**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-21xxx**

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

**Agenda item:** 5.5.2.3

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [98-bis-e][208] NR\_pos\_3

**Document for:** Information

# Introduction

The document contains discussion related to the RRM performance requirements for gNB positioning measurements:

The document contains the following four main topics:

* Topic #1: General aspects (Agenda item: 5.5.2.3.1)
* Topic #2: SRS-RSRP requirements (Agenda item: 5.5.2.3.2)
* Topic #3: gNB Rx-Tx time difference requirements (Agenda item: 5.5.2.3.3)
* Topic #4: UL RTOA requirements (Agenda item: 5.5.2.3.4)

# Topic #1: General aspects

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2106399**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106399.zip) | Ericsson | Summary of link level simulation results of SRS RSRP and gNB TOA |
| [**R4-2106400**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106400.zip) | Ericsson | **gNB positioning link level simulation results:** **Observation 1: Agnostic behavior from gNB TOA simulated accuracy towards UL-SRS-NumSymbols and UL-SRS-CombSizeN can be observed.****Observation 2: Somewhat agnostic behavior from gNB TOA simulated accuracy towards TSRS can be observed.****Observation 3: TDL profile has tremendous negative effect on TOA accuracy which can be lessened by using multiple samples (e.g. Ns = 4) instead of a single shot measurement.****Observation 4: Depending on side conditions and number of samples used, low bandwidth (in terms of RB) SRS configurations tend to have unfeasibly low accuracy values, which leads to a discussion of a minimum bandwidth (in RB) for defining gNB TOA measurement accuracy requirements.****Observation 5: TOA accuracy is dependent on SCS setting.****Observation 6: SRS-RSRP accuracy is agnostic to SCS, NumSymbols and CombSizeN.****Observation 7: SRS-RSRP accuracy is dependent on SRS BW (RB), consider using bandwidth minimum definition to exclude configurations that lead to unreasonable accuracy.** |
| [**R4-2106922**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106922.zip) | ZTE Corporation | **Proposal 1: gNB accuracy requirements do not mandate gNB RX beam sweeping is captured only in the WF.** |
| [**R4-2107013**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107013.zip) | Huawei, HiSilicon | **Proposal 1: gNB accuracy requirements do not mandate gNB RX beam sweeping is captured only in the WF.****Proposal 2: The gNB positioning measurement requirements apply for the same RoAoA as OTA reference sensitivity requirements for 1-O and 2-O BS.** **Proposal 3: Define the gNB accuracy requirements based on single shot measurement assumption.** |
| [**R4-2107014**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107014.zip) | Huawei, HiSilicon | **Updated link simulation assumptions for gNB positioning measurement** |
| [**R4-2107177**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107177.zip) | Nokia, Nokia Shanghai Bell | 1. gNB accuracy requirements do not mandate gNB RX beam sweeping is included in the accuracy side conditions in TS 38.133.
2. Consider the SRS BW grouping in Tables 1 to 3 for the discussion on structuring SRS based accuracy requirements in TS 38.133.
3. Continue the study into dependency on other SRS parameters such as SRS comb size and SRS symbol size in order to confirm there is an impact.
4. Define the gNB accuracy requirements in TS 38.133 based on multiple shots and agree the number of shots.
 |

## Open issues summary

### Sub-topic 1-1: Beam sweeping during gNB measurement

According to the approved WF in R4-2103587:

* *gNB accuracy requirements do not mandate gNB RX beam sweeping*
* *Options for capturing above agreements:*
	+ *Option 1:*
		- *gNB accuracy requirements do not mandate gNB RX beam sweeping is captured only in the WF.*
	+ *Option 2:*
		- *gNB accuracy requirements do not mandate gNB RX beam sweeping is included in the accuracy side conditions.*
	+ *Other options not precluded*

**Issue 1-1-1: Beam sweeping during gNB measurement**

* Proposals
	+ Option 1: ZTE, Huawei, CATT
		- gNB accuracy requirements do not mandate gNB RX beam sweeping is captured only in the WF.
	+ Option 2: Ericsson, Nokia
		- gNB accuracy requirements do not mandate gNB RX beam sweeping is included in the accuracy side conditions.
* Recommended WF
	+ Further discuss the options

### Sub-topic 1-2: Samples for gNB accuracy requirements

According to the approved WF in R4-2103587:

* *FFS: number of samples/snapshots used for deriving gNB accuracy requirements.*
* *Option 1:*
	+ *Define the gNB accuracy requirements based on single shot measurement assumption*
* *Option 2:*
	+ *Define the gNB accuracy requirements based on multiple shots (Ns)*
		- *Ns is FFS*
* *Other options not precluded.*

**Issue 1-2-1: Number of samples for gNB accuracy requirements**

* Proposals
	+ Option 1: Huawei
		- Define the gNB accuracy requirements based on single shot measurement assumption
	+ Option 2: Ericsson, Nokia
		- Define the gNB accuracy requirements based on multiple shots (Ns)
* Recommended WF
	+ Further discuss the options

### Sub-topic 1-3: RoAoA for gNB accuracy requirements

**Issue 1-3-1: RoAoA side conditions for meeting gNB accuracy requirements for 1-O and 2-O gNB types**

* Proposals
	+ Option 1: Huawei
		- gNB positioning measurement requirements apply for the same RoAoA as OTA reference sensitivity requirements for 1-O and 2-O BS
	+ Option 2:
		- None
* Recommended WF
	+ Further discuss option 1

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 1-1: Issue 1-1-1: Beam sweeping during gNB measurement**

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| **Company** | **Comments** |
| ZTE | We support Option 1. We don’t see why this should be captured in the spec since by default, the gNB behavior is not mandated. Given that this is already the common practice (only specify requirements but not to mandate implementations), we oppose capturing this into the spec. |
| CATT | Support option 1. Don’t see the necessity to capture it into specification. The beam sweeping is gNB implementation and not mandated by the requirements.  |
| Ericsson | Support option 2. |
| Nokia | We support option 2. The previous agreement that gNB accuracy requirements do not mandate gNB beam sweeping is to be captured in the accuracy side conditions. This does not mandate any gNB behavior, it rather characterizes the scope of the requirement and of the related conformance testing. Accuracy requirements in our view should not be based on the need to perform RX beam sweeping during the gNB measurement, which is implementation specific, rather based on the simplified beam arrangement that the UE is located in the peak direction of the gNB antenna beam. This setup forms a common assumption for the different gNB types under investigation. |
| Huawei  | We support option 1.In our view, the accuracy requirement would not enforce gNB Rx beam sweeping. Whether and how to do Rx beam sweeping is up to gNB implementation, as long as it can meet the requirements. Rx beam sweeping is a gNB behavior which is not a condition.What we think relevant as side condition for gNB requirements is in which directions the requirements are applicable, and this is addressed in issue 1-3-1.  |
| ZTE | Still support Option 1.To Nokia: we agree that gNB behavior shall not be mandated but we don’t have to capture anything in the spec. By default (not capturing specific gNB behavior), it is already interpreted this way. Do not understand why this shall be captured in the spec, capturing it in the WF is enough. |
| Ericsson | If option 1 in issue 1-3-1 is agreeable, at least for gNB type 1-O and 2-O this issue would be resolved.  |
| Intel | We slightly prefer Option 2 since WF is just like stage 2 documents. Eventually the agreements in WF shall be reflected in TS. |
| Qualcomm | We support option 1. We still have not heard a convincing argument for capturing it in the specifications. |

