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Foreword

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

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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.

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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.

1 Scope

The present document specifies the stage 3 protocol and data model for the Ngmlc Service Based Interface. It provides stage 3 protocol definitions and message flows, and specifies the API for each service offered by the Ngmc.

The 5G System stage 2 architecture and procedures are specified in 3GPP TS 23.501 [2] and 3GPP TS 23.502 [3].

The Technical Realization of the Service Based Architecture and the Principles and Guidelines for Services Definition are specified in 3GPP TS 29.500 [5] and 3GPP TS 29.501 [6].

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 23.502: "Procedures for the 5G System; Stage 2".

[4] 3GPP TS 23.273: "5G System Location Services (LCS)".

[5] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

[6] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition; Stage 3".

[7] OpenAPI Initiative, "OpenAPI 3.0.0 Specification", https://github.com/OAI/OpenAPI-Specification/blob/master/versions/3.0.0.md.

[8] IETF RFC 7540: "Hypertext Transfer Protocol Version 2 (HTTP/2)".

[9] IETF RFC 8259: "The JavaScript Object Notation (JSON) Data Interchange Format".

[10] IETF RFC 7807: "Problem Details for HTTP APIs".

[11] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".

[12] 3GPP TS 29.572: "5G System; Location Management Services; Stage 3".

[13] ITU Recommendation E.164: "The international public telecommunication numbering plan".

[14] 3GPP TS 29.503: "5G System; Unified Data Management Services; Stage 3".

[15] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

[16] IETF RFC 6749: "The OAuth 2.0 Authorization Framework".

[17] 3GPP TS 29.510: "Network Function Repository Services; Stage 3".

[18] 3GPP TS 22.071: "Location Services (LCS); Service description; Stage 1".

[19] 3GPP TR 21.900: "Technical Specification Group working methods".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms and definitions given in 3GPP 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 3GPP TR 21.905 [1].

3.2 Symbols

Void

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP 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 3GPP TR 21.905 [1].

5GC	5G Core Network
AMF	Access and Mobility Management Function
GAD	Geographical Area Description
GMLC	Gateway Mobile Location Centre
GPSI	Generic Public Subscription Identifier
LCS	Location Services
LDR	Location Deferred Request
MO-LR	Mobile Originated Location Request
MT-LR	Mobile Terminated Location Request
NEF	Network Exposure Function
NI-LR	Network Induced Location Request
NRF	Network Repository Function
SUPI	Subscription Permanent Identifier

4 Overview

The Gateway Mobile Location Centre (GMLC) is the network entity in the 5G Core Network (5GC) supporting Location Services (LCS). Within the 5GC, the GMLC offers services to the AMF, GMLC and NEF via the Ngmlc service based interface (see 3GPP TS 23.501 [2] and 3GPP TS 23.502 [3]).

Figure 4-1 provides the reference model (in service based interface representation and in reference point representation), with focus on the GMLC:

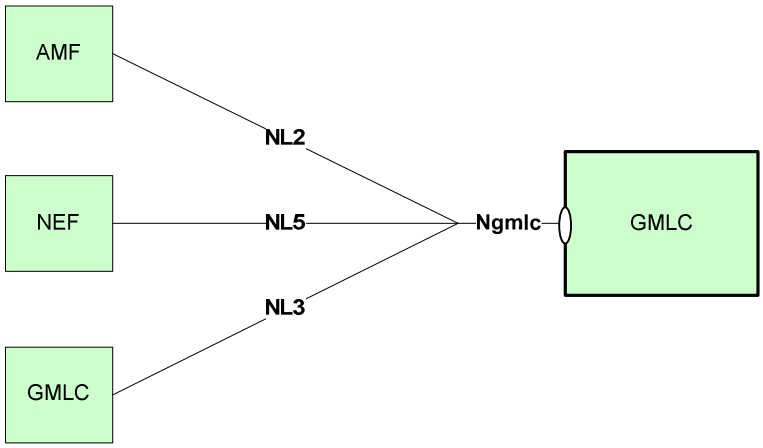

Figure 4-1: Reference model – GMLC

The functionalities supported by the GMLC are listed in clause 4.3.3 of 3GPP TS 23.273 [4].

5 Services offered by the GMLC

5.1 Introduction

The table 5.1-1 shows the GMLC Services and GMLC Service Operations:

Table 5.1-1: List of GMLC Services

Service Name	Service Operations	Operation Semantics	Example Consumer(s)
Ngmlc_Location	ProvideLocation	Request/Response	H-GMLC, NEF
	LocationUpdate	Request/Response	AMF, V-GMLC
	LocationUpdateNotify	Notify	NEF
	CancelLocation	Request/Response	H-GMLC, NEF
	EventNotify	Notify	H-GMLC, NEF

Table 5.1-2 summarizes the corresponding APIs defined for this specification.

Table 5.1-2: API Descriptions

Service Name	Clause	Description	OpenAPI Specification File	apiName	Annex
Ngmlc_Location	6.1	Ngmlc Location Service	TS29515_Ngmlc_Location.yaml	ngmlc-loc	A.2

5.2 Ngmlc_Location Service

5.2.1 Service Description

The Ngmlc_Location service enables an NF to request location determination (current geodetic and optionally civic location) for a target UE. The following are the key functionalities of this NF service.

- Allow the consumer NF to request the current geodetic and optionally civic location of a target UE.

- Allow the consumer NF to subscribe/unsubscribe the geodetic and optionally civic location of a target UE for some certain events.
- Allow the consumer NF to cancel an on-going periodic or triggered location request of a target UE.
- Allow the consumer NF to get notified about the geodetic and optionally civic location of a target UE when some certain events are detected.

5.2.2 Service Operations

5.2.2.1 Introduction

The service operations defined for the Ngmlc_Location services are as follows:

- ProvideLocation
- LocationUpdate
- LocationUpdateNotify
- CancelLocation
- EventNotify

5.2.2.2 ProvideLocation

5.2.2.2.1 General

The service operation is used during the procedures:

- 5GC-MT-LR Procedure for the commercial location service (see 3GPP TS 23.273 [4], clause 6.1.2)
- Deferred 5GC-MT-LR Procedure for Periodic, Triggered and UE Available Location Events (see 3GPP TS 23.273 [4], clause 6.3.1)

The ProvideLocation service operation is invoked by a NF Service Consumer, e.g. a NEF or GMLC, towards the GMLC to request to provide the location information (geodetic location and, optionally, civic location) for a target UE or to subscribe to periodic or triggered deferred location for a target UE. See Figure 5.2.2.2.1-1..

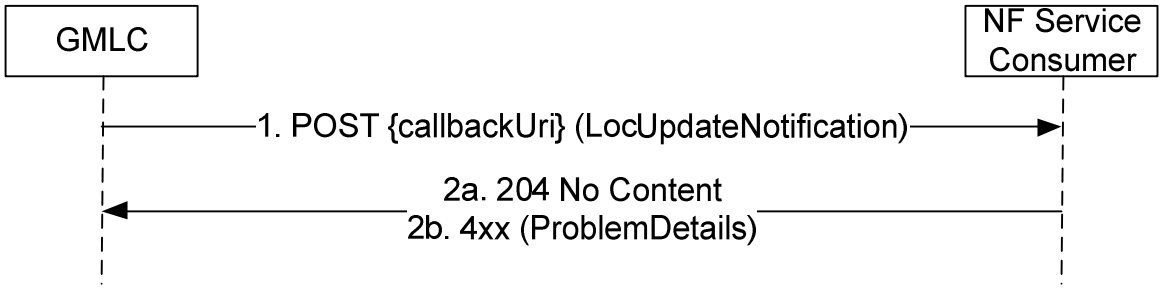

Figure 5.2.2.2.1-1: ProvideLocation Request/Response

1. The NF Service Consumer shall send an HTTP POST request to the URI associated with the "provide-location" custom operation. The input parameters for the request (required QoS, supported GAD shapes, LCS client type, external Service Identity, Codeword, service coverage, LDR type, serving AMF address, LDR reference, H-GMLC Callback URI) should be included in the HTTP POST request body.

