



Location Services Requirements

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Introduction



- This presentation provides an overview of key elements of the 3GPP Location Services Stage 1 Specification, 3GPP TS 22.071.
- For additional information and further details, please refer to the specification.

TS 22.071 Scope

- “Location Services may be considered as a network provided enabling technology consisting of standardized service capabilities which enable the provision of location based applications.”
- 3GPP TS 22.071 provides core requirements to an extent sufficient to derive a complete definition of location services at the service level.

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TS 22.071 Scope

Location Services are provided using a Client / Server paradigm to the following categories of Clients:

- **Value Added Services LCS Clients**
- **PLMN Operator LCS Clients**
- **Emergency Services LCS Clients**
- **Lawful Intercept LCS Clients**

Key Terms

See 22.071 for more exact and detailed definitions.

- **LCS Client:** a software and/or hardware entity that interacts with a LCS Server for the purpose of obtaining location information for one or more Mobile Stations.
- **LCS Server:** a software and/or hardware entity offering LCS capabilities. The LCS Server accepts requests, services requests, and sends back responses to the received requests.

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Key Terms

- **LCS Feature:** the capability of a PLMN to support LCS Client/server interactions for locating Target MSs.
- **Location Estimate:** the geographic location of an MS and/or a valid Mobile Equipment (ME), expressed in latitude and longitude data.

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Key Terms

- **Initial Location:** the location estimate and the associated time stamp at the commencement of call set-up.
- **Current Location:** the location estimate and time stamp at the time it is delivered after a successful location attempt.
- **Last Known Location:** The current location estimate and its associated time stamp for Target MS stored in the LCS Server until replaced by a later location estimate and a new time stamp.

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Key Terms

- **Immediate location request:** a location request where a single location response only is required immediately.
- **Deferred location request:** a location request where the location response (responses) is (are) not required immediately.

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3G TS 22.071 Contents

Key Sections:

(Described in subsequent slides)

- **Functional Requirements**
- Logical Description
- Informative Descriptions of Services

Functional Requirements

It shall be possible to identify and report in a standard format (e.g. geographical coordinates) the current location of the user's terminal and to make the information available to the user, ME, network operator, service provider, value added service providers and for PLMN internal operations.

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Functional Requirements

Location-based services may be described in terms of attributes whose importance varies from service to service, including:

- **Accuracy:** the difference between the actual and estimated location
- **Coverage:** the geographic area in which the user receives an adequate service,
- **Privacy:** confidentiality of the location information
- **Transaction Rate:** how frequently network messaging is required to support the service.

Functional Requirements

Key Topics:

(Described in subsequent slides)

- High Level Requirements
- Quality of Service
- Reliability
- Security
- Privacy

Functional Requirements

Main Topics described in subsequent slides

- High Level Requirements
- Location Information
- Quality of Service
- Reliability
- Security
- Privacy

Functional Requirements

- High Level Requirements (1 of 7)
 1. The supporting mechanisms should incorporate flexible modular components with open interfaces that facilitate equipment interoperability and the evolution of service providing capabilities.

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Functional Requirements

- High Level Requirements (2 of 7)

2. The network should be sufficiently flexible to accommodate evolving enabling mechanisms and service requirements to provide new and improved services.

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Functional Requirements

- High Level Requirements (3 of 7)
3. It shall be possible to provide multiple layers of permissions to comply with local, national, and regional privacy requirements.

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Functional Requirements

- High Level Requirements (4 of 7)

4. Multiple positioning methods should be supported in the different Access Networks, including (but not limited to) UL-TOA, E-OTD, IPDL-OTDOA, Network Assisted GPS and methods using cell site or sector information and Timing Advance or RoundTrip Time measurements.

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Functional Requirements

- High Level Requirements (5 of 7)

5. The location determining process should be able to combine diverse positioning techniques and local knowledge when considering quality of service parameters to provide an optimal positioning request response.

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Functional Requirements

- High Level Requirements (6 of 7)
6. It should be possible to provide position information to location services applications existing within the PLMN, external to the PLMN, or in Mobile Equipment.

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Functional Requirements

- High Level Requirements (7 of 7)
7. Support should be provided for networks based on an Intelligent Network architecture (i.e. with specific support for CAMEL based Location Services).

Functional Requirements

- Quality of Service

When location information is delivered with a

location estimate,

confidence region, (horizontal, vertical accuracy)

speed and heading (velocity)

an application may improve the service delivered to the MS user by requesting a subsequent positioning if the desired Quality of Service isn't provided.

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Functional Requirements

- Quality of Service

Response Time

Different location based services, or different LCS Clients, may have different requirements (depending on the urgency of the positioning request) for obtaining a response. The location server may need to make trade-offs between requirements for positioning accuracy and response time.

