**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.8.2-8.8.4

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for RAN4#94e\_#57\_NR\_pos\_RRM\_Part\_2

**Document for:** Information

# Introduction

The documents in agenda items 8.8.2, 8.8.3 and 8.8.4 contains the following 4 main topics and sub-topics under each main topic:

* Topic #1: gNB measurement accuracy requirements (AI 8.8.2)
	+ Issue 1-1: Selection of option for gNB measurement accuracy requirements
	+ Issue 1-2: Optionality of gNB measurement accuracy requirements
	+ Issue 1-3: Basic scenario/condition for gNB measurement accuracy requirements
* Topic #2: gNB measurement report mapping (AI 8.8.2)
	+ Issue 2-1: Report mapping for SRS-RSRP measurement
	+ Issue 2-2: Report mapping for gNB Rx-Tx time difference measurement
	+ Issue 2-3: Report mapping for UL RTOA measurement
	+ Issue 2-4: Report mapping for AoA and ZoA
* Topic #3: Positioning measurement impact on RRM (AI 8.8.3)
	+ Issue 3-1: Impact of TA change on UE Rx-Tx time difference measurement
	+ Issue 3-2: Measurement gaps
	+ Issue 3-3: Scheduling restriction
	+ Issue 3-4: Active BWP status during measurements
* Topic #4: UE-based positioning performance requirements (AI 8.8.4)
	+ Issue 4-1: Requirements for UE based positioning

# Topic #1: gNB measurement accuracy requirements (AI 8.8.2)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000054 | ZTE Corporation | gNB requirements for NR positioning is optional |
| R4-2000390 | Intel Corporation | Define requirements for NR positioning gNB measurements in Rel16.• gNB Rx-Tx time difference• UL SRS-RSRP |
| R4-2000736 | Qualcomm Incorporated | Define gNB measurement accuracy requirements for gNB measurement types in the Perf part• Rx-Tx timing difference• UL SRS-RSRP measurements |
| R4-2001196 | NTT DOCOMO, INC. | Define at least following gNB measurement accuracy requirements in the Perf part- Rx-Tx timing difference- UL SRS-RSRP measurementsStudy the feasibility of defining accuracy requirements for AoA measurements if necessary.Study the necessity of defining accuracy requirements for UL RTOA measurements if necessary. |
| R4-2001496 | Ericsson | Define gNB measurement accuracy requirements for gNB measurement types in the Perf part• Rx-Tx timing difference• UL SRS-RSRP measurements |
| R4-2001634 | Huawei, HiSilicon, CMCC | Define gNB measurement accuracy requirements for UL-RTOA. Define gNB measurement accuracy requirements for AoA/ZoA. |
| R4-2001919 | Nokia, Nokia Shanghai Bell | gNB requirements for NR positioning are optional.Define gNB minimum accuracy requirements for gNB Rx-Tx time difference and UL SRS-RSRP for the serving cell UE scenario. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1

According to WF in R4-1915854, “Way forward on NR Positioning RRM”, approved in RAN4#93 the following options were agreed:

* + Option 1: Define gNB measurement accuracy requirements for gNB measurement types in the Perf part
		- Rx-Tx timing difference
		- UL SRS-RSRP measurements
	+ Option 2: Define gNB measurement accuracy requirements for gNB measurement types in the Perf part
		- Rx-Tx timing difference
		- UL SRS-RSRP measurements
		- AoA / ZoA measurements
		- UL RTOA measurements
	+ Option 3: Do not define gNB requirements

In RAN4#94-e, one of the 3 options is to be agreed.

**Issue 1-1: Selection of option for gNB measurement accuracy requirements**

* Proposals
	+ Option 1: (Intel, Qualcomm, NTT DoCoMo\*, Ericsson, Nokia)
		- select option 1 in R4-1915854 for defining accuracy requirements.
	+ Option 2: (Huawei, CMCC)
		- select option 2 in R4-1915854 for defining accuracy requirements.

\*proposes at least option 1 and define AoA and UL RTOA if necessary.

* Recommended WF
	+ Agree to define at least Rx-Tx timing difference and UL SRS-RSRP measurements and further investigate the feasibility and necessity of defining AoA/ZoA and UL RTOA.

### Sub-topic 1-2

**Issue 1-2: Optionality of gNB measurement accuracy requirements**

* Proposals
	+ Option 1: ZTE, Nokia
		- gNB measurement accuracy requirements are optional
* Recommended WF
	+ Collect feedback from other companies if the proposal is acceptable.