2a. On success, "200 OK" shall be returned. The response body shall contain the parameters related to the determined position of the UE if any (geodetic position, civic location, positioning methods…).

2b On failure, one of the HTTP status code listed in Table 6.1.3.2.2-2 may be returned. For a 4xx/5xx response, the message body may contain a ProblemDetails structure with the "cause" attribute set to one of the application error listed in Table 6.1.3.2.2-2.

5.2.2.3 LocationUpdate

5.2.2.3.1 General

The service operation is used during the procedure:

- 5GC-MO-LR Procedure (see 3GPP TS 23.273 [4], clause 6.2)

The LocationUpdate enables the NF consumer (e.g. AMF) to update UE location information towards the GMLC. See Figure 5.2.2.3.1-1.

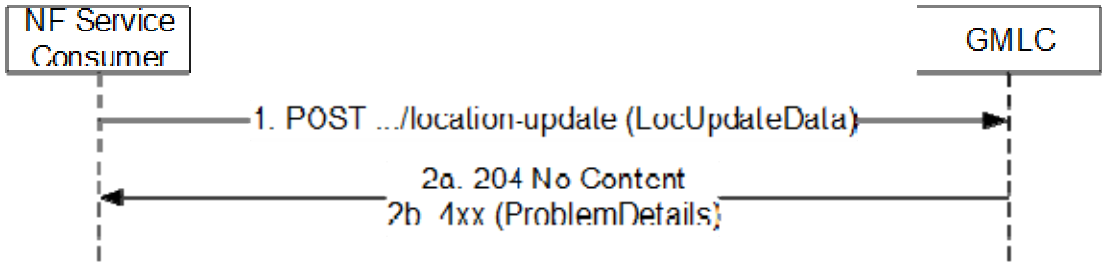

Figure 5.2.2.3.1-1: LocationUpdate Request/Response

1. The NF Service Consumer shall send an HTTP POST request to the URI associated with the "location-update" custom operation. The request body shall contain a LocUpdateData object..

2a. On success, "204 No content" shall be returned by the GMLC.

2b. On failure, one of the HTTP status code listed in Table 6.1.3.4.2-2 may be returned. For a 4xx response, the message body may contain a ProblemDetails structure with the "cause" attribute set to one of the application errors listed in Table 6.1.3.4.2-2.

5.2.2.4 CancelLocation

5.2.2.4.1 General

The service operation is used during the procedure:

- Deferred 5GC-MT-LR Procedure for Periodic, Triggered and UE Available Location Events (see 3GPP TS 23.273 [4], clause 6.3.3)

The CancelLocation enables the consumer NF to use the service operation to cancel a deferred 5GC-MT-LR procedure for periodic or triggered location. See Figure 5.2.2.4.1-1.

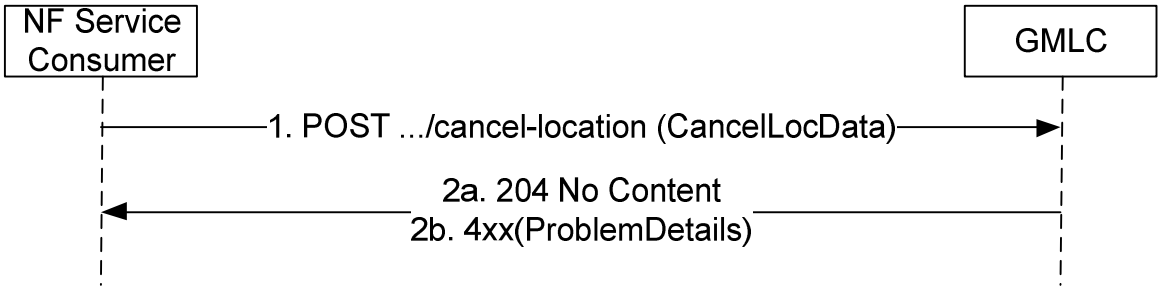

Figure 5.2.2.4.1-1: CancelLocation Request/Response

1. The NF Service Consumer shall send an HTTP POST request to the URI associated with the "cancel-location" custom operation. The input parameters for the request ((H-)GMLC contact address, LDR reference number, LMF identification, serving AMF address) should be included in the HTTP POST request body.

2a. On success, "204 No Content" shall be returned.

2b. On failure, one of the HTTP status code listed in Table 6.1.3.3.2-2 may be returned. For a 4xx response, the message body may contain a ProblemDetails structure with the "cause" attribute set to one of the application errors listed in Table 6.1.3.3.2-2.

5.2.2.5 EventNotify

5.2.2.5.1 General

The service operation is used during the procedure:

- Deferred 5GC-MT-LR Procedure for Periodic, Triggered and UE Available Location Events (see 3GPP TS 23.273 [4], clause 6.3.1 or clause 6.3.2)

The EventNotify enables the consumer NF to get notified about the geodetic and optionally civic location for a target UE when some certain events are detected. See Figure 5.2.2.5.1-1.

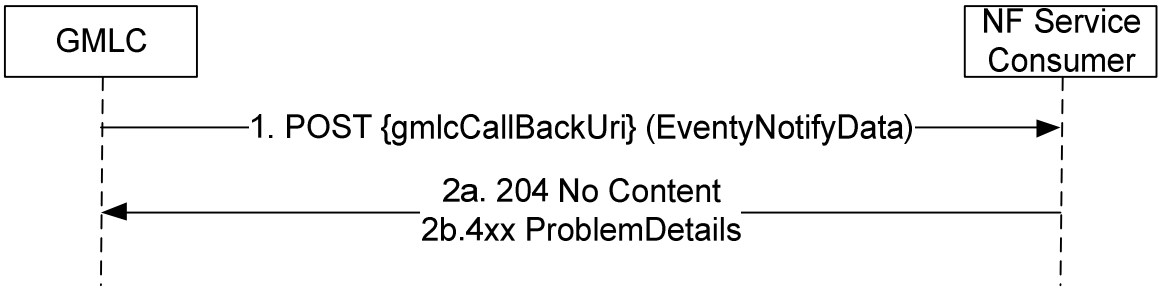

Figure 5.2.2.5.1-1: EventNotify Notification

1. The GMLC shall send an HTTP POST to the callback URI to send a notification. The input parameters for the notification (Notification Correlation ID, UE (SUPI and if available GPSI), Type of location related event (e.g. deferred location for the UE available event, activation of location for periodic or triggered location, mobility of a target UE to a new AMF or MME for a deferred location, Geodetic Location, Civic Location, Position Methods Used, serving LMF identification) should be included in the HTTP POST request body.

2a. If the notification is received, the NF Service Consumer shall reply with the status code 204 indicating the notification is received, in the response message.

2b. On failure, one of the HTTP status code listed in Table 6.1.4.2.3.1-2 may be returned. For a 4xx response, the message body may contain a ProblemDetails structure with the "cause" attribute set to one of the application errors listed in Table 6.1.4.2.3.1-2.

