**3GPP TSG RAN WG1 #107-e R1-211xxxx**

**e-Meeting, November 11th – 19th, 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
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|  |  | **CR** |  | **rev** | **-** | **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 | **X** | Core Network |  |

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| ***Title:*** | Introduction of NR positioning enhancements | | | | | | | | | |
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| ***Source to WG:*** | Intel Corporation | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_pos\_enh-Core | | | | |  | ***Date:*** | | | 2021-11-26 |
|  |  | | | |  | |  | | |  |
| ***Category:*** |  |  | | | | | ***Release:*** | | | Rel-17 |
|  | *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-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
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| ***Reason for change:*** | | Introduction of NR positioning enhancements | | | | | | | | |
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| ***Summary of change:*** | | 1. Extend support of “DL PRS-RSRP”, “DL RSTD”, “UE Rx – Tx time difference” measurements to RRC\_INACTIVE state  2. Added new measurement definitions for  - DL PRS reference signal received path power (DL PRS-RSRPP)  - UL SRS reference signal received path power (UL SRS-RSRPP) | | | | | | | | |
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| ***Consequences if not approved:*** | | Incomplete support of NR positioning enhancements | | | | | | | | |
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| ***Clauses affected:*** | | 5.1.28, 5.1.29, 5.1.30 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

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### 5.1.28 DL PRS reference signal received power (DL PRS-RSRP)

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| **Definition** | DL PRS reference signal received power (DL PRS-RSRP), is defined as the linear average over the power contributions (in [W]) of the resource elements that carry DL PRS reference signals configured for RSRP measurements within the considered measurement frequency bandwidth.  For frequency range 1, the reference point for the DL PRS-RSRP shall be the antenna connector of the UE. For frequency range 2, DL PRS-RSRP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. For frequency range 1 and 2, if receiver diversity is in use by the UE, the reported DL PRS-RSRP value shall not be lower than the corresponding DL PRS-RSRP of any of the individual receiver branches. |
| **Applicable for** | RRC\_CONNECTED,  RRC\_INACTIVE |

### 5.1.29 DL reference signal time difference (DL RSTD)

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| **Definition** | DL reference signal time difference (DL RSTD) is the DL relative timing difference between the Transmission Point (TP) [18] *j* and the reference TP *i*, defined as TSubframeRxj – TSubframeRxi,  Where:  TSubframeRxj is the time when the UE receives the start of one subframe from TP *j*.  TSubframeRxi is the time when the UE receives the corresponding start of one subframe from TP *i* that is closest in time to the subframe received from TP *j*.  Multiple DL PRS resources can be used to determine the start of one subframe from a TP.  For frequency range 1, the reference point for the DL RSTD shall be the antenna connector of the UE. For frequency range 2, the reference point for the DL RSTD shall be the antenna of the UE. |
| **Applicable for** | RRC\_CONNECTED,  RRC\_INACTIVE |

### 5.1.30 UE Rx – Tx time difference

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| **Definition** | The UE Rx – Tx time difference is defined as TUE-RX –TUE-TX  Where:  TUE-RX is the UE received timing of downlink subframe #*i* from a Transmission Point (TP) [18], defined by the first detected path in time.  TUE-TX is the UE transmit timing of uplink subframe #*j* that is closest in time to the subframe #i received from the TP.  Multiple DL PRS resources can be used to determine the start of one subframe of the first arrival path of the TP.  For frequency range 1, the reference point for TUE-RX measurement shall be the Rx antenna connector of the UE and the reference point for TUE-TX measurement shall be the Tx antenna connector of the UE. For frequency range 2, the reference point for TUE‑RX measurement shall be the Rx antenna of the UE and the reference point for TUE‑TX measurement shall be the Tx antenna of the UE. |
| **Applicable for** | RRC\_CONNECTED,  RRC\_INACTIVE (only applicable for DL PRS based measurements) |

### 5.1.31 SS reference signal antenna relative phase (SS-RSARP)

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| **Definition** | SS reference signal antenna relative phase (SS-RSARP) is defined as the difference of the average phase of the receive signals on the resource elements that carry secondary synchronization signals (SS) received by the reference individual receiver branch (Rx0) and the average phase of the receive signals on the resource elements that carry secondary synchronization signals (SS) received by one other individual receiver branch (Rx1 ... Rxn). The measurement time resource(s) for SS-RSARP are confined within SS/PBCH Block Measurement Time Configuration (SMTC) window duration.  SS-RSARP shall be measured only among the reference signals corresponding to SS/PBCH blocks with the same SS/PBCH block index and the same physical-layer cell identity.  If higher-layers indicate certain SS/PBCH blocks for performing SS-RSARP measurements, then SS-RSARP is measured only from the indicated set of SS/PBCH block(s).  For frequency range 1, the reference point for the SS-RSARP shall be the antenna connector of the UE. For frequency range 2, SS-RSARP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. |
| **Applicable for** | RRC\_CONNECTED intra-frequency |

NOTE 1: The number of resource elements within the measurement period that are used by the UE to determine SS-RSARP is left up to the UE implementation with the limitation that corresponding measurement accuracy requirements have to be fulfilled.

