LPP Extensions Specification

Candiate Version 2.0 – 04 Aug 2020

Open Mobile Alliance

OMA-TS-LPPe–V2_0-20200804-C

Contents

Figures

Tables

1. Scope

The present document specifies OMA LPP Extensions (LPPe) Release 2.0.

2. References

2.1 Normative References

[23.003] 3GPP TS 23.003, "Numbering, addressing and identification" URL: http://www.3gpp.org/ftp/specs/html-info/23003.htm

[25.101] 3GPP TS 25.101, "User Equipment (UE) radio transmission and reception (FDD)" URL: http://www.3gpp.org/ftp/specs/html-info/25101.htm

[25.102] 3GPP TS 25.102, "User Equipment (UE) radio transmission and reception (TDD)" URL: http://www.3gpp.org/ftp/specs/html-info/25102.htm

[25.123] 3GPP TS 25.123, "Requirements for support of radio resource management (TDD)" URL: http://www.3gpp.org/ftp/specs/html-info/25123.htm

[25.133] 3GPP TS 25.133, "Requirements for support of radio resource management (FDD)" URL: http://www.3gpp.org/ftp/specs/html-info/25133.htm

[25.214] 3GPP TS 25.214: "Physical layer procedures (FDD)" URL: http://www.3gpp.org/ftp/specs/html-info/25214.htm

[25.224] 3GPP TS 25.224: "Physical Layer Procedures (TDD)" URL: http://www.3gpp.org/ftp/specs/html-info/25224.htm

[25.225] 3GPP TS 25.225, "Physical layer; Measurements (TDD)" URL: http://www.3gpp.org/ftp/specs/html-info/25225.htm

[25.331] 3GPP TS 25.331, "Radio Resource Control (RRC)" URL: http://www.3gpp.org/ftp/specs/html-info/25331.htm

[36.101] 3GPP TS 36.101, "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception" URL: http://www.3gpp.org/ftp/specs/html-info/36101.htm

[36.133] 3GPP TS 36.133, "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management" URL: http://www.3gpp.org/ftp/specs/html-info/36133.htm

[36.213] 3GPP TS 36.213, "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures" URL: http://www.3gpp.org/ftp/specs/html-info/36213.htm

[36.214] 3GPP TS 36.214, "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements" URL: http://www.3gpp.org/ftp/specs/html-info/36214.htm

[36.314] 3GPP TS 36.213, "Evolved Universal Terrestrial Radio Access (E-UTRA); Layer 2 – Measurements" URL: http://www.3gpp.org/ftp/specs/html-info/36314.htm

[36.331] 3GPP TS 36.331, "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification" URL: http://www.3gpp.org/ftp/specs/html-info/36331.htm

[45.001] 3GPP TS 45.001, "Physical layer on the radio path; General description" URL: http://www.3gpp.org/ftp/specs/html-info/45001.htm

[45.008] 3GPP TS 45.008, "Radio subsystem link control" URL: http://www.3gpp.org/ftp/specs/html-info/45008.htm

[AES] Federal Information Processing Standards Publication 197, "Specification for the ADVANCED ENCRYPTION STANDARD (AES)", November 26, 2001, URL: http://csrc.nist.gov/publications/fips/fips197/fips-197.pdf.

[ASN.1] ITU-T Recommendation X.680: "Information technology – Abstract Syntax Notation One, (ASN.1): Specification of basic notation", URL:http://www.itu.int/ITU-T/

[EGM96] "Earth Gravitational Model 96 (EGM96)," National Geospatial-Intelligence Agency, NASA.

[IEEE 802.11] IEEE 802.11, URL:http://www.ieee.org

[IEEE 802.15.1] Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPANs)

[ITU-JP2000] JPEG 2000 image coding system: Core coding system – URL: http://www.itu.int/rec/T-REC-T.800/en

[ITU-JPEG]	Digital compression and coding of continuous-tone still images – Requirements and guidelines URL: http://www.itu.int/rec/T-REC-T.81/en
[LPP]	3GPP TS 37.355, LTE Positioning Protocol, URL: http://www.3gpp.org/ftp/specs/html-info/37355.htm
[NFC1]	NFC Forum Type 1 Tag Operation Specification, NFCForum-TS-Type-1-Tag_1.0
[NFC2]	NFC Forum Type 2 Tag Operation Specification, NFCForum-TS-Type-2-Tag_1.0
[NIST-180-4]	NIST FIPS Publication 180-4, "Secure Hash Standards (SHS)", March 2012, URL: http://csrc.nist.gov/publications/fips/fips180-4/fips-180-4.pdf
[NIST-800-38A]	NIST Special Publication 800-38A, "Recommendation for Block Cipher Modes of Operation Methods and Techniques", 2001, URL: http://csrc.nist.gov/publications/nistpubs/800-38a/sp800-38a.pdf
[OMA-MC]	OMA Mobile Codes, Version 1.0, Open Mobile Alliance™, OMA-TS-MC-V1_0, URL:http://www.openmobilealliance.org/
[OMNA]	URL:http://www.openmobilealliance.org/Tech/OMNA/
[PKCS#1]	"PKCS#1 v2.1: RSA Cryptography Standard", RSA Laboratories, June 2002, URL: ftp://ftp.rsasecurity.com/pub/pkcs/pkcs-1/pkcs-1v2-1.pdf.
[RFC2119]	IETF RFC 2119, "Key words for use in RFCs to Indicate Requirement Levels", S. Bradner, March 1997, URL:http://www.ietf.org/rfc/rfc2119.txt
[RFC3447]	IETF RFC 3447, "Public-Key Cryptography Standards (PKCS) #1: RSA Cryptography Specifications Version 2.1", URL: http://www.ietf.org/rfc/rfc3447.txt
[RFC3825]	IETF RFC 3825, "Dynamic Host Configuration Protocol Option for Coordinate-based Location Configuration Information" URL: http://www.ietf.org/rfc/rfc3825.txt.
[RFC3986]	IETF RFC 3986, "Uniform Resource Identifier (URI): Generic Syntax". T. Berners-Lee, R. Fielding. January 2005, URL:http://www.ietf.org/rfc/rfc3986.txt
[RFC 4119]	IETF RFC 4119, "A Presence-based GEOPRIV Location Object Format", J. Peterson. December 2005, URL:http://www.ietf.org/rfc/rfc4119.txt
[RFC4234]	IETF RFC 4234, "Augmented BNF for Syntax Specifications: ABNF". D. Crocker, Ed., P. Overell. October 2005, URL:http://www.ietf.org/rfc/rfc4234.txt
[RFC4776]	IETF RFC 4776, Dynamic Host Configuration Protocol (DHCPv4 and DHCPv6) Option for Civic Addresses Configuration Information
[RFC5139]	IETF RFC 5139, "Revised Civic Location Format for Presence Information Data Format Location Object (PIDF-LO)". M. Thomson, J. Winterbottom. February 2008, URL:http://www.ietf.org/rfc/rfc5139.txt
[RFC6848]	IETF RFC 6848, "Specifying Civic Address Extensions in the Presence Information Data Format Location Object (PIDF-LO)". J. Winterbottom, M. Thomson, R. Barnes, B. Rosen, R. George. January 2013, URL:http://www.ietf.org/rfc/rfc6848.txt
[SCRRULES]	"SCR Rules and Procedures", Open Mobile Alliance™, OMA-ORG-SCR_Rules_and_Procedures, URL:http://www.openmobilealliance.org/
[X.691]	ITU-T X.691, "Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)"
[X.694]	ITU-T X.694, "Information technology – ASN.1 encoding rules: Mapping W3C XML schema definitions into ASN.1"

