**3GPP TSG-RAN WG4 Meeting #98-bis-eR4-2105677**

**Electronic Meeting, 12 – 20 April, 2021**

**Agenda item:** 5.5.2.2

**Source:** Moderator (Intel Corporation)

**Title:** Email discussion summary for [98-bis-e][207] NR\_pos\_RRM\_Part\_2

**Document for:** Information

# Introduction

The scope of this email discussion is UE RRM requirements for NR positioning from the following agenda items:

* AI 5.5.2.2.1 RRM Perf requirements: General
* AI 5.5.2.2.2. Measurement accuracy requirements
* AI 5.5.2.2.3 Test cases

In providing comments, companies are encouraged to:

* Be concise
* Provide comments on all topics/sub-topics of interest
* Ensure that 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: General performance requirements for NR Positioning (AI 5.5.2.1)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2107158**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107158.zip) Draft Big CR: Introduction of Rel-16 NR Positioning RRM performance requirements and test cases | Ericsson, Intel |  |

## Open issues summary and companies views’ collection for 1st round

*N.A.*

### Open issues

N.A.

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
|  |  |
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## Summary for 1st round

### Open issues

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| [**R4-2107158**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107158.zip) | Big CR, to be further revised to capture agreements in this meeting. |
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## Discussion on 2nd round

Please only comment on topics that are selected for discussion in 2nd round.

**Sub-topic#1-1**

## Summary on 2nd round

# Topic #2: Measurement Accuracy Requirements for PRS RSTD (AI5.5.2.2.2.1)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104745**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2104745.zip)Discussion on PRS RSTD accuracy requirements | CATT | **Proposal 1: The applicable accuracy requirements are not impacted by HO****Proposal 2: Captured in the specification the propagation channel models based on which the accuracy requirements are derived.** **Observation 1: When the PRS bandwidth is larger, the measurement accuracy for all PRS configurations is same.** **Observation 2: When the PRS bandwidth is same, there is no big difference for the measurement error for different SCS.** **Proposal 3: The measurement accuracy of PRS RSTD is defined based on the PRS bandwidth and PRS\_NormLenthPerSlot.** **Proposal 4: Define the PRS RSTD measurement accuracy following the tables as below:** **Table 1 RSTD measurement accuracy in FR1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| accuracy | PRS Ês/Iot | SCS | PRS BW | Repetition |
| dB | dB | kHz | PRB | - |
| [±TBD] | ≥-6dB | 15/30/60 | ≥[24] | ≥[1] |
| [±TBD] | ≥-13dB | ＞ [104] | ≥[1] |
| ≤ [104] | ≥[1] |
| [±TBD] | ≤ [52] | ＞[1] |
| [±TBD] | ≤ [52] | [1] |

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| [**R4-2106454**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106454.zip)Discussion on NR PRS RSTD measurement accuracy requirements | Intel Corporation | **Observation 1: There is no obvious performance gap when SCSs are different.****Observation 1: The performance gap among the results with the difference SCSs is mainly due to the different sampling rate, which can be less than 64Tc in same FR.*****Proposal 1: The requirements of RSTD measurement accuracy can be defined independent with SCS.*****Observation 2: There is obvious performance gap when PRS measurement BW in PRB size is different.*****Proposal 2: The requirements based on the different PRS measurement bandwidth shall be defined.*****Observation 3: The gap between the two adjacent RSTD requirements sets can be up to 64Tc.*****Proposal 3: RAN4 could NOT define any applicability depending on channel propagation condition.******Proposal 4:*** ***During the HO, the measurement accuracy shall be same as that of without HO.*** ***Proposal 5: The accuracy requirements of RSTD can be defined by the table below*****Table 1: RSTD accuracy requirements (Tc)**

|  |  |  |  |
| --- | --- | --- | --- |
| **FR** | **PRS BW (PRBs)** | **PRS\_NormLenthPerSlot** |  **SINR= [-6dB, -13dB]** |
| FR1 | ≥24 | ≥1 | ±236 |
| ≥4 | ±108 |
| ≥52 | ≥1 | ±148 |
| ≥6 | ±44 |
| ≥104 | ≥1 | ±148 |
| ≥3 | ±108 |
| ≥268 | ≥1 | ±84 |
| ≥4 | ±52 |
| FR2 | ≥24 | ≥1 | TBD |
| ≥32 | ≥1 | ±372 |
| ≥64 | ≥1 | ±132 |
| ≥128 | ≥1 | ±132 |

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| [**R4-2106520**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106520.zip) | OPPO | **Proposal 1: Both AWGN and fading channel models should be considered when defining PRS RSTD accuracy.****Proposal 2: Further discuss the group delay margin with different PRS layer combinations and UE capability****Proposal 3: PRS repetition times, defined as the number of “1” in MutingPattern-r16 for mutingOption2-r16, should be considered for RSTD accuracy.****Proposal 4: The minimum value of other PRS configuration parameters, if introduced, should be considered for applicability of RSTD accuracy requirements.** |
| [**R4-2106632**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106632.zip) Discussion on PRS RSTD accuracy requirements | vivo | **Proposal 1: Applicable accuracy requirements are not impacted by any serving cell change.****Proposal 2: No need to define the applicability with propagation channels for accuracy requirement. (e.g. TDL-C channel model with 300 ns delay spread shall be considered also when defining accuracy requirments).****Proposal 3: RSTD accuracy rquirements are specified as in Table 1 and Table 2 for FR1 and FR2 respectively.**Table 1: RSTD measurement accuracy in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accuracy | **((PRS Ês/Iot)ref,** (PRS Ês/Iot)*i* ) | Minimum PRSbandwidth | PRS SCS | Total number of repetitions of PRS resource |
| Ts Note 2 | dB | RB | kHz |  |
|  | (≥-6dB, ≥-13dB) | ≥ 24 | 15kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 24 | 15kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 52 | 15kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 52 | 15kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 104 | 15kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 104 | 15kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 268 | 15kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 268 | 15kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 48 | 30kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 48 | 30kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 132 | 30kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 132 | 30kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 272 | 30kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 272 | 30kHz | 4 |

Table 2: RSTD measurement accuracy in FR2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accuracy | **((PRS Ês/Iot)ref,** (PRS Ês/Iot)*i* ) | Minimum PRSbandwidth | PRS SCS | Total number of repetitions of PRS resource |
| Ts Note 2 | dB | RB | kHz |  |
|  | (≥-6dB, ≥-13dB) | ≥ 32 | 120kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 32 | 120kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 64 | 120kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 64 | 120kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 128 | 120kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 128 | 120kHz | 4 |

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| [**R4-2106338**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106338.zip) On PRS-RSTD measurement accuracy requirements | Qualcomm Incorporated | **Observation 1: It is already specified in TS 38.133 that RSTD accuracy requirements are not impacted by HO.****Proposal 1: Applicable RSTD accuracy requirements are not impacted by HO.****Proposal 2: Exclude simulations results for TDL-C channel model with 300 ns delay spread in FR1 for defining RSTD and UE Rx-Tx accuracy requirements.****Proposal 3: RAN4 to consider defining PRS-RSTD and UE Rx-Tx measurement accuracy requirements only for AWGN.****Proposal 4: RAN4 will add a non-zero group delay calibration margin to the RSTD accuracy requirements in FR1 and FR2. FFS the exact values of the margins for FR1 and FR2.****Observation 2: The group delay calibration margin should scale inversely with PRS bandwidth.****Proposal 5: RAN4 should discuss the assumptions for UE frequency error and separation between PRS resources and decide on a frequency drift margin to be added to RSTD measurement requirements.** |
| [**R4-2107165**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107165.zip) On RSTD measurement accuracy requirements | Ericsson | ***Proposal 1****: Clarify in section 9.9.2.5 of TS 38.133:* * + *If intra-frequency or inter-frequency handover occurs while RSTD measurements are being performed, then the UE shall continue and complete the on-going RSTD measurements.*

*[Moderator: this is related to core requirements]****Proposal 2****: The UE shall continue and complete an RSTD measurement while meeting RSTD measurement accuracy requirements in clause 10.1.23 even when a serving cell change (intra-frequency handover, inter-frequency handover, SCell reconfiguration, addition, release, activation, or deactivation, or PSCell reconfiguration, addition, or release) occurs during the measurement****Proposal 3****: No need to define the applicability for propagation channels in accuracy requirements (i.e., Option 1 in the RAN4#97-e WF [1]).****Proposal 4****: The RSTD accuracy requirements shall apply for any DL-PRS-ResourceRepetitionFactor≥1 and any LPRS≥2 which is given by the higher-layer parameter dl-PRS-NumSymbols and any comb pattern****Proposal 7****: The RSTD accuracy is defined based on the earlier agreed 4 samples (already in the core requirements). RAN4 shall not reopen the discussion on the number of samples.****Proposal 5****: For FR1, the RSTD measurement accuracy is as in Table 1.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table 1: RSTD accuracy in FR1Accuracy,** **Tc** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±90 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±50 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±35 | BW >132 | 15, 30 | All | All | All |

***Proposal 8****: For FR2, the RSTD measurement accuracy is as in Table 2.***Table 2: RSTD accuracy in FR2**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±80 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±40 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±30 | BW >64 | 60, 120 | All | All | All |

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| [**R4-2107006**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107006.zip) Discussion on accuracy requirements for RSTD measurement | Huawei, HiSilicon | **Proposal 1: Applicable accuracy requirements is not impacted by HO.****Proposal 2: Captured in the specification the propagation channel models based on which the accuracy requirements are derived, or the accuracy requirements are applicable only for AWGN.****Proposal 3: Use the following margins to account for the group delay calibration error for RSTD*** **0, if reference resource and neighbour resource are on the same PRS layer**
* **32Tc, reference resource and neighbour resource are on different PRS layers**

**Proposal 4: RSTD accuracy requirements are defined based on PRS configuration parameters of** * **PRS BW defined in number of PRBs**
* **PRS SCS**
* **PRS repetition factor *dl-PRS-ResourceRepetitionFactor \* dl-PRS-NumSymbols / dl-PRS-CombSizeN***

**Proposal 5: Use Table 2 as template to form RSTD accuracy requirements.****Table 2: Template for RSTD accuracy requirements**

|  |  |  |  |
| --- | --- | --- | --- |
| **Accuracy (Tc)** | **SCS (kHz)** | **PRB num** | **Repetition**  |
|  | 15/30/60/120 | 24-40 | 2 |
|  | 44-84 | 1 |
|  | 88-168 | 1 |
|  | 172-max | 1 |

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| [**R4-2107007**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107007.zip)draftCR to introduce accuracy requirements for RSTD measurement | Huawei, HiSilicon | CR |

## Open issues summary and companies’ views collection for 1st round

### Sub-topic 2-1 Applicable accuracy requirement in case of intra-/inter-frequency HO and other serving cell changes

* Option 1 (Huawei, Intel, Qualcomm, CATT, vivo) Applicable accuracy requirements are not impacted by HO.
* Option 2 (Ericsson): Clarification on the current spec below
	+ *“If intra-frequency or inter-frequency handover occurs while RSTD measurements are being performed, then the UE shall continue and complete the on-going RSTD” measurements.*

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Support Option 1. In our view, Option 2 is same as Option 1 from the accuracy requirements perspective. We didn’t see any RSTD measurement accuracy difference when intra-f and inter-f HO happened. |
| CATT | Support option 1. The resources to be measured before and after HO are the same and the positioning measurements are always gap-based in R16 NR. So the accuracy requirements are not impacted by HO. For option 2, we don’t see the necessity of the clarification.  |
| vivo | Support option 1. The RSTD measurement accuracy are based on PRS resources configuration, e.g., PRS bandwidth, comb size, number of PRS symbols, repetition of PRS resource etc. If handover happens, as long as the PRS resource configuration of the cells are not changed, then accuracy requirements are not impacted. |
| Huawei | Support option 1.Option 2 seems to be about the core requirements rather than the accuracy requirements, and the RSTD measurement period requirements for HO case is already defined in the spec. Also, we do not see a clear need for such a clarification.  |
| Ericsson | We are also fine with option 1 |
| Qualcomm | We favor option 1. Regarding option 2, the text in the spec implies any type of handover. |
| OPPO | Support option 1. |

### Sub-topic 2-2 Applicable propagation channel for accuracy requirement

* Option 1 (vivo, Intel, Ericsson, OPPO). No need to define the applicability with propagation channels for accuracy requirement. (e.g. TDL-C channel model with 300 ns delay spread shall be considered also)
* Option 2 (Huawei): Captured in the specification the propagation channel models based on which the accuracy requirements are derived, or the accuracy requirements are applicable only for AWGN
* Option 2a (CATT): Captured in the specification the propagation channel models based on which the accuracy requirements are derived.
* Option 3 (Qualcomm): RAN4 to consider defining PRS-RSTD and UE Rx-Tx measurement accuracy requirements only for AWGN

Recommended WF: Can the proposal below be agreeable?

* Captured in the specification the propagation channel models based on which the accuracy requirements are derived.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | As a compromise, we can accept the recommended WF. The exact text in spec can be discussed with CR together.  |
| CATT | Support option 2a. The accuracy can be derived by AWGN or fading channel and capture in the specification which channel model is used.  |
| vivo | Support option 1. Since only one set of requirements are specified, it should reflect what will happen in the field. Does the recommended WF indicate different requirements will be specified for different propagation channel models? If so, we don’t think it is necessary to do so. RAN4 only specifies minimum requirements. |
| Huawei | We are fine with the Recommended WF. |
| Ericsson | The text proposed in the WF is ambiguous. We support option 1, which is the principle used for accuracy in 38.133. |
| Qualcomm | The recommended WF is agreeable but it does not fully address the issue here. First of all, in our view, specifying one set of requirements that would apply to any arbitrary propagation channel is not the goal. That would not be very useful because it would lead to requirements that are very loose. We still favor option 3. Note that for gNB measurements, it was agreed to define measurement accuracy requirements for AWGN. If RAN4 does not define UE requirements for AWGN, then the requirements would be very unbalanced and inconsistent. It may cause confusion to 3rd parties interested in NR positioning.On a related note, we noticed a particular behavior in the sim results where RSTD performance is better than UE Rx-Tx for fading channels and high PRS BW. This is due to the channels between the UE and neighbor and reference TRPs being highly correlated. For fading channels with large delay spread the errors in first time of arrival (which can be significant) would be correlated between the refence and neighbor TRPs and it would be substantially cancelled when RSTD is calculated. The same would not happen for UE Rx-Tx time difference and this accounts for the perhaps unexpected performance difference. However, if the channels were uncorrelated (e.g. reference and neighbor PRS resources spaced far apart in time) the story would be different. This behavior is just one example of challenges of characterizing performance with fading channels and it would be avoided if the requirements are based on AWGN.To vivo’s comment: RAN4 routinely specifies requirements for different propagation channels for demod performance. There is not single requirement for all types of channels. |
| OPPO | Support option 1 and can compromise to recommended WF. |

### Sub-topic 2-3 How to define the accuracy requirements with the combinations of PRS BW and other parameters (e.g. SCS, comb size, repetition)

* Option 1 (Intel, CATT). RSTD accuracy requirements are defined based on PRS configuration parameters of
	+ PRS BW defined in number of PRBs
	+ PRS repetition factor *dl-PRS-ResourceRepetitionFactor \* dl-PRS-NumSymbols / dl-PRS-CombSizeN*
* Option 2 (Huawei, vivo). RSTD accuracy requirements are defined based on PRS configuration parameters of
	+ PRS BW defined in number of PRBs
	+ PRS SCS
	+ PRS repetition factor dl-PRS-ResourceRepetitionFactor \* dl-PRS-NumSymbols / dl-PRS-CombSizeN
* Option 3 (Ericsson): The RSTD accuracy requirements
	+ Depend on PRS BW defined in number of PRBs
* Option 4 (OPPO).
	+ For PRS repetition factor,the number of “1” in MutingPattern-r16 for mutingOption2-r16 should be considered instead of *dl-PRS-ResourceRepetitionFactor* .
	+ The minimum value of other PRS configuration parameters, e.g., repetition factor if introduced, should be considered for applicability of RSTD accuracy requirements.

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

[*Moderator notes: We can firstly identify how much performance variance for the difference parameters sets based on the simulation results collected in [R4-2106457]. Then we can consider to group these parameter sets to define the requirements*]

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| --- | --- |
| **Company** | **Comments** |
| Intel | From the simulation results collected in this meeting[*R4-2106457]*, the performance difference due to SCS is mainly because of the quantization error. So we can firstly conclude that the requirements can be defined independent with SCS. If the proponent of Option 2 can accept this, Option 1 and Option 2 are exactly same. For Option 3, we can see some performance difference when the other parameters are different especially when the PRS BW is too small (e.g. <24PRBs). So the requirements for some worse can be separated with other typical cases. But in principle, we fully agree the requirements sets must to be grouped for simplicity of testing. For Option 4, it is unnecessary to define the specific accuracy requirements for muting pattern.  |
| CATT | Support option 1 for FR2. For FR1, the performance is quite similar for the different repetition factor, so the accuracy requirements can also base on the PRS bandwidth only.  |
| vivo | Option 1 and option 2 are similar. However, for some PRS BW, lower SCS may not be applicable. For example, if requirements are specified for 272PRBs then it is not applicable to 15kHz SCS.If PRS BW is carefully selected that it is applicable for both SCSs then option 1 is also fine.In addition, accuracy requirements for FR1 and FR2 should be specified separately. |
| Huawei | Support option 2 based on our simulation results. On SCS, we do see a clear dependence specially for large RB number and AWGN channel, where the accuracy is proportional with SCS.On repetition, we also see some impacts for small RB number. To clarify, we suggest to define to repetition number as side condition, and we do not support to define separate requirements for different repetition numbers for a certain BW. |
| Ericsson | The agreement should be based on comparison of results for different SCS etc. |
| Qualcomm | Option 2 is our preferred option. Whether the third bullet point is very relevant should be decided by comparing the sim results from different companies as agreed in the last meeting. |
| OPPO | Support option 2 and option 4. We do not think the proposals in option 4 are in contradiction with other options. The first bullet is to consider mutingOption2 to calculate the number of PRS repetitions, which is more reasonable as the some PRS instances can be muted in practical. The second bullet is about the applicability of accuracy requirement when the PRS configurations for the two cells are different. In LTE, accuracy is determined based on the minimum PRS bandwidth and minimum available PRS subframes among different cells. And in RAN4 #97-e meeting, it is captured in the WF that “min {PRS\_BWi} of the positioning frequency layers should be used for applicability of accuracy requirements”. Therefore, same rules should be used for PRS repetition factors and SCS.  |

### Sub-topic 2-4 Group delay calibration margin

* Option 1 (Huawei). RAN4 to decide on the group delay calibration margin.
	+ margin equals to zero if the reference and neighbouring resources are on the same frequency layer in FR1
	+ 32Tc, reference resource and neighbour resource are on different PRS layers
* Option 1a(Qualcomm) RAN4 will add a non-zero group delay calibration margin to the RSTD accuracy requirements in FR1 and FR2.
	+ FFS the exact values of the margins for FR1 and FR2.
	+ The group delay calibration margin should scale inversely with PRS bandwidth.

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | We slightly prefer Option 1 for FR1. FR2’s margin need more inputs.  |
| Huawei  | We prefer to keep the agreement regarding FR1 single PFL case. Based on our understanding, the difference in group delay for different Rx paths is very small, so we propose zero margin also for FR2 single PFL case. But we are open to other views.For separate PFL case, we are open to hear other values. We need more time to check on the BW dependence, as it relates to the details of the calibration process.  |
| Qualcomm | We encourage other companies to check internally with their teams regarding this question. The assumption of zero margin for FR1 is too optimistic. Please take a look at the argument in our contribution and provide your view.To Huawei: Thanks for checking on the BW dependence. |

### Sub-topic 2-5 Frequency drift margin

* Option 1 (Qualcomm): RAN4 should discuss the assumptions for UE frequency error and separation between PRS resources and decide on a frequency drift margin to be added to RSTD measurement requirements.

