

ETSI TS 123 273 V19.6.0 (2026-03)



TECHNICAL SPECIFICATION

**5G;
5G System (5GS) Location Services (LCS);
Stage 2
(3GPP TS 23.273 version 19.6.0 Release 19)**

get full document from standards.iteh.ai



Reference

RTS/TSGS-0223273vj60

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 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from the
[ETSI Search & Browse Standards](#) application.

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 on [ETSI deliver](#) repository.

Users should be aware that the present document may be revised or have its status changed, this information is available in the [Milestones listing](#).

If you find errors in the present document, please send your comments to the relevant service listed under [Committee Support Staff](#).

If you find a security vulnerability in the present document, please report it through our [Coordinated Vulnerability Disclosure \(CVD\)](#) program.

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

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 2026.
All rights reserved.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are 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 IPR online database](#).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, 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.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™**, **LTE™** and **5G™** logo 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.

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 at [3GPP to ETSI numbering cross-referencing](#).

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	10
2 References	10
3 Definitions and Abbreviations.....	12
3.1 Definitions	12
3.2 Abbreviations	13
4 Architecture Model and Concepts.....	14
4.1 General Concepts	14
4.1a Types of Location Request.....	15
4.1a.1 Network Induced Location Request (NI-LR)	15
4.1a.2 Mobile Terminated Location Request (MT-LR).....	15
4.1a.3 Mobile Originated Location Request (MO-LR)	15
4.1a.4 Immediate Location Request	15
4.1a.5 Deferred Location Request	15
4.1a.5.1 Types of event.....	15
4.1b LCS Quality of Service	16
4.1c Scheduled Location Time.....	17
4.2 Architectural Reference Model	17
4.2.1 Non-roaming reference architecture	17
4.2.2 Roaming reference architecture	19
4.2.3 Reference architecture with sidelink positioning.....	20
4.2a Interconnection between 5GC and EPC	20
4.2a.1 General.....	20
4.2a.2 Non-roaming architecture	20
4.2a.3 Roaming architecture.....	21
4.2b Positioning methods	23
4.3 Functional description of LCS per network function	23
4.3.1 Access Network	23
4.3.2 LCS Clients, Application Functions and Network Functions	24
4.3.3 Gateway Mobile Location Centre, GMLC	24
4.3.4 Location Retrieval Function, LRF	25
4.3.5 UE.....	25
4.3.6 UDM.....	26
4.3.7 Access and Mobility Management Function, AMF.....	26
4.3.8 Location Management Function, LMF	27
4.3.9 Network Exposure Function, NEF.....	30
4.3.10 Unified Data Repository, UDR.....	30
4.3.11 Positioning Reference Unit, PRU	30
4.3.12 Network Repository Function, NRF	31
4.3.13 Network Data Analytics Function, NWDAF.....	31
4.4 Reference Point to Support Location Services	31
4.4.1 Le Reference Point.....	31
4.4.2 NL3 Reference Point	31
4.4.3 N1 Reference Point.....	32
4.4.4 N2 Reference Point.....	32
4.4.5 Void	32
4.4.6 NL5 Reference Point	32
4.4.7 NL2 Reference Point	32
4.4.8 NL6 Reference Point	32
4.4.9 N51 Reference Point.....	32
4.4.10 NL1 Reference Point	32

