LPP Extensions Requirements

Candidate Version 1.0 – 12 Oct 2010

Open Mobile Alliance

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1. Scope (Informative)

This document specifies the requirements of the OMA LPP Extensions (LPPe).

2. References

2.1 Normative References

[3GPP-LPP]	LTE Positioning Protocol, 3GPP TS 36.355, URL:http://www.3gpp.org/
[RFC2119]	"Key words for use in RFCs to Indicate Requirement Levels", S. Bradner, March 1997, URL:http://www.ietf.org/rfc/rfc2119.txt
[OMA-SUPLv3-RD]	"Secure User Plane Location Requirements" , Open Mobile Alliance™, Version 3.0, OMA-RD-SUPL-V3_0, URL: http://www.openmobilealliance.org/

2.2 Informative References

3. Terminology and Conventions

3.1 Conventions

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [RFC2119].

All sections and appendixes, except “Scope” and “Introduction”, are normative, unless they are explicitly indicated to be informative.

3.2 Definitions

Target	Termination point of LPP/LPPe
Server	Termination point of LPP/LPPe
Baseline	Vector between antenna reference points
Relative Position	See baseline
Relative Velocity	First time derivative of the baseline

3.3 Abbreviations

OMA	Open Mobile Alliance
DSL	Digital Subscriber Line
E-OTD	Enhanced Observed Time Difference
E-UTRAN	Evolved UTRAN
ECID	Enhanced Cell ID
EDGE	Enhanced Data rates for Global Evolution
EPDU	External Protocol Data Unit
FDD	Frequency-Division Duplex
GERAN	GSM/EDGE RAN
GNSS	Global Navigation Satellite System, collective name for a variety of satellite positioning systems including GPS, Galileo and GLONASS
GSM	Global System for Mobile communications
IPDL	Idle Period Downlink
LAN	Local Area Network
LBS	Location-Based Services
LCS	Location Services
LPP	LTE Positioning Protocol, defined in [3GPP-LPP]
LPPe	OMA LPP Extensions
LTE	Long Term Evolution
OTDOA	Observed Time Difference of Arrival
RAN	Radio Access Network
SLP	SUPL Location Platform
SUPL	Secure User Plane Location
SV	Space Vehicle
TDD	Time-Division Duplex

UE	User Equipment
UMTS	Universal Mobile Telecommunication System
UTC	Universal Time Coordinated
UTRAN	UMTS Terrestrial RAN
WLAN	Wireless Local Area Network

4. Introduction (Informative)

4.1 Version 1.0

LTE Positioning Protocol LPP [3GPP-LPP] is a positioning protocol for E-UTRAN control plane. However, LPP has been designed in such a way that it can also be utilized outside the control plane domain such as in the user plane in the context of SUPL.

LPP elementary messages (Request and Provision of Capabilities and Location Information and Assistance Data) each include a container, an EPDU, which can be used by standardization fora outside 3GPP to define their own extensions to LPP messages. OMA LPP Extensions take advantage of this option.

A variety of known and emerging positioning technologies are not in the scope of 3GPP work. This is natural, because control plane deployments are bandwidth-constrained and limited to access types that are part of the control plane system. However, the user plane does not have any such limitations and, hence, new positioning technologies improving accuracy, availability and integrity can be realized in the user plane.

The advantages resulting from OMA building LPPe on top of the 3GPP-defined LPP include the convergence of control and user plane positioning protocols, reduced work load and being able to use the same LPPe protocol stack both in the control and user planes.

5. LPP Extensions release description (Informative)

3GPP LPP is a positioning protocol that provides procedures for

- Request and Provision of location information including raw measurements
- Request and Provision of assistance data
- Request and Provision of capabilities

OMA LPP Extensions (LPPe) build on the 3GPP-defined LPP and extends the location, measurement and assistance data capabilities beyond 3GPP LPP without unnecessarily duplicating the work done in 3GPP.

The purpose of OMA LPPe Release 1.0 is to enable support for

- High accuracy GNSS methods in the form of new positioning methods and assistance data types
- Emerging radio network –based positioning technologies including the radio network measurement reports for selected radio access types
- Terminal-to-terminal positioning and assistance data transfer

Moreover, OMA LPPe attempts to be bearer-independent as far as possible with respect to non-bearer associated position methods like A-GNSS and any terrestrial method applicable to a non-serving network.