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | In our understanding, such frequency drift will led the timing offset over a long period. But for RSTD estimation, the timing offset compensation shall be needed in the practical implementation. Such extra margin is unnecessary.  |
| vivo | We are open for further discussion. However, UE frequency error requirements are specified in TS 38.101 already. What conclusion is expected from this sub-topic? |
| Huawei | We can understand the issue, but we need more time to check how severe it is in practice.  |
| Qualcomm | The issue here is similar to the discussion of SRS/PRS proximity. In this case, it is about proximity between the neighbor and reference PRS resources used to calculate a given RSTD measurement. Ultimately, what we need to decide is an applicability condition based on proximity and a corresponding margin. Note that from a UE requirements perspective, this issue is more critical for RSTD measurements than for UE Rx-Tx measurements due to how the measurements are defined (UE Rx-Tx time difference is defined to be between adjacent UL/DL subframes).From a conformance test perspective this may not be a big issue since RAN4 can specify the test scenarios to ensure proximity. The value of the proximity condition would be to alert 3rd parties of potential issues in real deployments. |

### Sub-topic 2-6 RSTD accuracy requirements for FR1/FR2

*[Moderator notes: the exact accuracy requirements can be discussed after the principles above agreed.]*

* Option 1 (Ericsson)

The RSTD accuracy requirements shall apply for any DL-PRS-ResourceRepetitionFactor≥1 and any LPRS≥2 which is given by the higher-layer parameter dl-PRS-NumSymbols and any comb pattern

**Table 1: RSTD accuracy in FR1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±90 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±50 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±35 | BW >132 | 15, 30 | All | All | All |

**Table 2: RSTD accuracy in FR2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **PRS BW,** **PRB** |  | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±80 | 24 ≤ BW ≤ 32 |  | 60, 120 | All | All | All |
| ±40 | 32 < BW≤ 64 |  | 60, 120 | All | All | All |
| ±30 | BW >64 |  | 60, 120 | All | All | All |

* Option 2 (CATT)
* **Table 1 RSTD measurement accuracy in FR1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| accuracy | PRS Ês/Iot | SCS | PRS BW | Repetition |
| Tc | dB | kHz | PRB | - |
| [±TBD] | ≥-6dB | 15/30/60 | ≥[24] | ≥[1] |
| [±TBD] | ≥-13dB | ＞ [104] | ≥[1] |
| ≤ [104] | ≥[1] |
| [±TBD] | ≤ [52] | ＞[1] |
| [±TBD] | ≤ [52] | [1] |

* Option 3(Intel)
* **Table 1: RSTD accuracy requirements (Tc)**

|  |  |  |  |
| --- | --- | --- | --- |
| **FR** | **PRS BW (PRBs)** | **PRS\_NormLenthPerSlot** | **Accuracy requirements when SINR= [-6dB, -13dB]** |
| FR1 | ≥24 | ≥1 | ±236 |
| ≥4 | ±108 |
| ≥52 | ≥1 | ±148 |
| ≥6 | ±44 |
| ≥104 | ≥1 | ±148 |
| ≥3 | ±108 |
| ≥268 | ≥1 | ±84 |
| ≥4 | ±52 |
| FR2 | ≥24 | ≥1 | TBD |
| ≥32 | ≥1 | ±372 |
| ≥64 | ≥1 | ±132 |
| ≥128 | ≥1 | ±132 |

* Option 4. vivo
* Table 1: RSTD measurement accuracy in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accuracy | **((PRS Ês/Iot)ref,** (PRS Ês/Iot)*i* ) | Minimum PRSbandwidth | PRS SCS | Total number of repetitions of PRS resource |
| Ts Note 2 | dB | RB | kHz |  |
|  | (≥-6dB, ≥-13dB) | ≥ 24 | 15kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 24 | 15kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 52 | 15kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 52 | 15kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 104 | 15kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 104 | 15kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 268 | 15kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 268 | 15kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 48 | 30kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 48 | 30kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 132 | 30kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 132 | 30kHz | 4 |
|  | (≥-6dB, ≥-13dB) | ≥ 272 | 30kHz | 1 |
|  | (≥-6dB, ≥-13dB) | ≥ 272 | 30kHz | 4 |

* Option 5 (Huawei)
* **Table 2: Template for RSTD accuracy requirements**

|  |  |  |  |
| --- | --- | --- | --- |
| **Accuracy (Tc)** | **SCS (kHz)** | **PRB num** | **Repetition**  |
|  | 15/30/60/120 | 24-40 | 2 |
|  | 44-84 | 1 |
|  | 88-168 | 1 |
|  | 172-max | 1 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Accuracy (Tc)** | **SCS (kHz)** | **PRB num** | **Repetition**  |
|  | 60 | 24-40 | 2 |
|  | 44-84 | 1 |
|  | 88-168 | 1 |
|  | 172-max | 1 |
|  | 120 | 24-40 | 2 |
|  | 44-84 | 1 |
|  | 88-168 | 1 |
|  | 172-max | 1 |

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

*[Moderator notes: the exact accuracy requirements can be discussed after the principles above agreed.]*

### CRs/TPs

[*Moderator notes: suggest take one of these CR drafts as the baseline which can be revised in 2nd round discussion*.]

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2107007**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107007.zip) (Huawei, Hi Silicon) |  |
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## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#2-1** | **Applicable accuracy requirement in case of HO and other serving cell changes***Tentative agreements:* Applicable accuracy requirements are not impacted by HO*Candidate options:**Recommendations for 2nd round: No further discussion needed.* |
| **Sub-topic#2-2** | **Applicable propagation channel for accuracy requirement***Tentative agreements:**GTW agreements:** + Agreements:
		- PRS-RSTD and UE Rx-Tx measurement accuracy requirements
			* Option 1: Single set of requirements is defined for AWGN and fading conditions
			* Option 2: Two set of requirements are defined for AWGN and fading conditions
		- Test cases for accuracy requirements are defined for
			* AWGN conditions
			* FFS: fading conditions for FR1

*Candidate options:**Recommendations for 2nd round: Can be FFS* |
| **Sub-topic#2-3** | **How to define the accuracy requirements with the combinations of PRS BW, repetitions and others***Tentative agreements: None.**Candidate options:** Option 1 (Intel, CATT). RSTD accuracy requirements are defined based on PRS configuration parameters of
	+ PRS BW defined in number of PRBs
	+ PRS repetition factor *dl-PRS-ResourceRepetitionFactor \* dl-PRS-NumSymbols / dl-PRS-CombSizeN*
* Option 2 (Huawei, vivo). RSTD accuracy requirements are defined based on PRS configuration parameters of
	+ PRS BW defined in number of PRBs
	+ PRS SCS
	+ PRS repetition factor dl-PRS-ResourceRepetitionFactor \* dl-PRS-NumSymbols / dl-PRS-CombSizeN
* Option 3 (Ericsson): The RSTD accuracy requirements
	+ Depend on PRS BW defined in number of PRBs
* Option 4 (OPPO).
	+ For PRS repetition factor,the number of “1” in MutingPattern-r16 for mutingOption2-r16 should be considered instead of *dl-PRS-ResourceRepetitionFactor* .
	+ The minimum value of other PRS configuration parameters, e.g., repetition factor if introduced, should be considered for applicability of RSTD accuracy requirements.

*Recommendations for 2nd round: Can be FFS* |
| **Sub-topic#2-4** | **Group delay calibration margin***Tentative agreements:* *Candidate options:** Option 1 (Huawei, Intel). RAN4 to decide on the group delay calibration margin.
	+ margin equals to zero if the reference and neighbouring resources are on the same frequency layer in FR1
	+ 32Tc, reference resource and neighbour resource are on different PRS layers
* Option 1a(Qualcomm) RAN4 will add a non-zero group delay calibration margin to the RSTD accuracy requirements in FR1 and FR2.
	+ FFS the exact values of the margins for FR1 and FR2.

The group delay calibration margin should scale inversely with PRS bandwidth*Recommendations for 2nd round: Can be FFS in next meeting* |
| **Sub-topic#2-5** | **Frequency drift margin***Tentative agreements:None**Candidate options:*Option 1 (Qualcomm): RAN4 should discuss the assumptions for UE frequency error and separation between PRS resources and decide on a frequency drift margin to be added to RSTD measurement requirements*Recommendations for 2nd round: Can be FFS in the next meeting.* |
| **Sub-topic#2-6** | **RSTD accuracy requirements for FR1/FR2***Moderator Notes:**Tentative agreements:**Candidate options:**Recommendations for 2nd round: as discussed in GTW, firstly we can continue discussion on alignment. How to structure the requirements can be identified based on averaged results.* |

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2107007 (Huawei, Hi Silicon) | Revised |
|  |  |
|  |  |

## Discussion on 2nd round

Please only comment on topics that are selected for discussion in 2nd round.

### Sub-topic 2-2 Applicable propagation channel for accuracy requirement

*According to GTW agreements below, companies can provide your further view on the following two issues: :*

* **Sub-topic 2-2-1** PRS-RSTD and UE Rx-Tx measurement accuracy requirements
	+ Option 1: Single set of requirements is defined for AWGN and fading conditions
	+ Option 2: Two set of requirements are defined for AWGN and fading conditions

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | In order to reduce the testing efforts, we support Option 1. And as RAN4 requirements will be used for the field testing, the requirements defined can be based on the simulation results with fading channel. |
| vivo | Support option 1. The requirements should be reasonable indication of performance that can be achieved in the field. The requirements are based on fading channel since RAN4 specifies minimum requirements. |
| Qualcomm | Support option 2. If accuracy tests are going to be defined with AWGN, then it would be good to specify separate requirements for AWGN and fading conditions. The requirements for fading conditions would provide an indication of how performance degrades with mutli-path and fading. It would be informative to note in the specification which propagation channel model is eventually used to derive the requirements for fading conditions.[Moderator: Could we prioritize the single requirement based on the fading channel simulation results? From the realistic deployment perspective, the requirements on the time estimation based on the multiple path fading make more sense. And from the simulation results provided the companies, some companies were not simulate AWGN cases but fading channels. ]  |
|  |  |
|  |  |

* **Sub-topic 2-2-2** Test cases for accuracy requirements are defined for
	+ AWGN conditions
	+ FFS: fading conditions for FR1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Regarding to the some TE vendors’ concerns, we can define test case with AWGN only. The same methodology was adopted in NR and LTE.  |
| vivo | We are open to define tests in fading channels as long as TE vendors thinks testing in fading channel is feasible. |
| Qualcomm | From the GTW agreement we understand tests forFR2 will be defined in AWGN. For FR1 that is also the default option at this point.  |
|  |  |
|  |  |

### Sub-topic 2-3&2-6 How to define the accuracy requirements with the combinations of PRS BW, repetitions and others

*[Moderator notes: According to simulation results we collected, it seems the performance gap due PRS BW and repetition are quite similar. Thus we suggest that the following table can be taken as the baseline to define RSTD requirements. Please companies can provide your further view on this WF.]:*

*Recommended WF: the following table can be taken as the baseline to define RSTD requirements*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
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|  |  |  |  |  |

**Table 1: RSTD accuracy in FR1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Accuracy,** **Tc** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition within per slot** **(** |
| [±813] | ≥[24] | 15 | All |
| [±129] | ≥[52] | All |
| [±79] | >[104] | All |
| [±122] | ≥[48] | 30,60 | All |
| [±35] | ≥132 | All |

**Table 2: RSTD accuracy in FR2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Accuracy,** **Tc** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition within per slot** **(** |
| [±326] | ≥[24] | 60/120 | All |
| [±94] | ≥[64] | All |

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Support the recommended WF. For the exact value, they can be updated depending on the corresponding simulation results. In some case in which the low PRS BW and small repetition (e.g. PRS BW <=24 and rep<=4), we can add some side condition as below.**Table 1: RSTD accuracy in FR1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| [±164] | ≥[24] | 15 | ≥4 | All | All |
| [±129] | ≥[52] | All | All | All |
| [±79] | >[104] | All | All | All |
| [±122] | ≥[48] | 30 | All | All | All |
| [±35] | ≥132 | All | All | All |

**Table 2: RSTD accuracy in FR2**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| TBD | ≥[24] | 60/120 | ≥4 | All | All |
| [±94] | ≥[64] | All | All | All |

 |
| vivo | In general, the updated Table 1 and Table 2 are fine for us. One comment is accuracy requirements for repetition should be defined. To make requirements simple we propose accuracy requirements for PRS BW of 24PRBs are defined for repetition 1 and repetition 4 respectively.In addition, we think accuracy requirements for FR2 should also be define for larger PRS BW, e.g., 128PRBs.The exact value can be decided in the next meeting. |
| Qualcomm | The last column in the tables above is counting total number of comb pattern repetitions, no just repetitions within slot as indicated in the heading.Alternatively, we would support the structure below as baseline. Repetition factor could be ≥1 for some BW bins.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  | **Repetition within slot**  |
| **TBD** |  |  | ≥TBD | ≥1 |

[Moderator: the updated table in which the parameter “**Repetition within per slot** **(**” ca address the first issue you mentioned. For FR1, why stop at 104 RBs for SCS=15 and 132 RBs for SCS=30? Sim results from several companies show there is differentiation at higher number of RBs even for TDL-A. We support adding two more rows for ≥[208 or 268] RBs at SCS=15 and for ≥[264] RBs at SCS=30 .[Moderator :from the results averaged, we didn’t see obivious gap when PRS BW>268 (e.g. abut 10Tc ). If Qualcomm has more results to identify such observation, please share your results ASAP. Thanks!] Similarly for FR2, we support adding an extra row for ≥[128] RBs at SCS=120.[Moderator: we have not simulate the case >128PRBs in FR2 according to the agreements in the last meeting] |
|  |  |

## Summary on 2nd round

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc status update recommendation**  |
|  |  |
|  |  |

# Topic #3: Measurement Accuracy Requirements for PRS RSRP (AI5.5.2.2.2.2)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104746**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2104746.zip)Discussion on PRS RSRP accuracy requirements | CATT | **Observation 1: There is no big difference on the measurement accuracy for SINR = -3dB and SINR = -6dB.** **Observation 2: When the PRS bandwidth is same, there is no big difference for the measurement error for different SCS.** **Observation 3: The measurement accuracy improves as the value of PRS\_NormLenthPerSlot increases. And the impact of PRS\_NormLenthPerSlot reduces when the PRS bandwidth become larger.** **Proposal 1: Define the side condition #1 for PRS RSRP measurement accuracy requirements in DL-AoD as -6dB.** **Proposal 2: The measurement accuracy of PRS RSRP is defined based on the PRS bandwidth and PRS\_NormLenthPerSlot.** **Proposal 3: Define the PRS RSRP measurement accuracy following the tables as below:** **Table 1 PRS RSRP measurement accuracy in FR1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| accuracy | PRS Ês/Iot | SCS | PRS BW | Repetition |
| dB | dB | kHz | PRB | - |
| [±3.5] | ≥[-6]dB | 15/30/60 | ≥[24] | ≥[1] |
| [±3.5] | ≥-13dB | ≥ [52] | ≥[1] |
| ≤ [52] | ＞[2] |
| [±4.5] | ≤ [52] | ≤[2] |

**Table 2 PRS RSRP measurement accuracy in FR2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| accuracy | PRS Ês/Iot | SCS | PRS BW | Repetition |
| dB | dB | kHz | PRB | - |
| [±3.5] | ≥[-6]dB | 60/120 | ≥[24] | ≥[1] |
| [±3.5] | ≥-13dB | ≥ [32] | ≥[1] |
| ≤ [32] | ＞[2] |
| [±4.5] | ≤ [32] | ≤[2] |

 |
|  CR on PRS-RSRP accuracy requirements | CATT | CR |
| [**R4-2106339**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106339.zip)On PRS-RSRP measurement accuracy requirements | Qualcomm | **Proposal 1: Add calibration error margin of ±2.5 dB to PRS-RSRP absolute accuracy requirements for FR1.****Proposal 2: Add calibration error margin of ±4.0 dB to PRS-RSRP absolute accuracy requirements for FR2.****Proposal 3: FFS the calibration error margins for PRS-RSRP relative accuracy requirements for FR1 and FR2.****Proposal 4: RAN4 needs to consider the following** **questions before deciding the calibration error margin for relative accuracy requirements:**1. **Whether relative accuracy requirements would apply to any two PRS-RSRP measurements reported for any positioning method using either absolute report mapping or differential report mapping.**
2. **Whether relative accuracy requirements would apply to any two PRS-RSRP measurements corresponding to PRS resources from different TRPs.**
3. **Whether relative accuracy requirements would apply to any two PRS-RSRP measurements made in different PFLs or in the same PFL.**
4. **Whether relative accuracy requirements would apply to any two PRS-RSRP measurements made in different FRs.**
5. **Whether relative accuracy requirements would apply to any two PRS-RSRP measurements made in the same PFL with different Rx antennas/paths.**
6. **Whether relative accuracy requirements would apply to any two PRS-RSRP measurements with a large difference in RSRP levels (different AGC) in the same PFL.**
7. **Whether relative accuracy requirements would apply to any two PRS-RSRP measurements made with different Rx beams in FR2.**

**Observation 1: Rx beam indication is only provided in certain cases for PRS-RSRP measurements reported for DL-AoD.** |
| [**R4-2106456**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106456.zip)Discussion on NR PRS RSRP measurement accuracy requirements | Intel Corporation | **Observation 1a: With the same PRS BW, when SINR is higher enough (>= -3dB) the performance gap because of DL-PRS-NumSymbols ,DL-PRS\_ResourceRepetitionFactor and DL-PRS-CombSizeN can be less than about 1dB**.**Observation 1b: With the same PRS BW, when SINR is higher enough (>= -13dB) the performance gap because of DL-PRS-NumSymbols ,DL-PRS\_ResourceRepetitionFactor and DL-PRS-CombSizeN can be less than about 2dB**.***Proposal 1 : The accuracy requirements of RSRP can be independent with the following parameters:**** **DL-PRS-NumSymbols**
* **DL-PRS\_ResourceRepetitionFactor**
* **DL-PRS-CombSizeN**

**Observation 2a: When SINR is higher enough (>= -3dB) the performance gap because of PRS BW can be less than 1dB**.**Observation 2b: When SINR is higher enough (>= -13dB) the performance gap because of PRS BW can be less than 5dB**.***Proposal 2-1 : The accuracy requirements of RSRP when SINR is larger than [-3dB] can be independent with PRS BS.******Proposal 2-2 : The accuracy requirements of RSRP when SINR is larger than [-13dB] can be dependent with PRS BS.*** ***Proposal 3 : The absolute accuracy requirements of PRS RSRP can be specified by the Table 1 below***.**Table 1: PRS RSRP Absolute Accuracy**

|  |  |  |  |
| --- | --- | --- | --- |
| **FR** | **PRS BW, MHz (or PRBs)** | **Accuracy (dB)****(SINR= -3dB)** | **Absolute Accuracy (dB)****(SINR= -13dB)** |
| **FR1** | **≥24** | [±2.0] | [±6.5] |
|  **≥ 52** | [±6.5] |
|
|
|
| **≥104** | [±5.0] |
|
|
|
|  **≥ 268** |  [±4.5] |
|
|
|
| **FR2** | **≥32**  | [±2.0] | [±6.0] |
|
|
|
| **≥64**  | [±6.0] |
|
|
|
| **≥128** | [±5.5] |
|
|
|