4.4.11	N52 Reference Point	32
4.4.12	NL7 Reference Point	33
4.4.13	NL8 Reference Point	33
4.4.14	NL9 Reference Point	33
4.4.15	NL10 Reference Point	33
4.4.16	NL11 Reference Point	33
4.5	Service Based Interfaces to Support Location Services	33
5	High Level Features	33
5.1	LMF Discovery and Selection	33
5.1a	GMLC Discovery and Selection	35
5.2	3GPP access specific aspects.....	35
5.3	Non-3GPP Access Specific Aspects	35
5.3.1	Location Information for Non-3GPP Access	35
5.3.2	Access Type Selection for LCS Service	36
5.4	UE LCS privacy	37
5.4.1	General.....	37
5.4.2	Content of UE LCS Privacy Profile.....	37
5.4.2.1	General	37
5.4.2.2	Privacy Classes	38
5.4.2.2.1	Universal Class.....	38
5.4.2.2.2	Call/Session related Class.....	38
5.4.2.2.3	Call/Session unrelated Class.....	38
5.4.2.2.4	PLMN Operator Class	38
5.4.2.3	Location Privacy Indication (LPI).....	39
5.4.3	Provision of UE LCS privacy profile.....	39
5.4.4	Privacy Override Indicator (POI).....	39
5.4.5	LCS service authorization for an Immediate UE Location	39
5.4.6	LCS service authorization for a Deferred UE Location.....	40
5.5	Location service exposure	41
5.6	LCS Charging.....	43
5.7	Support of Concurrent Location Requests.....	43
5.7.1	General.....	43
5.7.2	Combining location requests by an H-GMLC or NEF	44
5.7.3	Combining location requests by a V-GMLC	44
5.7.4	Combining location requests by an AMF	44
5.7.5	Combining location requests by an LMF.....	44
5.7.6	Combining location requests by a UE.....	44
5.8	Interworking with the IMS	45
5.9	Location Service involving Mobile Base Station Relay	45
5.9.1	General.....	45
5.9.2	Obtaining location information for the MBSR	45
5.9.3	Privacy check for MBSR	45
5.10	Support of Positioning over user plane connection between UE and LMF for non-regulatory service	46
5.11	Collection of GNSS assistance data	46
5.12	UE Unaware Positioning	47
5.13	Support of location service in PNI-NPN with signalling optimisation.....	47
5.14	Event Report Allowed Area	48
5.15	Support of Low Power and High Accuracy Positioning.....	48
5.16	Location services assisted by NWDAF.....	48
5.16A	Network data analytics assisted by LCS.....	49
5.16B	LCS Continuity During UE Mobility	49
5.16B.1	Mobility Between 5GS and EPS.....	49
5.17	Support of Ranging and Sidelink Positioning	49
5.18	Support for UE positioning based on a ML Model at the LMF.....	49
5.18.0	General.....	49
5.18.1	Void	51
5.18.2	AI/ML model performance monitoring for LMF-based AI/ML Positioning.....	51
5.19	Location Service involving Mobile Wireless Access Backhaul.....	51
5.19.1	General.....	51
5.19.2	Obtaining location information for the MWAB.....	52
5.19.3	Privacy check for MWAB	52

