposals

* Option 1: (Nokia, Huawei)
	+ TEG is applicable for both gNB/TRP and UE.
* Option 2: (Ericsson)
	+ TEG reporting is applicability for UEs only
		- TEG reporting for gNB is not needed, since gNB RX/TX timing errors can be mitigated by defining each gNB antenna panel as a separate TRP with its own DL PRS transmissions and positioning measurements.
* Recommended WF
	+ *Need more discussion*

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| **Sub-topic 1-4 Applicability of TEG with gNB/TRP and UE** |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1. We do not think RAN4 needs to decide the applicability of multiple TEGs to UE or TRP because there is no feasibility issue for either UE or TRP to use multiple TEGs, so we suggest to not further discuss on this issue. |
| Vivo | Option 1. The timing error mitigation mechanism is feasible for both UE Rx/Tx and gNB Rx/Tx. |
| Intel | Option 1. According to RAN1’s agreement, TEG shall be appliable for both gNB/TRP and UE. “Agreement:* Support the following for mitigating TRP Tx timing errors and/or UE Rx timing errors for DL TDOA
	+ Support a UE to provide the association information of RSTD measurements with UE Rx TEG(s) to the LMF when the UE reports the RSTD measurements to the LMF if the UE has multiple TEGs
	+ Support a TRP providing the association information of DL PRS resources with Tx TEGs to the LMF if the TRP has multiple TEGs
	+ Support the LMF to provide the association information of DL PRS resources with Tx TEGs to a UE for UE-based positioning if the TRP has multiple TEGs
	+ FFS: the details of the signalling, procedures, and UE capability

Send an LS to RAN4 to check if there is any issue to support the above enhancements |
| Ericsson | Option 2. |
| Qualcomm | Option 1. TEGs are not just about timing errors between multiple antenna panels. |
| CATT | Option 1. TE grouping implementation is not decided and gNB can also group the timing error based on some principle.  |
| Nokia | RAN4 can start to discuss based on option-1. |
| OPPO | Option 1.  |

### Sub-topic 1-5 RRM requirements

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

Proposals

* Option 1: (CATT, ZTE)
	+ The testability of this approach on mitigating TRP/UE Tx/Rx timing errors should be considered.
* Option 2: (vivo)
	+ RAN4 is to further study whether RRM requirements for timing error mitigation are needed.
* Option 3: (Nokia)
	+ RAN4 conducts feasibility study on timing error mitigation/measurement, but no performance spec impact is expected.
		- A new device requirement ( i.e. positioning reference unit) is FFS up to RAN1/2 conclusion.
* Option 4: (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.
* Recommended WF
	+ *Need more discussion*

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

Proposals

* 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.
* Recommended WF
	+ *Need more discussion*