***Proposal 4 : The relative accuracy requirements of PRS RSRP can be specified by the Table 21 below***.**Table 2: PRS RSRP Relative Accuracy**

|  |  |  |  |
| --- | --- | --- | --- |
| **FR** | **PRS BW, MHz (or PRBs)** | **Accuracy (dB)****(SINR= -3dB)** | **Absolute Accuracy (dB)****(SINR= -13dB)** |
| **FR1** | **≥24** | [±2.0] | [±3.5] |
|  **≥ 52** | [±3.0] |
|
|
|
| **≥104** | [±3.0] |
|
|
|
|  **≥ 268** |  [±3.0] |
|
|
|
| **FR2** | **≥32**  | [±1.5] | [±3.0] |
|
|
|
| **≥64**  | [±2.0] |
|
|
|
| **≥128** | [±1.0] |

 |
| [**R4-2106521**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106521.zip)Discussion on PRS RSRP accuracy requirements | OPPO | **Proposal 1: -6dB SINR side condition should be introduced for PRS RSRP.****Proposal 2: For RSRP RF margin in FR1, support 2.5dB for absolute accuracy and 0dB for relative accuracy.****Observation 1: For PRS RSRP with high SINR side condition, the performance loss among with different PRS configurations are ignorable.** **Proposal 4: For PRS RSRP with high SINR side condition, support single set of accuracy requirements for different PRS configuration.** **Proposal 5: For PRS RSRP with low SINR side condition, the accuracy requirements should be defined based on PRS bandwidth\*normalized PRS length.****Table 4: PRS-RSRP accuracy requirements for FR1**

|  |  |  |  |
| --- | --- | --- | --- |
| Es/Iot (dB) | Absolute accuracy (dB) | Relativeaccuracy (dB) | Total number of PRS Res (i.e., PRS bandwidth\*normalized PRS length) |
| -6 | ±(1+2.5 margin) | ±(2.0+0 margin) | >=24\*12 |
| -13 | ±(6+2.5 margin) | ±(8.0+0 margin) | >=24\*12 |
| ±(1.5+2.5 margin) | ±(3.0+0 margin) | >=104\*12 |
| ±(1.0+2.5 margin) | ±(1.5+0 margin) | >=320\*12 |

 |
| [**R4-2106633**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106633.zip)Discussion on PRS-RSRP accuracy requirements | vivo | **Proposal 1: RF margin as in option 1 is used to define PRS-RSRP absolute and relative accuracy requirements.****Proposal 2: PRS-RSRP measurement accuracy rquirements are specified as in Table 1 and Table 2 for FR1 and FR2 respectively.**Table 1: PRS-RSRP measurement accuracy in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accuracy | PRS Ês/Iot | Minimum PRSbandwidth | PRS SCS | Total number of repetitions of PRS resource |
| dB | dB | RB | kHz |  |
|  | ≥ -3 | ≥ 24 | 15kHz | 1 |
|  | ≥ -3 | ≥ 24 | 15kHz | 4 |
|  | ≥ -3 | ≥ 52 | 15kHz | 1 |
|  | ≥ -3 | ≥ 52 | 15kHz | 4 |
|  | ≥ -3 | ≥ 104 | 15kHz | 1 |
|  | ≥ -3 | ≥ 104 | 15kHz | 4 |
|  | ≥ -3 | ≥ 268 | 15kHz | 1 |
|  | ≥ -3 | ≥ 268 | 15kHz | 4 |
|  | ≥ -3 | ≥ 48 | 30kHz | 1 |
|  | ≥ -3 | ≥ 48 | 30kHz | 4 |
|  | ≥ -3 | ≥ 132 | 30kHz | 1 |
|  | ≥ -3 | ≥ 132 | 30kHz | 4 |
|  | ≥ -3 | ≥ 272 | 30kHz | 1 |
|  | ≥ -3 | ≥ 272 | 30kHz | 4 |
|  | ≥-13 | ≥ 24 | 15kHz | 1 |
|  | ≥-13 | ≥ 24 | 15kHz | 4 |
|  | ≥-13 | ≥ 52 | 15kHz | 1 |
|  | ≥-13 | ≥ 52 | 15kHz | 4 |
|  | ≥-13 | ≥ 104 | 15kHz | 1 |
|  | ≥-13 | ≥ 104 | 15kHz | 4 |
|  | ≥-13 | ≥ 268 | 15kHz | 1 |
|  | ≥-13 | ≥ 268 | 15kHz | 4 |
|  | ≥-13 | ≥ 48 | 30kHz | 1 |
|  | ≥-13 | ≥ 48 | 30kHz | 4 |
|  | ≥-13 | ≥ 132 | 30kHz | 1 |
|  | ≥-13 | ≥ 132 | 30kHz | 4 |
|  | ≥-13 | ≥ 272 | 30kHz | 1 |
|  | ≥-13 | ≥ 272 | 30kHz | 4 |
|  | ≥-13 | ≥ 24 | 15kHz | 1 |

Table 2: PRS-RSRP measurement accuracy in FR2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accuracy | PRS Ês/Iot | Minimum PRSbandwidth | PRS SCS | Total number of repetitions of PRS resource |
| dB | dB | RB | kHz |  |
|  | ≥ -3 | ≥ 32 | 120kHz | 1 |
|  | ≥ -3 | ≥ 32 | 120kHz | 4 |
|  | ≥ -3 | ≥ 64 | 120kHz | 1 |
|  | ≥ -3 | ≥ 64 | 120kHz | 4 |
|  | ≥ -3 | ≥ 128 | 120kHz | 1 |
|  | ≥ -3 | ≥ 128 | 120kHz | 4 |
|  | ≥-13 | ≥ 32 | 120kHz | 1 |
|  | ≥-13 | ≥ 32 | 120kHz | 4 |
|  | ≥-13 | ≥ 64 | 120kHz | 1 |
|  | ≥-13 | ≥ 64 | 120kHz | 4 |
|  | ≥-13 | ≥ 128 | 120kHz | 1 |
|  | ≥-13 | ≥ 128 | 120kHz | 4 |

**Proposal 3: Parameters in Table 1 and Table 2 can be further simplified or grouped based on agreements on accuracy.** |
| [**R4-2107166**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107166.zip)On PRS-RSRP measurement accuracy requirements | Ericsson | ***Proposal 1****: The PRS-RSRP accuracy requirements shall apply for any DL-PRS-ResourceRepetitionFactor≥1 and any LPRS≥2 which is given by the higher-layer parameter dl-PRS-NumSymbols and any comb pattern.****Proposal 2****: For FR1, the absolute PRS-RSRP measurement accuracy is as in Table 1.***Table 1: Absolute PRS-RSRP accuracy in FR1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,****dB** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±3 | -3 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±2.5 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±2 | BW >132 | 15, 30 | All | All | All |
| ±4.5 | -6 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±3.5 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±2.5 | BW >132 | 15, 30 | All | All | All |
| ±7 | -13 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±5 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±3 | BW >132 | 15, 30 | All | All | All |

***Proposal 3****: For FR2, the absolute PRS-RSRP measurement accuracy is as in Table 2.***Table 2: Absolute PRS-RSRP accuracy in FR2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,****dB** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±4 | -3 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±3.5 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±3 | BW >64 | 60, 120 | All | All | All |
| ±6 | -6 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±5 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±4 | BW >64 | 60, 120 | All | All | All |
| ±9 | -13 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±7 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±6 | BW >64 | 60, 120 | All | All | All |

* ***Proposal 4****: The PRS-RSRP accuracy is defined based on the earlier agreed 4 samples (already in the core requirements). RAN4 shall not reopen the discussion on the number of samples.*
* ***Proposal 5****: discuss the collected simulation results for the agreed side conditions (-3 dB and -13 dB). Note: -6 dB somehow was mistakenly used in the template in RAN4#98-e in R4-2104092.*
 |
| [**R4-2107008**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107008.zip)Discussion on accuracy requirements for PRS-RSRP measurement | Huawei, HiSilicon | **Proposal 1: The RF margin for PRS-RSRP accuracy is defined as** * **2.5dB for FR1 absolute accuracy requirements**
* **4dB for FR2 absolute accuracy requirements**
* **0dB for FR1 relative accuracy requirements**
* **0dB for FR2 relative accuracy requirements, provided that two PRS-RSRP are measured with the same Rx beam**

**Proposal 2: PRS-RSRP accuracy requirements are defined based on PRS configuration parameters of** * **PRS BW defined in number of PRBs**
* **PRS repetition factor *dl-PRS-ResourceRepetitionFactor \* dl-PRS-NumSymbols / dl-PRS-CombSizeN***

**Proposal 3a: For -3dB side condition, define a single set of accuracy requirements based on 24-PRB and no repetition.****Proposal 3b: For -13dB side condition, consider the following two options.*** **Option 1: define a single accuracy for all BWs based on different repetitions.**
* **Option 2: define different accuracies for different BWs based on no repetition**
 |

## Open issues summary and companies’ views collection for 1st round

### Sub-topic 3-1 PRS-RSRP SINR side condition of #1

Candidate options:

* Option 1(OPPO): -6dB
* Option 1a (CATT): Define the side condition #1 for PRS RSRP measurement accuracy requirements in DL-AoD as -6dB.
* Option 2 (Ericsson): -3dB

Recommended WF: Could we agreed [-3dB] as there is ignorable performance variance and [-3dB] was agreed in the last meeting?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Since there are not obvious performance gap when SINR is -3dB and -6dB, we prefer to keep the -3dB as the side condition. So we can support Option 2 and recommended WF. |
| CATT | Support option 1a. It has been agreed that when the PRS RSRP measurement is configured to be measured along with RSTD or UE Rx-Tx time difference measurement, the side condition of PRS-RSRP should follow those of RSTD or Rx-Tx time difference measurement respectively. Then there is one thing to be clarified that whether the PRS-RSRP measurement is needed for reference cell in DL-TDOA? If it is needed, then the PRS-RSRP accuracy requirements for -6dB is needed. Also while there is ignorable performance variance between -6dB and -3dB, why the side condition is defined as a higher value? |
| vivo | Recommended WF is fine. In addition, would SINR side condition for RSTD measurement accuracy requirements be also specified with (-3dB, -13dB)? |
| Huawei  | We are fine with either option. |
| Ericsson | Support the WF and option 2 |
| Qualcomm | Since there seems to be little difference in performance between the two options, one might argue that either choice is OK. However, option 1 is more inclusive because of the lower side-condition. Why is that not preferable? Also, option 1 is the same as the reference cell side condition for RSTD. Consistency between the side conditions would be another reason to prefer option 1a over option 2. Is there a compelling reason to choose option 2? We’re willing to discuss. For now, we prefer option 1a. |
| OPPO | Support option 1 and option 1a. |

### Sub-topic 3-2 How to define the accuracy requirements with the combinations of PRS BW and other parameters (e.g., comb size, repetition)

* Option 1a (Huawei).
	+ For -3dB side condition, define a single set of accuracy requirements based on 24-PRB and no repetition.
	+ For -13dB side condition, consider the following two options.
		- define a single accuracy for all BWs based on different repetitions or
		- define different accuracies for different BWs based on no repetition
* Option 1b (Intel, CATT): PRS-RSRP accuracy requirements are defined based on PRS configuration parameters of
	+ when SINR >[-3dB] , single set requirement
	+ when SINR >[-13dB]
		- PRS BW defined in number of PRBs
* Option 1c (Ericsson): *The PRS-RSRP accuracy requirements*
	+ Apply for:
		- any DL-PRS-ResourceRepetitionFactor≥1 and
		- any LPRS≥2 which is given by the higher-layer parameter dl-PRS-NumSymbols
		- any comb pattern.
	+ Dependend on PRS BW in PRBs
* Option 1d(OPPO)
	+ For PRS RSRP with high SINR side condition, support single set of accuracy requirements for different PRS configuration
	+ For PRS RSRP with low SINR side condition, the accuracy requirements should be defined based on PRS bandwidth\*normalized PRS length.
* Option 2. (vivo) Requirement sets can be further simplified or grouped based on agreements on accuracy.

Recommended WF: *Regarding to the options above are quite similar, could we agree the following proposal?*

* when SINR >[-3dB] ,
	+ single set requirement for all parameter sets
* when SINR >[-13dB]
	+ single set requirement for all parameter sets or
	+ multiple requirements depending on PRS BW (in PRBs )

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | According to the proposals on the RSRP requirements and simulation results from the different companies, there is little variance in case of SINR=-3/-6dB. So the single requirement for high SINR can be agreed. And for the requirements for low SINR (-13dB), we have not strong preference. But if we need to define the multiple requirements for PRS RSRP, only the PRS BW need to be considered.  |
| CATT | Support option 1b.  |
| vivo | In principle, recommended WF is fine. For SINR > [-13]dB, our view is that two set of requirements would be enough depending on PRS BW, e.g. one for smaller PRS BW and the other for larger PRS BW. Single set of requirements for lower SINR is not enough. |
| Huawei | We are fine with the Recommended WF, except that the repetition number may need to be considered also. |
| Qualcomm | In our view, specifying different requirements as a function of num PRBs may be warranted for the lower side condition of -13 dB. Given that, we’re not sure if there would be much saving in specifying only a single requirement for all PRBs at the higher side condition (presumably they would be listed in the same table). We don’t have a very strong opinion on this.We agree with Huawei that number of repetitions should be included in the proposed WF.  |
| OPPO | We can support the recommended WF as the starting point. For SINR >-13dB, our preference is to define multiple requirements depending on PRS BW and repetitions based on the simulation results. But we are open to discuss the whether and how to capture repetitions in accuracy requirements. |

### Sub-topic 3-3 RF calibration margin

Candidate options:

* Option 1(Huawei, vivo):

The RF margin for PRS-RSRP accuracy is defined as

* + 2.5dB for FR1 absolute accuracy requirements
	+ 4dB for FR2 absolute accuracy requirements
	+ 0dB for FR1 relative accuracy requirements
	+ 0dB for FR2 relative accuracy requirements, provided that two PRS-RSRP are measured with the same Rx beam
* Option 1a (Qualcomm):
	+ ±2.5 dB to PRS-RSRP absolute accuracy requirements for FR1.
	+ ±4.0 dB to PRS-RSRP absolute accuracy requirements for FR2.
	+ FFS the calibration error margins for PRS-RSRP relative accuracy requirements for FR1 and FR2.
		- RAN4 needs to consider the following questions before deciding the calibration error margin for relative accuracy requirements:
			* Whether relative accuracy requirements would apply to any two PRS-RSRP measurements reported for any positioning method using either absolute report mapping or differential report mapping.
			* Whether relative accuracy requirements would apply to any two PRS-RSRP measurements corresponding to PRS resources from different TRPs.
			* Whether relative accuracy requirements would apply to any two PRS-RSRP measurements made in different PFLs or in the same PFL.
			* Whether relative accuracy requirements would apply to any two PRS-RSRP measurements made in different FRs.
			* Whether relative accuracy requirements would apply to any two PRS-RSRP measurements made in the same PFL with different Rx antennas/paths.
			* Whether relative accuracy requirements would apply to any two PRS-RSRP measurements with a large difference in RSRP levels (different AGC) in the same PFL.
			* Whether relative accuracy requirements would apply to any two PRS-RSRP measurements made with different Rx beams in FR2.

Recommended WF: *Could we agree the following proposals*

* + 2.5dB for FR1 absolute accuracy requirements
	+ 4dB for FR2 absolute accuracy requirements
	+ FFS the calibration error margins for PRS-RSRP relative accuracy requirements for FR1 and FR2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | The recommended WF can be agreeable for us. |
| vivo | The recommended WF is fine for us. |
| Huawei | The recommended WF can be agreeable for us.Regarding the relative accuracy, we understand the target scenario is DL-AoD, where the difference between RSRPs measured on different PRS resources from the resource set is used for AoD estimation. We can further check the questions in option 2. |
| Ericsson | We are fine with the recommended WF |
| Qualcomm | The recommended WF is agreeable. |

### Sub-topic 3-4 PRS RSRP accuracy requirements

*[Moderator notes: the exact accuracy requirements can be discussed after the principles above agreed. And the accuracy requirements below were not include any margin.]*

* Option 1 (Intel)
* **Table 1: PRS RSRP Absolute Accuracy**

|  |  |  |  |
| --- | --- | --- | --- |
| **FR** | **PRS BW, MHz (or PRBs)** | **Absolute Accuracy (dB)****(SINR= -3dB)** | **Absolute Accuracy (dB)****(SINR= -13dB)** |
| **FR1** | **≥24** | [±2.0] | [±6.5] |
|  **≥ 52** | [±6.5] |
|
|
|
| **≥104** | [±5.0] |
|
|
|
|  **≥ 268** |  [±4.5] |
|
|
|
| **FR2** | **≥32**  | [±2.0] | [±6.0] |
|
|
|
| **≥64**  | [±6.0] |
|
|
|
| **≥128** | [±5.5] |
|
|
|

**Table 2: PRS RSRP Relative Accuracy**

|  |  |  |  |
| --- | --- | --- | --- |
| **FR** | **PRS BW, MHz (or PRBs)** | **Accuracy (dB)****(SINR= -3dB)** | **Absolute Accuracy (dB)****(SINR= -13dB)** |
| **FR1** | **≥24** | [±2.0] | [±3.5] |
|  **≥ 52** | [±3.0] |
|
|
|
| **≥104** | [±3.0] |
|
|
|
|  **≥ 268** |  [±3.0] |
|
|
|
| **FR2** | **≥32**  | [±1.5] | [±3.0] |
|
|
|
| **≥64**  | [±2.0] |
|
|
|
| **≥128** | [±1.0] |

* Option 2 (OPPO)
* **Table 4: PRS-RSRP accuracy requirements for FR1**

|  |  |  |  |
| --- | --- | --- | --- |
| Es/Iot (dB) | Absolute accuracy (dB) | Relativeaccuracy (dB) | Total number of PRS Res (i.e., PRS bandwidth\*normalized PRS length) |
| -6 | ±(1+2.5 margin) | ±(2.0+0 margin) | >=24\*12 |
| -13 | ±(6+2.5 margin) | ±(8.0+0 margin) | >=24\*12 |
| ±(1.5+2.5 margin) | ±(3.0+0 margin) | >=104\*12 |
| ±(1.0+2.5 margin) | ±(1.5+0 margin) | >=320\*12 |

* Option 3 (Ericsson) For FR1, the absolute PRS-RSRP measurement accuracy is as in Table 1.

**Table 1: Absolute PRS-RSRP accuracy in FR1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,****dB** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±3 | -3 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±2.5 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±2 | BW >132 | 15, 30 | All | All | All |
| ±4.5 | -6 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±3.5 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±2.5 | BW >132 | 15, 30 | All | All | All |
| ±7 | -13 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±5 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±3 | BW >132 | 15, 30 | All | All | All |

**Table 2: Absolute PRS-RSRP accuracy in FR2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,****dB** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±4 | -3 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±3.5 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±3 | BW >64 | 60, 120 | All | All | All |
| ±6 | -6 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±5 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±4 | BW >64 | 60, 120 | All | All | All |
| ±9 | -13 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±7 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±6 | BW >64 | 60, 120 | All | All | All |

* Option 4(CATT):
	+ Define the PRS RSRP measurement accuracy following the tables as below:

**Table 1 PRS RSRP measurement accuracy in FR1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| accuracy | PRS Ês/Iot | SCS | PRS BW | Repetition |
| dB | dB | kHz | PRB | - |
| [±3.5] | ≥[-6]dB | 15/30/60 | ≥[24] | ≥[1] |
| [±3.5] | ≥-13dB | ≥ [52] | ≥[1] |
| ≤ [52] | ＞[2] |
| [±4.5] | ≤ [52] | ≤[2] |

**Table 2 PRS RSRP measurement accuracy in FR2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| accuracy | PRS Ês/Iot | SCS | PRS BW | Repetition |
| dB | dB | kHz | PRB | - |
| [±3.5] | ≥[-6]dB | 60/120 | ≥[24] | ≥[1] |
| [±3.5] | ≥-13dB | ≥ [32] | ≥[1] |
| ≤ [32] | ＞[2] |
| [±4.5] | ≤ [32] | ≤[2] |

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | In principle, Option 1,2,3 are fine for us. How to define the exact conditions to differentiate the multiple requirements set in case of low SINR by PRS BW can be decided based on the simulation results. For Option 4, it seems no need to define the different requirements when rep is >1 according to your results below

|  |
| --- |
| [-0.81,2.28] |
| [-0.89,1.73] |

 |
| CATT | Support option 4. But can wait for the conclusions of general principle discussion. To Intel: From our results, when the bandwidth is smaller than 52dB, the results for all repetition factor ＞1 has no big difference. So only one requirement is suggested. But when the bandwidth is smaller than 52dB, the results for repetition ≤2 ([-0.81,2.28], [-0.89,1.73]) and repetition factor ＞2 ([-0.56,1.21], [-0.50,1.07]) has much difference. So different requirements are suggested. Similar principle for FR2.  |
| vivo | Option 4 can be starting point to define accuracy requirements. |
| Huawei | We suggest to discuss the general principles for -13dB, e.g. do we * + - define a single accuracy for all BWs based on different repetitions or
		- define different accuracies for different BWs based on no repetition?