**Sub-topic 1-2: Issue 1-2-1: Number of samples for gNB accuracy requirements**

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| **Company** | **Comments** |
| Ericsson | As link level simulation results have shown, measurement accuracy can be tremendously improved by using more than one sample, especially when evaluating TOA. It is noted that RAN4 defines minimum requirements and that in that case measurement accuracy requirements based on single shot measurement evaluation should suffice, however especially for TOA accuracy, for certain configurations it cannot be distinguished if certain SRS configuration ever would lead to reasonable accuracy when evaluating just one sample. Therefore, it is proposed to use more than one sample for measurement accuracy definition in order not to omit certain low bandwidth SRS configurations due to unfeasibility. |
| Nokia | We support option 2. The use of multiple shots is a commonly used measurement practice for RTOA in LTE, see TS 36.111, but also for DL TDOA, multi-RTT and DL AoD for NR positioning, where accuracy requirement is based on 4 measurement samples. Our results indicate an improvement for SRS-RSRP and gNB Rx-Tx time difference accuracy. |
| Huawei | We support option 1.Based on the simulation results, for TOA measurement, we can see that the gain from multi-shot is mainly visible for fading channel, but since we are only defining requirements for AWGN, we do not need to assume multi-shot. For SRS-RSRP, the max gain from multi-shot is ~1dB and observed with small BW, but considering the overall accuracy performance, we do not see it is justified to assume multi-shot as well (single-shot performance is sufficient).Finally, RAN4 is defining minimum requirements, so worst-case assumption should be used. Following option 1 does not prevent any gNB to use multi-shot measurement in real world. |
| Ericsson | After consideration of link level simulation results and evaluating performance gaps within results for AWGN, we are ok with option 1. Defining measurement accuracy based on single shot assumption does not mandate gNB to use just one sample, furthermore whilst applying AWGN characteristics, link level simulation results for single shot measurement have shown reasonable values for both gNB TOA and SRS-RSRP. |
| Intel | If the requirements is target to AWGN, single shot shall be enough. We are fine for Option 1.  |
| Qualcomm | We think the accuracy requirements should cover the low end of configurable SRS bandwidth. If multiple samples are required to get “reasonable accuracy” for low SRS bandwidth then requirements based on multiple samples should be considered. However, we note that if gNB accuracy requirements are defined for AWGN only, the need for multiple samples should be lessened. |

**Sub-topic 1-3: Issue 1-3-1: RoAoA side conditions for meeting gNB accuracy requirements for 1-O and 2-O gNB types**

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| **Company** | **Comments** |
| Ericsson | We are fine with option 1. |
| Nokia | We have concerns on option 1. It does not cover all gNB types under investigation. We suggest, as earlier pointed out, to instead use the side condition that the UE’s target direction matches with the peak direction of the RX antenna beam of the gNB. This is then used as common assumption for all considered gNB types. |
| Huawei | We support option 1 but we are also open to hear other views.To Nokia, we understand UE’s target direction matching with the Rx peak direction of gNB is a quite strong limitation. Even in the serving cell, not all UEs are in the Rx park direction of the gNB, and for positioning measurement, a gNB will measure UEs in neighbor cells, so we do not see it as a realistic condition. RoAoA is directions where gNB can meet the refsense, and we think gNB should also be able to perform measurement based on specified side conditions.  |
| Qualcomm | We are not sure this side condition is needed. Reference sensitivity is specified as a signal level in dBm so there it makes sense that the requirement would apply then the signal is measured within some angle range relative to max gain. For NR positioning accuracy requirements there is already a SINR side condition that limits applicability of the requirements. We are open to discuss further. |
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### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| [**R4-2107014**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107014.zip)(Huawei) | Nokia: we can agree to the proposed changes. |
| Ericsson: we are fine with the changes, we can also discuss addition of SCS = 60kHz to cover accuracy dependency with gNB TOA  |
|  |
| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

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|  | **Status summary**  |
| **Sub-topic 1-1** | **Issue 1-1-1: Beam sweeping during gNB measurement***Tentative agreements: None**Candidate options:** + *Option 1: ZTE, CATT, HW, QC*
		- *gNB accuracy requirements do not mandate gNB RX beam sweeping is captured only in the WF.*
	+ *Option 2: Nokia, E///, Intel*
		- *gNB accuracy requirements do not mandate gNB RX beam sweeping is included in the accuracy side conditions.*

*Recommendations for 2nd round: Continue discussion in 2nd round* |
| **Sub-topic 1-2** | **Issue 1-2-1: Number of samples for gNB accuracy requirements***Tentative agreements: None**Candidate options:** + Option 1: HW, E///, Intel, QC
		- Define the gNB accuracy requirements based on single shot measurement assumption
	+ Option 2: Nokia
		- Define the gNB accuracy requirements based on multiple shots (Ns)

*Recommendations for 2nd round: Continue discussion in 2nd round* |
| **Sub-topic 1-3** | **Issue 1-3-1: RoAoA side conditions for meeting gNB accuracy requirements for 1-O and 2-O gNB types***Tentative agreements: None**Candidate options:**Should we define the side condition that gNB positioning measurement requirements apply for the same RoAoA as OTA reference sensitivity requirements for 1-O and 2-O BS?** + Option 1: HW, E///
		- Yes
	+ Option 2: Nokia, QC
		- No

*Recommendations for 2nd round: Continue discussion in 2nd round* |

### CRs/TPs

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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

## Discussion on 2nd round (if applicable)

### Open issues

**Sub-topic 1-1: Issue 1-1-1: Beam sweeping during gNB measurement**

* Option 1: ZTE, CATT, HW, QC
	+ gNB accuracy requirements do not mandate gNB RX beam sweeping is captured only in the WF.
* Option 2: Nokia, E///, Intel
	+ gNB accuracy requirements do not mandate gNB RX beam sweeping is included in the accuracy side conditions.

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| **Company** | **Comments** |
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**Issue 1-2-1: Number of samples for gNB accuracy requirements**

* + Option 1: HW, E///, Intel, QC
		- Define the gNB accuracy requirements based on single shot measurement assumption
	+ Option 2: Nokia
		- Define the gNB accuracy requirements based on multiple shots (Ns)

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| **Company** | **Comments** |
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**Issue 1-3-1: RoAoA side conditions for meeting gNB accuracy requirements for 1-O and 2-O gNB types**

Should we define the side condition that gNB positioning measurement requirements apply for the same RoAoA as OTA reference sensitivity requirements for 1-O and 2-O BS?

