

ETSI TS 138 305 V15.5.0 (2020-01)



5G;
NG Radio Access Network (NG-RAN);
Stage 2 functional specification of User Equipment (UE)
positioning in NG-RAN
(3GPP TS 38.305 version 15.5.0 Release 15)



Reference

RTS/TSGR-0238305vf50

Keywords

5G

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommitteeSupportStaff.aspx>

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2020.

All rights reserved.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members.

3GPP™ and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

oneM2M™ logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners.

GSM® and the GSM logo are trademarks registered and owned by the GSM Association.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Legal Notice

This Technical Specification (TS) has been produced by ETSI 3rd Generation Partnership Project (3GPP).

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found under <http://webapp.etsi.org/key/queryform.asp>.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Intellectual Property Rights	2
Legal Notice	2
Modal verbs terminology.....	2
Foreword.....	8
1 Scope	9
2 References	9
3 Definitions, symbols and abbreviations	10
3.1 Definitions	10
3.2 Abbreviations	11
4 Main concepts and requirements	12
4.1 Assumptions and Generalities	12
4.2 Role of UE Positioning Methods.....	13
4.3 Standard UE Positioning Methods	13
4.3.1 Introduction.....	13
4.3.2 Network-assisted GNSS methods	14
4.3.3 OTDOA positioning	14
4.3.4 Enhanced Cell ID methods	14
4.3.5 Barometric pressure sensor positioning	15
4.3.6 WLAN positioning	15
4.3.7 Bluetooth positioning.....	15
4.3.8 TBS positioning	15
4.3.9 Motion sensor positioning	15
5 NG-RAN UE Positioning Architecture	16
5.1 Architecture	16
5.2 UE Positioning Operations	17
5.3 NG-RAN Positioning Operations.....	18
5.3.1 General NG-RAN Positioning Operations.....	18
5.3.2 OTDOA Positioning Support.....	18
5.4 Functional Description of Elements Related to UE Positioning in NG-RAN	18
5.4.1 User Equipment (UE)	18
5.4.2 gNB.....	18
5.4.3 ng-eNB.....	18
5.4.4 Location Management Function (LMF)	19
6 Signalling protocols and interfaces	19
6.1 Network interfaces supporting positioning operations	19
6.1.1 General LCS control plane architecture.....	19
6.1.2 NR-Uu interface.....	19
6.1.3 LTE-Uu interface.....	19
6.1.4 NG-C interface.....	19
6.1.5 N1 interface	20
6.2 UE-terminated protocols	20
6.2.1 LTE Positioning Protocol (LPP).....	20
6.2.2 Radio Resource Control (RRC) for NR	20
6.2.3 Radio Resource Control (RRC) for LTE	20
6.3 NG-RAN Node terminated protocols.....	20
6.3.1 NR Positioning Protocol A (NRPPa).....	20
6.3.2 NG Application Protocol (NGAP).....	21
6.4 Signalling between an LMF and UE	21
6.4.1 Protocol Layering	21
6.4.2 LPP PDU Transfer	21
6.5 Signalling between an LMF and NG-RAN node	23
6.5.1 Protocol Layering	23