5.2.2.6 LocationUpdateNotify

5.2.2.6.1 General

The service operation is used during the procedure:

- 5GC-MO-LR Procedure (see 3GPP TS 23.273 [4], clause 6.2)

The LocationUpdateNotify enables the NF consumer (e.g. NEF) to get notified about the UE location information update. See Figure 5.2.2.6.1-1.

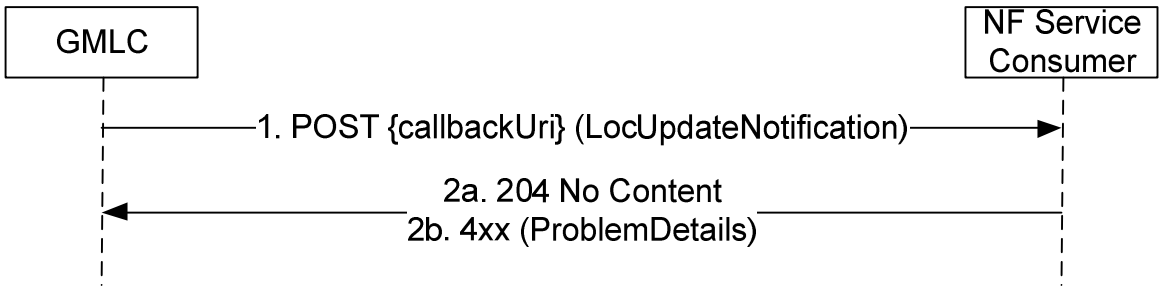

Figure 5.2.2.6.1-1: LocationUpdateNotify Notification

1. The GMLC shall send an HTTP POST request to the callback URI of the NF consumer (e.g. NEF). The response body shall contain a LocUpdateNotification object.

   The callback URI (e.g. NEF address for callback) is locally configured on GMLC or discovered via NRF.

2a. On success, "204 No content" shall be returned by the NF consumer.

2b. On failure, one of the HTTP status code listed in Table 6.1.4.3.3.1-2 may be returned. For a 4xx response, the message body may contain a ProblemDetails structure with the "cause" attribute set to one of the application errors listed in Table 6.1.4.3.3.1-2.

6 API Definitions

6.1 Mgmlc_Location Service API

6.1.1 Introduction

The Ngmlc_Location service shall use the Ngmlc_Location API.

The API URI of the Ngmlc_Location API shall be:

{apiRoot}/<apiName>/<apiVersion>/

The request URIs used in HTTP requests from the NF service consumer towards the NF service producer shall have the Resource URI structure defined in clause 4.4.1 of 3GPP TS 29.501 [6], i.e.:

{apiRoot}/<apiName>/<apiVersion>/<apiSpecificResourceUriPart>

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [6].
- The <apiName> shall be "ngmlc-loc".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in clause 6.1.3.

6.1.2 Usage of HTTP

6.1.2.1 General

HTTP/2, as defined in IETF RFC 7540 [8], shall be used as specified in clause 5 of 3GPP TS 29.500 [5].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [5].

HTTP/2, as defined in IETF RFC 7540 [8], shall be used as specified in clause 5 of 3GPP TS 29.500 [5].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [5].

HTTP messages and bodies for the Ngmlc_Location service shall comply with the OpenAPI [7] specification contained in Annex A.

6.1.2.2 HTTP standard headers

6.1.2.2.1 General

6.1.2.2.2 Content type

The following content types shall be supported:

- JSON, as defined in IETF RFC 8259 [9], shall be used as content type of the HTTP bodies specified in the present specification as indicated in clause 5.4 of 3GPP TS 29.500 [5].
- The Problem Details JSON Object (IETF RFC 7807 [10]). The use of the Problem Details JSON object in a HTTP response body shall be signalled by the content type "application/problem+json".

6.1.2.3 HTTP custom headers

6.1.2.3.1 General

The following HTTP custom headers shall be supported:

- 3gpp-Sbi-Message-Priority: See 3GPP TS 29.500 [5], clause 5.2.3.2.2.

This API does not define any new HTTP custom headers.

6.1.3 Custom Operations without associated resources

6.1.3.1 Overview

The structure of the custom operation URIs of the Ngmlc_Location service is shown in Figure 6.1.3.1-1.

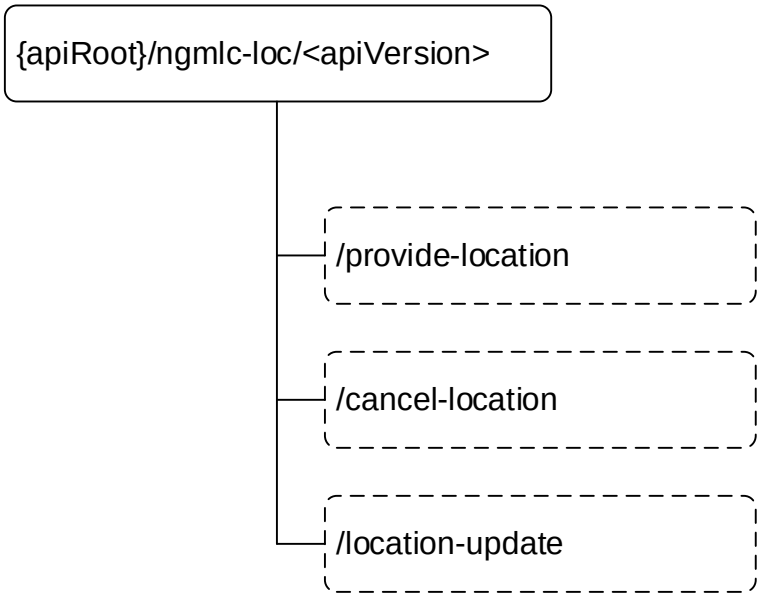

Figure 6.1.3.1-1: Custom operation URI structure of the Ngmlc_Location API

Table 6.1.3.1-1 provides an overview of the custom operations and applicable HTTP methods.

Table 6.1.3.1-1: Custom operations

Custom operation URI	Mapped HTTP method	Description
{apiRoot}/ngmlc-loc/<apiVersion>/provide-location	POST	Request or Subscribe the geodetic and optionally civic location of a target UE
{apiRoot}/ngmlc-loc/<apiVersion>/cancel-location	POST	Cancel an on-going periodic or triggered location request of a target UE
{apiRoot}/ngmlc-loc/<apiVersion>/location-update	POST	Enable the UE to update UE location information towards the consumer NF

6.1.3.2 Operation: provide-location

6.1.3.2.1 Description

This clause will describe the custom operation and what it is used for, and the custom operations URI.

6.1.3.2.2 Operation Definition

The operation shall support the response data structures and response codes specified in tables 6.1.3.2.2-1 and 6.1.3.2.2-2.

Table 6.1.3.2.2-1: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
InputData	M	1	Input parameters to the "Provide-Location" operation

Table 6.1.3.2.2-2: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
LocationData	M	1	200 OK	This case represents the successful retrieval of the location of the UE or successful subscription of periodic or triggered location of the UE. Upon success, a response body is returned containing the different parameters of the location data if obtained, such as: - Geographic Area - Civic Location - Age of Location - Accuracy of Location - Positioning methods
ProblemDetails	O	0..1	403 Forbidden	The "cause" attribute may be used to indicate one of the following application errors: - POSITIONING_DENIED - UNSPECIFIED - UNSUPPORTED_BY_UE See table 6.1.6.3-1 for the description of these errors.
ProblemDetails	O	0..1	500 Internal Server Error	The "cause" attribute may be used to indicate the following application error: - POSITIONING_FAILED See table 6.1.6.3-1 for the description of these errors.
ProblemDetails	O	0..1	504 Gateway Timeout	The "cause" attribute may be used to indicate the following application error: - UNREACHABLE_USER See table 6.1.6.3-1 for the description of this error.