2.2 Informative References

[GPS-ICD-200D]	Navstar Global Positioning System Interface Control Specification 200-D
[JPEG]	G. K. Wallace, "The JPEG still picture compression standard," IEEE Trans. Consumer Electronics, vol. 38, no. 1, pp. xviii-xxxiv, Feb. 1992.
[OMADICT]	"Dictionary for OMA Specifications", Version 2.8, Open Mobile Alliance™, OMA-ORG-Dictionary-V2_8, URL:http://www.openmobilealliance.org/

[RTCM 10403.1]	Differential GNSS (Global Navigation Satellite Systems) Services - Version 3 + Amendments 1, 2, and 3 to RTCM 10403.1, June 2009, Radio Technical Commission for Maritime Services, URL:http://www.rtcm.org
[SP3-C]	The Extended Standard Product 3 Orbit Format SP3-c. National Geodetic Survey, National Ocean Service, NOAA. 12th February 2007.

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

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

3.3 Abbreviations

AD	Assistance Data
AP	Access Point
ARFCN	Absolute Radio Frequency Channel Number
BCCH	Broadcast Control Channel
BSIC	Base Station Identity Code
BSSID	Basic Service Set Identifier
BT	Bluetooth
BT LE	Bluetooth Low Energy
BTS	Base Transceiver System
CCP	Continuous Carrier Phase
CCPCH	Common Control Pilot Channel
CPICH	Common Pilot Channel
DL-AoD	Downlink Angle-of-Departure
DL-TDOA	Downlink Time Difference Of Arrival
DSL	Digital Subscriber Line
EARFCN	EUTRA Absolute Radio Frequency Channel Number
ECID	Enhanced Cell ID
EDGE	Enhanced Data rates for Global Evolution
EGM	Earth Gravity Model
E-OTD	Enhanced Observed Time Difference
EPDU	External Protocol Data Unit
EPRE	Energy Per Resource Element
E-UTRAN	Evolved UTRAN
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
HA GNSS	High Accuracy GNSS. Refers to using continuous carrier phase measurements to deduce the accurate location of the target device.
HeNB	Home eNodeB
HNB	Home Node B
ICI	Indirect Code Identifier
IPDL	Idle Period Downlink
LAN	Local Area Network
LBS	Location-Based Services
LCS	Location Services
LPP	LTE Positioning Protocol, defined in 3GPP TS 37.355
LPPe	OMA LPP Extensions
LTE	Long Term Evolution
MBS	Metropolitan Beacon System
NAT	Network Address Translation
NFC	Near Field Communications
NR	New Radio
OMA	Open Mobile Alliance
OTD	Observed Time Difference
OTDOA	Observed Time Difference of Arrival
P-CPICH	Primary Control Pilot Channel
pidf-lo	Presence Information Data Format Location Object
QoR	Quality of Reference station
RAN	Radio Access Network
RLE	Run-Length Encoding
RS	Reference Signal
RSSI	Received Signal Strength Indicator
RTD	Real Time Difference
SLP	SUPL Location Platform
SRN	Short Range Node
SSID	Service Set Identifier
SUPL	Secure User Plane Location
SV	Space Vehicle
TA	Timing Advance
TDD	Time-Division Duplex
TEC	Total Electron Content
TECU	TEC Unit, 10^{16} electrons per square meter
TOA	Time Of Arrival

UARFCN	UTRA Absolute Radio Frequency Channel Number
UE	User Equipment
UMTS	Universal Mobile Telecommunication System
URI	Uniform Resource Identifier [#B073]
UTC	Universal Time Coordinated
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial RAN
WA	Wide Area
WGS	World Geodetic System
WLAN	Wireless Local Area Network

4. Introduction

4.1 Version 1.0

LTE Positioning Protocol 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 LPP and LPPe protocol stack both in the control and user plane.

4.2 Version 1.1

LPPe Version 1.1 supports the following capabilities additional to those in Version 1.0:

- Broadcast of unsolicited LPP/LPPe Provide Assistance Data messages
- Request and provision of assistance data point to point related to LPP/LPPe broadcast support

Receipt of broadcast LPP/LPPe Provide Assistance Data messages can be backward compatible with a target that supports version 1.0 of LPPe in the sense that such messages may be provided (e.g. by a broadcast process in the target) to an LPPe process in the target without causing errors or rejection of the contained assistance data. This backward compatibility applies to unencapsulated LPP/LPPe messages but not to encapsulated messages (see section 5.2.5.1).

