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**5G System (5GS) Location Services (LCS);**  
**Stage 2**  
**(3GPP TS 23.273 version 17.4.0 Release 17)**

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## Modal verbs terminology

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# Foreword

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

- |                  |   |
|------------------|---|
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| <b>shall not</b> | 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.

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- |                   |  |
|-------------------|--|
| <b>should</b>     | indicates a recommendation to do something     |
| <b>should not</b> | indicates a recommendation not to do something |
| <b>may</b>        | indicates permission to do something           |
| <b>need not</b>   | 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.

- |               |  |
|---------------|--|
| <b>can</b>    | indicates that something is possible   |
| <b>cannot</b> | indicates that something is impossible |

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

- |                 |  |
|-----------------|--|
| <b>will</b>     | 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     |
| <b>will not</b> | 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 |
| <b>might</b>    | 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:

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# 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 <https://standards.iteh.ai/catalog/standards/sist/b124bf61-02e9-4e8e-b57d-d413291e7eb7/etsi-ts-123-273-v17-4-0-2022-05>.
- [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".

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## 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].

**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].

**Immediate location request:** see TS 23.271 [4].

**Last Known Location:** see TS 23.271 [4].

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

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

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

**Location Estimate:** see TS 23.271 [4].

**Pseudonym:** see TS 23.271 [4].

**Pseudonym mediation device:** Functionality that verifies pseudonyms to verinym.

**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].

**Target UE:** see TS 23.271 [4].

**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
LMF	Location Management Function
LPI	LCS Privacy Indicator
LRF	Location Retrieval Function
MO-LR	Mobile Originated Location Request
MT-LR	Mobile Terminated Location Request
NI-LR	Network Induced Location Request
PMD	Pseudonym mediation device functionality
POI	Privacy Override Indicator
TNAN	Trusted Non-3GPP Access Network
TNAP	Trusted Non-3GPP Access Point
TWAP	Trusted WLAN Access Point
VGMLC	Visited GMLC

## 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 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.

#### 4.1a Types of Location Request

##### 4.1a.1 Network Induced Location Request (NI-LR)

With a Network Induced Location Request (NI-LR), a serving AMF for a UE initiates localization of the UE for a regulatory service (e.g. an emergency call from the UE) or for verification of a UE location (country or international area) for NR satellite access.

##### 4.1a.2 Mobile Terminated Location Request (MT-LR)

With a Mobile Terminated Location Request (MT-LR), an LCS client or AF external to or internal to a serving PLMN sends a location request to the PLMN (which may be the HPLMN or VPLMN) for the location of a target UE.

##### 4.1a.3 Mobile Originated Location Request (MO-LR)

With a Mobile Originated Location Request (MO-LR), a UE sends a request to a serving PLMN for location related information for the UE.

#### 4.1a.4 Immediate Location Request

With an immediate location request, an LCS client or AF sends or instigates a location request for a target UE (or group of target UEs) and expects to receive a response containing location information for the target UE (or group of target UEs) within a short time period which may be specified using QoS. An immediate location request may be used for an NI-LR, MT-LR or MO-LR.

#### 4.1a.5 Deferred Location Request

With a deferred location request, an LCS client or AF sends a location request to a PLMN for a target UE (or group of target UEs) and expects to receive a response containing the indication of event occurrence and location information if requested for the target UE (or group of target UEs) at some future time (or times), which may be associated with specific events associated with the target UE (or group of target UEs). In this version of the specification, only deferred location requests for an MT-LR are supported.

##### 4.1a.5.1 Types of event

The following types of event are defined for a deferred location request.

- a) UE availability: Any event in which the 5GCN has established a contact with the UE. This event is considered to be applicable when the UE is temporarily unavailable due to inaction by the user, or for temporarily loss of radio connectivity or IMSI detach and so on. The UE Available event only requires one response to an LCS client/AF and after this response, the UE Available event is concluded.
- b) Area: An event where the UE enters, leaves or remains within a pre-defined geographical area. At least one type of area event can be defined (i.e. entering, leaving or remaining within the area). The LCS client or AF may define the target area as a geographical area or as a geopolitical name of an area. The PLMN may translate and define the target area as the identities of one or more radio cells or tracking areas. The area event may be reported one time only, or multiple times. The area event report shall contain an indication of the event occurrence. The location estimate may be included in the report. If an area event is detected by the UE but an event report cannot be sent (e.g. because the UE cannot access the network or due to a minimum reporting interval), a report shall be sent later when possible irrespective of whether the area event still applies for the current UE location. Area event reporting is controlled by a minimum and a maximum reporting time. The minimum reporting time defines the minimum allowed time between successive area events. The maximum reporting time defines the maximum time between successive reports. When a UE sends a report due to expiration of the maximum reporting time, the UE indicates expiration of the maximum reporting time as the trigger event. The maximum reporting time enables the AF, LCS client and HGMLC to remain aware of continuing support by the UE for the area event (e.g. to detect if area event reporting may have been aborted due to UE power off).