Security, authentication, privacy and charging are out of scope of LPPe. It is assumed that these services are provided by the user plane protocol which uses LPP/LPPe as the positioning protocol.

5.1 End-to-end Service Description

3GPP LPP and OMA LPPe together provide a protocol for estimating user position and velocity at a desired accuracy and time to fix Estimation may include positioning method negotiation as well as assistance data and/or measurement transfer.

It should be noted that LPP/LPPe is not an LBS protocol and does not expose an API to LCS application. LPP/LPPe provides means for obtaining the position of the target as well as other location-related information from the target, which information may then be used by the LCS application.

6. Requirements (Normative)

6.1 High-Level Functional Requirements

Label	Description	Release
LPP-HLF-001	LPPe SHALL support fixed access types such as Cable, DSL, LAN, etc.	1.0
LPP-HLF-002	LPPe SHALL support dynamic swapping of LPP target and server roles in a client to client scenario and for certain instances of terminal to network scenario. **Informational Note 1**: In a client (terminal, laptop or any other end-user device) to client scenario, role swapping may be used to enable either end to provide location information and assistance data to the other; in a terminal to network scenario, it may be used to support transfer of capabilities and location information from a server to a target and transfer of assistance data from a target to a server. **Informational Note 2**: Additional capabilities may be needed to indicate an ability to swap roles	1.0
LPP-HLF-003	LPPe SHALL follow the protocol architecture, messaging, conventions and rules defined in [3GPP-LPP]. **Informational Note:** Protocol architecture refers to the LPP termination points defined as target and server in [3GPP-LPP]. Messaging refers to the messages, message directions as well as to procedure and transaction handling. Rules refer to e.g. use of error and abort messages.	1.0

Table 1: High-Level Functional Requirements

6.1.1 Security

Label	Description	Release
LPP-SEC-001	LPPe SHALL rely on the security procedures provided by its transport. **Informational Note:** LPPe contains no security procedures of its own	1.0

Table 2: High-Level Functional Requirements – Security Items

6.1.1.1 Authentication

Not applicable

6.1.1.2 Authorization

Not applicable

6.1.1.3 Data Integrity

Not applicable

6.1.1.4 Confidentiality

Not applicable

6.1.2 Charging Events

Not applicable

6.1.3 Administration and Configuration

Not applicable

6.1.4 Usability

Not applicable

6.1.5 Interoperability

Not applicable

6.1.6 Privacy

Not applicable

6.2 Overall System Requirements

Table 3: High-Level System Requirements

6.3 Location Technology Requirements

6.3.1 Assistance Data Requirements

Label	Description	Release
LPP-AD-001	LPPe SHALL support request and provision of assistance data change notifications for the conditions, where the data the UE has is invalid, incorrect, inaccurate or worse than determined performance threshold. **Informational Note 1**: Assistance data change notifications can be used with, e.g., extended navigation models, local troposphere models and local ionosphere models. **Informational Note 2:** Notification may also be given proactively, in which case the notification indicates the time from which onwards the data is invalid. **Informational Note 3:** This requirement relates to the use case B.1	1.0

LPP-AD-002	LPPe SHALL support more precise ionosphere models. **Informational Note 1**: More precise is with respect to the currently supported GNSS native ionosphere models in [3GPP-LPP]. **Informational Note 2**: More precision may be obtained for instance by new model types or limiting the validity area and period. **Informational Note 3:** This requirement relates to the use case B.2	1.0
LPP-AD-003	LPPe SHALL support troposphere models. **Informational Note:** This requirement relates to the use case B.2	1.0
LPP-AD-004	LPPe SHALL support altitude assistance for improved availability and altitude performance. **Informational Note:** This requirement relates to the use case B.2	1.0
LPP-AD-005	LPPe information elements SHOULD be specified so that they enable broadcasting the data for a wide area. **Informational Note:** This requirement relates to the use case B.3	1.0
LPP-AD-006	LPPe SHALL support measurements and assistance for high-accuracy relative positioning. **Informational Note:** This requirement relates to the use case B.6	1.0
LPP-AD-007	LPPe SHALL support periodic assistance data and periodic assistance data with data continuity between the assistance data messages. **Information Note 1:** Data continuity refers to the assistance data being generated and/or tracked also between the assistance data deliveries as opposed to the snapshot at the delivery time. **Informational Note 2:** This requirement relates to the use case B.6	1.0
LPP-AD-008	LPPe SHALL support modifying the (continuous) periodic assistance data session. **Informational Note 1**: Modification in this context may include terminating the session, extending the session or changing the delivery interval. **Informational Note 2:** This requirement relates to the use case B.6	1.0
LPP-AD-009	LPPe SHALL support the change of reference station providing position estimation continuity. **Informational Note:** This requirement relates to the use case B.6	1.0