6.5.2	NRPPa PDU Transfer for UE Positioning	23
6.5.3	NRPPa PDU Transfer for Positioning Support.....	24
6.6	Void.....	25
7	General NG-RAN UE Positioning procedures.....	25
7.1	General LPP procedures for UE Positioning.....	25
7.1.1	LPP procedures.....	25
7.1.2	Positioning procedures.....	26
7.1.2.1	Capability transfer.....	26
7.1.2.2	Assistance data transfer.....	26
7.1.2.3	Location information transfer.....	26
7.1.2.4	Multiple transactions.....	26
7.1.2.5	Sequence of procedures.....	26
7.1.2.6	Error handling.....	26
7.1.2.7	Abort.....	26
7.2	General NRPPa Procedures for UE Positioning.....	27
7.2.1	NRPPa procedures.....	27
7.2.2	NRPPa transaction types.....	27
7.2.2.1	Location information transfer.....	27
7.3	Service Layer Support using combined LPP and NRPPa Procedures.....	28
7.3.1	General.....	28
7.3.2	NI-LR and MT-LR Service Support.....	28
7.4	General RRC procedures for UE Positioning.....	29
7.4.1	NR RRC Procedures.....	29
7.4.1.1	Location Measurement Indication.....	29
7.4.2	LTE RRC Procedures.....	29
7.4.2.1	Inter-frequency RSTD measurement indication.....	30
8	Positioning methods and Supporting Procedures.....	30
8.1	GNSS positioning methods.....	30
8.1.1	General.....	30
8.1.2	Information to be transferred between NG-RAN/5GC Elements.....	31
8.1.2.1	Information that may be transferred from the LMF to UE.....	31
8.1.2.1.1	Reference Time.....	32
8.1.2.1.2	Reference Location.....	32
8.1.2.1.3	Ionospheric Models.....	32
8.1.2.1.4	Earth Orientation Parameters.....	32
8.1.2.1.5	GNSS-GNSS Time Offsets.....	32
8.1.2.1.6	Differential GNSS Corrections.....	33
8.1.2.1.7	Ephemeris and Clock Models.....	33
8.1.2.1.8	Real-Time Integrity.....	33
8.1.2.1.9	Data Bit Assistance.....	33
8.1.2.1.10	Acquisition Assistance.....	33
8.1.2.1.11	Almanac.....	33
8.1.2.1.12	UTC Models.....	33
8.1.2.1.13	RTK Reference Station Information.....	33
8.1.2.1.14	RTK Auxiliary Station Data.....	33
8.1.2.1.15	RTK Observations.....	34
8.1.2.1.16	RTK Common Observation Information.....	34
8.1.2.1.17	GLONASS RTK Bias Information.....	34
8.1.2.1.18	RTK MAC Correction Differences.....	34
8.1.2.1.19	RTK Residuals.....	34
8.1.2.1.20	RTK FKP Gradients.....	34
8.1.2.1.21	SSR Orbit Corrections.....	35
8.1.2.1.22	SSR Clock Corrections.....	35
8.1.2.1.23	SSR Code Bias.....	35
8.1.2.1a	Recommendations for grouping of assistance data to support different RTK service levels.....	35
8.1.2.2	Information that may be transferred from the UE to LMF.....	37
8.1.2.2.1	GNSS Measurement Information.....	37
8.1.2.2.1.1	UE-based mode.....	37
8.1.2.2.1.2	UE-assisted mode.....	38
8.1.2.2.2	Additional Non-GNSS Related Information.....	38