NOTE: To achieve more precise usage of area event in some scenario, e.g. for small target area, it may be useful if LCS Client/AF requests UE location estimate and compares the location estimate with the target area.

- c) Periodic Location: An event where a defined periodic timer expires in the UE and activates a location report. If a periodic event is detected by the UE but an event report cannot be sent (e.g. because the UE cannot access the network temporarily), a report shall be sent later when possible and the periodic timer for the next event shall then be started. The reporting duration for periodic location shall equal the requested number of reports multiplied by the periodic interval even when reports are delayed.
- d) Motion: An event where the UE moves by more than some predefined straight line distance from a previous location. The motion event may be reported one time only, or multiple times. The motion event report shall contain an indication of the event occurrence. A location estimate may be included in the report if requested by the LCS client or AF. For successive motion event reports, motion is determined relative to the UE location corresponding to the immediately preceding event report (including an event report triggered by expiration of the maximum reporting time). If a motion event is detected by the UE but an event report is deferred (e.g. because the UE cannot access the network temporarily), a report shall be sent later when possible irrespective of whether the motion event still applies to the current UE location. Motion reporting is controlled by a minimum and a maximum reporting time. The minimum reporting time defines the minimum allowed time between successive event reports. The maximum reporting time defines the maximum time between successive reports. When a UE sends a report due to expiration of the maximum reporting time, the UE indicates expiration of the maximum reporting time as the trigger event. The maximum reporting time enables the AF, LCS client and HGMLC to

remain aware of continuing support by the UE for the motion event (e.g. to detect if motion event reporting may have been aborted due to UE power off).

## 4.1b LCS Quality of Service

LCS Quality of Service is used to characterise the location request. It can either be determined by the operator or determined based on the negotiation with the LCS client or the AF. It is optional for LCS client or the AF to provide the LCS Quality of Service in the location request.

LCS Quality of Service information is characterised by 3 key attributes:

- LCS QoS Class as defined below.
- Accuracy: i.e. Horizontal Accuracy (see clause 4.3.1 of TS 22.071 [2]) and Vertical Accuracy (see clause 4.3.2 of TS 22.071 [2]).
- Response Time (e.g. no delay, low delay or delay tolerant as described in clause 4.3.3 of TS 22.071 [2]).

NOTE 1: One or two QoS values for Horizontal Accuracy, Vertical Accuracy can be provided in the location request in addition to a preferred accuracy when LCS QoS Class is set to Multiple QoS Class.

The LCS QoS Class defines the degree of adherence by the Location Service to another quality of service parameter (Accuracy), if requested. The 5G system shall attempt to satisfy the other quality of service parameter regardless of the use of QoS Class. There are 3 LCS QoS Classes:

- Best Effort Class: This class defines the least stringent requirement on the QoS achieved for a location request. If a location estimate obtained does not fulfil the other QoS requirements, it should still be returned but with an appropriate indication that the requested QoS was not met. If no location estimate is obtained, an appropriate error cause is sent.
- Multiple QoS Class: This class defines intermediate stringent requirements on the QoS achieved for a location request. If the obtained location estimate does not fulfil the most stringent (i.e. primary) other QoS requirements affected by the degree of adherence of the QoS class, then another location estimation may be triggered at LMF attempting less stringent other QoS requirements. The process may be iterated until the least stringent (i.e. minimum) other QoS requirements are attempted. If the least stringent other QoS requirements cannot be fulfilled by a location estimate, then the location estimate shall be discarded, and an appropriate error cause shall be sent.

NOTE 2: An AF may provide a location request with Multiple QoS Class via NEF. For an LCS client to provide a location request with Multiple QoS Class an Le interface implementation supporting Multiple QoS Class may be required.

NOTE 3: Multiple QoS Class can only be applied for Deferred 5GC-MT-LR Procedure in this release of the specification.

- Assured Class: This class defines the most stringent requirement on the accuracy achieved for a location request. If a location estimate obtained does not fulfil the other QoS requirements, then it shall be discarded, and an appropriate error cause shall be sent.

NOTE 4: How the LMF decides the positioning method is an implementation aspect not pre-determined by QoS criteria.

