**3GPP TSG-RAN WG4 Meeting #94-e R4-200xxxx**

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

**Agenda item:** 8.8.2.1

**Source:** Moderator (Qualcomm)

**Title:** Email discussion summary for RAN4#94e\_#56\_NR\_pos\_RRM\_Part\_1

**Document for:** Information

# 0 Introduction

The scope of this email discussion is core UE RRM requirements for NR positioning (AI 8.8.2.1.1 – 8.8.2.1.6). All Tdocs submitted to AI 8.8 were reviewed and relevant observations and proposals are included here. The following lists the topics discussed in submitted Tdocs.

* AI 8.8.2.1.2 PRS-RSTD measurements (Topic# 1 – 7)
  + Side conditions
  + Report mapping table(s)
  + Intra-frequency vs. inter-frequency measurement
  + Differential RSTD reporting
  + Measurement period
  + Measurement accuracy
  + Measurement capability and reporting criteria
* AI 8.8.2.1.3 PRS-RSRP measurement topics (Topic# 8 – 15)
  + Side conditions
  + Report mapping table(s)
  + Intra-frequency vs. inter-frequency measurement
  + Differential RSRP requirements and reporting
  + Non-DRX only mode in applicability of requirements
  + Measurement period
  + Measurement accuracy
  + Measurement capability and reporting criteria
* AI 8.8.2.1.4 Rx-Tx time difference measurements (Topic# 16 – 24)
  + Side conditions
  + Report mapping table(s)
  + Intra-frequency vs. inter-frequency measurement and their relationship to MG
  + Differential Rx-Tx reporting
  + Non-DRX only mode in applicability of requirements
  + Measurement period
  + Measurement accuracy
  + Measurement capability and reporting criteria
  + Proximity of SRS resources to PRS resources
* AI 8.8.2.1.5 SSB and CSI-RS RSRP/RSRQ measurements (Topic#35)
  + Applicability of core R15 requirements of SSB and CSI-RS RSRP/RSRQ and existing MG configurations to E-CID
  + Inclusion of SSB and CSI-RS SINR in E-CID measurements
* AI 8.8.2.1.6 Link-level evaluations for PRS-RSTD and PRS-RSRP (Topic#26)
  + Updates to simulation assumptions
* Need for MG in PRS measurements (common to DL-PRS measurements) (Topic#27)

No Tdoc was submitted under AI 8.8.2.1.1 (System-level evaluations for PRS-RSTD and PRS-RSRP).

The following schedule is proposed for email discussions in 1st and 2nd rounds:

* 1st round:
  + start Monday February 24
  + Companies’ comments by Thursday February 27 (23:59 CT)
  + Moderator to merge comments (if needed), collect tentative agreements (if any), WF for 2nd round of discussion on Friday February 28
* 2nd round:
  + start Monday March 2
  + Companies’ comments by Wednesday March 4 (23:59 CT)
  + Moderator to merge comments (if needed), collect all agreements, prepare WF for RAN4#94-Bis On Thursday March 5

In providing comments, companies are encouraged to:

* Be concise
* Provide comments on all topics/sub-topics of interest to them
* Ensure that their comments are inserted in the latest version of the document by checking the folder before uploading
* Use “Track changes” to help identify added comments/changes

# Topic #1: PRS-RSTD Side conditions

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000589 | CATT | Side conditions for PRS RSTD measurements are defined as follows:   * Side conditions for FR1 PRS RSTD measurements   + Neighbor cells: PRS Es/Iot = [-13] dB   + Reference cell: PRS Es/Iot = [-6] dB * Side conditions for FR2 PRS RSTD measurements   + Neighbor cells: PRS Es/Iot = [-13] dB   + Reference cell: PRS Es/Iot = [-6] dB |
| R4-2000998 | MediaTek | Side conditions for FR1 and FR2 PRS-RSTD measurements:   * Neighbor cells: PRS Es/Iot = -13 dB * Reference cell: PRS Es/Iot = -6 dB |
| R4-2001637 | Huawei, HiSi | The accuracy requirements are defined for a limited set of combinations of PRS configuration (BW, comb, symbol number, repetition). The side condition is defined as -6dB for reference cell and -13dB for neighbor cells for both FR1 and FR2. |
| R4-2001941 | Ericsson | RSTD side conditions for the reference cell in FR1: -6 dB.  RSTD side conditions for neighbour and reference cell in FR2: same as for FR1 |
| R4-2000735 | Qualcomm | For FR2, the side condition for PRS SNR of reference cell to be -3 dB and the side condition for PRS SNR of neighbor cells to be -10 dB. |

## Open issues summary

### Sub-topic 1-1 Reference cell side condition in FR1

From WF in RAN4-93, two options exist. Companies were asked to evaluate the two options in link-level evaluations of PRS-RSTD.

* Option 1: PRS Es/Iot = -6 dB (CATT/MediaTek/Huawei/Ericsson)
* Option 2: PRS Es/Iot = -3 dB (Qualcomm)

Agreed in the 1st round: Side condition for FR1 PRS-RTD reference cell to be PRS Es/Iot = -6 dB.

### Sub-topic 1-2 Reference and neighbor cells side conditions in FR2

From WF in RAN4-93, two options exist. Companies were asked to evaluate the two options in link-level evaluations of PRS-RSTD.

* Option 1: PRS Es/Iot = -6 dB for reference and PRS Es/Iot = -13 dB for neighbour (CATT/MediaTek/Huawei/Ericsson)
* Option 2: PRS Es/Iot = -3 dB for reference and PRS Es/Iot = -10 dB for neighbour (Qualcomm)

Recommended WF: Further discussion needed. Collect companies’ views.

## 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 | Sub-topic 1-1: Support possible agreement.  Sub-topic 1-2: We have no strong view, so option 2 is also fine for us. |
| Qualcomm | Sub topic 1-2: The side condition should be decided based on impact on accuracy of RSTD estimation in link-level simulations in addition to achievable SNR in system-level simulations. Our link-level simulations (R4-200735) clearly shows a difference in improving estimation accuracy in FR2. Our system level simulations from RAN4#93 meeting (R4-1915193) as well as others (e.g.,R4-1915256) show that strongest cell is never below 0 dB and in case 2 or more neighbor cells are seen, it is better than -10 dB. Therefore, we support option 2. |
| MTK | Sub topic 1-1: It is expected that the measurement capability/accuracy of NR UEs are not worse than that of LTE UEs. RAN4 to define baseline core/accuracy requirements. There is no need to evaluate two options in link-level evaluations of PRS-RSTD. Option 1 is sufficient.  Sub topic 1-2: We have the same view as for sub topic 1-1 |
| CATT | Sub-topic 1-1: Support possible agreement.  Sub-topic 1-2: support option1. |
| Ericsson | Sub topic 1-1: Support the possible agreement  Sub topic 1-2: support option 1 |
| Intel | Sub topic 1-1: Reference cell side condition in FR1  According to our SLS results in the last RAN4 meeting, we support Option 1 also. (PRS Es/Iot = -6 dB for the reference cell)  Sub topic 1-2: Reference and neighbor cells side conditions in FR2  Support Option 1( PRS Es/Iot = -6 dB for reference and PRS Es/Iot = -13 dB for neighbour ) |

## Summary for 1st round

### Open issues

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|  | **Status summary** |
| **Sub-topic#1-1** | **Reference cell side condition in FR1**  *Tentative agreements:*  Side condition for FR1 PRS-RTD reference cell to be PRS Es/Iot = -6 dB.  *Recommendations for 2nd round:*  No need to discuss further. |
| **Sub-topic#1-2** | **Reference and neighbor cells side conditions in FR2** *Candidate Options:*   * Option 1: PRS Es/Iot = -6 dB for reference and PRS Es/Iot = -13 dB for neighbour (CATT/MediaTek/Huawei/Ericsson/Intel) * Option 2: PRS Es/Iot = -3 dB for reference and PRS Es/Iot = -10 dB for neighbour (Qualcomm/Huawei)   *Recommendations for 2nd round:*  To be discussed further in 2nd round. Companies are encouraged to provide justification of their choice. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

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| **Company** | **Comments** |
| Ericsson | Sub topic 1-2: support option 1 |
| Huawei, HiSilicon | Sub-topic 1-2: support option 2 |

## 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: PRS-RSTD report mapping table(s)

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001632 | Huawei, HiSi | For RSTD report mapping, 1) The minimum value for configuration parameter k is -1. 2) Do not specify the scaling of the configuration parameter k with PRS BW. 3)The granularity is Tc\*2k for absolute value of RSTD <= 4096Ts, and 5\*Tc\*2k otherwise. |
| R4-2000389 | Intel | RSTD minimum reporting granularity can |
| R4-2000589 | CATT | The reporting resolution of RSTD is defined as T = Tc2k and k is configured according to DL PRS bandwidth with a minimum value at most 0 |
| R4-2000783 | Apple | Proposal 1: The RSTD report mapping table will be defined per SCS per FR and choose the finest granularity among different BWs within each SCS.  Proposal 2: The basic granularity of RSTD report mapping table is as defined in table 3.  Proposal 3: The oversampling rate of RSTD report mapping table is same as LTE, i.e., 2, for the range from RSTD\_2260 to RSTD\_10451.  Proposal 4: The granularity from RSTD\_2260 to RSTD\_10451 after oversampling is summarized in table 4 for FR1 and FR2.  Proposal 5: if RSTD measurement is performed between PRSs with different SCS, then UE can follow the worst granularity between two SCSs to report.  Proposal 6: similar as LTE, RAN4 will use a RSTD report mapping table together with a relative quantity mapping table for NR RSTD report.  Proposal 7: For different SCSs in FR1, use the same unit as LTE for the baseline RSTD report mapping table, i.e., 1Ts=64Tc  Proposal 8: Compared with relative RSTD quantity mapping table in LTE, Extend the relative quantity mapping table with more values to cover the different SCS in FR1 RSTD report mapping.  Proposal 9: For different SCSs in FR2, use the 16Tc as unit for the baseline RSTD report mapping table.  Proposal 10: for different SCS in FR2 RSTD report mapping, use the same number of values for relative quantity mapping table as FR1.  Proposal 11: The RSTD report mapping table and relative quantity mapping table for different SCSs in FR1 is designed as table x-1 and x-2.  Proposal 12: The RSTD report mapping table and relative quantity mapping table for FR2 is designed as table y-1 and y-2. |
| R4-2000998 | MediaTek | * One RSTD mapping table for both FR1 and FR2 * Time resolution is 4Tc for |RSTD|≤4096Ts * Time resolution is 20Tc for 15391Ts >|RSTD|> 4096Ts   The RSTD reporting granularity is a UE capability. UE may report its capability to the network |
| R4-2001942 | Ericsson | * **Proposal 1**: Reuse LTE approach, where the UE reports a reference quantity rstd and a relative quantity . * **Proposal 2**: The reportable reference quantities are the same as Table 9.1.10.3-1 from TS 36.133. * **Proposal 3**: The maximum step in Table 2 is 32 Tc (kmax=5) for both center and edge ranges of the reference quantities, which corresponds to 0.5 Ts in LTE, both FR1 and FR2. * **Proposal 4**: The minimum step in Table 2 is:   + In FR1:     - 16 Tc (kmin,FR1,center=4) for the center range of the reference quantities, which corresponds to 0.25 Ts in LTE,     - 32 Tc (kmin,FR1,edge=5) for the edge ranges of the reference quantities, which corresponds to 0.5 Ts in LTE.   + In FR2:     - 1 Tc (kmin,FR2,center=0) for the center range of the reference quantities,     - 16 Tc (kmin,FR2,edge=4) for the edge ranges of the reference quantities. * **Observation**: the network may not always have enough information to request a reasonable parameter k (suggested in [2]), e.g., it knows which k-values are applicable for FR1 and FR2 but it may not know whether the measured RSTD is large (falls in one of the edge parts of Table 1 where, for example, 1 Tc resolution does not make sense) or not. * **Proposal 5**: The UE shall use the recommended by the network k-value if the k-value is applicable for the measured RSTD to be reported, otherwise the UE shall choose, e.g., the applicable k´ closest to k. |
| R4-2000731 | Qualcomm | Observation. Using a different granularity for smaller vs. larger PRS-RSTD values of the same DL PRS BW is a violation of RAN1 agreement. PRS-RSTD measurements with larger values correspond to farther cells and they can be as important in the positioning fix. There is no reason to use a coarser granularity for them.  Proposal. RAN4 to use uniform report mapping table(s) for PRS-RSTD measurements, i.e., smaller and larger PRS-RSTD values to have the same reporting granularity.  Proposal. Reporting granularity for PRS-RSTD measurement to be as in Table 2  Proposal Use Table 3 for PRS-RSTD measurement report mapping for FR1 with 100 MHz PRS BW when UE also measures PRS with 100 MHz.   * RAN4 to consider extending the RSTD report mapping range to +/- 532 us as it does not increase the bitwidth of each measurement report.   Observation. In FR2, max RSTD of 500 us leads to more than 1.5 km cell radius which is quite impractical in terms of PRS hear-ability.  Proposal. Scale down maximum RSTD range in FR2 by a factor of 4 (i.e., +/- 125 us) and adopt Table 4 for PRS-RSTD measurement report mapping for FR2 with 400 MHz PRS BW when UE also measures PRS with 400 MHz.   * RAN4 to consider extending the RSTD report mapping range to +/- 133 us as it does not increase the bitwidth of each measurement report.   Proposal . PRS BW used for measurement report mapping is the minimum of configured DL PRS BW and the BW that UE can use for measurement subject to its capability.  The same report mapping table as in Tables 3-4 should be used for smaller PRS BW as reduction in reporting payload is not as significant as differential RSTD reporting. |

## Open issues summary

### Sub-topic 2-1 Uniform vs. Non-uniform granularity

The issue is whehter the entire range of RSTD report mapping table is covered with a uniform step size (granularity) or larger granularity is used for edges (as in LTE). Companies are encouraged to analyze the pros and cons of each option such as agreements in other WGs, complexity, savings in bitwidth (reporting payload), specification impact, etc.

* Option 1. Non-uniform granularity in report mapping table(s) similar to LTE (Huawei, MediaTek, Ericsson, Apple
* Option 2. Uniform granularity in report mapping table(s) (Qualcomm)

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 2-2 Number of report mapping tables

The issue is how many report mapping tables should be specified in TS 38.133. Companies are encouraged to analyze the pros and cons of each option such as complexity, signalling aspects, savings in bitwidth (reporting payload), specification impact, etc.

* Option 1. One table per SCS per FR (Apple)
* Option 2. One table per FR (Qualcomm)
* Option 3. One table (MediaTek)
* Option 4. One table per “k” (Huawei)
* Option 5: LTE approach – one table for coarse granularity (for this, even the LTE table can be reused) and one table for fine granularity (based on k for NR) (Ericsson)
* Other options are not precluded.

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 2-3 RSTD range in FR2 for report mapping table

The issue is the max RSTD range in FR2 that should be reflected in report mapping table. This issue is dependent on the outcome of Sub-topic 2-2. Companies are encouraged to evaluate whether +/- 500us in FR2 is a practical consideration or not.

* Option 1. Same as FR1 (+/- 500 us) (Ericsson, MediaTek)
* Option 2. Scaled down by 4 in FR2 (+/- 125 us) (Qualcomm, Apple)
* Other options are not precluded.

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 2-4 Relative report mapping table

The issue is whether two report mapping table is needed: one for reporting a coarse value of RSTD and one for refining the reported RSTD based on smaller granularity. This approach was taken in later release of LTE. Companies are encouraged to analyze the pros and cons of each option such as complexity, signalling aspects, savings in bitwidth (reporting payload), specification impact, etc.

* Option 1. No (Qualcomm, Huawei)
* Option 2. Yes (Apple, Ericsson)

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 2-5 Minimum granularity in report mapping table

The issue is the minimum granularity in the report mapping table to be specified in TS 38.133. Companies are encouraged to analyze the pros and cons of each option such as complexity, signalling aspects, savings in bitwidth (reporting payload), specification impact, etc.

* Option 1. Tc/2 (Huawei/Intel)
* Option 2. Tc (CATT)
* Option 3. 8Tc for FR1 and 2Tc for FR2 (Apple)
* Option 4. 16Tc (k=4) for FR1 and Tc (k=0) for FR2 for the center range (Ericsson)
* Option 5. 4Tc for FR1 and Tc for FR2 (Qualcomm)
* Option 6. Other options not precluded.

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 2-6 Parameter *k*

The issues related to parameter *k* are diverse and thus, companies are asked to reply to the questions below as raised in Tdocs.

* Q1: Does UE select parameter *k* or does it follow the configured value by NW?
* Q2: If UE selects parameter *k*, how is it done? Should this be specified, or should a minimum value of k be assumed based on e.g., configured PRS BW subject to UE capability?
* Q3: If UE selects parameter *k*, does it need to signal it to NW?

