**3GPP TSG RAN Meeting #91e RP-210628**

**Electronic Meeting, March 16 - 26, 2022 Revised from RP-202900**

**Source: Intel Corporation, CATT**

**Title: Revised WID on NR Positioning Enhancements**

**Document for: Approval**

**Agenda Item: 9.7.25**

3GPP™ Work Item Description

Information on Work Items can be found at <http://www.3gpp.org/Work-Items>
See also the [3GPP Working Procedures](http://www.3gpp.org/specifications-groups/working-procedures), article 39 and the TSG Working Methods in [3GPP TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm)

# Title: NR Positioning Enhancements

## Acronym: NR\_pos\_enh

## Unique identifier:900160

NOTE: For new WIs/SIs leave the Unique identifier empty and make a proposal for an Acronym.

 For a revised WI/SI: Take Unique identifier and acronym as shown in 3GPP workplan.

 If this is a RAN WID including Core and Perf. part, then Title, Acronym and Unique identifier refer to the feature WI.

 Please tick (X) the applicable box(es) in the table below:

 Either:

|  |  |
| --- | --- |
| **This WID includes a Core part** | **X** |
| **This WID includes a Performance part** | **X** |

 or:

|  |  |
| --- | --- |
| **This WID includes a Testing part** |  |
| **and it addresses the following 3GPP work area:** | **Radio Access** |  |
| **Core Network** |  |
| **Services** |  |

Potential target Release: Rel-17

Note that this field above indicates the proposed Release at the time of submission of the WID to TSG approval. It can later be changed without a need to revise the WID. The updated target Release is indicated in the Work Plan. NOTE: In case of contradiction with the target dates of clause 5, clause 5 determines the target release.

## 1 Impacts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Affects:** | UICC apps | ME | AN | CN | Others (specify) |
| **Yes** |  | X | X |  |  |
| **No** | X |  |  |  |  |
| **Don't know** |  |  |  | X |  |

## 2 Classification of the Work Item and linked work items

### 2.1 Primary classification

This work item is a

|  |  |
| --- | --- |
| X | Feature |
|  | Building Block |
|  | *Work Task* |
|  | Study Item |

NOTE: Normally, Core/Perf./Testing parts in RAN WIDs are Building Blocks. Only if they are under an SA or CT umbrella, they are defined as work tasks. If you are in doubt, please contact MCC.

### 2.2 Parent Work Item

|  |
| --- |
| Parent Work / Study Items  |
| Acronym | Working Group | Unique ID | Title (as in 3GPP Work Plan) |
|  |  |  |  |

NOTE: RAN agreed some time ago, that it describes the feature WI + Core/Perf. part WI or Testing part WI in one WID. Therefore the table above should just include the feature WI data (In case the feature covers Core and Perf. part, please list under Working Group the leading WG of the Core part).

### 2.3 Other related Work Items and dependencies

|  |
| --- |
| Other related Work Items (if any) |
| Unique ID | Title | Nature of relationship |
| 860034 | Study on NR Positioning Enhancements | Preceding Study Item |
| 830077 | NR Positioning Support | Preceding Work Item |

NOTE: Also related or dependent WIs/SIs in other TSGs should be indicated.

## 3 Justification

3GPP NR radio-technology is uniquely positioned to provide added value in terms of enhanced location capabilities. The operation in low and high-frequency bands (i.e. below and above 6GHz) and utilization of massive antenna arrays provide additional degrees of freedom to substantially improve the positioning accuracy. The possibility to use wide signal bandwidth in low and especially in high bands brings new performance bounds for user location for well-known positioning techniques, utilizing timing measurements to locate UE. The recent advances in massive antenna systems can provide additional degrees of freedom to enable more accurate user locations by exploiting spatial and angular domains of propagation channel in combination with time measurements.

3GPP Rel-16 has specified various location technologies to support regulatory as well as commercial use cases. The 5G service requirements specified in TS 22.261 include the positioning requirements of high accuracy, high availability and low latency, which are characterized by ambitious system requirements for positioning accuracy, availability and latency in many verticals. The 5G service requirements specified in TS 22.261 also include the need to determine the reliability, and the uncertainty or confidence level, of the position-related data.

To address the higher accuracy, lower latency location, high integrity and reliability requirements resulting from new applications and industry verticals for 5G, a Rel-17 Study Item of “Study on NR Positioning Enhancements” has been carried out by 3GPP, which covers the enhancements and solutions necessary to support the high accuracy (horizontal and vertical), low latency, network efficiency (scalability, RS overhead, etc.), and device efficiency (power consumption, complexity, etc.) requirements for commercial uses cases (incl. general commercial use cases and specifically IIoT use cases) and GNSS positioning integrity requirements. The accomplishments of the study for positioning enhancements are documented in [3GPP TR38.857]

Rel-17 target positioning requirements for commercial use cases and IIoT use cases -were defined during the study item, including the requirements for horizontal/vertical positioning accuracy, physical layer and higher layer end-to-end positioning latency and GNSS positioning integrity [3GPP TR38.857].