6	Location Service Procedures	52
6.1	5GC-MT-LR Procedure	52
6.1.1	5GC-MT-LR procedure for the regulatory location service	52
6.1.2	5GC-MT-LR Procedure for the commercial location service.....	54
6.1.3	5GC-MT-LR multiple location procedure for the regulatory location service	59
6.1.4	5GC-MT-LR procedure involving Mobile Base Station Relay	61
6.1.5	5GC-MT-LR procedure involving MWAB	63
6.2	5GC-MO-LR Procedure	66
6.3	Deferred 5GC-MT-LR Procedure for Periodic, Triggered and UE Available Location Events.....	69
6.3.1	Initiation and Reporting of Location Events.....	69
6.3.2	Cancellation of Reporting of Location Events by a UE.....	76
6.3.3	Cancellation of Reporting of Location Events by an AF, an NF or External LCS Client or GMLC.....	77
6.3.4	Cancellation of Reporting of data collection by a UE	78
6.3.5	Deferred 5GC-MT-LR Procedure for Periodic Location Events based on NRPPa Periodic Measurement.....	79
6.3.5.1	Initiation and Reporting of Periodic Events based on NRPPa Periodic Measurement.....	79
6.3.5.2	Cancellation of Reporting of Periodic Events by an AF, an NF or External LCS Client or GMLC	80
6.4	LMF Change Procedure	80
6.4.0	General.....	80
6.4.1	LMF Change Procedure for NRPPa Periodic Measurement.....	82
6.5	Unified Location Service Exposure Procedure.....	83
6.5.1	Unified Location Service Exposure Procedure without routing by a UDM	83
6.5.2	Unified Location Service Exposure Procedure with routing via a UDM.....	86
6.6	NG-RAN Location Service Exposure Procedure	87
6.7	Low Power Periodic and Triggered 5GC-MT-LR Procedures	87
6.7.1	Event Reporting with no change of LMF	88
6.7.2	Event Reporting with change of LMF	90
6.7.3	Event Reporting in RRC INACTIVE state for DL Positioning, RAT Independent Positioning or No Positioning	90
6.7.4	Event Reporting in RRC INACTIVE state for UL Positioning	92
6.7.5	Event Reporting in RRC INACTIVE state for UL+DL Positioning	95
6.8	Bulk Operation of LCS Service Request Targeting to Multiple UEs	98
6.9	Procedures to Support Non-3GPP Access.....	100
6.9.1	Common Positioning Procedures when a UE is served by only one PLMN	100
6.9.2	MT-LR Procedures when a UE is served by Different PLMNs for 3GPP Access and Non-3GPP Access.....	102
6.9.3	MO-LR Procedures when UE is served by the Different PLMNs via 3GPP Access and Non-3GPP Access.....	105
6.9.4	NI-LR Procedures when a UE is served by Different PLMNs for 3GPP access and non-3GPP access...	105
6.10	Procedures dedicated to Support Regulatory services	105
6.10.1	5GC-NI-LR Procedure.....	105
6.10.2	5GC-MT-LR Procedure without UDM Query.....	107
6.10.3	Location continuity for Handover of an Emergency session from NG-RAN	108
6.10.4	5GC-MT-LR multiple location procedure without UDM Query.....	110
6.10.5	Multiple location procedure for multiple emergency LCS clients	111
6.11	Common Sub-Procedures.....	111
6.11.0	General.....	111
6.11.1	UE Assisted and UE Based Positioning Procedure.....	111
6.11.2	Network Assisted Positioning Procedure.....	113
6.11.3	Obtaining Non-UE Associated Network Assistance Data	114
6.11.4	Positioning Procedure over User Plane.....	114
6.12	UE Location Privacy Setting Procedure.....	115
6.12.1	UE Location Privacy Setting Procedure Initiated by UE.....	115
6.12.2	UE Location Privacy Setting Procedure Initiated by AF	116
6.13	Procedures with interaction between 5GC and EPC	116
6.13.1	MT-LR Procedure.....	116
6.13.2	MO-LR Transfer to a Third Party Procedure	118
6.14	Procedures for Broadcast of Assistance Data	119
6.14.1	Broadcast of Assistance Data by an LMF.....	119
6.14.2	Delivery of Cipherring Keys to UEs for Broadcast Assistance Data	121
6.15	Procedures for GNSS assistance data Collection	122
6.15.1	GNSS assistance data collection from untrusted AF via NEF	122

