**3GPP TSG-RAN4 Meeting #112-bis *R4-241xxxx***

**Hefei, China, 14 – 18 October, 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  |  | **CR** |  | **rev** | 1 | **Current version:** |  |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | draftCR on performance requirements for RedCap positioning | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_pos\_enh2-Perf | | | | |  | ***Date:*** | | | 2024-10-05 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | There are TBDs in the Rx-Tx accuracy requirements for RedCap. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Resolve TBDs in the Rx-Tx accuracy requirements for RedCap:   1. Update the accuracy numbers based on new summary of simulation results provided in RAN4#112-bis. 2. In Table 10.1A.18.2.2-1b, the accuracy numbers are added by re-using those from Table 10.1A.16.2.1-1. 3. In 10.1A.18.2.3 and 10.1A.18.2.4, add definition for margin δ (group delay calibration margin) in two new tables. The values for margin δ are based RAN4#112 agreement. 4. Change reference section number B.x.y to B.2.14 5. Some format and typo correction. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The Rx-Tx accuracy requirements for RedCap are incomplete. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 10.1A.18.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | The draftCR is based on revised R4-2413983 shared on RAN4 reflector before RAN4#112-bis. | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

<Start of Change 1>

10.1A.18.2 Measurement Accuracy Requirements

The UE Rx-Tx time difference measurement accuracy requirements in this clause shall not apply, if:

- NTA\_offset defined in Table 7.1A.2-2 changes during the UE Rx-Tx measurement period or

- if the uplink transmission timing changes during the UE Rx-Tx measurement period due to the network-configured Timing Advance.

The UE Rx-Tx time difference measurement accuracy requirements in this clause shall apply provided that:

- The UE transmits SRS within [-160, 160] msec of at least one DL PRS resource of each of the TRPs in the assistance data.

If the uplink transmission timing changes during the UE Rx-Tx measurement period due to the autonomous timing adjustment defined in clause 7.1A.2 then:

- UE Rx-Tx measurement accuracy requirements shall apply for a cell, which is also the downlink reference cell (defined in section 7.1A.1) for SRS transmission even if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.

- UE Rx-Tx measurement accuracy requirements shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1A.1) for SRS transmission, if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.

When a serving cell change occurs during the UE Rx-Tx measurement period, the UE Rx-Tx time difference measurement accuracy requirements in this clause shall apply provided that the serving cell change does not impact SRS configuration for the UE Rx-Tx measurement.

The relative accuracy of UE Rx-Tx measurement in this clause is defined as accuracy of the difference between two UE Rx-Tx measurements.

10.1A.18.2.1 UE Rx-Tx Accuracy Requirement for 2RX RedCap UE without FH

For UE Rx-Tx time difference measurement performed by 2RX RedCap UE without RX FH, the accuracy requirements corresponding to the PRS bandwidth supported by the RedCap UE for PRS measurement without RX FH in clause 10.1.25.2 shall apply.

10.1A.18.2.2 UE Rx-Tx Accuracy Requirement for 1RX RedCap UE without FH

The accuracy requirements in Table 10.1A.18.2.2-1 for FR1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- AWGN propagation condition.

