**3GPP TSG RAN Meeting #96 RP-22xxxx**

**Budapest, Hungary, June 6 - 9, 2022** (revision of RP-213588)

**Source: Intel Corporation, CATT, [Ericsson]**

**Title: Revised SID on Study on expanded and improved NR positioning**

**Document for: Approval**

**Agenda Item: 9.2.5**

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: Study on expanded and improved NR positioning

## Acronym: FS\_NR\_pos\_enh2

## Unique identifier: 940081

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** |  |
| **This WID includes a Performance part** |  |

 or:

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

Potential target Release: Rel-18

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

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

*{List here other Work Items which relate to the proposed one, such as preceding SI or a preceding WI (e.g. if further enhancing a feature).}*

|  |
| --- |
| Other related Work Items (if any) |
| Unique ID | Title | Nature of relationship |
| 830077 | NR Positioning Support | Preceding Work Item (Rel-16) |
| 860034 | Study on NR Positioning Enhancements  | Preceding Study Item (Rel-17) |
| 900160 | NR Positioning Enhancements | Preceding Work Item (Rel-17) |
| 880075 | Study on scenarios and requirements of in-coverage, partial coverage, and out-of-coverage NR positioning use cases | Preceding Study Item (Rel-17) |
| 860042 | NR sidelink enhancement | Work item for NR sidelink communication enhancements (Rel-17) |
| 830078 | 5G V2X with NR sidelink | Work item introducing NR sidelink communication (Rel-17) |
|  |  |  |

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

## 3 Justification

In Release 17, 3GPP RAN conducted studies on "NR Positioning Enhancements" and "Scenarios and requirements of in-coverage, partial coverage, and out-of-coverage NR positioning use cases".

The study on "Scenarios and requirements of in-coverage, partial coverage, and out-of-coverage NR positioning use cases" focussed on V2X and public safety use cases with the outcome being captured in TR38.845. Additionally, SA1 has developed requirements in TS22.261 for "Ranging based services", and has developed positioning accuracy requirements in TS22.104 for IIoT uses cases in out-of-coverage scenarios. There is a need for 3GPP to study and develop sidelink positioning solutions that can support the use cases, scenarios and requirements identified during these activities.

The study on "NR Positioning Enhancements" investigated higher accuracy, and lower latency location, high integrity and reliability requirements resulting from new applications and industry verticals for 5G. Some of the enhancements identified during that work have been specified during the Rel-17 Work Item on "NR Positioning Enhancements", but there remain a number of opportunities for enhancement that have not yet been incorporated into the specifications.

Positioning integrity is a measure of the trust in the accuracy of the position-related data and the ability to provide timely warnings based on assistance data provided by the network. The focus in Rel 17 work was on GNSS integrity, and for Rel-18 it is natural to extend this to address other positioning techniques as well as there are relevant integrity aspects of mission critical use cases that rely on positioning estimates and the corresponding uncertainty estimate. Integrity enables applications to make the correct decisions based on the reported position, e.g., when monitoring a robotic arm to decide whether its arm movement are within allowed limits to ensure safety distances to humans and other objects.

Regarding higher accuracy, two promising techniques identified in earlier studies will be considered in Rel-18: one is to take the advantage of the rich 5G spectrum to increase the bandwidth for the transmission and reception of the positioning reference signals based on PRS/SRS bandwidth aggregation for intra-band carriers, and the other is to use the NR carrier phase measurements. GNSS carrier phase positioning has been used very successfully for centimetre-level positioning but is limited to outdoor applications. NR carrier phase positioning has the potential for significant performance improvements for indoor and outdoor deployments in comparison with the existing NR positioning methods, as well as shorter latency and lower UE power consumption in comparison with RTK-GNSS outdoors.

SA1 has introduced requirements for LPHAP (Low Power High Accuracy Positioning) for industrial IoT scenarios including use cases such as massive asset tracking, AGV tracking in industrial factory and person localization in danger zones. The SA1 requirements are for high accuracy and extreme low power consumption with battery life sustainable up to one or more years. A typical scenario of interest is use case 6 as defined TS 22.104, which corresponds to tracking of workpiece (in- and outdoor) in assembly area and warehouse with a target accuracy of <1m, a positioning interval of 15-30 seconds, and a battery life of 6-12 months. While Rel-17 NR positioning has introduced support for positioning in RRC\_INACTIVE state, there is a need to evaluate whether the current system allows LPHAP requirements to be met.

Release-17 has specified support for RedCap UEs with reduced bandwidth support and reduced complexity including reduced number of receive chains. Such UEs could support NR positioning functionality but there is a gap in that the core and performance requirements have not been specified for the positioning related measurements performed by RedCap UEs, and no evaluation was performed to see how the reduced capabilities of RedCap UEs might impact eventual position accuracy. This gap is to be investigated by the present SI.