6.15.2	GNSS assistance data collection from trusted AF	123
6.16	Periodic and Triggered 5GC-MT-LR Procedure with User Plane.....	124
6.16.1	Reporting of Location Events to an LCS Client or AF via user plane	124
6.16.2	Cancellation of Reporting of Location Events with a User Plane Connection	126
6.17	Procedures applicable to a PRU	127
6.17.1	PRU Association Procedure.....	127
6.17.2	LMF Initiated PRU Disassociation Procedure.....	129
6.17.3	PRU Initiated PRU Disassociation Procedure	130
6.17.4	Positioning of a target UE.....	131
6.18	Procedures of User Plane Connection between UE and LMF	133
6.18.0	General.....	133
6.18.1	LMF initiated User Plane Connection	134
6.18.2	UE initiated User Plane Connection	135
6.18.3	Modification of User Plane Connection between UE and LMF	137
6.19	Location Service Continuity between EPS and 5GS	139
6.19.0	General.....	139
6.19.1	Location Service Continuity for Immediate Location Request.....	139
6.19.1.1	Location Service Continuity from 5GS to EPS with N26 Interface for Immediate Location Request.....	139
6.19.1.2	Location Service Continuity from EPS to 5GS with N26 Interface for Immediate Location Request.....	141
6.19.1.3	Location Service Continuity from 5GS to EPS without N26 Interface for Immediate Location Request.....	142
6.19.1.4	Location Service Continuity from EPS to 5GS without N26 Interface for Immediate Location Request.....	143
6.19.2	Location Service Continuity between EPS and 5GS (bi-direction) for deferred MT-LR	143
6.19.2.1	Location Service Continuity from 5GS to EPS.....	144
6.19.2.2	Location Service Continuity from EPS to 5GS.....	145
6.20	Ranging/Sidelink Positioning procedures	146
6.20.1	Procedures of SL-MO-LR involving LMF	146
6.20.2	5GC-MO-LR Procedure using Ranging/SL positioning.....	150
6.20.3	Procedures of SL-MT-LR involving LMF.....	151
6.20.4	Procedures of SL-MT-LR for periodic, triggered Location Events	154
6.20.5	5GC-MT-LR Procedure using Ranging/SL positioning	157
6.21	Procedure for NWDAF assistance to location services	158
6.21.1	General.....	158
6.21.1	Location Accuracy Analytics Retrieval by LMF	159
6.21.2	UE Mobility Analytics Retrieval by AMF.....	159
6.22	Procedures of data collection for LMF-based AI/ML Positioning	159
6.22.1	General.....	159
6.22.2	Void	159
6.22.3	Data collection to train models for LMF-based AI/ML positioning based on NG RAN measurements ..	159
6.22.4	Input data collection by NWDAF for AI/ML positioning ML model training or ML model performance monitoring	161
6.22.5	LMF retrieval of a trained AI/ML Model for positioning.....	163
6.23	Procedures of data collection for NG RAN-sided models for AI/ML positioning	164
6.23.1	General.....	164
6.23.2	Data Collection for NG RAN-sided models for UEs under positioning	164
7	Information storage	165
7.1	UDM	165
7.2	GMLC	168
7.2.1	Information for an LCS Client.....	168
8	Network Function Services	170
8.1	AMF Services.....	170
8.2	UDM Services	170
8.3	LMF Services	170
8.3.1	General.....	170
8.3.2	Nlmf_Location service	170
8.3.2.1	General	170
8.3.2.2	Nlmf_Location_DetermineLocation service operation	171

8.3.2.3	Nlmf_Location_EventNotify service operation	171
8.3.2.4	Nlmf_Location_CancelLocation service operation.....	172
8.3.2.5	Nlmf_Location_LocationContextTransfer service operation.....	172
8.3.2.6	Nlmf_Location_MeasurementData service operation.....	172
8.3.2.7	Nlmf_Location_UPConfig service operation.....	173
8.3.2.8	Nlmf_Location_UPSubscribe service operation	173
8.3.2.9	Nlmf_Location_UPNotify service operation	173
8.3.2.10	Nlmf_Location_UPUnSubscribe service operation	173
8.3.3	Nlmf_Broadcast service.....	174
8.3.3.1	General	174
8.3.3.2	Nlmf_Broadcast_CipheringKeyData service operation	174
8.3.4	Nlmf_DataExposure service	174
8.3.4.1	General	174
8.3.4.2	Nlmf_DataExposure_Subscribe service operation.....	174
8.3.4.3	Nlmf_DataExposure_Notify service operation	175
8.3.4.4	Nlmf_DataExposure_UnSubscribe service operation.....	175
8.4	GMLC Services.....	175
8.4.1	General.....	175
8.4.2	Ngmlc_Location service	176
8.4.2.1	General	176
8.4.2.2	Ngmlc_Location_ProvideLocation service operation	176
8.4.2.3	Ngmlc_Location_LocationUpdate service operation.....	177
8.4.2.4	Ngmlc_Location_EventNotify service operation.....	177
8.4.2.5	Ngmlc_Location_CancelLocation service operation	177
8.4.2.6	Ngmlc_Location_LocationUpdateNotify service operation	178
8.4.2.7	Ngmlc_Location_PrivacyCheck_IDMapping service operation.....	178
8.4.2.8	Void.....	178
8.5	NEF Services.....	178
8.6	UDR Services.....	178
Annex A (informative): Differences with TS 23.271 [4].....		179
A.0	General	179
A.1	Differences in Parameters for a Location Request.....	179
A.2	Differences in Information Storage in the UDR/UDM versus HSS/GMLC for EPS.....	179
A.3	Differences in Information Storage in the GMLC	180
A.4	Differences with TS 23.271 [4] on Privacy.....	181
A.4.1	Differences in UE LCS Privacy	181
Annex B (informative): LCS privacy selection rule in serving NF		183
B.1	LCS privacy selection flow rule.....	183
Annex C (informative): PNI-NPN architecture to support location service with signalling optimisation		184
Annex D (informative): Change history		185
History		192