For LCS client, it may indicate accuracy defined in TS 29.572 [12], tables 6.1.6.3.2-1 and 6.1.6.3.5-1. For AF, it may either indicate the accuracy defined in TS 29.572 [12], table 6.1.6.3.2-1, or indicate a particular value e.g. PLMN ID defined in TS 29.122 [35], table 5.3.2.4.7-1.

## 4.1c Scheduled Location Time

A scheduled location time allows an external LCS Client, AF or the UE to specify a time in the future at which a current location of the UE is to be obtained. A scheduled location time can be used with a 5GC-MT-LR, 5GC-MO-LR or deferred 5GC-MT-LR for periodic or triggered location events. The location preparation phase starts when a location related request is sent by an LCS Client, AF or UE requesting a current location of the UE. The request includes the scheduled location time T. As part of the location preparation phase, the 5GC, and UE interact to determine suitable



position methods and schedule location measurements of the UE. The LMF coordinates the interaction and is aware of the scheduled location time. The location preparation phase ends at or near to the time T and is followed by a location execution phase in which the UE location is obtained and returned to the external LCS Client, AF or the UE.

A scheduled location time only applies when an external LCS Client, AF or the UE is aware of a specific time in the future at which the location of the UE is needed. A location estimate returned to an LCS Client, AF or UE for a scheduled location time can be treated by the LCS Client, AF or UE as an estimate of the location of the UE at the scheduled location time.

To support the Scheduled Location Time in 5GC-MO-LR, the UE defers sending the request to AMF until the time remaining until the scheduled location time is within some implementation dependent threshold in order to avoid failure triggered by HTTP request timeout.

When support the Scheduled Location Time in 5GC-MT-LR (i.e. the LCS Client/AF obtains one time UE location at Scheduled Location Time), to avoid failure triggered by HTTP request timeout, one of the following methods is applied:

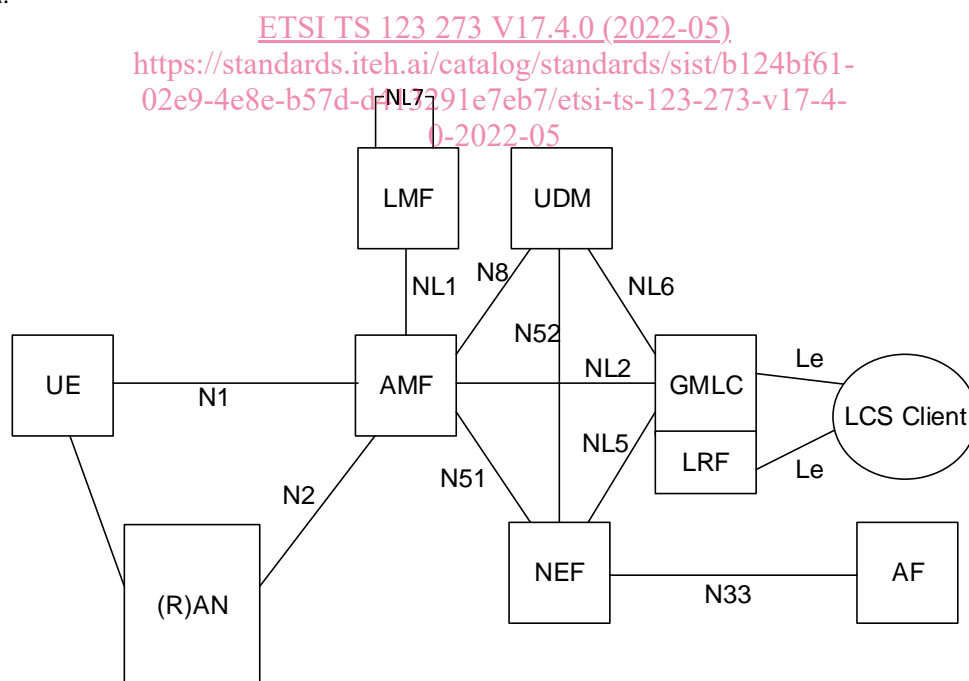
- The LCS Client or AF defers sending the request until the time remaining until the scheduled location time is within some implementation dependent threshold; or
- Re-using the deferred 5GC-MT-LR for periodic location events procedure to realize providing one time UE location at Scheduled Location Time by, e.g. set the value of total reporting number parameter in the location request to one.

NOTE: Which method to be used is implementation specific.

## 4.2 Architectural Reference Model

### 4.2.1 Non-roaming reference architecture

Figure 4.2.1-1 shows an architectural reference model for 5GS LCS for a non-roaming UE in reference point representation.



**Figure 4.2.1-1: Non-roaming reference architecture for Location Services in reference point representation**

NOTE 1: (R)AN represents NG-RAN, trusted non-3GPP access or untrusted non-3GPP access.