## 4 Objective

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

* Study solutions for sidelink positioning considering the following: [RAN1, RAN2]
* Scenario/requirements
	+ Coverage scenarios to cover: in-coverage, partial-coverage and out-of-coverage
	+ Requirements: Based on requirements identified in TR38.845 and TS22.261 and TS22.104
	+ Use cases: V2X (TR38.845), public safety (TR38.845), commercial (TS22.261), IIOT (TS22.104)
	+ Spectrum: ITS, licensed
* Identify specific target performance requirements to be considered for the evaluation based on existing 3GPP work and inputs from industry forums [RAN1]
* Define evaluation methodology with which to evaluate SL positioning for the uses cases and coverage scenarios, reusing existing methodologies from sidelink communication and from positioning as much as possible [RAN1].
* Study and evaluate performance and feasibility of potential solutions for SL positioning, considering relative positioning, ranging and absolute positioning: [RAN1, RAN2]
	+ Evaluate bandwidth requirement needed to meet the identified accuracy requirements [RAN1]
	+ Study of positioning methods (e.g. TDOA, RTT, AOA/D, etc) including combination of SL positioning measurements with other RAT dependent positioning measurements (e.g. Uu based measurements) [RAN1]
	+ Study of sidelink reference signals for positioning purposes from physical layer perspective, including signal design, resource allocation, measurements, associated procedures, etc, reusing existing reference signals, procedures, etc from sidelink communication and from positioning as much as possible [RAN1]
	+ Study of positioning architecture and signalling procedures (e.g. configuration, measurement reporting, etc) to enable sidelink positioning covering both UE based and network based positioning [RAN2, including coordination and alignment with RAN3 and SA2 as required]

Note: When the bandwidth requirements have been determined and the study of sidelink communication in unlicensed spectrum has progressed, it can be reviewed whether unlicensed spectrum can be considered in further work. Checkpoint at RAN#97 to see if sufficient information is available for this review.

* Improved accuracy, integrity, and power efficiency:
	+ Study solutions for Integrity for RAT dependent positioning techniques [RAN2, RAN1]:
		- Identify the error sources, [RAN1, RAN2].
		- Study methodologies, procedures, signalling, etc for determination of positioning integrity for both UE-based and UE-assisted positioning [RAN2]
		- Focus on reuse of concepts and principles being developed for RAT-Independent GNSS positioning integrity, where possible.
	+ Study solutions for accuracy improvement based on PRS/SRS bandwidth aggregation for intra-band carriers considering e.g. timing errors, phase coherency, frequency errors, power imbalance, etc [RAN4]:
	+ Study solutions for accuracy improvement based on NR carrier phase measurements [RAN1, RAN4]
		- Reference signals, physical layer measurements, physical layer procedures to enable positioning based on NR carrier phase measurements for both UE-based and UE-assisted positioning [RAN1]
		- Focus on reuse of existing PRS and SRS, with new reference signals only considered if found necessary
	+ Study the requirements on LPHAP as developed by SA1 and evaluate whether existing RAN functionality can support these power consumption and positioning requirements. Based on the evaluation, and, if found beneficial, study potential enhancements to help address any limitations [RAN2, RAN1]
		- Study is limited to a single representative use case (use case 6 as defined TS 22.104). The choice of selected use case can be reviewed at the start of the study.
		- Study is limited to enhancements to RRC\_INACTIVE and/or RRC\_IDLE state
* Positioning support for RedCap UEs, considering the following:
	+ Evaluate positioning performance of existing positioning procedures and measurements with RedCap UEs[RAN1]
	+ Based on the evaluation, assess the necessity of enhancements and, if needed, identify enhancements to help address limitations associated with for RedCap UEs [RAN1, RAN2]

### 4.2 Objective of Performance part WI

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

### 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 |
| Internal TR  | 38.859 | Study on expanded and improved NR positioning | RAN#97 | RAN#98 | Alexey Khoryaev, Intel, alexey.khoryaev@intel.com |

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 |
|  |  |  |  |

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)

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Florent Munier, Ericsson, florent.munier@ericsson.com

## 7 Work item leadership

Primary: RAN1

Secondary: RAN2, RAN3, RAN4

## 8 Aspects that involve other WGs

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

Study of positioning architecture and signalling procedures to enable sidelink positioning covering both UE based and network based positioning may require coordination and alignment with SA2.

## 9 Supporting Individual Members

|  |
| --- |
| Supporting IM name |
| Intel Corporation |
| CATT |
| Ericsson |
| DanKook University |
| Locaila |
| Fraunhofer IIS |
| Fraunhofer HHI |
| vivo |
| H3C |
| Sony |
| AT&T |
| Lenovo |
| Motorola Mobility |
| FirstNet |
| Philips |
| FUTUREWEI |
| CAICT |
| Huawei  |
| HiSilicon |
| ZTE |
| DENSO CORPORATION |
| Xiaomi |
| NTT DOCOMO |
| MediaTek Inc |
| Nokia |
| Nokia Shanghai Bell |
| InterDigital |
| Sharp Corp. |
| Robert Bosch GmbH |
| HONOR |
| Telia Company |
| Deutsche Telekom |
| Samsung |
| CMCC |
| LG Electronics |
| Fujitsu |
| OPPO |
| China Unicom |
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