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.

In the present document, modal verbs have the following meanings:

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

can indicates that something is possible

cannot indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

will indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

will not indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

might indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

Sample Document

get full document from standards.iteh.ai

1 Scope

The present document specifies the stage 2 of the service-based architecture used for location services in the 5G system, and corresponding Network Functions (NFs), NF services and procedures, to meet the service requirements defined in TS 22.261 [3] and TS 22.071 [2].

Location Services specified in the present document include regulatory location services and commercial location services. The architecture and signalling procedures in NG-RAN are defined in TS 38.305 [9].

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 22.071: "Technical Specification Group Systems Aspects; Location Services (LCS)".
- [3] 3GPP TS 22.261: "Service requirements for the 5G system; Stage 1".
- [4] 3GPP TS 23.271: "Functional stage 2 description of Location Services (LCS)".
- [5] 3GPP TS 43.059: "Functional Stage 2 description of Location Services in GERAN".
- [6] Void.
- [7] 3GPP TS 36.305: "Stage 2 functional specification of User Equipment (UE) positioning in E-UTRAN".
- [8] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".
- [9] 3GPP TS 38.305: "Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".
- [10] 3GPP TS 23.167: "IP Multimedia Subsystem (IMS) emergency sessions".
- [11] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".
- [12] 3GPP TS 29.572: "5G System; Location Management Services; Stage 3".
- [13] OMA MLP TS: "Mobile Location Protocol", [<http://www.openmobilealliance.org>].
- [14] Void.
- [15] 3GPP TS 38.455: "NG-RAN; NR Positioning Protocol A (NRPPa)".
- [16] 3GPP TS 29.518: "5G System; Access and Mobility Management Services; Stage 3".
- [17] 3GPP TS 25.305: "Stage 2 functional specification of User Equipment (UE) positioning in UTRAN".
- [18] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".
- [19] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

- [20] 3GPP TS 37.355: "LTE Positioning Protocol (LPP)".
- [21] 3GPP TS 23.316: "Wireless and wireline convergence access support for the 5G System (5GS)".
- [22] Void.
- [23] ITU-T Recommendation E.164: "The international public telecommunication numbering plan".
- [24] 3GPP TS 23.222: "Common Application Programming Interface (API) framework for 3GPP northbound APIs".
- [25] RFC 2396: "Uniform Resource Identifiers".
- [26] RFC 3261: "SIP: Session Initiation Protocol".
- [27] 3GPP TS 23.228: "IP multimedia subsystem (IMS)".
- [28] 3GPP TS 23.003: "Numbering, addressing and identification".
- [29] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".
- [30] 3GPP TS 32.271: "Telecommunication management; Charging management; Location Services (LCS) charging".
- [31] 3GPP TS 32.298: "Telecommunication management; Charging management; Charging Data Record (CDR) parameter description".
- [32] Void.
- [33] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".
- [34] Void.
- [35] 3GPP TS 29.122: "T8 reference point for Northbound APIs".
- [36] 3GPP TS 24.571: "5G System (5GS); Control plane Location Services (LCS) procedures; Stage 3".
- [37] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".
- [38] 3GPP TS 38.413: "NG-RAN; NG Application Protocol (NGAP)".
- [39] 3GPP TS 22.104: "Service requirements for cyber-physical control applications in vertical domains".
- [40] 3GPP TS 23.586: "Architectural Enhancements to support Ranging based services and Sidelink Positioning".
- [41] 3GPP TS 23.503: "Policy and charging control framework for the 5G System (5GS); Stage 2".
- [42] 3GPP TS 23.632: "User data interworking, coexistence and migration; Stage 2".
- [43] 3GPP TS 29.563: "Home Subscriber Server (HSS) services for interworking with Unified Data Management (UDM); Stage 3".
- [44] 3GPP TS 33.536: "Security aspects of 3GPP support for advanced Vehicle-to-Everything (V2X) services".
- [45] 3GPP TS 33.503: "Security Aspects of Proximity based Services (ProSe) in the 5G System (5GS)".
- [46] 3GPP TS 33.533: "Security aspects of ranging based services and sidelink positioning".
- [47] 3GPP TS 38.355: "Sidelink Positioning Protocol (SLPP)".
- [48] 3GPP TS 24.572: " User Plane Location Services (LCS) Protocols And Procedures; Stage 3".