Response Time is a QoS parameter that is determined either at provisioning or when the location request is made.

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Functional Requirements

- Quality of Service

Response Time Options

Three Response Time values are defined (each explained in subsequent slides):

- No Delay
- Low Delay
- Delay Tolerant

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Functional Requirements

- Quality of Service

Response Time Options (1 of 3)

- **No Delay:** the server should immediately return any location estimate that it currently has. The LCS Server shall return either Initial or Last Known Location of the Target MS. If no estimate is available, the LCS Server shall return the failure indication and may optionally initiate procedures to obtain a location estimate (e.g. to be available for a later request).

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Functional Requirements

- Quality of Service

Response Time Options (2 of 3)

- **Low Delay:** fulfillment of the response time requirement takes precedence over fulfillment of the accuracy requirement. The LCS Server shall return the Current Location with minimum delay. The LCS shall attempt to fulfill any accuracy requirement, but in doing so shall not add any additional delay (i.e. a quick response with lower accuracy is more desirable than waiting for a more accurate response).

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Functional Requirements

- Quality of Service

Response Time Options (3 of 3)

- **Delay Tolerant:** fulfillment of the accuracy requirement takes precedence over fulfillment of the response time requirement. If necessary, the server should delay providing a response until the accuracy requirement of the requesting application is met. The LCS Server shall obtain a Current Location with regard to fulfilling the accuracy requirement.

Functional Requirements

- Reliability

Reliability provides a measure of how often positioning requests that satisfy QoS requirements are successful. For some applications, such as cross-country vehicle tracking, this may not be especially critical. If a positioning attempt fails, due to lack of coverage or transient radio conditions, etc, another positioning attempt may be made. However for other services, perhaps such as child tracking, reliability may be more important.

The network shall provide statistical reporting of reliability (QoS parameters) data.

Functional Requirements

- Priority

The LCS Server may allow different location requests to be assigned different levels of priority. A location request with a higher priority may be accorded faster access to resources than one with a lower priority and may receive a faster, more reliable and/or more accurate location estimate.

For Emergency Services (where required by local regulatory requirements) the location request shall be processed with the highest priority level.

Functional Requirements

- Security

Specific local, national, and regional security regulations must be complied with.

Only authorized LCS Clients shall be able to access the LCS Server. Before providing the location of a Target MS to any authorized LCS Client, the LCS Server shall verify both the identity and authorization privileges of the LCS Client .

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Functional Requirements

- Security

Location information shall be safeguarded against unapproved disclosure or usage, and provided in a secure and reliable manner that ensures information is neither lost nor corrupted.

Audit records should be maintained of positioning requests and responses to facilitate resolution of security violations.

Functional Requirements

- Privacy

Specific local, national, and regional privacy regulations must be complied with, and multiple layers of permissions may be required.

Location information must always be available to the network service provider.

Means shall be provided for the MS subscriber to control privacy for value added services.

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Functional Requirements

- Privacy

Unless required by local regulatory requirements, or overridden by the target MS User, the target MS may be positioned only if allowed in the MS subscription profile.

In general the target MS being positioned should be afforded the maximum possible privacy, and should not be positioned unless the positioning attempt is explicitly authorized. In the absence of specific permission to position the target MS, the target MS should not be positioned.

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Functional Requirements

- Privacy

The default treatment, which is applicable in the absence of a response from the Target MS, shall be specified in the LCS Subscription Profile.

The default condition shall normally be to deny the positioning attempt.

For Emergency Services and Lawful Interception) MSs may be positioned under all circumstances required by local regulatory requirements.

Functional Requirements

- Service Activation, Deactivation

Three types of service packages may be distinguished:

On Demand: the user accesses services only when required.

Period Subscription: the subscriber requires periodic availability of the service

Mixed: some services provided on subscription and the remainder on-demand.

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Functional Requirements

- Service Activation, Deactivation
- The process of activation + service delivery + deactivation may be provided in a single transaction. It may be possible for a subscriber to activate a location service on one occasion before deactivating an existing invocation.
- Furthermore, a location service may be ‘enabled’ at the point of sale as part of the service package purchased by the MS subscriber. The use of Over-The-Air (OTA) provisioning may allow the location feature to be enabled for MS-based positioning methods.