8.1.3	Assisted-GNSS Positioning Procedures.....	38
8.1.3.1	Capability Transfer Procedure	38
8.1.3.2	Assistance Data Transfer Procedure.....	38
8.1.3.2.1	LMF initiated Assistance Data Delivery	38
8.1.3.2.1a	LMF initiated Periodic Assistance Data Delivery	39
8.1.3.2.2	UE initiated Assistance Data Transfer.....	39
8.1.3.2.2a	UE initiated Periodic Assistance Data Transfer	40
8.1.3.3	Location Information Transfer Procedure	41
8.1.3.3.1	LMF initiated Location Information Transfer Procedure	41
8.1.3.3.2	UE-initiated Location Information Delivery Procedure	42
8.2	OTDOA positioning	42
8.2.1	General.....	42
8.2.2	Information to be transferred between NG-RAN/5GC Elements	43
8.2.2.1	Information that may be transferred from the LMF to UE.....	43
8.2.2.2	Information that may be transferred from the ng-eNB to LMF.....	43
8.2.2.3	Information that may be transferred from the UE to LMF.....	43
8.2.3	OTDOA Positioning Procedures.....	44
8.2.3.1	Capability Transfer Procedure	44
8.2.3.2	Assistance Data Transfer Procedure.....	44
8.2.3.2.1	Assistance Data Transfer between LMF and UE.....	44
8.2.3.2.1.1	LMF initiated Assistance Data Delivery.....	44
8.2.3.2.1.2	UE initiated Assistance Data Transfer	44
8.2.3.2.2	Assistance Data Delivery between LMF and ng-eNB	45
8.2.3.2.2.1	LMF-initiated assistance data delivery to the LMF	45
8.2.3.3	Location Information Transfer Procedure	46
8.2.3.3.1	LMF-initiated Location Information Transfer Procedure.....	46
8.2.3.3.2	UE-initiated Location Information Delivery procedure	46
8.3	Enhanced cell ID positioning methods.....	47
8.3.1	General.....	47
8.3.2	Information to be transferred between NG-RAN/5GC Elements	47
8.3.2.1	Information that may be transferred from the LMF to UE.....	47
8.3.2.2	Information that may be transferred from the ng-eNB to LMF.....	47
8.3.2.3	Information that may be transferred from the gNB to LMF.....	48
8.3.2.4	Information that may be transferred from the UE to LMF.....	48
8.3.3	Downlink E-CID Positioning Procedures.....	48
8.3.3.1	Capability Transfer Procedure	49
8.3.3.2	Assistance Data Transfer Procedure.....	49
8.3.3.3	Location Information Transfer Procedure	49
8.3.3.3.1	LMF-initiated Location Information Transfer.....	49
8.3.3.3.2	UE-initiated Location Information Delivery procedure	49
8.3.4	Uplink E-CID Positioning Procedures.....	50
8.3.4.1	Capability Transfer Procedure	50
8.3.4.2	Assistance Data Transfer Procedure.....	50
8.3.4.3	Position Measurement Procedure	50
8.3.4.3.1	LMF-initiated Position Measurement.....	50
8.4	Barometric pressure sensor positioning.....	51
8.4.2	Information to be transferred between NG-RAN/5GC Elements	52
8.4.2.1	Information that may be transferred from the LMF to UE.....	52
8.4.2.1.1	Barometric pressure sensor assistance data	52
8.4.2.2	Information that may be transferred from the UE to LMF.....	52
8.4.2.2.1	Standalone mode	52
8.4.2.2.2	UE-assisted mode	52
8.4.2.2.3	UE-based mode	52
8.4.3	Barometric Pressure Sensor Positioning Procedures	53
8.4.3.1	Capability Transfer Procedure	53
8.4.3.2	Assistance Data Transfer Procedure.....	53
8.4.3.2.1	LMF initiated Assistance Data Delivery	53
8.4.3.2.2	UE initiated Assistance Data Transfer.....	53
8.4.3.3	Location Information Transfer Procedure	54
8.4.3.3.1	LMF initiated Location Information Transfer Procedure	54
8.4.3.3.2	UE-initiated Location Information Delivery Procedure	54
8.5	WLAN positioning	55

8.5.1	General.....	55
8.5.2	Information to be transferred between NG-RAN/5GC Elements	55
8.5.2.1	Information that may be transferred from the LMF to UE.....	55
8.5.2.1.1	WLAN AP BSSID.....	55
8.5.2.1.2	WLAN AP SSID	56
8.5.2.1.3	WLAN AP Type Data	56
8.5.2.1.4	WLAN AP Location.....	56
8.5.2.2	Information that may be transferred from the UE to LMF.....	56
8.5.2.2.1	Standalone mode	56
8.5.2.2.2	UE-assisted mode	56
8.5.2.2.3	UE-based mode	56
8.5.3	WLAN Positioning Procedures.....	57
8.5.3.1	Capability Transfer Procedure	57
8.5.3.2	Assistance Data Transfer Procedure.....	57
8.5.3.2.1	LMF initiated Assistance Data Delivery	57
8.5.3.2.2	UE initiated Assistance Data Transfer.....	57
8.5.3.3	Location Information Transfer Procedure	58
8.5.3.3.1	LMF initiated Location Information Transfer Procedure	58
8.5.3.3.2	UE-initiated Location Information Delivery Procedure	58
8.6	Bluetooth positioning	59
8.6.2	Information to be transferred between NG-RAN/5GC Elements	59
8.6.2.1	Information that may be transferred from the LMF to UE.....	59
8.6.2.2	Information that may be transferred from the UE to LMF.....	59
8.6.2.2.1	Standalone mode	59
8.6.2.2.2	UE-assisted mode	60
8.6.3	Bluetooth Positioning Procedures.....	60
8.6.3.1	Capability Transfer Procedure	60
8.6.3.2	Assistance Data Transfer Procedure.....	60
8.6.3.3	Location Information Transfer Procedure.....	60
8.6.3.3.1	LMF initiated Location Information Transfer Procedure	60
8.6.3.3.2	UE-initiated Location Information Delivery Procedure	60
8.7	TBS positioning.....	61
8.7.1	General.....	61
8.7.2	Information to be transferred between NG-RAN/5GC Elements	61
8.7.2.1	Information that may be transferred from the LMF to UE.....	61
8.7.2.1.1	Acquisition Assistance	62
8.7.2.1.2	Almanac.....	62
8.7.2.2	Information that may be transferred from the UE to LMF.....	62
8.7.2.2.1	Standalone mode	62
8.7.2.2.2	UE-assisted mode	62
8.7.2.2.3	UE-based mode	62
8.7.3	TBS Positioning Procedures	62
8.7.3.1	Capability Transfer Procedure	62
8.7.3.2	Assistance Data Transfer Procedure.....	62
8.7.3.2.1	LMF initiated Assistance Data Delivery	63
8.7.3.2.2	UE initiated Assistance Data Transfer.....	63
8.7.3.3	Location Information Transfer Procedure.....	63
8.7.3.3.1	LMF initiated Location Information Transfer Procedure	64
8.7.3.3.2	UE-initiated Location Information Delivery Procedure	64
8.8	Motion sensor positioning method	64
8.8.1	General.....	64
8.8.2	Information to be transferred between NG-RAN/5GC Elements	65
8.8.2.1	General	65
8.8.2.2	Information that may be transferred from the UE to LMF.....	65
8.8.2.2.1	UE-assisted, UE-based, Standalone mode.....	65
8.8.2.2.2	UE Displacement and Movement Information.....	65
8.8.2.3	Information that may be transferred from the LMF to the UE.....	65
8.8.3	Motion Sensors Location Information Transfer Procedure.....	65
8.8.3.1	General	65
8.8.3.2	LMF initiated Location Information Transfer Procedure.....	65
8.8.3.3	UE-initiated Location Information Delivery Procedure.....	66