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| **Sub-topic 1-5 RRM requirements** |
| **Company** | **Comments** |
| XXX | **Issue 1-5-1:** **Issue 1-5-2:**  |
| ZTE | 1-5-1: Support Option 1. Whatever the definition is, we need to make sure that it can be tested (both FR1 and FR2 need to be considered, where different test methods are used). |
| Huawei | **Issue 1-5-1:** Option 4**Issue 1-5-2:** We are not sure if all of the issues listed are to be discussed in RAN41. number of TEGs should be defined by RAN1, and we do not see it as a performance issue2. we understand TEG information would be only provided when LMF configures UE/TRP to report this information, so it is not fully clear to us what needs to be discussed in RAN4.3. we think it is a RAN1 issue4. as commented in Issue 1-3-2, we prefer to leave the time validity of TEG to LMF implementation 5. we are not sure if such scenario would happen. If a measurement has different timing error from all other measurements, then it should have its own TEG.6. it is not clear to us when this case would happen, could proponent help to clarify? |
| Vivo | **Issue 1-5-1:** Option 2. Since the timing error grouping is up to UE implementation, RRM requirements may be needed to guarantee that UE is grouping timing error properly. The existing UE RSTD and UE Rx-Tx time difference accuracy requirements should not be impacted.**Issue 1-5-2:** We think most of the UE/TRP behaviors would be discussed in RAN1. If there is no discussion in RAN1 in the end, then RAN4 can discuss these aspects if necessary.For the validity of TEG configurations due to time variant of timing error, it may need RAN4 involvement. |
| Intel | **Issue 1-5-1:** Can be FFS. At least so far we are not clear whether and how UE report the timing error.**Issue 1-5-2:** Can be FFS and most of these items in Option are out of RAN4 scope. E.g. How to indicate the association of RS resource instances to Tx TEGs shall be defined by RAN2, |
| Ericsson | **Issue 1-5-1:** Option 2.**Issue 1-5-2:** Option 1, however we think the maximum number of TEGs that may be configured at any time can be left to implementation. |
| Qualcomm | **Issue 1-5-1:** We agree that RAN4 should continue discussing potential impact to RRM requirements due to the introduction of TEGs. Testability of new requirements should be considered. Details of any new accuracy requirements to be introduced can be addressed during the performance part.**Issue 1-5-2:** Even if some of the listed behaviors fall within scope of other working groups, it would be useful for RAN4 to discuss these questions.Regarding 3, we understand RAN1 is discussing this aspect and we agree to wait for their conclusions.Regarding 4, see our response to issue 1-3.2.Regarding 5, one TEG per measurement in the extreme case could be excessive. That’s why it may be useful to have e.g. a default TEG with large (unbounded?) error margin or have the option of not reporting a TEG for some measurements.Regarding 6, there could be multiple ways to group measurements into TEGs. It could be more  |
| CATT | **Issue 1-5-1:** Option 1. Our understanding is that the testability of this approach is also the part of feasibility study. For example, if the reported information cannot be verified, whether the approach is still feasible?**Issue 1-5-2:** Most of the items are out of RAN4 scope (item 1,2,3). For other items, it may need RAN4 work but should wait for more outcomes from other groups on this approach.  |
| Nokia | **Issue 1-5-1:** We are fine with option-2. The requirement impacts from TEG should be discussed.**Issue 1-5-2:** We support bullets 1,2, 4 in RAN4 scope. Others seems to fall in other RAN group discussions |
| OPPO | **Issue 1-5-1:** **The first bullet option 4 can be supported. The measurement delay requirements are not impacted by TEG and we don’t need to discuss new requirement or test case for that.****For the accuracy requirements, we are fine with option 1 and option 2.****Issue 1-5-2:** **We agree to wait for more conclusions from other WGs.** |

### Sub-topic 1-6 LS reply

**Issue 1-6-1 Whether the response LS to RAN1 is needed?**

Proposals

* Option 1: (CATT, Nokia, ZTE, Huawei)
	+ Yes
* Recommended WF
	+ *Need more discussion*

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| **Sub-topic 1-6 LS reply** |
| **Company** | **Comments** |
| XXX | **Issue 1-6-1:**  |
| ZTE | Can send LS to RAN1. |
| Huawei  | Option 1, but RAN4 needs to first agree on what to inform RAN1. |
| vivo | **Issue 1-6-1:** It depends on conclusion we made in this meeting. |
| Intel | **Issue 1-6-1:** **LS can be sent after RAN4 achieve the consensus on the issues above .**  |
| Ericsson | **Issue 1-6-1:** Option 1. |
| Qualcomm | **Issue 1-6-1:** Option 1. The content need to be discussed. |
| CATT | **Issue 1-6-1:** Option 1.  |
| Nokia | Option-1 |
| OPPO | Option 1. Do we need to prepare reply LS in this meeting? |

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary**  |
| **Sub-topic #1-1** | **Issue 1-1-1 Framework of TEG***Tentative 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. *Candidate options:* None. *Recommendations for 2nd round: Check the tentative agreement.* **Issue 1-1-2 Clarification about”DL measurement” in the definition of UE Rx TEGs.** *Tentative agreements:* None.*Candidate options:** 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.

*Recommendations for 2nd round: Continue discussion.* **Issue 1-1-3 On the absolute timing error***Tentative agreements:*It is not necessary to know the absolute timing error for UE Rx/Tx TEG.*Candidate options:* None.*Recommendations for 2nd round: No more discussion.*  |
| **Sub-topic #1-2** | **Issue 1-2-1 Feasibility of TEGs for timing error mitigation mechanism***Tentative agreements:* None.*Candidate options:** Option 1: (CATT, Nokia)
	+ UE/TRP may group the timing error based on RF chains and antenna panel, such that timing errors in the same group are within certain margin. Timing error grouping method and criterion with margin need to be further discussed.
* Option 1a: (Ericsson)
	+ UE/TRP may group the timing error based on RF chains and antenna panel, such that timing errors differences in the same group are within certain margin. Timing error grouping method and criterion with margin need to be further discussed.
* Option 2: (ZTE)
	+ UE/TRP may group the timing error based on RF chains and antenna panel, such that timing errors in the same group are within certain margin. However the UE/TRP may not be able to ensure that timing errors are within the same margin
* Option 3: (vivo, Huawei, Qualcomm)
	+ RAN4 confirms the timing error mitigation mechanism defined by RAN1is feasible for both UE Rx/Tx and gNB Rx/Tx.
	+ The timing error grouping is UE implementation dependent and no specific UE behaviour is need to be specified.