### Sub-topic 1-3

**Issue 1-3: Basic scenario/condition for gNB measurement accuracy requirements**

* Proposals
	+ Option 1: Nokia
		- gNB measurement accuracy requirements are defined for:
			* the serving cell of the UE,
			* fixed antenna beams only,
			* depending on BS types operating in FR1 and FR2.
* Recommended WF
	+ Collect feedback from other companies if the proposal is acceptable.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Sub topic 1-1: While we support option 1, we’d like to note that at least two papers (R4-2001634 from Huawei and R4-2001919 from Nokia) discussed that the additional work for defining UL RTOA requirements once gNB Rx-Tx time difference requirements are determined is trivial. If other companies agree then UL RTOA requirements can also be included in Option 1 leaving only AoA/ZoA measurements out of R16. We hope this can be agreed as a compromise at least for R16. Sub topic 1-2: Option 1 needs to be clarified. It is common knowledge that support for a particular type of positioning method is an optional feature and as such the accuracy requirements corresponding to the measurements of that positioning method becomes optional. However, does option 1 (as phrased above) mean that even if gNB supports a particular positioning method, it should optionally meet the accuracy requirements for the corresponding measurements? If so, then we don’t agree. Sub topic 1-3: We do not understand why the accuracy requirements should be defined only for the serving cell of the UE. Once the side conditions are met, gNB requirements should be fulfilled regardless of whether it is or is not for the serving gNB of the UE. Whether the scenario in conformance testing includes only the serving gNB of the UE or not is a separate discussion.….Others: |
| Huawei, HiSilicon | Issue 1-1: We do not agree with the current recommended WF. * On the necessity, we think RAN4 should define some gNB measurement requirements that enable network based positioning, otherwise an important part of the WI objectives is missing. Also there are clear interests from operators and vendors. Therefore, the measurement requirements for UL-RTOA and AOA/ZOA are clearly needed.
* On the feasibility,
	+ We understand for UL-RTOA there should be no problem as also mentioned by Docomo and Nokia. The measurement is effectively same as Rx-Tx time difference, so the specification efforts to define the requirements are minor assuming RAN4 is going to define requirements for Rx-Tx time difference.
	+ For AoA/ZOA, we also see no problem because it is clearly testable by comparing the reported value and the ideal value known to the test system, and how gNB derives the measurement is up to implementation. It’s true we need to discuss the gNB antenna setup when defining the requirements, but the same needs to be done also for Rx-Tx time difference.

For the WF, as a compromise, we suggest to define at least Rx-Tx timing difference, UL SRS-RSRP and UL-RTOA measurements requirements, and further investigate the feasibility of defining AoA/ZoA. For UL-RTOA, we support Nokia proposal in R4-2001919, i.e. the gNB measurement requirements for UL-RTOA are defined by re-using the requirements for gNB Rx-Tx time difference.Issue 1-2: Support option 1.Issue 1-3: We would need like to first clarify the proposals from Nokia* Requirements defined for the serving cell of the UE: does it means the side condition would be -6dB instead of -13dB (or similar) for DL measurements?
* Requirements defined for the fixed antenna beam: we understand it may impact the test setup, but how would it be reflected in the requirements?
 |
| ZTE | Sub topic 1-1: We support Option 1.Sub topic 1-2: Support Option 1.Sub topic 1-3: We would also like to ask for clarification on the proposal of only defining requirements for serving cell. We think this is more related to test cases other than performance requirements. |
| CATT | Sub topic 1-1: We support option 2, considering the timeline of R16, if all companies agreed, we can compromise to the suggestion which leaves the consideration of AOA/ZOA to R17. Sub topic 1-2: We support option 1.  |
| Ericsson | Sub-topic 1-1: Support option 1. Both methods do not require very tight synchronization among cells. By contrast option 2, AoA or RTOA may have to use complex algorithms in a real environment and it is not clear what actual measurement capability would be required of the NB to satisfy a simple requirement.Sub-topic 1-2: Support option 1. Sub-topic 1-3: Need more discussion. |
| Intel | Sub topic 1-1: **Issue 1-1**: **Selection of option for gNB measurement accuracy requirements**Support Option1. The other gNB requirements can be deprioritized due to the limited time left to close NR Pos WI in RAN4.Sub topic 1-2:**Issue 1-2: Optionality of gNB measurement accuracy requirements**These gNB requirements can be applicable for the devices which support corresponding NR positioning method (e.g. if the device which didn’t support multi-RTT positioning, the requirements on gNB RX-TX time difference need not be required). Sub topic 1-3:**Issue 1-3: Basic scenario/condition for gNB measurement accuracy requirements**These gNB requirements need not only for the serving cell but the neighbour cells which are used for the positioning measurement. ….Others: |
| CMCC | Issue 1-1: we prefer option 2, it is necessary to define requirements for the positioning types which only rely on BS measurement. To move forward, we can accept to define requirements for at least Rx-Tx timing difference, UL SRS-RSRP measurement, UL RTOA measurements, and FFS for AoA / ZoA measurements. |
| MTK | Agree with QC’s views |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: gNB measurement report mapping (AI 8.8.2)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000054 | ZTE Corporation | Further study the report mapping of AoA and ZoA measurement based on simulations |
| R4-2000390 | Intel Corporation | * UL RTOA reporting granularity ca be defined as: T=T\_c 2k, where k is a configuration parameter with a minimum value of “-1”.
* The reporting range for AoA and ZoA is from 0 to 360 degree, with resolution of 0.1 degree.
* UL SRS (PRS) RSRP reporting granularity is set to 1dB.
 |
| R4-2001632 | Huawei, HiSilicon | * For UL-RTOA report mapping,