We suggest to define to repetition number as side condition, and we do not support to define separate requirements for different repetition numbers for a certain BW. |
| Qualcomm | Agree that we can focus on defining requirements for SINR = -13 dB first. The high SINR side condition should be simpler.First, for PRS-RSRP, SCS can be ignored. Second, we think there should group the requirements into 4-5 bandwith bins across the range of configurable PRS bandwidths and these should be common (reused) across measurement types (RSTD, RSRP, UE Rx-Tx) for consistency/uniformity. The reference configurations for the test cases should align with the BW bins/ranges. Also, we agree that a minimum number of repetitions should be specified per BW bin.None of the options include all of the above. A combination of options 1 and 4 could serve as a baseline for further discussion. |

###  CRs/TPs

[Moderator notes: suggest take one of these CR drafts as the baseline which can be revised in 2nd round discussion.]

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
|  [[**R4-2104747**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2104747.zip)](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/R4-2100446.zip) **(CATT)**  |  |
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## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#3-1a** | **SINR side condition***Tentative agreements:* * + Agreements:
		- PRS-RSRP SINR side condition of #1 is -3dB

*Candidate options:**Recommendations for 2nd round: No further discussion.*  |
| **Sub-topic#3-2** | **How to define the accuracy requirements with the combinations of PRS BW and repetitions** *Tentative agreements:** when SINR >[-3dB] ,
	+ single set requirement for all parameter sets
* when SINR >[-13dB]
	+ multiple requirements depending on PRS BW (in PRBs )

*Candidate options:**Recommendations for 2nd round: Please companies check the tentative agreements is acceptable.* |
| **Sub-topic#3-3** | **RF margin***Tentative agreements:** + 2.5dB for FR1 absolute accuracy requirements
	+ 4dB for FR2 absolute accuracy requirements
	+ FFS the calibration error margins for PRS-RSRP relative accuracy requirements for FR1 and FR2

*Candidate options:**Recommendations for 2nd round. No further discussion needed in this meeting.* |
| **Sub-topic#3-4** | **PRS RSRP accuracy requirements***Tentative agreements:**Candidate options:**Recommendations for 2nd round:* Continue discussion on alignment. How to structure the requirements can be identified based on averaged results. |

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| [[**R4-2104747**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2104747.zip)](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/R4-2100446.zip) **(CATT)** | Revised |
|  |  |
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## Discussion on 2nd round

Please only comment on topics that are selected for discussion in 2nd round.

### Sub-topic 3-2 How to define the accuracy requirements with the combinations of PRS BW and other parameters (e.g., comb size, repetition)

*[Moderator notes: Qualcomm proposed that “min number of repetitions depending on PRS BW” shall be considered as one of parameters to define RSRP requirements. But based on the simulation results we got, there is very small variance when the repetition different but PRS BW same. Therefore, we suggest we can reconsider the tentative agreement is agreeable for you in 2nd discussion]*

*Recommended WF: tentative agreements:*

* when SINR >[-3dB] ,
	+ single set requirement for all parameter sets
* when SINR >[-13dB]
	+ multiple requirements depending on PRS BW (in PRBs )

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company 1 |  |
| Intel | We support the tentative agreements.According to the simulation results from all companies, we didn’t see the obvious variance when repetition are different with same PRS BW. For an example, SINR=-13dB, PRS BW=52, the average results for different repletion and comb, symb are give below, there is less than.1.5dB variance. For other PRS BW larger, such variance will be smaller)

|  |
| --- |
| 3.5 |
| 3.7 |
| 3.3 |
| 2.2 |
| 2.2 |

 |
| vivo | Support recommended WF. |
| Qualcomm | We agree that there is limited differentiation in some cases such as the one shown above, but given that a) we are still expecting simulation results to be updated in the next meeting, and b) we are still discussing whether separate requirements will be specified for AWGN and fading conditions, we think it is reasonable to keep this option open. Otherwise, if we exclude number of repetitions now it will be harder to reconsider in the next meeting.Support to keep the number of repetitions as a parameter for now and decide based on simulation results to be updated in the next meeting and the outcome of sub-topic 2-2-1. |
|  |  |

### Sub-topic 3-4 PRS RSRP accuracy requirements

*[Moderator notes: As no concerns on the tentative agreements for sub-topic 3-2. We can define RSRP requirements based on the table below and averaged simulation results in [R4-2106457] ].*

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**Table 1: PRS-RSRP accuracy in FR1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Absolute** **Accuracy,****dB** | **Relative** **Accuracy,****dB** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor per slot** **[38.211]** |
| [±1.5] | [±1.2] | -3 | ≥[24] | 15, 30, 60 | All |
| [±6.3] | [±3.6] | -13 | 24 ≤ BW ≤ 52 | 15, 30, 60 | All |
| [±3.5] | [±2.9] | 52< BW≤ 104 | 15, 30, 60 | All |
| [±2.6] | [±2.2] | BW >104 | 15, 30, 60 | All |

**Table 2: PRS-RSRP accuracy in FR2**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Absolute** **Accuracy,****dB** | **Relative** **Accuracy,****dB** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor per slot** **[38.211]** |
| [±1.1] | [±0.9] | -3 | ≥[24] | 60,120 | All |
| [±4.6] | [±2.3] | -13 | 24 ≤ BW ≤ 64 | 60,120 | All |
| [±2.7] | [±2.0] | BW >64 | 60,120 | All |

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company 1 |  |
| Intel | Support the recommended WF. The exact value can be updated depending on the corresponding simulation results updating if have. |
| vivo | Support recommended WF.The exact value can be decided in the next meeting. |
| Qualcomm | Similar comments as in sub-topic 2-3&2-6 (2nd round).In addition, we should have separate tables for absolute and relative accuracy requirements since they will be in different sections.We would support the structure below as baseline for FR1. Repetition factor could be ≥1 for some BW bins. Similar structure for FR2.We suggest to use the same BW ranges as for RSTD as baseline. We can always reduce the number of bins based on the final results.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Absolute accuracy,** **dB** | **Es/Iot,** **dB** | **PRS BW,****PRB** | **PRS SCS,****kHz** | **Repetition factor**  | **Repetition within slot**  |
| **TBD** | ≥-3 | **[ ]** | 15, 30, 60 | ≥TBD | ≥1 |
| **TBD** | ≥-13 | **[ ]** | 15, 30, 60 | ≥TBD | ≥1 |

 |
|  |  |

**Sub-topic 3-3 RF margin**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company A  |  |
| Intel | FFS the calibration error margins for PRS-RSRP relative accuracy requirements for FR1 and FR2 in the next meeting. |
| Qualcomm | We are OK with keeping the PRS-RSRP relative accuracy margins as FFS until the next meeting. We look forward to discussing all the questions we posed. |
|  |  |
|  |  |

## Summary on 2nd round

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc status update recommendation**  |
|  |  |
|  |  |

# Topic #4: Measurement Accuracy Requirements for UE Rx-Tx Time Difference (AI5.5.2.2.2.3)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2106455**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106455.zip)Discussion on NR UE RX-TX time difference measurement accuracy requirements | Intel Corporation | ***Proposal 1 : UE Rx-Tx measurement requirements in TS38.133 shall be applicable unless the NTA\_offset changes during the measurement period.******Proposal 2: The accuracy of UE Rx-Tx time difference can be specified by the Table 1 below***.**Table 1: UE Rx-Tx difference measurement accuracy requirements (ns)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **FR** | **PRS BW (PRBs)** | **PRS\_NormLenthPerSlot** |  **SINR= [-6dB]** |  **SINR= -13dB** |
| FR1 | 52 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| 104 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| 268 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| FR2 | 32 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| 64 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| 128 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| Note 1: **PRS\_NormLenthPerSlot = (DL-PRS-NumSymbols x DL-PRS\_ResourceRepetitionFactor) /DL-PRS-CombSizeN** |

 |
| [**R4-2106340**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106340.zip) On UE Rx-Tx measurement accuracy requirements | Qualcomm Incorporated | **Proposal 1: Clarify in section 10.1.25.2 in TS 38.133: “UE Rx-Tx time difference accuracy requirements shall not apply if NTA\_offset defined in Table 7.1.2-2 in 38.133 changes during the UE Rx-Tx measurement period.”****Proposal 2a: UE Rx-Tx measurement accuracy requirements shall not apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to network-configured TA command.****Proposal 2b: UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.****Proposal 3: UE Rx-Tx measurement accuracy requirements in the case of serving cell changes other than HO that do not impact the configuration of SRS for positioning are FFS.****Proposal 4: RAN4 will add a non-zero group delay calibration margin to the UE Rx-Tx accuracy requirements in FR1 and FR2. FFS the exact values of the margins for FR1 and FR2.****Observation 1: The group delay calibration margin should scale inversely with PRS bandwidth.****Proposal 5: For UE Rx-Tx measurements in FR1, add a group delay calibration margin of 4 ns \* (100/BW), where BW is the PRS bandwidth in MHz, to the accuracy requirements.** |
| [**R4-2107167**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107167.zip) On UE Rx-Tx measurement accuracy requirements | Ericsson | ***Proposal 1****: Clarify in section 10.1.25.2 in TS 38.133: “UE Rx-Tx time difference accuracy requirements shall not apply if NTA\_offset defined in Table 7.1.2-2 in 38.133 changes during the UE Rx-Tx measurement period.”****Proposal 2****: UE Rx-Tx measurement accuracy requirements shall not apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment or based on network-configured TA.****Proposal 3****: The UE shall continue and complete a UE Rx-Tx measurement while meeting UE Rx-Tx measurement accuracy requirements in clause 10.1.23, when a serving cell change (including Scell change, addition, release, activation, or deactivation, or PSCell change, addition, or release) occurs during the measurement, provided the cell change does not impact the configuration of the SRS used for the measurement.****Proposal 4****: The UE Rx-Tx accuracy requirements shall apply for any DL-PRS-ResourceRepetitionFactor≥1 and any LPRS≥2 which is given by the higher-layer parameter dl-PRS-NumSymbols and any comb pattern.****Proposal 7****: The UE Rx-Tx accuracy is defined based on the earlier agreed 4 samples (already in the core requirements). RAN4 shall not reopen the discussion on the number of samples.****Proposal 5****: For FR1, the UE Rx-Tx measurement accuracy is as in Table 1:***Table 1: UE Rx-Tx accuracy in FR1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±60 | -3 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±30 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±20 | BW >132 | 15, 30 | All | All | All |
| ±70 | -6 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±40 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±25 | BW >132 | 15, 30 | All | All | All |
| ±90 | -13 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±50 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±30 | BW >132 | 15, 30 | All | All | All |

***Proposal 6****: For FR2, the UE Rx-Tx measurement accuracy is as in Table 2:***Table 2: UE Rx-Tx accuracy in FR2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±70 | -3 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±40 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±25 | BW >64 | 60, 120 | All | All | All |
| ±90 | -6 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±50 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±30 | BW >64 | 60, 120 | All | All | All |
| ±100 | -13 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±60 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±40 | BW >64 | 60, 120 | All | All | All |

 |
| [**R4-2107168**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107168.zip)UE Rx-Tx measurement accuracy requirements | Ericsson | CR |
| [**R4-2107009**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107009.zip)Discussion on accuracy requirements for UE Rx-Tx time difference measurement | Huawei, HiSilicon | **Proposal 1: Capture in the specification that UE Rx-Tx accuracy requirements do not apply in case the UE UL timing changes during the measurement period.****Proposal 2: Accuracy requirements apply with serving cell change, provided that the serving cell change does not impact the UL timing. No need to capture this in the spec.****Proposal 3: Use 32Tc as the group delay calibration margin for UE Rx-Tx accuracy.****Proposal 4: UE Rx-Tx accuracy requirements are defined based on PRS configuration parameters of** * **PRS BW defined in number of PRBs**
* **PRS SCS**
* **PRS repetition factor *dl-PRS-ResourceRepetitionFactor \* dl-PRS-NumSymbols / dl-PRS-CombSizeN***

**Proposal 5: Use Table 1 as template to form UE Rx-Tx accuracy requirements.****Table 1: Template for UE Rx-Tx accuracy requirements**

|  |  |  |  |
| --- | --- | --- | --- |
| **Accuracy (Tc)** | **SCS (kHz)** | **PRB num** | **Repetition**  |
|  | 15/30/60/120 | 24-40 | 2 for -13dB |
| 1 for -6dB |
|  | 44-84 | 1 |
|  | 88-168 | 1 |
|  | 172-max | 1 |

**Proposal 4: Use 32Tc as the group delay calibration margin for UE Rx-Tx accuracy.****Proposal 5: Capture in the specification that UE Rx-Tx accuracy requirements do not apply in case the UE UL timing changes during the measurement period.** |
| [**R4-2106522**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106522.zip) | OPPO | **Proposal 1: For the applicability of accuracy requirements under TA adjustment, support option 2:*** **UE Rx-Tx measurement accuracy requirements shall not apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to network-configured TA command.**
* **UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment**
 |
| [**R4-2106634**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106634.zip) | vivo | **Proposal 1: UE Rx-Tx time difference accuracy requirements shall not apply if NTA\_offset defined in Table 7.1.2-2 in 38.133 changes during the UE Rx-Tx measurement period****Proposal 2: UE Rx-Tx measurement accuracy requirements shall not apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to network-configured TA command.** **Proposal 3: UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment****Proposal 4: For the serving cell change not impacting SRS configuration, the UE shall continue the on-going UE Rx-Tx time difference measurement and the current measurement accuracy requirements apply.****Proposal 5: UE Rx-Tx time difference measurement accuracy equirements are specified as in Table 1 and Table 2 for FR1 and FR2 respectively.**Table 1: UE Rx-Tx time difference measurement accuracy in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accuracy | PRS Ês/Iot | Minimum PRSbandwidth | PRS SCS | Total number of repetitions of PRS resource |
| Ts | dB | RB | kHz |  |
|  | ≥ -3 | ≥ 24 | 15kHz | 1 |
|  | ≥ -3 | ≥ 24 | 15kHz | 4 |
|  | ≥ -3 | ≥ 52 | 15kHz | 1 |
|  | ≥ -3 | ≥ 52 | 15kHz | 4 |
|  | ≥ -3 | ≥ 104 | 15kHz | 1 |
|  | ≥ -3 | ≥ 104 | 15kHz | 4 |
|  | ≥ -3 | ≥ 268 | 15kHz | 1 |
|  | ≥ -3 | ≥ 268 | 15kHz | 4 |
|  | ≥ -3 | ≥ 48 | 30kHz | 1 |
|  | ≥ -3 | ≥ 48 | 30kHz | 4 |
|  | ≥ -3 | ≥ 132 | 30kHz | 1 |
|  | ≥ -3 | ≥ 132 | 30kHz | 4 |
|  | ≥ -3 | ≥ 272 | 30kHz | 1 |
|  | ≥ -3 | ≥ 272 | 30kHz | 4 |
|  | ≥-13 | ≥ 24 | 15kHz | 1 |
|  | ≥-13 | ≥ 24 | 15kHz | 4 |
|  | ≥-13 | ≥ 52 | 15kHz | 1 |
|  | ≥-13 | ≥ 52 | 15kHz | 4 |
|  | ≥-13 | ≥ 104 | 15kHz | 1 |
|  | ≥-13 | ≥ 104 | 15kHz | 4 |
|  | ≥-13 | ≥ 268 | 15kHz | 1 |
|  | ≥-13 | ≥ 268 | 15kHz | 4 |
|  | ≥-13 | ≥ 48 | 30kHz | 1 |
|  | ≥-13 | ≥ 48 | 30kHz | 4 |
|  | ≥-13 | ≥ 132 | 30kHz | 1 |
|  | ≥-13 | ≥ 132 | 30kHz | 4 |
|  | ≥-13 | ≥ 272 | 30kHz | 1 |
|  | ≥-13 | ≥ 272 | 30kHz | 4 |
|  | ≥-13 | ≥ 24 | 15kHz | 1 |

Table 2: UE Rx-Tx time difference measurement accuracy in FR2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accuracy | PRS Ês/Iot | Minimum PRSbandwidth | PRS SCS | Total number of repetitions of PRS resource |
| Ts | dB | RB | kHz |  |
|  | ≥ -3 | ≥ 32 | 120kHz | 1 |
|  | ≥ -3 | ≥ 32 | 120kHz | 4 |
|  | ≥ -3 | ≥ 64 | 120kHz | 1 |
|  | ≥ -3 | ≥ 64 | 120kHz | 4 |
|  | ≥ -3 | ≥ 128 | 120kHz | 1 |
|  | ≥ -3 | ≥ 128 | 120kHz | 4 |
|  | ≥-13 | ≥ 32 | 120kHz | 1 |
|  | ≥-13 | ≥ 32 | 120kHz | 4 |
|  | ≥-13 | ≥ 64 | 120kHz | 1 |
|  | ≥-13 | ≥ 64 | 120kHz | 4 |
|  | ≥-13 | ≥ 128 | 120kHz | 1 |
|  | ≥-13 | ≥ 128 | 120kHz | 4 |

 |

## Open issues summary and companies’ views collection for 1st round

### Sub-topic 4-1 Applicability of accuracy requirements in the case of NTA\_offset change

* Option 1(Ericsson, Intel, Qualcomm): Clarify in section 10.1.25.2 in TS 38.133: “UE Rx-Tx time difference accuracy requirements shall not apply if NTA\_offset defined in Table 7.1.2-2 in 38.133 changes during the UE Rx-Tx measurement period.”
* Option 2 (Huawei, OPPO, vivo): Capture in the specification that UE Rx-Tx accuracy requirements do not apply in case the UE UL timing changes during the measurement period

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | NTA\_offset change will impact the UL timing. So we support Option 1. But for Option 2, we are also fine depending how these clarifications are to be captured exactly. So the proponents of Option 2 can propose the exact words or sentence for such clarification to be checked.  |
| CATT | Support option 2. It can include the option 1 and it is not necessary to clarify the NTA\_offset change since it is a constant.  |
| Vivo | If this topic is only for NTA\_offset, then option 1 should be agreeable, which is also our proposal. If UL timing change due to TA command is also considered, option 2 is more generic. |
| Huawei | Support option 2.The wording can something like “UE Rx-Tx accuracy requirements do not apply in case the UE UL timing changes during the measurement period”. |
| Ericsson | We support option 1. Problem with option 2 is that the term, “UE UL timing changes” is too generic and road. It may lead to misinterpretation of the requirements. The UL timing includes everything and may even include other aspects e.g. timing change due to single UL Tx switching(single UL CC in MR-DC), timing change due to antenna switching etc. We therefore suggest separate bullet for all cases:* UE Rx-Tx measurement accuracy requirements shall not apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to any of:
	+ NTA\_offset defined in Table 7.1.2-2 in 38.133 changes during the UE Rx-Tx measurement period,
	+ Network-configured TA command and
	+ FFS: autonomous timing adjustment.