Annex A (informative):	Use of LPP with SUPL.....	67
A.1	SUPL 2.0 Positioning Methods and Positioning Protocols.....	67
A.2	SUPL 2.0 and NR Architecture.....	68
A.3	LPP session procedures using SUPL.....	69
A.4	Procedures combining C-plane and U-plane operations	70
Annex B (informative):	Change history	72
History		73

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Full standard:
<https://standards.iteh.ai/catalog/standards/sist/c00bcad2-237b-4e4c-8300-a3de23f1f448/etsi-ts-138-305-v15.5.0-2020-01>

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
 - 1 presented to TSG for information;
 - 2 presented to TSG for approval;
 - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

PREVIEW
STANDARD
ETSI
(standards.iteh.ai)
Full standard:
<https://standards.iteh.ai/catalog/standards/sist/c00bcad2-237b-4e4c-8300-a3de23f1f448/etsi-ts-138-305-v15.5.0-2020-01>

1 Scope

The present document specifies the stage 2 of the UE Positioning function of NG-RAN which provides the mechanisms to support or assist the calculation of the geographical position of a UE. UE position knowledge can be used, for example, in support of Radio Resource Management functions, as well as location-based services for operators, subscribers, and third-party service providers. The purpose of this stage 2 specification is to define the NG-RAN UE Positioning architecture, functional entities and operations to support positioning methods. This description is confined to the NG-RAN Access Stratum. It does not define or describe how the results of the UE position calculation can be utilised in the Core Network (e.g., LCS) or in NG-RAN (e.g., RRM).

UE Positioning may be considered as a network-provided enabling technology consisting of standardised service capabilities that enable the provision of location applications. The application(s) may be service provider specific. The description of the numerous and varied possible location applications which are enabled by this technology is outside the scope of the present document. However, clarifying examples of how the functionality being described may be used to provide specific location services may be included.