Recommended WF: Further discussion needed. Collect companies’ views.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 2-1: No strong view, we are also fine with option 2.  Sub-topic 2-2: We prefer to define one mapping table for each *k* value.  Sub-topic 2-3: Option 1 (same range for all *k* values).  Sub-topic 2-4: Option 1. If we understand correctly, relative mapping was introduced in LTE mainly due to backward compatibility issue, which does not exists for NR.  Sub-topic 2-5: Option 1. It should be noted that RAN1 already agreed that min value for k is 0 or -1, as indicated in R1-1913522.  Sub-topic 2-6: Our view is that UE should follow the configuration. |
| Apple | Sub-topic 2-1: As proposed in our paper, we support option 1. Non-uniform table can achieve both the positioning granularity(especially in center range) and coverage, and it can also make the same signaling shared by different cases as much as possible.  [New added comment]: (1) in RAN1 LS, we think RAN1 mentioned that “RAN1 assumes that the details of the reporting granularity and ranges for the UE/gNB timing measurements (DL RTSD, the UE Rx-Tx time difference, UL RTOA, gNB Rx-Tx time difference) will be determined by RAN4, including the potential relation of the parameter *k* to DL PRS bandwidth.”, so we believe RAN4 is the decision maker actually, and that’s also the same working procedure for other mapping tables as before. (2) In Apple proposal, the bit amount for baseline table is ceil(log2(12711)) = 14 bits, but for relative quantity table the bit amount can be reduced for 15kHz and 60kHz(in our table X-2 and Y-2): 15kHz case can be ceil(log2(12))=4bits and 60kHz in FR2 case can be ceil(log2(12))=4bits if we design signaling for 15kHz and 60kHz(FR2) by kicking out all “NA” rows (in our original table we used same bit string for all cases so that’s why relative table would needs 5 bits for all cases, but it can be improved by re-organizing for different SCSs if needed); then in total signaling bit amount for 15kHz is 18bits, 30kHz/60kHz in FR1 is 19bits, 60kHz in FR2 is 18bits, 120kHz is 19bits from theoretical perspective. So relatively it has saved signaling overhead even though I agree it’s not a significant improvement. (3) in last meeting RAN4 had agreement that “RSTD reporting range: The Max/Min reported values are same as in LTE for FR1 and FR2”, so that’s why we consider to use same mechanism as LTE: 1 baseline table plus 1 relative table and the reported values in baseline table is same as LTE.  Sub-topic 2-2: We support option 1. We have analysis in our paper for option 2 and 3 as well. If we design table per FR and if we choose the finest granularity in each FR it will be too tight for UE with low SCS. For instance, in FR1, if we choose 16Tc as the baseline granularity for mapping table, the UE who’s working on SCS=15kHz may need 8192 FFT to achieve so fine granularity and it’s not realistic. Similar situation for FR2 60kHz case, if we choose 4Tc as the baseline granularity for mapping table, the UE who’s working on SCS=60kHz may need 8192 FFT to achieve so fine granularity and it’s not realistic. To use same granularity cross all some SCSs or all SCSs will probably result into max FFT size exceeding.  [New added comment]: actually we already considered PRS BW in our paper, and for one specific SCS we analysed the granularity for different PRS BWs; and finally we chose the finest granularity among different BWs for each specific SCS which is same as LTE case (1.4MHz share the same granularity as 20MHz). But cross different SCSs, the situation is quite different, as we explain in original comment, if PRS is on 15kHz, even with max BW=268PRBs, the granularity is 32Tc based on 4096 FFT size, and we believe 4096 is the baseline FFT size throughout the NR spec design for RAN1/4 (in section 4.1 TS38.211). Of course UE can have better implementation on even larger FFT size, like 8192; but we don’t think that shall be the baseline assumption to define the minimum requirement.  Sub-topic 2-3: we support option 2. We have same proposal as Qualcomm in our paper: for FR2, the positioning coverage can be smaller than FR1, due to the network coverage of FR2. Since we suggest using ¼ unit from FR1 for FR2 (that means the unit for FR2 case can be 16Tc), the boundary of RSTD report range can be 16Tc\*15391 = 246256Tc (=125us), and it can cover positioning measurement for distance difference up to 37.6km. We believe this positioning coverage is sufficient in theory for FR2  Sub-topic 2-4: support option 2. Using two tables will be very readable and understandable for spec design. We prefer to reuse the same methodology in LTE to design the mapping tables and also prefer to keep the signalling structure similar as LTE, that is to say, we propose to use a RSTD report mapping table together with a relative quantity mapping table for NR RSTD report. Otherwise one table will be very complicated and big. Of course the table structure design might be decided after we have conclusion on granularity stuffs.  Sub-topic 2-5: options here are all the minimum granularity for per-FR basis, actually we propose to have minimum granularity per-SCS basis. Even for per-FR basis, we think it’s necessary to consider the practical FFT size and UE oversampling rate, we have detailed analysis in our paper, e.g., in FR1 with 60kHz, the baseline FFT size used to achieve the CBW (132RPB) is 2048, so the baseline granularity is 16Tc, then regarding the oversampling rate =2 (we propose to reuse it from LTE), then the minimum granularity of FR1 is 8Tc. To be honest, we have concern on RAN1 suggestion on this granularity, because RAN1 may not discuss deeply on UE capability and implementation limitation.  Sub-topic 2-5:  Q1: this k shall be up to UE capability. Network shall not configure k beyond UE capability of timing granularity (e.g. if k=0 is configured for 15kHz case, we think it’s beyond the UE capability of baseline granularity). We think there might be some options: e.g. option 1: UE reports the capability of finest granularity and network can configure k based on that capability(but cannot beyond that capability); option 2: like in LTE, define the requirement based on a specified granularity derived from SCS/FR/BW and no any k will be needed; and other options might be FFS.  Q2: Answer as to Q1.  Q3: Answer as to Q1 |
| Qualcomm | Sub topic 2-1: Non-uniform report mapping has three major drawbacks compared to uniform mapping: 1) it is against RAN1 agreement as discussed in our paper, 2) it does not save anything in terms of bitwidths of reporting payload, 3) it indicates that measurements from farther cells are less important (and need to be less accurate) for a positioning fix. On reason 2), we use Apple’s paper as an example looking at their FR1 proposal. We need ceil(log2(12711)) = 14 bits for coarse RSTD and ceil(log2(24)) = 5 bits for relative report mapping. Total bits required is 19 bits. Our proposal also requires exactly 19 bits with uniform mapping. On reason 3), we have field logs from LTE OTDOA showing that TRP’s that are towering on the hillside of a city have good SNR conditions and can play as a good role in fixing the position of a UE as the near cells. There is no reason to believe that such TRPs should be measured with lesser accuracy than the closer ones.  Sub topic 2-2: We support option 2 assuming different granularities between FR1 and FR2 (e.g., 4Tc for FR1 and Tc for FR2). It is very important to not conflate report mapping granularity with accuracy requirement (as Apple is arguing above). Reporting granularity has nothing to do with accuracy. In fact, granularity has to be much better than achievable accuracy so as to not play a role in becoming the bottleneck in overall performance (analogous to quantization noise in fixed point design). In LTE, the reporting granularity used 1Ts (assuming 2048-point FFT) even for 1.4 MHz PRS BW. But it didn’t mean that UE had to do 2K FFT or achieve the same accuracy as in 20 MHz. The same arguments apply to having one report mapping per “k”.  Sub topic 2-3: we share the same view as Apple. 500us in FR2 is overkill.  Sub topic 2-4: We share the same view as Huawei. Also, we don’t understand why report mapping tables would be more complicated with having only one table and less complicated with having two tables!!! We also note that per our comments in sub topic 2-1, there is actually no savings in reporting payload by taking the LTE approach (which was mainly adopted due to backward compatibility issues)  Sub topic 2-5: We support option 5 but we can agree to use Tc/2 for FR2 as well. Using Tc/2 for FR1 is too much and unnecessary. Again, we’d like to not that granularity is not the same thing as accuracy.  Sub topic 2-6: In our view, this parameter should be based on DL PRS BW that UE is configured to measure subject to UE’s capability of max PRS BW that it signals. We have the proposed table in our paper. UE should not be asked to report based on a granularity that is beyond its capability. |
| MTK | Sub topic 2-1: Roughly, 4096Ts = 40km. The measurement for gNB with distance greater than 40km is not expected to be very accurate. Instead, such gNBs are expected to help determining coarse positioning for a UE. Therefore, we support to use non-uniform granularity reporting table(s). The value 4096Ts and the granularity for RSTD > |4096Ts| can be further discussed  Sub topic 2-2: Consider the case that FR1 and FR2 are both measured by the UE, for simplicity, we support to use one report mapping table supporting granularity 4Tc. In this way UE doesn’t need to signal for which reporting table UE is currently in use.  Sub topic 2-3: Agree with QC’s view that FR2 range should be down scaled in comparison with FR1. However, we support one report mapping table that can be used for both FR1 and FR2. Therefore the maximum RSTD should align the maximum range for FR1.  Sub topic 2-4: Support option 2. Granularity lower than 4Tc can be reported via relative reporting table.  Sub topic 2-5: Our proposal is missing in the listed options. We add it as option 6 in above. We support 4Tc for one reporting table for use in both FR1 and FR2, where 4Tc corresponds to the setting that SCS = 120kHz and BW = 400MHz. Granularity lower than 4Tc can be considered to be reported by using additional relative report mapping table  Sub topic 2-6: In our view, the parameter k should be determined by the UE. The parameter k is related to PRS BW, but may not bounded by PRS BW.  Depending on UE’s implementation, UE may achieve granularity better than the basic granularity associated with configured SCS and PRS BW.  UE may signal the selected parameter k to the network. Such information can be used by the NW to identify the capability and precision level of the UE.  Furthermore, with the knowledge of UEs’ supporting granularity, the NW may configure PRS settings accordingly in order to achieve better POS performance.  The UE granularity can be an optional signalling. |
| CATT | Sub-topic 2-1: support option 1.  Sub-topic 2-2: agree HUAWEI to define one mapping table for each *k* value and choose k value according to BW.  Sub-topic 2-3: support option 1（same as FR1）.  Sub-topic 2-4: support option 1, relative mapping does not reduce the report bit comparing to using one fix table and is not necessary.  Sub-topic 2-5: support option 1, choose k value from 0 or 1, and we think resolution Tc is enough for current usage and smaller value is not necessary.  Sub-topic 2-6: Our view is that k is configured by NW based on BW. |
| Ericsson | Sub topic 2-1: option 1 (non-uniform), it does not make sense to have it uniform  Sub topic 2-2: we support option 5 (LTE approach with coarse/fine granularity). Our proposal was not correctly captured, so we corrected this.  Sub topic 2-3: the studied FR2 and FR1 network deployments are assumed to be the same, so the ranges should also be the same for FR1 and FR2. If the range with FR2 is smaller then the sufficient number of neighbor cells may be not found by the UE.  Sub topic 2-4: postpone the relative measurements discussion until RAN2 specifications get agreed.  Moderator: In the description of the sub topic, the relative table refers to the table with finer granularity which seems to be Ericsson’s proposal. So the above comment is confusing.  Sub topic 2-5: the question about the minimum granularity is a bit confusing. In general, it is configurable via configurable k which is bounded by kmin and kmax which further depend on whether it is for the center or of the edges of the table. Our proposal:  kmax=5 (for both FR1 and FR2)  kmin in FR1: kmin,FR1,center=4, kmin,FR1,edge=5,  kmin in FR2: kmin,FR1,center=0, kmin,FR1,edge=4.  This above gives us:  k={4,5} in the center and k=5 at the edges for FR1,  k={0,1,2,3,4,5} in the center and k={4,5} at the edges for FR2.  Moderator: this means k=0 (i..e, 1Tc) is the min value for FR2 and k=4 (16Tc) is the min value for FR1.  Sub topic 2-6: the UE receives k, but then it may need to adjust it to the applicable range, e.g., if k is configured to be 0 but the RSTD is large (corresponding to the table edges), then the UE should use the closest applicable k value, i.e., kmin in this example or max(k, kmin) more generally. In this example, no need to signal to the network, since the NW can figure this out itself. |
| Intel | Sub topic 2-1: Uniform vs. Non-uniform granularity  Use the uniform granularity for reporting is different with the method in LTE, which can increase the reporting signalling overhead and unnecessary. The larger RSTD value related the cell edge usually may have the larger error estimation due to lower SINR.  Sub topic 2-2: Number of report mapping tables  the different tables for FR1 and FR2 are reasonable because of the coverage of FR1 and FR2 are quite different. But we need not to introduce additional signaling to NW because FR1 or FR2 is predefined.  Sub topic 2-3: RSTD range in FR2 for report mapping table  Slightly prefer scaled based on that of FR1.  Sub topic 2-4: Relative report mapping table  Not needed as NR need not the finer resolution so far.  Sub topic 2-5: Minimum granularity in report mapping table  From the positioning performance requirements, Tc/2 can guarantee the positioning accuracy meet the regulation. According RAN1 agreement, at least Tc shall be applicable.  Sub topic 2-6: Parameter *k*  This parameter shall be configured by NW or NR location server. |

### 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** |
| R4-2001943 | Qualcomm: should be postponed until further agreements are reached. |
| 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#2-1** | **Uniform vs. Non-uniform granularity**  *Candidate options:*   * Option 1. Non-uniform granularity in report mapping table(s) similar to LTE (Huawei, MediaTek, Ericsson, Apple, CATT, Intel) * Option 2. Uniform granularity in report mapping table(s) (Qualcomm/Huawei)   *Recommendations for 2nd round:*  To be discussed further in 2nd round. Companies are encouraged to analyze both options to understand the pros and cons of each. |
| **Sub-topic#2-2** | **Number of report mapping tables**  *Candidate options:*   * Option 1. One table per SCS per FR (Apple) * Option 2. One table per FR (Qualcomm, Intel) * Option 3. One table (MediaTek) * Option 4. One table per “k” (Huawei, CATT) * Option 5: LTE approach – one table for coarse granularity (for this, even the LTE table can be reused) and one table for fine granularity (based on k for NR) (Ericsson) * Other options are not precluded.   *Recommendations for 2nd round:*  To be discussed further in 2nd round. Companies are encouraged to analyze options above to understand the pros and cons of each. |
| **Sub-topic#2-3** | **RSTD range in FR2**  *Candidate options:*   * Option 1. Same as FR1 (+/- 500 us) (Ericsson, MediaTek, Huawei, CATT) * Option 2. Scaled down by 4 in FR2 (+/- 125 us) (Qualcomm, Apple, Intel) * Other options are not precluded.   *Recommendations for 2nd round:*  Defer discussion to after the conclusion of sub-topic 2-1 and 2-2. |
| **Sub-topic#2-4** | **Relative report mapping table (i.e, fine granularity table)**  *Candidate options:*   * Option 1. No (Qualcomm, Huawei, CATT, Intel) * Option 2. Yes (Apple, Ericsson, MediaTek)   *Recommendations for 2nd round:*  Defer discussion to after the conclusion of sub-topic 2-1 and 2-2. |
| **Sub-topic#2-5** | **Minimum granularity in report mapping table (i.e, smallest step size)**  *Candidate options:*   * Option 1. Tc/2 (Huawei/Intel) * Option 2. Tc (CATT) * Option 3. 8Tc for FR1 and 2Tc for FR2 (Apple) * Option 4. 16Tc for FR1 and Tc for FR2 (Ericsson) * Option 5. 4Tc for FR1 and Tc for FR2 (Qualcomm) * Option 6. 4Tc for FR1 and FR2 (MediaTek) * Option 7. Other options not precluded.   *Recommendations for 2nd round:*  To be discussed further in 2nd round. Companies are encouraged to analyze options above to understand the pros and cons of each. |
| **Sub-topic#2-6** | **Parameter k**  **Q1: Does UE select parameter *k* or does it follow the configured value by NW?**  *Candidate options:*   * Option 1. UE selects or adjusts parameter k (MediaTek, Qualcomm, Apple, Ericsson) * Option 2. UE follows the configured parameter k (Intel, CATT, Huawei)   *Recommendations for 2nd round:*  To be discussed further in 2nd round. Companies are encouraged to analyze options. Q2 and Q3 can be discussed after concluding Q1. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 2-1: option 1 (non-uniform), it does not make sense to have it uniform  Sub topic 2-2: we support option 5 (LTE approach with coarse/fine granularity, i.e., 2 tables, where the 2nd table is based on k according to RAN1 agreements). Our proposal was not correctly captured in the beginning of the 1st round and was corrected afterwards.  Sub topic 2-3: option 1. the studied FR2 and FR1 network deployments are assumed to be the same, so the ranges should also be the same for FR1 and FR2, to get the sufficient number of neighbor cells.  Sub topic 2-4: option 2, it is easy to reuse the LTE implementation we already have and incorporate k factor into it.  Sub topic 2-5: the question about the minimum granularity is a bit confusing. In general, it is configurable via configurable k which is bounded by kmin and kmax which further depend on whether it is for the center or of the edges of the table. Our proposal:  FR1: 4≤k≤5 in the center range, k=5 at the edge,  FR2: 0≤k≤5 in the center range, 4≤k≤5 at the edge.  Sub topic 2-6: the UE generally follows k which it receives from the NW, unless the received k cannot be used for some reason in which case the UE may need to adjust it to the applicable range, e.g., to the closest k the UE can use. In this example, no need to signal to the network, since the NW can figure this out itself once receiving the measurement report. |
| Huawei, HiSilicon | Suggest to postpone the decision on RSTD mapping table to next meeting. All the sub-topics can be listed in the WF to facilitate further discussions. |

## 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: Inter-frequency vs. Intra-frequency PRS-RSTD

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000389 | Intel | Observation 1: If the measured PRS resource’s central frequency is same as that of serving cell’s activated bandwidth, UE need NOT the measurement gap for RF operations.  Proposal 1. Define several types of PRS measurements as: intra-frequency is defined as DL PRS resources of the measured neighbor cells/TRPs and the serving/reference cell/TRP have the same SCS and CP type, the same centre frequency, the same point-A, same configured PRS BW. MG is needed when measurements for PRS outside of activated BWP. Inter-frequency if DL PRS resources of the measured neighbor cells/TRPs and the serving/reference cell/TRP is different in any of SCS and CP type, centre frequency, point-A , configured PRS BW. MG not needed if the center PRS BW of the measured cell/TRP is same as that of serving cell’s activated BWP. |
| R4-2000998 | MediaTek | RAN4 to define intra-frequency RSTD measurement as when the positioning frequency layer associated with a DL PRS resource set is   * the same as that of the DL PRS resource set of the reference cell * within UE’s active BWP   A RSTD measurement is defined to be an inter-frequency RSTD measurement if it is not an intra-frequency RSTD measurement |
| R4-2001637 | Huawei,HiSi | RAN4 not to define intra/inter-frequency for PRS measurement. |
| R4-2001941 | Ericsson | RAN4 defines the following RSTD measurement requirements:   * + Intra-frequency measurement requirements, FR1 and FR2,   + Inter-frequency measurement requirements, FR1 and FR2.   RAN4 defines the following RSTD measurement accuracy requirements:   * Intra-frequency measurement accuracy requirements, FR1 and FR2 * Inter-frequency measurement accuracy requirements, FR1 and FR2.   Intra/inter-frequency RSTD measurement definitions are as in Table 1 (R4-20001941) and follow similar principles as intra/inter-frequency CSI-RS based measurement definitions, earlier agreed by RAN4. |
| R4-2000731 | Qualcomm | Intra-frequency RSTD is defined as RSTD measurements within the same positioning frequency layer if the SCS and CP of the positioning frequency layer is the same as UE’s active BWP and the BW of the positioning frequency layer is contained within the UE’s active BWP**.** |
| R4-2000593 | CATT | The measurement is defined as intra-frequency measurement in these cases：   * The PRS resources to be measured are in the same frequency layer * The PRS resources to be measured are not in the same frequency layer but have the same SCS and centre frequency, and the bandwidth are all within the active BWP   Otherwise the measurement is defined as Inter-frequency measurement. |

## Open issues summary

### Sub-topic 3-1

The first issue on this topic is whether intra-frequency and inter-frequency RSTD should be defined in RAN4. Companies are encouraged to provide their views considering the specification impact, how many types of requirements are needed with respect to MG and intra-vs-inter, and whether requirements need to be different for each type.

* Option 1: definition of intra-frequency and inter-frequency RSTD measurement is needed (CATT, MediaTek, Qualcomm, Intel, Ericsson)
* Option: No need to define intra-frequency and inter-frequency RSTD measurement (Huawei)

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 3-2

If option 1 is agreed in Sub-topic 3-1, RAN4 needs to agree on the definition of intra-frequency and inter-frequency RSTD and the scenarios in which each category will require MG (if any). Companies’ opinions here are very diverse so the proposed definitions are not replicated below for the sake of brevity. Instead, the following questions are posed in hope of a better mutual understanding of the issue.

* Q1: if MG is needed for both intra-frequency and inter-frequency RSTD measurement according to a company’s definition, are the requirements (accuracy, measurement period, …) expected to be different between intra-frequency RSTD with MG and inter-frequency RSTD with MG? If yes, please elaborate
* Q2: if the answer to Q1 is No, what is the advantage of having intra-frequency with MG and inter-frequency with MG?
* Other views not previously expressed in Tdocs are welcomed.

Recommended WF: Further discussion needed. Collect companies’ views.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 3-1: In our view, there are two type of PRS measurement, i.e. type-1: measurement that can be done without gap and type-2: measurement that needs to be with gaps. The requirements may be different for the two types, so we need to differentiate between them. To avoid confusion, we prefer to not use the term of ‘intra-/inter-frequency’. On the other hand, since it is to us only a naming issue and most companies agreed to use the term, we can compromise to option 1 conditioned on that intra-frequency measurement is defined as type-1 and inter-frequency as type-2.  Sub-topic 3-2: please refer to above comments. |
| Apple | Sub-topic 3-1: support option1.  Sub-topic 3-2:  Q1: it depends on how we define the requirement. But in general, our initial understanding is “yes”. For instance, intra-frequency RSTD measurement with MG is: UE have positioning cell PRSs share the same SCS and center-frequency but they are outside active BWP; and inter-frequency RSTD measurement with MG is: UE have positioning cell PRSs on multiple frequencies or have different SCS and they are outside active BWP. So within each MG duration the intra-frequency with MG case can measure all cells together, but inter-frequency with MG case needs UE to tune RF from MG to MG; so if the same SINR condition and sample number is assumed, inter-freq with MG case will have longer measurement delay than intra-freq with MG case. And one more example is: intra-freq with MG case may have positioning cells share same SCS, but inter-freq with MG case may have positioning cells of different SCS or different FR, then the granularity of intra-freq with MG and inter-freq with MG are different, and we guess it will also impact the accuracy/reporting. |
| Qualcomm | We almost share the same view as Huawei and would prefer to limit the types of PRS measurements as much as possible. In our view, inter-frequency PRS (if defined to be different SCS, different CP, not same active DL BWP) would always require a MG. Intra-frequency may require a MG (e.g., in FR2) or if UE capability signaling indicates that PRS processing only in MG is possible (this discussion is happening in RAN1). Also, if the requirements are defined per positioning frequency layer, we don’t see why they would be different between intra-frequency with MG and inter-frequency with MG. |
| MTK | Sub topic 3-1: Support option 1. In TS 38.215, it has been assume that intra-frequency and inter-frequency will be defined by RAN4. It is preferred not to change RAN1’s specification and complete the definition in RAN4 accordingly.  In our view, intra-frequency RSTD should be defined in a manner that the corresponding requirements are the baseline requirements for the UE.  Therefore, we propose to define intra-frequency RSTD measurement such that it can be measured with or without MG, and at most one positioning frequency layer can be classified as intra-frequency measurement.  Sub topic 3-2: MG may or may not be needed for intra-frequency RSTD measurement based on the definition in our proposal.  Requirements on accuracy and measurement period should be different for intra- and inter-frequency RSTD measurement.  For intra-frequency RSTD measurement, RAN4 to define the requirements by considering measurement in one POS frequency layer within UE’s active BWP.  For inter-frequency RSTD measurement, RAN4 to define the requirements by considering multiple POS frequency layers, and POS frequency layer may not in UE’s active BWP. |
| CATT | Sub-topic 3-1: support option 1.  Sub-topic 3-2: our view is that we define the intra and inter frequency according whether the measurement gap is needed. |
| Ericsson | Sub topic 3-1: option 1  Sub topic 3-2: MG may also be needed for intra-frequency measurements, same concept as in Rel-15 NR for other measurements. Whether the requirements are the same or different cannot be decided at this stage, since this depends on many details. |
| Intel | Sub topic 3-1:  Support Option1. Some fundamental requirements for the inter-f shall count the total measurement frequency layers, which can lead quite different requirements in comparison with these of intra-f.  Sub topic 3-2:  Same as above |

## Summary for 1st round

### Open issues

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|  | **Status summary** |
| **Sub-topic#3-1** | **Whether definition of intra-frequency and inter-frequency RSTD measurement is needed**  *Tentative agreements:*  **RAN4 to define intra-frequency and inter-frequency RSTD measurements and the corresponding requirements** |
| **Sub-topic#3-2** | **Definitions of intra-frequency and inter-frequency RSTD measurement**  *Candidate options:*   * Option 1. Intra-frequency is defined as DL PRS resources of the measured neighbor cells/TRPs and the serving/reference cell/TRP have the same SCS and CP type, the same centre frequency, the same point-A, same configured PRS BW. Inter-frequency if DL PRS resources of the measured neighbor cells/TRPs and the serving/reference cell/TRP is different in any of SCS and CP type, centre frequency, point-A , configured PRS BW. (Intel) * Option 2. Intra-frequency RSTD measurement as when the positioning frequency layer associated with a DL PRS resource set is the same as that of the DL PRS resource set of the reference cell within UE’s active BWP. A RSTD measurement is defined to be an inter-frequency RSTD measurement if it is not an intra-frequency RSTD measurement. (MediaTek) * Option 3. Intra-frequency RSTD is defined if the bandwidth of the PRS resource configured for the measurement on the neighbour cell is within the bandwidth of at least one resource (e.g., PRS or CSI-RS resource or SSB) configured for a measurement on the serving cell, and the SCS of the active BWP in the serving cell and of the RSTD measurement are the same (NOTE: for RSTD, the above conditions are met for both reference and the other DL links). Inter-frequency RSTD is defined if at least one of the two conditions above is not met for at least of one of the reference and other DL links. (Ericsson) * Option 4. Intra-frequency RSTD is defined as RSTD measurements within the same positioning frequency layer if the SCS and CP of the positioning frequency layer is the same as UE’s active BWP and the BW of the positioning frequency layer is contained within the UE’s active BWP (Qualcomm) * Option 5. The measurement is defined as intra-frequency measurement in these cases: The PRS resources to be measured are in the same frequency layer, and the PRS resources to be measured are not in the same frequency layer but have the same SCS and centre frequency, and the bandwidth are all within the active BWP. Otherwise the measurement is defined as Inter-frequency measurement. (CATT)   *Recommendations for 2nd round:*  To be discussed further in 2nd round. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

Moderator: after offline discussions with some companies, the candidate options are clarified below and some are merged. Please provide comments based on the following candidate options:

* Option 1. Intra-frequency RSTD measurement is defined as when the neighbor DL PRS resource and the reference DL PRS resource belong to the same positioning frequency layer. Otherwise, the RSTD measurement is inter-frequency. (Intel)
* Option 2. Intra-frequency RSTD measurement is defined when neighbor DL PRS resource and reference DL PRS resource belong to the same positioning frequency layer and the BW of the positioning frequency layer is within the BW of UE’s active DL BWP. Otherwise, the RSTD measurement is inter-frequency. (MediaTek, Qualcomm)
* Option 3. Intra-frequency RSTD measurement: the center frequency of PRS BW is the center frequency of an serving cell SSB and has the same SCS as that of the serving cell SSB, otherwise it is inter-frequency. MG may be needed for intra- or inter-frequency, depending on whether or not the PRS BW is within the active BWP (NOTE: for RSTD, the above conditions are met for both reference and the other DL links) (Ericsson)
* Option 4. Intra-frequency RSTD measurement is defined if the PRS resources to be measured are in the same positioning frequency layer, or the PRS resource to be measure are not in the same positioning frequency layer but have the same SCS and center frequency, and the bandwidth are all within the active BWP. Otherwise, the RSTD measurement is inter-frequency. (CATT).