**Table 10.1A.18.2.2-1: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | | |
| **PRS Ês/Iot** | **Minimum PRS bandwidth** | **PRS SCS** | **PRS resource repetition Note 3** | **NR operating band groupsNote 2** | **IoNote 4 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 5** | **dB** | **RB** | **kHz** |  |  | **dBm / SCSPRS** | **dBm/BW** |
| ±89+δ | -3 | ≥24 | 15 | ≥4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -127 | -50 |
| NR\_FDD\_FR1\_B | -126.5 |
| NR\_TDD\_FR1\_C | -126 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -125.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -125 |
| NR\_FDD\_FR1\_F | -124.5 |
| NR\_FDD\_FR1\_G, NR\_TDD\_FR1\_G | -124 |
| NR\_FDD\_FR1\_H | -123.5 |
| NR\_FDD\_FR1\_N | -120.5 |
| ±51+δ | ≥52 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±25+δ | 104 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±49+δ | ≥24 | 30 | ≥4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -124 | -50 |
| NR\_FDD\_FR1\_B | -123.5 |
| NR\_TDD\_FR1\_C | -123 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -122.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -122 |
| NR\_FDD\_FR1\_F | -121.5 |
| NR\_FDD\_FR1\_G, NR\_TDD\_FR1\_G | -121 |
| NR\_FDD\_FR1\_H | -120.5 |
| NR\_FDD\_FR1\_N | -117.5 |
| ±27+δ | 48 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±27+δ | 24 | 60 | ≥4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
| NR\_FDD\_FR1\_B | -120.5 |
| NR\_TDD\_FR1\_C | -120 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 |
| NR\_FDD\_FR1\_F | -118.5 |
| NR\_FDD\_FR1\_G, NR\_TDD\_FR1\_G | -118 |
| NR\_FDD\_FR1\_H | -117.5 |
| NR\_FDD\_FR1\_N | -114.5 |
| ±98+δ | -13 | ≥24 | 15 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±61+δ | ≥52 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±32+δ | 104 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±55+δ | ≥24 | 30 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±34+δ | 48 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±31+δ | 24 | 60 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN* defined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1A.18.2.2-3. | | | | | | | |

The accuracy requirements in Table 10.1A.18.2.2-1a for FR1 for are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- Number of measurement samples is less than 4.

- AWGN propagation condition.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 10.1A.18.2.2-1a: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN with reduced measurement samplesAccuracy** | **Conditions** | | | | | | |
| **PRS Ês/Iot** | **Minimum PRS bandwidth** | **PRS SCS** | **PRS resource repetition Note 3** | **NR operating band groupsNote 2** | **IoNote 4 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 5** | **dB** | **RB** | **kHz** |  |  | **dBm / SCSPRS** | **dBm/BW** |
| ±65+δ | 0 | ≥52 | 15 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±36+δ | 104 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±35+δ | 48 | 30 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±73+δ | -6 | ≥52 | 15 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±40+δ | 104 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±39+δ | 48 | 30 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS as defined in Table 10.1A.18.2.2-1.  NOTE 7: δ is the margin determined from Table 10.1A.18.2.2-3. | | | | | | | |

The relative accuracy requirements in Table 10.1A.18.2.2-1b for FR1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- AWGN propagation condition.

- the two UE Rx-Tx time difference measurements are associated with the same RxTx TEG

**Table 10.1A.18.2.2-1b: UE Rx-Tx time difference relative measurement accuracy in FR1 in AWGN with TEG reporting**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | | |
| **PRS Ês/Iot** | **PRS SCS** | **PRS bandwidth**  **Note 1** | **PRS resource repetition ()**  **Note 2** | **Io Note 3 range** | | |
| **NR operating band groups Note 4** | **Minimum Io** | **Maximum Io** |
| **Tc Note 5** | **dB** | **kHz** | **RB** |  |  | **dBm/SCS** | **dBm/BWChannel** |
| 137 +ΔNote 7 | (PRS Ês/Iot)*j*≥-6dB  (PRS Ês/Iot)*i* ≥-13dB | 15 | ≥ 24 | ≥ 4 | Note 6 | Note 6 | Note 6 |
| 79 +Δ | ≥ 52 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 45 +Δ | 104 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 81 +Δ | 30 | ≥ 24 | ≥ 4 | Note 6 | Note 6 | Note 6 |
| 46 +Δ | 48 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 52 +Δ | 60 | 24 | ≥ 4 | Note 6 | Note 6 | Note 6 |
| NOTE 1: Minimum PRS bandwidth, which is minimum of the PRS bandwidths of resource j and resource i.  NOTE 2: Minimum number of PRS resource repetitions among resource j and resource i. are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34], respectively.  NOTE 3: Io is assumed to have constant EPRE across the bandwidth.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS as defined in Table 10.1A.18.2.2-1.  NOTE 7: Δ is the value of the timing error margin for the RxTx TEG, reported via *nr-UE-RxTxTEG-TimingErrorMargin*. Δ cannot be larger than the sum of the margins in table 10.1A.18.2.2-3 (dependent on PRS/SRS BW) for any pair of individual UE Rx-Tx time difference measurements associated with the RxTx TEG. | | | | | | | |

The accuracy requirements in Table 10.1A.18.2.2-2 for FR1 for are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- Fading propagation condition.