The last bullet is FFS as some companies do not want to include autonomous adjustment.  |
| Qualcomm | We support option 1 and we prefer to keep different cases separate. |
| OPPO | We prefer option 2 and can also compromise to option 1. |

### Sub-topic 4-2 Applicability of accuracy requirements under TA adjustment

* Option 1. (Ericsson)
	+ UE Rx-Tx measurement accuracy requirements shall not apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment or based on network-configured TA
* Option 2. (Qualcomm, vivo, OPPO)
	+ UE Rx-Tx measurement accuracy requirements shall not apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to network-configured TA command.
	+ UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment
* Option 3. (Huawei):
	+ Capture in the specification that UE Rx-Tx accuracy requirements do not apply in case the UE UL timing changes during the measurement period

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | No strong preference. These three options are fine for us. In our understanding, if the timing change by UE autonomously shall be known by UE itself, UE then can report the exact UE Rx-Tx time difference to NW exclude such adjustment. |
| CATT | Support option 3.  |
| Vivo | Support option 2. For the TA change due to UE autonomous adjustment, UE should continue Rx-Tx time difference measurement and measurement period requirements and accuracy requirements should be applicable. The UE autonomous adjustment of uplink transmit timing could happen very frequently, e.g., every 200ms. If UE always aborts ongoing measurement, then UE may never finish the measurement. Furthermore, since the UE autonomous adjustment is gradual, the impact on positioning accuracy would be acceptable. |
| Huawei | Support option 3 which can accommodate also option 1 and option 2.We think what Intel mentioned above is a new UE behavior (UE to exclude the impact of UL timing change when deriving Rx-Tx). |
| Ericsson | Support option 1. Our see out comments in subtopic 4-1. |
| Qualcomm | We support option 2. |
| OPPO | Support option 2. |

### Sub-topic 4-3 Applicable accuracy requirement in case of other (non-HO) serving cell changes

Candidate options

* Option 1 (Ericsson, vivo): The UE shall continue and complete a UE Rx-Tx measurement while meeting UE Rx-Tx measurement accuracy requirements in clause 10.1.23, when a serving cell change (including Scell change, addition, release, activation, or deactivation, or PSCell change, addition, or release) occurs during the measurement, provided the cell change does not impact the configuration of the SRS used for the measurement.
* **Option 2(Huawei): Accuracy requirements apply with serving cell change, provided that the serving cell change does not impact the UL timing. No need to capture this in the spec.**

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Option 1 is fine for us. In our understanding, Option 2 is quite similar as Option 1 but with some wording clarification (e.g. what the exact UL timing impacts is )  |
| CATT | The clarification in sub-topic 4-1 and 4-2 is sufficient and no need to further capture the sentence above.  |
| Vivo | Option 1 is fine considering similar agreements for handover. |
| Huawei | Support option 2. Same comment as CATT. |
| Ericsson | Option 1. Option 2 is too vague. It may happen in some situation such as in small cells that the serving cell change does not impact the UL timing; but the SRS configuration changes. In this case the UE should not continue the measurement. But according to option 2 the UE will continue the measurement which is incorrect.  |
| Qualcomm | In our view this is not high priority and can be FFS. |

### Sub-topic 4-4 How to define the accuracy requirements with the combinations of PRS BW and other parameters (e.g. comb size, repetition)

* Option 1 (Huawei, vivo). UE Rx-Tx accuracy requirements are defined based on PRS configuration parameters of
	+ PRS BW defined in number of PRBs
	+ PRS SCS
	+ PRS repetition factor *dl-PRS-ResourceRepetitionFactor \* dl-PRS-NumSymbols / dl-PRS-CombSizeN*
* Option 2 (Ericsson): The UE Rx-Tx accuracy requirements
	+ depend on PRS BW defined in number of PRBs
	+ apply for:
		- any DL-PRS-ResourceRepetitionFactor≥1 and
		- any LPRS≥2 which is given by the higher-layer parameter dl-PRS-NumSymbols and
		- any comb pattern.
* Option 3(Qualcomm)
	+ PRS BW defined in number of PRBs
	+ PRS SCS
	+ number of PRS symbols per slot equal to PRS comb size.

Recommended WF: *Follow the same principle of RSTD accuracy.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Can follow the same conclusion for RSTD requirements |
| CATT | Support the recommended WF. |
| Vivo | Follow the conclusion for RSTD accuracy requirements. |
| Huawei | Support the recommended WF. |
| Qualcomm | Agree with the recommended WF. |
| OPPO | Support the recommended WF. |

### Sub-topic 4-5 Applicable propagation channel for accuracy requirement

* Option 1 (Qualcomm):
	+ Need the applicability with propagation channels for accuracy requirement (e.g. Exclude number from simulations for TDL-C channel model with 300 ns delay spread in FR1 for defining the RSTD accuracy requirements.)
	+ RAN4 to consider defining PRS-RSTD and UE Rx-Tx measurement accuracy requirements only for AWGN.

Recommended WF: *follow the same conclusion for RSTD.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Can follow the same conclusion for RSTD requirements |
| CATT | Support the recommended WF. |
| Vivo | Follow the conclusion for RSTD accuracy requirements. |
| Huawei | Support the recommended WF. |
| Ericsson | Support the recommended WF. |
| Qualcomm | Agree with the recommended WF. |
| OPPO | Support the recommended WF. |

### Sub-topic 4-6 Group delay calibration margin

* Option 1 (Huawei). Use 32Tc as the group delay calibration margin for UE Rx-Tx accuracy**.**
* Option 2(Qualcomm). For UE Rx-Tx measurements in FR1, add a group delay calibration margin of 4 ns \* (100/BW), where BW is the PRS bandwidth in MHz, to the accuracy requirements

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Can follow the same conclusion for RSTD requirements |
| Huawei | We also suggest to follow same principle for RSTD, but some difference to be considered: e.g. Rx-Tx is a single TRP measurement, so there should be no issue with different Rx panels, and also both Rx and Tx calibration error needs to be considered.  |
| Qualcomm | Option 2. |

### Sub-topic 4-7 UE Rx-Tx time difference measurement accuracy requirements

* Option 1(Intel): The accuracy of UE Rx-Tx time difference can be specified by the Table 1 below.

**Table 1: UE Rx-Tx difference measurement accuracy requirements (ns)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **FR** | **PRS BW (PRBs)** | **PRS\_NormLenthPerSlot** |  **SINR= [-6dB]** |  **SINR= -13dB** |
| FR1 | 52 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| 104 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| 268 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| FR2 | 32 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| 64 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| 128 | 1 | TBD | TBD |
| ≥2 | TBD | TBD |
| ≥4 | TBD | TBD |
| ≥6 | TBD | TBD |
| Note 1: **PRS\_NormLenthPerSlot = (DL-PRS-NumSymbols x DL-PRS\_ResourceRepetitionFactor) /DL-PRS-CombSizeN** |

* Option 2 (Ericsson): The UE Rx-Tx accuracy requirements shall apply for any DL-PRS-ResourceRepetitionFactor≥1 and any LPRS≥2 which is given by the higher-layer parameter dl-PRS-NumSymbols and any comb pattern.
	+ *For FR1, the UE Rx-Tx measurement accuracy is as in Table 1:*

**Table 1: UE Rx-Tx accuracy in FR1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±60 | -3 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±30 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±20 | BW >132 | 15, 30 | All | All | All |
| ±70 | -6 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±40 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±25 | BW >132 | 15, 30 | All | All | All |
| ±90 | -13 | 24 ≤ BW ≤ 48 | 15, 30 | All | All | All |
| ±50 | 48 < BW≤ 132 | 15, 30 | All | All | All |
| ±30 | BW >132 | 15, 30 | All | All | All |

*: For FR2, the UE Rx-Tx measurement accuracy is as in Table 2*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| ±70 | -3 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±40 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±25 | BW >64 | 60, 120 | All | All | All |
| ±90 | -6 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±50 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±30 | BW >64 | 60, 120 | All | All | All |
| ±100 | -13 | 24 ≤ BW ≤ 32 | 60, 120 | All | All | All |
| ±60 | 32 < BW≤ 64 | 60, 120 | All | All | All |
| ±40 | BW >64 | 60, 120 | All | All | All |

* Option 3 (Huawei): Use Table 1 as template to form UE Rx-Tx accuracy requirements.

**Table 1: Template for UE Rx-Tx accuracy requirementsFR1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Accuracy (Tc)** | **SCS (kHz)** | **PRB num** | **Repetition**  |
|  | 15 | 24-40 | 2 |
|  | 44-84 | 1 |
|  | 88-168 | 1 |
|  | 172-max | 1 |
|  | 30 | 24-40 | 2 |
|  | 44-84 | 1 |
|  | 88-168 | 1 |
|  | 172-max | 1 |
|  | 60 | 24-40 | 2 |
|  | 44-84 | 1 |
|  | 88-168 | 1 |
|  | 172-max | 1 |

**FR2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Accuracy (Tc)** | **SCS (kHz)** | **PRB num** | **Repetition**  |
|  | 60 | 24-40 | 2 |
|  | 44-84 | 1 |
|  | 88-168 | 1 |
|  | 172-max | 1 |
|  | 120 | 24-40 | 2 |
|  | 44-84 | 1 |
|  | 88-168 | 1 |
|  | 172-max | 1 |

* Option 4 (vivo)
* Table 1: UE Rx-Tx time difference measurement accuracy in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accuracy | PRS Ês/Iot | Minimum PRSbandwidth | PRS SCS | Total number of repetitions of PRS resource |
| Ts | dB | RB | kHz |  |
|  | ≥ -3 | ≥ 24 | 15kHz | 1 |
|  | ≥ -3 | ≥ 24 | 15kHz | 4 |
|  | ≥ -3 | ≥ 52 | 15kHz | 1 |
|  | ≥ -3 | ≥ 52 | 15kHz | 4 |
|  | ≥ -3 | ≥ 104 | 15kHz | 1 |
|  | ≥ -3 | ≥ 104 | 15kHz | 4 |
|  | ≥ -3 | ≥ 268 | 15kHz | 1 |
|  | ≥ -3 | ≥ 268 | 15kHz | 4 |
|  | ≥ -3 | ≥ 48 | 30kHz | 1 |
|  | ≥ -3 | ≥ 48 | 30kHz | 4 |
|  | ≥ -3 | ≥ 132 | 30kHz | 1 |
|  | ≥ -3 | ≥ 132 | 30kHz | 4 |
|  | ≥ -3 | ≥ 272 | 30kHz | 1 |
|  | ≥ -3 | ≥ 272 | 30kHz | 4 |
|  | ≥-13 | ≥ 24 | 15kHz | 1 |
|  | ≥-13 | ≥ 24 | 15kHz | 4 |
|  | ≥-13 | ≥ 52 | 15kHz | 1 |
|  | ≥-13 | ≥ 52 | 15kHz | 4 |
|  | ≥-13 | ≥ 104 | 15kHz | 1 |
|  | ≥-13 | ≥ 104 | 15kHz | 4 |
|  | ≥-13 | ≥ 268 | 15kHz | 1 |
|  | ≥-13 | ≥ 268 | 15kHz | 4 |
|  | ≥-13 | ≥ 48 | 30kHz | 1 |
|  | ≥-13 | ≥ 48 | 30kHz | 4 |
|  | ≥-13 | ≥ 132 | 30kHz | 1 |
|  | ≥-13 | ≥ 132 | 30kHz | 4 |
|  | ≥-13 | ≥ 272 | 30kHz | 1 |
|  | ≥-13 | ≥ 272 | 30kHz | 4 |
|  | ≥-13 | ≥ 24 | 15kHz | 1 |

* Table 2: UE Rx-Tx time difference measurement accuracy in FR2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accuracy | PRS Ês/Iot | Minimum PRSbandwidth | PRS SCS | Total number of repetitions of PRS resource |
| Ts | dB | RB | kHz |  |
|  | ≥ -3 | ≥ 32 | 120kHz | 1 |
|  | ≥ -3 | ≥ 32 | 120kHz | 4 |
|  | ≥ -3 | ≥ 64 | 120kHz | 1 |
|  | ≥ -3 | ≥ 64 | 120kHz | 4 |
|  | ≥ -3 | ≥ 128 | 120kHz | 1 |
|  | ≥ -3 | ≥ 128 | 120kHz | 4 |
|  | ≥-13 | ≥ 32 | 120kHz | 1 |
|  | ≥-13 | ≥ 32 | 120kHz | 4 |
|  | ≥-13 | ≥ 64 | 120kHz | 1 |
|  | ≥-13 | ≥ 64 | 120kHz | 4 |
|  | ≥-13 | ≥ 128 | 120kHz | 1 |
|  | ≥-13 | ≥ 128 | 120kHz | 4 |

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | The principle to differentiate the requirements sets can be same as these of RSTD. For the exact requirements may be a little bit different (e.g. both 2 SINR side conditions needed the requirements, and RF margin can be different) |
| Huawei | Same comment as Intel. |
| Qualcomm | Follow a similar structure as for RSTD accuracy requirements. |

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2107168**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107168.zip) **(Ericsson)** | Huawei: can be revised based on technical conclusions. |
|  |
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## Summary for 1st round

### Open issues

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| --- | --- |
|  | **Status summary**  |
| **Sub-topic#4-1** | **Applicability of accuracy requirements in the case of NTA\_offset change***Tentative agreements: None**Candidate options:** Option 1(Ericsson, Intel, Qualcomm,OPPO): Clarify in section 10.1.25.2 in TS 38.133: “UE Rx-Tx measurement accuracy requirements shall not apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to any of:
	+ NTA\_offset defined in Table 7.1.2-2 in 38.133 changes during the UE Rx-Tx measurement period,
	+ Network-configured TA command and
	+ FFS: autonomous timing adjustment.”
* Option 2 (Huawei, OPPO, vivo, CATT): Capture in the specification that UE Rx-Tx accuracy requirements do not apply in case the UE UL timing changes during the measurement period

*Recommendations for 2nd round: Can be FFS* |
| **Sub-topic#4-2** | **Applicability of accuracy requirements in the case of in the case of TA adjustment***Tentative agreements:* *Candidate options:** Option 1. (Ericsson)
	+ UE Rx-Tx measurement accuracy requirements shall not apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment or based on network-configured TA
* Option 2. (Qualcomm, vivo, OPPO)
	+ UE Rx-Tx measurement accuracy requirements shall not apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to network-configured TA command.
	+ UE Rx-Tx measurement accuracy requirements shall apply if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment
* Option 3. (Huawei, CATT):
	+ Capture in the specification that UE Rx-Tx accuracy requirements do not apply in case the UE UL timing changes during the measurement period

*Recommendations for 2nd round: Can be FFS* |
| **Sub-topic#4-3** | **Applicable accuracy requirement in case of other (non-HO) serving cell changes***Tentative agreements:* *Candidate options:** Option 1 (Ericsson, vivo, Intel): The UE shall continue and complete a UE Rx-Tx measurement while meeting UE Rx-Tx measurement accuracy requirements in clause 10.1.23, when a serving cell change (including Scell change, addition, release, activation, or deactivation, or PSCell change, addition, or release) occurs during the measurement, provided the cell change does not impact the configuration of the SRS used for the measurement.
* Option 2(Huawei): Accuracy requirements apply with serving cell change, provided that the serving cell change does not impact the UL timing. No need to capture this in the spec.

*Recommendations for 2nd round: Can be FFS* |
| **Sub-topic#4-4** | **How to define the accuracy requirements with the combinations of PRS BW and other parameters** *Tentative agreements: Follow the same principle of RSTD accuracy.**Candidate options:**Recommendations for 2nd round:* continue discussion on alignment of simulation results |
| **Sub-topic#4-5** | **Applicable propagation channel for accuracy requirement***Tentative agreements: Follow the same principle of RSTD accuracy.**Candidate options:**Recommendations for 2nd round:*No further discussion |
| **Sub-topic#4-6** | **Group delay calibration margin***Tentative agreements:* * *Candidate options:*
* Option 1 (Huawei). Use 32Tc as the group delay calibration margin for UE Rx-Tx accuracy**.**
* Option 2(Qualcomm). For UE Rx-Tx measurements in FR1, add a group delay calibration margin of 4 ns \* (100/BW), where BW is the PRS bandwidth in MHz, to the accuracy requirements

*Recommendations for 2nd round:*Can be FFS |
| **Sub-topic#4-7** | **UE Rx-Tx time difference measurement accuracy requirements** *Tentative agreements:**Candidate options:**Recommendations for 2nd round:. continue discussion on alignment. How to structure the requirements can be* identified based on averaged results. |

### CRs/TPs

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| [**R4-2107168**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107168.zip) **(Ericsson)** | *Revised* |
|  |  |
|  |  |

## Discussion on 2nd round

Please only comment on topics that are selected for discussion in 2nd round.

### Sub-topic 4-7 UE Rx-Tx time difference measurement accuracy requirements

*[Moderator notes: Following the same principle for RSTD requirements, according to simulation results we collected, we suggest that the following table can be taken as the baseline to define RSTD requirements. Please companies can provide your further view on this WF.]:*

*Recommended WF: the following table can be taken as the baseline to define UE Rx-Tx time difference requirements*

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**Table 1: UE Rx-Tx accuracy in FR1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor per slot** **[38.211]** |
| [TBD] | -3 | ≥[24] | 15 | All |
| [TBD] | ≥[52] | All |
| [TBD] | >[104] | All |
| [TBD] | ≥[48] | 30,60 | All |
| [TBD] | ≥132 | All |
| [TBD] | -13 | ≥[24] | 15 | All |
| [TBD] | ≥[52] | All |
| [TBD] | >[104] | All |
| [TBD] | ≥[48] | 30,60 | All |
| [TBD] | ≥132 | All |

**Table 2: UE Rx-Tx accuracy in FR2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor per slot** **[38.211]** |
| [TBD] | -3 | ≥[24] | 60/120 | All |
| [TBD] | ≥[64] | All |
| [TBD] | -13 | ≥[24] | 60/120 | All |
| [TBD] | ≥[64] |  | All |

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Support the recommended WF. For the exact value, they can be updated depending on the corresponding simulation results. In some case in which the low PRS BW and small repetition (e.g. PRS BW <=24 and rep<=4), we can add some side condition also.**Table 1: UE Rx-Tx accuracy in FR1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| [TBD] | -3 | ≥[24] | 15 | ≥4 | All | All |
| [TBD] | ≥[52] | All | All | All |
| [TBD] | >[104] | All | All | All |
| [TBD] | ≥[48] | 30,60 | ≥4 | All | All |
| [TBD] | ≥132 | All | All | All |
| [TBD] | -13 | ≥[24] | 15 | All | All | All |
| [TBD] | ≥[52] | All | All | All |
| [TBD] | >[104] | All | All | All |
| [TBD] | ≥[48] | 30,60 | All | All | All |
| [TBD] | ≥132 | All | All | All |

**Table 2: UE Rx-Tx accuracy in FR2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy,** **Tc** | **Es/Iot,** **dB** | **PRS BW,** **PRB** | **PRS SCS,****kHz** | **Repetition factor**  **[38.211]** | **Repetition within slot** **(i.e.** **[38.211])** | **Comb size** **[38.211]** |
| [TBD] | -3 | ≥[24] | 60/120 | ≥4 | All | All |
| [TBD] | ≥[64] | All | All | All |
| [TBD] | -13 | ≥[24] | 60/120 | ≥4 | All | All |
| [TBD] | ≥[64] |  | All | All | All |

 |
| vivo | In general, the updated Table 1 and Table 2 are fine for us. One comment is accuracy requirements for repetition should be defined. To make requirements simple we propose accuracy requirements for PRS BW of 24PRBs are defined for repetition 1 and repetition 4 respectively.In addition, we think accuracy requirements for FR2 should also be define for larger PRS BW, e.g., 128PRBs.The exact value can be decided in the next meeting. |
| Qualcomm | Agree we can follow the same principle as for RSTD, with the exception that an additional column for Es/Iot needs to be added to the table.Please see our 2nd round comments under sub-topic 2-3&2-6. |