4.3 Version 2.0

LPPe Version 2.0 supports the following capabilities additional to those in Version 1.0 and 1.1:

- Support of new positioning methods
- Support for Indoor location
- Support for Crowd Sourcing

4.4 Version Negotiation (Normative)

Each LPPe message segment indicates the version of the LPPe protocol that was used to encode it. The version includes a major version number (0-255) and a minor version number (0-255). Later major versions of LPPe should be backward compatible at both a procedural level and an encoding level with earlier versions. Later minor versions SHALL be backward compatible with previous minor versions for the same major version number.

To allow for possible non-backward compatibility between different major LPPe versions, an LPPe message segment also carries a compatibility level (0-15). The compatibility level for this version of LPPe is zero. The compatibility level SHALL be increased in any new major version of LPPe that is non-backward compatible with the previous major version. A receiver SHALL discard any received LPPe message that indicates a compatibility level different to all those supported and may return an LPP/LPPe Error message indicating the highest LPPe compatibility level supported.

If a receiver supports the LPPe compatibility level indicated in a received LPPe message but supports a higher major and/or minor version of LPPe than indicated in the message, it may either use the higher major/minor version in subsequent LPPe messages that it sends and allow for the possibility that not all information will be understood or fallback to the lower major/minor version. If a receiver supports the compatibility level indicated in a received LPPe message but supports only a lower major and/or minor version of LPPe than indicated, it SHALL use the highest major/minor version of LPPe that it supports in subsequent LPPe messages. Once either end has sent an LPPe message to the other end, it SHALL continue to use the same major/minor version of LPPe in subsequent messages belonging to the same LPP session. Version adaptation is thus applicable only to a receiver that has not yet sent an LPPe message on any new session.

Table 1: shows the association between compatibility levels and major LPPe versions.

Compatibility Level	Major Version
0	1
0	2

Table 1: LPPe Compatibility Levels and Major Versions

5. LPPe functionality (Normative)

The LPPe protocol functionality builds on the 3GPP LPP procedure and transaction handling.

5.1 Integration with 3GPP LPP

The extension of 3GPP LPP messages is based on the EPDU-Sequence (External Protocol Data Unit) included in the following 3GPP messages:

- LPP Provide / Request Capabilities (from 3GPP Rel-9 or later)
- LPP Provide / Request Assistance Data (from 3GPP Rel-9 or later)
- LPP Provide / Request Location Information (from 3GPP Rel-9 or later)
- LPP Abort (from 3GPP Rel-9 or later)
- LPP Error (from 3GPP Rel-9 or later)

The LPP transaction control is handled by the LPP messaging and, thus, LPPe message extensions do not need to carry a LPP transaction ID.

EPDU is defined in Chapter 6.4.1 of [LPP]:

```
EPDU-Sequence ::= SEQUENCE (SIZE (1..maxEPDU)) OF EPDU

maxEPDU INTEGER ::= 16

EPDU ::= SEQUENCE {
  ePDU-Identifier         EPDU-Identifier,
  ePDU-Body               EPDU-Body
}

EPDU-Identifier ::= SEQUENCE {
  ePDU-ID                 EPDU-ID,
  ePDU-Name               EPDU-Name       OPTIONAL,
  ...
}

EPDU-ID ::= INTEGER (1..256)

EPDU-Name ::= VisibleString (SIZE (1..32))

EPDU-Body ::= OCTET STRING
```

***EPDU-Sequence* field descriptions**
EPDU-ID This field provides a unique ID for the external positioning method.
EPDU-Name This field provides an optional character encoding which can be used to provide a quasi-unique name for an external PDU – e.g., by containing the name of the defining organization and/or the name of the associated public or proprietary standard for the EPDU.
EPDU-Body The content and encoding of this field are defined externally to LPP.

External PDU Identifier Definition

EPDU-ID	EPDU Defining entity	Method name	Reference
1	OMA LOC	OMA LPP extensions (LPPe)	OMA-TS-LPPe_V1_0

LPPe specifies an extension to each of the eight LPP messages as shown at the beginning of this section. When encoding the LPP/LPPe message, it is expected that the LPPe extension for the message is first parsed and the resulting ASN.1-coded binary stream is included in the EPDU-Body of the EPDU in the appropriate message.

Duplication of information in LPP and LPPe layer within an “LPP Request” message SHOULD be avoided. If contradicting information is received in LPP and LPPe layer within an “LPP Provide” message the recipient SHALL use the information in LPPe layer.

5.2 LPPe Procedures

Procedures defined in [LPP] carry over to use of LPP with LPPe._The additional procedures defined in this section apply to LPPe only and extend the LPP procedures defined in [LPP].

5.2.1 Periodic/Triggered Assistance Data Transfer with Update

This procedure enables a target to request a server to send assistance data periodically either at defined intervals or when specific triggering criteria are met. The procedure also allows a target or a server to modify the type of assistance data and/or the periodicity and triggering criteria while the delivery procedure is ongoing. The procedure SHALL NOT be combined with the support of any other assistance data and SHALL thus use LPP transactions that are dedicated to starting, transferring or updating one specific type of Periodic/Triggered Assistance Data.

5.2.1.1 Initiating and Terminating the Procedure

Figure 1 shows how a Periodic/Triggered Assistance Data Transfer with Update may be initiated and terminated.