**Table 10.1A.18.2.2-2: UE Rx-Tx time difference measurement accuracy in FR1 in fading**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | | |
| **PRS Ês/Iot** | **Minimum PRS bandwidth** | **PRS SCS** | **PRS resource repetition Note 3** | **NR operating band groupsNote 2** | **IoNote 4 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 5** | **dB** | **RB** | **kHz** |  |  | **dBm / SCSPRS** | **dBm/BW** |
| ±202+δ | -3 | ≥24 | 15 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±158+δ | ≥52 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±114+δ | 104 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±153+δ | ≥24 | 30 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±120+δ | 48 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±72+δ | 24 | 60 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±179+δ | -10 | ≥24 | 15 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±169+δ | ≥52 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±126+δ | 104 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±152+δ | ≥24 | 30 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±133+δ | 48 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ±72+δ | 24 | 60 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols* and *dl-PRS-CombSizeN* defined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS as defined in Table 10.1A.18.2.2-1.  NOTE 7: δ is the margin determined from Table 10.1A.18.2.2-3. | | | | | | | |

**Table 10.1A.18.2.2-3: Margin for UE Rx-Tx time difference measurement accuracy in FR1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Min(PRS BW, SRS BW) (RB)** | | | **Margin (Tc Note 1)** |
| **SCS = 15 kHz** | **SCS = 30 kHz** | **SCS = 60 kHz** |
| ≥ 24 | N/A | N/A | [160] |
| ≥ 52 | ≥ 24 | N/A | [80] |
| 104 | 48 | 24 | [56] |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | | |

10.1A.18.2.3 UE Rx-Tx Accuracy Requirement for 2RX RedCap UE with FH

The accuracy requirements in Table 10.1A.18.2.3-1 for FR1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- AWGN propagation condition.

- The BWtotal as defined in clause 9.9A.4.8 for RRC\_CONNECTED and in clause 5.6A.6.6 for RRC\_INACTIVE is no less than the “Total PRS bandwidth after FH”.

**Table 10.1A.18.2.3-1: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | | |
| **PRS Ês/Iot** | **PRS bandwidth per hop** | **PRS SCS** | **Total PRS bandwidth after FH** | **NR operating band groupsNote 2** | **IoNote 3 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 4** | **dB** | **RB** | **kHz** |  |  | **dBm / SCSPRS** | **dBm/BW** |
| ± 23+δ | -3 | ≥52 | 15 | 268 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -127 | -50 |
| NR\_FDD\_FR1\_B | -126.5 |
| NR\_TDD\_FR1\_C | -126 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -125.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -125 |
| NR\_FDD\_FR1\_F | -124.5 |
| NR\_FDD\_FR1\_G, NR\_TDD\_FR1\_G | -124 |
| NR\_FDD\_FR1\_H | -123.5 |
| NR\_FDD\_FR1\_N | -120.5 |
| ± 17+δ | 48 | 30 | 272 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -124 | -50 |
| NR\_FDD\_FR1\_B | -123.5 |
| NR\_TDD\_FR1\_C | -123 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -122.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -122 |
| NR\_FDD\_FR1\_F | -121.5 |
| NR\_FDD\_FR1\_G, NR\_TDD\_FR1\_G | -121 |
| NR\_FDD\_FR1\_H | -120.5 |
| NR\_FDD\_FR1\_N | -117.5 |
| ± 21+δ | 24 | 60 | 132 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
| NR\_FDD\_FR1\_B | -120.5 |
| NR\_TDD\_FR1\_C | -120 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 |
| NR\_FDD\_FR1\_F | -118.5 |
| NR\_FDD\_FR1\_G, NR\_TDD\_FR1\_G | -118 |
| NR\_FDD\_FR1\_H | -117.5 |
| NR\_FDD\_FR1\_N | -114.5 |
| ± 54+δ | -13 | ≥52 | 15 | 268 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 38+δ | 48 | 30 | 272 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 40+δ | 24 | 60 | 132 | NOTE 5 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: δ is the margin determined from Table 10.1A.18.2.3-5. | | | | | | | |

The accuracy requirements in Table 10.1A.18.2.3-1a for FR1 for are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- Number of measurement samples is less than 4.