*Recommendations for 2nd round: Continue discussion.***Issue 1-2-2 The values of timing error margins associated with TEGs.***Tentative agreements:* None.*Candidate options:** 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

*Recommendations for 2nd round: Continue discussion.* |
| **Sub-topic #1-3** | **Issue 1-3-1 Impact of the time variation of timing error on the TEGs***Moderator: All the option 2a, 2b, 2c are further study, so they are merged into one option.* *Tentative agreements:* None.*Candidate options:** 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.

*Recommendations for 2nd round:* *Postpone to next meeting.***Issue 1-3-2 Whether to define time variant (semi-static or dynamic) TEGs?***Tentative agreements:* None.*Candidate options:** 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.

*Recommendations for 2nd round: Postpone to next meeting.* |
| **Sub-topic #1-4** | *Tentative agreements:* RAN4 discussion is based on that TEG is applicable for both gNB/TRP and UE. *Candidate options:* None.*Recommendations for 2nd round: Check the tentative agreement.* |
| **Sub-topic #1-5** | **Issue 1-5-1 RRM requirements for verifying the timing error mitigation***Tentative agreements:* None. *Candidate options:** 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.

*Recommendations for 2nd round: Postpone to next meeting.* **Issue 1-5-2 UE and TRP behaviours that need to be discussed and specified in RAN4***Tentative agreements:* None.*Candidate options:** 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.

*Recommendations for 2nd round: Postpone to next meeting.* |
| **Sub-topic #1-6** | *Tentative agreements:*Send response LS to RAN1 based on RAN4 agreements. *Candidate options:* None. *Recommendations for 2nd round: Continue discussion based on LS details.*  |