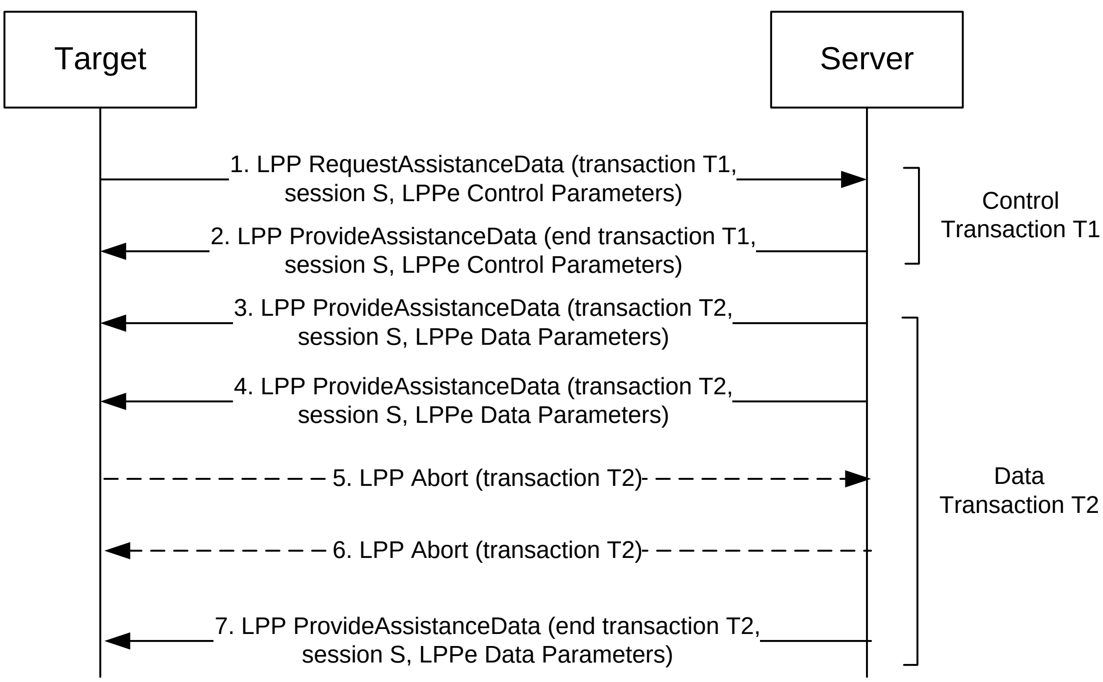


Figure 1: LPPe Periodic/Triggered Assistance Data transfer procedure with Update

1. The target sends an LPP *RequestAssistanceData* message to the server using some available transaction ID T1. The message contains a periodic/triggered session ID S (different to any other LPPe periodic/triggered session ID currently in use between the target and server), an indication that this is an initial request for a Periodic/Triggered Assistance Data transfer and LPPe control parameters identifying the type of assistance data being requested, the triggering or periodicity conditions for sending it and either a duration or other specific conditions for ending the assistance data transfer.

2. The server responds with an LPP *ProvideAssistanceData* message to the target. The message uses the transaction ID T1 in step 1 and indicates the end of this transaction. The message contains the periodic/triggered session ID S, an indication that this is a response to an initial request, and LPPe control parameters indicating whether or not the request in step 1 can be supported. If the request can be supported, the LPPe control parameters may explicitly confirm or redefine the type of assistance data, the triggering or periodicity parameters and the duration or other conditions for ending the assistance data transfer. Further characteristics of the assistance data to be delivered may also be provided. If the procedure cannot be supported, an error reason SHALL be provided at the LPPe level and remaining steps are then not performed.

3. When the first triggering or periodicity condition occurs, the server sends an unsolicited LPP *ProvideAssistanceData* message to the target containing the periodic/triggered session ID S, an indication that this is a periodic/triggered assistance data delivery, and LPPe data parameters containing the assistance data confirmed or defined in step 2. The message uses some available transaction ID T2 that may be different to T1.

   NOTE: LPPe control parameters and LPPe data parameters applicable to this procedure SHALL be explicitly distinguished from one another in the message encoding definitions in section 6.

4. The server may continue to send further LPP *ProvideAssistanceData* messages to the target containing the assistance data confirmed or redefined in step 2 when each additional triggering or periodicity condition occurs.

5. If an error condition occurs at the target that requires the session to end, the target sends an LPP Abort to the server for transaction T2 that may optionally include LPP and/or LPPe error codes. Remaining steps are then omitted. Error conditions that may induce an abort include an attempt by either end to update the assistance data transfer, as described in sections 5.2.1.2 and 5.2.1.3, where the final control parameters provided by the server are not acceptable to the target.

6. If an error condition occurs at the server that requires the session to end without the delivery of further assistance data, the server sends an LPP Abort to the target for transaction T2 that may optionally include LPP and/or LPPe error codes. Remaining steps are then omitted.

7. When the duration or other conditions for ending the assistance data transfer occur, the last LPP *ProvideAssistanceData* message transferred indicates the end of transaction T2. Terminating the transfer as in this step is preferred over the use of an abort (as in step 6) where possible, since additional termination information specific to the assistance data transfer may then be included.

5.2.1.2 Target Update

Figure 2: shows how the target may update an ongoing a Periodic/Triggered Assistance Data Transfer that was started according to section 5.2.1.1.

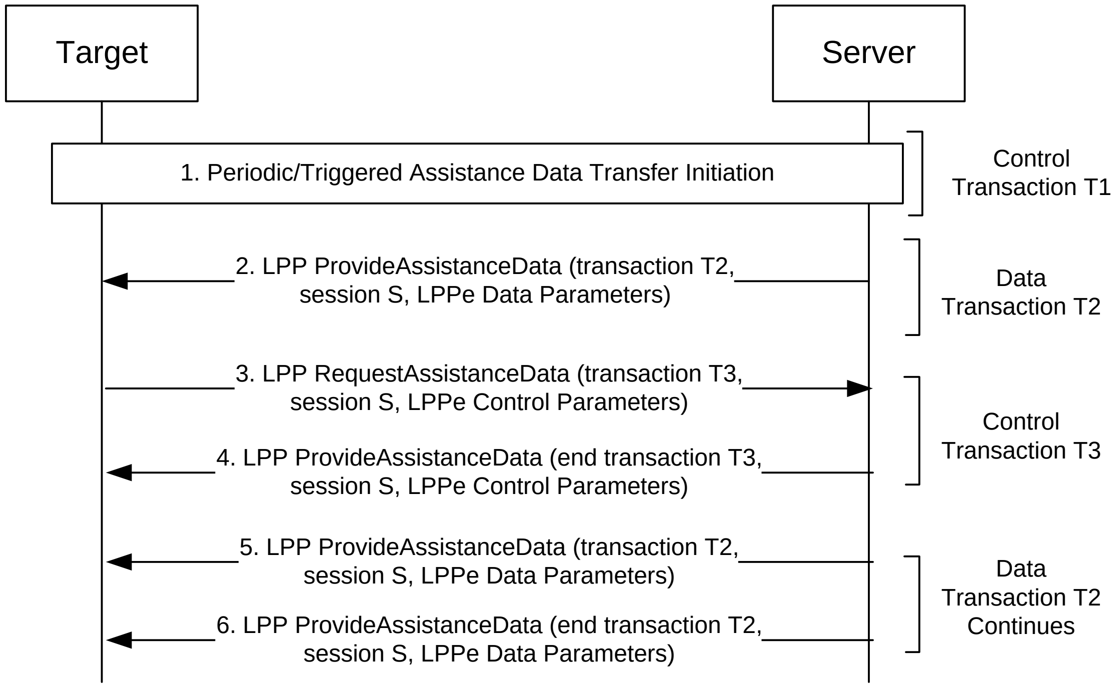


Figure 2: LPPe Periodic/Triggered Assistance Data transfer procedure with Target Update