- AWGN propagation condition.

- The BWtotal as defined in clause 9.9A.4.8 for RRC\_CONNECTED and in clause 5.6A.6.6 for RRC\_INACTIVE is no less than the “Total PRS bandwidth after FH”.

**Table 10.1A.18.2.3-1a: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN with reduced measurement samples**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | | |
| **PRS Ês/Iot** | **PRS bandwidth per hop** | **PRS SCS** | **Total PRS bandwidth after FH** | **NR operating band groupsNote 2** | **IoNote 3 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 4** | **dB** | **RB** | **kHz** |  |  | **dBm / SCSPRS** | **dBm/BW** |
| ± 17+δ | 0 | ≥52 | 15 | 268 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 11+δ | 48 | 30 | 272 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 18+δ | 24 | 60 | 132 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 32+δ | -6 | ≥52 | 15 | 268 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 20+δ | 48 | 30 | 272 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 31+δ | 24 | 60 | 132 | NOTE 5 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS as defined in Table 10.1A.18.2.3-1.  NOTE 6: δ is the margin determined from Table 10.1A.18.2.3-5. | | | | | | | |

The accuracy requirements in Table 10.1A.18.2.3-2 for FR1 for are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- Fading propagation condition.

- The BWtotal as defined in clause 9.9A.4.8 for RRC\_CONNECTED and in clause 5.6A.6.6 for RRC\_INACTIVE is no less than the “Total PRS bandwidth after FH”.

**Table 10.1A.18.2.3-2: UE Rx-Tx time difference measurement accuracy in FR1 in fading**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | | |
| **PRS Ês/Iot** | **PRS bandwidth per hop** | **PRS SCS** | **Total PRS bandwidth after FH** | **NR operating band groupsNote 2** | **IoNote 3 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 4** | **dB** | **RB** | **kHz** |  |  | **dBm / SCSPRS** | **dBm/BW** |
| ± 94+δ | -3 | ≥52 | 15 | 268 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 52+δ | 48 | 30 | 272 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 52+δ | 24 | 60 | 132 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 99+δ | -13 | ≥52 | 15 | 268 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 53+δ | 48 | 30 | 272 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 63+δ | 24 | 60 | 132 | NOTE 5 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS as defined in Table 10.1A.18.2.3-1.  NOTE 6: δ is the margin determined from Table 10.1A.18.2.3-5. | | | | | | | |

The accuracy requirements in Table 10.1A.18.2.3-3 for FR2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- AWGN propagation condition.

- The BWtotal as defined in clause 9.9A.4.8 for RRC\_CONNECTED and in clause 5.6A.6.6 for RRC\_INACTIVE is no less than the “Total PRS bandwidth after FH”.

**Table 10.1A.18.2.3-3: UE Rx-Tx time difference measurement accuracy in FR2 in AWGN**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | |
| **PRS Ês/Iot** | **Minimum PRS bandwidth per hop** | **PRS SCS** | **Total PRS bandwidth after FH** | **IoNote 4 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 5** | **dB** | **RB** | **kHz** |  | **dBm / SCSPRS** | **dBm/BWChannel** |
| ± 11+δ | -3 | ≥64 | 60 | 264 | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| ± 7+δ | 64 | 120 | 264 | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| ± 33+δ | -13 | ≥64 | 60 | 264 | NOTE 5 | NOTE 5 |
| ± 27+δ | 64 | 120 | 264 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: δ is the margin determined from Table 10.1A.18.2.3-6. | | | | | | |

The accuracy requirements in Table 10.1A.18.2.3.3-3a for FR2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- Number of measurement samples is less than 4.

- AWGN propagation condition.