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| **Company** | **Comments** |
| Ericsson | Sub topic 3-1: was agreed in the 1st round  Sub topic 3-2: support option 3, which we have slightly updated: Intra-frequency RSTD measurement: the center frequency of PRS BW is the center frequency of an intra-frequency SSB and has the same SCS, otherwise it is inter-frequency. MG may be needed for intra- or inter-frequency, depending on whether or not the PRS BW is within the active BWP (NOTE: for RSTD, the above conditions are met for both reference and the other DL links). |
| Huawei, HiSilicon | Sub-topic 3-2: we support neither of the options. We prefer to update option 2   * Option 2a. Intra-frequency RSTD measurement is defined when the BW of the positioning frequency layer is within the BW of UE’s active DL BWP and SCS of PRS is same as the SCS of UEs’s active DL BWP. Otherwise, the RSTD measurement is inter-frequency.   The problem with option 2 is that if we have a PRS frequency layer to which the reference resource does not belong but within UE’s active DL BWP, it will be defined as inter-frequency. However, from requirements pov we think it should be same as intra-frequency with current option 2. In addition, the SCS should be considered. |

## 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 #4: Differential PRS-RSTD reporting

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000731 | Qualcomm | Observation. The value of M PRS-RSTD reports between different pairs of DL PRS resources or DL PRS resource sets of the same pair of TRP are close as they reflect the distance between the same two geographically separated TRPs.  Proposal. RAN4 to define differential RSTD report mapping table. UE to report the minimum RSTD value from the set of M RSTD values of the same TRP pair with absolute report mapping as in Tables 3-4 and use positive differential RSTD value for the remaining M-1 RSTD values.   * FFS: the maximum range of differential RSTD report mapping |

## Open issues summary

### Sub-topic 4-1

Reporting payload reduction is important in signaling overhead for NR positioning. Differential RSTD reporting can reduce this overhead. Companies are encouraged to share their views on this topic.

* Q1: RAN4 to define differential RSTD report mapping table?
  + Option 1: Yes (Qualcomm)
  + Option 2: No

Recommended WF: Further discussion needed. Collect companies’ views.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 4-1: support option 1. |
| Apple | Sub-topic 4-1: fine with option 1. |
| MTK | Sub topic 4-1: Support option 1. Details FFS. |
| CATT | Sub-topic 4-1: support option 1. |
| Ericsson | Wait for RAN2 |
| Intel | Sub topic 4-1:  No differential reporting for RSTD. For PRS RSRP, it can be useful because the reference measurement is target to the serving cell/reference cell. But for RSTD , how to define the offset between RSTD1 and RSTD2? In other words, how will we define the measurement pair which was composed by the reference cell and other any measured cell?  ….  Others: |
| Qualcomm | In response to Intel’s comment: it is actually quite simple. Among the M pairs of RSTD measurements between the same pair of TRPs, the minimum RSTD value will be chosen as reference and all the other M-1 pairs will just include the additional difference compared to the min value. |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#4-1** | **RAN4 to define differential RSTD report mapping table**  *Candidate options:*   * Option 1. Yes (Qualcomm, Huawei, CATT, Apple, MediaTek) * Option 2. Wait for RAN2 (Ericsson) * Option 3. No (Intel)   *Recommendations for 2nd round:*  To be discussed further in 2nd round with further consultation with RAN2 WG. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

Moderator: Last week, RAN2 WG made the following agreement and will send an LS to RAN4 WG accordingly.

**Agreements:**

Confirm (same as current running CR) when a UE is configured to report  multiple DL PRS RSTD, PRS RSRP, RxTX measurements with each measurement between a different pair of DL PRS resources or DL PRS resource sets, and those multiple measurements being performed on the same pair of TRPs, the UE reports one full measurement results and additional delta measurement(s).

As such, recommended WF on sub-topic#4-1 is to agree on option 1.

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| **Company** | **Comments** |
| Ericsson | Sub topic 4-1: Postpone the discussion to the next meeting. Need to further check the RAN2 discussion and the meaning of “delta” measurements. We need to wait for the LS, anyway. |
| Huawei, HiSilicon | Sub-topic 1-2: support recommended WF from moderator. |

## 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 #5: PRS-RSTD measurement period

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000389 | Intel | The number of cells/TRPs which UE can perform the accurate DL PRS RSTD measurement can be [8].  UE capability related to NR positioning measurement requirements in RAN4 RRM can also be defined by the number of measurement positioning frequency layer.  The allowed RSTD measurement delay would be multiplied by the number of layers that need to be measured as defined for LTE RSTD measurement.  Where in, is the periodicity of DL PRS allocation in slots configured per DL PRS resource,  is the number of PRS positioning resource for all cells (e.g. n=16 in []) to be detected and measured,  is the measurement time for a single PRS positioning resource which includes the sampling time and the processing time.  UE can continue PRS measurement in all target cells/TRPs for HO.  The total measurement delay when serving cell changed (e.g. HO) can defined as:  Where  is the number of times the intra/inter-frequency handover occurs during .  is the time during which the intra/inter-frequency RSTD measurement may not be possible due to intra/inter-frequency handover. |
| R4-2000589 | CATT | The measurement period requirements of NR can reuse the same equation as LTE. |
| R4-2000998 | MediaTek | UE measures at least n =16 cells and reports at least 15 RSTDs within  ms  provided that reference cell and there are at least 15 neighbor cells satisfying the side conditions in proposal1, where *k* is the number of positioning frequency layers, M = 16, and is the number of PRS slots in one PRS instance.  Furthermore, it is assumed that is the same for all positioning frequency layers.  The requirement on RSTD measurement period under cell is given by  ms  where *K* is the number of HO, is the PRS periodicity, and is given above |
| R4-2001637 | Huawei, HiSi | PRS measurement period is defined as  Tmeas\_PRS = NRxBeam \* Nfreq \* [(max(Tres, Tproc) \* [3] + Tproc]  where NRxBeam is the scaling factor for Rx beam sweeping, Nfreq is the number of PRS frequency layers, Tres is the maximum resource periodicity among all PRS resources on the PRS frequency layer, Tproc is the PRS processing time as indicated in UE capability reporting.  The requirements apply provided that on a PRS frequency layer the duration of any PRS occasion is no larger than the PRS buffering time as indicated in UE capability reporting, and the separation between any two PRS occasions is no less than Tproc.  Follow the same principle as in LTE to define extension of RSTD measurement period due to HO. |
| R4-2001941 | Ericsson | * The RSTD measurement under handover depends on the number of serving cell changes and on the handover interruption time. * RSTD measurement period is extended, but not more than a certain maximum, to compensate for the number of PRS occasions not available at the UE over a certain time period due to their overlap with SSB symbols, at least when the number of the non-available PRS occasions is large (e.g., >X% of the needed samples) and the SSB symbols location is known to the UE. * When the measurement period is extended, the increase in the measurement period depends at least on the periodicity of the PRS resource which has non-available occasions and the number of such non-available PRS occasions, but may further depend on the measurement gap configuration, etc.   + The extension is proportional to max(T1\_PRS\*N1\_PRS,T2\_PRS\*N2\_PRS), where T1\_PRS and T2\_PRS are the PRS periodicity for the reference and neighbor TRPs, respectively, and N1\_PRS and N2\_PRS are the numbers of periodic occasions with dropped PRS in the reference and neighbor TRPs, respectively. * If the number of PRS occasions not available at the UE exceeds an acceptable limit, the measurement can be dropped, i.e., no further extension of the measurement period is allowed. |
| R4-2000731 | Qualcomm | Max number of DL PRS resources per frequency layer constrained by UE capability is  The total number of required PRS periods, in units of TPRS to process PRS resources is where and {N1, T1} is the signalled capability duplet for PRS processing.  Observation 3. The total number of PRS periods, in units of TPRS, required to process PRS resources is where and {N2, T2} is the signalled capability duplet for PRS buffering.  PRS-RSTD measurement period for PRS resources in one frequency layer can be expressed as  Where   * is the UE processing time as expressed in Observation 2 (FFS) * is the UE buffering time as expressed in Observation 3 (FFS) * When UE signals a list of {N1,T1} and {N2,T2}, as opposed to one {N1,T1} and one {N2,T2}, a separate is derived for each pair and max of all is used. |

## Open issues summary

### Sub-topic 5-1 Number of TRPs/DL-PRS resource sets/DL-PRS resources

RSTD measurement period is a function of number of DL PRS resources that UE should measure. The issue is whether the measurement period should be defined based on a minimum number of RSTDs or it should be based on UE’s signaled capabilities.

* Option 1: PRS-RSTD measurement period is based on a minimum number of RSTDs to be measured (Intel, MediaTek, CATT)
* Option 2: PRS-RSTD measurement period is based on UE’s signalled capabilities (details FFS) without a minimum number of RSTDs to be measured (Huawei, Qualcomm)
* Option 3: other options not precluded.

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 5-2 Parameters impacting measurement period

A few companies have presented their views on which parameters impact the RSTD measurement period. The goal in this section is to only list the relevant parameters. Companies are encouraged to review the list below and provide their comments.

* PRS-RSTD measurement period per frequency layer is a function of the following parameters:
  + Number of RSTD pairs per frequency layer to be measured
  + Periodicity of PRS resources (FFS on details if PRS resources have different periodicities)
  + : the measurement time for a single PRS positioning resource which includes the sampling time and the processing time.
  + NRxBeam : the scaling factor for Rx beam sweeping
  + UE processing time per signalled UE capability (details FFS)
  + UE buffering time per signalled UE capability (details FFS)
  + Number of PRS occasions not available at the UE over a certain time period due to their overlap with SSB symbols (details FFS)
  + Other parameters are not excluded.

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 5-3 Impact of HO on measurement period

During RSTD measurement period, several HO’s may occur. In WF from RAN4#93, it was agreed to extend the measurement period but details were left as FFS.

PRS-RSTD measurement period is extended due to HO as:

* Option 1: The total measurement delay when serving cell changed (e.g. HO) can defined as: where is the number of times the intra/inter-frequency handover occurs during . is the time during which the intra/inter-frequency RSTD measurement may not be possible due to intra/inter-frequency handover (Intel, Huawei)
* Option 2: The RSTD measurement under handover depends on the number of serving cell changes and on the handover interruption time (Ericsson).
* Option 3: The requirement on RSTD measurement period under cell is given by ms where *K* is the number of HO, is the PRS periodicity, and is RSTD measurement period without HO.
* Option 4: other options not precluded.

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 5-1: While we support Option 2, we would like to note that the measurement period may need to account the configured number of PRS resource per occasion, and the requirements apply only when the total number of PRS resources does not exceed indicated UE capabilities.  Sub-topic 5-2: ‘Number of PRS frequency layers’ should be also added. Could the proponent of the first bullet clarify how ‘Number of RSTD pairs per frequency layer to be measured’ impacts the measurement period?  Sub-topic 5-3: We also discussed the issue with Proposal 8 in R4-2001637. It is technically same as option 1. |
| Qualcomm | Sub topic 5-1: we support option 2. Several UE capabilities (X1, X2, … , X7) in addition to processing limit and memory limit is being discussed in RAN1. The requirements apply if none of these capabilities is exceeded.  Sub topic 5-2: The title of the question indicates “RSTD measurement period per frequency layer” so that’s why number of positioning frequency layer is not listed. Qualcomm listed number of RSTD pairs to be measured. This is equivalent to the total number of cells to be measured in LTE which in NR is now also a UE capability. Since UE cannot process all of the PRS resources at the same time and needs to do one (or a few) at a time, the RSTD measurement period scales by the total number of RSTD pairs.  Sub topic 5-3; Option 1 is agreeable to us and is aligned with LTE requirements in the presence of HO. |
| MTK | * Sub topic 5-1:   In RAN1#99 there is an agreement:  Agreement:  Duration of DL PRS symbols in units of ms a UE can process every T ms assuming 272 PRB allocation is a UE capability  In our view the capability is not clearly defined yet since the number of positioning frequency layers and number of TRPs are not specified.  It is noted that RAN1 has designed several parameters X1,X2,…,X7 and some values as part of UE capability are FFS.  However, there may be many combinations of parameters and it is complicated to define measurement period based on it.  To avoid confusion, we propose to define PRS-RSTD measurement period with clear specification on side conditions, number of frequency layers, number of cells to measure, PRS configuration of each cell (e.g., # of repetitions), and number/timing of PRS occasions for each cell within the measurement period.   * Sub topic 5-2:   In our view, the PRS-RSTD measurement period is at least related to 1 and 2 listed above.  In addition, the PRS-RSTD measurement period is also related to the side conditions, number of frequency layers, PRS configuration, and number/time of PRS occasions for each cell.  It is unclear why there is a measurement time for a single positioning resource.  For FR2, the scaling factor for Rx beam sweeping can be taken into consideration for defining PRS-RSTD measurement period as in FR2 it is expected that UE may perform Rx beamsweeping to search for a best Rx beam.  The PRS-RSTD measurement period is related to item 5, 6, but it does not imply that PRS-RSTD measurement period has to be defined based on items 5,6.  For item 7, if there exist scenarios that PRS occasions are not available to due overlapping with SSB, then it is reasonable to extend the PRS-RSTD measurement period. However, in our view, the network should configure PRSs such that PRS and SSBs don’t overlap in time, otherwise the PRS would be dropped by the UE.   * Sub topic 5-3: For option 1, it is unclear why there is a term . In our view, k more PRS occasions should be given to the UE if k PRS occasions are dropped due to k handovers. There is no need to introduce . |
| CATT | Sub-topic 5-1:support option 2, the measurement period is based on the number of PRS resources configured to be measured according to UE’s signaled capabilities.  Sub-topic 5-3:support option 1. |
| Ericsson | Sub topic 5-1: further discussion is needed  Sub topic 5-2: further discussion is needed, no need to agree on the list in this meeting.  Sub topic 5-3: do not agree with option 3 which lacks the interruption time |
| Intel | Sub topic 5-1: Number of TRPs/DL-PRS resource sets/DL-PRS resources  Generally RAN4 requirements can consider the minimum resource UE can utilize.  Sub topic 5-2: Parameters impacting measurement period  Actually these parameters will determine PRS processing time, which is most important factor to define this measurement delay requirements. We can identify the key parameters firstly, e.g. Tproc. ….  Sub topic 5-3: Impact of HO on measurement period  In principle, the HO interruption time during PRS measurement shall be counted. |

## 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#5-1** | **Number of TRPs/DL-PRS resource sets/DL-PRS resources** *Candidate options:*   * Option 1: PRS-RSTD measurement period is based on a minimum number of RSTDs to be measured (Intel, MediaTek) * Option 2: PRS-RSTD measurement period is based on UE’s signalled capabilities (details FFS) without a minimum number of RSTDs to be measured (Huawei, Qualcomm, CATT) * Option 3: other options not precluded.   *Recommendations for 2nd round:*  To be discussed further in 2nd round with consulting RAN1 WG on UE feature list and capabilities. |
| **Sub-topic#5-2** | **Parameters impacting measurement period** *Recommendations for 2nd round:*  Defer discussion to RAN4#94-Bis meeting. |
| **Sub-topic#5-3** | **Impact of HO on measurement period** *Candidate options:*   * Option 1: The total measurement delay when serving cell changed (e.g. HO) can defined as: where is the number of times the intra/inter-frequency handover occurs during . is the time during which the intra/inter-frequency RSTD measurement may not be possible due to intra/inter-frequency handover (Intel, Huawei, Qualcomm, CATT) * Option 2: The RSTD measurement under handover depends on the number of serving cell changes and on the handover interruption time (Ericsson). * Option 3: The requirement on RSTD measurement period under cell is given by ms where *K* is the number of HO, is the PRS periodicity, and is RSTD measurement period without HO (MediaTek). * Option 4: other options not precluded.   *Recommendations for 2nd round:*  To be discussed further in 2nd round. The approach in TS 36.133 can be re-used. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 5-1: postpone the discussion to the next meeting, difficult to decide now, too many open issues which would impact the decision (e.g., measurement gap length, etc.)  Sub topic 5-3: support option 2, agree to use the LTE approach in 36.133 as a starting point. |
| Huawei, HiSilicon | Sub-topic 5-1: suggest to postpone the discussion to next meeting as the discussion on UE capability is not complete in RAN1.  Sub-topic 5-3: agree to use LTE approach in 36.133 as baseline. |

## 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 #6: PRS-RSTD measurement accuracy

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000731 | Qualcomm | PRS-RSTD measurement accuracy requirements to be defined using samples from only one DL PRS resource repetition for reference and neighbor, i.e., the time duration spanned by one DL PRS resource after repetition by *DL-PRS-ResourceRepetitionFactor*. Combining measurements across PRS repetitions, if possible and available, to improve performance should be left to UE implementation. |
| R4-2001941 | Ericsson | Applicable accuracy requirements for RSTD measurements under cell change:   * For intra-frequency HO, intra-frequency accuracy applies; * For inter-frequency HO,   + When the measured inter-frequency becomes a serving carrier frequency: inter-frequency accuracy applies,   + When the measured inter-frequency remains inter-frequency: inter-frequency accuracy applies,   When the measured intra-frequency becomes inter-frequency: inter-frequency accuracy applies. . |

## Open issues summary

The accuracy requirement is defined based on “N” DL PRS resource repetition for reference and neighbor. Companies are encouraged to provide their views on the value of N.

### Sub-topic 6-1 Number of samples for accuracy requirements (N)

* Option 1. N = 1 (Qualcomm, Huawei)
* Option 2. ?

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 6-2 Accuracy requirements in HO

Applicability of accuracy requirements under HO.

Option 1.Applicable accuracy requirements for RSTD measurements under cell change (Ericsson):

* For intra-frequency HO, intra-frequency accuracy applies;
* For inter-frequency HO,
  + When the measured inter-frequency becomes a serving carrier frequency: inter-frequency accuracy applies,
  + When the measured inter-frequency remains inter-frequency: inter-frequency accuracy applies,
* When the measured intra-frequency becomes inter-frequency: inter-frequency accuracy applies. .

Option 2. ?

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 6-1: Option 1  Sub-topic 6-2: We do not agree with Option 1. It depends on the definition of intra- and inter-frequency, but technically the accuracy of PRS measurement does not depend on the frequency layer of the serving cell. The serving cell may not even transmit PRS. |
| Apple | Sub-topic 6-2: same view as Huawei, and also we are wondering why we need accuracy for HO case. We think this accuracy requirement for HO is unnecessary. |
| Qualcomm | Sub topic 6-2: we share the same view as Huawei. |
| MTK | Sub topic 6-1: supports option 1  Sub topic 6-2: postpone the discussion until the intra- inter-frequency RSTD measurement is clearly defined. |
| CATT | Sub-topic 6-1: support ption 1  Sub-topic 6-2: our view is that applicability of accuracy requirements under HO depends on the intra/inter frequency state after HO. |
| Ericsson | Sub topic 6-1: needs more discussion, not the number of samples should drive the accuracy, rather we need to further check the number of samples giving the desired accuracy.  Sub topic 6-2: support option 1. Actually PRS measurement can depend on the serving cell configuration, so in some cases the accuracy requirements applicable before the change may not be applicable any more after the change. Since the UE still need to complete the measurement and report it, we need to define the applicable accuracy requirements. |
| Intel | Sub topic 6-1: Number of samples for accuracy requirements  Option 1(N=1) can be agreed. |

## 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#6-1** | **Number of samples for accuracy requirements**  *Candidate options:*   * Option 1. N = 1 (Qualcomm, Huawei, MediaTek, CATT, Intel) * Option 2. Needs further discussion (Ericsson)   *Recommendations for 2nd round:*  To be discussed further in 2nd round considering. |
| **Sub-topic#6-2** | **Accuracy requirements in HO**  *Recommendations for 2nd round:*  Defer to the conclusion of intra-frequency and inter-frequency RSTD definition. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 6-1: needs more discussion, not the number of samples should drive the accuracy, rather we need to further check the number of samples giving the desired accuracy. |
| Huawei, HiSilicon | Sub-topic 6-1: support option 1 |

## 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 #7: PRS-RSTD reporting capability and criteria

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000589 | CATT | The UE capability that the number of frequency layer UE can monitor can be defined as {1,2,4} and the number of TRPs per frequency layer is depend on the system simulation. |
| R4-2001637 | Huawei, HiSi | RAN4 not to define measurement capability in terms of number of PRS frequency layers, TRPs, resource sets and resources that UE shall be able to measure.  The measurement requirements apply only if the number of configured PRS frequency layers, TRPs, resource sets and resources is within UE reported capabilities.  Ecat = 1 for RSTD measurement per positioning session. |
| R4-2001941 | Ericsson | Ecat=1 for intra-frequency RSTD measurements, 1 report capable of RSTD measurements and PRS-RSRP measurements (when configured together with the RSTD) on at least TBD PRS resources, per intra-frequency layer.  Ecat=1 for inter-frequency RSTD measurements, 1 report capable of RSTD measurements and PRS-RSRP measurements (when configured together with the RSTD) on at least TBD PRS resources, per inter-frequency layer. |
| R4-2000731 | Qualcomm | In DL-TDOA positioning, each PRS-RSTD measurement reporting criterion corresponds to one frequency layer with Ecat = 1 indicating PRS-RSTD measurement reports.  FFS: |

## Open issues summary

### Sub-topic 7-1 Measurement capability

Per RAN1 agreement, a list of UE capabilities in terms of number of positioning frequency layers, number of TRPs per frequency layer, number of resource sets per TRP, .... are defined and will be signalled as UE capability. The issue is whether RAN4 should specify anything further.

RAN4 to define measurement capability in terms of number of positioning frequency layers, number of TRPs per frequency layer, number of resurce sets per TRP, .... ?

* Option 1: Yes (at least for positioning frequency layer) (CATT)
* Option 2. No (Huawei, Qualcomm)

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 7-2 Reporting criteria (Ecat)

RAN4 should define measurement reporting criteria (Ecat) for PRS-RSTD measurement. The issues are the value of Ecat, the level of separation (separate Ecat for inter-frequency and inter-frequency).