6.1.3.3 Operation: cancel-location

6.1.3.3.1 Description

This clause will describe the custom operation and what it is used for, and the custom operation's URI.

6.1.3.3.2 Operation Definition

This operation shall support the request and response data structures and response codes specified in table 6.1.3.3.2-1 and table 6.1.3.3.2-2.

Table 6.1.3.3.2-1: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
CancelLocData	M	1	The information is used to cancel location.

Table 6.1.3.3.2-2: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	This case represents successful cancellation of location.
ProblemDetails	O	0..1	403 Forbidden	The "cause" attribute may be used to indicate one of the following application errors: - UNSPECIFIED - LOCATION_SESSION_UNKNOWN See table 6.1.6.3-1 for the description of this error.

6.1.3.4 Operation: location-update

6.1.3.4.1 Description

This clause will describe the custom operation and what it is used for, and the custom operation's URI.

6.1.3.4.2 Operation Definition

This operation shall support the request and response data structures and response codes specified in table 6.1.3.4.2-1 and table 6.1.3.4.2-2.

Table 6.1.3.4.2-1: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
LocUpdateData	M	1	Input parameters to the "location-update" operation

Table 6.1.3.4.2-2: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	This case represents successful update of location.
ProblemDetails	O	0..1	403 Forbidden	The "cause" attribute may be used to indicate one of the following application errors: - UNSPECIFIED - UNREQUESTED_BY_UE - UNKOWN_EXTERNAL_CLIENT_OR_AF - UNREACHABLE_EXTERNAL_CLIENT_OR_AF See table 6.1.6.3-1 for the description of this error.

6.1.4 Notifications

6.1.4.1 General

6.1.4.2 Eventnotify

6.1.4.2.1 Description

The EventNotify operation is used to the occurrence of periodic or triggered location event for a target UE to a consumer NF (e.g. GMLC).

6.1.4.2.2 Notification Definition

Call-back URI: {hgmlcCallBackUri}

Call-back URI is provided by NF Service Consumer during requesting the subscription of the periodic or triggered deferred location for a target UE. See clause 5.3.2.2 for the description of how the GMLC obtains the Call-back URI of the NF Service Consumer.

6.1.4.2.3 Notification Standard Methods

6.1.4.2.3.1 POST

This method sends a Location event notify to the NF Service Consumer.

This method shall support the request and response data structures and response codes specified in table 6.1.4.2.3.1-1 and table 6.1.4.2.3.1-2.

Table 6.1.4.2.3.1-1: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
EventNotifyData	M	1	Input parameters to the "Event Notify" operation

Table 6.1.4.2.3.1-2: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	This case represents successful notification of the event.
ProblemDetails	O	0..1	403 Forbidden	The "cause" attribute may be used to indicate one of the following application errors: - UNSPECIFIED - LOCATION_SESSION_UNKNOWN See table 6.1.6.3-1 for the description of this error.

6.1.4.3 LocationUpdateNotify

6.1.4.3.1 Description

The LocationUpdateNotify operation is used to deliver the location update for a UE to a consumer NF (e.g. NEF).

6.1.4.3.2 Notification Definition

Call-back URI: {locationUpdateCallbackUri}

6.1.4.3.3 Notification Standard Methods

6.1.4.3.3.1 POST

This method sends a Location update notification to the NF Service Consumer.

This method shall support the request and response data structures and response codes specified in table 6.1.4.3.3.1-1 and table 6.1.4.3.3.1-2.

Table 6.1.4.3.3.1-1: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
LocUpdateNotification	M	1	Input parameters to the "LocationUpdateNotification" operation

Table 6.1.4.3.3.1-2: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	This case represents successful notification of the event.
ProblemDetails	O	0..1	403 Forbidden	The "cause" attribute may be used to indicate one of the following application errors: - UNSPECIFIED - UNKOWN_EXTERNAL_CLIENT_OR_AF - UNREACHABLE_EXTERNAL_CLIENT_OR_AF See table 6.1.6.3-1 for the description of this error.

6.1.5 Data Model

6.1.5.1 General

This clause specifies the application data model supported by the API.

Table 6.1.5.1-1 specifies the data types defined for the Ngmlc_Location service based interface protocol.

Table 6.1.5.1-1: Ngmlc_Location specific Data Types

Data type	Clause defined	Description	Applicability
InputData	6.1.5.2.2	the input parameters in ProvideLocation service operation	
LocationData	6.1.5.2.3	the response parameters in ProvideLocation service operation	
CancelLocData	6.1.5.2.4	the input parameters in CancelLocation service operation	
LocUpdateData	6.1.5.2.5	the input parameters in LocationUpdate service operation	
EventNotifyData	6.1.5.2.6	the input parameters in EventNotify Notification service operation	
UePrivacyRequirements	6.1.5.2.7	UE privacy requirements from (H)GMLC to the serving AMF or VGMLC(in the roaming case) for the target UE	
LocUpdateNotification	6.1.5.2.9	Location Update Notification	
ServiceIdentity	6.1.5.3.2	service identity	
CodeWord	6.1.5.3.2	codeword	
ExternalClientIdentification	6.1.5.3.2	external client identification	
E164CountryCodeOfGeographicArea	6.1.5.3.2	E.164 country codes for geographic areas	
PseudonymIndicator	6.1.5.3.3	It defines if a pseudonym is requested	
LocationRequestType	6.1.5.3.4	NI-LR, MT-LR or MO-LR	
LocationTypeRequested	6.1.5.3.5	the location type requested by the LCS client	
EventNotifyDataType	6.1.5.3.6	the type of event that triggers event notification	

Table 6.1.5.1-2 specifies data types re-used by the Ngmlc_Location service based interface protocol from other specifications, including a reference to their respective specifications and when needed, a short description of their use within the Ngmlc_Location service based interface.

Table 6.1.5.1-2: Ngmlc_Location re-used Data Types

Data type	Reference	Comments	Applicability
Gpsi	3GPP TS 29.571 [11]		
Supi	3GPP TS 29.571 [11]		
Uri	3GPP TS 29.571 [11]		
AmfId	3GPP TS 29.571 [11]		
NfInstanceId	3GPP TS 29.571 [11]		
ExternalClientType	3GPP TS 29.572 [12]		
LocationQoS	3GPP TS 29.572 [12]		
LcsQosClass	3GPP TS 29.572 [12]		
SupportedGADShapes	3GPP TS 29.572 [12]		
PeriodicEventInfo	3GPP TS 29.572 [12]		
AreaEventInfo	3GPP TS 29.572 [12]		
MotionEventInfo	3GPP TS 29.572 [12]		
LdrType	3GPP TS 29.572 [12]		
LdrReference	3GPP TS 29.572 [12]		
AgeOfLocationEstimate	3GPP TS 29.572 [12]		
PositioningMethod	3GPP TS 29.572 [12]		
AccuracyFulfilmentIndicator	3GPP TS 29.572 [12]		
LmfIdentification	3GPP TS 29.572 [12]		
LcsServiceType	3GPP TS 29.572 [12]		
VelocityRequested	3GPP TS 29.572 [12]		
LcsPriority	3GPP TS 29.572 [12]		
VelocityEstimate	3GPP TS 29.572 [12]		
TerminationCause	3GPP TS 29.572 [12]		
PositioningMethodAndUsage	3GPP TS 29.572 [12]		
GnssPositioningMethodAndUsage	3GPP TS 29.572 [12]		
LcsServiceAuth	3GPP TS 29.571 [11]		

6.1.5.2 Structured data types

6.1.5.2.1 Introduction

This clause defines the structures to be used in resource representations.