### CRs/TPs

## Discussion on 2nd round (if applicable)

# Topic #2: Measurement in RRC\_INACTIVE state

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2112002 | CATT | **Proposal 1: The measurement requirements in RRC\_CONNECTED state can be the baseline for RRC\_INACTIVE state. And it can be revisited based on further conclusions in RRC\_INACTIVE state.** **Proposal 2: It needs further study whether the enhancements in R17 RRC\_CONNECTED state requirements can be used for RRC\_INACTIVE state.** **Proposal 3: RAN4 wait for the outcomes of RAN2 on measurement report procedure and define the reporting requirements based on the conclusions.**  |
| R4-2112553 | vivo | ***Proposal 1: UE RRM requirements for DL PRS-RSRP measurements in RRC-INACTIVE state are specified.******Proposal 2: UE RRM requirements for DL RSTD measurements in RRC-INACTIVE state are specified.******Proposal 3: UE RRM requirements for DL PRS-RSRP measurements and DL RSTD measurements in RRC-INACTIVE state are specified without taking measurement gap into consideration.******Proposal 4: 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.******Proposal 5: For PRS-RSRP measurement in a positioning frequency layer, the requirements can be specified for INACTIVE state as***  $T\_{PRS-RSRP,i}=\left(N\_{RxBeam,i}\*\left⌈\frac{N\_{PRS,i}^{slot}}{N^{'}}\right⌉\left⌈\frac{L\_{available\\_PRS,i}}{N}\right⌉\*N\_{sample}-1\right)\*T\_{effect,i}+T\_{last}$where  $N\_{sample}$ is the number of PRS-RSRP measurement samples and $N\_{sample}$= TBD,$T\_{effect,i}= \left⌈\frac{T\_{i}}{T\_{PRS,i}}\right⌉\*T\_{PRS,i}$ is the periodicity of PRS-RSRP measurement in positioning frequency layer *i*, Other parameters are the same as for CONNECTED measurements.***Proposal 6: For RSTD measurement in a positioning frequency layer, the requirements can be specified for INACTIVE state as***  $T\_{RSTD,i}=\left(N\_{RxBeam,i}\*\left⌈\frac{N\_{PRS,i}^{slot}}{N^{'}}\right⌉\left⌈\frac{L\_{available\\_PRS,i}}{N}\right⌉\*N\_{sample}-1\right)\*T\_{effect,i}+T\_{last}$where  $N\_{sample}$ is the number of PRS RSTD samples and $N\_{sample}$= TBD. $T\_{effect,i}= \left⌈\frac{T\_{i}}{T\_{PRS,i}}\right⌉\*T\_{PRS,i}$ is the periodicity of PRS-RSRP measurement in positioning frequency layer *i*, Other parameters are the same as for CONNECTED measurements.***Proposal 7: 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.*** |
| R4-2112600 | Nokia, Nokia Shanghai Bell | **Observation 1 :** It is early to discuss UE measurement behaviors in inactive mode , since RAN1/2 discussion are on-going. **Proposal 1**: Review at least the DL RSTD and DL PRS-RSRP measurements applicable for the RRC\_INACTIVE state with corresponding requirements in RAN4.**Proposal 2 :** RAN4 starts with analysis on PRS resource configuration, positioning measurement period and DRX behaviors in the UE RRC\_INACTIVE state. Consider following for minimum requirement.- 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. |
| R4-2113877 | ZTE Corporation | Observation 1: The UE behavior in INACTIVE mode with respect to positioning measurement is similar with the UE behavior under measurement gap in CONNECTED mode.**Proposal 1: 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.** |
| R4-2114053 | Ericsson | 1. RRC connected state positioning requirements should be taken as baseline for defining in active state positioning requirements.
2. RAN4 shall define inactive state positioning measurements for FR1 and FR2
3. RAN4 to wait for RAN1 progress regarding UE measurement capability within DL RSTD.
4. RAN4 to wait for other WG progress to define measurement reporting delay
5. RAN4 to consider reusing the framework or formula of Rel-16 DL RSTD measurement period to derive the inactive state DL-RSTD measurement period
6. RAN4 to take connected mode measurement performance requirements for DL RSTD as baseline for inactive state measurement performance requirements
7. RAN4 to define following periodic inactive state positioning measurements and reporting of positioning measurement which involves state transition to connected state from inactive state.
8. RAN4 to wait for RAN1 progress regarding UE measurement capability within PRS\_RSRP.
9. RAN4 to consider reusing the framework or formula of Rel-16 PRS\_RSRP measurement period to derive the inactive state PRS-RSRP measurement period.
10. RAN4 to take connected mode measurement performance requirements for PRS\_RSRP as baseline for inactive state measurement performance requirements.
11. RAN4 to discuss impact of positioning measurements on RRC INACTIVE state functions.
 |
| R4-2114312 | Huawei, HiSilicon | **Proposal 1: Rel-16 measurement requirements are taken as baseline for defining requirements for DL PRS measurement in RRC\_INACTIVE****Proposal 2: The measurement interval Teffect should take DRX cycle but not MGRP into account.****Proposal 3: The parameter Kcarrier should take one additional PFL into account.** **Proposal 4: Measurement requirements do not apply for a PRS resource if it has instances colliding with paging.** |

## Open issues summary

### Sub-topic 2-1 General aspects

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

Proposals

* Option 1: (vivo, Nokia, Ericsson)
	+ At least UE RRM requirements for DL RSTD and DL PRS-RSRP measurements in RRC-INACTIVE state are specified.
* Recommended WF
	+ *Need more discussion*

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

Proposals

* Option 1: (Ericsson)
	+ RAN4 shall define inactive state positioning measurements for FR1 and FR2.
	+ 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)
	+ Measurement requirements do not apply for a PRS resource if it has instances colliding with paging.
* Recommended WF
	+ *Need more discussion*

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

Proposals

* Option 1: (Ericsson)
	+ RAN4 to wait for RAN1 progress regarding UE measurement capability within DL RSTD and PRS-RSRP
* Recommended WF
	+ *Need more discussion*