LPP-AD-010	LPPe SHALL support more precise and/or more extended SV orbit and clock parameterizations. **Informational Note 1**: More precise and more extended are with respect to the currently supported GNSS native orbit/clock parameterizations in [3GPP-LPP]. **Informational Note 2:** This requirement relates to the use case B.7	1.0
LPP-AD-011	LPPe SHALL support SV orbit and clock model degradation models. **Informational Note:** This requirement relates to the use case B.7	1.0
LPP-AD-012	LPPe shall support SV differential code biases for transmitted RF signals andantenna offset vectors. **Informational Note:** This requirement relates to the use case B.7	1.0
LPP-AD-013	LPPe SHALL support request and provision of updated assistance data, e.g. to replace invalid, incorrect or out-of-date data in a UE. **Informational Note 1:** AD-001 introduces the notification to the target that some event, related to the assistance data the UE has, has taken place. This requirement defines the request for the potentially changed data. **Informational Note 2:** This requirement relates to the use case B.10	1.0
LPP-AD-014	LPPe SHALL support requesting information, if the data the UE has is invalid, incorrect or out-of-date, and support providing the UE with information from which time onwards the data the UE has is invalid. **Informational Note 1:** AD-001 introduces the notification to the target that some event, related to the assistance data the UE has, has taken place. This requirement defines the request/response procedure for checking the applicability of the data the UE has. **Informational Note 2:** This requirement relates to the use case B.10	1.0
LPP-AD-015	LPPe SHALL support mechanism for providing the UE an estimation of the assistance data size that might be provided **Informational Note:** This requirement relates to the use case B.10	1.0
LPP-AD-016	LPPe SHALL support mechanism for proprietary assistance data and measurement extensions with standardized labeling and a data container. LPPe capabilities SHALL enable an endpoint to indicate its support of such proprietary data. **Informational Note:** This requirement relates to the use case B.10	1.0

LPP-AD-017	LPPe SHALL support versioning of assistance data, where applicable. **Informational Note 1:** Versioning does not refer to the versioning of the data formats, but to the different revisions of the content, i.e. to changing the version number, when the data is updated at the server side. Timestamping is one example of providing versioning. **Informational Note 2:** This requirement relates to the use case B.10	1.0
LPP-AD-018	LPPe SHALL support for applicable data types request and provision for assistance data that extends assistance data that the UE already has. **Informational Note:** This requirement relates to the use case B.10	1.0
LPP-AD-019	LPPe SHALL support request and provision of assistance data comprising base station, WiFi AP, BT AP and other short range communication node identities and/or addresses, locations, transmit power, antenna gain, maximum antenna range, frequency use and other information helpful to performing measurements of these network nodes.	1.0
LPP-AD-020	LPPe SHALL support request and provision of assistance data for non-serving access networks that may be visible to a UE for position methods supported by LPP and LPPe for a serving network.	1.0
LPP-AD-021	LPPe SHALL support assistance data applicable to positioning-enabled nodes in a building. **Informational Note 1:** Assistance data may include node positions (absolute, relative, civic address, in-building address), node IDs, node types, antenna, calibration or other useful information on such nodes. **Informational Note 2:** Positioning nodes are any tags, beacons or devices that are used for positioning. This requirement focuses on tag positioning technology whereas LPP-AD-019 focuses on wireless communication systems (WIFi, BT, etc.).	1.0