6.1.5.2.2 Type: InputData

Table 6.1.5.2.2-1: Definition of type InputData

Attribute name	Data type	P	Cardinality	Description	Applicability
gpsi	Gpsi	O	0..1	Generic Public Subscription Identifier	
supi	Supi	O	0..1	Subscription Permanent Identifier	
externalClientType	ExternalClientType	M	1	External client type	
locationQoS	LocationQoS	O	0..1	Requested location QoS	
supportedGADShapes	array(SupportedGADShapes)	O	1..N	Supported Geographical Area Description shapes	
serviceIdentity	ServiceIdentity	O	0..1	Service identity	
serviceCoverage	array(E164CountryCodeOfGeographicArea)	O	1..N	A list of E.164 country codes for geographic areas (see ITU Recommendation E.164 [13]) where the LCS client is permitted to request and receive UE location information.	
ldrType	LdrType	C	0..1	Location deferred request event type	
periodicEventInfo	PeriodicEventInfo	C	0..1	Periodic event information of the location request for a target UE	
areaEventInfo	AreaEventInfo	C	0..1	Area event information of the location request for a target UE	
motionEventInfo	MotionEventInfo	C	0..1	Motion event information of the location request for a target UE	
ldrReference	LdrReference	C	0..1	Notification correlation ID It shall be present in the request from NEF if it is allocated by NEF for the Deferred 5GC-MT-LR procedure. It shall be present in the request to VGMLC for the Deferred 5GC-MT-LR procedure.	
hgmlcCallBackUri	Uri	O	0..1	Notification target address	
externalClientIdentification	ExternalClientIdentification	O	0..1	External LCS client identification	
afId	string	O	0..1	The identification of AF that initiated location request	
uePrivacyRequirements	UePrivacyReqirements	O	0..1	UE privacy requirement	
lcsServiceType	LcsServiceType	O	0..1	LCS service type	
velocityRequested	VelocityRequested	O	0..1	Velocity of the target UE is requested	
priority	LcsPriority	O	0..1	Priority of the location request	
locationTypeRequested	LocationTypeRequested	O	0..1	Requested type of location, applicable to location immediate request	
maximumAgeOfLocationEstimate	AgeOfLocationEstimate	O	0..1	Requested maximum age of the location estimate	
amfId	AmfId	O	0..1	The identification of serving AMF	
codeWord	CodeWord	O	0..1	Code word	

6.1.5.2.3 Type: LocationData

Table 6.1.5.2.3-1: Definition of type LocationData

Attribute name	Data type	P	Cardinality	Description	Applicability
gpsi	Gpsi	O	0..1	Generic Public Subscription Identitfier	
supi	Supi	O	0..1	Subscription Permanent Identifier	
locationEstimate	GeographicArea	O	0..1	Geographic area of the target UE	
civicAddress	CivicAddress	O	0..1	Civic address of the target UE	
ageOfLocationEstimate	AgeOfLocationEstimate	O	0..1	Age of location estimate	
positioningDataList	array(PositioningMethodAndUsage)	O	1..N	If present, this IE shall indicate the usage of each non-GANSS positioning method that was attempted to determine the location estimate, either successfully or unsuccessfully.	
gnssPositioningDataList	array(GnssPositioningMethodAndUsage)	O	1..N	If present, this IE shall indicate the usage of each GANSS positioning method that was attempted to determine the location estimate, either successfully or unsuccessfully.	
accuracyFulfilmentIndicator	AccuracyFulfilmentIndicator	O	0..1	The indication whether the obtained location estimate satisfies the requested accuracy or not	
ueVelocity	VelocityEstimate	O	0..1	Responded UE velocity, if requested and available	
ldrReference	LdrReference	C	0..1	Notification correlation ID It shall be present in the response to NEF if it is allocated by HGMLC for the the Deferred 5GC-MT-LR procedure.	

6.1.5.2.4 Type: CancelLocData

Table 6.1.5.2.4-1: Definition of type CancelLocData

Attribute name	Data type	P	Cardinality	Description	Applicability
supi	Supi	O	0..1	Subscription Permanent Identifier	
gpsi	Gpsi	O	0..1	Generic Public Subscription identifier	
hgmlcCallBackUri	Uri	M	1	Notification target address	
ldrReference	LdrReference	M	1	LDR Reference	
lmfIdentification	LmfIdentification	O	0..1	The latest LMF identification received	
amfId	AmfId	O	0..1	The identification of the serving AMF	

6.1.5.2.5 Type: LocUpdateData

Table 6.1.5.2.5-1: Definition of type LocUpdateData

Attribute name	Data type	P	Cardinality	Description	Applicability
supi	Supi	O	0..1	Subscription Permanent Identifier	
gpsi	Gpsi	O	0..1	Generic Public Subscription identitfier	
pseudonymIndicator	PseudonymIndicator	O	0..1	Pseudonym indicator	
locationRequestType	LocationRequestType	M	1	Event causing the location estimate (5GC-MO-LR)	
locationEstimate	GeographicArea	M	1	Geographic area of the target UE	
ageOfLocationEstimate	AgeOfLocationEstimate	M	1	Age of location estimate	
accuracyFulfilmentIndicator	AccuracyFulfilmentIndicator	M	1	The indication whether the obtained location estimate satisfies the requested accuracy or not	
civicAddress	CivicAddress	O	0..1	Civic address of the target UE	
lcsQosClass	LcsQosClass	M	1	The LCS QoS Class requested by the target UE	
externalClientIdentification	ExternalClientIdentification	O	0..1	Identity of the LCS client	
afId	string	O	0..1	Identity of the AF	
hgmlcAddress	Uri	O	0..1	The address of H-GMLC	
serviceIdentity	ServiceIdentity	O	0..1	Service Identity specified by the UE	

6.1.5.2.6 Type: EventNotifyData

Table 6.1.5.2.6-1: Definition of type EventNotifyData

Attribute name	Data type	P	Cardinality	Description	Applicability
Supi	Supi	O	0..1	Subscription Permanent Identifier	
Gpsi	Gpsi	O	0..1	Generic Public Subscription Identitfier	
ldrReference	LdrReference	M	1	LDR Reference	
eventNotifyDataType	EventNotifyDataType	M	1	The type of event that triggers event notification	
locationEstimate	GeographicArea	O	0..1	Geographic area of the target UE	
civicAddress	civicAddress	O	0..1	Civic address of the target UE	
ageOfLocationEstimate	AgeOfLocationEstimate	O	0..1	Age of location estimate	
positioningDataList	array(PositioningMethodAndUsage)	O	1..N	If present, this IE shall indicate the usage of each non-GANSS positioning method that was attempted to determine the location estimate, either successfully or unsuccessfully.	
gnssPositioningDataList	array(GnssPositioningMethodAndUsage)	O	1..N	If present, this IE shall indicate the usage of each GANSS positioning method that was attempted to determine the location estimate, either successfully or unsuccessfully.	
lmfIdentification	LmfIdentification	O	0..1	LMF identification that stores the location context of the target UE	
amfId	AmfId	O	0..1	The identification of AMF that is serving the target UE	
terminationCause	TerminationCause	C	0..1	The IE shall be included if event reporting has been terminated	

6.1.5.2.7 Type: UePrivacyRequirements

Table 6.1.5.2.7-1: Definition of type UePrivacyRequirements

Attribute name	Data type	P	Cardinality	Description	Applicability
lcsServiceAuthInfo	LcsServiceAuthInfo	O	0..1	When present, this IE shall contain an indication of privacy related notification or verification for the target UE. The default value of this parameter if not presents is "LOCATION_ALLOWED_WITHOUT_NOTIFICATION".	
codeWordCheck	CodeWordCheck	O	0..1	When present, it shall indicate that codeword shall be checked in UE.	