- The BWtotal as defined in clause 9.9A.4.8 for RRC\_CONNECTED and in clause 5.6A.6.6 for RRC\_INACTIVE is no less than the “Total PRS bandwidth after FH”.

**Table 10.1A.18.2.3-3a: UE Rx-Tx time difference measurement accuracy in FR2 in AWGN with reduced measurement samples**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | |
| **PRS Ês/Iot** | **Minimum PRS bandwidth per hop** | **PRS SCS** | **Total PRS bandwidth after FH** | **IoNote 4 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 5** | **dB** | **RB** | **kHz** |  | **dBm / SCSPRS** | **dBm/BWChannel** |
| ± 11+δ | 0 | ≥64 | 60 | 264 | NOTE 5 | NOTE 5 |
| ± 5+δ | 64 | 120 | 264 | NOTE 5 | NOTE 5 |
| ± 17+δ | -6 | ≥64 | 60 | 264 | NOTE 5 | NOTE 5 |
| ± 14+δ | 64 | 120 | 264 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS as defined in Table 10.1A.18.2.3-3.  NOTE 6: δ is the margin determined from Table 10.1A.18.2.3-6. | | | | | | |

The accuracy requirements in Table 10.1A.18.2.3-4 for FR2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- Fading propagation condition.

- The BWtotal as defined in clause 9.9A.4.8 for RRC\_CONNECTED and in clause 5.6A.6.6 for RRC\_INACTIVE is no less than the “Total PRS bandwidth after FH”.

**Table 10.1A.18.2.3-4: UE Rx-Tx time difference measurement accuracy in FR2 in fading**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | |
| **PRS Ês/Iot** | **Minimum PRS bandwidth per hop** | **PRS SCS** | **Total PRS bandwidth after FH** | **IoNote 4 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 5** | **dB** | **RB** | **kHz** |  | **dBm / SCSPRS** | **dBm/BWChannel** |
| ± 27+δ | -3 | ≥64 | 60 | 264 | NOTE 5 | NOTE 5 |
| ± 17+δ | 64 | 120 | 264 | NOTE 5 | NOTE 5 |
| ± 41+δ | -13 | ≥64 | 60 | 264 | NOTE 5 | NOTE 5 |
| ± 38+δ | 64 | 120 | 264 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS as defined in Table 10.1A.18.2.3-3.  NOTE 6: δ is the margin determined from Table 10.1A.18.2.3-6. | | | | | | |

**Table 10.1A.18.2.3-5: Margin for UE Rx-Tx time difference measurement accuracy in FR1 with FH**

|  |  |  |  |
| --- | --- | --- | --- |
| **Min(PRS BW, SRS BW) (RB)** | | | **Margin (Tc Note 1)** |
| **SCS = 15 kHz** | **SCS = 30 kHz** | **SCS = 60 kHz** |
| ≥ 52 | N/A | N/A | 80 |
| N/A | 48 | 24 | 56 |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies.  NOTE 3: PRS BW and SRS BW refer to BW per hop. | | | |

**Table 10.1A.18.2.3-6: Margin for UE Rx-Tx time difference measurement accuracy in FR2 with FH**

|  |  |  |
| --- | --- | --- |
| **Min(PRS BW, SRS BW) (MHz)** | | **Margin (Tc Note 1)** |
| **SCS = 60 kHz** | **SCS = 120 kHz** |
| ≥ 64 | N/A | 32 |
| N/A | 64 | 24 |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies.  NOTE 3: PRS BW and SRS BW refer to BW per hop. | | |

10.1A.18.2.4 UE Rx-Tx Accuracy Requirement for 1RX RedCap UE with FH

The accuracy requirements in Table 10.1A.18.2.4-1 for FR1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- AWGN propagation condition.