Based on the investigation, it was recommended to support positioning enhancements for supporting Rel-17 target positioning requirements for both general commercial use cases and IIoT use cases.

## 4 Objective

### 4.1 Objective of SI or Core part WI or Testing part WI

The objective of this work item is to specify solutions to enable RAT dependent (for both FR1 and FR2) and RAT independent NR positioning enhancements for improving positioning accuracy, latency, network and/or device efficiency. The objective of this work item also includes the support of GNSS enhancements.

The specific objectives of this work are:

* Specify methods, measurements, signalling, and procedures for improving positioning accuracy of the Rel-16 NR positioning methods by mitigating UE Rx/Tx and/or gNB Rx/Tx timing delays, including [RAN1, RAN2, RAN3, RAN4]
	+ DL, UL and DL+UL positioning methods
	+ UE-based and UE-assisted positioning solutions
* Specify the procedure, measurements, reporting, and signalling for improving the accuracy of [RAN1, RAN2, RAN3]
	+ UL AoA for network-based positioning solutions.
	+ DL-AoD for UE-based and network-based (including UE-assisted) positioning solutions.
* Specify the enhancements of signalling, and procedures for improving positioning latency of the Rel-16 NR positioning methods, for DL and DL+UL positioning methods, including:
	+ Latency reduction related to the request and response of location information and positioning assistance data; [RAN2, RAN3, RAN1]
	+ Latency reduction related to the time needed to perform UE measurements; [RAN1, RAN4]
	+ Latency reduction related to the measurement gap; [RAN1, RAN4, RAN2]

]

* Specify methods, measurements, signalling and procedures to support positioning for UEs in RRC\_ INACTIVE state, for UE-based and UE-assisted positioning solutions, including [RAN2, RAN1, RAN3,RAN4]:
	+ DL NR positioning methods and RAT-independent positioning methods
		- Support of UE positioning measurements for UEs in RRC\_INACTIVE state
		- Reporting of positioning measurement or location estimate performed in RRC\_INACTIVE when the UE is in RRC\_INACTIVE state

Note: this work will be coordinated with the SDT WI.

* + As 2nd priority:
		- UL and DL+UL NR positioning methods
		- Support of gNB positioning measurements for UEs in RRC\_INACTIVE state
* Specify on-demand transmission and reception of DL PRS for DL and DL+UL positioning for UE-based and UE-assisted positioning solutions, including: [RAN2, RAN1, RAN3]
	+ UE-initiated request of on-demand DL PRS transmission;
	+ LMF (network)-initiated request of on-demand DL PRS transmission;
* Specify the signalling, and procedures to support GNSS positioning integrity determination, including [RAN2, RAN3]:
	+ The assistance information that will be used to support integrity determination
	+ The information that will be used to provide the positioning integrity KPIs and integrity results
	+ Support of integrity for UE-based and UE-assisted A-GNSS positioning.

Note: This objective is applicable to NR and E-UTRAN.

* Support the following enhancements of A-GNSS positioning [RAN2, RAN3, RAN4]
	+ Specify support for BDS B2a signal
	+ Specify support for BDS B3I signal
	+ Specify support for NavIC to NR

Note: This objective is applicable to NR and E-UTRAN.

* Study and specify, if agreed, the enhancements of information reporting from UE and gNB for multipath/NLOS mitigation [RAN1, RAN2, RAN3]

]

* Discuss and specify new as well as the impact on the existing RAN4 requirements for positioning and other RRM measurements and corresponding procedures [RAN4]
* Define extensions of signalling, protocol and procedure for NR positioning enhancement, as needed [RAN3]

[Note: RAN3 shall perform checking with RAN2 on the architecture aspects, as needed.]

Notes:

* Solutions for RAT-dependent positioning enhancements are designed to operate in both frequency ranges (i.e. FR1 & FR2)
* RAN working groups will take into account the work from other working group SA/CT which involves same objectives.

### 4.2 Objective of Performance part WI

NOTE: Leave empty if the WI proposal does not contain a RAN performance part.

* Define corresponding performance requirements and test cases for NR positioning enhancements [RAN4]

### 4.3 RAN time budget request (not applicable to RAN5 WIs/SIs)

NOTE: For all new RAN related WIs/SIs which are not led by RAN WG5 the WI/SI rapporteur has to fill out the attached Excel table to request time budgets for corresponding RAN WG meetings.
The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI.
One time unit (TU) corresponds to ~ 2 hours in the meeting.
If no TU is needed, then leave the field empty otherwise enter a number >0 in the field.