Ecat for PRS-RSTD reporting to be:

* Option 1: In DL-TDOA positioning, each PRS-RSTD measurement reporting criterion corresponds to one frequency layer with Ecat = 1 indicating PRS-RSTD measurement reports. (Qualcomm)
* Option 2: Ecat=1 for (Ericsson)
  + intra-frequency RSTD measurements, 1 report capable of RSTD measurements and PRS-RSRP measurements (when configured together with the RSTD) on at least TBD PRS resources, per intra-frequency layer.
  + inter-frequency RSTD measurements, 1 report capable of RSTD measurements and PRS-RSRP measurements (when configured together with the RSTD) on at least TBD PRS resources, per inter-frequency layer.
* Option 3 Ecat = 1 for RSTD measurement per positioning session.(Huawei)
* Option 4. Other options are not precluded.

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 7-1: Option 1, no need for RAN4 to define further requirements.  Sub-topic 7-2: Option 3, the maximum number of RSTD measurements are limited by UE capabilities defined in other WG, we see no need for RAN4 to repeat or define further requirements. |
| Qualcomm | Sub topic 7-1: Option 2. (I think Huawei also meant to say option 2)  Sub topic 7-2: We proposed option 1 because at least in LTE, RSTD reporting criteria mentioned at least 16 cells should be included. However, we agree with Huawei that this is already a UE capability and although our proposal was also based on capabilities that UE signals, we can see that it is not necessary and can agree to option 3. |
| MTK | Sub topic 7-1: Support option 2.  Sub topic 7-2: Support option 3. |
| CATT | Sub-topic 7-1: support option 1, define different type of UE according to the capability in terms of number of positioning frequency layers. Define minimum number of TRPs per frequency layer, number of resource sets per TRP, etc that UE can monitor.  Sub-topic 7-2: support option 3. |
| Ericsson | Sub topic 7-1: some capabilities need to be defined, but further discussion is needed and also we need to align with RAN1 agreements  Sub topic 7-2: support option 2. Note also that the Ecat is shared by RSTD and PRS RSRP only in case they are reported together, otherwise separate Ecat apply for PRS RSTD and PRS RSRP. |
| Intel | Sub topic 7-1: Measurement capability  According to RAN1 agreement, the capability in terms of “positioning frequency layer” is needed |

## 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#7-1** | **RAN4 to define measurement capability in terms of number of positioning frequency layers, number of TRPs per frequency layer, number of resurce sets per TRP, .... ?**  *Candidate options:*   * Option 1: Yes (Details FFS) (CATT) * Option 2. No (Huawei, Qualcomm, MediaTek) * Option 3: at least number of frequency layers need to be defined since e.g. because inter-frequency PRS-based measurements may need to be configured on the frequency layers different from those supported for mobility (Ericsson). Further, RAN1 agreements need to be reflected in 38.133 somehow too.   *Recommendations for 2nd round:*  To be discussed further in 2nd round and consult with RAN1 WG. |
| **Sub-topic#7-2** | **Ecat for PRS-RSTD reporting to be:**  *Candidate options:*   * Option 1: In DL-TDOA positioning, each PRS-RSTD measurement reporting criterion corresponds to one frequency layer with Ecat = 1 indicating PRS-RSTD measurement reports. (Qualcomm) * Option 2: Ecat=1 for (Ericsson)   + intra-frequency RSTD measurements, 1 report capable of RSTD measurements and PRS-RSRP measurements (when configured together with the RSTD) on at least TBD PRS resources, per intra-frequency layer.   + inter-frequency RSTD measurements, 1 report capable of RSTD measurements and PRS-RSRP measurements (when configured together with the RSTD) on at least TBD PRS resources, per inter-frequency layer. * Option 3 Ecat = 1 for RSTD measurement per positioning session.(Huawei, Qualcomm, MediaTek, CATT) * Option 4. Other options are not precluded.   *Recommendations for 2nd round:*  To be discussed further in 2nd round and consult with RAN1 WG. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 7-1: some capabilities need to be defined, but further discussion is needed and also we need to align with RAN1 agreements. Support option 3. At least number of frequency layers need to be defined since e.g. because inter-frequency PRS-based measurements may need to be configured on the frequency layers different from those supported for mobility. Further, RAN1 agreements need to be reflected in 38.133 somehow too.  Sub topic 7-2: support option 2. Note also that the Ecat is shared by RSTD and PRS RSRP only in case they are reported together, otherwise separate Ecat apply for PRS RSTD and PRS RSRP. |
| Huawei, HiSilicon | Sub-topic 7-1: support option 2  Sub-topic 7-2: support option 3. We are also open to Ericsson approach to address the PRS-RSRP, i.e. Ecat = 1 for RSTD per session, and it includes RSTD measurements and PRS-RSRP measurements (when configured together with the RSTD), otherwise it includes RSTD measurement. In this way, for reporting criteria for PRS-RSRP, we just need to consider the case where PRS-RSRP is measured for DL-AoD. |

## 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 #1: PRS-RSRP side conditions

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000732 | Qualcomm | Only one side condition is needed and applicable to PRS resources in the assistance data for PRS-RSRP. This side condition is proposed to be the same as neighbour cell side condition in RSTD requirements. |
| R4-2000590 | CATT | The side condition for serving cell for PRS RSRP should be defined and the value is the same as the side condition for reference cell for RSTD |
| R4-2000999 | MediaTek | RAN4 to discuss side conditions for PRS-RSRP relative accuracy requirement |
| R4-2001638 | Huawei, HiSi | Define the side conditions on reference cell and neighbor cells for PRS-RSRP measurement by re-using the SINR levels from RSTD measurement requirements. |
| R4-2001944 | Ericsson | For OTDOA, PRS-RSRP side conditions are specified for reference (which may or may not be serving) TRP and neighbor TRPs, in which case the PRS-RSRP side conditions are the same as for RSTD.  For DL-AoD and Multi-RTT, PRS-RSRP side conditions are specified for serving TRP and neighbor TRPs.  For DL-AoD and Multi-RTT, the side conditions for FR1 and FR2 are:   * + -3 dB for serving TRP,   + -13 dB for non-serving TRP. |

## Open issues summary

The open issues on this topic include how many different sets of side conditions are needed for PRS-RSRP (e.g., depending on concurrency with other positioning measurements), whether side condition for serving cell is necessary, whether side condition for reference cell is necessary, and their values.

### Sub-topic 8-1 Side condition for neighbor cells

Side condition for neighbor cell in PRS-RSRP measurement:

* Option 1. Same as side condition for neighbor cell in PRS-RSTD (Qualcomm, Huawei, Ericsson)
* Option 2. ?

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 8-2 Side condition for serving cells

Side condition for serving cell in PRS-RSRP measurement:

* Option 1. Needed in DL-AoD and multi-RTT and proposed to be -3 dB (Ericsson)
* Option 2. Needed and same as side condition for reference cell PRS-RSTD, i.e., -6 dB (CATT)
* Option 3. Not needed (Huawei, Qualcomm)

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 8-3 Side condition for reference cells

Side condition for reference cell in PRS-RSRP measurement:

* Option 1. Needed in DL-TDOA and proposed to be the same as that in PRS-RSTD (Ericsson)
* Option 2. Needed in all positioning methods and proposed to be the same as that in PRS-RSTD (Huawei)
* Option 3. Not needed (Qualcomm)

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 8-1: option 1  Sub-topic 8-2: option 3, only reference cell is defined in the PRS assistance data but not serving cell.  Sub-topic 8-3: we are also fine with option 3. |
| Qualcomm | Sub topic 8-1: option 1  Sub topic 8-2: option 3  Sub topic 8-3: option 3 |
| MTK | * Sub topic 8-1: No need to defined for side conditions for neighbor cell.   Main use case of PRS-RSRP measurement is for DL-AoD positioning, the focus should be on relative PRS-RSRP accuracy since the AoD estimation is done by making use of the difference between PRS-RSRPs of PRS beams from a TRP.  DL-AoD positioning is mostly likely to be used for indoor office scenario since it requires high LOS probability. Therefore the SINR side condition should be different from that for PRS-RSTD.  In TS 38.133, relative RSRP accuracy requirements are defined for SS-RSRP. The side conditions defined for SSB may be reused for PRS-RSRP accuracy requirements.   * Sub topic 8-2: No need to defined side condition for serving cell. The reason and proposal is as described for sub topic 8-1. * Sub topic 8-3: No need to defined side condition for reference cell. The reason and proposal is as described for sub topic 8-1. |
| CATT | Sub-topic 8-1: support option 1  Sub-topic 8-2: option 2, needed at least in DL-AoD. In other positioning method, we are fine not to define.   * Sub-topic 8-3: support option 3. |
| Ericsson | Sub topic 8-1: option 1  Sub topic 8-2: option 1  Sub topic 8-3: option 1. Disagree with option 2 that reference RSRP is needed for all positioning methods, because the RSRP does not have the reference component in it unlike RSTD, even if some PRS configuration is used to derive another PRS configuration in the signaling to reduce the signaling overhead.  Moderator: This is already captured in TS 38.214: “The UE expects to be configured with higher layer parameter *DL-PRS-expectedRSTD*, which defines the time difference with respect to the received DL subframe timing the UE is expected to receive DL PRS, and *DL-PRS-expectedRSTD-uncertainty*, which defines a search window around the expectedRSTD.”  This paragraph is applicable to all DL-PRS measurements regardless of the positioning method. |
| Intel | Sub topic 8-1: Side condition for neighbor cells  Same as these for PRS RSTD measurement.  Sub topic 8-2:  In case of reference cell is not same as the serving cell, it shall be defined for reference cell  Sub topic 8-3:  Same as these for PRS RSTD measurement |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#8-1** | **Side condition for neighbor cell in PRS-RSRP measurement:**  *Candidate options:*   * Option 1. Same as side condition for neighbor cell in PRS-RSTD (Qualcomm, Huawei, Ericsson, CATT, Intel) * Option 2. Not needed (MediaTek)   *Recommendations for 2nd round:*  To be discussed further in 2nrd round. It is noted that DL-AoD is not restricted to serving TRP in RAN1. |
| **Sub-topic#8-2** | **Side condition for serving cell in PRS-RSRP measurement:**  *Candidate options:*   * Option 1. Needed in DL-AoD and multi-RTT and proposed to be -3 dB (Ericsson) * Option 2. Needed and same as side condition for reference cell PRS-RSTD, i.e., -6 dB (CATT) * Option 3. Not needed (Huawei, Qualcomm, MediaTek, Intel)   *Recommendations for 2nd round:*  To be discussed further in 2nrd round. It is noted that DL-AoD is not restricted to serving TRP in RAN1. |
| **Sub-topic#8-3** | **Side condition for reference cell in PRS-RSRP measurement:**  *Candidate options:*   * Option 1. Needed in DL-TDOA and proposed to be the same as that in PRS-RSTD (Ericsson, Intel) * Option 2. Needed in all positioning methods and proposed to be the same as that in PRS-RSTD (Huawei) * Option 3. Not needed (Qualcomm, Huawei, MediaTek, CATT)   *Recommendations for 2nd round:*  To be discussed further in 2nrd round. It is noted that the concept of “reference cell” exists for all positioning methods as captured in TS 38.214 |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 8-1: option 1  Sub topic 8-2: option 1  Sub topic 8-3: option 1, applicable only when PRS RSRP is configured together with PRS RSTD. Disagree with option 2 that reference RSRP is needed for all positioning methods, because the RSRP does not have the reference component in it unlike RSTD, even if some PRS configuration is used to derive another PRS configuration in the signaling to reduce the signaling overhead. |
| Huawei, HiSilicon | Sub-topic 8-1: support option 1  Sub-topic 8-2: support option 3  Sub-topic 8-3: support option 2 |

## 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 #9: Differential (relative) PRS-RSRP requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000590 | CATT | Both relative and absolute accuracy are needed for PRS RSRP. |
| R4-2000999 | MediaTek | No need to define absolute PRS-RSRP accuracy requirements  RAN4 to define relative accuracy requirements for PRS-RSRP |
| R4-2001638 | Huawei | Both absolute and relative accuracy requirements are defined for PRS-RSRP. |
| R4-2001944 | Ericsson | RAN4 defines the following PRS-RSRP measurement requirements:   * Intra-frequency measurement requirements, FR1 and FR2, * Inter-frequency measurement requirements, FR1 and FR2.   RAN4 defines the following PRS-RSRP measurement accuracy requirements:   * Intra-frequency measurement accuracy requirements, FR1 and FR2 * Inter-frequency measurement accuracy requirements, FR1 and FR2. |
| R4-2000732 | Qualcomm | DL-AoD is the only clear use case of PRS-RSRP measurement wherein serving gNB transmit PRS resources in a beam-sweeping manner and UE measures RSRP of each PRS resource with a fixed Rx beam. Positioning calculation is based on TRP geographical locations and PRS beam information (e.g., azimuth, width, elevation).  In multi-RTT and DL-TDOA, no clear use case of PRS-RSRP measurement other than being a weighting factor on other measurements (e.g., UE Rx-Tx time difference or RSTD) has yet been identified.  In DL-AoD positioning method, differential PRS-RSRP measurement is used for positioning calculation. In multi-RTT or DL-TDOA with PRS-RSRP used as a weighting factor for other timing related measurements, differential RSRP serves the purpose and there is no need to have absolute PRS-RSRP requirements.  RAN4 to define only differential measurement accuracy requirements for PRS-RSRP. |

## Open issues summary

The issue here is how many sets of requirements are needed for PRS-RSRP; relative (differential) and/or absolute requirements. Companies are encouraged to consider the usage of relative and absolute requirements in different positioning methods.

### Sub-topic 9-1

Type of requirements should be defined for PRS-RSRP measurements in RAN4:

* Option 1. Both relative (differential) and absolute (Ericsson, Huawei, CATT)
* Option 2. Only relative (differential) (MediaTek, Qualcomm)

Recommended WF: Further discussion needed. Collect companies’ views

Possible agreement: RAN4 to define at least relative (differential) requirements for PRS-RSRP.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 9-1: we are also fine with option 2. |
| Qualcomm | Sub topic 9-1: option 2. We encourage proponents of option 1 to justify why absolute PRS-RSRP requirement is necessary and what the use case is. |
| MTK | Sub topic 9-1: We support option 2.  Main use case of PRS-RSRP measurement is for DL-AoD positioning, the focus should be on relative PRS-RSRP accuracy since the AoD estimation is done by making use of the difference between PRS-RSRPs of PRS beams from a TRP.  For DL-TDOA and multi-RTT, PRS-RSRP is not the key measurement for positioning, instead PRS-RSRP is an additional information that can be used for weighting the RSTD measurement in the location server. Therefore, no need to define absolute accuracy requirements |
| CATT | Sub-topic 9-1: for the case that RSRP is configured to be measured alone in DL-AoD, the absolute value of RSRP represents the distance of different cells or power loss of different beams. So we think the absolute accuracy may be needed. |
| Ericsson | Wait for RAN2 |
| Intel | Sub topic 9-1:  Both of them shall be defined. Otherwise, with only the differential report, how will NW get the absolute value without the reference one? |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#9-1** | **Type of requirements should be defined for PRS-RSRP measurements in RAN4:**  *Candidate options:*   * Option 1. Both relative (differential) and absolute (Huawei, CATT, Intel) * Option 2. Only relative (differential) (MediaTek, Qualcomm, Huawei) * Option 3. Wait for RAN2 (Ericsson)   *Recommendations for 2nd round:*  To be discussed further in 2nd round with consultation with RAN2 WG. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

Moderator: Last week, RAN2 WG made the following agreement and will send an LS to RAN4 WG accordingly.

**Agreements:**

Confirm (same as current running CR) when a UE is configured to report  multiple DL PRS RSTD, PRS RSRP, RxTX measurements with each measurement between a different pair of DL PRS resources or DL PRS resource sets, and those multiple measurements being performed on the same pair of TRPs, the UE reports one full measurement results and additional delta measurement(s).

As such, recommended WF on sub-topic#9-1 is to agree to eliminate option 3 and decide between options 1 and 2.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 9-1: Postpone the discussion to the next meeting. Need to further check the RAN2 discussion and the meaning of “delta” measurements. We need to wait for the LS, anyway. |
| Huawei, HiSilicon | Sub-topic 9-1: support option 2 |

## 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 #10: PRS-RSRP report mapping tables

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000590 | CATT | For the minimum value of PRS-RSRP report mapping there is no need to define a lower value than the existing SS-RSRP report mapping. |
| R4-2000999 | MediaTek | The minimum value of SS-RSRP reporting table, namely -140 dBm, can be reused for PRS-RSRP reporting  Support PRS-RSRP differential report. Reuse SS-RSRP differential reporting design for PRS-RSRP differential report, i.e., 30dB as maximum range and 2dB as step size |
| R4-2001945 | Ericsson | For PRS-RSRP, reuse measurement report mapping specified for Rel-15 SS-RSRP, i.e., the measurement report mapping consists of 128 values.  For differential PRS-RSRP, the range of the measured quantities specified in the measurement report mapping for Rel-15 differential SS-RSRP is reused but with the resolution 1 dB, i.e., the measurement report mapping consists of 31 values. |
| R4-2000732 | Qualcomm | Differential PRS-RSRP report mapping table can be one-sided covering only negative values since UE can select one PRS resource from each TRP as reference and report differential PRS-RSRP measurement with respect to it.  RAN4 to use Table 1 (differential SS-RSRP report mapping table) for differential PRS-RSRP report mapping table.  Min value of absolute PRS-RSRP report mapping table to be the same as that in existing RSRP reporting mapping table in TS 38.133. |
| R4-2001632 | Huawei, HiSi | For PRS-RSRP report mapping, the minimum value is same as SS-RSRP. |

## Open issues summary

Companies views are aligned in regard to absolute PRS-RSRP report mapping table. The SS-RSRP absolute report mapping table in TS 38.133 can be used for absolute PRS-RSRP report mapping. For differential report mapping, the range (-30, 0] dB appears agreeable but different views exist for granularity*.*

### Sub-topic 10-1 Absolute PRS-RSRP report mapping table

Possible agreement: RAN4 to use absolute SS-RSRP report mapping table in TS 38.133 for absolute PRS-RSRP report mapping table.

### Sub-topic 10-2 Relative PRS-RSRP report mapping table

Possible agreement: The min/max values of differential PRS-RSRP report mapping table shall be the same as min/max of differential SS-RSRP report mapping table in TS 38.133

Granularity (step size) of differential PRS-RSRP report mapping table:

* Option 1. 2 dB (Qualcomm, MediaTek)
* Option 2. 1 dB (Ericsson)
* Other options not precluded

Recommended WF: Further discussion needed. Collect companies’ 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** |
| R4-2001946 | Company A |
| Company B |
|  |

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 10-1: support the possible agreement.  Sub-topic 10-2: support the possible agreement. We prefer 1dB as the granularity of differential reporting, i.e. option 2. |
| Qualcomm | Sub topic 10-2: we can agree to option 2 as well. |
| MTK | Sub topic 10-2: We supports option 1.  Our simulation results show that step size 2dB has nearly no impact for positioning performance. In addition, the step size for SS-RSRP differential report is also 2dB. Reuse the SS-RSRP differential reporting table for PRS-RSRP differential report has the minimum change to specification. |
| CATT | Sub-topic 10-1: support the possible agreement.  Sub-topic 10-2: support the possible agreement and option 2. |
| Ericsson | Sub topic 10-1: agree with the possible agreement  Sub topic 10-2: wait for RAN2 |
| Intel | Sub topic 10-2:  Support Option 2 (1dB) |

## 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#10-1** | *Tentative agreements:*  **RAN4 to use absolute SS-RSRP report mapping table in TS 38.133 for absolute PRS-RSRP report mapping table.**  *Recommendations for 2nd round:*  No further discussion is needed. |
| **Sub-topic#10-2** | **Relative PRS-RSRP report mapping table**  *Tentative agreements:*  The min/max values of differential PRS-RSRP report mapping table shall be the same as min/max of differential SS-RSRP report mapping table in TS 38.133  **Step size in relative PRS-RSRP report mapping table**  *Candidate options:*   * Option 1. 2 dB (MediaTek) * Option 2. 1 dB (Qualcomm, Huawei, CATT, Intel) * Wait for RAN2 (Ericsson)   *Recommendations for 2nd round:*  To be discussed further in 2nd round with consultation with RAN2 WG. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

Moderator: please also comment on CR in R4-2001946.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 10-1: CR R4-2001946 was revised to R4-2002289 (file name “revised\_R4-2001946 R4-2002289 CR38.133 Measurement report mapping for PRS RSRP”), to capture the agreements from the 1st round.  Sub topic 10-2: Postpone the discussion to the next meeting. Need to further check the RAN2 discussion and the meaning of “delta” measurements. We need to wait for the LS, anyway. |
| Huawei, HiSilicon | Sub-topic 10-2: support tentative agreement and support option 2 for step size |

## 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 #11: Non-DRX requirements for PRS-RSRP

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000999 | MediaTek | Non-DRX requirements apply for PRS-RSRP measurement period, regardless of whether and which DRX configuration is configured for the UE. |
| R4-2001638 | Huawei, HiSi | Non-DRX requirements apply for PRS-RSRP measurement period, regardless of whether and which DRX configuration is configured for the UE |
| R4-2001944 | Ericsson | RAN4 will define different PRS-RSRP measurement requirements for the non-DRX case and DRX case.  When DRX is used and PRS-RSRP is configured to be measured along with UE Rx-Tx or configured for AOD positioning, the PRS-RSRP measurement period depends on DRX cycle length. |

## Open issues summary

In RAN4#93, it was agreed that non-DRX requirements apply for PRS-RSTD measurement period, regardless of whether and which DRX configuration is configured for the UE. The issue here is whether the same should be applicable to PRS-RSRP measurement period.