1. Steps 1 and 2 of Figure 1 are performed to start an LPPe Periodic/Triggered Assistance Data transfer procedure with Update and using a periodic/triggered session ID S.
2. The server may send zero, one or more LPP *ProvideAssistanceData* messages to the target containing the assistance data agreed in step 1 and using a transaction ID T2.
3. If, before the delivery of assistance data has terminated, the target needs to update the type of assistance data and/or the triggering and periodicity conditions and/or the duration or conditions for termination, the target sends an LPP *RequestAssistanceData* message to the server using some available transaction ID T3. The ID T3 SHALL be different to T2 (if T2 has been started). The message contains the periodic/triggered session ID S, an indication that this is an update request for a Periodic/Triggered Assistance Data transfer and LPPe control parameters identifying any new type of assistance data being requested, any new triggering or periodicity conditions for sending it and any new duration or specific conditions for ending the assistance data transfer. The request also indicates whether the previous assistance data delivery SHALL continue or be aborted if the new request cannot be supported.
4. The server responds with an LPP *ProvideAssistanceData* message to the target. The message uses the transaction ID T3 and indicates the end of this transaction. The message contains the periodic/triggered session ID S and an indication that this is a response to an update request. The message also contains LPPe control parameters indicating whether or not the update request in step 3 can be supported. If the request can be supported, the control parameters may explicitly confirm or redefine any new type of assistance data, and new triggering or periodicity parameters and any new duration or other conditions for ending the assistance data transfer. Further characteristics of the assistance data to be delivered may also be provided. If the request in step 3 cannot be supported, then, if requested in step 3, the earlier request agreed in step 1 SHALL continue via further repetitions of step 2 until it ends normally or is modified by a repetition of step 3 or is aborted. But if requested otherwise in step 3, the earlier request (including transaction T2) SHALL be aborted at the server without the sending of any further assistance data to the target. In either case, steps 5 and 6 are then omitted.
5. If the server can support the request in step 3, it ceases to support the request in step 1 following step 4. Note that due to race conditions, one or more repetitions of step 2 may be perceived to occur by the target following step 3 and prior to step 4. When the first updated triggering or periodicity condition occurs following step 4, the server sends an unsolicited LPP *ProvideAssistanceData* message to the target containing the session ID S, an indication that this is periodic/triggered assistance data and LPPe data parameters containing the new assistance data confirmed or defined

in step 4. The message continues to uses transaction ID T2.

6. The server may continue to send further LPP *ProvideAssistanceData* messages to the target containing the session ID S and LPPe data parameters containing the new assistance data confirmed or redefined in step 4 when each additional triggering or periodicity condition occurs. If the duration or other conditions for ending the assistance data transfer occur, the last LPP *ProvideAssistanceData* message transferred indicates the end of transaction T2. If before this occurs the target needs to update the type of assistance data, triggering or periodicity conditions and/or duration or other conditions for terminating the transfer, steps 3 and 4 are repeated.

5.2.1.3 Server Update

Figure 3: shows how the server may update an ongoing a Periodic/Triggered Assistance Data Transfer that was started according to section 5.2.1.1.

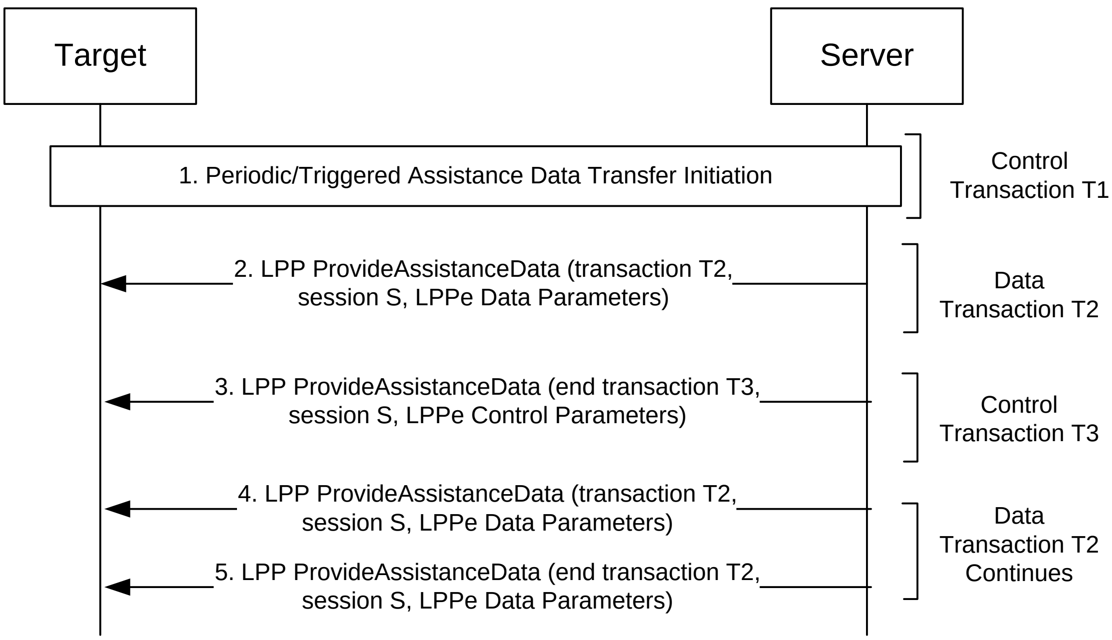


Figure 3: LPPe Periodic/Triggered Assistance Data transfer procedure with Server Update

1. Steps 1 and 2 of Figure 1 are performed to start an LPPe Periodic/Triggered Assistance Data transfer procedure with Update and using a periodic/triggered session ID S.