Table 4: Location Technology Requirements – Assistance Data Items

6.3.2 Measurement and Location Information Requirements

Label	Description	Release
LPP-MLI-001	LPPe SHALL support local troposphere measurements. **Informational Note:** This requirement relates to the use case B.4	1.0
LPP-MLI-002	LPPe SHALL support ionosphere delay measurements. **Informational Note:** This requirement relates to the use case B.4	1.0

LPP-MLI-003	LPPe SHALL support UE provision of satellite assistance data. **Informational Note 1**: UE may provide satellite assistance data to another UE or to a server (SLP). **Informational Note 2**: Satellite assistance data may include ephemerides, almanac, UTC model, GNSS-GNSS time offsets and broadcast ionosphere model. **Informational Note 3:** This requirement relates to the use case B.4	1.0
LLP-MLI-004	LPPe MAY support periodic measurements with measurement continuity between the measurement messages. **Informational note 1:** Data continuity refers to the measurements being made also over the interval between the measurement messages as opposed to the snapshot measurements at the message delivery time. **Informational Note 2:** This requirement may be better supported in LPP or SUPL 3.0 which may be evaluated during the TS phase. **Informational Note 3:** This requirement relates to the use case B.6	1.0
LPP-MLI-005	LPPe MAY support modifying the (continuous) periodic measurement session. **Informational Note 1**: Modification in this context may include terminating the session, extending the on-going session or changing the delivery interval. **Informational Note 2:** This requirement may be better supported in LPP or SUPL 3.0 which may be evaluated during the TS phase. **Informational Note 3:** This requirement relates to the use case B.6	1.0
LPP-MLI-006	LPPe SHALL support carrying antenna information for improved performance. **Informational Note 1**: Antenna information may include antenna identification and antenna orientation information. **Informational Note 2:** This requirement relates to the use case B.6	1.0
LPP-MLI-007	LPPe SHALL support carrying pressure information between the entities being positioned with respect to each other for improved relative altitude performance. **Informational Note:** This requirement relates to the use case B.6	1.0
LPP-MLI-008	LPPe SHALL support UE-assisted GERAN ECID **Informational Note:** This requirement relates to the use case B.8	1.0
LPP-MLI-009	LPPe SHALL support UE-assisted UTRA-TDD/FDD ECID **Informational Note:** This requirement relates to the use case B.8	1.0
LPP-MLI-010	LPPe SHALL support UE-assisted/UE-based WLAN ECID **Informational Note:** This requirement relates to the use case B.8	1.0

LPP-MLI-011	LPPe SHALL support UE-assisted/UE-based E-OTD **Informational Note:** This requirement relates to the use case B.8	1.0
LPP-MLI-012	LPPe SHALL support UE-assisted/UE-based OTDOA-IPDL **Informational Note:** This requirement relates to the use case B.8	1.0
LPP-MLI-013	LPPe SHALL support representing absolute position in centimeter-level resolution in WGS-84 or other geographic coordinate system. The associated uncertainty MUST have similar resolution. **Informational Note:** This requirement relates to the use case B.9	1.0
LPP-MLI-014	LPPe SHALL support representing absolute velocity in millimeter/second-level resolution. The associated uncertainty MUST have similar resolution. **Informational Note:** This requirement relates to the use case B.9	1.0
LPP-MLI-015	LPPe SHALL support presenting relative position in centimeter-level resolution. The associated uncertainty MUST have similar resolution. **Informational Note 1**: The meaning of the relative position, i.e. the end points of the vector representing relative position, must be defined during the LPPe TS work. **Informational Note 2:** This requirement relates to the use case B.9	1.0
LPP-MLI-016	LPPe SHALL support presenting relative velocity in millimeter/second-level resolution. **Informational Note 1**: Relative velocity is to be understood as the time derivative of the vector representing relative position, i.e. it is the relative motion of the baseline end points. **Informational Note 2:** This requirement relates to the use case B.9	1.0
LPP-MLI-017	LPPe SHALL support requesting and providing information related to the UE motion state. **Informational Note 1**: Motion state may include attributes such as walking, running, cycling and driving. **Informational Note 2**: Transferred requirement from [OMA-SUPLv3-RD]	1.0
LPP-MLI-018	LPPe SHALL support UE-based OTDOA positioning for E-UTRAN. Support of OTDOA (UE assisted and UE based versions) SHALL extend to femtocells. **Informational Note 1:** Assistance data provided will not duplicate support already in LPP. **Informational Note 2:** Additional information may be provided to identify and assist use of femtocells.	1.0