### Sub-topic 11-1

PRS-RSRP measurement requirements will be defined for:

* Option 1: only non-DRX regardless of whether and which DRX configuration is configured for the UE (Huawei, MediaTek, Qualcomm)
* Option 2: both non-DRX and DRX cases (Ericsson)

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 11-1: option 1, we see no difference between DL-AoD/multi-RTT and DL-TDOA. For DL-TDOA, RAN4 has agreed that non-DRX requirements always apply for PRS-RSTD measurement period. |
| Qualcomm | Sub topic 11-1: we share the same view as Huawei and support option 1. |
| MTK | Sub topic 11-1: We support option 1, since in our view the priority of positioning should be higher than that of DRX. |
| CATT | Sub-topic 11-1: support option 1. |
| Ericsson | Sub topic 11-1: The reason for supporting option 2 is to enable UE battery saving. If there is no concern on power consumption due to non-DRX period even the UE configured with DRX then we are ok with option 1. |
| Intel | Sub topic 11-1  Support Option 1. The requirement for DRX can be deprioritized in Rel16. |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#11-1** | **Non-DRX only requirements for PRS-RSRP**  *Tentative agreements:*  PRS-RSRP measurement requirements will be defined for only non-DRX regardless of whether and which DRX configuration is configured for the UE.  *Recommendations for 2nd round:*  No further discussion is needed. |

# Topic #12: Inter-frequency vs. Intra-frequency PRS-RSRP

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000999 | MediaTek | For the scenario that PRS-RSRP measurement is configured independently, RAN4 to define intra-frequency PRS-RSRP measurement as when the positioning frequency layer of a DL PRS resource set is within UE’s active BWP.  A PRS-RSRP measurement is defined to be an inter-frequency PRS-RSRP measurement if it is not an intra-frequency PRS-RSRP measurement |
| R4-2001638 | Huawei, HiSi | Conclusions for RSTD measurement on PRS measurement capability and the need for measurement gap or scheduling restriction should be re-used for PRS-RSRP measurement. |
| R4-2001944 | Ericsson | Intra/inter-frequency PRS-RSRP measurement definitions are as in Table 1 and follow similar principles as intra/inter-frequency CSI-RS based measurement definitions, earlier agreed by RAN4. |

## Open issues summary

Companies views on this issue are not any different from definition of intra-frequency and inter-frequency for PRS-RSTD. Instead of replicating the thread, the question is posed whether companies agree to apply the same conclusions and/or agreements from Topic#3 to this topic.

### Sub-topic 12-1

Can the same definitions for intra-frequency and inter-frequency PRS-RSTD measurements (if defined) be applicable to PRS-RSRP measurements?

* Option 1. Yes (Ericsson, Huawei, MediaTek, Qualcomm)
* Option 2. No (please elaborate)

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Qualcomm | Sub topic 12-1: we support option 1. |
| MTK | Sub topic 12-1: We support option 1.  Note that the assistance information of the reference cell is also provided to the UE for DL-AoD positioning. Therefore, the definition of intra- inter-frequency RSTD measurement can be reused for PRS-RSRP. |
| CATT | Sub-topic 12-1: support option 1. |
| Ericsson | It cannot be exactly the same, since the measurements are based on two links in one case and on one link in another case, but we agree that there can be the same conditions and then for RSTD these conditions would have to be met for both links. |
| Intel | Sub topic 12-1:  Option 1 (Yes). |

## 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#12-1** | *Recommendations for 2nd round:*  Defer further discussion to after conclusion of similar topic in PRS-RSTD (Topic#3) |

# Topic #13: PRS-RSRP measurement period

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000590 | CATT | Measurement period requirements of PRS RSRP when measured alone can reuse the requirement of RSTD measurement. |
| R4-2000999 | MediaTek | For non-DRX case, UE measures and reports PRS-RSRP for at least n =16 cells within  ms  provided that there are 16 cells satisfying Es/Iot , where *k* is the number of positioning frequency layers, M = 16, and is the number of PRS slots in one PRS instance.  Furthermore, it is assumed that is the same for all positioning frequency layers.  **Proposal 5**: The requirement on PRS-RSRP measurement period under cell is given by  ms  where *K* is the number of HO, is the PRS periodicity, and is given above |
| R4-2001638 | Huawei, HiSi | As a starting point, re-use the measurement period requirements of RSTD for PRS-RSRP measurement. The achievable accuracy should be further checked. |
| R4-2001944 | Ericsson | **Proposal**:If PRS-RSRP is configured to be measured along with UE Rx-Tx using the same assistance data:  Then the measurement periods of PRS-RSRP and UE Rx-Tx are the same.  **Proposal**: When not configured to be measured along with RSTD or UE Rx-Tx measurements, the PRS-RSRP measurement period is extended to compensate for the number of PRS occasions not available at the UE due to their overlap with SSB symbols, at least when the number of the non-available PRS occasions is large (e.g., >X% of the needed samples) and the SSB symbols location is known to the UE.  When configured with UE Rx-Tx or RSTD, the PRS-RSRP measurement period is the same as that for UE Rx-Tx or RSTD, respectively.  **Proposal:** When the measurement period is extended, the increase in the measurement period depends at least on the periodicity of the PRS resource which has non-available occasions and the number of such non-available PRS occasions, but may further depend on the measurement gap configuration, DRX, etc.  The extension is proportional to T\_PRS\*N\_PRS, where T\_PRS is the PRS periodicity, and N\_PRS is the number of periodic occasions with dropped PRS.  **Proposal**: If the number of PRS occasions not available at the UE exceeds an acceptable limit, the measurement can be dropped, i.e., no further extension of the measurement period is allowed..  **Proposal**: When not configured together with UE Rx-Tx, the UE behavior rules for PRS-RSPR measurement under cell change are the same as for RSTD; otherwise, the rules are the same as for UE Rx-Tx. |
| R4-2000732 | Qualcomm | Max number of DL PRS resources per frequency layer constrained by UE capability is for PRS-RSRP measurement.  The total number of required PRS periods, in units of TPRS to process PRS resources is where and {N1, T1} is the signalled capability duplet for PRS processing.  The total number of PRS periods, in units of TPRS, required to process PRS resources is where and {N2, T2} is the signalled capability duplet for PRS buffering.  Proposal . PRS-RSRP measurement period for PRS resources in one frequency layer can be expressed as  Where   * is the UE processing time as expressed in Observation 4 (FFS) * is the UE buffering time as expressed in Observation 5 (FFS) * When UE signals a list of {N1,T1} and {N2,T2}, as opposed to one {N1,T1} and one {N2,T2}, a separate is derived for each pair and max of all is used. |

## Open issues summary

Companies views on this issue are not any different from discussion on PRS-RSTD measurement period. Instead of replicating the thread, the question is posed whether companies agree to apply the same conclusions and/or agreements from Topic#5 to this topic.

### Sub-topic 13-1

Can the same principals in the definition of PRS-RSTD measurement period be applicable to PRS-RSRP measurement period?

* Option 1. Yes (Huawei, MediaTek, Qualcomm, CATT, Intel)
* Option 2. No (please elaborate)

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Qualcomm | Sub topic 13-1: we support option 1. |
| MTK | Sub topic 13-1: We support option 1.  From UE’s implementation point of view, the processing effort for PRS-RSTD and PRS-RSRP measurement is almost the same. |
| CATT | Sub-topic 13-1: support option 1. |
| Ericsson | Sub topic 13-1: The options are not clear (what does it mean “the same principles”?), therefore we are not even sure if Ericsson name should be mentioned under option 1 or option 2. We do not agree to have the same measurement period for RSTD and PRS RSRP in a generic way, regardless of whether PRS RSRP is configured together with RSTD or not.  Moderator: I have removed Ericsson’s name from option 1.“Same principals” refer to parameters that play a role in defining the measurement period, i.e., do we expect that there is a parameter that plays a role in PRS-RSTD measurement period but will not have any effect on PRS-RSRP measurement period? |
| Intel | Sub topic 13-1: we support option 1. |

## 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#13-1** | *Recommendations for 2nd round:*  Defer further discussion to after conclusion of similar topic in PRS-RSTD (Topic#5) |

# Topic #14: PRS-RSRP measurement accuracy

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000591 | CATT | The PRS-RSRP measurement accuracy becomes better as the number of used samples increase, and the absolute measurement error of PRS-RSRP is less than 2dB in the case of 5 samples. |
| R4-2000732 | Qualcomm | PRS RSRP measurement accuracy to be defined using samples from only one DL PRS resource repetition, i.e., the time duration spanned by one DL PRS resource after repetition by *DL-PRS-ResourceRepetitionFactor*. Combining measurements across PRS repetitions, if possible and available, to improve performance should be left to UE implementation. |
| R4-2001638 | Huawei, HiSi | As a starting point, re-use the measurement period requirements of RSTD for PRS-RSRP measurement. The achievable accuracy should be further checked. |

## Open issues summary

The accuracy requirement is defined based on “N” DL PRS resource repetition for reference and neighbor. Companies are encouraged to provide their views on the value of N.

### Sub-topic 14-1 Number of samples for accuracy requirements (N)

* Option 1. N = 1 (Qualcomm)
* Option 2. N = 5 (CATT)
* Option 3. Needs further study. Other values are not precluded (Huawei).

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 14-1: option 3. We think RAN4 needs to check the link level performance of PRS-RSRP measurement under the agreed side condition. If the accuracy is very poor with 1 sample, we may need to increase the number. |
| Qualcomm | Sub topic 14-1: since we advocate only relative accuracy requirements, we believe N=1 should be sufficient but we are ok with option 3 as well. |
| MTK | Sub topic 14-1: We supports option 1. RAN4 to define the baseline requirements. Therefore, N = 1 is sufficient. |
| Ericsson | Sub topic 14-1: Further discussion is needed. We need to choose the number of samples with which the target accuracy is achievable. And the accuracy at least should not be worse than for SS-RSRP. |
| Intel | Sub topic 14-1:  1 sample is preferred. Otherwise the measurement delay for positioning will be too long. |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#14-1** | **Number of samples (N) for accuracy requirements**  *Candidate options:*   * Option 1. N = 1 (Qualcomm, MediaTek, Intel) * Option 2. N = 5 (CATT) * Option 3. Needs further study. Other values are not precluded (Huawei, Ericsson)   *Recommendations for 2nd round:*  To be discussed further in RAN4#94-Bis meeting after review of link-level simulation results from more companies. |

# Topic #15: PRS-RSRP reporting capability and criteria

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001638 | Huawei, HiSi | UE should be able to support 1 reporting criteria per supported positioning technique among DL-TDOA, DL-AoD and Multi-RTT. |
| R4-2001944 | Ericsson | **Proposal**: When PRS-RSRP measurements are configured together with RSTD, the RSTD reporting criteria shall also include PRS-RSRP reports.  **Proposal**: When PRS-RSRP measurements are configured together with UE Rx-Tx, the UE Rx-Tx reporting criteria shall also include PRS-RSRP reports.  **Proposal**: Separate reporting criteria for PRS-RSRP are specified when PRS-RSRP measurements are not configured with RSTD or UE Rx-Tx. |
| R4-2000732 | Qualcomm | In DL-AoD positioning, each PRS-RSRP measurement reporting criterion corresponds to one frequency layer with Ecat = 1 indicating PRS resources.   * FFS: |

## Open issues summary

### Sub-topic 15-1 Measurement capability

Per RAN1 agreement, a list of UE capabilities in terms of number of positioning frequency layers, number of TRPs per frequency layer, number of resource sets per TRP, .... are defined and will be signalled as UE capability. The issue is whether RAN4 should specify anything further.

RAN4 to define measurement capability in terms of number of positioning frequency layers, number of TRPs per frequency layer, number of resurce sets per TRP, .... ?

* Option 1: Yes
* Option 2. No (Huawei, Qualcomm)

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 15-2 Reporting criteria (Ecat)

RAN4 should define measurement reporting criteria (Ecat) for PRS-RSRP measurement. The issues are the value of Ecat, the level of separation (separate Ecat for PRS-RSRP reporting alone or along with other measuremnts).

Ecat for PRS-RSRP reporting to be:

* Option 1: In DL-AoD positioning, each PRS-RSRP measurement reporting criterion corresponds to one frequency layer with Ecat = 1 indicating PRS resources. FFS: (Qualcomm)
* Option 2: When PRS-RSRP measurements are configured together with RSTD, the RSTD reporting criteria shall also include PRS-RSRP report. When PRS-RSRP measurements are configured together with UE Rx-Tx, the UE Rx-Tx reporting criteria shall also include PRS-RSRP reports. Separate reporting criteria for PRS-RSRP are specified when PRS-RSRP measurements are not configured with RSTD or UE Rx-Tx.(Ericsson)
* Option 3. UE should be able to support 1 reporting criteria per supported positioning technique among DL-TDOA, DL-AoD and Multi-RTT.(Huawei)
* Option 4. Other options are not precluded.

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 15-1: We suggest to follow the same conclusion from the discussion for RSTD measurement addressed in Sub-topic 7-1.  Sub-topic 15-2: Option 3. When measurements for multiple positioning techniques are measured, there could be different PRS-RSRP reports. We see no need to define the maximum number of PRS-RSRP measurements for the same reason as commented for Sub-topic 7-2. |
| Qualcomm | Sub topic 15-1: We support option 2.  Sub topic 15-2: We are fine with option 3. |
| MTK | Sub topic 15-1: We support option 2.  Sub topic 15-2: We support option 3. |
| CATT | Sub-topic 15-1: agree to follow the same conclusion from the discussion for RSTD measurement. |
| Ericsson | Sub topic 15-1: some measurement capability needs to be defined, but the details need further discussion, and the we need to also align with RAN1 agreements.  Sub topic 15-2: support option 2. On option 3: if the US supports multiple positioning techniques, which Ecat will apply; furthermore, the UE is configured with measurements, not with positioning techniques… |
| Intel | Sub topic 15-1: FFS and shall align with RAN1’s agreements. |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#15-1** | **RAN4 to define measurement capability in terms of number of positioning frequency layers, number of TRPs per frequency layer, number of resurce sets per TRP, .... ?**  *Recommendations for 2nd round:*  To be discussed further in 2nd round and consult with RAN1 WG. Align with conclusion of same issue on sub-topic#7-1. |
| **Sub-topic#15-2** | **Ecat for PRS-RSRP reporting:**  *Candidate options:*   * Option 1: In DL-AoD positioning, each PRS-RSRP measurement reporting criterion corresponds to one frequency layer with Ecat = 1 indicating PRS resources. FFS: (Qualcomm) * Option 2: When PRS-RSRP measurements are configured together with RSTD, the RSTD reporting criteria shall also include PRS-RSRP report. When PRS-RSRP measurements are configured together with UE Rx-Tx, the UE Rx-Tx reporting criteria shall also include PRS-RSRP reports. Separate reporting criteria for PRS-RSRP are specified when PRS-RSRP measurements are not configured with RSTD or UE Rx-Tx.(Ericsson) * Option 3. UE should be able to support 1 reporting criteria per supported positioning technique among DL-TDOA, DL-AoD and Multi-RTT.(Huawei, MediaTek) * Option 4. Other options are not precluded.   *Recommendations for 2nd round:*  To be discussed further in 2nd round and consult with RAN1 WG. Align with conclusion of same issue on sub-topic#7-2. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Conclusions on this topic are to be aligned with those on PRS RSTD capabilities  Sub topic 15-1: some capabilities need to be defined, but further discussion is needed and also we need to align with RAN1 agreements. Support option 3. At least number of frequency layers need to be defined since e.g. because inter-frequency PRS-based measurements may need to be configured on the frequency layers different from those supported for mobility. Further, RAN1 agreements need to be reflected in 38.133 somehow too.  Sub topic 15-2: support option 2. Note also that the Ecat is shared by RSTD and PRS RSRP only in case they are reported together, otherwise separate Ecat apply for PRS RSTD and PRS RSRP. Same goes for PRS RSRP and UE Rx-Tx. |
| Huawei, HiSilicon | Sub-topic 15-1: should be aligned with conclusion for RSTD in sub-topic 7-1  Sub-topic 15-2: we support option 3. We are also open to Ericsson approach to address PRS-RSR. Please refer to our comments for sub-topic 7-2. With this approach, here we only need to define Ecat =1 for PRS-RSRP when it is reported alone. PRS-RSRP reported together with RSTD or Rx-Tx can be included in the criterion for RSTD or Rx-Tx. |

## 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 #16: Rx-Tx time difference side conditions

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000603 | CATT | Side conditions (PRS Es/Iot) for UE Rx-Tx time difference for serving cell are defined same as side conditions for SSB-RSRP measurement in FR1 or FR2. |
| R4-2001000 | MediaTek | Serving cell:   * Side conditions (PRS Es/Iot) for UE Rx-Tx time difference in FR1: -6dB * Side conditions (PRS Es/Iot) for UE Rx-Tx time difference in FR2: -6dB. |
| R4-2001639 | Huawei, HiSi | Define the side conditions on reference cell and neighbor cells for Rx-Tx time different measurement by re-using the SINR levels from RSTD measurement requirements. |
| R4-2001940 | Ericsson | Serving cell side condition for UE Rx-Tx: -3 dB. |
| R4-2000733 | Qualcomm | In multi-RTT positioning technique, only one side condition is needed and applicable to PRS resources in the assistance data for UE Rx-Tx time difference measurement. This side condition is proposed to be the same as neighbour cell side condition in RSTD requirements. |

## Open issues summary

In RAN4#93 meeting, it was agreed to use the same side condition for neighbour cell in PRS-RSTD for Rx-Tx time difference measurement. The open issues on this topic include whether side condition for reference cell is needed and if so, what it should be, and whether side condition for serving cell is needed and if so, what it should be.

### Sub-topic 16-1 Side condition for serving cells

Side condition for serving cell in Rx-Tx time difference measurement:

* Option 1. Needed and proposed to be -3 dB (Ericsson)
* Option 2: Needed and proposed to be -6 dB (MediaTek)
* Option 3. Needed and same as side condition for serving cell in PRS-RSRP (CATT)
* Option 4. Not needed (Huawei, Qualcomm)

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 16-2 Side condition for reference cells

Side condition for reference cell in Rx-Tx time difference measurement:

* Option 1. Needed and same as reference cell side condition for PRS-RSTD (Huawei)
* Option 2. Not needed (Qualcomm)

Recommended WF: Further discussion needed. Collect companies’ views

Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 16-1: We suggest follow the same conclusion from PRS-RSRP discussion addressed in Topic 8.  Sub-topic 16-2: We suggest follow the same conclusion from PRS-RSRP discussion addressed in Topic 8. |
| Qualcomm | We agree that the conclusions of PRS-RSRP and UE Rx-Tx time difference should be the same. |
| MTK | Sub topic 16-1: We turn to support option 4.  Since the assistance information of reference cell is also configured to UE for multi-RTT positioning, it is sufficient to define side condition for reference cell. The serving cell may or may not be the reference cell to the UE.  Sub topic 16-2: We support option 1. |
| CATT | Sub-topic 16-1: support option 2, as discussed in our paper R4-2000603, we suggest to define the side condition of serving cell same as SSB-RSRP，i.e.-6dB.  Sub-topic 16-2: support option 2. |
| Ericsson | Sub topic 16-1: support option 1  Sub topic 16-2: support option 1 |
| Intel | Sub topic 16-1:  Support option 4.  Sub topic 16-2:  Support Option 1. Same as reference cell side condition for PRS-RSTD |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#16-1** | **Side condition for serving cell in Rx-Tx time difference measurement:**  *Candidate options:*   * Option 1. Needed and proposed to be -3 dB (Ericsson) * Option 2: Needed and proposed to be -6 dB * Option 3. Needed and same as side condition for serving cell in PRS-RSRP (CATT) * Option 4. Not needed (Huawei, Qualcomm, MediaTek, Intel)   *Recommendations for 2nd round:*  To be discussed further in 2nd round and align with conclusion of sub-topic#8-2. |
| **Sub-topic#16-2** | **Side condition for reference cell in Rx-Tx time difference measurement:**  *Candidate options*   * Option 1. Needed and same as reference cell side condition for PRS-RSTD (Huawei, MediaTek, Ericsson, Intel) * Option 2. Not needed (Qualcomm, CATT)   *Recommendations for 2nd round:*  To be discussed further in 2nd round and align with conclusion of sub-topic#8-3. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 16-1: support option 1  Sub topic 16-2: this should actually be treated all together with sub topic 16-1 and also with side conditions for neighbor cell. We need just two side conditions for UE Rx-Tx: serving cell -3 dB and neighbor cell -13 dB. |
| Huawei, HiSilicon | Sub-topic 16-1: support option 4.  Sub-topic 16-2: support option 1. |

## 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 #17: Rx-Tx report mapping table(s)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000604 | CATT | The UE Rx – Tx time difference measurement can be negative value.  The report mapping of UE Rx – Tx time difference measurement should be designed coverage range of -0.5ms ~ 0.5ms.  Similarly, the report mapping of gNB Rx – Tx time difference measurement should be designed coverage range of -0.5ms ~ 0.5ms.  The RTT can be calculated from (UE Rx – Tx time difference) + (gNB Rx – Tx time difference). If calculated RTT is negative value, it should be corrected by adding 1ms. |
| R4-2001000 | MediaTek | For the UE Rx-Tx time difference mapping table   * One mapping table for both FR1 and FR2 * Time resolution is 4Tc for | Rx-Tx\_time\_diff | < 4096Ts * Time resolution is 16Tc for 20472Ts >| time\_diff | 4096Ts   The UE Rx-Tx time difference reporting granularity is a UE capability. UE may report its capability to the network |
| R4-2001859 | Ericsson | In FR1 the serving gNB can configure one of the three possible values ofwhich impacts the UE Rx-Tx measurement report mapping.  The positioning node needs to be aware of the *N*TA offset used by the UE for deriving the reported UE Rx-Tx measurement value.  gNB needs to be aware of the granularity parameter (*k*) used by the UE for deriving the reported UE Rx-Tx measurement value when reporting the UE Rx-Tx measurement value to gNB.  In FR1 the UE shall signal the information about the *N*TA offset used for deriving the reported value when reporting UE Rx-Tx measurement value to the positioning node.  UE shall signal the granularity parameter (*k*) used for deriving the reported value when reporting UE Rx-Tx measurement value to gNB.  Smaller value of granularity parameter, *k*, leads to finer resolution compared to larger value of k. In FR1 the sampling rate is much lower than in FR2.  The basic principle is that the resolution shall not be larger than 128Tc and 1024Tc for lower and upper parts of the report mapping (i.e. at least as good as LTE UE Rx-Tx report mapping). The resolution proportionally increases with *k* as shown inTdoc  In FR1 the UE Rx-Tx reporting mapping is defined for the granularity parameter, *k* ≥ 3.  In FR2 the UE Rx-Tx reporting mapping is defined for all values of the granularity parameter, *k* ≥ 0.  In FR1, for UE Rx-Tx measured only on the serving cell, the largest number of reportable values (for *k* =3) shall be 8189.  In FR2, for UE Rx-Tx measured only on the serving cell, the largest number of reportable values (for *k* =0) shall be 131041.  UE configured with multi-RTT positioning is required to report the UE Rx-Tx measurement from multiple cells with measured value which can be larger than the maximum value in the UE Rx-Tx report mapping being defined for only serving cell measurement.  For multi-RTT positioning the UE Rx-Tx report mapping is obtained by extending the upper bound of the UE Rx-Tx report mapping defined for serving cell by 10308\*64 Tc resulting in the maximum range corresponding to RSTD in LTE.  In FR1, for UE Rx-Tx measured on serving and neighbor cells (multi-RTT), the largest number of reportable values for (*k* =3) shall be 21535.  In FR2, for UE Rx-Tx measured on serving and neighbor cells (multi-RTT), the largest number of reportable values for (*k* =0) shall be 172273. |
| R4-2001632 | Huawei, HiSi | For UE Rx-Tx time different report mapping, Reporting range is from -15391Ts to +15391Ts. Reporting granularity is re-used from RSTD. |
| R4-200073 | Qualcomm | Using a different granularity for smaller vs. larger UE Rx-Tx time difference values of the same DL PRS BW is a violation of RAN1 agreement. In multi-RTT, measurements with larger UE Rx-Tx time difference values correspond to farther cells and they are as important in the positioning fix. There is no reason to use a coarser granularity for them.  RAN4 to use uniform report mapping table(s) for UE Rx-Tx time difference measurements, i.e., smaller and larger UE Rx-Tx time difference values to have the same reporting granularity.  Reporting granularity for UE Rx-Tx time difference measurement to be as in Table 2 of Tdoc  Use Table 3 of Tdoc for UE Rx-Tx time difference measurement report mapping for FR1 with 100 MHz PRS BW when UE also measures PRS with 100 MHz BW where is either configured through *n-TimingAdvanceOffset* or default values in Table 7.1.2-3 of TS 38.133 is used.  Use Table 4 of Tdoc for UE Rx-Tx time difference measurement report mapping for FR2 with 400 MHz PRS BW when UE also measures PRS with 400 MHz BW where is either configured through *n-TimingAdvanceOffset* or default values in Table 7.1.2-3 of TS 38.133 is used.  PRS BW used for measurement report mapping is the minimum of configured DL PRS BW and the BW that UE can use for measurement subject to its capability. |

## Open issues summary

### Sub-topic 17-1 Uniform vs. Non-uniform granularity

The issue is whehter the entire range of Rx-Tx time difference report mapping table is covered with a uniform step size (granularity) or larger granularity is used for edges (as in LTE). Companies are encouraged to analyze the pros and cons of each option such as agreements in other WGs, complexity, savings in bitwidth (reporting payload), specification impact, etc.