- Reporting range is from 0 to 9600Ts.- Reporting granularity is Tc\*2k for the whole range.* For SRS-RSRP report mapping, the range and granularity of SS-RSRP are re-used.
* For gNB Rx-Tx time different report mapping,

- Reporting range is from -15391Ts to +15391Ts.- Reporting granularity is re-used from RSTD.* For gNB AoA/ZoA report mapping,

- Reporting range is from -180 degree to +180 degree for AoA and from 0 to +180 degree for ZoA.- Reporting granularity is 0.1 degree. |
| R4-2001919 | Nokia, Nokia Shanghai Bell | * RAN4 should study if a higher reporting resolution of Tc/2 is possible for gNB Rx-Tx time difference.
* RAN4 should study if a lower reporting granularity than 1 dB is feasible for UL SRS-RSRP.
* Investigate a variable reporting granularity and the reporting range for AoA and ZoA.
 |

## Open issues summary

### Sub-topic 2-1

**Issue 2-1: Report mapping for SRS-RSRP measurement**

* Proposals
	+ Option 1: (Intel, Nokia)
		- reporting granularity = 1dB
		- Maximum and minimum values = TBD
	+ Option 2: (Huawei)
		- reporting granularity = 1dB
		- Maximum and minimum values as for SS-RSRP
* Recommended WF
	+ Agree on reporting granularity of SRS-RSRP = 1dB
	+ Collect feedback if maximum and minimum values can be same as for SS-RSRP. If there is no consensus then investigate until next meeting.

### Sub-topic 2-2

**Issue 2-2: Report mapping for** **gNB Rx-Tx time difference measurement**

* Proposals
	+ Option 1: (Intel)
		- gNB Rx-Tx report mapping is same as for UL RTOA
	+ Option 2: (Huawei)
		- Reporting range is from -15391Ts to +15391Ts.
		- Reporting granularity is re-used from RSTD.
	+ Option 3: (Nokia)
		- Study if a higher reporting resolution of Tc/2 is possible for gNB Rx-Tx time difference-
* Recommended WF
	+ Proposals are very diverse. Need further discussion.

### Sub-topic 2-3

**Issue 2-3: Report mapping for UL RTOA measurement**

* Proposals
	+ Option 1: (Intel)
		- UL RTOA reporting granularity defined as: T=T\_c 2k, where k is a configuration parameter with a minimum value of “-1”.
	+ Option 2: (Huawei)
		- Reporting range is from 0 to 9600Ts.
		- Reporting granularity is Tc\*2k for the whole range.
* Recommended WF
	+ Proposals are very diverse. Need further discussion.