LPP-MLI-019	LPPe SHALL support reporting of multiple serving and non-serving, current and past E-CID measurements from the UE to an appropriate entity in the network for all the supported wireless access types. LPPe SHALL support reporting of multiple serving and non-serving positioning supporting measurements to the network for all the supported fixed access types. **Informational Note:** this requirement is synonymous to the Multiple Location ID feature in SUPL 2.0	1.0
LPP-MLI-020	LPPe SHALL support request and provision of high confidence error bounds **Informational Note:** This requirement relates to the use case B.11	1.0
LPP-MLI-021	LPPe SHALL support request and provision of relative changes in location over a single time period or over a sequence of time periods including historic time periods.	1.0
LPP-MLI-022	LPPe SHALL support request for and provision of the IP address of all the available bearers.	1.0
LPP-MLI-023	LPPe SHALL support request and provision of location measurements (or a location estimate based on measurements) for non-serving access networks that may be visible to a UE for position methods supported by LPP and LPPe for a serving network	1.0
LPP-MLI-024	LPPe SHALL support request and provision of the target orientation information. **Informational Note**: Transferred requirement from [OMA-SUPLv3-RD]	1.0

Table 5: Location Technology Requirements – Measurement and Location Information Items

6.3.3 Capability Requirements

Label	Description	Release
LPP-C-001	LPPe capability transfer SHALL be capable of operating in a bidirectional manner (i.e. UE capability transfer to an SLP and SLP capability transfer to a UE) **Informational Note:** This requirement relates to the use case B.5	1.0

Table 6: Location Technology Requirements – Capability Items

6.4 Improved Performance for Indoor Location

Label	Description	Release
LPP-IL-001	LPPe SHALL support delivery of indoor context information to the UE. **Informational Note:** Indoor context information may include information such as the indoor location (e.g. JFK Airport, terminal 3), anchor points from which to determine relative location (e.g. Terminal 1, gate 20C is at lat x, long y, etc.) or other relevant information.	1.0

LPP-IL-002	LPPe SHALL support delivery of indoor context information from the UE to an appropriate entity in the network. **Informational Note 1**: UE may provide indoor reference point data to a location server. **Informational Note 2**: Indoor reference point assistance data may include map-aided absolute/relative coordinate, civic address and place label.	1.0

Table 7: Improved Performance for Indoor Location

Appendix A. Change History (Informative)