* Option 1. Non-uniform granularity in report mapping table(s) similar to LTE (Huawei, MediaTek, Ericsson)
* Option 2. Uniform granularity in report mapping table(s) (Qualcomm)

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 17-2 Number of report mapping tables

The issue is how many report mapping tables should be specified in TS 38.133. Companies are encouraged to analyze the pros and cons of each option such as complexity, signalling aspects, savings in bitwidth (reporting payload), specification impact, etc.a

* Option 1. One table per FR (Qualcomm)
* Option 2. One table (MediaTek)
* Option 3. Three tables in FR1 and one table in FR2 (Ericsson)
* Option 4. One table per “k” (Huawei)
* Other options are not precluded.

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 17-3 Negative values in report mapping

In multi-RTT, UE measures Rx-Tx time difference from neighbor cells in addition to serving cell. Given the definition of Rx-Tx time difference measurement in TS 38.215, some companies believe the report mapping should cover both positive and negative values. Companies are encouraged to investigate this issue.

Should the Rx-Tx time difference report mapping table(s) be double-sided (both positive and negative values) or single-sided?

* Option 1. Double-sided (Huawei, CATT, MediaTek)
* Option 2. Single-sided (Qualcomm, Ericsson)

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 17-4 Range of report mapping table

The issue is the max range that should be reflected in report mapping table. Companies are encouraged to evaluate the range given the agreements in RAN1 for max RSTD as well as cell radius supported in each numerology.

* Option 1. Same as LTE (20472Ts) (MediaTek)
* Option 2. Same as RSTD in FR1 (15391Ts) (Huawei)
* Option 3. 1969920\*Tc in FR1 and 1983712\*Tc in FR2 (Ericsson)
* Option 4. 2097148\*Tc in FR1 and 65536\*Tc in FR2 (Qualcomm)
* Other options are not precluded.

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 17-5 Relative report mapping table

The issue is whether two report mapping table is needed: one for reporting a coarse value of Rx-Tx and one for refining the reported Rx-Tx based on smaller granularity. This approach was taken in later release of LTE. Companies are encouraged to analyze the pros and cons of each option such as complexity, signalling aspects, savings in bitwidth (reporting payload), specification impact, etc.

* Option 1. No (Qualcomm)
* Option 2. Yes

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 17-6 Minimum granularity in report mapping table

The issue is the minimum granularity in the report mapping table to be specified in TS 38.133. Companies are encouraged to analyze the pros and cons of each option such as complexity, signalling aspects, savings in bitwidth (reporting payload), specification impact, etc.

* Option 1. 4Tc (MediaTek)
* Option 2. 32Tc in FR1 and 4Tc in FR2 (Ericsson)
* Option 3. 4Tc in FR1 and Tc in FR2 (Qualcomm)
* Option 4. Same as RSTD (Huawei)
* Other options not precluded.

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 17-7 Parameter *k*

The issues related to parameter *k* are diverse and thus, companies are asked to reply to the questions below as raised in Tdocs.

* Q1: Does UE select parameter *k* or does it follow the configured value by NW?
* Q2: If UE selects parameter *k*, how is it done? Should this be specified, or should a minimum value of k be assumed based on e.g., configured PRS BW subject to UE capability?
* Q3: If UE selects parameter *k*, does it need to signal it to NW?

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 17-8 Parameter NTA,Offset

The issues relates to at least 4 possible values of NTA,Offset in NR compared to two values in LTE and whether this vlaue (or an index to the proper table) should be signalled to NW.

Does UE need to signal NTA,Offset used for Rx-Tx time difference measurement and report mapping to NW?

* Option 1. Yes (Ericsson)
* Option 2. No (Qualcomm, Huawei)

Recommended WF: Further discussion needed. Collect companies’ views.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 17-1: We are also fine with option 2.  Sub-topic 17-2: We prefer to define one mapping table for each *k* value.  Sub-topic 17-3: We think the negative values are needed in NR Rx-Tx time difference reporting, since the measurement is performed for neighbor cells which may be asynchronous to UE’s serving cell.  Sub-topic 17-4: The discussion depends on conclusion from Sub-topic 17-3. It should be noted that even for FR2 the asynchronous case may happen if PRS frequency layer is a different band than the UE’s serving frequency.  Sub-topic 17-5: option 1.  Sub-topic 17-6: Option 4. It should be noted that RAN1 already agreed that min value for k is 0 or -1, as indicated in R1-1913522.  Sub-topic 17-7: Our view is that UE should follow the configuration.  Sub-topic 17-8: Option 2. The NTA,Offset will be cancelled out when UE Rx-Tx and gNB Rx-Tx time difference are added for positioning fix. |
| Apple | Sub-topic 17-2: we propose to use per SCS per FR, same as we proposed for RSTD mapping table.  Sub-topic 17-3: Support option 1. Rx-Tx values could be similar as TA values in general, and both negative and positive shall be supported.  Sub-topic 17-6: same as our comment in RSTD discussion  Sub-topic 17-7: same as our comment in RSTD discussion |
| Qualcomm | Sub topic 17-1: same view as sub topic 2-1 with similar comments. We also note that in multi-RTT, UE needs to measure neighbor cells as well hence, there is no reason to require a different granularity for closer or farther cells.  Sub topic 17-2: same view as sub topic 2-2. What UE uses to report can be decoupled from a generic report mapping table that can cover all possibilities of k.  Sub topic 17-3: we understand the issue now and support option 1.  Sub topic 17-4: We agree that possible RSTD range (as agreed for FR1 and FR2 per sub topic 2-3) can be used to derive UE Rx-Tx time difference range. There is a scaling factor of 2 involved in round-trip-time though.  Sub topic 17-5: support option 1.  Sub topic 17-6: same conclusion as in topic 2-5 can be used here.  Sub topic 17-7: same conclusion as in topic 2-6 can be used here.  Sub topic 17-8: We support option 2. |
| MTK | * Sub topic 17-1: Roughly, 4096Ts = 40km. The measurement for gNB with distance greater than 40km is not expected to be very accurate. Instead, such gNBs are expected to help determining coarse positioning for a UE. Therefore, we support to use non-uniform granularity reporting table(s). The value 4096Ts and the granularity for RSTD > |4096Ts| can be further discussed * Sub topic 17-2: Consider the case that FR1 and FR2 are both measured by the UE, for simplicity, we support to use one report mapping table supporting granularity 4Tc. In this way UE doesn’t need to signal for which reporting table UE is currently in use. The corresponding complexity and specification impact is minimum. * Sub topic 17-3: We support option 2.   We correct our typo in our proposal as follows:  Proposal: For the UE Rx-Tx time difference mapping table   * One mapping table for both FR1 and FR2 * Time resolution is 4Tc for Rx-Tx\_time\_diff < 4096Ts * Time resolution is 16Tc for 20472Ts > time\_diff 4096Ts   In our view the Rx-Tx time difference can always be positive since UE may choose to report Rx-Tx time difference measured from the Rx timing corresponding to the PRS transmitted latter than the UE Tx timing.   * Sub topic 17-4: Support option 1. The maximum range should be kept the same as LTE considering the supported cell radius 100km. * Sub topic 17-5: We support option 1. * Sub topic 17-6: We support option 1. The best granularity can be achieved is 4Tc, which corresponding to SCS 120kHz and BW 400MHz. Granularity 1Tc is not achievable. * Sub topic 17-7: Our view is the same as that for sub topic 2-6 * Sub topic 17-8: Support option 2. NTA,Offset is known at gNB side. gNB may signal NTA,Offset to the location server. |
| CATT | Sub-topic 17-1: support option 1.  Sub-topic 17-2: agree to define one mapping table for each *k* value.  Sub-topic 17-3: support option 1 as analysed in our paper R4-2000604, the negative value of UE Rx-Tx time difference is needed.  Sub-topic 17-4: The discussion depends on conclusion from Sub-topic 17-3. Our view is [-0.5ms, 0.5ms] which is similar as option 2.  Sub-topic 17-5: support option 1.  Sub-topic 17-6: same as RSTD which is discussed in sub-topic 2-5.   * Sub-topic 17-7: Our view is that k is a configured value by NW which is same as RSTD. |
| Ericsson | Sub topic 17-1: support non-uniform granularity, though it does not need to be the same as in LTE.  Sub topic 17-2: we support option 3, since the there can be three different offsets (NTA,offset) in FR1.  Sub topic 17-3: We agree for some cases of multi-RTT (e.g. asynchronous) negative values of UE Rx-Tx time difference report mapping is required.  Sub topic 17-4: support option 3.  Sub topic 17-5: wait for RAN2.  Moderator: same comment and question as in sub topic 2-4  Sub topic 17-6: the question about the minimum granularity is a bit misleading. In general, it is configurable via configurable k which is bounded by kmin and kmax which further depend on whether it is for the center or of the edges of the table.  Moderator: same comment and question as in sub topic 2-5  Sub topic 17-7: the UE receives k, but then it may need to adjust it and choose the closest k value from the applicable range. The UE may not need signal the adjusted k to LMF, but gNB needs to be aware of the k to know the mapping used by the UE for UE Rx-Tx.  Sub topic 17-8: Positioning (LMF) is not aware of NTA,offset used in the serving cell (in FR1) of the UE on which the UE Rx-Tx is measured. UE has to signal NTA,offset to LMF to enable LMF to be aware of the mapping used by the UE for reporting the UE Rx-Tx value. |
| Intel | Sub topic 17-1: Uniform vs. Non-uniform granularity  Non-uniform is slightly preferred.  Sub topic 17-2: Number of report mapping tables  Sub topic 17-3:Support Option 1  Sub-topic 17-4 Range of report mapping table: same as that of RSTD.  Sub-topic 17-6 Minimum granularity in report mapping table: Tc/2 which is same as RSTD |
| MTK | Sub topic 17-3: We support option 2.  See the figure below.  In this figure, for serving cell, the UE transmit timing of uplink subframe that is closest in time to subframe #0 received is UL subframe#1.  However, the UE actually determines Rx-Tx time difference as TUE,RX,sering - TUE,TX ~= TA.  Namely, UE actually search for the closest uplink subframe timing with the condition that Rx-Tx must be positive (so the uplink timing is uplink subframe #0), otherwise the Rx-Tx time difference may be negative for serving cell.  Our view is that the same rule should apply for neighbour cell.  For example, in the following figure, although the uplink timing closest to TUE,RX,neighbour is uplink subframe#1, the UE reports Rx-Tx time difference as TUE,RX,neighbour - TUE,TX, where TUE,TX corresponds to uplink subframe#0. |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#17-1** | **Uniform vs. non-uniform granularity**  *Recommendations for 2nd round:*  Defer discussion to after conclusion on same issue in PRS-RSTD (sub-topic 2-1). |
| **Sub-topic#17-2** | **Number of report mapping tables**  *Recommendations for 2nd round:*  Defer discussion to after conclusion on same issue in PRS-RSTD (sub-topic 2-2). |
| **Sub-topic#17-3** | **Negative values in report mapping table**  *Candidate options:*   * Option 1. Double-sided (Huawei, Apple, CATT, Qualcomm, Ericsson, Intel) * Option 2. Single-sided (MediaTek)   *Recommendations for 2nd round:*  To be discussed further in the 2nd round by considering the asynchronous scenarios and the definition of Rx-Tx time difference in TS 38.215. |
| **Sub-topic#17-4** | **Range of repot mapping table**  *Candidate options:*   * Option 1. Same as LTE (20472Ts) (MediaTek) * Option 2. Same as RSTD in FR1 (15391Ts) (Huawei, CATT) * Option 3. 1969920\*Tc in FR1 and 1983712\*Tc in FR2 (Ericsson) * Option 4. 2097148\*Tc in FR1 and 65536\*Tc in FR2 (Qualcomm) * Other options are not precluded.   *Recommendations for 2nd round:*  Defer discussion to after the conclusion of sub-topic#17-3. |
| **Sub-topic#17-5** | **Relative report mapping table (i.e., fine granularity table)**  *Candidate options:*   * Option 1. No (Qualcomm, Huawei, CATT, MediaTek) * Option 2. Yes (Apple)   *Recommendations for 2nd round:*  Defer discussion to after the conclusion of similar topic in PRS-RSTD (sub-topic#2-4) |
| **Sub-topic#17-6** | **Minimum granularity (step size) in report mapping table**  *Recommendations for 2nd round:*  Defer discussion to after the conclusion of similar topic in PRS-RSTD (sub-topic#2-5) |
| **Sub-topic#17-7** | **Parameter k**  *Recommendations for 2nd round:*  Defer discussion to after the conclusion of similar topic in PRS-RSTD (sub-topic#2-6) |
| **Sub-topic#17-8** | **Parameter NTA,Offset**  Does UE need to signal NTA,Offset used for Rx-Tx time difference measurement and report mapping to NW?  *Candidate options:*   * Option 1. Yes (Ericsson) * Option 2. No (Qualcomm, Huawei, MediaTek)   *Recommendations for 2nd round:*  To be discussed further in the 2nd round. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

Moderator: In addition to the above issues, Do the companies agree that NTA,Offset needs to be accounted for the UE Rx-Tx measurement report mapping?

Ericsson: why is the moderator driving UE RxTx as if it is linked to RSTD (applies to the moderator’s recommendation for the 2nd round on many sub topics below) – do we have such an agreement already??

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Yes, we agree that NTA,Offset needs to be accounted in the UE Rx-Tx measurement report mapping.  Sub topic 17-1: why the recommendation for the 2nd round is linked with RSTD?? This gives an impression as if there is an agreement that RSTD and UE Rx-Tx mappings are related, which is not an agreement at all and this has not been the case in LTE either. We support non-uniform mapping for UE Rx-Tx, does not need to be exactly the same as in LTE.  Sub topic 17-2: we support option 3, since the there can be three different offsets (NTA,offset) in FR1. why the recommendation for the 2nd round is linked with RSTD?? This gives an impression as if there is an agreement that RSTD and UE Rx-Tx mappings are related, which is not an agreement at all and this has not been the case in LTE either.  Sub topic 17-3: We agree for some cases of multi-RTT (e.g. asynchronous) negative values of UE Rx-Tx time difference report mapping is required.  Sub topic 17-4: agree, need to first conclude on issue 17-3, on the offset, etc.  Sub topic 17-5: this topic has nothing to do with RSTD  Sub topic 17-6: the question about the minimum granularity is a bit misleading. In general, it is configurable via configurable k which is bounded by kmin and kmax which further depend on whether it is for the center or of the edges of the table and also depends on FR1 and FR2.  Sub topic 17-7: the UE receives k and generally should use it, unless it cannot, in which case the UE may need to adjust it, e.g., choose the closest k value from the applicable range the UE can use for the report.  The UE may not need signal the adjusted k to LMF.  At least for RRC-based UE Rx-Tx, gNB needs to be aware of the k to know the mapping used by the UE for UE Rx-Tx.  Sub topic 17-8: In FR1, the UE can be configured with one out of three possible NTA,offset values. Positioning (LMF) is not aware of NTA,offset used in the serving cell (in FR1) of the UE on which the UE Rx-Tx is measured. UE has to signal NTA,offset to LMF to enable LMF to be aware of the mapping used by the UE for reporting the UE Rx-Tx value. |
| Huawei, HiSilicon | Suggest to postpone the decision on RSTD mapping table to next meeting. All the sub-topics from 17-1 to 17-7 can be listed in the WF to facilitate further discussions.  Sub-topic 17-8: option 2.  Need more time to check if NTA,Offset needs to be accounted in report mapping. Suggest to postpone the decision to next meeting as this is anyway related to the range issue. |

## 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 #18: Differential Rx-Tx time difference measurement reporting

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000733 | Qualcomm | The M UE Rx-Tx time difference report belong to the same TRP and are logically close in value as they are a measure of round-trip delay to that TRP.  RAN4 to define differential UE Rx-Tx time difference report mapping table. UE to report the minimum UE Rx-Tx time difference value from the set of M UE Rx-Tx time difference values of the same TRP with absolute report mapping as in Tables 3-4 and use positive differential UE Rx-Tx time difference value for the remaining M-1 UE Rx-Tx time difference values.   * FFS: the maximum range of differential UE Rx-Tx time difference report mapping |

## Open issues summary

### Sub-topic 18-1 Differential report mapping table(s)

Reporting payload reduction is important in signaling overhead for NR positioning. Differential Rx-Tx reporting can reduce this overhead. Companies are encouraged to share their views on this topic.

* Q1: RAN4 to define differential Rx-Tx report mapping table?
  + Option 1: Yes (Qualcomm, Huawei)
  + Option 2: No

Recommended WF: Further discussion needed. Collect companies’ views.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 18-1: We support option 1. |
| MTK | Sub topic 18-1: Support option 1. |
| Ericsson | Wait for RAN2 |
| Intel | Sub topic 1-1:  No. How to define the offset between the results for multiple TRPs? Same concerns as that for RSTD differential report |
| Qualcomm | To Intel: please refer to the reply on sub topic 4-1. Same methodology applies. |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#18-1** | **RAN4 to define differential Rx-Tx time difference report mapping table**  *Candidate options:*   * Option 1. Yes (Qualcomm, Huawei, MediaTek) * Option 2. Wait for RAN2 (Ericsson) * Option 3. No (Intel)   *Recommendations for 2nd round:*  To be discussed further in 2nd round with further consultation with RAN2 WG. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

Moderator: Last week, RAN2 WG made the following agreement and will send an LS to RAN4 WG accordingly.

**Agreements:**

Confirm (same as current running CR) when a UE is configured to report  multiple DL PRS RSTD, PRS RSRP, RxTX measurements with each measurement between a different pair of DL PRS resources or DL PRS resource sets, and those multiple measurements being performed on the same pair of TRPs, the UE reports one full measurement results and additional delta measurement(s).

As such, recommended WF on sub-topic#18-1 is to agree on option 1.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 18-1: Postpone the discussion to the next meeting. Need to further check the RAN2 discussion and the meaning of “delta” measurements. We need to wait for the LS, anyway. |
| Huawei, HiSilicon | Sub topic 18-1: support option 1. |

## 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 #19: Non-DRX requirements for Rx-Tx time difference

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001000 | MediaTek | For multi-RTT, Non-DRX requirements apply for UE Rx-Tx time difference measurement period, regardless of whether and which DRX configuration is configured for the UE |
| R4-2001639 | Huawei, HiSi | Non-DRX requirements apply for Rx-Tx time different measurement period, regardless of whether and which DRX configuration is configured for the UE. |
| R4-2000733 | Qualcomm | The same high-level requirements in terms of final positioning error and time-to-fix also applies to multi-RTT. Given the sensitivity of timing measurements to latency, UE and gNB clock drift, and UE mobility, non-DRX mode in UE Rx-Tx time difference measurement is as important.  Non-DRX requirements apply for UE Rx-Tx time difference measurement period, regardless of whether and which DRX configuration is configured for the UE. |

## Open issues summary

In RAN4#93, it was agreed that non-DRX requirements apply for PRS-RSTD measurement period, regardless of whether and which DRX configuration is configured for the UE. The issue here is whether the same should be applicable to Rx-Tx time difference measurement period.

### Sub-topic 19-1

Rx-Tx time difference measurement requirements will be defined for:

* Option 1: only non-DRX regardless of whether and which DRX configuration is configured for the UE (Huawei, MediaTek, Qualcomm)
* Option 2: both non-DRX and DRX cases

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 19-1: option 1, we see no difference between DL-AoD/multi-RTT and DL-TDOA. For DL-TDOA, RAN4 has agreed that non-DRX requirements always apply for PRS-RSTD measurement period. |
| Qualcomm | Sub topic 19-1: we share the same view as Huawei. |
| MTK | Sub topic 19-1: Support option 1 as the priority of positioning is expected to be higher than DRX. |
| CATT | Sub-topic 19-1: support option 1, |
| Ericsson | We are ok with option 1 if there is no concern with impact on UE power consumption. In LTE the UE Rx-Tx time difference measurement period scales with DRX when configured with DRX. |
| Intel | Sub topic 19-1:  The requirements under DRX can be deprioritized. |

## 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#19-1** | **Non-DRX only requirements for Rx-Tx time difference**  *Tentative agreements:*  Rx-Tx time difference measurement requirements will be defined for only non-DRX regardless of whether and which DRX configuration is configured for the UE.  *Recommendations for 2nd round:*  No further discussion is needed. |

# Topic #20: Inter-frequency vs. Intra-frequency Rx-Tx time difference

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001000 | MediaTek | RAN4 to define intra-frequency UE Rx-Tx time difference measurement as when the positioning frequency layer of a DL PRS resource set is within UE’s active BWP.  Otherwise, the UE Rx-Tx time difference measurement is defined to be an inter-frequency measurement |

## Open issues summary

Companies views on this issue are not any different from definition of intra-frequency and inter-frequency for PRS-RSTD. Instead of replicating the thread, the question is posed whether companies agree to apply the same conclusions and/or agreements from Topic#3 to this topic.