This stage 2 specification covers the NG-RAN positioning methods, state descriptions, and message flows to support UE Positioning.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 23.501 "System Architecture for the 5G System; Stage 2".
- [3] 3GPP TS 22.071: "Location Services (LCS); Service description, Stage 1".
- [4] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".
- [5] IS-GPS-200, Revision D, Navstar GPS Space Segment/Navigation User Interfaces, March 7th, 2006.
- [6] IS-GPS-705, Navstar GPS Space Segment/User Segment L5 Interfaces, September 22, 2005.
- [7] IS-GPS-800, Navstar GPS Space Segment/User Segment L1C Interfaces, September 4, 2008.
- [8] Galileo OS Signal in Space ICD (OS SIS ICD), Draft 0, Galileo Joint Undertaking, May 23rd, 2006.
- [9] Global Navigation Satellite System GLONASS Interface Control Document, Version 5, 2002.
- [10] IS-QZSS, Quasi Zenith Satellite System Navigation Service Interface Specifications for QZSS, Ver.1.0, June 17, 2008.
- [11] Specification for the Wide Area Augmentation System (WAAS), US Department of Transportation, Federal Aviation Administration, DTFA01-96-C-00025, 2001.
- [12] RTCM 10402.3, RTCM Recommended Standards for Differential GNSS Service (v.2.3), August 20, 2001.

- [13] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".
- [14] 3GPP TS 38.331: "NR Radio Resource Control (RRC) protocol specification".
- [15] OMA-AD-SUPL-V2_0: "Secure User Plane Location Architecture Approved Version 2.0".
- [16] OMA-TS-ULP-V2_0_4: "UserPlane Location Protocol Approved Version 2.0.4".
- [17] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer – Measurements".
- [18] 3GPP TS 36.302: "Evolved Universal Terrestrial Radio Access (E-UTRA); Services provided by the physical layer".
- [19] 3GPP TS 36.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)"
- [20] BDS-SIS-ICD-2.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal (Version 2.0)", December 2013.
- [21] IEEE 802.11: "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications"
- [22] Bluetooth Special Interest Group: "Bluetooth Core Specification v4.2", December 2014.
- [23] ATIS-0500027: "Recommendations for Establishing Wide Scale Indoor Location Performance", May 2015.
- [24] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation".
- [25] 3GPP TS 36.305: "Stage 2 functional specification of User Equipment (UE) positioning in E-UTRA".
- [26] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".
- [27] 3GPP TS 38.455: "NG-RAN; NR Positioning Protocol A (NRPPa)".
- [28] 3GPP TS 29.518: "5G System; Access and Mobility Management Services; Stage 3".
- [29] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".
- [30] 3GPP TS 38.413: "NG-RAN; NG Application Protocol (NGAP)".
- [31] RTCM 10403.3, "RTCM Recommended Standards for Differential GNSS Services (v.3.3)", October 7, 2016.
- [32] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".
- [33] 3GPP TS 29.572: "Location Management Services; Stage 3".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

As used in this document, the suffixes "-based" and "-assisted" refer respectively to the node that is responsible for making the positioning calculation (and which may also provide measurements) and a node that provides measurements (but which does not make the positioning calculation). Thus, an operation in which measurements are provided by the

UE to the LMF to be used in the computation of a position estimate is described as "UE-assisted" (and could also be called "LMF-based"), while one in which the UE computes its own position is described as "UE-based".

Transmission Point (TP): A set of geographically co-located transmit antennas for one cell, part of one cell or one PRS-only TP. Transmission Points can include base station (ng-eNB or gNB) antennas, remote radio heads, a remote antenna of a base station, an antenna of a PRS-only TP, etc. One cell can be formed by one or multiple transmission points. For a homogeneous deployment, each transmission point may correspond to one cell.

PRS-only TP: A TP which only transmits PRS signals for PRS-based TBS positioning for E-UTRA and is not associated with a cell.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

5GC	5G Core Network
5GS	5G System
ADR	Accumulated Delta Range
AoA	Angle of Arrival
AP	Access Point
ARP	Antenna Reference Point
BDS	BeiDou Navigation Satellite System
BSSID	Basic Service Set Identifier
CID	Cell-ID (positioning method)
E-SMLC	Enhanced Serving Mobile Location Centre
E-CID	Enhanced Cell-ID (positioning method)
ECEF	Earth-Centered, Earth-Fixed
ECI	Earth-Centered-Inertial
EGNOS	European Geostationary Navigation Overlay Service
E-UTRAN	Evolved Universal Terrestrial Radio Access Network
FDMA	Frequency Division Multiple Access
FKP	Flächenkorrekturparameter (Engl.: Area Correction Parameters)
GAGAN	GPS Aided Geo Augmented Navigation
GLONASS	GLObal'naya NAVigatsionnaya Sputnikovaya Sistema (Engl.: Global Navigation Satellite System)
GMLC	Gateway Mobile Location Center
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRS80	Geodetic Reference System 1980
HESSID	Homogeneous Extended Service Set Identifier
LCS	LoCation Services
LMF	Location Management Function
LPP	LTE Positioning Protocol
MAC	Master Auxiliary Concept
MBS	Metropolitan Beacon System
MO-LR	Mobile Originated Location Request
MT-LR	Mobile Terminated Location Request
NG-C	NG Control plane
NG-AP	NG Application Protocol
NI-LR	Network Induced Location Request
N-RTK	Network – Real-Time Kinematic
NRPPa	NR Positioning Protocol A
OTDOA	Observed Time Difference Of Arrival
PDU	Protocol Data Unit
PPP	Precise Point Positioning
PRS	Positioning Reference Signal (for E-UTRA)
QZSS	Quasi-Zenith Satellite System
RRM	Radio Resource Management
RSSI	Received Signal Strength Indicator
RTK	Real-Time Kinematic