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| **Sub-topic 2-1 General aspects** |
| **Company** | **Comments** |
| XXX | **Issue 2-1-1:** **Issue 2-1-2:** **Issue 2-1-3:**  |
| Huawei | **Issue 2-1-1:** Option 1 is fine.**Issue 2-1-2:** We suppport option 2 as we see paging reception is more important than posiotning measurement in RRC\_Inactive, but as this is early stage we are also fine with FFS. It is noted that optino 2 is related to Issue 2-5.On option 1, we are fine with the first bullet, but we think the second bullet is low proiority. RAN4 should focus on measurement requirements during RRC\_Inactive. **Issue 2-1-3:** Option 1 is fine. |
| vivo | **Issue 2-1-1:** Support Option 1.**Issue 2-1-2:** First bullet of option 1 is fine. Second bullet of option 1 and option 2 can be further studied.**Issue 2-1-3:** Fine with Option 1. |
| Intel | **Issue 2-1-1:** **Option 1****Issue 2-1-2:** **In prinicple, Option 2 is fine. Option 1 can be FFS****Issue 2-1-3:**  |
| Ericsson | **Issue 2-1-1:** Option 1 based on RAN1 agreements.**Issue 2-1-2:** Option 1: Our view is RRC connected state positioning measurement requirements should be taken as baseline and define requirements for FR1 and FR2. Since SDT is expected to be configured for positioning measurement reports in inactive state, periodic measurements to be supported. Also, in some scenarios UE may have to transition to connected state to report positioning measurements. RAN4 shall study if we need to define any requirements for the transition.Option 2: Our view is RAN4 shall study positioning measurements collision with inactive state functions such as paging, SI reception, Inactive mode mobility measurements. It is early to agree on something at this stage. **Issue 2-1-3:** Since it is still early stage, we suggest to wait for other WG progress. Hence, we support option 1. |
| Qualcomm | **Issue 2-1-1:** Option 1.**Issue 2-1-2:** For option 1, we agree that requirements should cover both FR1 and FR2. RAN4 should discuss the following:* + Measurement period requirements in RRC\_INACTIVE
	+ Measurement reporting requirements in RRC\_INACTIVE
	+ Measurement requirements when collisions with paging or other procedures occur in RRC\_INACTIVE
	+ Requirements associated with RRC state transitions

**Issue 2-1-3:** In our view, a new UE capability would be needed to distinguish the behavior of Rel-16 UEs that do not support positioning in RRC\_INACTIVE vs newer UEs that do support it. |
| CATT | **Issue 2-1-1:** Fine with option 1. **Issue 2-1-2:** Fine with the first bullet of option 1. Option 2 and the second bullet of option 1 need further study. **Issue 2-1-3:** Fine with option 1. For QC’s comment, we don’t think new UE capability for R16 UE is needed. Because this is a R17 feature, R16 UE is not required to support, we don’t need back to R16 UE capability.  |
| Nokia | **Issue 2-1-1:** Option-1**Issue 2-1-2:** Both options needs clarification.In option-1, it is unclear ”reporting of positioning measurement which involves state transition to connected state from inactive state”. We agree to the scope of QC comment regarding measurement and reporting.Does option 2 mean that Rel-16 Measurement requirements do not apply? **Issue 2-1-3:** A new UE capability would be required to support the feature. |
| OPPO | **Issue 2-1-1:** **Agree with option 1.****Issue 2-1-2:** **Currently we are fine with the first bullete of option 1.****Issue 2-1-3:** **Fine with option 1.** |

### 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**

Proposals

* Option 1: (vivo)
	+ UE RRM requirements for DL PRS-RSRP measurements and DL RSTD measurements in RRC-INACTIVE state are specified without taking measurement gap into consideration.
	+ 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.
	+ 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 2: (Nokia)
	+ 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 3: (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 4: (Huawei)
	+ The measurement interval Teffect should take DRX cycle but not MGRP into account.
	+ The parameter Kcarrier should take one additional PFL into account.
* Recommended WF
	+ *Need more discussion*

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

Proposals

* Option 1: (CATT, vivo, Ericsson, Huawei)
	+ RAN4 to consider reusing the framework or formula of Rel-16 PRS\_RSRP measurement period to derive the inactive state PRS-RSRP measurement period.
* Option 1a: (vivo)
	+ For PRS-RSRP measurement in a positioning frequency layer, the requirements can be specified for INACTIVE state as $T\_{PRS-RSRP,i}=\left(N\_{RxBeam,i}\*\left⌈\frac{N\_{PRS,i}^{slot}}{N^{'}}\right⌉\left⌈\frac{L\_{available\\_PRS,i}}{N}\right⌉\*N\_{sample}-1\right)\*T\_{effect,i}+T\_{last}, $where
		- $N\_{sample}$ is the number of PRS-RSRP measurement samples and $N\_{sample}$= TBD,
		- $T\_{effect,i}= \left⌈\frac{T\_{i}}{T\_{PRS,i}}\right⌉\*T\_{PRS,}$ is the periodicity of PRS-RSRP measurement in positioning frequency layer i,
		- Other parameters are the same as for CONNECTED measurements.
* Option 1b: (CATT)
	+ It needs further study whether the enhancements in R17 RRC\_CONNECTED state requirements can be used for RRC\_INACTIVE state.
* Recommended WF
	+ *Need more discussion*