6.1.5.2.8 Void

6.1.5.2.9 Type: LocUpdateNotification

Table 6.1.5.2.9-1: Definition of type LocUpdateNotification

Attribute name	Data type	P	Cardinality	Description	Applicability
supi	Supi	O	0..1	Subscription Permanent Identifier	
gpsi	Gpsi	O	0..1	Generic Public Subscription identitfier	
locationRequestType	LocationRequestType	M	1	Event causing the location estimate (5GC-MO-LR)	
locationEstimate	GeographicArea	M	1	geographic area of the target UE	
ageOfLocationEstimate	AgeOfLocationEstimate	M	1	Age of location estimate	
accuracyFulfilmentIndicator	AccuracyFulfilmentIndicator	M	1	The indication whether the obtained location estimate satisfies the requested accuracy or not	
civicAddress	CivicAddress	O	0..1	Civic address of the target UE	
lcsQosClass	LcsQosClass	M	1	The LCS QoS Class requested by the target UE	
afId	string	O	0..1	Identity of the AF	
serviceIdentity	ServiceIdentity	O	0..1	Service Identity specified by the UE	

6.1.5.3 Simple data types and enumerations

6.1.5.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

6.1.5.3.2 Simple data types

The simple data types defined in table 6.1.5.3.2-1 shall be supported.

Table 6.1.5.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability
ServiceIdentity	string	Service identity	
ExternalClientIdentification	string	External LCS client identification	
CodeWord	string	codeword	
E164CountryCodeOfGeographicArea	string	The combination of one, two or three digits identifying a specific country, countries in an integrated numbering plan, or a specific geographic area	

6.1.5.3.3 Enumeration: PseudonymIndicator

The enumeration PseudonymIndicator represents whether pseudonym should be used as the identity of the target UE. It shall comply with the provisions defined in table 6.1.5.3.3-1.

Table 6.1.5.3.3-1: Enumeration PseudonymIndicator

Enumeration value	Description	Applicability
"PSEUDONYM_REQUESTED"	A pseudonym is requested	
"PSEUDONYM_NOT_REQUESTED"	A pseudonym is not requested	

6.1.5.3.4 Enumeration: LocationRequestType

The enumeration LocationRequestType represents how the location request is triggered. It shall comply with the provisions defined in table 6.1.5.3.4-1.

Table 6.1.5.3.4-1: Enumeration LocationRequestType

Enumeration value	Description	Applicability
"NI-LR"	Network induced location request	
"MT-LR"	Mobile terminated location request	
"MO-LR"	Mobile originated location request	

6.1.5.3.5 Enumeration: LocationTypeRequested

The enumeration LocationTypeRequested represents the requested type of location which is only applicable to location immediate request. It shall comply with the provisions defined in table 6.1.5.3.5-1.

Table 6.1.5.3.5-1: Enumeration LocationTypeRequested

Enumeration value	Description	Applicability
"CURRENT_LOCATION"	Requesting the current location of the target UE	
"CURRENT_OR_LAST_KNOWN_LOCATION"	Requesting the current or last known location of the target UE	
"INITIAL_LOCATION"	Requesting the initial location of the target UE	
"NOTIFICATION_VERIFICATION_ONLY"	Requesting notification verification only	

6.1.5.3.6 Enumeration: EventNotifyDataType

The enumeration EventNotifyDataType represents the type of event notification. It shall comply with the provisions defined in table 6.1.5.3.6-1.

Table 6.1.5.3.6-1: Enumeration EventNotifyDataType

Enumeration value	Description	Applicability
"UE_AVAILABLE"	UE available event	
"PERIODIC"	Periodic event	
"ENTERING_INTO_AREA"	Entering area event	
"LEAVING_FROM_AREA"	Leaving area event	
"BEING_INSIDE_AREA"	Being inside area event	
"MOTION"	Motion event	
"MAXIMUM_INTERVAL_EXPIRATION_EVENT"	Expiration of maximum reporting interval event	
"LOCATION_CANCELLATION_EVENT"	Cancellation of location reporting event	
"ACTIVATION_OF_DEFERRED_LOCATION"	A confirmation that periodic or triggered location was successfully activated in the target UE	

6.1.6 Error Handling

6.1.6.1 General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [5].

6.1.6.2 Protocol Errors

Protocol errors handling shall be supported as specified in clause 5.2.7 of 3GPP TS 29.500 [5].

6.1.6.3 Application Errors

The application errors defined for the Ngmlc_Location service are listed in Table 6.1.6.3-1.

Table 6.1.6.3-1: Application errors

Application Error	HTTP status code	Description
POSITIONING_DENIED	403 Forbidden	the positioning procedure was denied.
UNSPECIFIED	403 Forbidden	the request is rejected due to unspecified reasons.
UNSUPPORTED_BY_UE	403 Forbidden	the position request for periodic or triggered location is not supported by the target UE
LOCATION_SESSION_UNKNOWN	403 Forbidden	the location context was not found
UNREQUESTED_BY_UE	403 Forbidden	the UE did not request transfer of its location to an LCS Client or AF
UNKOWN_EXTERNAL_CLIENT_OR_AF	403 Forbidden	the external LCS client or AF is unknown
UNREACHABLE_EXTERNAL_CLIENT_OR_AF	403 Forbidden	the external LCS client or AF is unreachable
POSITIONING_FAILED	500 Internal Server Error	the positioning procedure failed
UNREACHABLE_USER	504 Gateway Timeout	the user could not be reached in order to perform positioning procedure

6.1.7 Feature negotiation

The optional features in table 6.1.7-1 are defined for the Ngmlc_Location API.

Table 6.1.7-1: Supported Features

Feature number	Feature Name	Description

6.1.8 Security

As indicated in 3GPP TS 33.501 [15], the access to the Ngmlc_Location API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [16]), using the "Client Credentials" authorization grant, where the NRF (see 3GPP TS 29.510 [17]) plays the role of the authorization server.

If Oauth2 authorization is used, an NF Service Consumer, prior to consuming services offered by the Ngmlc_Location API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in 3GPP TS 29.510 [17], clause 5.4.2.2.

NOTE: When multiple NRFs are deployed in a network, the NRF used as authorization server is the same NRF that the NF Service Consumer used for discovering the Ngmlc_Location service.

The Ngmlc_Location API defines scopes for OAuth2 authorization as specified in 3GPP TS 33.501 [15]; it defines a single scope consisting on the name of the service (i.e., "ngmlc-loc"), and it does not define any additional scopes at resource or operation level.

Annex A (normative): OpenAPI specification

A.1 General

This Annex specifies the formal definition of the Ngmlc_Location service. It consists of OpenAPI 3.0.0 specifications, in YAML format.

This Annex takes precedence when being discrepant to other parts of the specification with respect to the encoding of information elements and methods within the API(s).