### Sub-topic 2-4

**Issue 2-4: Report mapping for AoA and ZoA**

* Proposals
	+ Option 1: (Intel)
		- The reporting range for AoA and ZoA is from 0 to 360 degree, with resolution of 0.1 degree.
	+ Option 2: (Huawei)
		- Reporting range is from -180 degree to +180 degree for AoA and from 0 to +180 degree for ZoA.
		- Reporting granularity is 0.1 degree.
	+ Option 3: (Nokia)
		- Investigate a variable reporting granularity and the reporting range for AoA and ZoA.
* Recommended WF
	+ Proposals are very diverse. Need further discussion.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Sub topic 2-1: We agree with the WFSub topic 2-2: Decisions on gNB Rx-Tx time difference report mapping should follow closely those from UE Rx-Tx time difference report mapping including min, max, granulatiry, … The multi-RTT positioning method relies on Rx-Tx time difference measurements from UE and gNB side so it would make sense to have similar conclusions. Our proposal is to discuss this in parallel with UE side or perhaps wait for decisions on UE side and extend them to gNB.Sub topic 2-3: There is a lot of synergy between the report mapping of UL RTOA and gNB Rx-Tx time difference report mapping. We proposed to extend at least some of the decisions such as granularity level from Sub topic 2-2 to Sub topic 2-3. ….Others: |
| Huawei, HiSilicon | Issue 2-1 (SRS-RSRP): On maximum value, we think -31dBm from SS-RSRP is already quite large thus should be high enough for SRS-RSRP. On minimum value, the -156dBm from SS-RSRP is reused from LTE which was derived for eMTC/NB-IoT with SNR down to -15dB. From LTE UL-RTOA requirements in 36.111, the Es/IoT condition considering measurement of neighbor cell UE is -16.9 dB, so we think -156dBm should also be low enough for SRS-RSRP. We are open to other opinions.Issue 2-2 (Rx-Tx time difference): For the range, the measurement is performed for UEs in neighbour cells which may be asynchronous to the serving cell, so the time difference can be any value between -0.5ms to +0.5ms. For the granularity, RAN1 already had agreement in R1-1913522.Issue 2-3 (UL-RTOA): For the range we suggest to reuse the values from LTE. For the granularity, RAN1 already had agreement in R1-1913522.Issue 2-4 (AOA/ZoA): For AOA there is no difference between [0,360) and [-180,180). For ZOA the range can only be [0,180), e.g. 270 degree is same as 90 degree. For the granularity, RAN1 already had agreement in R1-1913522, which is 0.1 degree. |
| ZTE | Issue 2-4: Agree with Option 2 to be consistent with RAN1 agreement. |
| CATT | Sub topic 2-1: We agree with the WFSub topic 2-2: Since the definition of gNB Rx-Tx time difference is similar with UE Rx-Tx time difference and both are used for Multi-RTT, we think the report mapping can be extended from UE Rx-Tx time difference if without special reasons.Sub topic 2-3: For UL RTOA, support to reuse LTE report mapping. Sub topic 2-4: For AOA/ZOA, the granularity is defined as 0.1 degree following RAN1’s agreement, for report range, AOA is between [-180,180) degree and ZOA is between [0,180) degree according to the definition. |
| Ericsson | Sub-topic 2-1: We agree with 1 dB resolution. Need more discussion on maximum and minimum valuesSub-topic 2-2: Need more discussion.Sub-topic 2-3: Need more discussion.Sub-topic 2-4: Need more discussion. |
| Intel | Sub topic 2-1: **Issue 2-1: Report mapping for SRS-RSRP measurement**For Maximum and minimum values as for SS-RSRP, these for SS-RSRP can be fine for us. Sub topic 2-2:**Issue 2-2: Report mapping for gNB Rx-Tx time difference measurement**For the reporting granularity, it can be same as UL-RTOA (also RSTD), the scaling factor “k” can be configured by NW itself.For the reporting range, it can be same as that of RSTD so far (e.g. from -15391Ts to +15391Ts).Thus these report mapping can follow the conclusion of similar ones for UE(e.g. RSTD).Sub topic 2-3:**Issue 2-3: Report mapping for UL RTOA measurement**For the reporting granularity and range, it can be same as RSTD.Sub topic 2-4:**Issue 2-4: Report mapping for AoA and ZoA**Option 2 can be agreed. ….Others: |
| MTK | Sub topic 2-1: Agree with the recommended WFSub topic 2-2: Reporting granularity can be the same as that for UE Rx-Tx report mapping. Other details can be discussed after UE Rx-Tx report mapping is concluded. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: Positioning measurement impact on RRM (AI 8.8.3)

According to WF in R4-1915854, “Way forward on NR Positioning RRM”, approved in RAN4#93 the following was agreed regarding impact of positioning on RRM:

* Existing handover requirements shall apply while the UE performs PRS based measurements.
* Existing requirements on UE transmit timing in section 7.1 and TA in section 7.3 in TS 38.133 shall apply during the PRS based positioning measurements.
* UE behaviour on scheduling restriction in FR1 shall be the same as agreed for FR2