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

Proposals

* Option 1: (CATT, vivo, Ericsson, Huawei)
	+ RAN4 to consider reusing the framework or formula of Rel-16 RSTD measurement period to derive the inactive state RSTD measurement period.
* Option 1a: (vivo)
	+ For RSTD measurement in a positioning frequency layer, the requirements can be specified for INACTIVE state as $T\_{RSTD,i}=\left(N\_{RxBeam,i}\*\left⌈\frac{N\_{PRS,i}^{slot}}{N^{'}}\right⌉\left⌈\frac{L\_{available\\_PRS,i}}{N}\right⌉\*N\_{sample}-1\right)\*T\_{effect,i}+T\_{last}, $where
		- $N\_{sample}$ is the number of PRS RSTD samples and $N\_{sample}$= TBD.
		- $T\_{effect,i}= \left⌈\frac{T\_{i}}{T\_{PRS,i}}\right⌉\*T\_{PRSi}$ is the periodicity of PRS-RSRP measurement in positioning frequency layeI i,
		- Other parameters are the same as for CONNECTED measurements.
* Option 1b: (CATT)
	+ It needs further study whether the enhancements in R17 RRC\_CONNECTED state requirements can be used for RRC\_INACTIVE state.
* Recommended WF
	+ *Need more discussion*

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| **Sub-topic 2-2 Measurement requirements in RRC\_INACTIVE state** |
| **Company** | **Comments** |
| XXX | **Issue 2-2-1:** **Issue 2-2-2:** **Issue 2-2-3:**  |
| Huawei | **Issue 2-2-1:** There are some overlpping part in the options. We think it should be striaghtforward that MGRP is not to be considered in the measurement period. We suggest to consider DRX cycle but it can be FFS. The impact to the parameter Kcarrier should be consideredWe are also fine to take the sum based approach to define multi-PFL requriemens as in option 1.We need more time to check if reduced sample number or other enhancements in Rel-17 should be considered in RRC\_Inactive requriements. **Issue 2-2-2:** Option 1. We think it is common understanding that there will be some differneces between measurement in Connected and Inactive, and they will be further studied and accounted in the requirements. **Issue 2-2-3:** Same comment as Issue 2-2-2. |
| vivo | **Issue 2-2-1:** We support aspects in option 1 to be considered when defining measurement requirements in RRC\_INACTIVE state.In addition, DRX cycle for paging can be considered by taking UE power saving into consideration.How to take other RRM measurement for cell reselection in INACTIVE state into consideration can be FFS.**Issue 2-2-2:** Option 1. Details can be further discussed.**Issue 2-2-3:** Option 1. Details can be further discussed. |
| Intel | **Issue 2-2-1:** In prinicple, Option 2, 4 are fine for us. In other words, the requirements of RRC\_INACTIVE, shall based on paging DRX instead of MG.**Issue 2-2-2:** **Can be FFS** **Issue 2-2-3:** **Can be FFS**  |
| Ericsson | **Issue 2-2-1:** Our comments for Option 1:we agree that MG shall not be taken into consideration for inactive state positioning measurements. Reduced number of samples are discussed as part of latency reduction in Rel-17. It may be early to agree on number of samples for inactive state positioning. Our view is to consider Rel-16 RRC connected state positioning measurements as baseline and discuss any optimizations for inactive state measurements. Option 2 and 3: Our view is we should not limit measurement occasions as DRX cycle for paging alone. RAN4 should wait for other working group conclusions on measurement occasion. Option 4: our understanding is it can be FFS for now as it is too early. **Issue 2-2-2:** Option 1 as it is early stage of the discussion. Other details can be FFS for now. **Issue 2-2-3:** Option 1 as it is early stage of the discussion. Other details can be FFS for now.  |
| Qualcomm | **Issue 2-2-1:** We agree that measurement gaps are not relevant to measurement period requirements in RRC\_INACTIVE.In principle, we think it would be reasonable to scale measurement requirements in RRC\_INACTIVE with the DRX cycle period. However, RAN4 should discuss system-level impact of introducing different requirements in RRC\_INACTIVE. If there’s a prolonged measurement period in RRC\_INACTIVE it should be reflected in the reponse time for the location request. However, our current understanding is that the LMF will not be aware of the RRC state of the UE. Another related issue to be discussed would be alignment of PRS ocassions with DRX active periods.FFS. Needs further discussion and coordination with other WGs.**Issue 2-2-2:** FFS. See comments for issue 2-2-1. The Rel-16 framework can be used as a baseline (starting point) but changes are not precluded.**Issue 2-2-3:** Same as issue 2-2-2. |
| CATT | **Issue 2-2-1:** Agree that the MG is not considered in RRC\_INACTIVE state measurement requirements. The reduced sample number is enhancement in R17 for RRC\_CONNECTED state, whether it can be used for RRC\_INACTIVE state need further study. Impact on DRX, paging and Kcarrier also need further study. **Issue 2-2-2:** Option 1 and 1b. **Issue 2-2-3:** Option 1 and 1b.  |
| Nokia | **Issue 2-2-1:** Option-2 is a basic assumption. But we don’t preclude measurement period other than paging.**Issue 2-2-2:** A few companies provide specific modification, we think the discussion comes after concluding 2-2-1.**Issue 2-2-3:** A few companies provide specific modification, we think the discussion comes after concluding 2-2-1. |
| OPPO | **Issue 2-2-1:** **Agree that MG should not be considered in RRC\_inactive mode and DRX cycle should be considered instead. Teffect and Kcarrier are not the only two parameters to be revisied due to DRX cycle. Other parameters like Tavailable, Tlast and the definition of overlapping (between PRS and MGL / on duration) need to be further discussed.****Issue 2-2-2:** **Option 1 is ok****Issue 2-2-3:** **Option 1.** |

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

Proposals

* Option 1: (Ericsson)
	+ RAN4 to take connected mode measurement performance requirements for DL RSTD and PRS-RSRP as baseline for inactive state measurement performance requirements.
* Recommended WF
	+ *Need more discussion*

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| --- |
| **Sub-topic 2-3 Performance requirements in RRC\_INACTIVE state** |
| **Company** | **Comments** |
| XXX |  |
| Huawei | FFS, it is too early to discuss the performance part for Inactive. |
| Vivo | FFS. Can be discussed during performance part. |
| Intel | FFS |
| Ericsson | FFS. |
| Qualcomm | FFS |
| CATT | FFS |
| Nokia | FFS |
| OPPO | FFS |

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

Proposals

* Option 1: (CATT, Ericsson)
	+ RAN4 wait for the outcomes of other WGs and define the reporting requirements based on the conclusions.
* Recommended WF
	+ *Need more discussion*

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| --- |
| **Sub-topic 2-4 Reporting requirements in RRC\_INACTIVE state** |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1 is fine. |
| Vivo | Fine with option 1. |
| Intel | Option 1 |
| Ericsson | Option 1 as it is in early stage in other WGs also |
| Qualcomm | Option 1 |
| CATT | Option 1.  |
| Nokia | Option-1 is fine with us. |
| OPPO | Option 1. |

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

Proposals

* Option 1: (Ericsson)
	+ RAN4 to discuss impact of positioning measurements on RRC INACTIVE state functions.
* Recommended WF
	+ *Need more discussion*

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| --- |
| **Sub-topic 2-5 Impact on inactive state functions** |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1 is fine. |
| Vivo | Support option 1. |
| Intel | Option 1 is fine.  |
| Ericsson | Option 1 as we discussed in our paper |
| Qualcomm | Option 1 |
| CATT | Option 1.  |
| Nokia | Option-1 |
| OPPO | Option 1. |

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic #2-1** | **Issue 2-1-1 The type of measurement requirements to be specified in RRC\_INACTIVE state***Tentative agreements:*At least UE RRM requirements for DL RSTD and DL PRS-RSRP measurements in RRC-INACTIVE state are specified. *Candidate options:* None. *Recommendations for 2nd round:* *No more discussion*. **Issue 2-1-2 The requirements applicability in RRC\_INACTIVE state***Tentative agreements:* RAN4 shall define inactive state positioning measurements for FR1 and FR2. *Candidate options:*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.

*Recommendations for 2nd round: Check the tentative agreements*.**Issue 2-1-3 The UE measurement capability***Tentative agreements:* None. *Candidate options:** 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.

*Recommendations for 2nd round: Continue discussion*. |
| **Sub-topic #2-2** | **Issue 2-2-1 The factors considered for the** **measurement requirements in RRC\_INACTIVE state***Tentative agreements:*MG is not to be considered in the measurement period requirements in RRC\_INACTIVE state.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.

*Recommendations for 2nd round: Check the tentative agreements.* **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.*Candidate options:* None. *Recommendations for 2nd round: Check the tentative agreement.* **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.*Candidate options:* None. *Recommendations for 2nd round: Check the tentative agreement.*  |
| **Sub-topic #2-3** | *Tentative agreements:* None.FFS: RAN4 to take connected mode measurement performance requirements for DL RSTD and PRS-RSRP as baseline for inactive state measurement performance requirements. *Candidate options:* None.*Recommendations for 2nd round: No more discussion*. |
| **Sub-topic #2-4** | *Tentative agreements:*RAN4 wait for the outcomes of other WGs and define the reporting requirements based on the conclusions. *Candidate options:* None.*Recommendations for 2nd round: No more discussion*. |
| **Sub-topic #2-5** | *Tentative agreements:*RAN4 to discuss impact of positioning measurements on RRC INACTIVE state functions. *Candidate options:* None.*Recommendations for 2nd round: No more discussion*. |

### CRs/TPs

## Discussion on 2nd round (if applicable)

# Topic #3: Enhancements of A-GNSS positioning

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2112003 | CATT | **Not available** |
| R4-2113873 | ZTE Corporation | **Observation 1:** TS 38.171, TS 37.171 and TS 36.171 don’t have a release 17 version.**Proposal 1: Suggest to the MCC to update TS 36.171, 37.171 and 38.171 to release 17 to capture possible RAN4 agreements.** |
| R4-2114314 | Huawei, HiSilicon | **Observation 1: In 38.171 and 36.171 there are a number of side conditions and test setup that are specific to A-GNSS system****Observation 2: When a new A-GNSS system was introduced to 3GPP, RAN4 has added the side conditions and test setup that are specific to it in 38.171 and 36.171.****Proposal: RAN4 to introduce BDS and NavIC to 36.171 and 38.171 following the existing approach after RAN2 has introduced the ignalling support.** |

## Open issues summary

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

Proposals

* Option 1: (ZTE)
	+ Suggest to the MCC to update TS 36.171, 37.171 and 38.171 to release 17 to capture possible RAN4 agreements.
* Recommended WF
	+ *Need more discussion*

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| --- |
| **Sub-topic 3-1 Specification release update** |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1 is fine. |
| Ericsson | Option 1 is not needed.Companies should write R17 CRs based on the latest R16 version of the corresponding specs (TS 36.171, 37.171 and 38.171). This will trigger the creation of R17 versions because then MCC will create R17 when there is R17 CR based on last R16 version. It is normal procedure.  |
| Qualcomm2 | Not needed, normal process as indicated by Ericsson. |
| CATT | Agree with Ericsson. Option 1 is not needed for now.  |
| Nokia | Same view with Ericsson. |

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

Proposals

* Option 1: (Huawei)
	+ RAN4 to introduce BDS and NavIC to 36.171 and 38.171 following the existing approach after RAN2 has introduced the signaling support.
* Recommended WF
	+ *Need more discussion*

|  |
| --- |
| **Sub-topic 3-2 RAN4 requirements for A-GNSS enhancements** |
| **Company** | **Comments** |
| XXX |  |
| Huawei | Option 1. |
| Qualcomm2 | The Proposal is a bit unclear.(1) NavIC requirements can be copied from Rel-16 36.171. There should be no different requirements for LTE and NR.(2) BDS is already supported. We don't have requirements per GNSS signal. The additional BDS signals B2a and B3I would only affect the Table 4.1 in 36.171 and 38.171. |
| CATT | Suggest waiting for RAN2 progress.  |
| Nokia | What is following the “existing approach”? BDS is already supported in the spec, additions in Rel-17 is additional BDS signals in new bands. If RAN2 agrees to the signaling, RAN4 can work to add it. Proposal intention is agreeable. |

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic #3-1** | *Tentative agreements:*It is not needed to update TS 36.171, 37.171 and 38.171 to release 17 at this stage. *Candidate options:* None.*Recommendations for 2nd round: No more discussion*. |
| **Sub-topic #3-2** | *Tentative agreements:*RAN4 define requirements for additional BDS signals and NavIC after RAN2 has introduced the signaling support. *Candidate options:* None.*Recommendations for 2nd round: Check the tentative agreement*. |

### CRs/TPs

## Discussion on 2nd round (if applicable)

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
| WF on Rel-17 positioning enhancements RRM\_2 | CATT |  |
| Reply LS on gNB/UE Rx/Tx timing error mitigation | CATT | Reply to: RAN1 |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
|  |  |  |  |  |
|  |  |  |  |  |
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|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-2115367 | WF on Rel-17 positioning enhancements RRM – Part 2 | CATT | Agreeable |  |
| R4-2115368 | Reply LS on gNB/UE Rx/Tx timing error mitigation | CATT | Agreeable | Reply to: RAN1 |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)