 For revisions of already approved WI/SI descriptions: Please remove the Excel table from the WID/SID's zip file. The time budgets are already recorded. If you want to modify them, then this has to be done via the status report and not via a revised WID/SID.

 If this WID is covering Core and Performance part, then please fill out one line for each part in the attached Excel table.

**additional comments to the time budget request in the attached Excel table:**

## 5 Expected Output and Time scale

|  |
| --- |
| **New specifications** *{One line per specification. Create/delete lines as needed}* |
| Type  | TS/TR number | Title | For info at TSG#  | For approval at TSG# | Remarks |
|  |  |  |  |  |  |

*{Note 1: Only TSs may contain normative provisions. Study Items shall create or impact only TRs.
"Internal TR" is intended for 3GPP internal use only whereas "External TR" may be transposed by OPs.}*

NOTE: If this is a RAN WI including Core and Perf. part, then all new Core part specs have to be listed first and then all new Perf. part specs. Indicate "Core part" or "Perf. part" under Remarks for each spec.
By default a new specs can only be new for one of both parts.

|  |
| --- |
| **Impacted existing TS/TR** *{One line per specification. Create/delete lines as needed}* |
| TS/TR No. | Description of change  | Target completion plenary# | Remarks |
| *38.211* | *NR positioning enhancements* | *94* | *Core part* |
| *38.212* | *NR positioning enhancements* | *94* | *Core part* |
| *38.213* | *NR positioning enhancements* | *94* | *Core part* |
| *38.214* | *NR positioning enhancements* | *94* | *Core part* |
| *38.215* | *NR positioning enhancements* | *94* | *Core part* |
| *38.305* | *NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN* | *95* | *Core part* |
| *37.355* | *Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)* | *95* | *Core part* |
| *38.331* | *NR; Radio Resource Control (RRC); Protocol specification* | *95* | *Core part* |
| *38.321* | *NR;**Medium Access Control (MAC) protocol specification* | *95* | *Core part* |
| *38.306* | *NR; User Equipment (UE) radio access capabilities* | *95* | *Core part* |
| *38.300* | *NR; NR and NG-RAN Overall Description; Stage 2* | *95* | *Core part* |
| *38.401* | *NG-RAN; Architecture description* | *95* | *Core part* |
| *38.413* | *NG-RAN; NG Application Protocol (NGAP)* | *95* | *Core part* |
| *38.423* | *NG-RAN; Xn application protocol (XnAP)* | *95* | *Core part* |
| *38.455* | *NG-RAN; NR Positioning Protocol A (NRPPa)* | *95* | *Core part* |
| *38.473* | *NG-RAN; F1 application protocol (F1AP)* | *95* | *Core part* |
| *38.133* | *NR; Requirements for support of radio resource management -Core* | *95* | *Core part* |
| *38.133* | *NR; Requirements for support of radio resource management -Performance* | *97* | *Performance part and test cases* |
| *38.171* | *NR; Requirements for support of Assisted Global Navigation Satellite System (A-GNSS)* | *97* | *Performance part and test cases* |
| *36.305* | *Evolved Universal Terrestrial Radio Access Network* *(E-UTRAN);Stage 2 functional specification of**User Equipment (UE) positioning in E-UTRAN* | *95* | *Core part* |
| *36.171* | *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for Support of Assisted Global Navigation Satellite System (A-GNSS)* | *97* | *Performance part and test cases* |

NOTE: If this is a RAN WI including Core and Perf. part, then all new Core part specs have to be listed first and then all new Perf. part specs. Indicate "Core part" or "Perf. part" under Remarks for each spec.
If an existing spec is affected by both (Core part and Perf. part), then it has to be listed twice with appropriate approval dates.

## 6 Work item Rapporteur(s)

*Guo, Yi, Intel Corporation,* *yi.Guo@intel.com* *(RAN2)*

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## 7 Work item leadership

Primary: RAN1

Secondary: RAN2, RAN3, RAN4

## 8 Aspects that involve other WGs

NOTE: For RAN WIs: Section 8 applies only to WGs outside of TSG RAN because RAN WG aspects have to be covered in section 4.

## 9 Supporting Individual Members

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| --- |
| Supporting IM name |
| Intel Corporation |
| CATT |
| Telecom Italia |
| Huawei |
| HiSilicon |
| Qualcomm |
| Ericsson |
| Apple |
| LG Electronics |
| FUTUREWEI |
| InterDigital |
| ZTE |
| SoftBank |
| OPPO |
| Xiaomi |
| vivo |
| Lenovo |
| Motorola Mobility |
| MediaTek Inc. |
| Spreadtrum |
| PHY Wireless |
| SONY |
| Deutsche Telekom  |
| AT&T |
| Polaris Wireless |
| NextNav |