* + Option 1: HW, E///
		- Yes
	+ Option 2: Nokia, QC
		- No

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| **Company** | **Comments** |
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### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| Revision of simulation assumptions [**R4-2107014**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107014.zip) (Huawei) |  |
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# Topic #2: SRS-RSRP requirements

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2106401**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106401.zip) | Ericsson | **Proposal 1: Define gNB SRS-RSRP measurement accuracy requirements agnostic to SCS, NumSymbols and CombSizeN.****Proposal 2: Use following table format structure to define SRS-RSRP accuracy requirements:**

|  |  |
| --- | --- |
| **SRS bandwith in RB** | **SRS-RSRP accuracy in dB** |
| **Ês/Iot ≥ -13dB** | **Ês/Iot ≥ +3dB** |
| **BWmin ≤ BW ≤ BW1** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** | **TBD** | **TBD** |
| **…** |  |  |

**Proposal 3: Define SRS-RSRP measurement accuracy requirements for all gNB types 1-C, 1-H, 1-O and 2-O** |
| [**R4-2106948**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106948.zip) | Huawei, HiSilicon | **Link simulation results for SRS-RSRP measurement performance.****Observation 1: The performance is very dependent on SNR conditions.****Observation 2: There is a performance difference between different comb and symbol sizes.****Observation 3: The accuracy improves in proportion with BW in RB and the impact of SCS is small.** |
| [**R4-2107017**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107017.zip) | Huawei, HiSilicon | **Proposal 1: Define the SRS-RSRP accuracy requirements as follows.*** **For SINR +3dB, one set of accuracy for all SRS BWs and for all combinations of comb+symbol**
* **For SINR -13dB,**
	+ **two sets of requirements, one for 24≤RB\_num<[64] and the other for [64]≤RB\_num.**
	+ **FFS if separate requirements should be defined for different combinations of comb+symbol**
* **The requirements are defined agnostic to SRS SCS**

**Proposal 2: RF calibration margin for gNB SRS-RSRP accuracy*** **X=2.5dB for gNB type 1-C**
* **X=4dB for gNB typr 1-H, 1-O and 2-O**

**Proposal 3: gNB SRS-RSRP measurement accuracy requirements apply in AWGN.** |
| [**R4-2107178**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107178.zip) | Nokia, Nokia Shanghai Bell | **Link simulation results for SRS-RSRP accuracy.**1. The SRS-RSRP accuracy for all SRS configurations depends majorly on the Ês/Iot ratio in the considered range +3 dB …-13 dB, and lesser on the SRS BW (a clear dependency is observed for low Ês/Iot condition only), whilst no dependency on SRS comb size and number of continuous SRS symbols is observed.
2. The SRS-RSRP accuracy can be improved for the low Ês/Iot condition adopting multiple shots (e.g. 2 or 4) compared to single shot by around 0.5 dB (two shots) and 0.9 dB (four shots).

Following proposal for agreement is made:1. The provided SRS-RSRP accuracy results are taken into account in the discussion on SRS BW grouping and other SRS configuration parameter grouping and for identifying the number of shots.
 |

## Open issues summary

### Sub-topic 2-1: SRS BW grouping for SRS-RSRP accuracy requirements

According to the approved WF in R4-2103587:

* *gNB accuracy requirements shall be defined for group of SRS BWs*
	+ *grouping of SRS BWs will be decided based on link simulation results*

**Issue 2-1-1: SRS BW grouping for defining SRS-RSRP accuracy requirements**

* Proposals
	+ Option 1: Ericsson

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| **SRS bandwith in RB** | **SRS-RSRP accuracy in dB** |
| **Ês/Iot ≥ -13dB** | **Ês/Iot ≥ +3dB** |
| **BWmin ≤ BW ≤ BW1** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** | **TBD** | **TBD** |
| **…** |  |  |

* + Option 2: Huawei
		- For SINR +3dB, one set of accuracy for all SRS BWs and for all combinations of comb+symbol
		- For SINR -13dB,
			* two sets of requirements, one for 24≤RB\_num<[64] and the other for [64]≤RB\_num.
	+ Option 3: Nokia

**FR1, SCS= 15 kHz**

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| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 24 - 40 | 5 - 7.5 | 512 |
| 44 - 84 | 10 - 15 | 1024 |
| 88 - 168 | 15 - 30 | 2048 |
| 176 - 264 | 30 – 50 | 4096 |

 **FR1, SCS= 30 kHz**

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| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 48 - 84  | 20 - 30 | 1024 |
| 88 - 168 | 30 - 60 | 2048 |
| 176 - 272 | 60 – 100 | 4096 |

**FR2, SCS= 120 kHz**

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| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 32 - 40  | 50 - 60 | 512 |
| 44 - 84 | 60 - 120 | 1024 |
| ≥ 88 | ≥ 120  | 2048 |

* Recommended WF
	+ Further discuss the proposals

### Sub-topic 2-2: SRS-RSRP measurement accuracy requirement dependency on SCS, symbols and comb size

According to the approved WF in R4-2103587:

* *FFS: whether gNB measurement accuracy is agnostic to or depends on comb and symbols size*
	+ *Decision will be based on link simulation results*
* *FFS: whether gNB accuracy requirements are also be based on grouping of SRS parameters other than SRS BW (e.g. SCS).*
	+ *grouping of other parameters (e.g. SCS) will be decided based on link simulation results*

**Issue 2-2-1: Define** S**RS-RSRP accuracy agnostic to SCS within the same FR?**

* Proposals
	+ Option 1: Ericsson, Huawei
		- Yes
	+ Option 2: None
* Recommended WF
	+ Further discuss proposal in option 1

**Issue 2-2-2: Define** S**RS-RSRP accuracy agnostic to symbols and comb size?**

* Proposals
	+ Option 1: Ericsson, Nokia
		- Yes
	+ Option 2: Huawei
		- Need further analysis
		- Update simulation assumption to evaluate more combinations of symbol and comb sizes
* Recommended WF
	+ Further discuss proposals

### Sub-topic 2-3: Applicable propagation condition for SRS-RSRP measurement accuracy requirement

**Issue 2-3-1: Propagation condition under which the** S**RS-RSRP accuracy is specified**

* Proposals
	+ Option 1: Huawei
		- AWGN
	+ Option 2:
		- None
* Recommended WF
	+ Further discuss proposal in option 1

### Sub-topic 2-4: RF margin for SRS-RSRP measurement accuracy requirement

According to the approved WF in R4-2103587:

* *Baseline SRS-RSRP measurement accuracy without margin is based on link simulation results*
* *RF calibration error for SRS-RSRP measurement for gNB type 1-C (X) is small than that for gNB types 1-O/2-O (Y) i.e. Y>X.*
* *Implementation and RF margins are specific to SRS-RSRP. Values are FFS.*

**Issue 2-4-1:** **RF margin for** S**RS-RSRP accuracy for different gNB types**

* Proposals
	+ Option 1: Huawei
		- RF calibration margin differs between gNB type 1-C and other gNB types:
* X=2.5dB for gNB type 1-C
* X=4dB for gNB typr 1-H, 1-O and 2-O
	+ Option 2: Ericsson
		- Separate RF margin for different gNB types (1-C, 1-H, 1-O and 2-O)
* Recommended WF
	+ Further discuss proposals

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 2-1: Issue 2-1-1: SRS BW grouping for defining SRS-RSRP accuracy requirements**

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| **Company** | **Comments** |
| Ericsson | We prefer option 1 as a general grid for accuracy definition, however we are fine with defining SRS-RSRP accuracy figures agnostic to Comb and Sym, grouped with respect to SRS BW in RB and different accuracy values for the different Ês/Iot side conditions. Furthermore, defining different numbers of BW ranges for different side conditions could be done, when we further identify how large of a performance gap we allow thereby. From our simulation results proposed grouping from option 2 would allow an performance gap within one grouping of 0.7dB for FR1, 24≤RB≤64, Ês/Iot≥-13dB, 0.4dB for FR1, 64≤RB≤272, Ês/Iot≥-13dB and 0.2dB for FR1, 24≤RB≤272, Ês/Iot≥+3dB, all with AWGN condition. [For TDLA conditions those performance gaps would change to 3dB for FR1, 24≤RB≤64, Ês/Iot≥-13dB, 1.1dB for FR1, 24≤RB≤272, Ês/Iot≥-13dB and 1.3dB for FR1, 24≤RB≤272, Ês/Iot≥+3dB.] |
| Nokia  | We support option 3 as a baseline for further simplification, e.g. related to observed performance for different SCS in same FR. |
| Huawei | We support option 2 based on our simulation results.On option 3, first we may not need separate tables for different SCS-es as RSRP performance is agnostic to SCS. Second, we are not sure if we need to define 4 sets of requirements for RSRP, we think 2 sets may be more reasonable.  |
| Intel | Based on the similar discussion and observations for PRS RSRP, we believe at least one set for higher SINR is enough.  |
| Qualcomm | In our view it would be better to use the same BW ranges (bins) for all measurement types. Reference SRS configurations should be specified for each BW range. |
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**Sub-topic 2-2: Issue 2-2-1: Define SRS-RSRP accuracy agnostic to SCS within the same FR?**