A.1 Draft/Candidate Version 1.0 History

Document Identifier	Date	Sections	Description
Draft Versions	15 Mar 2010	All	First empty baseline
OMA-RD-LPPe-V1_0	14 Apr 2010	6.3.1, B.1	OMA-LOC-2010-0050R01-CR_LPPe1_0_RD_AssistanceDataChangeNotifications
		6.3.1, B.2	OMA-LOC-2010-0053R02-CR_LPPe1_0_RD_AtmosphereModels
		6.3.1, B.3	OMA-LOC-2010-0054R01-CR_LPPe1_0_RD_Broadcasting
		6.3.2, B.4	OMA-LOC-2010-0055-CR_LPPe1_0_RD_CollectingMeasurementsFromUEs
		6.3.3, B.5	OMA-LOC-2010-0057R01-CR_LPPe1_0_RD_GenericCapabilityRequirement
		6.3, B.6	OMA-LOC-2010-0058R02-CR_LPPe1_0_RD_HighAccuracyRelativePositioning
		6.3.1, B.7	OMA-LOC-2010-0059R04-CR_LPPe1_0_RD_NavigationModelImprovements
		6.3, B.8	OMA-LOC-2010-0060R01-CR_LPPe1_0_RD_PositioningMethods
		6.3.2, B.9	OMA-LOC-2010-0061-CR_LPPe1_0_RD_PositionRepresentation
		6.1.	OMA-LOC-2010-0067-CR_LPPe1.0_RD_Fixed_Access_Types
		6.4	OMA-LOC-2010-0070R02-CR_LPPe1.0_RD_Indoor_Location_I
		6.4	OMA-LOC-2010-0071R01-CR_LPPe1.0_RD_Indoor_Location_II
		6.5	OMA-LOC-2010-0072-CR_LPPe1.0_RD_UE_based_OTDOA_for_E_UTRA
	29-Apr-2010	1, 3.2, 3.3, 4, 5	OMA-LOC-2010-0091-CR_LPPe1_0_RD_General_Text.
		6.3, B 10	OMA-LOC-2010-0051R04-CR_LPPe1_0_RD_AssistanceDataImprovements
		6.1	OMA-LOC-2010-0096R01-CR_LPPe1.0_RD_Client_to_Client
		2, 6.1	OMA-LOC-2010-0092R02-CR_LPPe1_0_RD_LPP
	08-Jun-2010	2, 3, 6, A, B	OMA-LOC-2010-0099R01-CR_LPPe1_0_RD_cleanup
	06-Jul 2010	6.3.2, B 11	OMA-LOC-2010-0063R01-CR_LPPe1_0_RD_Integrity
		2.1, 3.2, 3.3	OMA-LOC-2010-0118R01-CR_LPPe1_0_RD_Editorial.
		6.1	OMA-LOC-2010-0132R02-CR_LPPe_1.0_RD_high_level_functional_requirement_I
		6.3.1	OMA-LOC-2010-0133-CR_LPPe_1.0_RD_location_technology_requirement_I
		6.3.1	OMA-LOC-2010-0134-CR_LPPe_1.0_RD_location_technology_requirement_II
		6.3.2	OMA-LOC-2010-0135-CR_LPPe_1.0_RD_measurement_and_location_information_requirement_I
		6.3.2	OMA-LOC-2010-0136-CR_LPPe_1.0_RD_measurement_and_location_information_requirement_II
		6.3.2	OMA-LOC-2010-0137R01-CR_LPPe_1.0_RD_measurement_and_location_information_requirement_III
		6.3.2	OMA-LOC-2010-0138-CR_LPPe_1.0_RD_measurement_and_location_information_requirement_IV
		6.3.2	OMA-LOC-2010-0139-CR_LPPe_1.0_RD_measurement_and_location_information_requirement_V
		6.1.1	OMA-LOC-2010-0140R01-CR_LPPe_1.0_RD_security_clarification
		6.4	OMA-LOC-2010-0152R03-CR_LPPe1_0_RD_Fingerprinting_Method
		6.3.1	OMA-LOC-2010-0153R01-CR_LPPe1_0_RD_PositioningTags
		6.3.2	OMA-LOC-2010-0175R03-CR_LPPe1_0_RD_Delivery_of_compass_data
	16-Aug-2010	All	OMA-LOC-2010-0187-CR_LPPe_RD_Editorials_for_Informal_Review
	01 Sep 2010	All	OMA-LOC-2010-0194R01-CR_LPPe1_0_RD_editorials

Document Identifier	Date	Sections	Description
		6	OMA-LOC-2010-0242-CR_LPPe1_0_RD_Editorials2
Candidate Versions OMA-RD-LPPe-V1_0	12 Oct 2010	n/a	TP approved via R&A: OMA-TP-2010-0427-INP_LPPe_V1_0_RD_for_Candidate_approval

Appendix B. Use Cases (Informative)

B.1 Assistance Data Change Notification

B.1.1 Short Description

Some assistance data types, such as extended navigation models, may have unpredictable life-time. The same also applies to atmosphere models. Hence, it is advantageous to have the capability to notify the UE about the changes in the quality of the data it has.

Such changes may be the invalidation of the data, availability of newer data or if the quality of the data the UE has drops below a threshold. Changes may be indicated per defined assistance data block or per SV. Moreover, the notification may include information such as from which time onwards the data is invalid.

B.1.2 Market benefits

The technology allows for the terminal to be sure that the data it has is up-to-date/usable. The technology works in the background transparently to the user, but ultimately the purpose is to be able to provide the end user reliable position information.