Functional Requirements

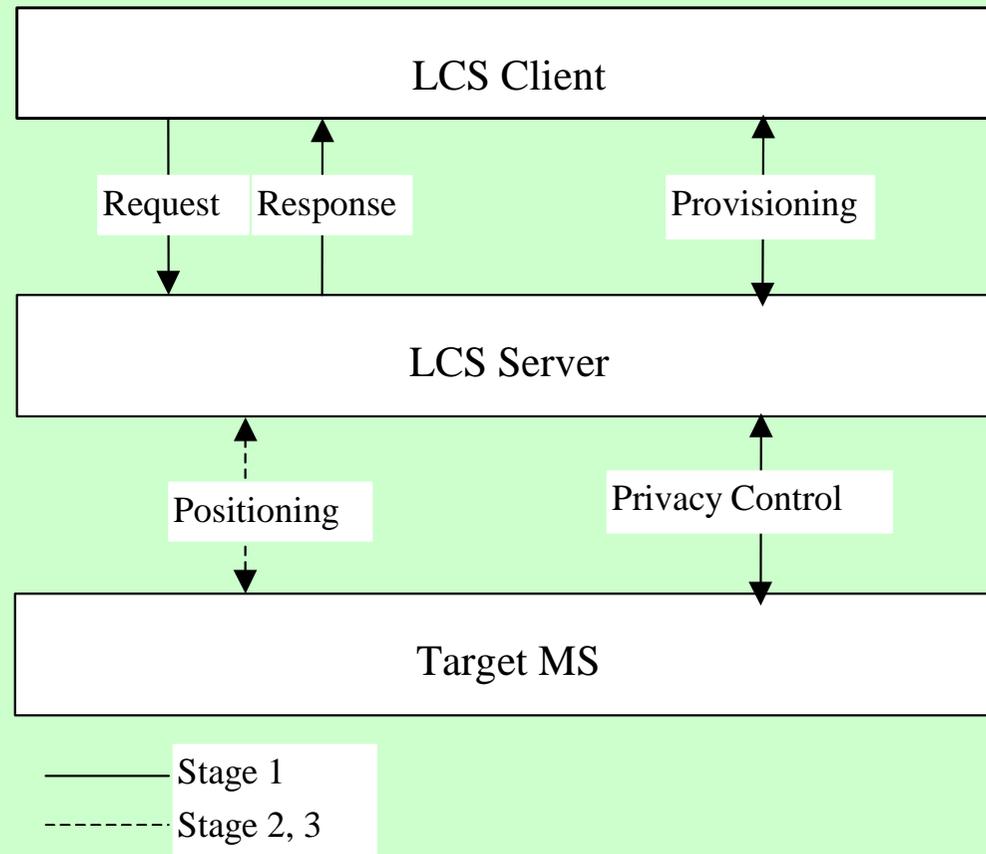
- Coverage
- In general, provided that a roaming agreement exists, any properly authorized location-based service may position a Target MS in either the Home PLMN (HPLMN) or a Visited PLMN (VPLMN).
- It may be noteworthy that some location based services (such as location based information services) may be especially attractive to subscribers roaming outside their home networks.

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Functional Requirements

- Coverage
- The provided quality of service may vary due to dynamic environmental (i.e. radio) conditions, such that a homogeneous service quality can not be guaranteed.
- The roaming partner's network may not accept the same location method as that of the home network and the service may not be available in a roaming partner's network despite technical interoperability between the location method supported by the MS and the network.

Logical Reference Model



Logical Reference Model

Client / Server Interface

- Location Service Request: 2 Types

Request Type	Response Time	Number of Responses
Immediate	Immediate	Single
Deferred	Delayed (event driven)	One or More

Logical Reference Model

Privacy Exception List

- To support privacy , the LCS Server shall enable each Target MS Subscriber to subscribe to a “privacy exception list” containing the LCS Client identifiers and classes of LCS Clients to which the MS’s location may be provided.

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Logical Reference Model

Privacy Exception List

- The following LCS Client Classes are supported
 - Universal Class: provided to all LCS Clients
 - Call-related Class: provided to a Target MS in the form of an established voice or data call
 - Call-unrelated Class: provided to a Target MS without an established voice or data call
 - PLMN Operator Class: may include various broadcast services

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USA FCC Wireless E911 Rules

Annex A (Informative) provides an overview of Wireless E911 Rules for the USA.

Various deployment schedules exist depending on the approach (network based, handset based, hybrid) being pursued.

Accuracy Requirement summary:

- For network-based solutions: 100 meters for 67 percent of calls, 300 meters for 95 percent of calls;
- For handset-based solutions: 50 meters for 67 percent of calls, 150 meters for 95 percent of calls.

Commercial Services

Annex B (Informative) provides an overview of the requirements for various possible commercial services, including:

Public Safety Services

Location based charging

Tracking Services

Enhanced Call Routing

Location Based Information Services

Network Enhancing Services

Commercial Services

Annex C (Informative) provides an overview of the requirements of various possible commercial services in terms of their attributes, and considers:

Service Authorization, Privacy, Target Subscription Notification, Accuracy (Horizontal and Vertical), Response Time, Reliability, Security, Periodic Location Reporting, Service Registration, Service Activation, Service Invocation, Roaming, Service Specific Considerations, and Interactions with other wireless services.