SBAS	Space Based Augmentation System
SET	SUPL Enabled Terminal
SLP	SUPL Location Platform
SSID	Service Set Identifier
SSR	State Space Representation
SUPL	Secure User Plane Location
T _{ADV}	Timing Advance
TBS	Terrestrial Beacon System
TP	Transmission Point
UE	User Equipment
WAAS	Wide Area Augmentation System
WGS-84	World Geodetic System 1984
WLAN	Wireless Local Area Network

4 Main concepts and requirements

4.1 Assumptions and Generalities

The stage 1 description of LCS at the service level is provided in TS 22.071 [3]; the stage 2 LCS functional description, including the LCS system architecture and message flows, is provided in TS 23.501 [2] and TS 23.502 [26].

Positioning functionality provides a means to determine the geographic position and/or velocity of the UE based on measuring radio signals. The position information may be requested by and reported to a client (e.g., an application) associated with the UE, or by a client within or attached to the core network. The position information shall be reported in standard formats, such as those for cell-based or geographical co-ordinates, together with the estimated errors (uncertainty) of the position and velocity of the UE and, if available, the positioning method (or the list of the methods) used to obtain the position estimate.

Restrictions on the geographic shape encoded within the 'position information' parameter may exist for certain LCS client types. The 5GS, including NG-RAN, shall comply with any shape restrictions defined in 5GS and, in a particular country, with any shape restrictions defined for a specific LCS client type in relevant national standards. For example, in the US, national standard J-STD-036-C-2 restricts the geographic shape for an emergency services LCS client to minimally either an "ellipsoid point" or an "ellipsoid point with uncertainty circle" as defined in TS 23.032 [4].

It shall be possible for the majority of the UEs within a network to use the LCS feature without compromising the radio transmission or signalling capabilities of the NG-RAN.

The uncertainty of the position measurement shall be network-implementation-dependent, at the choice of the network operator. The uncertainty may vary between networks as well as from one area within a network to another. The uncertainty may be hundreds of metres in some areas and only a few metres in others. In the event that a particular position measurement is provided through a UE-assisted process, the uncertainty may also depend on the capabilities of the UE. In some jurisdictions, there is a regulatory requirement for location service accuracy that is part of an emergency service. Further details of the accuracy requirements can be found in TS 22.071 [3].

The uncertainty of the position information is dependent on the method used, the position of the UE within the coverage area and the activity of the UE. Several design options of the NG-RAN system (e.g., size of cell, adaptive antenna technique, pathloss estimation, timing accuracy, ng-eNB and gNB surveys) shall allow the network operator to choose a suitable and cost-effective UE positioning method for their market.

There are many different possible uses for the positioning information. The positioning functions may be used internally by the 5GS, by value-added network services, by the UE itself or through the network, and by "third party" services. The feature may also be used by an emergency service (which may be mandated or "value-added"), but the location service is not exclusively for emergencies.

Design of the NG-RAN positioning capability as documented in this specification includes position methods, protocols and procedures that are either adapted from capabilities already supported for E-UTRAN, UTRAN and GERAN, or created separately from first principles. In contrast to GERAN and UTRAN but similarly to E-UTRAN, the NG-RAN positioning capabilities are intended to be forward compatible to other access types and other position methods, in an effort to reduce the amount of additional positioning support needed in the future. This goal also extends to user plane