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000605 | CATT | * No new measurement gap pattern needs to be defined for NR positioning. PRS periodicities shorter than a measurement gap periodicity can still be used for positioning measurements if measurement gap is not required.
* Existing HO requirements apply while UE performs PRS measurements, and the measurement period of RSTD measurement will be extended.
* Existing requirements on Tx timing including accuracy and application of TA apply even during an LPP session.
* The requirements for Rx – Tx time difference measurement is not applied if the transmit timing change by TA adjust signal.
* The UE Rx – Tx time difference measurement is not additional capability and is not impact on existing RRM requirements. The requirements for measurement period, accuracy and reporting mapping will be defined in RRM specification.
* The requirements for measurement period and accuracy of UE Rx – Tx time difference measurement should be defined based on the working bandwidth.
* One additional PRS measurement layer is defined for UE measurement.
 |
| R4-2000737 | Qualcomm Incorporated | * RAN4 to adhere to the RAN1 agreement regarding scheduling restriction of PRS symbols with other DL signals and channels in FR2 and apply the same rule and UE behavior to FR1.
* RAN4 to define new measurement gap lengths to enable PRS measurements with gaps. Maximum length of new measurement gap patterns to be further discussed with [40] ms as an option.
* PRS-RSTD and PRS-RSRP measurement requirements apply when UE’s active DL BWP is not changed during the measurement period. UE Rx-Tx time difference measurement requirements apply when UE’s active DL and UL BWP is not changed during the measurement period.
	+ Exact definitions of start and end of measurement period are FFS.
* RAN4 to consider UE’s active DL BWP change before the start of PRS measurement period such that it contains PRS BW and reverting it back once measurements are completed.
* Send an LS to RAN2 to provide the necessary signalling for Proposal 4.
 |
| R4-2001640 | Huawei, HiSilicon | * UE is not expected to perform RRM measurement during the processing time after a PRS occasion, or to perform PRS measurement during the processing time after the SMTC or CSI-RS occasion. Detailed UE measurement behavior is FFS.
* RAN4 to discuss whether UE can be configured with a separate gap configuration for PRS measurement in parallel to the gap configuration for RRM measurement.
* RAN4 should discuss whether to introduce new gap patterns with larger MGL for PRS measurement.
 |
| R4-2001918(AI: 8.8.2.1) | Nokia  | * UE behaviour in FR1 should be the same as in FR2, i.e. the UE is not expected to process DL PRS in the same OFDM symbol where other DL signals and channels are transmitted to the UE.
 |
| R4-2000389(AI: 8.8.2.12.) | Intel | * A single measurement gap pattern for RSTD inter-frequency measurements and other existing NR inter-frequency measurements (e.g. SSB based RSRRP/RSRQ) is beneficial for UE implementation complexity.
* If the gap for PRS measurement shall reuse the existing one [5] for NR measurement (e.g. SSB), UE may not utilize any one intact PRS resource within a gap.
* Regarding to the limited PRS resource within a legacy gap [5], RAN4 shall discuss necessity and feasibility of new measurement gap patterns for PRS measurement.
* The message to request the new RSTD measurement gap from UE is beneficial to improve the utilization of measurement gap for both RSTD and other legacy NR inter-frequency measurements.
 |

## Open issues summary

### Sub-topic 3-1

**Issue 3-1: Impact of TA change on UE Rx-Tx time difference measurement**

* Proposals
	+ Option 1: (CATT)
		- The requirements for UE Rx-Tx time difference measurement is not applied if the transmit timing change by TA adjust signal.
		- UE Rx-Tx time difference measurement does not impact any RRM requirement
* Recommended WF
	+ Collect feedback from companies if the above proposal is agreeable.

### Sub-topic 2-2

According to clause 5.1.6.4, TS 38.214 v16.0.0, PRS resource set (PRS burst) can be larger than 6 ms (current maximum MGL defined in 38.133).