## Summary on 2nd round

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc status update recommendation**  |
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# Topic #5: Test cases (AI5.5.2.2.3)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2106921**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106921.zip) [draft CR] Test cases for PRS-RSRP measurement accuracy | ZTE Corporation | CR  |
| [**R4-2107048**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107048.zip)Test case design principles for NR Positioning | ZTE | Proposal 1: Prioritize specifying TCs for NR SA and then consider other scenarios.Proposal 2: For PRS-RSRP, there can be separate tests (e.g., Test 1, Test 2, …) inside the test case, one for each side condition.Proposal 3: Further study if absolute measurement reporting is needed to be tested for all PRS measurements. |
| [**R4-2104748**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2104748.zip) CR on test case for PRS-RSRP measurement requirements for FR2 in SA | CATT | CR |
| [**R4-2106449**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106449.zip)Discussion on NR Positioning test cases configuration | Intel Corporation | ***Proposal 1: The PRS configuration patterns in Table 1 for NR Positioning measurement tests can be specified in the Annex A.3.x of TS 38.133.******Proposal 2: SRS configuration can be specified as Table 2.*** ***Proposal 3: It is enough to define the test cases for NR standalone cells.*** ***Proposal 4: Absolute measurement reporting is tested for all PRS measurements. It is unnecessary to define the test case for differential RSTD.*** ***Proposal 5: In order to minimize the testing efforts, we can define two subtests per accuracy test cases corresponding to different combinations of {Es/Iot, PRS BW****}.****Proposal 6 : F***or **the different SINR side condition , we can *associate different cells with different Es/Iot in a single test* when testing PRS RSRP and UE Rx-Tx time difference.*****Proposal 7-1: 3 cells deployment scenarios (one is serving/reference cell , the other two neighbor cells) can be used for RSTD measurement test.*** ***Proposal 7-2: 2 cells deployment scenarios (one is serving/reference cell , the other neighbor cell) can be used for UE Rx-Tx time difference, PRS RSRP measurement tests.*** ***Proposal 7-3: 2 cells deployment scenarios (one is serving/reference cell , the other two neighbor cells) can be used for RSTD/PRS RSRP/UE Rx-Tx time difference accuracy test.*** ***Proposal 8: The synchronous cells will be tested for the measurement delay requirements test.*** ***Proposal 9: For the core requirements test cases, only the non-muting PRS configuration will be used.******Proposal 9a: For the core requirements test cases, the muting PRS configuration will be used if the corresponding requirements for muting defined.******Proposal 10: The number of positioning frequency layers measured can not be larger than 2.*** ***Proposal 11: Gap pattern #0 and #24 can be used for NR Positioning tests.*** ***Proposal 12: The test procedure for LTE OTDoA[4] can be reused for NR positioning measurement testing.***  |
| [**R4-2106450**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106450.zip) [draftCR] CR for PRS configurations for NR Pos RRM tests | Intel Corporation | CR |
| [**R4-2106451**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106451.zip) [draftCR] CR for the test case of RSTD measurement requirements reporting in SA | Intel Corporation | ***CR*** |
| [**R4-2106341**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106341.zip) Design of test cases for NR positioning | Qualcomm Incorporated | **Proposal 1: Only define test cases for SA.****Proposal 2: Multiple (2) SINR conditions for UE Rx-Tx and PRS-RSRP could be tested in one test case.****Proposal 3: Test two PRS BW configurations per test**1. **The first configuration could be the minimum PRS BW supported (PRBs = 24) paired with the smallest SCS for the FR being tested, i.e. SCS = 15 kHz for FR1 and SCS = 60 kHz for FR2.**
2. **The second configuration could be the highest PRS BW (num. PRBs) supported by the UE among the PRS reference configurations than RAN4 will define, paired with the highest SCS for the FR being tested (SCS = 30 kHz for FR1 and SCS = 120 kHz for FR2).**

**Proposal 4: RAN4 should define test cases with one PFL for RSTD, PRS-RSRP and UE Rx-Tx. Optionally, RAN4 could also define RSTD test cases with two PFLs.****Proposal 5: For RSTD and UE Rx-Tx define test cases with absolute reporting. For PRS-RSRP define test cases with differential reporting and optionally with absolute reporting.****Proposal 6:**1. **Use 160 ms PRS periodicity as baseline for all tests. Offsets may be specified in each test case in order to achieve orthogonality between PRS resources from multiple TRPs.**
2. **Comb size equal to 2 or 4 would be good choices. Number of PRS symbols = K\*comb\_size, K = 1, 2, 3 (if needed).**

**Specify multiple PRS BW configurations matching the ones specified in the accuracy requirements. E.g. number of PRBs = 24, 48, 96, 192, 264****Proposal 7: Match SRS periodicity to PRS periodicity, i.e. 160 ms.****Proposal 8: Support the proposed reference test configurations below under the assumption that they correspond to the Pcell configuration and do not constrain the PRS bandwidth and SCS to be tested in each test case.** *Supported test configurations for FR1:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *15 kHz SSB SCS, 10 MHz bandwidth, FDD duplex mode* |
| *2* | *15 kHz SSB SCS, 10 MHz bandwidth, TDD duplex mode* |
| *3* | *30 kHz SSB SCS, 40 MHz bandwidth, TDD duplex mode* |
| *NOTE: The UE is only required to be tested in one of the supported test configurations.* |

*Supported test configurations for FR2:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *120 kHz SSB SCS, 100 MHz bandwidth, TDD duplex mode* |

**Proposal 9: Option 1a. for RSTD measurement requirements, test cases with 3 cells are developed: NR PCell (cell 1) and two NR neighbor cells (cell 2, cell 3).****Proposal 10: At least some test cases for NR positioning should feature more than one positioning frequency layer****Proposal 11: FFS whether type 1 PRS muting should be used in the test case PRS configurations, pending the outcome of the discussion of whether and how to modify measurement period requirements to account for type 1 PRS muting****Proposal 12: Time synchronicity constraints between cells/TRPs may be incorporated in the test configurations to the extent needed to ensure that the Es/Iot side conditions are met during testing.** |
| [**R4-2107169**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107169.zip) On positioning test cases | Ericsson | ***Observation 1****: Only test cases for SA NR with a single FR have been agreed for NR positioning so far; no test cases have been agreed so far for deployments with both FR1 and FR2.****Proposal 1****: RAN4 will define NR positioning test cases for NR-DC, where PCell is in FR1, and PSCell is in FR2; otherwise define test cases for other deployments with both FR1 and FR2 (e.g., CA or SA with FR1 PCell and FR2 neighbors).****Proposal 2****: Each measurement type (RSTD, PRS-RSRP, or UE Rx-Tx) is tested in both configurations:** + *The cells are spread on two frequencies (regardless on the number of cells agreed for the test)*
	+ *All cells are on the same frequency*

***Proposal 3****: Further clarify the test case list:*

|  |  |  |
| --- | --- | --- |
| TC1a | RSTD measurement requirements for FR1 in SA, for the same frequency | A6.6.x RSTD measurements |
| TC1b | RSTD measurement requirements for FR1 in SA, for different frequencies | A6.6.x RSTD measurements |
| TC 2a | RSTD measurement requirements for FR2 in SA, for the same frequency | A7.6.x RSTD measurements |
| TC 2b | RSTD measurement requirements for FR2 in SA, for different frequencies | A7.6.x RSTD measurements |
| TC 3a | PRS-RSRP measurement requirements for FR1 in SA, for the same frequency | A6.6.xx PRS-RSRP measurements |
| TC 3b | PRS-RSRP measurement requirements for FR1 in SA, for different frequencies | A6.6.xx PRS-RSRP measurements |
| TC 4a | PRS-RSRP measurement requirements for FR2 in SA, for the same frequency | A7.6.xx PRS-RSRP measurements |
| TC 4b | PRS-RSRP measurement requirements for FR2 in SA, for different frequencies | A7.6.xx PRS-RSRP measurements |
| TC 5a | UE Rx-Tx time difference measurement requirements for FR1 in SA, for the same frequency | A6.6.xxx UE Rx-Tx time difference measurements |
| TC 5b | UE Rx-Tx time difference measurement requirements for FR1 in SA, for different frequenciesv | A6.6.xxx UE Rx-Tx time difference measurements |
| TC 6a | UE Rx-Tx time difference measurement requirements for FR2 in SA, for the same frequency | A7.6.xxx UE Rx-Tx time difference measurements |
| TC 6b | UE Rx-Tx time difference measurement requirements for FR2 in SA, for different frequencies | A7.6.xxx UE Rx-Tx time difference measurements |
| TC 7a | RSTD measurement accuracy for FR1 in SA, for the same frequency | A6.7.x RSTD measurements |
| TC 7b | RSTD measurement accuracy for FR1 in SA, for different frequencies | A6.7.x RSTD measurements |
| TC 8a | RSTD measurement accuracy for FR2 in SA, for the same frequency | A7.7.x RSTD measurements |
| TC 8b | RSTD measurement accuracy for FR2 in SA, for different frequencies | A7.7.x RSTD measurements |
| TC 9a | PRS RSRP measurement accuracy for FR1 in SA, for the same frequency | A6.7.xx xx PRS-RSRP measurements |
| TC 9b | PRS RSRP measurement accuracy for FR1 in SA, for different frequencies | A6.7.xx xx PRS-RSRP measurements |
| TC 10a | PRS RSRP measurement accuracy for FR2 in SA, for the same frequency | A7.7.xx xx PRS-RSRP measurements |
| TC 10b | PRS RSRP measurement accuracy for FR2 in SA, for different frequencies | A7.7.xx xx PRS-RSRP measurements |
| TC 11a | UE Rx-Tx time difference measurement accuracy for FR1 in SA, for the same frequency | A6.7.xxx UE Rx-Tx time difference measurements |
| TC 11b | UE Rx-Tx time difference measurement accuracy for FR1 in SA, for different frequencies | A6.7.xxx UE Rx-Tx time difference measurements |
| TC 12a | UE Rx-Tx time difference measurement accuracy for FR2 in SA, for the same frequency | A7.7.xxx UE Rx-Tx time difference measurements |
| TC 12b | UE Rx-Tx time difference measurement accuracy for FR2 in SA, for different frequencies | A7.7.xxx UE Rx-Tx time difference measurements |

***Proposal 4****: The number of cells in RSTD test cases:** + *3 for measurements testing,*
	+ *2 for accuracy testing (provided there are separate test cases for the same and different frequencies).*

***Proposal 5****: The number of cells in PRS-RSRP test cases:** + *2 for measurements testing,*
	+ *2 for accuracy testing (provided there are separate test cases for the same and different frequencies), with*
		- *separate tests in the same test case for the different signal levels in the requirements*
		- *absolute measurements (on two cells) and relative measurements (on 1 cell) accuracy are tested in the same test*

***Proposal 6****: The number of cells in UE Rx-Tx test cases:** + *2 for measurements testing,*
	+ *2 for accuracy testing (provided there are separate test cases for the same and different frequencies).*

*NOTE: the signal levels in the two cells correspond to the different signal levels in the requirements.****Proposal 7****: In each test case, the NR measurements are tested for multiple measurement bandwidths, with at least:** + *the smallest bandwidth,*
	+ *a bandwidth from the medium bandwidths range (e.g., >48 PRBs in FR1 or >32 PRBs in FR2),*
	+ *a bandwidth from the large bandwidths range (e.g., >132 PRBs in FR1 or >64 PRBs in FR2).*

***Proposal 8****: No PRS repetitions (within a slot or across slots within a single PRS period) are configured in NR positioning test cases.****Proposal 9****: In each test case the NR measurements are tested for two combinations of PRS periodicity and MGL, e.g.:** + *TPRS>MGL, and*
	+ *TPRS<MGL.*

***Proposal 10****: PRS SCS is the same as SSB SCS.****Proposal 11****: The network configured k is set as follows:** + *timingReportingGranularityFactor=0 for FR1,*
	+ *timingReportingGranularityFactor=2 for FR2.*

***Proposal 12****: Absolute measurement reporting is tested.****Proposal 13****: No additional path reporting is configured (additionalPaths is not included in the measurement request).****Proposal 14****: No PRS-RSRP is configured together for multi-RTT (nr-RequestedMeasurements in the measurement request indicates no PRS-RSRP is requested together with UE Rx-Tx).****Proposal 15****: Configure DRX in all NR positioning test cases.****Proposal 16****: Supported test configurations for FR1:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *15 kHz SSB SCS, 10 MHz bandwidth, FDD duplex mode* |
| *2* | *15 kHz SSB SCS, 10 MHz bandwidth, TDD duplex mode* |
| *3* | *30 kHz SSB SCS, 40 MHz bandwidth, TDD duplex mode* |
| *NOTE: The UE is only required to be tested in one of the supported test configurations.* |

***Proposal 17****: Supported test configurations for FR2:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *120 kHz SSB SCS, 100 MHz bandwidth, TDD duplex mode* |

***Proposal 18****: SRS configuration in UE Rx-Tx test cases is based on the following assumptions:** + *frequency hopping: no*
	+ *group or sequence hopping: no*
	+ *Number of antenna ports: 1*
	+ *Resource type: periodic*

*SCS: same as for SSB* |
| [**R4-2107170**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107170.zip) TC5 and TC6: UE Rx-Tx time difference measurement requirements for FR1 and FR2 in SA | Ericsson | ***CR*** |
| [**R4-2107171**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107171.zip) TC11 and TC12: UE Rx-Tx time difference measurement accuracy for FR1 and FR2 in SA | Ericsson | ***CR*** |
| [**R4-2107010**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107010.zip) Discussion on RRM test case for UE positioning requirements | Huawei, HiSilicon | **Proposal 1: Define positioning RRM test cases for NR SA only.** **Proposal 2: Test both SINR side conditions in the accuracy tests, by associating different cells with different Es/Iot in a single test case.****Proposal 3: No need to define test cases for the serving carrier frequencies and non-serving carrier frequencies.****Proposal 4a: Test both Case 1 and Case 2 for delay tests** * **Case 1: 1 PFL, and all cells are on the same PFL**
* **Case 2: 2 PLFs, and cells are distributed on two PFLs**

**UE supporting more than one PFL only needs to pass tests for Case 2.****Proposal 4b: Test both Case 1 and Case 2 for delay tests and RSTD accuracy tests. Test Case 1 for PRS-RSRP and UE Rx-Tx accuracy tests.****Proposal 5: The number of cells/TRPs in the test cases is 2.****Proposal 6: Define test cases for sync scenarios only.****Proposal 7: Define test cases without muting.****Proposal 8: Do not define RSTD accuracy tests with differential RSTD.****Proposal 9: RAN4 should not need to limit the reporting format for the test cases.** **Proposal 10: Consider Table 1 for general PRS configuration for positioning RRM test cases.****Table 1: general PRS configuration for positioning RRM test cases**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **PRS Pattern 1.1** | **PRS Pattern 1.2** | **PRS Pattern 2.1** | **PRS Pattern 2.2** | **PRS Pattern 3.1** | **PRS Pattern 3.2** |
| **SCS** | FR1, 15k | FR1, 30k | FR2, 120k |
| **PRS periodicity and offset** | 160ms, 10ms |
| **BW (num of PRBs)** | 52 | 106 | 66 |
| **Comb size** | 2 |
| **Number of PRS symbols** | 2 | 4 | 2 | 4 | 2 | 4 |
| **Number of PRS slots** | 1 |

**Proposal 11: Consider Table 2 for general SRS configuration for UE Rx-Tx test cases.****Table 2: general SRS configuration for UE Rx-Tx RRM test cases**

|  |  |  |
| --- | --- | --- |
| SRS-Resource | SRS-ResourceId | 0 |
|  | nrofSRS-Ports | Port1 |
|  | transmissionComb  | n4 |
|  | combOffset-n4 | 0 |
|  | cyclicShift-n4 | 0 |
|  | resourceMappingstartPosition | 0 |
|  | resourceMappingnrofSymbols  | n4 |
|  | resourceMappingrepetitionFactor | n1 |
|  | freqDomainPosition | 0 |
|  | freqDomainShift | 0 |
|  | freqHoppingc-SRS | Matches NRB,c  |
|  | groupOrSequenceHopping | Neither |
|  | resourceType | Periodic |
|  | periodicityAndOffset-p | 80\*2^u, 20\*2^u |
|  | sequenceId | 0 |

**Proposal 12: Define two subtests per accuracy test cases corresponding to different combinations of {Es/Iot, PRS BW}.** **Proposal 13: Re-use the test configurations {10MHz BW, 15kHz SCS}, {40MHz BW, 30kHz SCS} and {100MHz BW, 120kHz SCS} for serving cell and also PRS in case of delay test.** |
| [**R4-2107011**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107011.zip) draftCR to introduce TC for PRS-RSRP measurement requirements for FR1 in SA | Huawei, HiSilicon | ***CR*** |
| [**R4-2107012**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107012.zip) draftCR to introduce TC for RSTD measurement accuracy for FR1 and FR2 in SA | Huawei, HiSilicon | ***CR*** |
| [**R4-2106523**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106523.zip)Discussion on remaining issues of test cases for NR positioning | OPPO | **Proposal 1: Define positioning RRM test cases for NR SA only.****Proposal 2: Define RSTD test cases with 3 cells/TRPs, and other test cases with 2 cells/TRPs.****Proposal 3: For the different SINR side condition for UE Rx-Tx time difference, prefer different Es/Iot in a single test.****Proposal 4: Define two subtests per accuracy test cases corresponding to different combinations of {Es/Iot, PRS BW}.** |

## Open issues summary and companies’ views collection for 1st round

### Sub-topic 5-1 Test cases for the different SINR side conditions

* Option 1 (Ericsson, ZTE, Intel)
	+ Both SINR side conditions for UE Rx-Tx are tested in the same test with two cells.
	+ For PRS-RSRP, there can be separate tests (e.g., Test 1, Test 2, …) inside the test case, one for each side condition.
* Option 1a (Qualcomm) : Multiple (2) SINR conditions for UE Rx-Tx and PRS-RSRP could be tested in one test case.
* Option 1b(Huawei, OPPO): Test both SINR side conditions in the accuracy tests, by associating different cells with different Es/Iot in a single test case

Recommended WF: *Could the following proposal be agreeable?*

* For UE Rx-Tx time difference, one test case with 2 cells can be defined with different SINR, one for each side condition.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | For UE Rx-Tx time difference, the recommend WF can be agreeable. But for PRS RSRP test, how many cells shall be configured is under debating (issue 5-8). If there are number of cells/TRP for PRS RSRP is larger than 1, Option 1a/1b is fine for us.  |
| CATT | Option 1a and 1b are quite same. The different SINR side condition can be tested in one test case with different cells.  |
| ZTE | We support Option 1 which can cover all scenarios. |
| vivo | Option 1 can be starting point. |
| Huawei  | Support option 1a and 1b.On option 1, we do not see why for RSRP we need separate tests for different SINR condition. |
| Qualcomm | Support option 1a. It seems option 1b is the same as 1a. |

### Sub-topic 5-2 Test cases for the serving carrier frequencies and non-serving carrier frequencies

* Option 1(Huawei): No need to define test cases for the serving carrier frequencies and non-serving carrier frequencies.

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Option 1 can be agreeable because for NR positioning no measurements shall be depending on the serving carrier.  |
| CATT | Support option 1.  |
| Huawei | Support option 1.  |
| Qualcomm | Support option 1. |

### Sub-topic 5-3 Absolute measurement reporting in test cases

* Option 1 (Ericsson, Intel): Absolute measurement reporting is tested for all PRS measurements.
* Option 1a(Huawei): Do not define RSTD accuracy tests with differential RSTD. No need to limit the reporting format for the test cases.
* Option 2( Qualcomm): **:**
	+ For RSTD and UE Rx-Tx define test cases with absolute reporting.
	+ For PRS-RSRP define test cases with differential reporting and optionally with absolute reporting.
* Option 3(ZTE): FFS

Recommended WF: Can the proposals below agreeable?