2. The server may send zero, one or more LPP *ProvideAssistanceData* messages to the target containing the assistance data agreed in step 1 and using a transaction ID T2.

3. If, before the delivery of assistance data has terminated, the server needs to update the type of assistance data and/or the triggering and periodicity conditions and/or the duration or conditions for termination, the server sends an unsolicited LPP *ProvideAssistanceData* message to the target using some available transaction ID T3. The ID T3 SHALL be different to T2. The message contains the periodic/triggered session ID S, an indication this is a server update for a Periodic/Triggered Assistance Data transfer and LPPe control parameters identifying any new type of assistance data to be provided, any new triggering or periodicity conditions for sending it and any new duration or specific conditions for ending the assistance data transfer. After sending this message, the server ceases to transfer assistance data according to step 2.

4. When the first updated triggering or periodicity condition occurs (as defined in step 3) following step 3, the server sends an unsolicited LPP *ProvideAssistanceData* message to the target containing the periodic/triggered session ID S, an indication that this is periodic/triggered assistance data and LPPe data parameters containing the new assistance data defined in step 3. The message continues to uses transaction ID T2.

5. The server may continue to send further LPP *ProvideAssistanceData* messages to the target containing the periodic/triggered session ID S and LPPe data parameters containing the new assistance data defined in step 3 when

each additional triggering or periodicity condition occurs. If the duration or other conditions for ending the assistance data transfer occur, the last LPP *ProvideAssistanceData* message transferred indicates the end of transaction T2. If before this the server needs to update the type of assistance data, triggering or periodicity conditions and/or duration or other conditions for terminating the transfer, step 3 is repeated.

5.2.1.4 Delivery via Broadcast (version 1.1)

Figure 4 shows how a Periodic/Triggered Assistance Data Transfer may be initiated and terminated in the case that assistance data is transferred via broadcast. The purpose of this procedure is to enable the same assistance that would normally be transferred according to the point to point procedures shown in Figure 1, Figure 2 and Figure 3 to be transferred using broadcast. The procedure is mainly a degenerate version of that described in Figure 1 in section 5.2.1.1.

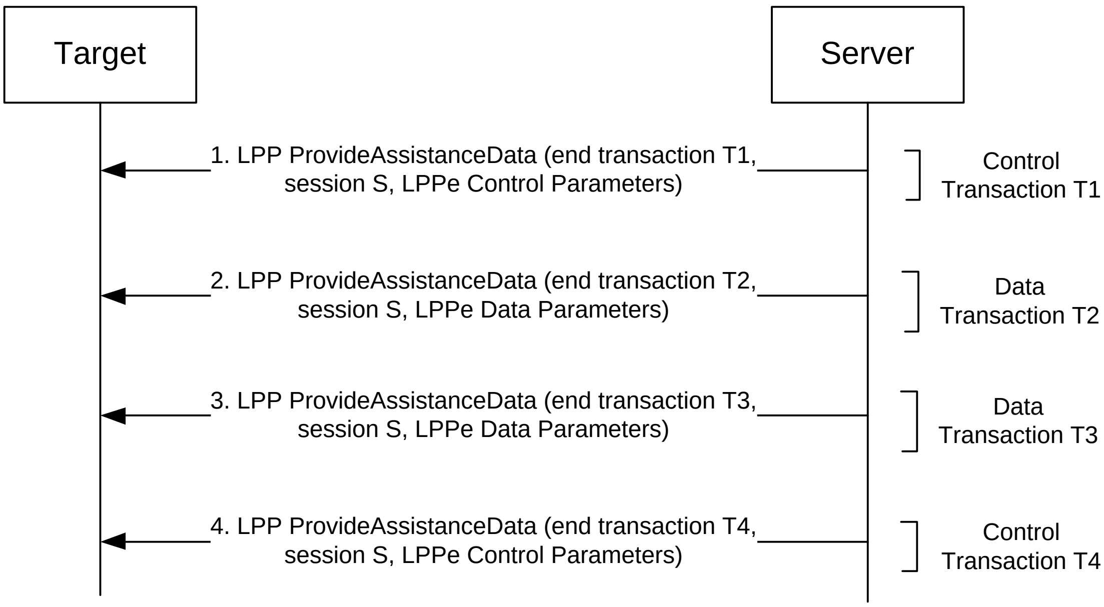


Figure 4: LPPe Periodic/Triggered Assistance Data transfer procedure with Broadcast

1. The server broadcasts an LPP *ProvideAssistanceData* message using the procedure described in section 5.2.5. The message uses an arbitrary transaction ID T1 and indicates the end of this transaction. The message contains a periodic/triggered session ID S chosen by the server, an indication that this is a response to an initial request (for compatibility with LPPe version 1.0 ASN.1), and LPPe control parameters identifying the type of assistance data to be transferred in later steps, the triggering or periodicity conditions for sending this data and either a duration or other specific conditions for ending the assistance data transfer. No other assistance data SHALL be included in the mssage. The server SHALL ensure that the session ID S is not used for any other periodic/triggered assistance data transfer in any geographic area at the same time as the procedure in Figure 4 is ongoing and for a period of at least 24 hours after this procedure terminates. The server may periodically re-broadcast the message in step 1 to reach additional targets. A target device that receives the message in step 1 via broadcast may identify it as belonging to this procedure from inclusion of the session ID S and the indication that this is a response to an initial request for periodic/triggered assistance data transfer. If a target receives a subsequent message via broadcast that is identified as belonging to step 1 and carries the same session ID S as that for an ongoing procedure of this type and if the message cannot be identified as a duplicate of the message that iniated this procedure (e.g. from use of the same version 1.1 message ID), then the target SHALL abort reception for the ongoing procedure and may instigate reception for a new procedure based on the control parameters included in the message.