NOTE: The semantics and procedures, as well as conditions, e.g. for the applicability and allowed combinations of attributes or values, not expressed in the OpenAPI definitions but defined in other parts of the specification also apply.

Informative copies of the OpenAPI specification files contained in this 3GPP Technical Specification are available on a Git-based repository hosted in ETSI Forge, that uses the GitLab software version control system (see 3GPP TS 29.501 [6] clause 5.3.1 and 3GPP TR 21.900 [19] clause 5B).

A.2 Ngmlc_Location API

```
openapi: 3.0.0
info:
  version: '1.0.0'
  title: Ngmlc_Location
  description: |
    Ngmlc_Location Service.
    © 2020, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

externalDocs:
  description: 3GPP TS 29.515 V16.1.0; 5G System; Gateway Mobile Location Services; Stage 3
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.515/'

servers:
  - url: '{apiRoot}/ngmlc-loc/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501

security:
  - {}
  - oAuth2ClientCredentials:
      - ngmlc-loc

paths:
  /provide-location:
    post:
      summary: Request Location of an UE
      operationId: RequestLocation
      tags:
        - Request Location
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/InputData'
        required: true
      responses:
        '200':
          description: Expected response to a valid request
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/LocationData'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '401':
```

```
        $ref: 'TS29571_CommonData.yaml#/components/responses/401'
      '403':
        $ref: 'TS29571_CommonData.yaml#/components/responses/403'
      '404':
        $ref: 'TS29571_CommonData.yaml#/components/responses/404'
      '411':
        $ref: 'TS29571_CommonData.yaml#/components/responses/411'
      '413':
        $ref: 'TS29571_CommonData.yaml#/components/responses/413'
      '415':
        $ref: 'TS29571_CommonData.yaml#/components/responses/415'
      '429':
        $ref: 'TS29571_CommonData.yaml#/components/responses/429'
      '500':
        $ref: 'TS29571_CommonData.yaml#/components/responses/500'
      '503':
        $ref: 'TS29571_CommonData.yaml#/components/responses/503'
      '504':
        $ref: 'TS29571_CommonData.yaml#/components/responses/504'
      default:
        $ref: 'TS29571_CommonData.yaml#/components/responses/default'
    callbacks:
      EventNotify:
        '{$request.body#/hgmlcCallBackUri}':
          post:
            requestBody:
              description: UE Event Notification
              content:
                application/json:
                  schema:
                    $ref: '#/components/schemas/EventNotifyData'
            responses:
              '204':
                description: Expected response to a valid notification
              '400':
                $ref: 'TS29571_CommonData.yaml#/components/responses/400'
              '401':
                $ref: 'TS29571_CommonData.yaml#/components/responses/401'
              '403':
                $ref: 'TS29571_CommonData.yaml#/components/responses/403'
              '404':
                $ref: 'TS29571_CommonData.yaml#/components/responses/404'
              '411':
                $ref: 'TS29571_CommonData.yaml#/components/responses/411'
              '413':
                $ref: 'TS29571_CommonData.yaml#/components/responses/413'
              '415':
                $ref: 'TS29571_CommonData.yaml#/components/responses/415'
              '429':
                $ref: 'TS29571_CommonData.yaml#/components/responses/429'
              '500':
                $ref: 'TS29571_CommonData.yaml#/components/responses/500'
              '503':
                $ref: 'TS29571_CommonData.yaml#/components/responses/503'
              '504':
                $ref: 'TS29571_CommonData.yaml#/components/responses/504'
              default:
                $ref: 'TS29571_CommonData.yaml#/components/responses/default'
  /cancel-location:
    post:
      summary: request cancellation of periodic or triggered location
      operationId: CancelLocation
      tags:
        - Cancel Location
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/CancelLocData'
        required: true
      responses:
        '204':
          description: Expected response to a successful cancellation
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29571_CommonData.yaml#/components/responses/401'
        '403':
```

```
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '411':
          $ref: 'TS29571_CommonData.yaml#/components/responses/411'
        '413':
          $ref: 'TS29571_CommonData.yaml#/components/responses/413'
        '415':
          $ref: 'TS29571_CommonData.yaml#/components/responses/415'
        '429':
          $ref: 'TS29571_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        '504':
          $ref: 'TS29571_CommonData.yaml#/components/responses/504'
        default:
          $ref: 'TS29571_CommonData.yaml#/components/responses/default'
  /location-update:
    post:
      summary: update UE location information
      operationId: UpdateLocation
      tags:
        - Update Location
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/LocUpdateData'
        required: true
      responses:
        '204':
          description: Expected response to successful location context transfer
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29571_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '411':
          $ref: 'TS29571_CommonData.yaml#/components/responses/411'
        '413':
          $ref: 'TS29571_CommonData.yaml#/components/responses/413'
        '415':
          $ref: 'TS29571_CommonData.yaml#/components/responses/415'
        '429':
          $ref: 'TS29571_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        '504':
          $ref: 'TS29571_CommonData.yaml#/components/responses/504'
        default:
          $ref: 'TS29571_CommonData.yaml#/components/responses/default'

components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            ngmlc-loc: Access to the Ngmlc_Location API

  callbacks:
    LocationUpdateNotify:
      '{locationUpdateCallbackUri}': # The {locationUpdateCallbackUri} is configured in GMLC or
discovered via NRF
        post:
          requestBody:
            description: Location Update Notification
            content:
              application/json:
```

```
              schema:
                $ref: '#/components/schemas/LocUpdateNotification'
        responses:
          '204':
            description: Expected response to a valid notification
          '400':
            $ref: 'TS29571_CommonData.yaml#/components/responses/400'
          '401':
            $ref: 'TS29571_CommonData.yaml#/components/responses/401'
          '403':
            $ref: 'TS29571_CommonData.yaml#/components/responses/403'
          '404':
            $ref: 'TS29571_CommonData.yaml#/components/responses/404'
          '411':
            $ref: 'TS29571_CommonData.yaml#/components/responses/411'
          '413':
            $ref: 'TS29571_CommonData.yaml#/components/responses/413'
          '415':
            $ref: 'TS29571_CommonData.yaml#/components/responses/415'
          '429':
            $ref: 'TS29571_CommonData.yaml#/components/responses/429'
          '500':
            $ref: 'TS29571_CommonData.yaml#/components/responses/500'
          '503':
            $ref: 'TS29571_CommonData.yaml#/components/responses/503'
          '504':
            $ref: 'TS29571_CommonData.yaml#/components/responses/504'
          default:
            $ref: 'TS29571_CommonData.yaml#/components/responses/default'

  schemas:
#
# COMPLEX TYPES
#
    InputData:
      type: object
      required:
        - externalClientType
      properties:
        gpsi:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
        supi:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
        externalClientType:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/ExternalClientType'
        locationQoS:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LocationQoS'
        supportedGADShapes:
          type: array
          items:
            $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/SupportedGADShapes'
          minItems: 1
        serviceIdentity:
          $ref: '#/components/schemas/ServiceIdentity'
        serviceCoverage:
          type: array
          items:
            $ref: '#/components/schemas/E164CountryCodeOfGeographicArea'
          minItems: 1
        ldrType:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LdrType'
        periodicEventInfo:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/PeriodicEventInfo'
        areaEventInfo:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/AreaEventInfo'
        motionEventInfo:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/MotionEventInfo'
        ldrReference:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LdrReference'
        hgmlcCallBackUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        externalClientIdentification:
          $ref: '#/components/schemas/ExternalClientIdentification'
        afId:
          type: string
        uePrivacyRequirements:
          $ref: '#/components/schemas/UePrivacyRequirements'
        lcsServiceType:
```

```
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LcsServiceType'
      velocityRequested:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/VelocityRequested'
      priority:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LcsPriority'
      locationTypeRequested:
        $ref: '#/components/schemas/LocationTypeRequested'
      maximumAgeOfLocationEstimate:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/AgeOfLocationEstimate'
      amfId:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/AmfId'
      codeWord:
        $ref: '#/components/schemas/CodeWord'


  LocationData:
    type: object
    properties:
      gpsi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
      supi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
      locationEstimate:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/GeographicArea'
      civicAddress:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/CivicAddress'
      ageOfLocationEstimate:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/AgeOfLocationEstimate'
      positioningDataList:
        type: array
        items:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/PositioningMethodAndUsage'
        minItems: 1
      gnssPositioningDataList:
        type: array
        items:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/GnssPositioningMethodAndUsage'
        minItems: 1
      accuracyFulfilmentIndicator:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/AccuracyFulfilmentIndicator'
      ueVelocity:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/VelocityEstimate'
      ldrReference:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LdrReference'

  CancelLocData:
    type: object
    required:
      - hgmlcCallBackUri
      - ldrReference
    properties:
      gpsi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
      supi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
      hgmlcCallBackUri:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
      ldrReference:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LdrReference'
      lmfIdentification:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LMFIdentification'
      amfId:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/AmfId'

  LocUpdateData:
    type: object
    required:
      - locationRequestType
      - locationEstimate
      - ageOfLocationEstimate
      - accuracyFulfilmentIndicator
      - lcsQosClass
    properties:
      gpsi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
      supi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
      locationRequestType:
```

```
        $ref: '#/components/schemas/LocationRequestType'
      locationEstimate:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/GeographicArea'
      ageOfLocationEstimate:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/AgeOfLocationEstimate'
      accuracyFulfilmentIndicator:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/AccuracyFulfilmentIndicator'
      civicAddress:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/CivicAddress'
      lcsQosClass:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LcsQosClass'
      externalClientIdentification:
        $ref: '#/components/schemas/ExternalClientIdentification'
      afId:
        type: string
      hgmlcAddress:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
      serviceIdentity:
        $ref: '#/components/schemas/ServiceIdentity'

  EventNotifyData:
    type: object
    required:
      - eventNotifyDataType
      - ldrReference
    properties:
      gpsi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
      supi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
      ldrReference:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LdrReference'
      eventNotifyDataType:
        $ref: '#/components/schemas/EventNotifyDataType'
      locationEstimate:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/GeographicArea'
      civicAddress:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/CivicAddress'
      ageOfLocationEstimate:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/AgeOfLocationEstimate'
      positioningDataList:
        type: array
        items:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/PositioningMethodAndUsage'
        minItems: 1
      gnssPositioningDataList:
        type: array
        items:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/GnssPositioningMethodAndUsage'
        minItems: 1
      lmfIdentification:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LMFIdentification'
      amfId:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/AmfId'
      terminationCause:
        $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/TerminationCause'

  UePrivacyRequirements:
    type: object
    properties:
      lcsServiceAuthInfo:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/LcsServiceAuth'
      codeWordCheck:
        type: boolean

  LocUpdateNotification:
    type: object
    required:
      - locationRequestType
      - locationEstimate
      - ageOfLocationEstimate
      - accuracyFulfilmentIndicator
      - lcsQosClass
    properties:
      gpsi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
      supi:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
```

```
        locationRequestType:
          $ref: '#/components/schemas/LocationRequestType'
        locationEstimate:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/GeographicArea'
        ageOfLocationEstimate:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/AgeOfLocationEstimate'
        accuracyFulfilmentIndicator:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/AccuracyFulfilmentIndicator'
        civicAddress:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/CivicAddress'
        lcsQosClass:
          $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/LcsQosClass'
        afId:
          type: string
        serviceIdentity:
          $ref: '#/components/schemas/ServiceIdentity'

#
# SIMPLE TYPES
#
    ServiceIdentity:
      type: string
    ExternalClientIdentification:
      type: string
    CodeWord:
      type: string
    E164CountryCodeOfGeographicArea:
      type: string
#
# ENUMS
#
    PseudonymIndicator:
      anyOf:
        - type: string
          enum:
            - PSEUDONYM_REQUESTED
            - PSEUDONYM_NOT_REQUESTED
        - type: string
    LocationRequestType:
      anyOf:
        - type: string
          enum:
            - NI_LR
            - MT_LR
            - MO_LR
        - type: string
    LocationTypeRequested:
      anyOf:
        - type: string
          enum:
            - CURRENT_LOCATION
            - CURRENT_OR_LAST_KNOWN_LOCATION
            - INITIAL_LOCATION
            - NOTIFICATION_VERIFICATION_ONLY
        - type: string
    EventNotifyDataType:
      anyOf:
        - type: string
          enum:
            - UE_AVAILABLE
            - PERIODIC
            - ENTERING_INTO_AREA
            - LEAVING_FROM_AREA
            - BEING_INSIDE_AREA
            - MOTION
            - MAXIMUM_INTERVAL_EXPIRATION_EVENT
            - LOCATION_CANCELLATION_EVENT
            - ACTIVATION_OF_DEFERRED_LOCATION
        - type: string
```