* For RSTD and UE Rx-Tx timing difference, only the absolute accuracy test cases will be defined.
* For PRS RSRP
	+ only the absolute accuracy test cases will be defined or
	+ define test cases with differential reporting and optionally with absolute reporting.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | The recommended WF can be agreeable. Furthermore, for PRS RSRP as a compromised proposal, we can agree “define test cases with differential reporting and optionally with absolute reporting” to cover the relative RSRP accuracy requirement tests. |
| CATT | The first bullet of recommended WF is fine for us. Only absolute accuracy test cases are defined for RSTD and UE Rx-Tx. And no need to limit the reporting format.  |
| ZTE | Support the recommended WF and we can further discuss from there. |
| vivo | In general, we are fine with the recommended WF.  |
| Huawei | We do not think anything needs to be agreed here.NW cannot configure the reporting format (absolute v.s. differential), but it depends on number of PRS resources measured per resource set.  |
| Qualcomm | Considering Huawei’s comment, there seems to be different understanding by various companies and further discussion may be needed. We’d like to point out that for conformance testing, one measurement per TRP should be sufficient so differential reporting may not be needed. We would like to check further. |

### Sub-topic 5-4 Test case list clarifications

* Option 1 (Ericsson)
* *Further clarify the test case list:*

|  |  |  |
| --- | --- | --- |
| TC1a | RSTD measurement requirements for FR1 in SA, for the same frequency | A6.6.x RSTD measurements |
| TC1b | RSTD measurement requirements for FR1 in SA, for different frequencies | A6.6.x RSTD measurements |
| TC 2a | RSTD measurement requirements for FR2 in SA, for the same frequency | A7.6.x RSTD measurements |
| TC 2b | RSTD measurement requirements for FR2 in SA, for different frequencies | A7.6.x RSTD measurements |
| TC 3a | PRS-RSRP measurement requirements for FR1 in SA, for the same frequency | A6.6.xx PRS-RSRP measurements |
| TC 3b | PRS-RSRP measurement requirements for FR1 in SA, for different frequencies | A6.6.xx PRS-RSRP measurements |
| TC 4a | PRS-RSRP measurement requirements for FR2 in SA, for the same frequency | A7.6.xx PRS-RSRP measurements |
| TC 4b | PRS-RSRP measurement requirements for FR2 in SA, for different frequencies | A7.6.xx PRS-RSRP measurements |
| TC 5a | UE Rx-Tx time difference measurement requirements for FR1 in SA, for the same frequency | A6.6.xxx UE Rx-Tx time difference measurements |
| TC 5b | UE Rx-Tx time difference measurement requirements for FR1 in SA, for different frequenciesv | A6.6.xxx UE Rx-Tx time difference measurements |
| TC 6a | UE Rx-Tx time difference measurement requirements for FR2 in SA, for the same frequency | A7.6.xxx UE Rx-Tx time difference measurements |
| TC 6b | UE Rx-Tx time difference measurement requirements for FR2 in SA, for different frequencies | A7.6.xxx UE Rx-Tx time difference measurements |
| TC 7a | RSTD measurement accuracy for FR1 in SA, for the same frequency | A6.7.x RSTD measurements |
| TC 7b | RSTD measurement accuracy for FR1 in SA, for different frequencies | A6.7.x RSTD measurements |
| TC 8a | RSTD measurement accuracy for FR2 in SA, for the same frequency | A7.7.x RSTD measurements |
| TC 8b | RSTD measurement accuracy for FR2 in SA, for different frequencies | A7.7.x RSTD measurements |
| TC 9a | PRS RSRP measurement accuracy for FR1 in SA, for the same frequency | A6.7.xx xx PRS-RSRP measurements |
| TC 9b | PRS RSRP measurement accuracy for FR1 in SA, for different frequencies | A6.7.xx xx PRS-RSRP measurements |
| TC 10a | PRS RSRP measurement accuracy for FR2 in SA, for the same frequency | A7.7.xx xx PRS-RSRP measurements |
| TC 10b | PRS RSRP measurement accuracy for FR2 in SA, for different frequencies | A7.7.xx xx PRS-RSRP measurements |
| TC 11a | UE Rx-Tx time difference measurement accuracy for FR1 in SA, for the same frequency | A6.7.xxx UE Rx-Tx time difference measurements |
| TC 11b | UE Rx-Tx time difference measurement accuracy for FR1 in SA, for different frequencies | A6.7.xxx UE Rx-Tx time difference measurements |
| TC 12a | UE Rx-Tx time difference measurement accuracy for FR2 in SA, for the same frequency | A7.7.xxx UE Rx-Tx time difference measurements |
| TC 12b | UE Rx-Tx time difference measurement accuracy for FR2 in SA, for different frequencies | A7.7.xxx UE Rx-Tx time difference measurements |

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | In principle, 2 PLFs are necessary because the requirements of RSTD/UE Rx-Tx time difference/RSRP were defined for the multiple PLFs already. But we can consider to reduce the number of TCs as possible. So it is unnecessary to define both same PFL and different PFL for all test cases.  |
| Huawei  | Similar comment as Intel, and this issue can be discussed after we conclude on issue 5-9. |
|  |  |

### Sub-topic 5-5 Test cases for the different deployment scenarios

* Option 1 (Intel, Huawei, ZTE, Qualcomm, OPPO): Only need to define the test cases for SA
* Option 2 (Ericsson). RAN4 will define NR positioning test cases for NR-DC, where Pcell is in FR1, and PSCell is in FR2; otherwise define test cases for other deployments with both FR1 and FR2 (e.g., CA or SA with FR1 Pcell and FR2 neighbors).

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Support Option 1. In our view, the requirements applied to SA are definitely same as these for Pcell in CA. That is the test cases proposed by Option 2 are redundant. |
| CATT | Support option 1.  |
| ZTE | In general we support Option 1. Can the proponent of Option 2 point out the difference between PCell in SA and PCell / PSCell in DC? If there is difference then we should specify test cases for those scenarios. |
| vivo | Fine with option 1. |
| Huawei | Support option 1.  |
| Qualcomm | We support option 1. |

### Sub-topic 5-6 General PRS configuration for NR Positioning test cases

**Sub-topic 5-6-1 PRS periodicity and offset**

* Option 1 (Huawei, CATT, Intel): PRS periodicity is 160ms with 10ms offset in all test cases.
* Option 1a (Qualcomm): **Use 160 ms PRS periodicity as baseline for all tests. Offsets may be specified in each test case in order to achieve orthogonality between PRS resources from multiple TRPs**
* Option 2 (Ericsson):
	+ *In each test case the NR measurements are tested for two combinations of PRS periodicity and MGL, e.g.:*
		- *TPRS>MGL, and*
		- *TPRS<MGL.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Both Option 1 and 1a are fine for us. The specific PRS offset can be defined individual if necessary, which will not impact the common PRS configuration. For Option 2, we don’t think it is necessary which can double the testing efforts.  |
| CATT | Fine with option 1 and option 1a.  |
| Huawei | We can support option 1a. |
| Qualcomm | Option 1a. |

**Sub-topic 5-6-2 Comb size, number of symbol , slot repetition factor**

*[Moderator notes: In previous discussion, the PRS density in both time and frequency domain may introduce the performance diver. Therefore, these factors can be verified with several combinations.]*

* Option 1 (Huawei ,CATT):
* **Table 1: general PRS configuration for positioning RRM test cases**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **PRS Pattern 1.1** | **PRS Pattern 1.2** | **PRS Pattern 2.1** | **PRS Pattern 2.2** | **PRS Pattern 3.1** | **PRS Pattern 3.2** |
| **SCS** | FR1, 15k | FR1, 30k | FR2, 120k |
| **PRS periodicity and offset** | 160ms, 10ms |
| **BW (num of PRBs)** | 52 | 106 | 66 |
| **Comb size** | 2 |
| **Number of PRS symbols** | 2 | 4 | 2 | 4 | 2 | 4 |
| **Number of PRS slots** | 1 |

* + PRS comb size is 2 for all test cases
		- For measurement delay test, use symbol size 4, slot repetition 1, and PRS BW same as CH BW or
		- For measurement accuracy test, verify performance of different combinations with subtests
* Option 2 (Intel)：The following PRS configuration combinations are proposed:
* **Table 1: PRS configuration patterns for NR positioning measurement**

|  |  |  |  |
| --- | --- | --- | --- |
|  | PRS Pattern 1 | PRS Pattern 2 | PRS Pattern 3 |
| SCS | FR1, 15k | FR1, 30k | FR2, 120k |
| PRS periodicity | 160ms | 80ms | 20ms |
| Number of PRS symbol | 2 | 4 | 6 |
| Comb size | 2 | 4 | 6 |
| Repetition factor | 4 | 2 | 1 |

* Option 3 (Ericsson)：The following PRS configuration combinations are proposed:
	+ *No PRS repetitions (within a slot or across slots within a single PRS period) are configured in NR positioning test cases*
	+ *PRS SCS is the same as SSB SCS.*
	+ *The network configured k is set as follows:*
		- *timingReportingGranularityFactor=0 for FR1,*
		- *timingReportingGranularityFactor=2 for FR2.*
* Option 4(Qualcomm)
	+ Comb size equal to 2 or 4 would be good choices.
	+ Number of PRS symbols = K\*comb\_size, K = 1, 2, 3 (if needed).

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Repetition and other parameters which can impact the accuracy requirements can be up to the requirements themselves. If we define the requirement regardless with them, we can simply to use either of them as Option 1,2,4 |
| CATT | Based on the configuration used to define accuracy requirements. Use the smallest boundary of each accuracy group as test configuration.  |
| Huawei | We agree to decide these parameters based on accuracy requirements.  |

**Sub-topic 5-6-2 PRS BW**

* Option 1 (Huawei): 10MHz for 15kHz SCS, 40MHz for 30kHz SCS and 100MHz for 120kHz SCS for delay tests. For accuracy tests, the BWs to be tested needs to be further discussed based on outcome of accuracy requriements.
* Option 2 (Ericsson)
	+ *In each test case, the NR measurements are tested for multiple measurement bandwidths, with at least:*
		- *the smallest bandwidth,*
		- *a bandwidth from the medium bandwidths range (e.g., >48 PRBs in FR1 or >32 PRBs in FR2),*
		- *a bandwidth from the large bandwidths range (e.g., >132 PRBs in FR1 or >64 PRBs in FR2).*
* Option 3 (Qualcomm)
	+ Specify multiple PRS BW configurations matching the ones specified in the accuracy requirements. E.g. number of PRBs = 24, 48, 96, 192, 264

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | For the BW, the different BWs shall be configured for the accuracy requirements TC. But how many configuration is needed is up to the eventual requirement. So far, we think 2 groups BW is enough.  |
| CATT | Based on the bandwidth used to define accuracy requirements. Use the smallest boundary of each accuracy group as test configuration. |
| Huawei  | Support option 1.For delay test, we do not need to test many PRS BWs, so a fixed BW is preferred for the reference PRS configuration. |

### Sub-topic 5-7 SRS configuration for NR Positioning test case

* Option 1 (Huawei)
	+ BW: to define the SRS BW corresponding to the channel BW, i.e. 10MHz for 15kHz SCS, 40MHz for 30kHz SCS and 100MHz for 120kHz SCS.
	+ comb size 4 with 4 OFDM symbols.
	+ 80ms, and the offset is 20ms (the separation between PRS and SRS is 10ms).
* **Table 2: general SRS configuration for UE Rx-Tx RRM test cases**

|  |  |  |
| --- | --- | --- |
| SRS-Resource | SRS-ResourceId | 0 |
|  | nrofSRS-Ports | Port1 |
|  | transmissionComb  | n4 |
|  | combOffset-n4 | 0 |
|  | cyclicShift-n4 | 0 |
|  | resourceMappingstartPosition | 0 |
|  | resourceMappingnrofSymbols  | n4 |
|  | resourceMappingrepetitionFactor | n1 |
|  | freqDomainPosition | 0 |
|  | freqDomainShift | 0 |
|  | freqHoppingc-SRS | Matches NRB,c  |
|  | groupOrSequenceHopping | Neither |
|  | resourceType | Periodic |
|  | periodicityAndOffset-p | 80\*2^u, 20\*2^u |
|  | sequenceId | 0 |

* Option 2(Ericsson)
	+ *frequency hopping: no*
	+ *group or sequence hopping: no*
	+ *Number of antenna ports: 1*
	+ *Resource type: periodic*
	+ *SCS: same as for SSB*
* Option 3 (Qualcomm) Match SRS periodicity to PRS periodicity, i.e. 160 ms

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Option 1 and 2 can be combined together.For Option 1, the periodicity and offset can be configured same for all SCS as we defined for PRS common configuration.  |
| Huawei | We support option 1, which already captures the principles in option 2. We are also fine to define the SRS periodicity based on option 3. |
| Qualcomm | Question about both options: why the choice of SRS period = 80 ms? Why not match the PRS periodicity of 160 ms? |

### Sub-topic 5-8 Number of cells/TRPs for NR Positioning test case

* Option 1. (Intel, Qualcomm, OPPO)
	+ for RSTD measurement requirements, test cases with 3 cells are developed: NR Pcell (cell 1) and two NR neighbor cells (cell 2, cell 3);
	+ for RSTD measurement accuracy requirements, test cases with 2 cells can be sufficient, provided separate test cases are developed for measurements on the same and different frequency layers: NR Pcell (cell 1) and one NR neighbor cell (cell 2)
	+ for PRS-RSRP (DL-AoD) and UE Rx-Tx time difference measurement requirements and measurement accuracy requirements, the same test set-up as for RSTD can be used
* Option 2 (Huawei): two TRPs in the test case
* Option 3 (Ericsson):
	+ The number of cells in RSTD test cases:
		- 3 for measurements testing,
		- 2 for accuracy testing (provided there are separate test cases for the same and different frequencies).
	+ The number of cells in PRS-RSRP test cases:
		- 2 for measurements testing,
		- 2 for accuracy testing (provided there are separate test cases for the same and different frequencies), with separate tests in the same test case for the different signal levels in the requirements;
		- Note: absolute measurements (on two cells) and relative measurements (on 1 cell) accuracy are tested in the same test
	+ The number of cells in UE Rx-Tx test cases:
	+ 2 for measurements testing,
	+ 2 for accuracy testing (provided there are separate test cases for the same and different frequencies).

NOTE: the signal levels in the two cells correspond to the different signal levels in the requirements.

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Option 1 and 3 can be acceptable for us.  |
| Huawei | We support option 2, as we still do not see clear point to have 3 cells in RSTD delay tests.  |
| Qualcomm | Option 1. |
| R&S | In terms of test system complexity, we have a preference for Option 2. |
| R&S | (Further elaborating the previous comment) As mentioned in the GoTo Session:* The LBS testing systems are mostly dedicated and more compact than the general RRM systems, since also most of the users are not interested in the “classical RRM”. Thus the system complexity for LBS becomes a very sensitive topic.
* The test system complexity needs to be checked as overall, considering the number of cells, MIMO and channel propagation condition, which in case of FR2 is even more important, due the additional HW and the appliance of Wireless Cable method for Fading.
* We prefer Option 2, in order to keep the complexity at least from number of cells perspective as acceptable from the LBS ecosystem.
 |

### Sub-topic 5-9 Number of positioning frequency layers

* Option 1. (Intel): The number of positioning frequency layers measured cannot be larger than [2].
* Option 1a (Qualcomm): one or two PRS frequency layers
* Option 2 (Ericsson): Each measurement type (RSTD, PRS-RSRP, or UE Rx-Tx) is tested in both configurations:
	+ The cells are spread on two frequencies (regardless on the number of cells agreed for the test)
	+ All cells are on the same frequency
* Option 3 (Huawei)
	+ Test both Case 1 and Case 2 for delay tests
		- Case 1: 1 PFL, and all cells are on the same PFL
		- Case 2: 2 PLFs, and cells are distributed on two PFLs
		- UE supporting more than one PFL only needs to pass tests for Case 2.
	+ Test both Case 1 and Case 2 for delay tests and RSTD accuracy tests. Test Case 1 for PRS-RSRP and UE Rx-Tx accuracy tests

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Option 3 is fine to use which can minimize the test cases number. Cant’ agree Option 2. We need NOT to test all cases with two configurations(same and different PFL).  |
| Huawei | We support option 3.  |
| Qualcomm | All the option seems to include 1 or 2 frequency layers. It looks like companies agree at least on that.For option 3, we could support running either case 1 or case 2 for measurement period tests and test case 1 for accuracy tests. |

### Sub-topic 5-10 Synchronous/Asynchronous cells

* Option 1. (Intel, Huawei): The synchronous cells will be tested for the measurement delay requirements test.
* Option 1a(Qualcomm): Time synchronicity constraints between cells/TRPs may be incorporated in the test configurations to the extent needed to ensure that the Es/Iot side conditions are met during testing

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Some restriction on the time restriction is needed. We can have not any specific definition on synchronous/asynchronous.  |
| Huawei | We support option 1. As the test setup needs to make sure side conditions are met, we do not see the need to use async setup, which will complicate the design. |
| Qualcomm | Option 1a. |

### Sub-topic 5-11 Muting pattern

* Option 1. (Intel, Huawei): only the non-muting PRS configuration will be used.
* Option 2 (Qualcomm) FFS up to **the outcome of the discussion of whether and how to modify measurement period requirements to account for type 1 PRS muting**

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Prefer Option 1 according to current requirements regardless muting pattern. If there is any updates on the core part due to the muting pattern, we can update these tests also.  |
| CATT | Support option 1.  |
| Huawei | We support option 1.  |
| Qualcomm | Option 2 |

### Sub-topic 5-12 Subsets of accuracy tests

* Option 1. (Huawei, Intel, OPPO): Define two subtests per accuracy test cases corresponding to different combinations of {Es/Iot, PRS BW}.
* Option 1a(Qualcomm) Test two PRS BW configurations per test
	+ The first configuration could be the minimum PRS BW supported (PRBs = 24) paired with the smallest SCS for the FR being tested, i.e. SCS = 15 kHz for FR1 and SCS = 60 kHz for FR2.
	+ The second configuration could be the highest PRS BW (num. PRBs) supported by the UE among the PRS reference configurations than RAN4 will define, paired with the highest SCS for the FR being tested (SCS = 30 kHz for FR1 and SCS = 120 kHz for FR2).
* Option 2 (Ericsson): In each test case, the NR measurements are tested for multiple measurement bandwidths, with at least:
	+ the smallest bandwidth,
	+ a bandwidth from the medium bandwidths range (e.g., >48 PRBs in FR1 or >32 PRBs in FR2),
	+ a bandwidth from the large bandwidths range (e.g., >132 PRBs in FR1 or >64 PRBs in FR2).