B.2 Atmosphere Models

B.2.1 Short Description

Positioning accuracy may be improved by introducing new assistance data types. Such data types include local atmosphere models (ionosphere and troposphere) that are major error sources in GNSS-based positioning. Troposphere model may, for example, be expressed in terms of surface weather parameters (temperature, pressure, humidity, partial vapor pressure) or 3D delay model.

Availability of positioning may be improved by introducing altitude assistance (such as local air pressure, potentially e.g. its time derivative, altitude), which may be used in the UE to compensate the lack of GNSS observations.

Further, atmospheric pressure allows for compensating atmospheric load increasing the accuracy.

Local ionosphere model may either include utilizing the existing models (Klobuchar, NeQuick) and defining applicability areas, validity time, or additionally introducing new models.

B.2.2 Market benefits

With the new assistance data types the consumers see improved positioning performance in terms of accuracy, availability and speed. Moreover, having local ionosphere model can help maintaining decent performance under geomagnetic storm conditions.

B.3 Broadcasting

B.3.1 Short Description

Majority of the GNSS assistance data is global by nature. Examples of such global data include SV navigation models and global ionosphere model. Moreover, various data elements are valid over a large area. Examples include differential GNSS corrections. Because of these considerations, cellular networks (e.g. GERAN) support broadcast of selected assistance elements.

From the LPP perspective broadcast can be understood as “Unsolicited LPP Provide Assistance Data”. Hence, the “LPP Provide Assistance Data” –message could already today be transferred over an appropriate broadcast enabler to the UE.

When defining further assistance data elements for LPPe, broadcast option should be taken into account explicitly. To exemplify, when defining the reference measurement assistance information element for carrier phase –based positioning, the broadcast option can be taken into account by enabling the provision of the reference measurement assistance not just for a single reference station, but for a number reference stations.

B.3.2 Market benefits

Broadcasting has benefits both to consumers and service providers. Receiving data in broadcast means that the terminal can be “always hot” with the latest assistance data. This improves time-to-first-fix and consumer experience. In the service provider side the architecture requirements can be eased, because the majority of the assistance data can be distributed as point-to-multipoint delivery instead of point-to-point connections.

B.4 Collecting Measurements from the UEs

B.4.1 Short Description

UEs may also be used as measurement devices collecting data that can be refined for further assistance in the server. For example, having a large device population providing atmospheric pressure allows for providing good quality altitude assistance to other terminals. The same applies to ionosphere delay information that the multi-frequency GNSS receivers can provide. The LPPe WID also covers the possibility for the UE act as a satellite data provider.

B.4.2 Market benefits

The measurement additions allow the service providers to collect positioning related information from the terminals in the field. The data allows the service providers to provide the end users with higher quality assistance data.

B.5 Generic Capability Requirement

B.5.1 Short Description

LPP already covers, for example, the capabilities for the positioning methods and modes supported by LPP.

LPPe will add positioning methods (relative positioning), assistance data types and measurement types. Capability exchange for these LPPe features needs to be supported as well.

Moreover, the new features including the relative high-accuracy positioning may require that the UE can obtain information on the SLP capabilities.

B.5.2 Market benefits

The capability exchange results in lesser amount of network traffic compared to the case, in which no capability transfer is performed.

B.6 Relative High Accuracy GNSS

B.6.1 Short Description

Relative high accuracy GNSS refers to determining the UE location at sub-meter (or even better) accuracy with respect to a reference point. High accuracy GNSS enables, say, lane-precise navigation instead of current road-level accuracy.

The reference point for positioning can be another UE, a static physical GNSS reference receiver or a virtual computational GNSS reference receiver. In case the reference receiver location is accurately known, the absolute position of the UE can be deduced at high accuracy.

In contrast to the currently supported GNSS-based positioning methods, this class of high accuracy methods requires continuous periodic assistance data or measurement delivery.

Some requirements may require support in SUPL 3.0 (e.g. extended positioning sessions for relative positioning). It is expected that the necessary support would be evaluated and defined during the TS phases for SUPL 3.0 and LPPe..

B.6.2 Market benefits

Relative positioning allows for a completely new set of applications by introducing a new type of positioning technology. Use cases for high accuracy relative positioning range from consumer applications to professional use.