**Issue 3-2: Measurement gaps**

* Proposals
	+ Option 1: (Qualcomm)
		- RAN4 to define new measurement gap lengths to enable PRS measurements with gaps. Maximum length of new measurement gap patterns to be further discussed with [40] ms as an option.
	+ Option 2: (Huawei)
		- RAN4 to discuss whether UE can be configured with a separate gap configuration for PRS measurement in parallel to the gap configuration for RRM measurement.
		- RAN4 should discuss whether to introduce new gap patterns with larger MGL for PRS measurement.
	+ Option 3: (CATT)
		- No new measurement gap pattern needs to be defined for NR positioning.
		- PRS periodicities shorter than a measurement gap periodicity can still be used for positioning measurements if measurement gap is not required
	+ Option 4 (Intel)
		- Regarding to the limited PRS resource within a legacy gap [5], RAN4 shall discuss necessity and feasibility of new measurement gap patterns for PRS measurement.
	+ Summary of options:
		- New gap pattern needed or further study new gap pattern for PRS measurements?
			* Yes (QC, Intel, HW)
			* No (CATT)
* Recommended WF
	+ Collect feedback on two main issues:
		- Is new gap pattern with MGL > 6 ms needed for PRS measurements and possible MGL values?
		- RRM and PRS measurements can be done using the same gap pattern or in separate gap patterns in parallel?

### Sub-topic 3-3

According to clause 5.1.6.4, TS 38.214 v16.0.0, “The UE assumes that for the serving cell the DL PRS is not mapped to any symbol that contains SS/PBCH. If the time frequency location of the SS/PBCH block transmissions from non-serving cells are provided to the UE then the UE also assumes that the DL PRS is not mapped to any symbol that contains the SS/PBCH block of the non-serving cell”.

**Issue 3-3: Scheduling restriction**

* Proposals
	+ Option 1: (Qualcomm, Nokia)
		- RAN4 to adhere to the RAN1 agreement regarding scheduling restriction of PRS symbols with other DL signals and channels in FR2 and apply the same rule and UE behavior to FR1.
	+ Option 2: (Huawei)
		- UE is not expected to perform RRM measurement during the processing time after a PRS occasion, or to perform PRS measurement during the processing time after the SMTC or CSI-RS occasion. Detailed UE measurement behavior is FFS.
* Recommended WF
	+ Confirm RAN4 previous agreement on scheduling restriction of PRS symbols with other DL signals and channels in FR2 and apply same rule for FR1.

### Sub-topic 3-4

**Issue 3-4: Active BWP status during measurements**

* Proposals
	+ Option 1: (Qualcomm)
		- PRS-RSTD and PRS-RSRP measurement requirements apply when UE’s active DL BWP is not changed during the measurement period.
		- UE Rx-Tx time difference measurement requirements apply when UE’s active DL and UL BWP is not changed during the measurement period
		- RAN4 to consider UE’s active DL BWP change before the start of PRS measurement period such that it contains PRS BW and reverting it back once measurements are completed. Send an LS to RAN2 to provide the necessary signalling.
* Recommended WF
	+ Collect companies’ feedback on proposed conditions related to active DL BWP for applicability of PRS-RSTD and PRS-RSRP measurement requirements.
	+ Collect companies’ feedback on proposed condition related to active DL BWP and active UL BWP for applicability of UE Rx-Tx time difference measurement requirements.

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Qualcomm | Sub topic 3-1: This issue seems misplaced. Similar topic is discussed in Sub topic 22-2 in email discussion #56 on positioning UE RRM requirements. Sub topic 3-2: In our view, limiting MGL to 6ms severely limits the possible PRS configurations for measurements with gap in both FR1 and FR2. We have showed typical examples in our discussion paper. Regarding the question of whether the same gap pattern or two parallel gap patterns for RRM and positioning is needed, we believe the merits of having two parallel gap patterns are now more visible in NR compared to LTE and eMTC. In NR, RRM measurements are only possible on SMTC which is also periodic whereas in LTE/eMTC, PSS/SSS/CRS signals were much more regular. However, we also understand the complexities associated with two parallel gap patterns both in terms of specification impact and implementation.Sub topic 3-3: we agree with WF and confirm that the text quoted from TS 38.214 settles the issue. ….Others: |
| Huawei, HiSilicon | Issue 3-1: We support the first bullet, e.g. the requirements for UE Rx-Tx time difference measurement is not applied if the transmit timing change by TA adjust signal. The second bullet “UE Rx-Tx time difference measurement does not impact any RRM requirement” is rather big, and it clearly needs more discussion.Issue 3-2: We slightly prefer to introduce new GP with larger MGL so that more PRS configurations can be used. For same/separate gap for PRS and RRM measurement, we have no strong view. One consideration factor is that having all PRS resources per occasion within the SMTC window may be a difficult task for network. Issue 3-3: There are several sub-issues as we can see.* Our Proposal 1 in R4-2001640 is not related to scheduling restriction discussion, instead it is for inter-action between PRS measurement and RRM measurement. We suggest to list it as a separate sub-topic, but it is up to the moderator to decide.
* For the scheduling restriction, we think it is related to the measurement gap discussion which is addressed by Sub-topic 27-2 in email discussion #56. The reason is that the current RAN1 rule allows UE to drop PRS measurement when colliding with other DL channels/signals, so to have guaranteed performance, UE may also need gap to measure PRS within active BWP. We discussed in this in our paper R4-2001637. We suggest to merge the discussion to have a full picture on gap and scheduling restriction issue, but it is up to two moderators to decide.
* For the scheduling restriction in FR1, we do not see the need to apply the same rule as for FR2. Since there is no Rx beam issue, UE should be able to do the PRS measurement and receive other DL signals/channels simultaneously. This is Proposal 4a in our paper R4-2001637.