2. When the first triggering or periodicity condition occurs, the server sends via broadcast (using the procedure in section 5.2.5) an unsolicited LPP ProvideAssistanceData message containing the periodic/triggered session ID S assigned in step 1, an indication that this is a periodic/triggered assistance data delivery, and LPPe data parameters containing the assistance data indicated in step 1. The message carries an arbitary transaction ID T2 and indicates the end of a transaction. No other assistance data SHALL be included other than that indicated in step 1.

NOTE: LPPe control parameters and LPPe data parameters applicable to this procedure are explicitly distinguished from one another in the message encoding definitions in section 6.

3. The server may continue to broadcast further LPP *ProvideAssistanceData* messages containing new assistance data conforming to what was indicated in step 1 when each additional triggering or periodicity condition occurs. Each subsequent message carries the session ID S, an arbitrary transaction ID T3 and an end of transaction indication. The session may be terminated by the server at any time after which the session ID S SHALL NOT be used again for a period of at least 24 hours. A target that is receiving the messages in steps 1, 2 and 3 should assume the procedure has terminated if step 2 or a repetition of step 3 is not observed for a period of one hour.

4. When the session is terminated, a server may optionally broadcast an LPP *ProvideAssistanceData* message to indicate this. The message SHALL contain an arbitrary transaction ID T4, an indication that this is the end of a transaction, the periodic/triggered session ID S and an indication that this is a server update for a Periodic/Triggered Assistance Data transfer. The message SHALL also contain LPPe control parameters indicating either a zero or minimal duration (depending on what is defined for the associated assistance data) and a zero or minimal applicable geographic region. The message may be periodically re-broadcast to reach more targets. Targets that follow the rules in step 1 will replace the old control parameters with the new ones and thereby end or soon end the session.

   NOTE: Step 4 SHALL NOT be used to modify the control parameters for an ongoing session with a view to continuing the session. This is because the message in step 4 may not be received by all targets, who would then continue using the old control parameters. A server wishing to modify an ongoing session SHALL instead terminate the session and start a new session using a different session ID.

5.2.2 Periodic/Triggered Location Information Transfer with Update

This procedure enables a server to request a target to send location information periodically either at defined intervals or when specific triggering criteria are met. The procedure also allows a target or a server to modify the type of location information and/or the periodicity and triggering criteria while the delivery procedure is ongoing. The procedure SHALL NOT be combined with the support of any other location information and SHALL thus use LPP transactions that are dedicated to starting, transferring or updating one specific type of Periodic/Triggered Location Information.

5.2.2.1 Initiating and Terminating the Procedure

Figure 5: shows how a Periodic/Triggered Location Information Transfer with Update may be initiated and terminated.

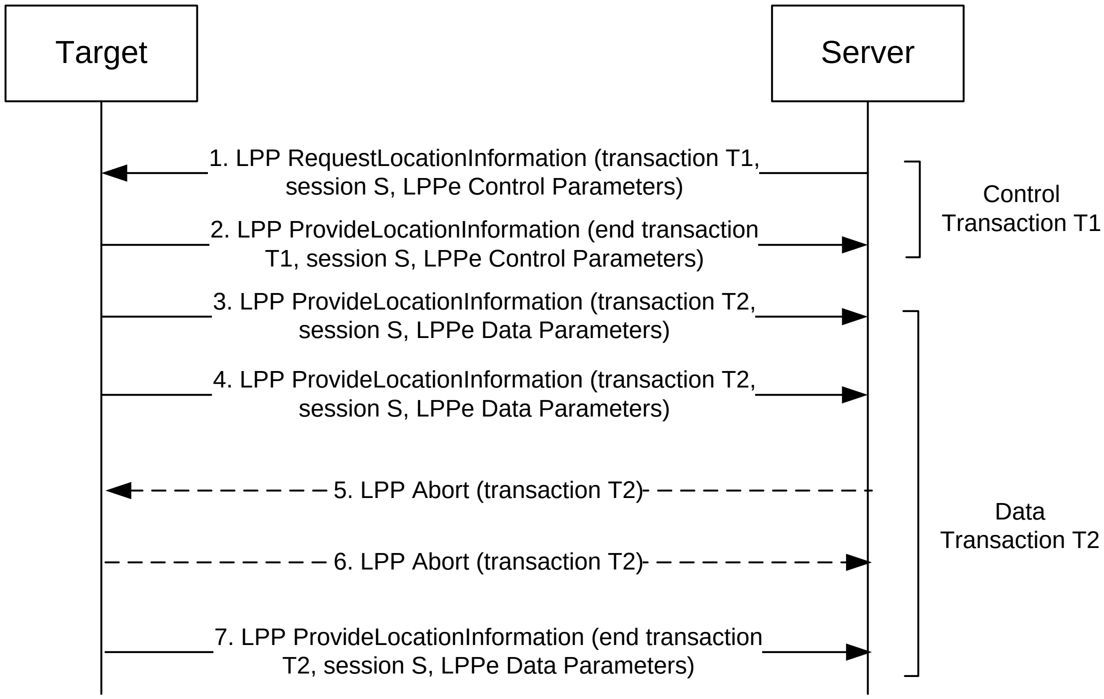


Figure 5: LPPe Periodic/Triggered Location Information transfer procedure with Update

1. The server sends an LPP *RequestLocationInformation* message to the target using some available transaction ID T1. The message contains a periodic/triggered session ID S (different to any other LPPe periodic/triggered session ID currently in use between the target and server), an indication that this is an initial request for a Periodic/Triggered Location Information transfer and LPPe control parameters identifying the type of location information being requested, the triggering or periodicity conditions for sending it and either a duration or other specific conditions for ending the location information transfer.

2. The target responds with an LPP *ProvideLocationInformation* message to the server. The message uses the transaction ID T1 in step 1 and indicates the end of this transaction. The message contains the periodic/triggered session ID S, an indication that this is a response to an initial request, and LPPe control parameters indicating whether or not the request in step 1 can be supported. If the request can be supported, the control parameters may explicitly confirm or redefine the type of location information, the triggering or periodicity parameters and the duration or other conditions for ending the location information transfer. Further characteristics of the location information to be delivered may also be provided. If the procedure cannot be supported, an error reason SHALL be provided at the LPPe level and remaining steps are then not performed.