- [49] OMA-AD-SUPL-V2_0: "Secure User Plane Location Architecture Approved Version 2.0".
- [50] 3GPP TS 33.501: " Security architecture and procedures for 5G system".
- [51] 3GPP TS 33.256: "Security aspects of Uncrewed Aerial Systems (UAS)".
- [52] RFC 5985: "HTTP-Enabled Location Delivery (HELD)".
- [53] 3GPP TS 28.105: "Artificial Intelligence / Machine Learning (AI/ML) management".

3 Definitions 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].

5G enhanced positioning area: see TS 22.261 [3].

5G positioning service area: see TS 22.261 [3].

Backhaul PLMN (BH PLMN): see TS 23.501 [18].

LCS Client: entity that interacts with GMLC for the purpose of obtaining location information for one or more UEs. The LCS Client may reside in the UE.

For the purposes of the present document, the following terms and definitions given in TS 23.271 [4] apply:

Call Related: see TS 23.271 [4].

Codeword: see TS 23.271 [4].

Current Location: see TS 23.271 [4].

Deferred location request: see TS 23.271 [4].

DL Positioning: positioning of a target UE in which the target UE obtains downlink measurements for a 3GPP RAT.

GNSS Assistance Data: see clause 6.5.2.1 of TS 37.355 [20].

Immediate location request: see TS 23.271 [4].

Last Known Location: see TS 23.271 [4].

LCS (LoCation Services): see TS 23.271 [4].

LMF-based AI/ML Positioning: refers to NG-RAN node assisted positioning with LMF-side model.

Local Co-ordinates: see TS 23.032 [8].

Local Location: location determined by Local Co-ordinate(s).

Located UE: see TS 23.586 [40].

Location Estimate: see TS 23.271 [4].

LOS/NLOS measurement indication: LOS-NLOS-Indicator as defined in TS 37.355 [20] or LOS/NLOS information as defined in TS 38.455 [15].

Positioning Reference Unit (PRU): see TS 38.305 [9].

Mobile Base Station Relay: see TS 23.501 [18].

Mobile gNB with Wireless Access Backhauling (MWAB): see TS 23.501 [18].

MWAB Broadcasted PLMN: see TS 23.501 [18].

PRU association: association of a PRU with an LMF by providing PRU related information to an LMF.

PRU dis-association: remove the PRU related information to dis-associate a PRU with an LMF.

Pseudonym: see TS 23.271 [4].

Pseudonym mediation device: Functionality that verifies pseudonyms to verinym.

RAT Independent Positioning: positioning of a target UE in which the target UE obtains measurements not related to a 3GPP RAT.

Requestor: see TS 23.271 [4].

Requestor Identity: see TS 23.271 [4].

Response Method: for LCS Client using the OMA MLP protocol. Detail see TS 23.271 [4].

Scheduled Location Time: a future global time (e.g. UTC) at which a UE is to be located.