**Table 10.1A.18.2.4-1: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | | |
| **PRS Ês/Iot** | **PRS bandwidth per hop** | **PRS SCS** | **Total PRS bandwidth after FH** | **NR operating band groupsNote 2** | **IoNote 3 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 4** | **dB** | **RB** | **kHz** |  |  | **dBm / SCSPRS** | **dBm/BW** |
| ± 23+δ | -3 | ≥52 | 15 | 268 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -127 | -50 |
| NR\_FDD\_FR1\_B | -126.5 |
| NR\_TDD\_FR1\_C | -126 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -125.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -125 |
| NR\_FDD\_FR1\_F | -124.5 |
| NR\_FDD\_FR1\_G, NR\_TDD\_FR1\_G | -124 |
| NR\_FDD\_FR1\_H | -123.5 |
| NR\_FDD\_FR1\_N | -120.5 |
| ± 14+δ | 48 | 30 | 272 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -124 | -50 |
| NR\_FDD\_FR1\_B | -123.5 |
| NR\_TDD\_FR1\_C | -123 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -122.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -122 |
| NR\_FDD\_FR1\_F | -121.5 |
| NR\_FDD\_FR1\_G, NR\_TDD\_FR1\_G | -121 |
| NR\_FDD\_FR1\_H | -120.5 |
| NR\_FDD\_FR1\_N | -117.5 |
| ± 22+δ | 24 | 60 | 132 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
| NR\_FDD\_FR1\_B | -120.5 |
| NR\_TDD\_FR1\_C | -120 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 |
| NR\_FDD\_FR1\_F | -118.5 |
| NR\_FDD\_FR1\_G, NR\_TDD\_FR1\_G | -118 |
| NR\_FDD\_FR1\_H | -117.5 |
| NR\_FDD\_FR1\_N | -114.5 |
| ± 60+δ | -13 | ≥52 | 15 | 268 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 42+δ | 48 | 30 | 272 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 45+δ | 24 | 60 | 132 | NOTE 5 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: δ is the margin determined from Table 10.1A.18.2.3-5. | | | | | | | |

The accuracy requirements in Table 10.1A.18.2.4-1a for FR1 for are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- Number of measurement samples is less than 4.

- AWGN propagation condition.

**Table 10.1A.18.2.4-1a: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN with reduced measurement samples**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | | |
| **PRS Ês/Iot** | **PRS bandwidth per hop** | **PRS SCS** | **Total PRS bandwidth after FH** | **NR operating band groupsNote 2** | **IoNote 3 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 4** | **dB** | **RB** | **kHz** |  |  | **dBm / SCSPRS** | **dBm/BW** |
| ± 16+δ | 0 | ≥52 | 15 | 268 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 9+δ | 48 | 30 | 272 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 10+δ | 24 | 60 | 132 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 33+δ | -6 | ≥52 | 15 | 268 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 16+δ | 48 | 30 | 272 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 21+δ | 24 | 60 | 132 | NOTE 5 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS as defined in Table 10.1A.18.2.4-1.  NOTE 6: δ is the margin determined from Table 10.1A.18.2.3-5. | | | | | | | |

The accuracy requirements in Table 10.1A.18.2.4-2 for FR1 for are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- PRP|dBm according to Annex B.2.14 for a corresponding Band.

- Fading propagation condition.

**Table 10.1A.18.2.4-2: UE Rx-Tx time difference measurement accuracy in FR1 in fading**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | **Conditions** | | | | | | |
| **PRS Ês/Iot** | **PRS bandwidth per hop** | **PRS SCS** | **Total PRS bandwidth after FH** | **NR operating band groupsNote 2** | **IoNote 3 range** | |
| **Minimum IoNote 1** | **Maximum Io** |
| **TcNote 4** | **dB** | **RB** | **kHz** |  |  | **dBm / SCSPRS** | **dBm/BW** |
| ± 63+δ | -3 | ≥52 | 15 | 268 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 43+δ | 48 | 30 | 272 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 40+δ | 24 | 60 | 132 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 85+δ | -10 | ≥52 | 15 | 268 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 61+δ | 48 | 30 | 272 | NOTE 5 | NOTE 5 | NOTE 5 |
| ± 55+δ | 24 | 60 | 132 | NOTE 5 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS as defined in Table 10.1A.18.2.4-1.  NOTE 6: δ is the margin determined from Table 10.1A.18.2.3-5. | | | | | | | |

<End of Change 1>