### Sub-topic 20-1

Can the same definitions for intra-frequency and inter-frequency PRS-RSTD measurements (if defined) be applicable to Rx-Tx time difference measurements?

* Option 1. Yes (MediaTek, Huawei, Qualcomm)
* Option 2. No (please elaborate)

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 20-1: we also support option 1. |
| Qualcomm | Sub topic 20-1: we also support option 1. |
| CATT | Sub-topic 20-1: support option 1 |
| Ericsson | Sub topic 20-1: Further discussion is needed, but the same conditions can perhaps be reused to differentiate between intra- and inter-frequency |
| Intel | Sub topic 20-1:  Yes. But how to define can be FFS |

## 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#20-1** | *Recommendations for 2nd round:*  Defer further discussion to after conclusion of similar topic in PRS-RSTD (Topic#3) |

# Topic #21: Rx-Tx time difference measurement period

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000603 | CATT | The measurement period of UE Rx-Tx time difference is defined same as measurement period of PRS-RSRP measurement when UE Rx-Tx time difference measurement is configured to be measured along with PRS-RSRP using the same assistance data, otherwise, same as measurement period of SSB-RSRP or CSI-RSRP measurement in non-DRX and DRX mode. |
| R4-2001000 | MediaTek | For multi-RTT, the measurement period and the corresponding requirements are the same as that for RSTD measurement, provided that the side conditions are the same, and provided that SRS resource is configured in the measurement period  For multi-RTT, when PRS-RSRP is configured to be measured along with UE Rx-Tx time difference measurement using the same assistance data:   * the measurement period of UE Rx-Tx time difference measurement remains the same as that in proposal above. |
| R4-2000733 | Qualcomm | Max number of DL PRS resources per frequency layer constrained by UE capability is  The total number of required PRS periods, in units of TPRS to process PRS resources is where and {N1, T1} is the signalled capability duplet for PRS processing.  The total number of PRS periods, in units of TPRS, required to process PRS resources is where and {N2, T2} is the signalled capability duplet for PRS buffering.  PRS measurement period for PRS resources in one frequency layer can be expressed as  Where   * is the UE processing time as expressed in Observation 3 (FFS) * is the UE buffering time as expressed in Observation 4 (FFS) * When UE signals a list of {N1,T1} and {N2,T2}, as opposed to one {N1,T1} and one {N2,T2}, a separate is derived for each pair and max of all is used. |
| R4-2001639 | Huawei, HiSi | Re-use the measurement period requirements of RSTD for Rx-Tx time different measurement. |
| R4-2001940 | Ericsson | UE Rx-Tx measurement period depends on PRS periodicity and SRS periodicity and is based on  UE Rx-Tx measurement period is extended, but not more than a certain maximum, to compensate for the number of PRS occasions not available at the UE over a certain time period due to their overlap with SSB symbols, at least when the number of the non-available PRS occasions is large (e.g., >X% of the needed samples) and the SSB symbols location is known to the UE.   * Similarly, the impact of dropped SRS on the measurement period needs to be accounted for.   When the measurement period is extended, the increase in the measurement period depends at least on the periodicity of the PRS/SRS resource which has non-available occasions and the number of such non-available PRS/SRS occasions, but may further depend on the measurement gap configuration, DRX, etc.   * The extension is proportional to max(T\_PRS,T\_SRS)\*N, where T\_PRS and T\_SRS are the PRS periodicity and SRS periodicity, respectively, and N is the number of time intervals of length max(T\_PRS,T\_SRS) where at least one of PRS and SRS is dropped.   If the number of PRS/SRS occasions not available at the UE exceeds an acceptable limit, the measurement can be dropped, i.e., no further extension of the measurement period is allowed.  When the on-going UE Rx-Tx measurement continues under a serving cell change, the UE Rx-Tx time difference measurement period is extended, and the extension depends on the number of serving cell changes and on the corresponding interruption time. |

## Open issues summary

Companies views on this issue are not any different from discussion on PRS-RSTD measurement period. Instead of replicating the thread, the question is posed whether companies agree to apply the same conclusions and/or agreements from Topic#5 to this topic.

### Sub-topic 21-1 Principals of Rx-Tx measurement period

Can the same principals in the definition of PRS-RSTD measurement period be applicable to PRS-RSRP measurement period?

* Option 1. Yes (Ericsson, Huawei, MediaTek, Qualcomm)
* Option 2. No (please elaborate)

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 21-2 Additional factors specific to Rx-Tx measurement

In addition to the factors outlined in SubTopic 5-2, what are the factors specifically impacting Rx-Tx time difference measurement

* SRS resource periodicity (Ericsson)
* Others (please elaborate)

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 21-3 Rx-Tx measurement period under serving cell change

PRS-RSTD measurement period is extended due to HO change as discussed in SubTopic 5-3. However, in RAN4#93 meeting, it was agreed that Rx-Tx time difference measurement is restarted when serving cell changes if the changed serving cell is configured with SRS

Does Rx-Tx time difference measurement period need to be extended in case of serving cell change if serving cell change is not configured with SRS? Details FFS.

* Option 1. Yes (Ericsson)
* Option 2. No (please elaborate)

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 21-1: option 1.  Sub-topic 21-2: Not sure if SRS periodicity needs to be considered in the measurement period, or is it enough to have at least one SRS Tx within the measurement period based on PRS?  Sub-topic 21-3: We do not agree with option 1. After HO UE would apply new TA for SRS transmission, so we think UE should re-start the measurement. |
| Qualcomm | Sub topic 21-1: option 1  Sub topic 21-2: We believe this needs further consideration. Based on sub topic 24-1, SRS periodicity may be relevant but may not be the bottleneck.  Sub topic 21-3: Maybe Ericsson can clarify how their proposal is different from the agreement that we had in RAN4#93 where UE restarts the measurement in case of serving cell change without configured SRS. |
| MTK | * Sub topic 21-1: Option 1 * Sub topic 21-2: The measurement period is related to SRS configuration, but not necessary related to SRS periodicity. In our view, the RSTD measurement period can be used for multi Rx-Tx measurement period, provided that there are available SRS resources within the measurement period. * Sub topic 21-3: We support option 2. Since it is agreed that the Rx-Tx time difference measurement is restarted after handover, it should be understood that the measurement period is also reset. For the new Rx-Tx time difference measurement, the expected measurement period doesn’t need to be extended. |
| CATT | * Sub-topic 21-1: support option 1. |
| Ericsson | Sub topic 21-1: The question is formulated in a confusing way, it’s unclear which principles are the same and why they should actually be the same for the bidirectional measurement as for RSTD measurement?  Moderator: same comment as in sub topic 13-1.  Sub topic 21-2: UE Rx-tx is based on PRS measurements and SRS transmissions, and therefore can be impacted by the periodicity of or both DL and UL signals.  Sub topic 21-3: In one example, the SRS can be configured in a serving cell other than PCell. So, indeed the requirements are needed. |
| Intel | Sub topic 21-1:  Can follow the same principle for RSTD. |

## 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#21-1** | *Recommendations for 2nd round:*  Defer further discussion to after conclusion of similar topic in PRS-RSTD (Topic#5) |
| **Sub-topic#21-2** | *Recommendations for 2nd round:*  Defer further discussion to after conclusion of similar topic in PRS-RSTD (Topic#5) |
| **Sub-topic#21-3** | *Recommendations for 2nd round:*  Defer further discussion to after conclusion of similar topic in PRS-RSTD (Topic#5) and Topic#20 |

# Topic #22: Rx-Tx time difference measurement accuracy

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001940 | Ericsson | Applicable accuracy requirements for UE Rx-Tx measurements under cell change:   * For intra-frequency serving cell change, intra-frequency accuracy applies; * For inter-frequency serving cell change,   + When the measured inter-frequency becomes a serving carrier frequency: inter-frequency accuracy applies,   + When the measured inter-frequency remains inter-frequency: inter-frequency accuracy applies,   + When the measured intra-frequency becomes inter-frequency: inter-frequency accuracy applies. |
| R4-2000733 | Qualcomm | UE Rx-Tx time difference measurement accuracy requirements to be defined using samples from only one DL PRS resource repetition, i.e., the time duration spanned by one DL PRS resource after repetition by *DL-PRS-ResourceRepetitionFactor* and one SRS resource repetition. Combining measurements across PRS/SRS repetitions, if possible and available, to improve performance should be left to UE implementation.  With respect to TA commands during a positioning session, accuracy requirements are valid under the condition that no changes to UL transmission timing are applied during the measurement period.   * A measurement period includes an instance of PRS and its associated SRS as in Proposal 3. Exact definition is FFS.   Two factors impact the accuracy requirements of gNB/UE Rx-Tx time difference measurement:   * Time-of-arrival (TOA) estimation error from DL PRS (for UE) or UL SRS (for gNB) resources * Rx-Tx calibration error   RAN4 to use the same simulation assumptions as in RSTD link-level simulation assumptions to provide CDFs of TOA estimation error where TOA error = estimated TOA – ideal TOA.  The performance and accuracy of multi-RTT depends on Rx-Tx calibration error on both UE and gNB. Hence, the error budget should be viewed holistically from both sides. Allocating a small error budget on one side (UE or gNB) while permitting a disproportionately larger error budget on the other side is nonsensical. |

## Open issues summary

### Sub-topic 22-1 Number of samples for accuracy requirements (N)

The accuracy requirement is defined based on “N” DL PRS resource repetition for reference and neighbor. Companies are encouraged to provide their views on the value of N.

* Option 1. N = 1 (Qualcomm)
* Option 2. ?

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 22-2 Applicability of accuracy requirement with TA update

In LTE, accuracy requirements where applicable only if no update to UL timing due to TA change was applied during the measurement period.

Are accuracy requirements applicable to Rx-Tx time difference measurements if UL timing change is applied due to TA update during a measurement period? Details of measurement period is FFS.

* Option 1. No (Qualcomm)
* Option 2. Yes

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 22-3 Simulation assumptions

Companies’ views on how to define the Rx-Tx time difference measurement accuracy requirements are encouraged. As a first step, TOA estimation accuracy can be evaluated.

* Option 1. Use the PRS-RSTD simulation assumptions and add CDF of TOA for three cells as additional metrics to be evaluated (Qualcomm)
* Other options not precluded.

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 22-4 Applicable accuracy requirements under cell change

* Option 1. Applicable accuracy requirements for UE Rx-Tx measurements under cell change (Ericsson):
  + For intra-frequency serving cell change, intra-frequency accuracy applies;
  + For inter-frequency serving cell change,
    - When the measured inter-frequency becomes a serving carrier frequency: inter-frequency accuracy applies,
    - When the measured inter-frequency remains inter-frequency: inter-frequency accuracy applies,
    - When the measured intra-frequency becomes inter-frequency: inter-frequency accuracy appliesOther options not precluded.
* Other options are not precluded.

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 22-1: we support option 1.  Sub-topic 22-2: we support option 1.  Sub-topic 22-3: we support option 1.  Sub-topic 22-4: we do not agree option 1, for the same reason as commented for Sub-topic 21-3. |
| Qualcomm | Sub topic 22-4: we share the same view as Huawei and cannot agree to option 1. |
| MTK | * Sub topic 22-1: Support option 1. * Sub topic 22-2: Support option 1 * Sub topic 22-3: Agree with option 1, but two cells (1 reference cell + 1 neighbor cell) are sufficient. There is no need to simulate 3 cells. * Sub topic 22-4: Postpone the discussion until the intra-frequency measurement is defined. |
| CATT | Sub-topic 22-1: we support option 1.  Sub-topic 22-2: we support option 1.   * Sub-topic 22-3: we support option 1. |
| Ericsson | Sub topic 22-1: 1 sample is not agreeable  Sub topic 22-2: further discussion is needed  Sub topic 22-3: do not agree with option 1, TOA is not in the RAN1 agreed list of measurements.  Sub topic 22-4: support option 1 |
| Intel | Sub topic 22-1: Number of samples for accuracy requirements  Opiton 1 (N=1 )  Sub topic 22-2 Applicability of accuracy requirement with TA update:  Support option 1. No because when TA being updated, the RTT shall be recalculated.  Sub topic 22-3 Simulation assumptions  Can be same as the PRS RSTD simulation assumption if SINR side condition is same. |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#22-1** | **Number of samples (N) for accuracy requirements**  *Candidate options:*   * Option 1. N = 1 (Qualcomm, MediaTek, Intel, CATT, Huawei) * Option 2. Needs further study. Other values are not precluded (Ericsson)   *Recommendations for 2nd round:*  To be discussed further in RAN4#94-Bis meeting after review of link-level simulation results from more companies. |
| **Sub-topic#22-2** | **Applicability of accuracy requirements with TA update**  *Candidate options:*   * Option 1. No (Qualcomm, Huawei, CATT, MediaTek, Intel) * Option 2. Further discussion needed (Ericsson)   *Recommendations for 2nd round:*  To be discussed further in 2nd round. |
| **Sub-topic#22-3** | **Simulation assumptions**  *Candidate options:*   * Option 1. Use the PRS-RSTD simulation assumptions and add CDF of TOA for three cells as additional metrics to be evaluated (Qualcomm, MediaTek, Huawei, CATT) * Option 2. No. TOA is not defined in RAN1. (Ericsson)   *Recommendations for 2nd round:*  To be discussed further in 2nd round. |
| **Sub-topic#22-4** | **Applicable accuracy requirements under cell change**  *Candidate options:*   * Option 1. Applicable accuracy requirements for UE Rx-Tx measurements under cell change (Ericsson):   + For intra-frequency serving cell change, intra-frequency accuracy applies;   + For inter-frequency serving cell change,     - When the measured inter-frequency becomes a serving carrier frequency: inter-frequency accuracy applies,     - When the measured inter-frequency remains inter-frequency: inter-frequency accuracy applies,     - When the measured intra-frequency becomes inter-frequency: inter-frequency accuracy appliesOther options not precluded. * Other options are not precluded.   *Recommendations for 2nd round:*  Defer discussion to after conclusion of Topic#20. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

Moderator: It was mentioned in the 1st round that TOA is undefined in RAN1. To clarify, TOA refers to TUE-Rx as defined in TS 38.215 below:

|  |  |
| --- | --- |
| **Definition** | The UE Rx – Tx time difference is defined as TUE-RX –TUE-TX  Where:  TUE-RX is the UE received timing of downlink subframe #*i* from a positioning node, defined by the first detected path in time.  TUE-TX is the UE transmit timing of uplink subframe #*j* that is closest in time to the subframe #i received from the positioning node.  Multiple DL PRS resources can be used to determine the start of one subframe of the first arrival path of the positioning node.  For frequency range 1, the reference point for TUE-RX measurement shall be the Rx antenna connector of the UE and the reference point for TUE-TX measurement shall be the Tx antenna connector of the UE. For frequency range 2, the reference point for TUE‑RX measurement shall be the Rx antenna of the UE and the reference point for TUE‑TX measurement shall be the Tx antenna of the UE. |
| **Applicable for** | RRC\_CONNECTED intra-frequency  RRC\_CONNECTED inter-frequency |

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 22-1: 1 sample is not agreeable  Sub topic 22-2: further discussion is needed. In the issue description it is stated “*Are accuracy requirements applicable to Rx-Tx time difference measurements if UL timing change is applied due to TA update during a measurement period?* ***Details of measurement period is FFS.***”. We agree that the requirements defined for the case without TA adjustment (NW-based or UE autonomous) are not directly applicable for the case with TA adjustment. However, what does the FFS refer too – will we define measurement period for the latter case but not the accuracy or will we define a different accuracy? We are Ok to define some requirements for the case with TA adjustment but we need to further discuss the details. So, we propose to add “FFS requirements for UE Rx-Tx with TA adjustment”.  Sub topic 22-3: do not agree with option 1, TOA is not in the RAN1 agreed list of positioning measurements. The NR UE Rx-Tx measurement definition is not really different from that in LTE in that aspect, and in LTE we did not have anything for ToA measurements in RAN4 specifications.  Sub topic 22-4: support option 1 |
| Huawei, HiSilicon | Sub topic 22-1: support option 1  Sub topic 22-2: support option 1  Sub topic 22-3: support option 1  Sub topic 22-4: need to first have definition of intra and inter-frequency. |

## 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 #23: Rx-Tx time difference reporting capability and criteria

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001639 | Huawei, HiSi | Ecat = 1 for Rx-Tx time difference measurement per positioning session. |
| R4-2000733 | Qualcomm | In multi-RTT positioning, each UE Rx-Tx time difference measurement reporting criterion corresponds to one frequency layer with Ecat = 1 indicating UE Rx-Tx time difference measurement reports.   * FFS: |

## Open issues summary

### Sub-topic 23-1 Measurement capability

Per RAN1 agreement, a list of UE capabilities in terms of number of positioning frequency layers, number of TRPs per frequency layer, number of resource sets per TRP, .... are defined and will be signalled as UE capability. The issue is whether RAN4 should specify anything further.

RAN4 to define measurement capability in terms of number of positioning frequency layers, number of TRPs per frequency layer, number of resurce sets per TRP, .... ?

* Option 1: Yes
* Option 2. No (Huawei)

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 23-2 Reporting criteria (Ecat)

RAN4 should define measurement reporting criteria (Ecat) for Rx-Tx time difference measurement. The issues are the value of Ecat, the level of separation.

Ecat for Rx-Tx time difference reporting to be:

* Option 1. 1 per positioning session (Huawei)
* Option 2. In multi-RTT positioning, each UE Rx-Tx time difference measurement reporting criterion corresponds to one frequency layer with Ecat = 1 indicating UE Rx-Tx time difference measurement reports.(Qualcomm)
  + FFS:
* Other options are not precluded

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 23-1: suggest to follow same conclusion from RSTD discussion in Topic 7.  Sub-topic 23-1: suggest to follow same conclusion from RSTD discussion in Topic 7. |
| Qualcomm | Sub topic 23-1: We support option 2.  Sub topic 23-2: We can support option 1 as well. |
| MTK | Sub topic 23-1: Support option 2.  Sub topic 23-2: Support option 1. |
| CATT | Sub-topic 23-1: agree to follow same conclusion as RSTD |
| Ericsson | Sub topic 23-1: some capabilities need to be defined, but further discussion is needed, and we also need to align with the agreed RAN1 numbers.  Sub topic 23-2: we do not support option 1 and do not support option 2. The Ecat has to be per frequency layer. But then, it may also be shared by UE Rx-Tx and PRS RSRP if configured together, otherwise defined separately for UE Rx-Tx and PRS RSRP. |
| Intel | Sub topic 23-1:  Option 1. Same comments for RSTD measurement |

## 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#23-1** | **RAN4 to define measurement capability in terms of number of positioning frequency layers, number of TRPs per frequency layer, number of resurce sets per TRP, .... ?**  *Recommendations for 2nd round:*  To be discussed further in 2nd round and consult with RAN1 WG. Align with conclusion of same issue on sub-topic#7-1. |
| **Sub-topic#23-2** | **Ecat for Rx-Tx time difference reporting:**  *Candidate options:*   * Option 1. 1 per positioning session (Huawei, Intel, MediaTek) * Option 2. In multi-RTT positioning, each UE Rx-Tx time difference measurement reporting criterion corresponds to one frequency layer with Ecat = 1 indicating UE Rx-Tx time difference measurement reports.(Qualcomm)   + FFS: * Other options are not precluded (Ericsson)   *Recommendations for 2nd round:*  To be discussed further in 2nd round and consult with RAN1 WG. Align with conclusion of same issue on sub-topic#7-2. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 23-1: some capabilities need to be defined, but further discussion is needed, and we also need to align with the agreed RAN1 numbers.  Sub topic 23-2: we do not support option 1 and do not support option 2. The Ecat has to be per frequency layer. But then, it may also be shared by UE Rx-Tx and PRS RSRP if configured together, otherwise defined separately for UE Rx-Tx and PRS RSRP. |
| Huawei, HiSilicon | Please refer to our comment to Topic 7, suggest to have aligned conclusion as RSTD. |

## 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 #24: Proximity of SRS and PRS in Rx-Tx time difference measurement

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000733 | Qualcomm | UE motion, UE clock drift and gNB clock drift can all result in significant errors for measurements that are conducted apart in time but are all used to generate the same position fix.  The core measurement and performance requirements for UE Rx-Tx time difference applies if the configured *SRS-Slot-offset* and *SRS-Periodicity* parameters for SRS resource for positioning are such that any SRS transmission is within [-X, X] msec of at least one DL PRS resource from each of the TRPs in the assistance data.   * FFS: X = 25 msec * Note: Such a RS configuration may enable sufficiently close measurements in time in both the UE and TRPs |

## Open issues summary

UE motion, UE clock drift and gNB clock drift can all result in significant errors for measurements that are conducted apart in time but are all used to generate the same position fix.

### Sub-topic 24-1

* Option 1. The core measurement and performance requirements for UE Rx-Tx time difference applies if the configured *SRS-Slot-offset* and *SRS-Periodicity* parameters for SRS resource for positioning are such that any SRS transmission is within [-X, X] msec of at least one DL PRS resource from each of the TRPs in the assistance data (Qualcomm)
  + FFS: X = 25 msec
  + Note: Such a RS configuration may enable sufficiently close measurements in time in both the UE and TRPs
* Other options are not precluded.