Service Type: see TS 23.271 [4].

Sidelink Positioning: see TS 23.586 [40]

Target UE: see TS 23.271 [4].

UL Positioning: positioning of a target UE in which NG-RAN obtains uplink measurements of the target UE for a 3GPP RAT.

UL+DL Positioning: positioning of a target UE using both DL Positioning and UL Positioning.

Velocity: see TS 23.271 [4].

Verinym: see TS 23.271 [4].

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].

APN	Access Point Name
APN-NI	APN Network Identifier
EDT	Early Data Transmission
E-SMLC	Evolved Serving Mobile Location Centre
GMLC	Gateway Mobile Location Centre
HGMLC	Home GMLC
LCS	LoCation Services
LDR	Location Deferred Request
LIR	Location Immediate Request
LMF	Location Management Function
LOS	Line-Of-Sight
LPI	LCS Privacy Indicator
LPHAP	Low Power and High Accuracy Positioning
LRF	Location Retrieval Function
MBSR	Mobile Base Station Relay
MO-LR	Mobile Originated Location Request
MT-LR	Mobile Terminated Location Request
MWAB	Mobile gNB with wireless access backhauling
NLOS	Non-Line-Of-Sight
NI-LR	Network Induced Location Request
PMD	Pseudonym mediation device functionality
POI	Privacy Override Indicator

PRU	Positioning Reference Unit
SDT	Small Data Transmission
TNAN	Trusted Non-3GPP Access Network
TNAP	Trusted Non-3GPP Access Point
TWAP	Trusted WLAN Access Point
VGMLC	Visited GMLC
SL-MO-LR	Sidelink Mobile Originating Location Request
SL-MT-LR	Sidelink Mobile Terminating Location Request
SUPL	Secure User Plane Location

4 Architecture Model and Concepts

4.1 General Concepts

A general description of location services and service requirements are given in the specification TS 22.071 [2] and TS 22.261 [3]. Support of location services for GERAN, UTRAN and E-UTRAN access networks is described in TS 23.271 [4], TS 43.059 [5], TS 25.305 [17] and TS 36.305 [7].

The positioning of a UE can be supported by RAT dependent position methods, which rely on for example 3GPP RAT measurements obtained by a target UE and/or on measurements obtained by an Access Network of 3GPP RAT signals transmitted by a target UE. Positioning of a UE can also be supported by RAT independent position methods which may rely on non-RAT measurements obtained by a UE and/or on other information.

The Location Services defined in this specification are applicable to PLMN(s) and within a SNPN as described in clause 6, except for the following features, which are not supported in SNPNS:

- interworking with EPC;
- roaming; and
- direct access to SNPN via non-3GPP access.

The Location Service in PNI-NPN with signalling optimisation is defined as clause 5.13.

The positioning of a UE can be performed by either 3GPP access network or non-3GPP access network. A proper access type shall be determined to assure that the positioning result can fulfil the requested QoS and operator policy.

Location information for one or multiple target UEs may be requested by and reported to an LCS client or an AF within or external to a PLMN or SNPN, or a control plane NF within a PLMN or SNPN. Location information contained in the location request and location information contained in the location response are defined in clause 5.5.

For location request from LCS client (neither in the UE nor in the NG-RAN) or AF external to a PLMN or SNPN, privacy verification of the target UE shall be enabled to check whether it is allowed to acquire the UE location information based on UE LCS privacy profile and whether the LCS client or the AF is authorised to use the location service as defined in clause 5.4. Additionally, UEs may optionally support privacy notification and verification on behalf of a user. Privacy override is also supported for regulatory LCS services according to local regulation.

The capabilities of a target UE to support LCS may be signalled by the UE to a serving PLMN or to an SNPN at the AS, NAS and application (positioning protocol) levels to enable use of position methods supported by the UE.

To provide Location Service in the EPC interworking scenario, an EPC and 5GC common interface shall be used for the location request from LCS client or AF.

Ranging based services and Sidelink Positioning for a UE can be supported, and details are described in clause 5.17.