Annex B (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2019-04	CT4#90	C4-191340				Initial Draft of Gateway Mobile Location Services	0.1.0
2019-05	CT4#91	C4-192485				V0.2.0	0.2.0
2019-09	CT4#93	C4-193845				Implementation of pCRs agreed at CT4#93	0.3.0
2019-10	CT4#94	C4-194555				Implementation of pCRs agreed at CT4#94	0.4.0
2019-11	CT4#95	C4-195413, C4-195409, C4-195296				Implementation of pCRs agreed at CT4#95	0.5.0
2019-12	CT#86	CP-193065				TS presented for information	1.0.0
2020-03	CT4#96e	C4-200725, C4-200727, C4-200943, C4-200993, C4-200995, C4-201286				Implementation of pCRs agreed at CT4#96e	1.1.0
2020-03	CT#87e	CP-200060				TS presented for approval	2.0.0
2020/03	CT#87e					Approved at CT87e	16.0.0
2020/04	CT4#97e	C4-202409	0001	1	F	Correct the errors	16.1.0
2020/04	CT4#97e	C4-202325	0003	-	F	Miscellaneous corrections on TS 29.515	16.1.0
2020/04	CT4#97e	C4-202326	0004	-	F	Removing pseudonym of UE	16.1.0
2020/04	CT4#97e	C4-202532	0005	1	F	UE Privacy Requirements Corrections	16.1.0
2020/06	CT4#98e	C4-203181	0006	-	F	Error corrections	16.1.0
2020/06	CT4#98e	C4-203540	0007	1	F	Storage of YAML files in ETSI Forge	16.1.0
2020/06	CT4#98e	C4-203524	0008	1	F	Correct the Example Consumer(s) in Table 5.1-1	16.1.0
2020/06	CT4#98e	C4-203269	0010	-	F	LDRreference	16.1.0
2020/06	CT4#98e	C4-203360	0003	1	F	Miscellaneous corrections on TS 29.515	16.1.0
2020/06	CT4#98e	C4-203645	0011	-	F	3GPP TS 29.515 API Version Update	16.1.0

History

Document history		
V16.1.0	July 2020	Publication