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 24-1: We support option 1 in principle, and the details can be FFS. |
| MTK | Sub topic 24-1: Support option 1, the value of X is FFS. |
| Ericsson | Sub topic 24-1: We don’t see the need for such restriction. The UL SRS timing is based on serving cell timing and UE has to meet the existing UE transmit timing requirements. |

## 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#24-1** | **Proximity of SRS and PRS**  *Candidate options:*   * Option 1. The core measurement and performance requirements for UE Rx-Tx time difference applies if the configured *SRS-Slot-offset* and *SRS-Periodicity* parameters for SRS resource for positioning are such that any SRS transmission is within [-X, X] msec of at least one DL PRS resource from each of the TRPs in the assistance data. Details FFS. (Qualcomm, Huawei, MediaTek) * Other options are not precluded.   *Recommendations for 2nd round:*  To be discussed in 2nd round*.* |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 24-1: We don’t see the need for such restriction. The UL SRS timing is based on serving cell timing and UE has to meet the existing UE transmit timing requirements already. Furthermore, RAN4 should not limit how the assistance data is configured, we can only discuss whether and which requirements apply. How does this relate to clock drifts? Does the UE clock drift that much during the measurement period so that the measurement becomes not useful? |
| Huawei, HiSilicon | Sb-topic 24-1: support option 1 |

## 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 #25: E-CID positioning method

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000734 | Qualcomm | R15 core measurement requirements, measurement report mapping, and measurement accuracy requirements for SS-RSRP, SS-RSRQ, CSI-RS-RSRP and CSI-RS-RSRQ are applicable to E-CID positioning technique without any modification.  All existing measurement gap configurations in R15 applicable to RRM measurements to be applicable for E-CID measurements. |
| R4-2001950 (LS) | Ericsson | RAN4 would like to inform about RAN4 conclusion that SINR measurements (SS-SINR and CSI-SINR) would need to be included in the set of NR E-CID measurements and would not require any additional complexity in the UE, since the reportable NR E-CID measurements are the measurements that are already available in the UE. |

## Open issues summary

### Sub-topic 25-1 SS-RSRP/SS-RSRQ/CSI-RS-RSRP/CSI-RS-RSRQ requirements

* Option 1. (Qualcomm, Ericsson)
  + R15 core measurement requirements, measurement report mapping, and measurement accuracy requirements for SS-RSRP, SS-RSRQ, CSI-RS-RSRP and CSI-RS-RSRQ are applicable to E-CID positioning technique without any modification.
  + All existing measurement gap configurations in R15 applicable to RRM measurements to be applicable for E-CID measurements.
* Other options are not precluded.

Possible agreement: agree on option 1 above.

### Sub-topic 25-2 Addition of SS-SINR/CSI-RS-SINR for E-CID measurements

Should SS-SINR and CSI-RS SINR be included for E-CID measurements?

* Option 1. Yes (Ericsson)
* Option 2. No

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 25-1: We support the possible agreement.  Sub-topic 25-2: We support option 1. We understand the applicability of measurement requirements for ECID should follow the same UE capability for RRM measurement, e.g. UE not supporting SS-SINR for RRM cannot support SS-SINR for ECID either. |
| Qualcomm | Sub topic 25-2: we cannot agree to option 1. In our view, if RAN1 decides that SS-SINR or CSI-RS SINR is needed for E-CID, they can send an LS to RAN4 and ask for it. Just because UE has the information available (if so), it doesn’t mean it should be reported. This initiative should come from RAN 1 and RAN 2 first. |
| MTK | Sub topic 25-1: Support option 1.  Sub topic 25-2: Support option 2. The benefit of reporting SS-SINR and CSI-RS SINR is not clear. |
| CATT | Sub-topic 25-1: support the possible agreement. |
| Ericsson | Sub topic 25-1: support the proposed possible agreement  Sub topic 25-2: support option 1. if RAN4 identifies something missing, it’s generally no problem to send the LS, especially given RAN1 is not discussing this and there is no strong reason or complexity preventing the inclusion of SINR measurements, since for E-CID the UE reports anyway just the measurements that are *available*. And yes, this is also under the condition that the measurements are supported by the UE in general. |
| Intel | Sub topic 25-1:  Option 1. So the proposed WF can be agreed |

### 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** |
| R4-2001948 | Company A |
| Company B |
|  |
| R4-2001949 | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#25-1** | *Tentative agreements:*   * R15 core measurement requirements, measurement report mapping, and measurement accuracy requirements for SS-RSRP, SS-RSRQ, CSI-RS-RSRP and CSI-RS-RSRQ are applicable to E-CID positioning technique without any modification. * All existing measurement gap configurations in R15 applicable to RRM measurements to be applicable for E-CID measurements.   *Recommendations for 2nd round:*  No further discussion in 2nd round. |
| **Sub-topic#25-2** | **Should SS-SINR and CSI-RS SINR be included for E-CID measurements?**  *Candidate options:*   * Option 1. Yes (Ericsson, Huawei) * Option 2. No (Qualcomm, MediaTek)   *Recommendations for 2nd round:*  To be further discussed in 2nd round. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 25-1: the related CR in R4-2001948 was revised to R4-2002288 (file name “revised\_R4-2001948 R4-2002288 CR38.133 NR E-CID measurement requirements”), based on the agreements from the 1st round.  Sub topic 25-2: propose to indicate to RAN1/RAN2 the possibility for the UE to also report SS-SINR and CSI-SINR, when they are available.The LS in R4-2001950 can be revised as follows:  “*RAN4 would like to indicate the possibility for the UE to also report SINR measurements (SS-SINR and CSI-SINR) for NR E-CID, provided these measurements are already available in the UE.*” |

## 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 #26: Updates to link-level simulation assumptions

Few companies submitted link-level simulation results. Due to nature of e-meeting and lack of adequate participation from companies, the discussion here is only focused on necessary updates to simulation assumptions.

For RAN4#94-Bis meeting, interested companies are encouraged to provide simulation results according to simulation assumptions and the agreed updates (if any).

Morever, companies are encouraged to provide:

* any specific assumptions (e.g., number of samples used to arrive at a measurement, power boost, ...) not included or agreed in the simulation assumptions
* tabulated results according to the agreed metrics (e.g., 90% of RSTD error) as opposed to providing only graphs (reading graphs is time-consuming and prone to error)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001636 | Huawei, HiSi | We see some updates are needed to [1] as follows:   * In [1] three comb sizes are included: comb-4, comb-6, comb-2 (with muting). In RAN1#99, comb-12 was also agreed, so it should be included in the updated simulation assumption. * In [1] both sync and async cases are to be simulated, where the timing offset between the 3 cells for async case is <0, 7 symbols, -7 symbols>. It means the PRS from one cell will collide with data loads of the other two cells. In particular for the two neighbour cells, the reference cell will cause strong interference, and we understand this may not be the typical scenario in real deployment. Also, with 50% utilization of non-PRS symbols, it is difficult to control the Es/Iot to the required values. We therefore suggest to remove the async case from the assumption. * In [1] the performance metric for RSTD are ‘RSTD error CDFs for 3 cells’ and ‘90%-ile of the RSTD errors for each cell’, however, with 3 cells in the simulation, there are only two RSTD measurements for the two neighbor cells. The performance metric should be updated to avoid confusion.   [1] R4-1915802 |
| R4-2000735 | Qualcomm | Study the impact of *PRS-ResourceTimeGap* > 1 in FR1 before finalizing the RSTD accuracy requirements for mobility channels. |

## Open issues summary

### Sub-topic 26-1 Inclusion of comb-12

Should comb-12 be included in the simulation assumptions?

* Option 1. Yes (Huawei)
* Option 2. No

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 26-2 Removal of async scenario in FR1

Should async scenario be removed in the simulation assumptions for FR1?

* Option 1. Yes (Huawei)
* Option 2. No

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 26-3 Inclusion of PRS-ResourceTimeGap

Should different values of PRS-ResourceTimeGap be evaluated? Details FFS.

* Option 1. Yes (Qualcomm)
* Option 2. No

Recommended WF: Further discussion needed. Collect companies’ views

### Sub-topic 26-4 Inclusion of TOA as a performance metric

As discussed in Topic#22, TOA estimation accuracy is needed to define the accuracy requirements of Rx-Tx time difference measurement.

Should Time-of-arrival error (TOA error = real TOA – estimated TOA) be included for cells 1-3 in the list of performance metrics (i.e., 90% of CDF of TOA error)?

* Option 1. Yes (Qualcomm)
* Option 2. No

Recommended WF: Further discussion needed. Collect companies’ views

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 26-1: option 1, for the reason mentioned in our paper R4-2001636.  Sub-topic 26-2: option 1, for the reason mentioned in our paper R4-2001636. We also suggest to remove the option of ‘50% utilization in time’ for ‘Data and CCH load in non-PRS symbols’ as it creates uncertainty in the simulation results.  Sub-topic 26-3: Option 2. We already have many cases to simulate, so we suggest to have a fixed value ‘1’ for PRS-ResourceTimeGap. Larger value for this parameter is mainly intended for Rx beam sweeping which is not modeled in the simulation.  Sub-topic 26-4: option 1. |
| Qualcomm | Sub topic 26-1: we don’t see any performance difference between comb-2, comb-4 and comb-6 since all 3 cells are orthogonal and no power boosting is assumed. We don’t see any value in adding comb-12 but if companies are interested in simulating it, they sure can.  Sub topic 26-2: since all three cells are supposed to satisfy the side conditions, it doesn’t matter whether the scenario is sync or async. In sync case, source of noise might be different than async case but as long as Es/Iot is the same, performance should be the same. In our view, sync vs async does not matter. Same argument applies to 50% vs. 100% utilization time.  Sub topic 26-3: The issue with PRS-RsourceTimeGap >1 is that channel changes much more from one slot of repetition instance to another compared to the case where the slots of the repetition instance are back to back. This results in difference performance in channels with Doppler. |
| MTK | Sub topic 26-1: We support option 2. It is expected that in practice comb-2,4,6 will more likely to be configured since comb-12 has limited room for UE to improve its measurement. For the time being RAN4 should focus on comb-2,4,6 and comb-12 can be FFS.  Sub topic 26-2: Support option 1.  Sub topic 26-3: We support option 2 for simplicity.  Sub topic 26-4: TOA can be an optional metric. Interested companies can provide their results. |
| CATT | Sub-topic 26-1: support option 1.  Sub-topic 26-2: we have no strong view on removal of async scenario, but agree to remove the option of ‘50% utilization in time’ for ‘Data and CCH load in non-PRS symbols’.  Sub-topic 26-4: support option 1. |
| Ericsson | 26-1: no strong need to add comb 12 since the results are unlikely to impact the conclusions based on simulations for other combs.  26-2: Asynchronous scenario needs to be kept for deriving the requirements  26-3: we are Ok to study this until the April meeting.  26-4: We do not agree to include TOA as performance metric. TOA is not among the RAN1 agreed positioning measurements. |
| Intel | Sub topic 26-1: Inclusion of comb-12  No. Theoretically comb-12 performance is better than others. We need not to cover all configuration, but some worst ones.  Sub topic 16-2: Removal of async scenario in FR1  Yes. the aync case can be unnecessary as we discussed in the last meeting.  Sub topic 26-3: Inclusion of PRS-ResourceTimeGap  Maybe little impacts on the performance. Could not included.  Sub topic 26-4:  This metric will not impact the positioning performance. We need not to evaluate its performance. |

## Summary for 1st round

### Open issues

|  |  |
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|  | **Status summary** |
| **Sub-topic#26-1** | **Inclusion of comb-12**  *Candidate options:*   * Option 1. Yes (Huawei, CATT) * Option 2. No (Qualcomm, MediaTek, Ericsson, Intel)   *Recommendations for 2nd round:*  To be further discussed in 2nd round. |
| **Sub-topic#26-2** | **Removal of async scenarios**  *Candidate options:*   * Option 1. Yes (Huawei, MediaTek, Intel) * Option 2. No (Ericsson)   **Removal of 50% utilization in time**  *Candidate options:*   * Option 1. Yes (Huawei, CATT) * Option 2. No (Ericsson)   *Recommendations for 2nd round:*  To be further discussed in 2nd round. |
| **Sub-topic#26-3** | **Inclusion of PRS-ResourceTimeGap =1 and >1**  *Candidate options:*   * Option 1. Yes (Qualcomm, Ericsson) * Option 2. No (Huawei, MediaTek, Intel)   *Recommendations for 2nd round:*  To be further discussed in 2nd round. |
| **Sub-topic#26-4** | **Should Time-of-arrival error (TOA error = real TOA – estimated TOA) be included for cells 1-3 in the list of performance metrics (i.e., 90% of CDF of TOA error)?**  *Candidate options:*   * Option 1. Yes (Qualcomm, Huawei, MediaTek, CATT) * Option 2. No (Ericsson, Intel)   *Recommendations for 2nd round:*  To be further discussed in 2nd round. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | 26-1: no strong need to add comb 12 since the results are unlikely to impact the conclusions based on simulations for other combs.  26-2: Asynchronous scenario needs to be kept for deriving the requirements  26-3: we are Ok to study this until the April meeting.  26-4: We do not agree to include TOA as performance metric. TOA is not among the RAN1 agreed positioning measurements. The NR UE Rx-Tx measurement definition is not really different from that in LTE in that aspect, and in LTE we did not have anything for ToA measurements in RAN4 specifications. |
| Huawei, HiSilicon | Sub-topic 26-1: we understand the requirements are defined for all comb values, so it is important to check if the performance of comb-12 is same as for other comb values. We suggest to add it as optional and interested companies can check.  Sub-topic 26-2: we understand the simulation is done such that the Es/Iot seen by the UE is (-6, -13, -13). For sync case, it simply means Es/Noc is (-6, -13, -13). Could proponent of aysnc case please clarify what Es/Noc values are to be used, and how to guarantee the Es/Iot with 50% load? In any case, as long as Es/Iot seen by the UE is (-6, -13, -13) we do not see how async case will differ from sync case and why we should keep it in the simulation assumption.  Sub-topic 26-3: first the question is whether requirements are defined for all values of PRS-ResourceTimeGap. If the answer is yes, we are fine to add it as optional and interested companies can check how it impacts the performance.  Sub-topic 26-4: support option 1  We also have a question about where to capture the agreed updates to the simulation assumption. Our paper R4-2001636 was submitted for approval, and we propose to revise it (it is currently noted in the Chairman Notes) to capture what is agreed from the discussion here, so that we have a clear reference for the following simulation work. This is of course subject to the moderator’s decision. |

## 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 #27: MG for PRS measurements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000388 | Intel | With current agreements for NR positioning, measurement gaps is necessary for PRS measurements when the DL PRS resource is outside the configured BWPs.  Additional UE specific measurement gap for PRS measurement in the different BWP will introduce high system complexity.  If PRS BW central frequency is same as that of activated BWP of the serving cell, UE may NOT need the measurement gap for RF operations.  In order to reduce both system and UE implementation complexity when measuring PRS outside of activated BWP, it is unnecessary to configure the measurement gap for the PRS measurement outside of the activated BWP under the condition below. Otherwise the measurement gap is needed indeed.   * The center frequency of measurement PRS BW can overlap that of the activated BWP of serving cell |
| R4-2001637 | Huawei, HiSi | For FR1 and when PRS is within serving cell BWP and also the SCS is same as that of serving cell BWP, UE shall be able to measure PRS without measurement gap or causing any scheduling restriction.  Otherwise, UE should be allowed to request measurement gaps for PRS measurement and is required to meet the PRS measurement requirements only when it is provided measurement gaps for PRS measurement. |
| R4-2001941 | Ericsson | At least Rel-15 measurement gap configurations are also applicable for OTDOA measurements.   * + Measurement gaps applicability is clarified for OTDOA measurements in Section 9.1.2.   The need for gaps is according to Table 1 in Tdoc for PRS-RSTD measurements (Similar to table for PRS-RSRP) |

## Open issues summary

### Sub-topic 27-1 Applicability of R15 MG patterns to OTDOA measurements

* + Option 1: At least Rel-15 measurement gap configurations are also applicable for OTDOA measurements (Ericsson)
  + Measurement gaps applicability is clarified for OTDOA measurements in Section 9.1.2.
  + Other options are not precluded.

Recommended WF: Further discussion needed. Collect companies’ views.

### Sub-topic 27-2 Need for MG to measure PRS

* + Option 1 (Intel):
  + If PRS BW central frequency is same as that of activated BWP of the serving cell, UE may NOT need the measurement gap for RF operations.
  + In order to reduce both system and UE implementation complexity when measuring PRS outside of activated BWP, it is unnecessary to configure the measurement gap for the PRS measurement outside of the activated BWP under the condition below. Otherwise the measurement gap is needed indeed.
    - The center frequency of measurement PRS BW can overlap that of the activated BWP of serving cell

|  |  |  |
| --- | --- | --- |
|  | Definition | Need gap or Not |
| intra-frequency | DL PRS resources of the measured neighbor cells/TRPs and the serving/reference cell/TRP have   * the same SCS and CP type * the same centre frequency * the same point-A * same configured PRS BW | NO |
| Yes: when measurements for PRS outside of activated BWP. |
| inter-frequency | DL PRS resources of the measured neighbor cells/TRPs and the serving/reference cell/TRP is different in any of   * SCS and CP type * centre frequency * point-A * configured PRS BW | No: if the centre PRS BW of the measure cell/TRPs is same as that of serving cell’s activated BW. |
| Yes |

* + Option 2 (Huawei):
    - For FR1 and when PRS is within serving cell BWP and also the SCS is same as that of serving cell BWP, UE shall be able to measure PRS without measurement gap or causing any scheduling restriction.
    - Otherwise, UE should be allowed to request measurement gaps for PRS measurement and is required to meet the PRS measurement requirements only when it is provided measurement gaps for PRS measurement.
  + Option 3 (Ericsson): The need for gaps is according to Table below

|  |  |  |  |
| --- | --- | --- | --- |
|  | ***Definition*** | ***Need for measurement gaps Note 1*** | |
| *Intra-frequency* | * *the bandwidth of the PRS resource configured for the measurement on the neighbour cell is within the bandwidth of at least one resource (e.g., PRS or CSI-RS resource or SSB) configured for a measurement on the serving cell, and* * *the SCS of the active BWP in the serving cell and of the RSTD measurement are the same*   *NOTE: for RSTD, the above conditions are met for both reference and the other DL links* | *not needed* | *The measurement is over the PRS bandwidth which is fully within the active BWP of the UE* |
| *needed* | *The measurement is over the PRS bandwidth which is not fully within the active BWP of the UE* |
| *Inter-frequency* | *if at least one of the two conditions above is not met*  *NOTE: for RSTD, this applies for at least one of the reference and the other DL links* | *not needed* | *The measurement is over the PRS bandwidth which is fully within the active BWP of the UE* |
| *needed* | *The measurement is over the PRS bandwidth which is not fully within the active BWP of the UE* |
| *NOTE 1: For RSTD configured for a reference and the other DL links, measurement gaps may be needed for both DL links, for one of the two DL links, or for none of the two DL links, depending for which of the two DL links the conditions are met.* | | | |

* + Other options are not precluded.

Recommended WF: Further discussion needed. Collect companies’ views.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Huawei, HiSilicon | Sub-topic 27-1: we support option 1.  Sub-topic 27-2: We think for PRS outside active BWP or with different SCS than active BWP, the PRS measurement should be based on gaps. It should be noted that serving cell is unaware of PRS location of neighbor cells, so if we allow scheduling restriction, there will be a big impact on the UE throughput. For PRS within active BWP and with same SCS as active BWP, the need for gap would depend on the conclusion of scheduling restriction discussion addressed in Sub-topic/Issue 3-3 of email discussion #57. |
| Apple | Sub-topic 27-1: support option 1. |
| Qualcomm | Sub topic 27-1: option 1 is ok.  Sub topic 27-2: We cannot support any of the options above. The issue with options 1 and 3 is that it allows for inter-frequency PRS measurement without gap which is not possible in our view but of course this depends on how we define intra-frequency vs. inter-frequency (if we do at all). We cannot support option 2 either because mandating UE to measure PRS without MG if it falls inside active BWP and has the same SCS means UE will have to concurrently support PDCCH/PDSCH decoding in addition to PRS processing which may not be possible. There is a RAN1 discussion that will accommodate a UE capability for PRS processing only within MG and we can wait to see how it concludes. |
| MTK | Sub topic 27-1: Support option 1  Sub topic 27-2: Postpone the discussion until intra-frequency measurement is defined. |
| CATT | Sub-topic 27-1: support option 1.  Sub-topic 27-2: we think if the PRS to be measured has the center frequency and SCS and all the BW of PRS is within the active BWP, then measurement gap is not needed, otherwise, the measurement gap is needed. |
| Ericsson | Sub topic 27-1: Support option 1  Sub topic 27-2: maybe, it’s better to first decide on the intra-/inter-frequency definition and agree on the set of deciding conditions for that. |
| Intel | Sub topic 27-1: Applicability of R15 MG patterns to OTDOA measurements  there are some cases (e.g. PRS duration is too long) the R15 MG could not applicable. But regarding to the limited time we can defer the new gap pattern for NR positioning measurement in Rel17. |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#27-1** | *Tentative agreement:*  At least Rel-15 measurement gap configurations are also applicable for OTDOA measurements   * Measurement gaps applicability is clarified for OTDOA measurements in Section 9.1.2.   *Recommendations for 2nd round:*  No further discussion is needed. |
| **Sub-topic#27-2** | *Recommendations for 2nd round:*  To be discussed in the 2nd round considering the definition of of intra-frequency vs. inter-frequency topics in addition to comments on scheduling restrictions in sub-topic 3-3 of email discussion #57. |

## Discussion on 2nd round (if applicable)

Please provide comments based on summary for 1st round in previous section. Elaborating on the reasons each option is supported and/or analysis of other options is encouraged.

Moderator: Companies are encouraged to provide their views on scenarios when MG is needed. Please note that sub-topic 3-3 (scheduling restrictions) from email discussion “NR positioning Part 2 #57” is now merged in this section.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 27-2: MG are not needed when the PRS BW is within the active BWP, otherwise may be needed even for intra-frequency measurements. |
| Huawei, HiSilicon | We stick to our proposal in R4-2001637, which is copied below.   * + - For FR1 and when PRS is within serving cell BWP and also the SCS is same as that of serving cell BWP, UE shall be able to measure PRS without measurement gap or causing any scheduling restriction.     - Otherwise, UE should be allowed to request measurement gaps for PRS measurement and is required to meet the PRS measurement requirements only when it is provided measurement gaps for PRS measurement.   On the other hand, if RAN1 introduces UE capability such that UE can only measure PRS within gaps, then for such UE gaps are always needed. |

# Topic #28: Number of frequency layers per active BWP

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000998 | MediaTek | Within UE’s active BWP, at most one positioning frequency layer can be configured to the UE |

## 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 28-1

Do companies agree that within UE’s active BWP, at most one positioning frequency layer can be configured to the UE?

* Option 1: Yes (MediaTek)
* Option 2: No

Recommended WF: Further discussion needed. Collect companies’ views.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |

## 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)

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | This topic #28 was added only in the 2nd round, it has not been in the list of discussed topics for the 2st round.  First we need to decide on intra-/inter-frequency, then we are discussing already measurement capabilities, so why do we need to discuss frequency layers per active BWP separately? |
| Huawei, HiSilicon | We do not quite understand the motivation of the proposal. The number of PRS frequency layer UE can measure is reported as UE capability, then there seems to be no need to restrict where the PRS layer is located in frequency domain. Or will more than one PRS layer within UE active BWP cause any problem in the requirements? |

## 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”* |