B.7 Navigation Model Improvements

B.7.1 Short Description

Positioning accuracy may be improved by introducing new assistance data types. Such data types include new SV orbit and clock models that allow for delivering precise ephemerides.

The quality control of the position solution can be improved by introducing degradation models for the SV orbit and clock models. The same also applies to differential code biases and SV antenna offsets that allow for compensating the hardware delays and the discrepancy between the SV center-of-mass and antenna reference point.

Extended navigation model provides the UE with SV orbit and clock information several days or weeks in advance. In case the UE has extended navigation models for the SVs, the position calculation may be faster due to the UE not needing to connect to the assistance server in the beginning of each assistance data session.

B.7.2 Market benefits

With the new assistance data types the consumers see improved positioning performance in terms of accuracy, availability and speed.

B.8 Positioning Methods

B.8.1 Short Description

RRLP and RRC support UE-based/assisted ECID and TDOA positioning methods (E-OTD and OTDOA-IPDL, respectively).

LPP already includes the UE-assisted E-UTRAN ECID, but LPP Extensions needs to add ECID support other radio access types as well. ECID can be used

- for providing location estimate, when the QoS requirement is low in terms of accuracy, but high in terms of TTFF
- instead of an AGNSS fix in devices with no AGNSS receive
- as reference location to an AGNSS receiver
- as a fallback method for AGNSS

In addition, support for WLAN-based ECID is missing in [3GPP-LPP].

B.8.2 Market benefits

ECID- and TDOA-based methods increase the availability of location services.

B.9 Position Representation

B.9.1 Short Description

High accuracy absolute and relative methods require that the position parameterization is capable of presenting the position information at suitable resolution. The same also applies to velocity.

When representing the relative location between two entities, it can either be given in the global coordinates system (such as ITRS – International Terrestrial Reference System, which is very close to WGS84 used in GPS) or in a local East-North-Up coordinate system. In case the local coordinate system is used, its origin (and the uncertainty of the origin) must be stated.

When requesting the location estimate, the UE may also be requested to state its state of motion (see SUPL 3.0 requirements). Because it is always the UE that determines the state of motion, the information can be provided to the SLP in LPP Extensions.

B.9.2 Market benefits

Enabling high accuracy positioning also requires that the high accuracy position can be represented.

B.10 Assistance data improvements

B.10.1 Short Description

Retrieving only the updated assistance data decreases the data consumption. Moreover, in some cases it may be that for a set of satellite data, data in the UE is valid for all the SVs except for one. In such a case it's advantageous to be able to retrieve update only for the invalid data and not for all the data. This is useful, for example, in the context of extended navigation models, where the amounts of data to be transferred are high. Thus also a mechanism to receive just an indication of the amount of data to be delivered is useful

Also, in some cases the UE may simply wish to check the validity of the data it has. Having information that the data is invalid allows the UE simply to discard the specific data it has.

The data containers that have some standardized attributes allow for fast deployment of new features. Having the standardized attributes allows for using the same information elements from the data provider to the UE still maintaining the capability in the server side to handle the data appropriately.

Moreover, certain data types may be cached in the UE for future use. Examples include extended navigation models and atmosphere models based on (space) weather forecasts. In such a case it may be advantageous that the UE can in the assistance data request indicate the data it has (e.g. version of the data) and only request continuation for the existing data.

B.10.2 Market benefits

Benefits include reduced data consumption and, hence, faster assistance data delivery leading to improved TTFF and more reliable positioning. Moreover, data containers allow for faster deployment of new features.

B.11 Integrity

B.11.1 Short Description

In order to estimate the error bound of the fix, also referred as protection level (PL), different algorithms have been proposed by the GNSS community. This area of research is known as integrity. Each of the proposed solutions is based on its own assumptions and generates a corresponding PL depending on the algorithm. The confidence value may be selected by the application (e.g. people tracking, road tolling, etc.). Typical confidence values are 99.99% or 99.99999%.

B.11.2 Market benefits

High confidence error bound may be a valuable feature for a variety of commercial services, as work force tracking and triggering, children and elder people tracking. Location automotive application as road tolling requires error bound estimation. Safety of live services may also require integrity functions.