NOTE 2: The phase per resource element is determined from the energy received during the useful part of the symbol, excluding the CP.

NOTE 3: This UE measurement is defined only for conformance test purposes. It is described along with test control entity signalling in [14].

### 5.1.32 UTRA FDD CPICH RSCP

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| **Definition** | Received Signal Code Power, the received power on one code measured on the Primary CPICH. The reference point for the RSCP shall be the antenna connector of the UE. If Tx diversity is applied on the Primary CPICH the received code power from each antenna shall be separately measured and summed together in [W] to a total received code power on the Primary CPICH. If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding CPICH RSCP of any of the individual receive antenna branches. |
| **Applicable for** | RRC\_CONNECTED inter-RAT |

### 5.1.33 UTRA FDD carrier RSSI

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| **Definition** | The received wide band power, including thermal noise and noise generated in the receiver, within the bandwidth defined by the receiver pulse shaping filter. The reference point for the measurement shall be the antenna connector of the UE. If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding UTRA carrier RSSI of any of the individual receive antenna branches. |
| **Applicable for** | RRC\_CONNECTED inter-RAT |

NOTE: This definition does not correspond to a reported measurement. This definition is just an intermediate definition used in the definition of UTRA FDD CPICH Ec/No.

### 5.1.34 UTRA FDD CPICH Ec/No

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| **Definition** | The received energy per chip divided by the power density in the band. If receiver diversity is not in use by the UE, the CPICH Ec/No is identical to CPICH RSCP/UTRA Carrier RSSI. Measurement shall be performed on the Primary CPICH. The reference point for the CPICH Ec/No shall be the antenna connector of the UE. If Tx diversity is applied on the Primary CPICH the received energy per chip (Ec) from each antenna shall be separately measured and summed together in [Ws] to a total received chip energy per chip on the Primary CPICH, before calculating the Ec/No. If receiver diversity is in use by the UE, the measured CPICH Ec/No value shall not be lower than the corresponding CPICH RSCP*i*/UTRA Carrier RSSI*i* of receive antenna branch *i*. |
| **Applicable for** | RRC\_CONNECTED inter-RAT |

### 5.1.x DL PRS reference signal received path power (DL PRS-RSRPP)

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| **Definition** | DL PRS reference signal received path power (DL PRS-RSRPP), is defined as the power of the received DL PRS signal configured for the measurement at the i-th path delay of the channel response, where DL PRS-RSRPP for 1st path delay is the power corresponding to the first detected path in time.  For frequency range 1, the reference point for the DL PRS-RSRPP shall be the antenna connector of the UE. For frequency range 2, DL PRS-RSRPP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch.  For frequency range 1 and 2, if receiver diversity is in use by the UE for DL PRS-RSRPP measurements:  - if DL PRS-RSRP is measured, DL PRS-RSRPP for the first and additional paths shall be provided for the same receiver branch(es) as applied for DL PRS-RSRP measurements.  - otherwise, DL PRS-RSRPP for the first path shall not be lower than the corresponding DL PRS-RSRPP for the first path of any of the individual receiver branches. DL PRS-RSRPP for the additional paths shall be provided for the same receiver branch(es) as applied for the first path DL PRS-RSRPP measurements. |
| **Applicable for** | RRC\_CONNECTED,  RRC\_INACTIVE |

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## 5.2 NG-RAN measurement abilities

The structure of the table defining a NG-RAN measurement quantity is shown below.

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| **Column field** | Comment |
| **Definition** | Contains the definition of the measurement. |

### 5.2.1 SSS transmit power

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| **Definition** | SSS transmit power is determined as the linear average over the power contributions (in [W]) of the resource elements that carry secondary synchronization signals within the secondary synchronization signal (SSS) bandwidth.  For downlink reference signal transmit power determination the secondary synchronization signal according TS 38.211 [4] can be used.  For frequency range 1, the reference point for the downlink reference signal power measurement shall be the transmit antenna connector. |