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Option 1 and 1a are fine for us.  |
| CATT | Define test case for each Es/Iot side condition and smallest bandwidth.  |
| Huawei | We support option 1.We are fine with Option 1a regarding the BW, but for SCS we understand that the SCS to be tested are 15/30/120kHz following current RRM accuracy tests. Also do we not see the need to test different BWs for delay test. |
| Qualcomm | In general we are in favor of minimizing the number of test cases.For us the important point in this issue is whether more than one PRS BW is tested. We favor option 1a. Test the minimum configurable PRS BW (24 PRB) and the largest BW supported by the UE among the available reference PRS configurations.Question on option 1: doesn’t this option contradict options 1a/1b in sub-topic 5-1? |

### Sub-topic 5-13 Reporting configuration

* Option 1 (Ericsson): The network configured k is set as follows:
	+ timingReportingGranularityFactor=0 for FR1,
	+ timingReportingGranularityFactor=2 for FR2

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | The report resolution : can follow the minimum resolution UE can achieved because the network configured “k1” can be overrided by UE’s (k2) |
| CATT | Don’t need to limit the reporting granularity.  |
| Huawei | We have similar view as Intel. |
| Qualcomm | The network should configure the highest measurement resolution (k=0) in the test cases for both FR1 and FR2. |

### Sub-topic 5-14 Supported test configurations in FR1

* Option 1 (Ericsson): *Supported test configurations for FR1:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *15 kHz SSB SCS, 10 MHz bandwidth, FDD duplex mode* |
| *2* | *15 kHz SSB SCS, 10 MHz bandwidth, TDD duplex mode* |
| *3* | *30 kHz SSB SCS, 40 MHz bandwidth, TDD duplex mode* |
| *NOTE: The UE is only required to be tested in one of the supported test configurations.* |

* Option 1a (Qualcomm): : Support the proposed reference test configurations below under the assumption that they correspond to the Pcell configuration and do not constrain the PRS bandwidth and SCS to be tested in each test case.

*Supported test configurations for FR1:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *15 kHz SSB SCS, 10 MHz bandwidth, FDD duplex mode* |
| *2* | *15 kHz SSB SCS, 10 MHz bandwidth, TDD duplex mode* |
| *3* | *30 kHz SSB SCS, 40 MHz bandwidth, TDD duplex mode* |
| *NOTE: The UE is only required to be tested in one of the supported test configurations.* |

* Option 1b (Huawei): Re-use the test configurations {10MHz BW, 15kHz SCS}, {40MHz BW, 30kHz SCS} **for serving cell and also PRS in case of delay test**.

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Option 1, 1a are fine for us.  |
| Huawei | We support option 1b, i.e. the test configurations are for serving cell and also PRS in case of delay test. |
| Qualcomm | We support option 1a.To Huawei: What if the UE does not support e.g. PRS BW of 40 MHz? |

### Sub-topic 5-15 Supported test configurations in FR2

* Option 1 (Ericsson): *Supported test configurations for FR2:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *120 kHz SSB SCS, 100 MHz bandwidth, TDD duplex mode* |

* Option 1a (Qualcomm): : Support the proposed reference test configurations below under the assumption that they correspond to the Pcell configuration and do not constrain the PRS bandwidth and SCS to be tested in each test case.

*Supported test configurations for FR2:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *120 kHz SSB SCS, 100 MHz bandwidth, TDD duplex mode* |

* Option 1b (Huawei): Re-use the test configurations {100MHz BW, 120kHz SCS} **for serving cell and also PRS in case of delay test**.
* Recommended WF: Further discussion needed. Collect companies’ views.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Option 1, 1a are fine for us.  |
| Huawei | We support option 1b, i.e. the test configurations are for serving cell and also PRS in case of delay test. |
| Qualcomm | Option 1a. |

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2106921**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106921.zip) [draft CR] Test cases for PRS-RSRP measurement accuracy (ZTE) |  |
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| [**R4-2104748**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2104748.zip) CR on test case for PRS-RSRP measurement requirements for FR2 in SA (CATT) |  |
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|  |
| [**R4-2106450**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106450.zip) draftCR] CR for PRS configurations for NR Pos RRM tests (Intel) |  |
|  |
|  |
| [**R4-2106451**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106451.zip) draftCR] CR for the test case of RSTD measurement requirements reporting in SA (Intel) |  R&S: - Number of cells should be as per the decision in 5.2.8 Sub-topic 5-8. - The presence of Fading combined with a multicell test setup increases the test system complexity and costs considerably, especially if a similar test case would be applied for FR2. We strongly suggest to use AWGN channel.  |
| R&S: (Further elaborating the previous comment) As mentioned in 5.8.2, we are concerned about the overall system complexity. Fading combined with multiple cells increases the complexity to levels which might be unacceptable by the LBS ecosystem. In addition, for FR2, Fading will require Wireless Cable method, the effect of which is unclear for serving + neighbor and RSTD cell scenarios. Thus, we strongly recommend AWGN conditions. |
|  |
| [**R4-2107170**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107170.zip) TC5 and TC6: UE Rx-Tx time difference measurement requirements for FR1 and FR2 in SA (Ericsson) |  |
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| [**R4-2107171**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107171.zip) TC11 and TC12: UE Rx-Tx time difference measurement accuracy for FR1 and FR2 in SA (Ericsson) |  |
|  |
|  |
| [**R4-2107011**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107011.zip) draftCR to introduce TC for PRS-RSRP measurement requirements for FR1 in SA**(Huawei)** |  |
|  |
|  |
| [**R4-2107012**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107012.zip) draftCR to introduce TC for RSTD measurement accuracy for FR1 and FR2 in SA (Huawei) |  |
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## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#5-1** | **Test cases for the different SINR side condition for UE Rx-Tx time difference** *Tentative agreements:** + UE Rx-Tx tests: Both SINR side conditions are tested in the same test with two cells.
	+ PRS-RSRP test: FFS
		- Option 1: there can be separate tests (e.g., Test 1, Test 2, …) inside the test case, one for each side condition.
		- Option 2: Both SINR side conditions are tested in the same test with two cells

*Candidate options:**Recommendations for 2nd round: Please companies check whether the tentative agreements is agreeable.* |
| **Sub-topic#5-2** | **Test cases for** serving carrier frequencies and non-serving carrier frequencies **measurements***Tentative agreements:* * No need to define test cases for the serving carrier frequencies and non-serving carrier frequencies.

*Candidate options:**Recommendations for 2nd round : No further discussion needed.* |
| **Sub-topic #5-3** | **Absolute measurement reporting in test cases***Tentative agreements: None**Candidate options:** Option 1 (Ericsson, Intel): Absolute measurement reporting is tested for all PRS measurements.
* Option 1a(Huawei): Do not define RSTD accuracy tests with differential RSTD. No need to limit the reporting format for the test cases.
* Option 2( Qualcomm): **:**
	+ For RSTD and UE Rx-Tx define test cases with absolute reporting.
	+ For PRS-RSRP define test cases with differential reporting and optionally with absolute reporting.
* Option 3(ZTE): FFS

*Recommendations for 2nd round: Can be FFS* |
| **Sub-topic#5-4** | **Test case list clarifications** *Tentative agreements:**Candidate options:**Recommendations for 2nd round: Can be FFS up to* issue 5-9 |
| **Sub-topic#5-5** | **Test cases for the different deployment scenarios***Tentative agreements:* Only need to define the test cases for SA *Candidate options:**Recommendations for 2nd round:*  |
| **Sub-topic#5-6-1** | **General PRS configuration for NR Positioning test case***Tentative agreements:* Use 160 ms PRS periodicity as baseline for all tests. Offsets may be specified in each test case in order to achieve orthogonality between PRS resources from multiple TRPs*Candidate options**Recommendations for 2nd round:* |
| **Sub-topic#5-6-2** | **Combination of Comb size, number of symbol , slot repetition factor***Tentative agreements: None.**Candidate options**Recommendations for 2nd round: Can be FFS up to accuracy requirements*  |
| **Sub-topic#5-6-3** | **PRS BW***Tentative agreements:* 10MHz for 15kHz SCS, 40MHz for 30kHz SCS and 100MHz for 120kHz SCS for delay tests. For accuracy tests, the BWs to be tested needs to be further discussed based on outcome of accuracy requirements*Candidate options**Recommendations for 2nd round: Can be FFS.*  |
| **Sub-topic#5-7** | **SRS configuration for NR Positioning test case***Tentative agreements: None**Candidate options:* * Option 1 (Huawei)
	+ BW: to define the SRS BW corresponding to the channel BW, i.e. 10MHz for 15kHz SCS, 40MHz for 30kHz SCS and 100MHz for 120kHz SCS.
	+ comb size 4 with 4 OFDM symbols.
	+ 80ms, and the offset is 20ms (the separation between PRS and SRS is 10ms).
* **Table 2: general SRS configuration for UE Rx-Tx RRM test cases**

|  |  |  |
| --- | --- | --- |
| SRS-Resource | SRS-ResourceId | 0 |
|  | nrofSRS-Ports | Port1 |
|  | transmissionComb  | n4 |
|  | combOffset-n4 | 0 |
|  | cyclicShift-n4 | 0 |
|  | resourceMappingstartPosition | 0 |
|  | resourceMappingnrofSymbols  | n4 |
|  | resourceMappingrepetitionFactor | n1 |
|  | freqDomainPosition | 0 |
|  | freqDomainShift | 0 |
|  | freqHoppingc-SRS | Matches NRB,c  |
|  | groupOrSequenceHopping | Neither |
|  | resourceType | Periodic |
|  | periodicityAndOffset-p | 80\*2^u, 20\*2^u |
|  | sequenceId | 0 |

* Option 2(Ericsson)
	+ *frequency hopping: no*
	+ *group or sequence hopping: no*
	+ *Number of antenna ports: 1*
	+ *Resource type: periodic*
	+ *SCS: same as for SSB*
* Option 3 (Qualcomm) Match SRS periodicity to PRS periodicity, i.e. 160 ms

*Recommendations for 2nd round: Can be FFS.* |
| **Sub-topic#5-8** | **Number of cells/TRPs for NR Positioning test case***Tentative agreements: According to TE vendor’s comments on the testing complexity, could we agree the following option:* * two TRPs in the test case

*Candidate options:**Recommendations for 2nd round: Please companies check the tentative agreements is agreeable.**Can be FFS* |
| **Sub-topic#5-9** | **Number of positioning frequency layers***Tentative agreements** + Test Case 1 or Case 2 for delay tests and RSTD accuracy tests. Test Case 1 for PRS-RSRP and UE Rx-Tx accuracy tests
		- Case 1: 1 PFL, and all cells are on the same PFL
		- Case 2: 2 PLFs, and cells are distributed on two PFLs
		- UE supporting more than one PFL only needs to pass tests for Case 2.

*Candidate options:**Recommendations for 2nd round : Please companies check the tentative agreements is agreeable* |
| **Sub-topic#5-10** | **Synchronous/Asynchronous cells***Tentative agreements: None**Candidate options:** Option 1. (Intel, Huawei): The synchronous cells will be tested for the measurement delay requirements test.
* Option 1a(Qualcomm): Time synchronicity constraints between cells/TRPs may be incorporated in the test configurations to the extent needed to ensure that the Es/Iot side conditions are met during testing

*Recommendations for 2nd round: Can be FFS* |
| **Sub-topic#5-11** | **Muting pattern** *Tentative agreements: None**Candidate options:** Option 1. (Intel, Huawei): only the non-muting PRS configuration will be used.
* Option 2 (Qualcomm) FFS up to the outcome of the discussion of whether and how to modify measurement period requirements to account for type 1 PRS muting

*Recommendations for 2nd round: Can be FFS* |
| **Sub-topic#5-12** | **Subsets of accuracy tests***Tentative agreements:* * Test two PRS BW configurations per test
	+ The first configuration could be the minimum PRS BW supported (PRBs = [24]) paired with the smallest SCS for the FR being tested, i.e. SCS = 15 kHz for FR1 and SCS = 60 kHz for FR2.
	+ The second configuration could be the highest PRS BW (num. PRBs) supported by the UE among the PRS reference configurations, paired with the highest SCS for the FR being tested (SCS = 30 kHz for FR1 and SCS = 120 kHz for FR2).

*Candidate options:**Recommendations for 2nd round: Please companies check the tentative agreements are agreeable.* |
| **Sub-topic#5-13** | **Reporting configuration***Tentative agreements: None**Candidate options:** Option 1 (Ericsson): The network configured k is set as follows:
	+ timingReportingGranularityFactor=0 for FR1,
	+ timingReportingGranularityFactor=2 for FR2
* Option 2 : No need limit the reporting granularity.

*Recommendations for 2nd round: Can be FFS* |
| **Sub-topic #5-14** | **Supported test configurations in FR1***Tentative agreements: None**Candidate options:** Option 1 (Ericsson): *Supported test configurations for FR1:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *15 kHz SSB SCS, 10 MHz bandwidth, FDD duplex mode* |
| *2* | *15 kHz SSB SCS, 10 MHz bandwidth, TDD duplex mode* |
| *3* | *30 kHz SSB SCS, 40 MHz bandwidth, TDD duplex mode* |
| *NOTE: The UE is only required to be tested in one of the supported test configurations.* |

* Option 1a (Qualcomm): : Support the proposed reference test configurations below under the assumption that they correspond to the Pcell configuration and do not constrain the PRS bandwidth and SCS to be tested in each test case.

*Supported test configurations for FR1:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *15 kHz SSB SCS, 10 MHz bandwidth, FDD duplex mode* |
| *2* | *15 kHz SSB SCS, 10 MHz bandwidth, TDD duplex mode* |
| *3* | *30 kHz SSB SCS, 40 MHz bandwidth, TDD duplex mode* |
| *NOTE: The UE is only required to be tested in one of the supported test configurations.* |

* Option 1b (Huawei): Re-use the test configurations {10MHz BW, 15kHz SCS}, {40MHz BW, 30kHz SCS} **for serving cell and also PRS in case of delay test**.

*Recommendations for 2nd round: Can be FFS.* |
| **Sub-topic #5-15** | **Supported test configurations in FR2***Tentative agreements: None.** Option 1 (Ericsson): *Supported test configurations for FR2:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *120 kHz SSB SCS, 100 MHz bandwidth, TDD duplex mode* |

* Option 1a (Qualcomm): : Support the proposed reference test configurations below under the assumption that they correspond to the Pcell configuration and do not constrain the PRS bandwidth and SCS to be tested in each test case.

*Supported test configurations for FR2:*

|  |  |
| --- | --- |
| *Configuration* | *Description* |
| *1* | *120 kHz SSB SCS, 100 MHz bandwidth, TDD duplex mode* |

* Option 1b (Huawei): Re-use the test configurations {100MHz BW, 120kHz SCS} **for serving cell and also PRS in case of delay test**.

*Recommendations for 2nd round: Can be FFS.* |

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| [**R4-2106921**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106921.zip) [draft CR] Test cases for PRS-RSRP measurement accuracy (ZTE) | Return |
| [**R4-2104748**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2104748.zip) CR on test case for PRS-RSRP measurement requirements for FR2 in SA (CATT) | Return |
| [**R4-2106450**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106450.zip) [draftCR] CR for PRS configurations for NR Pos RRM tests | Return |
| [**R4-2106451**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106451.zip) draftCR] CR for the test case of RSTD measurement requirements reporting in SA (Intel) | Return |
| [**R4-2107170**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107170.zip) TC5 and TC6: UE Rx-Tx time difference measurement requirements for FR1 and FR2 in SA (Ericsson) | Return |
| [**R4-2107171**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107171.zip) TC11 and TC12: UE Rx-Tx time difference measurement accuracy for FR1 and FR2 in SA (Ericsson) | Return |
| [**R4-2107011**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107011.zip) draftCR to introduce TC for PRS-RSRP measurement requirements for FR1 in SA**(Huawei)** | Return |
| [**R4-2107012**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107012.zip) draftCR to introduce TC for RSTD measurement accuracy for FR1 and FR2 in SA (Huawei) | Return |
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## Discussion on 2nd round

Please only comment on topics that are selected for discussion in 2nd round.

### Sub-topic#5-1 Test cases for the different SINR side condition for UE Rx-Tx time difference and RSRP

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Intel** | **For PRS RSRP test, if number of cell/TRPs are two, Option 2 below can be supported.**Option 2: Both SINR side conditions are tested in the same test with two cell |
| **Qualcomm** | Option2 for PRS-RSRP tests |

### Sub-topic#5-3 Absolute measurement reporting in test cases

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Intel** | **We can support both Option 1, 1a and 2** |
| **Qualcomm** | This issue needs to be restated. Differential reporting is only used when multiple measurements per TRP (PRS-RSRP or UE Rx-Tx) or per TRP pair (RSTD) are reported by the UE based on different PRS resources or resource sets. The network sets the maximum number of such measurements that can be reported by the UE in response to a location request.If the test cases are going to feature one PRS resource per TRP then this is a non-issue. |

### Sub-topic#5-8 Number of cells/TRPs for NR Positioning test case

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Intel** | **Regarding to TE vendors concerns, two TRPs are fine for us.** |
| **Qualcomm** | We prefer to have 3 cells for RSTD measurement period test cases, at least for FR1. We believe this was done for LTE OTDOA. We can solicit more input from TE vendors on this issue. |

### Sub-topic#5-10 Synchronous/Asynchronous cells

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Intel** | **Support option 1. Actually we need not any sync or async setting.**  |
| **Qualcomm** | Support option 1a. |

### Sub-topic#5-11 Muting pattern

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Intel** | **UP to the core part discussion.** |
| **Qualcomm** | Depends on the outcome of the discussion of whether and how to account for type 1 PRS muting in the measurement period requirements |

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
|  |  |

## Summary on 2nd round

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| --- | --- |
| **CR/TP/LS/WF number** | **T-doc status update recommendation**  |
|  |  |

# Simulation results

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2106457](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106457.zip) | Intel Corporation | PRS simulation results collection |
| [**R4-2106519**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106519.zip) | OPPO | PRS simulation results collection |
| [**R4-2107216**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107216.zip) | Ericsson | PRS simulation results collection |
| [**R4-2106343**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106343.zip) | Qualcomm Incorporated | PRS simulation results collection |
| [**R4-2106637**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106637.zip) | vivo | PRS simulation results collection |
| [**R4-2106635**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106635.zip) | vivo | PRS simulation results collection |
| [**R4-2106636**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106636.zip) | vivo | PRS simulation results collection |
| [**R4-2106637**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106637.zip) | vivo | PRS simulation results collection |

## Open issues summary

[*Moderator notes: all simulation results from the different companies were be included in* [*R4-2106457*](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106457.zip) *for information only*.]

### Sub-topic 6-1

# Recommendation for Tdocs

**After first round:**

|  |  |  |  |
| --- | --- | --- | --- |
| Tdoc No. | Source company | Recommendation | Remarks |
| Big CR |
| [**R4-2107158**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107158.zip) | **Ericsson, Intel** | Revised |  |
| CR for accuracy requirements |
| **R4-2107007**  | (Huawei, Hi Silicon) | Revised |  |
| [**R4-2107168**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107168.zip)  | (Ericsson) | Revised |  |
| [[**R4-2104747**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2104747.zip)](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/R4-2100446.zip)  | (CATT) | Revised |  |
|  |  |  |  |
|  |  |  |  |
| CR for TC |
| [**R4-2106921**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106921.zip) | ZTE | Return |  |
| [**R4-2106450**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106450.zip) | Intel | Return |  |
| [**R4-2106451**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2106451.zip)  | Intel | Return |  |
| [**R4-2107170**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107170.zip)  | Ericsson | Return |  |
| [**R4-2107171**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107171.zip)  | Ericsson | Return |  |
| [**R4-2107011**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107011.zip)  | Huawei | Return |  |
| [**R4-2107012**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2107012.zip) | Huawei | Return |  |
| [[**R4-210474**](file:///C%3A%5CUsers%5Crhuang5%5COneDrive%20-%20Intel%20Corporation%5CDocuments%5Cmy_work%5CLTE_A%5CRAN4%5C98e-b%5CDocs%5CR4-2104747.zip)](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/R4-2100446.zip)**8** | CATT | Return |  |
|  |  |  |  |
| WF |
| New | Intel | Return |  |
| Simulation results collection |
| **R4-2106457** | Intel | Revised |  |

**After 2nd round**:

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| Tdoc No. | Revision from | Source company | Recommendation | Remarks |
| Big CR |
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| CR for accuracy requirements |
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| CR for TC |
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| WF |
|  |  |  |  |  |
| Simulation result collection and full set of the simulation parameter list  |
|  |  |  |  |  |