Issue 3-4: On the condition related to BWP change, we think it may be too limiting. PRS configuration comes from LPP while BWP may be dynamically changed by the serving cell. There is actually the same issue for RRM measurement. So we think the transition between gap based and gapless measurement is possible as long as measurement gap is configured.  |
| CATT | Sub topic 3-1: For the second bullet, based on HUAWEI’s comments, we have a clarification, as discussed in our discussion paper R4-2000605, it means no more additional resource is needed for UE Rx-Tx time difference comparing with the mobility measurement and OTDOA positioning measurement. That is if the UE Rx-Tx time difference is configured to be measured with PRS, then it has impact on SSB based RRM but it can use the same resource and measurement gap with PRS RSTD. Sub topic 3-2: We agree to introduce new gap pattern to cover the larger PRS configuration and the MGL needs further study. As for same/separate gap for PRS and RRM measurement, we prefer to use the same gap pattern considering the realizability of separate gap. In LTE, we use the same gap pattern for Inter-frequency measurement and measure one frequency in each gap, then we can use the same method to include the PRS measurement when we have introduced new pattern.Sub topic 3-3: We think the current rule in RAN1’s agreement may reduce the performance of positioning and agree to merge the discussion with measurement gap. Sub topic 3-4:During the measurement period, when active BWP changes, there are two cases, if the center frequency has no change and PRS is still within the active BWP, then it will not impact the PRS receiving and measurement, otherwise the PRS may be missed and the measurement can be valid.However the active BWP will not change frequently, we agree the first and second bullet.  |
| Ericsson | Sub-topic 3-1: Agree the requirements for UE Rx-Tx time difference measurement are not applied if UE timing change over the UE Rx-Tx time difference measurement period. But UE behavior if timing changes needs to be discussed. Sub-topic 3-2: We agree there is a need for new gap pattern with MGL > 6 ms. The exact MGL needs further discussion. Inform RAN2 in RAN4#94-e that RAN4 will provide details in April meeting. Sub-topic 3-3: We agree with RAN4 previous agreement on scheduling restriction of PRS symbols with other DL signals and channels in FR2 and apply same rule for FR1.Sub-topic 3-4: The UE shall also meet positioning measurement requirements when UE’s active DL BWP is changed during the measurement period. For this scenario need further discussion which requirements shall apply. |
| Intel | Sub topic 3-1: **Issue 3-1: Impact of TA change on UE Rx-Tx time difference measurement**Shall be discussed in other AI for UE Rx-Tx time difference.Sub topic 3-2:**Issue 3-2: Measurement gaps** Intel addressed the necessarity of new gap pattern for PRS in other WI [**R4-2000389**]. Our observation for this issues is:“**If the gap for PRS measurement shall reuse the existing one [TS38.133] for NR measurement (e.g. SSB), UE may not utilize any one intact PRS resource within a gap”**So regarding to the limited time for this WI in Rel16, we can endorsed such proposal and study in Rel17.Sub topic 3-3:**Issue 3-3: Scheduling restriction** Intel addressed this similar issue in other AI [R4-2000388]. Our view is no need to restrict UE PRS measurement under such case which is seldomly happened. It can be UE implementation when little performance degradation due to such co-symbol interference. Sub topic 3-4:**Issue 3-4: Active BWP status during measurements**Some clarification on the requirements when active BWP changing can be necessary. But the signalling or redefine the start point of measurement period could be unnecessary in Rel16 WI.Others: |
| CMCC | Issue 3-2: More discussion is needed on the necessity and feasibility of new measurement gap patterns for PRS measurement |
| MTK | * Sub topic 3-1: Agree with QC’s view. It should be discussed in Email discussion #56
* Sub topic 3-2: RAN4 not to define new gaps for positioning.