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| **Company** | **Comments** |
| ZTE | We can support Option 1. |
| Ericsson | Support option 1. |
| Nokia | We support option 1, which is also observed in our results.  |
| Huawei | Support option 1. |
| Intel | Support Option 1. |
| Qualcomm | Support option 1. |

**Sub-topic 2-2: Issue 2-2-2: Define SRS-RSRP accuracy agnostic to symbols and comb size?**

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| **Company** | **Comments** |
| Ericsson | In principle we support option 1, however we are also fine with adding the proposed symbols and comb size values to an updated simulation assumption and further evaluate if the SRS-RSRP accuracy depends on symbols and comb size. |
| Nokia  | We support option 1 based on our results for agreed combinations of symbol and comb sizes. If there is agreement to add further combinations of symbol and comb sizes to the current simulation assumptions, this will require further study. |
| Huawei | We support option 2 based on our simulation results. If we define requirements based on 12 REs (e.g. comb-2 with 2-symbol), gNB may not meet the requirements when 6 REs (e.g. comb-2 with 1-symbol or comb-8 with 4-symbol). |
| Qualcomm | We expect accuracy to be agnostic to comb size and num symbols when the ratio between the two parameters is fixed. E.g. when the ratio equals 1 and there is one comb pattern per SRS resource instance.  |
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**Sub-topic 2-3: Issue 2-3-1: Propagation condition under which the** S**RS-RSRP accuracy is specified**

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| **Company** | **Comments** |
| CATT | Fine with option 1. It is aligned with gNB Rx-Tx time difference.  |
| Ericsson | In alignment with gNB Rx-Tx measurement accuracy definition we are ok with option 1. |
| Nokia | We support option 1. |
| Huawei | We support option 1. |
| Qualcomm | Option 1. |

**Sub-topic 2-4: Issue 2-4-1: RF margin for SRS-RSRP accuracy for different gNB types**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Support option 2. We are principally fine with the values from option 1 as a working proposal, but see the need to further study if RF margin for 2-O should differ from 1-O. |
| Nokia | We support option 2. Further investigation is needed to define the RF margin for different gNB types based on agreements on SRS BW grouping and other SRS configuration parameters. |
| Huawei | We support option 1 and it is aligned with the principle in option 1.To Nokia, we do not think the RF margin is depending on the SRS parameters. |
| Qualcomm | For type 1-H, the margin would be applied to OTA requirements, i.e. at the Radiated interface boundary? Would the proposed margins apply for both FR1 and FR2? |
|  |  |
|  |  |

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2106403**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106403.zip) (Ericsson) | Nokia: Some further discussion is required before endorsing this draft CR. It is observed that the number of SRS bandwidth ranges for a given Ês/Iot is assumed to be always three. However, the number should be aligned to further agreements for each FR. Thus, an editorial note should be added to state that the number of SRS bandwidth ranges for given Ês/Iot is FFS. |
| Qualcomm: Suggest to return in the second round. |
|  |
|  |
| [**R4-2107018**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107018.zip)(Huawei) | Ericsson: Separate table for types 1-H and 1-O should be implemented, since the RF margin differs from 1-C. SRS BW grouping in units of RB needs discussion, to guarantee reasonable performance gap within one SRS BW group. |
| Nokia: We do not support this draft CR. First, there is no strong reasoning provided for using the breakpoint 64 PRB’s. We need more discussion here. Second, requirements are only distinguished between FR1 and FR2, although agreed to be specified separately for considered gNB types. Third, the side condition refers to receiver sensitivity / OTA sensitivity requirements, which we commented above not to be suitable. Fourth, the second condition refers to a TBD clause in the Annex, hence is left unclear. Fifth, the side conditions do not contain the statement that accuracy requirements for SRS-RSRP do not mandate RX antenna beamforming. Finally, the case of 24 PRBs in FR2 should be discussed, since the agreed simulation assumptions in R4-2012142 define a minimum size of 32 PRBs in FR2. |
| Qualcomm: Suggest to return in the second round. |
|  |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic 2-1** | **Issue 2-1-1: SRS BW grouping for defining SRS-RSRP accuracy requirements***Tentative agreements: None**Candidate options:** + Option 1: Ericsson

|  |  |
| --- | --- |
| **SRS bandwith in RB** | **SRS-RSRP accuracy in dB** |
| **Ês/Iot ≥ -13dB** | **Ês/Iot ≥ +3dB** |
| **BWmin ≤ BW ≤ BW1** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** | **TBD** | **TBD** |
| **…** |  |  |

* + Option 2: Huawei
		- For SINR +3dB, one set of accuracy for all SRS BWs and for all combinations of comb+symbol
		- For SINR -13dB,
			* two sets of requirements, one for 24≤RB\_num<[64] and the other for [64]≤RB\_num.
	+ Option 3: Nokia

**FR1, SCS= 15 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 24 - 40 | 5 - 7.5 | 512 |
| 44 - 84 | 10 - 15 | 1024 |
| 88 - 168 | 15 - 30 | 2048 |
| 176 - 264 | 30 – 50 | 4096 |

 **FR1, SCS= 30 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 48 - 84  | 20 - 30 | 1024 |
| 88 - 168 | 30 - 60 | 2048 |
| 176 - 272 | 60 – 100 | 4096 |

**FR2, SCS= 120 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 32 - 40  | 50 - 60 | 512 |
| 44 - 84 | 60 - 120 | 1024 |
| ≥ 88 | ≥ 120  | 2048 |

* *Option 4: QC*
	+ Use the same BW ranges (bins) for all measurement types

*Recommendations for 2nd round: Continue discussion* |
| **Sub-topic 2-2** | **Issue 2-2-1: Define SRS-RSRP accuracy agnostic to SCS within the same FR?***Tentative agreements:* SRS-RSRP accuracy agnostic to SCS within the same FR*Recommendations for 2nd round: None* |
| **Sub-topic 2-2** | **Issue 2-2-2: Define SRS-RSRP accuracy agnostic to symbols and comb size?***Tentative agreements:*Need further analysis to conclude. Update simulation assumptions will be used to evaluate more combinations of symbol and comb sizes util RAN4#99.*Recommendations for 2nd round: Continue discussion on simulation assumptions.* |
| **Sub-topic 2-3** | **Issue 2-3-1: Propagation condition under which the SRS-RSRP accuracy is specified***Tentative agreements:*SRS-RSRP measurement accuracy shall be defined under AWGN*Recommendations for 2nd round: None* |
| **Sub-topic 2-4** | **Issue 2-4-1: RF margin for SRS-RSRP accuracy for different gNB types***Tentative agreements: None**Candidate options:** + Option 1: Huawei
		- RF calibration margin differs between gNB type 1-C and other gNB types:
* X=2.5dB for gNB type 1-C
* X=4dB for gNB typr 1-H, 1-O and 2-O
	+ Option 2: Ericsson, Nokia
		- RF margin needs further discussion
			* Investigate RF margin for different gNB types (1-C, 1-H, 1-O and 2-O)

*Recommendations for 2nd round: Continue discussion* |

### CRs/TPs

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

## Discussion on 2nd round (if applicable)

### Open issues

 **Issue 2-1-1: SRS BW grouping for defining SRS-RSRP accuracy requirements**

* Option 1: Ericsson

|  |  |
| --- | --- |
| **SRS bandwith in RB** | **SRS-RSRP accuracy in dB** |
| **Ês/Iot ≥ -13dB** | **Ês/Iot ≥ +3dB** |
| **BWmin ≤ BW ≤ BW1** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** | **TBD** | **TBD** |
| **…** |  |  |

* Option 2: Huawei
	+ - For SINR +3dB, one set of accuracy for all SRS BWs and for all combinations of comb+symbol
		- For SINR -13dB,
			* two sets of requirements, one for 24≤RB\_num<[64] and the other for [64]≤RB\_num.
* Option 3: Nokia

**FR1, SCS= 15 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 24 - 40 | 5 - 7.5 | 512 |
| 44 - 84 | 10 - 15 | 1024 |
| 88 - 168 | 15 - 30 | 2048 |
| 176 - 264 | 30 – 50 | 4096 |

 **FR1, SCS= 30 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 48 - 84  | 20 - 30 | 1024 |
| 88 - 168 | 30 - 60 | 2048 |
| 176 - 272 | 60 – 100 | 4096 |

**FR2, SCS= 120 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 32 - 40  | 50 - 60 | 512 |
| 44 - 84 | 60 - 120 | 1024 |
| ≥ 88 | ≥ 120  | 2048 |

* *Option 4: QC*

Use the same BW ranges (bins) for all measurement types

|  |  |
| --- | --- |
| **Company** | **Comments** |
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**Issue 2-4-1: RF margin for SRS-RSRP accuracy for different gNB types**

* Option 1: Huawei
	+ RF calibration margin differs between gNB type 1-C and other gNB types:
		- X=2.5dB for gNB type 1-C
		- X=4dB for gNB typr 1-H, 1-O and 2-O
* Option 2: Ericsson, Nokia
	+ RF margin needs further discussion
		- Investigate RF margin for different gNB types (1-C, 1-H, 1-O and 2-O)

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| --- | --- |
| **Company** | **Comments** |
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### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| Revision of draft CR [**R4-2106403**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106403.zip) (Ericsson) |  |
|  |
|  |
|  |

# Topic #3: gNB Rx-Tx time difference requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104749**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104749.zip) | CATT | **Proposal 1: The agreement gNB accuracy requirements do not mandate gNB RX beam sweeping is not the precondition of the accuracy requirement and no need to be captured into the specification.** **Proposal 2: When gNB Rx-Tx time difference measurement requirements are defined, except the simulation error of measurement, at least two times of calibration error is needed as the margin.** **Proposal 3: When defining accuracy requirement, the same calibration error among all types of gNB should be used.** **Proposal 4: The gNB Rx-Tx time difference accuracy requirements can be reused for UL-RTOA measurement.** **Proposal 5: The reference time in the ideal UL-RTOA is based on gNB’s interpretation of the SFN initialisation time.**  |
| [**R4-2106342**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106342.zip) | Qualcomm Incorporated | **Proposal 1: For gNB Rx-Tx measurement accuracy requirements add a group delay calibration margin of [4] Tc for SRS BW = 100 MHz. FFS the margin values for other SRS bandwidths.** |
| [**R4-2106404**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106404.zip) | Ericsson | **Proposal 1: Define gNB TOA accuracy requirements agnostic to NumSymbols, CombSizeN and TSRS****Proposal 2: Use multiple samples and define number of samples Ns used for measurement accuracy definition.****Proposal 3: Define gNB TOA measurement accuracy requirements dependent of SCS setting.****Proposal 4: Collect gNB TOA measurement accuracy requirements based on following table format.**

|  |  |  |
| --- | --- | --- |
| **SRS bandwith in RB** | **SCS [kHz]** | **gNB TOA measurement accuracy [Tc]** |
| **Ês/Iot ≥ -13dB** | **Ês/Iot ≥ +3dB** |
| **BWmin ≤ BW ≤ BW1** | **15** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** | **TBD** | **TBD** |
| **…** | **TBD** | **TBD** |
| **BWmin ≤ BW ≤ BW1** | **30** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** |  | **TBD** | **TBD** |
| **…** |  | **TBD** | **TBD** |
| **…** | **…** | **TBD** | **TBD** |

**Proposal 5: Define gNB TOA measurement accuracy requirements for all gNB types 1-C, 1-H, 1-O and 2-O** |
| [**R4-2106949**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106949.zip) | Huawei, HiSilicon | **Observation 1: The performance is almost not dependent on SNR conditions.****Observation 2: The performance is almost not dependent on comb and symbol size.****Observation 3: The accuracy improves in proportion with BW in Hz due to better resolution.** |
| [**R4-2107015**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107015.zip) | Huawei, HiSilicon | **Proposal 1: Define the gNB Rx-Tx accuracy requirements as follows.*** **Separate requirements are defined for each SRS SCS**
* **The SRS PRB numbers are grouped as in Table 2**
* **The lower bound of SRS BW is [24] RB for +3dB SINR, and [32] RB for -13dB SINR**
* **The requirements are defined agnostic to combination of SRS comb and symbol sizes**

**Table 2: Template for gNB TOA estimation accuracy requirements**

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

**Proposal 2: Use [20]Tc as the group delay calibration margin for gNB Rx-Tx accuracy.** |
| [**R4-2107179**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107179.zip) | Nokia, Nokia Shanghai Bell | 1. The gNB Rx-Tx time difference accuracy for all SRS configurations depends majorly on the SRS bandwidth, on SRS comb size and number of continuous SRS symbols.
2. The gNB Rx-Tx time difference accuracy can be improved for the low Ês/Iot condition adopting multiple shots (e.g. 2 or 4) compared to single shot.

Following proposal for agreement is made: 1. The provided gNB Rx-Tx time difference accuracy results are taken into account in the discussion on SRS BW grouping and other SRS configuration parameter grouping and for identifying the number of shots.
 |

## Open issues summary

### Sub-topic 3-1: SRS BW grouping for gNB Rx-Tx accuracy requirements

According to the approved WF in R4-2103587:

* *gNB accuracy requirements shall be defined for group of SRS BWs*
	+ *grouping of SRS BWs will be decided based on link simulation results*

**Issue 3-1-1: SRS BW grouping for defining gNB Rx-Tx accuracy requirements**

* Proposals
	+ Option 1: Ericsson

|  |  |  |
| --- | --- | --- |
| **SRS bandwith in RB** | **SCS [kHz]** | **gNB TOA measurement accuracy [Tc]** |
| **Ês/Iot ≥ -13dB** | **Ês/Iot ≥ +3dB** |
| **BWmin ≤ BW ≤ BW1** | **15** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** | **TBD** | **TBD** |
| **…** | **TBD** | **TBD** |
| **BWmin ≤ BW ≤ BW1** | **30** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** |  | **TBD** | **TBD** |
| **…** |  | **TBD** | **TBD** |
| **…** | **…** | **TBD** | **TBD** |

* + Option 2: Huawei

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

* + - The lower bound of SRS BW is [24] RB for +3dB SINR, and [32] RB for -13dB SINR
	+ Option 3: Nokia

**FR1, SCS= 15 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 24 - 40 | 5 - 7.5 | 512 |
| 44 - 84 | 10 - 15 | 1024 |
| 88 - 168 | 15 - 30 | 2048 |
| 176 - 264 | 30 – 50 | 4096 |

**FR1, SCS= 30 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 48 - 84  | 20 - 30 | 1024 |
| 88 - 168 | 30 - 60 | 2048 |
| 176 - 272 | 60 – 100 | 4096 |

**FR2, SCS= 120 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 32 - 40  | 50 - 60 | 512 |
| 44 - 84 | 60 - 120 | 1024 |
| ≥ 88 | ≥ 120  | 2048 |

* Recommended WF
	+ Further discuss the proposals

### Sub-topic 3-2: gNB Rx-Tx measurement accuracy requirement dependency on SCS, symbols and comb size

According to the approved WF in R4-2103587:

* *FFS: whether gNB measurement accuracy is agnostic to or depends on comb and symbols size*
	+ *Decision will be based on link simulation results*
* *FFS: whether gNB accuracy requirements are also be based on grouping of SRS parameters other than SRS BW (e.g. SCS).*
	+ *grouping of other parameters (e.g. SCS) will be decided based on link simulation results*

**Issue 3-2-1: Define gNB Rx-Tx accuracy dependent on SCS?**

* Proposals
	+ Option 1: Ericsson, Huawei, Nokia
		- Yes
	+ Option 2: None
* Recommended WF
	+ Further discuss proposal in option 1

**Issue 3-2-2:** **Define** **gNB Rx-Tx accuracy agnostic to symbols and comb size?**

* Proposals
	+ Option 1: Ericsson, Huawei
		- Yes
	+ Option 2: Nokia
		- No
* Recommended WF
	+ Further discuss proposals

### Sub-topic 3-3: RF margin for gNB Rx-Tx measurement accuracy requirement

According to the approved WF in R4-2103587:

* *Implementation and RF margins are are FFS:*
* *Candidate options:*
	1. *Option 1:*
		+ *2 times calibration error*
	2. *Option 2:*
		+ *group delay calibration margin = 8 Tc*
	3. *Option 3:*
		+ *Depends on frequency range, SRS configuration and implementation (e.g. antenna)*
	4. *Other options not precluded*

**Issue 3-3-1: RF margin for gNB Rx-Tx accuracy for different gNB types**

* Proposals
	+ Option 1: CATT
		- At least 2 times calibration error
	+ Option 2: Huawei
		- [20] Tc as the group delay calibration margin
	+ Option 3: Ericsson
		- Separate RF margin for different gNB types (1-C, 1-H, 1-O and 2-O)
	+ Option 4: Qualcomm
		- Calibration margin depends on SRS BW:
			* Delay calibration margin of [4] Tc for SRS BW = 100 MHz. FFS the margin values for other SRS bandwidths.
* Recommended WF
	+ Further discuss proposals

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 3-1: Issue 3-1-1: SRS BW grouping for defining gNB Rx-Tx accuracy requirements**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We prefer option 1 as the general table format structure and thereby are fine with defining gNB Rx-Tx measurement accuracy requirements dependent on SCS parameter setting. The minimum SRS bandwidth in terms of RB cannot be distinguished as of yet since it is dependent on the number of samples used for deriving accuracy requirements. The SRS bandwidth ranges can then be defined by using underlying parameters of SRS parameter settings (e.g. FFT size) and performance gaps should be analyzed to prove reasonable groupings. |
| Nokia | We support option 3 as a baseline for further simplification, e.g. related to observed performance for different combinations of symbol and comb sizes. |
| Huawei | We support option 2. Option 2 is similar to option 3, but it is using same table for all SCS-es. Based on our results, we do not see clear need for different min-BW for different SCS-es. |
| Qualcomm | In our view it would be better to use the same BW ranges (bins) for all measurement types. Reference SRS configurations should be specified for each BW range. |
|  |  |
|  |  |

**Sub-topic 3-2: Issue 3-2-1: Define gNB Rx-Tx accuracy dependent on SCS?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Support option 1. |
| Nokia | We support option 1.  |
| Huawei | We support option 1.  |
| Intel | We support Option 2. The performance gap due to SCS is less than the quantization error. |
| Qualcomm | Option 1 |
|  |  |

**Sub-topic 3-2: Issue 3-2-2: Define gNB Rx-Tx accuracy agnostic to symbols and comb size?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1, however if the simulation assumption will change and more symbols and comb size permutations will be implemented, we are also fine with checking again on agnostic behavior (See issue 2-2-2).  |
| Nokia | We support option 2. Our results do not confirm that performance can be agnostic to the combination of symbol and comb size. Also, we need to see the impact from new symbol and comb size combinations in case they are agreed. Thus, we propose to take the decision once further investigation has been done. |
| Huawei  | We support option 1 based on our results, but we are fine to further study other combinations, as we have observed some dependence for RSRP (issue 2-2-2).  |
| Qualcomm | Same comments as for issue 2-2-2 |
|  |  |
|  |  |

**Sub-topic 3-3: Issue 3-3-1: RF margin for gNB Rx-Tx accuracy for different gNB types**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We prefer option 3. As previously discussed, timing calibration margin is highly dependent on gNB type, frequency range, channel bandwidth (channel filters) and therefore among the differences between OTA and conducted testing, these dependencies lead to an implementation specific calibration error value. Therefore, we propose to define minimum accuracy requirements for baseline values (or baseline values plus an initial common error margin between all types and implementations) that are subject to an additional timing error margin, which is declared by manufacturer.* Proposals
	+ Option 1:
		- Define gNB Rx-Tx measurement accuracy requirements which are subject to an additional error margin value, which is declared by manufacturer
	+ Option 2:

Define gNB Rx-Tx measurement accuracy requirements which include a common value for error margin, and additionally are subject to an error margin, which is declared by manufacturer |
| Nokia | We support option 3. Further investigation is needed to evaluate the RF margin for different gNB types, based on implementation aspects and also based on (pending) agreements on SRS BW grouping and other SRS configuration parameters, common to all gNB types. We agree to Ericsson’s proposal to define minimum accuracy requirements based on specified baseline performance and an additional timing error margin declared by the manufacturer. We are open to discuss further option 1 and option 2 of Ericsson’s proposals. |
| Huawei | We can support the new proposals from Ericsson above, as it may be difficult to agree on a specific number that can work for all gNB implementations. |
| Qualcomm | We support option 4.Regarding option 1, it should be understood the margin would account both Tx and Rx delay calibration errors.Regarding option 2, the same margin would apply regardless of bandwidth? |
|  |  |
|  |  |

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2106405**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106405.zip)(Ericsson) | Nokia: Some further discussion is required before endorsing this draft CR. It is observed that accuracy requirements for SRS configurations with SCS= 60 kHz are foreseen to be defined, although not included in the agreed simulation assumptions in R4-2012142. Further as commented for SRS-RSRP, the number of SRS bandwidth ranges for a given Ês/Iot is assumed to be always three. However, the number should be aligned to further agreements for each FR. Thus, an editorial note should be added here as well to state that the number of SRS bandwidth ranges for given Ês/Iot is FFS. |
| Ericsson: Agree with Nokia on SCS = 60kHz, however, since gNB TOA accuracy is dependent on SCS settings, we should include all possible SRS configurations for defining accuracy. So we propose to include the 60kHz SCS setting in the simulation assumptions to cover those SRS configurations. |
| Qualcomm: Suggest to return in the second round. |
|  |
| [**R4-2107016**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107016.zip)(Huawei) | Ericsson: The rationale for the lower SRS BW [RB] bound is likely to change when implementing a measurement accuracy definition based on multiple shots, therefore the lower bound in BW is dependent on the outcome of the discussion on number of samples, i.e. not yet agreeable. Also, as per discussion on error margins, it is not yet agreed if all gNB types for FR1 will have the same error margin, therefore, combining measurement accuracy requirements for all FR1 gNB types cannot be agreed as of yet. |
| Nokia: We do not support this draft CR. First, there is no reasoning provided for specifying requirements for SRS configurations with SCS=60 kHz, since not included in the agreed link simulation assumptions in R4-2012142. We need more discussion here. Second, requirements are only distinguished between FR1 and FR2, although agreed to be specified separately for considered gNB types. Third, the side condition refers to receiver sensitivity / OTA sensitivity requirements, which we commented above not to be suitable. Fourth, the second condition refers to a TBD clause in the Annex, hence is left unclear. Fifth, the side conditions do not contain the statement that accuracy requirements for SRS-RSRP do not mandate RX antenna beamforming. Sixth, the case of 172 PRBs is not specified for SRS bandwidth configuration in 38.211 (the next size is 176). And finally, the case of 24 PRBs in FR2 should be discussed, since the agreed simulation assumptions in R4-2012142 define a minimum size of 32 PRBs in FR2. |
| Qualcomm: Suggest to return in the second round. |
|  |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic 3-1** | **Issue 3-1-1: SRS BW grouping for defining gNB Rx-Tx accuracy requirements***Tentative agreements: None**Candidate options:** + Option 1: Ericsson

|  |  |  |
| --- | --- | --- |
| **SRS bandwith in RB** | **SCS [kHz]** | **gNB TOA measurement accuracy [Tc]** |
| **Ês/Iot ≥ -13dB** | **Ês/Iot ≥ +3dB** |
| **BWmin ≤ BW ≤ BW1** | **15** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** | **TBD** | **TBD** |
| **…** | **TBD** | **TBD** |
| **BWmin ≤ BW ≤ BW1** | **30** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** |  | **TBD** | **TBD** |
| **…** |  | **TBD** | **TBD** |
| **…** | **…** | **TBD** | **TBD** |

* + Option 2: Huawei

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

* The lower bound of SRS BW is [24] RB for +3dB SINR, and [32] RB for -13dB SINR
	+ Option 3: Nokia

**FR1, SCS= 15 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 24 - 40 | 5 - 7.5 | 512 |
| 44 - 84 | 10 - 15 | 1024 |
| 88 - 168 | 15 - 30 | 2048 |
| 176 - 264 | 30 – 50 | 4096 |

**FR1, SCS= 30 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 48 - 84  | 20 - 30 | 1024 |
| 88 - 168 | 30 - 60 | 2048 |
| 176 - 272 | 60 – 100 | 4096 |

**FR2, SCS= 120 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 32 - 40  | 50 - 60 | 512 |
| 44 - 84 | 60 - 120 | 1024 |
| ≥ 88 | ≥ 120  | 2048 |

* *Option 4: QC*
	+ Use the same BW ranges (bins) for all measurement types

*Recommendations for 2nd round: Continue discussion* |
| **Sub-topic 3-2** | **Issue 3-2-1: Define gNB Rx-Tx accuracy dependent on SCS?***Tentative agreements: None**Candidate options:*Define gNB Rx-Tx accuracy dependent on SCS?* + Option 1: Ericsson, Huawei, Nokia, QC
		- Yes
	+ Option 2: Intel
		- No

*Recommendations for 2nd round: Continue discussion* |
| **Sub-topic 3-2** | **Issue 3-2-2: Define gNB Rx-Tx accuracy agnostic to symbols and comb size?***Tentative agreements:*Need further analysis to conclude. Update simulation assumptions will be used to evaluate more combinations of symbol and comb sizes util RAN4#99.Same as for SRS-RSRP in issue 2-2-2.*Recommendations for 2nd round: Continue discussion on simulation assumptions.*  |
| **Sub-topic 3-3** | **Issue 3-3-1: RF margin for gNB Rx-Tx accuracy for different gNB types***Tentative agreements: None**Candidate options:** + Option 1: E///, HW, Nokia
		- Investigate if RF margin can be declared by manufacturer.
			* Separate RF margin declared for different gNB types (1-C, 1-H, 1-O and 2-O)
	+ Option 2: Qualcomm
		- Calibration margin depends on SRS BW:
			* Delay calibration margin of [4] Tc for SRS BW = 100 MHz. FFS the margin values for other SRS bandwidths.

*Recommendations for 2nd round: Continue discussion* |

### CRs/TPs

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

## Discussion on 2nd round (if applicable)

### Open issues

 **Issue 3-1-1: SRS BW grouping for defining gNB Rx-Tx accuracy requirements**

* Option 1: Ericsson

|  |  |  |
| --- | --- | --- |
| **SRS bandwith in RB** | **SCS [kHz]** | **gNB TOA measurement accuracy [Tc]** |
| **Ês/Iot ≥ -13dB** | **Ês/Iot ≥ +3dB** |
| **BWmin ≤ BW ≤ BW1** | **15** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** | **TBD** | **TBD** |
| **…** | **TBD** | **TBD** |
| **BWmin ≤ BW ≤ BW1** | **30** | **TBD** | **TBD** |
| **BW1 ≤ BW ≤ BW2** |  | **TBD** | **TBD** |
| **…** |  | **TBD** | **TBD** |
| **…** | **…** | **TBD** | **TBD** |

* Option 2: Huawei

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

* + The lower bound of SRS BW is [24] RB for +3dB SINR, and [32] RB for -13dB SINR
* Option 3: Nokia

**FR1, SCS= 15 kHz**

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| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 24 - 40 | 5 - 7.5 | 512 |
| 44 - 84 | 10 - 15 | 1024 |
| 88 - 168 | 15 - 30 | 2048 |
| 176 - 264 | 30 – 50 | 4096 |

**FR1, SCS= 30 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 48 - 84  | 20 - 30 | 1024 |
| 88 - 168 | 30 - 60 | 2048 |
| 176 - 272 | 60 – 100 | 4096 |

**FR2, SCS= 120 kHz**

|  |  |  |
| --- | --- | --- |
| **PRB start – end** | **SRS BW (MHz)** | **FFT size** |
| 32 - 40  | 50 - 60 | 512 |
| 44 - 84 | 60 - 120 | 1024 |
| ≥ 88 | ≥ 120  | 2048 |

* *Option 4: QC*
	+ Use the same BW ranges (bins) for all measurement types

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| **Company** | **Comments** |
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**Issue 3-2-1: Define gNB Rx-Tx accuracy dependent on SCS?**

Define gNB Rx-Tx accuracy dependent on SCS?

* Option 1: Ericsson, Huawei, Nokia, QC
	+ Yes
* Option 2: Intel
	+ No

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| **Company** | **Comments** |
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**Issue 3-3-1: RF margin for gNB Rx-Tx accuracy for different gNB types**

* Option 1: E///, HW, Nokia
	+ Investigate if RF margin can be declared by manufacturer.
		- Separate RF margin declared for different gNB types (1-C, 1-H, 1-O and 2-O)
* Option 2: Qualcomm
	+ Calibration margin depends on SRS BW:
		- Delay calibration margin of [4] Tc for SRS BW = 100 MHz. FFS the margin values for other SRS bandwidths.

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| **Company** | **Comments** |
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### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| Revision of [**R4-2107016**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107016.zip)(Huawei) |  |
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# Topic #4: UL RTOA requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2106406**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106406.zip) | Ericsson | **Proposal 1: Measurement accuracy requirements apply** **if the reference time is determined by the local timing of the gNB which executes the measurements.****Proposal 2: UL-RTOA measurement accuracy requirements shall be reused from gNB Rx-Tx time difference measurement accuracy requirements with the side condition that the reference time for measurements is based on gNBs local timing.** |
| [**R4-2107180**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107180.zip) | Nokia, Nokia Shanghai Bell | 1. For gNB supporting UL-RTOA, no minimum accuracy requirements will be specified for NR positioning in Rel-16.
 |

## Open issues summary

### Sub-topic 4-1: UL RTOA measurement accuracy requirements

According to the approved WF in R4-2103587:

* *FFS: whether gNB Rx-Tx time difference accuracy can be reused for UL RTOA accuracy*
* *FFS: how to define reference time in the ideal UL RTOA*
* *Candidate options to define the reference time in the ideal UL-RTOA:*
	+ *Option 1: it is based on gNB’s interpretation of the SFN initialization Time, and thus determined by gNB local timing.*
	+ *Option 2: it is based on an external interpretation of the SFN initialization Time*
* *Other options are not precluded.*

**Issue 4-1-1: Can gNB Rx-Tx time difference accuracy be reused for UL RTOA accuracy?**

* Proposals
	+ Option 1:
		- Option 1a: Ericsson
			* Yes. gNB Rx-Tx accuracy can be reused for UL RTOA but under the condition that the reference time is determined by the local timing of the gNB which executes the measurements.
		- Option 1b: CATT
			* + Yes: gNB Rx-Tx accuracy can be reused for UL RTOA measurement regardless of any condition.
	+ Option 2: Nokia
		- No.
			* Do not define UL RTOA measurement accuracy requirements.
* Recommended WF
	+ Further discuss the options

**Issue 4-1-2: Reference time definition if the UL RTOA accuracy requirements are defined**

* Proposals
	+ Option 1:
		- Option 1a: Ericsson
			* UL RTOA Reference Time used for performing the UL RTOA measurement is locally derived by the gNB
		- Option 1b: CATT
			* The reference time in the ideal UL-RTOA is based on gNB’s interpretation of the SFN initialisation time.
	+ Option 2:
		- None.
* Recommended WF
	+ Further discuss options 1a and 1b

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 4-1: Issue 4-1-1: Can gNB Rx-Tx time difference accuracy be reused for UL RTOA accuracy?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CATT | Support option 1b. The Tx time in gNB Rx-Tx time difference and the reference time in UL RTOA are both derived by gNB and do not impact the accuracy evaluation. The main issue is the Rx time evaluation which is the same for both gNB Rx-Tx and UL RTOA. The reference timing of UL RTOA is another issue and has been defined in physical layer specification.  |
| Ericsson | Support option 1a. |
| Nokia | We support option 2. We have provided rationale in our contribution, why accuracy requirements for gNB Rx-Tx time difference cannot be reused for UL-RTOA. Based on RAN1 core specification TS38.215, we derive different reference points for the Tx part of both gNB measurements, i.e. gNB Rx-Tx time difference and UL-RTOA, whilst there is a difference in the measurement definition of the Rx part regarding first path detection. Furthermore, “Ideal RTOA” is not part of the RAN1 specification and specifying accuracy requirements for an implementation option of UL-RTOA only, is not conforming to the 3GPP requirement specification process. |
| Huawei | We slightly prefer option 2 although we were supporting option 1 in last meetings.In our view, it might be possible to define the requirements by defining ideal RTOA based on gNB local time, but the point to have the requirements is then questionable as it does not really regulate the performance of the measurement.  |
| Ericsson | If no consensus regarding gNB’s locally derived reference time as a side condition can be reached, we also prefer option 2. |
| Qualcomm | In our understanding the gNB Rx-Tx accuracy requirements can be leveraged for UL RTOA. This should be true as long as the reference time is unambiguous (it does not introduce additional uncertainty). It does not have to be based on local gNB timing. We should refer to the definition of RTOA reference time in 38.455. |

**Sub-topic 4-1: Issue 4-1-2: Reference time definition if the UL RTOA accuracy requirements are defined**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CATT | We don’t see the difference between the two options. Both options mean the reference time is based on the gNB’s local time.  |
| Ericsson | Support option 1a, such that the locally derived timing is not limited to interpreting SFN initialization time but other timing references for deriving local timing can also be taken into account. |
| Ericsson | See updated comment 4-1-1 |
| Qualcomm | We should refer to the definition of RTOA reference time in 38.455. Send LS to RAN1 if clarification is needed. |
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### CRs/TPs comments collection

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2106407**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106407.zip) (Ericsson) | Nokia: Based on our concerns on the reuse of accuracy requirements for gNB Rx-Tx time difference for UL-RTOA, we cannot agree to endorse the draft CR. |
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## Summary for 1st round

### Open issues

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|  | **Status summary**  |
| **Sub-topic 4-1** | **Issue 4-1-1: Can gNB Rx-Tx time difference accuracy be reused for UL RTOA accuracy?***GTW agreement:** + - Do not define UL RTOA performance requirements in Rel-16 NR Positioning.

*Recommendations for 2nd round: None* |
| **Sub-topic 4-2** | **Issue 4-1-2: Reference time definition if the UL RTOA accuracy requirements are defined** *N/A see outcome of issue 4-1.**Recommendations for 2nd round: No further discussion* |

### CRs/TPs

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

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on gNB positioning measurement requirements | Ericsson | To capture all agreements related to gNB positioning |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| [**R4-2106403**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106403.zip) | gNB SRS-RSRP measurement | Ericsson | Revised |  |
| [**R4-2107018**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107018.zip) | draftCR to introduce SRS-RSRP requirements | Huawei, HiSilicon | Noted |  |
| [**R4-2106405**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106405.zip) | gNB Rx-Tx measurement | Ericsson | Noted |  |
| [**R4-2107016**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107016.zip) | draftCR to introduce gNB Rx-Tx time difference requirements | Huawei, HiSilicon | Revised |  |
| [**R4-2106407**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106407.zip) | UL RTOA requirements | Ericsson | Noted | No UL RTOA requirements will be defined as agreed at GTW |
| [**R4-2107014**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107014.zip) | Updated link simulation assumptions for gNB positioning measurement | Huawei, HiSilicon | Revised | Update to also include SCS = 60kHz  |

Notes:

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

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
|  | WF on gNB positioning measurement requirements | Ericsson |  |  |
| [**R4-2106403**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106403.zip) | gNB SRS-RSRP measurement | Ericsson |  |  |
| [**R4-2107016**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107016.zip) | draftCR to introduce gNB Rx-Tx time difference requirements | Huawei, HiSilicon |  |  |
| [**R4-2107014**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107014.zip) | Updated link simulation assumptions for gNB positioning measurement | Huawei, HiSilicon |  |  |

Notes:

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