### 5.2.2 UL Relative Time of Arrival (TUL-RTOA)

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| **Definition** | The UL Relative Time of Arrival (TUL-RTOA) is the beginning of subframe *i* containing SRS received in Reception Point (RP) [18] *j*, relative to the RTOA Reference Time [16].  The UL RTOA reference time is defined as , where  - is the nominal beginning time of SFN 0 provided by SFN Initialization Time [15, TS 38.455]  - , where and are the system frame number and the subframe number of the SRS, respectively.  Multiple SRS resources can be used to determine the beginning of one subframe containing SRS received at a RP.  The reference point for TUL-RTOA shall be:  - for type 1-C base station TS 38.104 [9]: the Rx antenna connector,  - for type 1-O or 2-O base station TS 38.104 [9]: the Rx antenna (i.e. the centre location of the radiating region of the Rx antenna),  - for type 1-H base station TS 38.104 [9]: the Rx Transceiver Array Boundary connector. |

### 5.2.3 gNB Rx – Tx time difference

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| **Definition** | The gNB Rx – Tx time difference is defined as TgNB-RX –TgNB-TX  Where:  TgNB-RX is the Transmission and Reception Point (TRP) [18] received timing of uplink subframe #*i* containing SRS associated with UE, defined by the first detected path in time.  TgNB-TX is the TRP transmit timing of downlink subframe #*j* that is closest in time to the subframe #*i* received from the UE.  Multiple SRS resources for positioning can be used to determine the start of one subframe containing SRS.  The reference point for TgNB-RX shall be:  - for type 1-C base station TS 38.104 [9]: the Rx antenna connector,  - for type 1-O or 2-O base station TS 38.104 [9]: the Rx antenna (i.e. the centre location of the radiating region of the Rx antenna),  - for type 1-H base station TS 38.104 [9]: the Rx Transceiver Array Boundary connector.  The reference point for TgNB-TX shall be:  - for type 1-C base station TS 38.104 [9]: the Tx antenna connector,  - for type 1-O or 2-O base station TS 38.104 [9]: the Tx antenna (i.e. the centre location of the radiating region of the Tx antenna),  - for type 1-H base station TS 38.104 [9]: the Tx Transceiver Array Boundary connector. |

### 5.2.4 UL Angle of Arrival (UL AoA)

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| **Definition** | UL Angle of Arrival (UL AoA) is defined as the estimated azimuth angle and vertical angle of a UE with respect to a reference direction, wherein the reference direction is defined:  - In the global coordinate system (GCS), wherein estimated azimuth angle is measured relative to geographical North and is positive in a counter-clockwise direction and estimated vertical angle is measured relative to zenith and positive to horizontal direction  - In the local coordinate system (LCS), wherein estimated azimuth angle is measured relative to x-axis of LCS and positive in a counter-clockwise direction and estimated vertical angle is measured relatize to z-axis of LCS and positive to x-y plane direction. The bearing, downtilt and slant angles of LCS are defined according to TS 38.901 [15].  The UL AoA is determined at the gNB antenna for an UL channel corresponding to this UE. |

### 5.2.5 UL SRS reference signal received power (UL SRS-RSRP)

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| **Definition** | UL SRS reference signal received power (UL SRS-RSRP) is defined as linear average of the power contributions (in [W]) of the resource elements carrying sounding reference signals (SRS). UL SRS‑RSRP shall be measured over the configured resource elements within the considered measurement frequency bandwidth in the configured measurement time occasions.  For frequency range 1, the reference point for the UL SRS-RSRP shall be the antenna connector of the gNB. For frequency range 2, UL SRS-RSRP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. For frequency range 1 and 2, if receiver diversity is in use by the gNB, the reported UL SRS-RSRP value shall not be lower than the corresponding UL SRS-RSRP of any of the individual receiver branches. |

### 5.2.x UL SRS reference signal received path power (UL SRS-RSRPP)

|  |  |
| --- | --- |
| **Definition** | UL SRS reference signal received path power (UL SRS-RSRPP) is defined as the power of the received UL SRS signal configured for the measurement at the i-th path delay of the channel response, where UL SRS-RSRPP for 1st path delay is the power corresponding to the first detected path.  For frequency range 1, the reference point for the UL SRS-RSRPP shall be the antenna connector of the gNB. For frequency range 2, UL SRS-RSRPP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch.  For frequency range 1 and 2, if receiver diversity is in use by the gNB for UL SRS-RSRPP measurements:  - if UL SRS-RSRP is measured, UL SRS-RSRPP for the first and additional paths shall be provided for the same receiver branch(es) as applied for UL SRS-RSRP measurements.  - otherwise, UL SRS-RSRPP for the first path shall not be lower than the corresponding UL SRS-RSRPP for the first path of any of the individual receiver branches. UL SRS-RSRPP for the additional paths shall be provided for the same receiver branch(es) as applied for the first path UL SRS-RSRPP measurements. |