In our view, although a PRS instance may have time duration longer than the maximum measurement gap length (MGL) currently supported in NR, defining measurement gaps (MGs) with long lengths in general degrades system data transmission throughput. In particular, it has been agreed in RAN1 that ResourceRepetitionFactor can be up to 32, and therefore it is possible that a PRS resource being transmitted consecutively in 32 slots. An MG with MGL > 32ms would be a waste of resources as no data transmission is available during the MG (note that a full slot may not be occupied by PRSs, therefore during UE’s measurement period for positioning, data transmission is possible by using the other available time/frequency resources).In fact, RAN1’s agreements allow many possible durations with length > 32ms for a PRS instance, and hence it is quite complex to design MGs to support all these possibility.* Sub topic 3-3: We note that based on the agreed scheduling restriction rule in FR2, if we apply the same rule in FR1, and if measurement gap is not configured, then whether UE measures a PRS resource on an OFDM symbol depends on gNB’s transmission scheduling.

In our understanding, gNB doesn’t know whether a UE is performing positioning measurement or not. Therefore the positioning measurement period would be prolonged (or even the positioning would fail) if the serving cell continuously transmitting data on OFDM symbol that carries PRS.Therefore, we prefer not to apply the same rue for FR1, more discussion is needed.Sub topic 3-4: Agree with first and second bullet. For the third bullet, we don’t see a need to introduce such signalling. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
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## 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** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #4: UE-based positioning performance requirements (AI 8.8.4)

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000738 | Qualcomm Incorporated | * RAT-dependent UE-based positioning has numerous benefits including but not limited to the following:
* Enabling new use cases
* Enabling improved performance of existing use cases
* Improved scalability
* Improved operational range
* Low UL overhead
* Low latency
* Very low specifications impact
* Parity with RAT-independent UE-based positioning
* UE-based positioning is optional from both gNB and UE side.
* In UE-based positioning, UE does not have to meet the measurement accuracy requirements defined in UE-assisted positioning so long as it meets the final positioning requirements. Hence, it cannot be assumed that a UE which meets the measurement accuracy requirements in UE-assisted positioning will meet the positioning requirements in UE-based positioning. In other words, UE-based and UE-assisted positioning are complementary modes.
* There is no risk in adding more capability to the standard and the requirement specifications. It enables another tool in the toolbox for the carriers to support their Emergency Services and LBS services. Commercial deployment choices will be driven by market needs and performance benefits on a carrier per carrier basis.
* Support of positioning modes are signalled independent of other modes. This means that a UE can support UE-based positioning but not UE-assisted positioning. Lack of performance requirements for UE-based positioning effectively means that UEs that only support UE-based positioning will operate in the NW without conformance testing or certification.
* RAN4 to define UE-based DL-only positioning performance requirements in terms of at least 2-D position error and max response time and the corresponding test case(s) in TS 38.133.
 |

## Open issues summary

### Sub-topic 4-1

**Issue 4-1: Requirements for UE based positioning**

* Proposals
	+ Option 1: (Qualcomm)
		- RAN4 to define UE-based DL-only positioning performance requirements in terms of at least 2-D position error and max response time and the corresponding test case(s) in TS 38.133.
* Recommended WF
	+ Collect feedback from companies:
		- Whether UE-based DL-only positioning performance requirements are to be define by RAN4?
		- Scope of work if requirements are defined?

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1: Sub topic 1-2:….Others: |
| Huawei, HiSilicon | We would like to first clarify with the proponent: what is the planned time line for the work if RAN4 would agree to define the requirements, is it supposed to be in core part or performance part? |
| ZTE | We are also interested in exploring UE based positioning, however given limited time left to complete R16 we suggest to deprioritize this topic. |
| Ericsson | Sub topic 4-1: Positioning error depends on too many factors, including UE implementation, network deployment, and environment. Therefore, specification work for defining such requirements will be highly complex and time consuming. Therefore, UE based positioning requirement should not be prioritized. |
| Intel | Sub topic 4-1: **Issue 4-1: Requirements for UE based positioning**Regarding to the timeline of this WI, prefer to not to define such requirements.  |
| MTK | Agree with ZTE and Ericssion’s views. UE based positioning requirement should be deprioritized. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

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|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |