**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-210XXXX**

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

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

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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

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|  | **Status summary** |
| **Sub-topic 1-1** | **Issue 1-1-1: Beam sweeping during gNB measurement**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 1-2** | **Issue 1-2-1: Number of samples for gNB accuracy requirements**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 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:*  *Candidate options:*  *Recommendations for 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)

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

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

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

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| **CR/TP number** | **Comments collection** |
| [**R4-2106403**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106403.zip) (Ericsson) |  |
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| [**R4-2107018**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107018.zip)  (Huawei) |  |
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## Summary for 1st round

### Open issues

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|  | **Status summary** |
| **Sub-topic 2-1** | **Issue 2-1-1: SRS BW grouping for defining SRS-RSRP accuracy requirements**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 2-2** | **Issue 2-2-1: Define SRS-RSRP accuracy agnostic to SCS within the same FR?**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 2-2** | **Issue 2-2-2: Define SRS-RSRP accuracy agnostic to symbols and comb size?**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 2-3** | **Issue 2-3-1: Propagation condition under which the SRS-RSRP accuracy is specified**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 2-4** | **Issue 2-4-1: RF margin for SRS-RSRP accuracy for different gNB types**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

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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)

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

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

## Companies’ contributions summary

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| **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

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| **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

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| **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**

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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 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**

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

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

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

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

|  |  |
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| **CR/TP number** | **Comments collection** |
| [**R4-2106405**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106405.zip)(Ericsson) |  |
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| [**R4-2107016**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107016.zip)(Huawei) |  |
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## Summary for 1st round

### Open issues

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|  | **Status summary** |
| **Sub-topic 3-1** | **Issue 3-1-1: SRS BW grouping for defining gNB Rx-Tx accuracy requirements**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 3-2** | **Issue 3-2-1: Define gNB Rx-Tx accuracy dependent on SCS?**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 3-2** | **Issue 3-2-2: Define gNB Rx-Tx accuracy agnostic to symbols and comb size?**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 3-3** | **Issue 3-3-1: RF margin for gNB Rx-Tx accuracy for different gNB types**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

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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)

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

# 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?**

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

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| **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. |
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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) |  |
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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?**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 4-2** | **Issue 4-1-2: Reference time definition if the UL RTOA accuracy requirements are defined**  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### 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 … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**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 |  |  |
| [**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 |  |  |
| [**R4-2106405**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106405.zip) | gNB Rx-Tx 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 |  |  |
| [**R4-2106407**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106407.zip) | UL RTOA requirements | Ericsson |  |  |
| [**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 incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
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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