3. When the first triggering or periodicity condition occurs, the target sends an unsolicited LPP *ProvideLocationInformation* message to the server containing the periodic/triggered session ID S, an indication that this is a periodic/triggered location information delivery, and LPPe data parameters containing the location information confirmed or defined in step 2. The message uses some available transaction ID T2 that may be different to T1.

4. The target may continue to send further LPP *ProvideLocationInformation* message to the server containing the location information confirmed or redefined in step 2 when each additional triggering or periodicity condition occurs.

5. If an error condition occurs at the server that requires the session to end, the server sends an LPP Abort to the target for transaction T2 that may optionally include LPP and/or LPPe error codes. Remaining steps are then omitted. Error conditions that may induce an abort include an attempt by either end to update the location information transfer, as described in sections 5.2.2.2 and 5.2.2.3, where the final control parameters provided by the target are not acceptable to the server.

6. If an error condition occurs at the target that requires the session to end without the delivery of further location information, the target sends an LPP Abort to the server for transaction T2 that may optionally include LPP and/or

LPPe error codes. Remaining steps are then omitted.

7. When the duration or other conditions for ending the location information transfer occur, the last LPP *ProvideLocationInformation* message transferred indicates the end of transaction T2. Terminating the transfer as in this step is preferred over the use of an abort (as in step 6) where possible, since additional termination information specific to the location information transfer may then be included.

5.2.2.2 Server Update

Figure 6: shows how the server may update an ongoing a Periodic/Triggered Location Information Transfer that was started according to section 5.2.2.1.

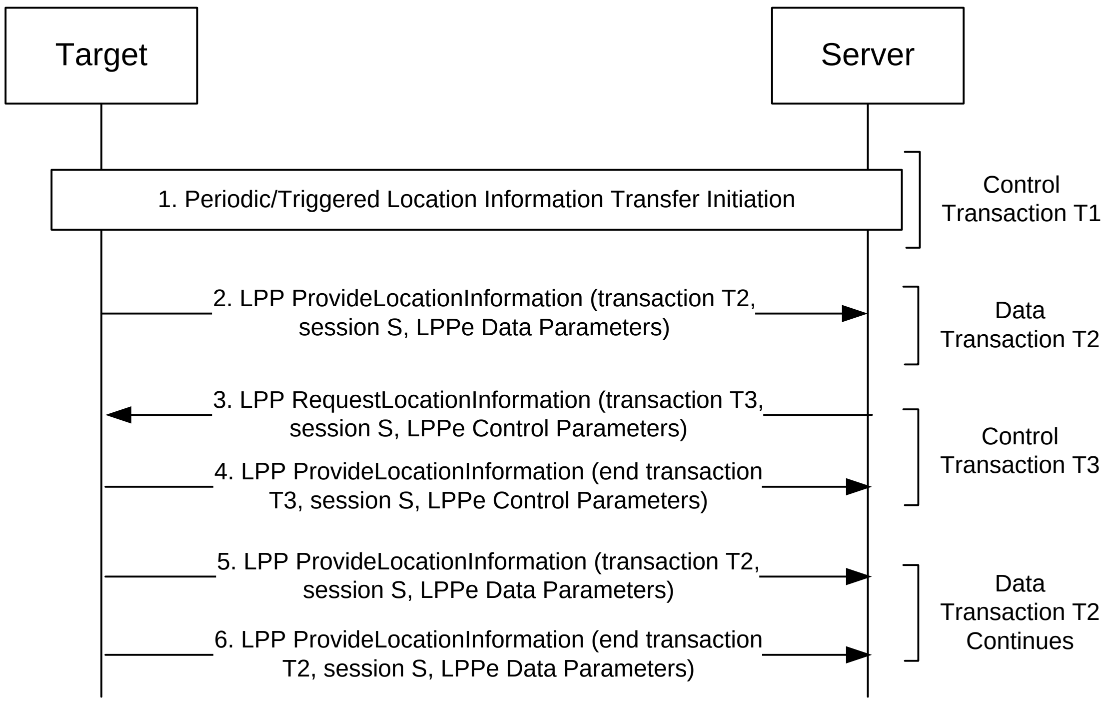


Figure 6: LPPe Periodic/Triggered Location Information transfer procedure with Server Update

1. Steps 1 and 2 of Figure 5 are performed to start an LPPe Periodic/Triggered Location Information transfer procedure with Update and using a session ID S.

2. The target may send zero, one or more LPP *ProvideLocationInformation* messages to the server containing the location information agreed in step 1 and using a transaction ID T2.

3. If, before the delivery of location information has terminated, the server needs to update the type of location information and/or the triggering and periodicity conditions and/or duration or conditions for termination, the server sends an LPP *RequestLocationInformation* message to the target using some available transaction ID T3. The ID T3 SHALL be different to T2 (if T2 has been started). The message contains the periodic/triggered session ID S, an indication that this is an update request for a Periodic/Triggered Location Information transfer and LPPe control parameters identifying any new type of location information being requested, any new triggering or periodicity conditions for sending it and any new duration or specific conditions for ending the location information transfer. The control parameters SHALL also indicate whether the previous location information delivery SHALL continue or be aborted if the new request cannot be supported.

4. The target responds with an LPP *ProvideLocationInformation* message to the server. The message uses the transaction ID T3 and indicates the end of this transaction. The message contains the periodic/triggered session ID S and an indication that this is a response to an update request. The message also contains LPPe control parameters indicating whether or not the update request in step 3 can be supported. If the request can be supported, the control parameters may explicitly confirm or redefine any new type of location information, and new triggering or periodicity parameters

and any new duration or other conditions for ending the location information transfer. Further characteristics of the location information to be delivered may also be provided. If the request in step 3 cannot be supported, then, if requested in step 3, the earlier request in step 1 SHALL continue via further repetitions of step 2 until it ends normally or is modified by a repetition of step 3 or is aborted. But if requested otherwise in step 3, the earlier request (including transaction T2) SHALL be aborted at the target without the sending of any further location information to the server. In either case, steps 5 and 6 are then omitted.

5. If the target can support the request in step 3, it ceases to support the request in step 1 following step 4. Note that due to race conditions, one or more repetitions of step 2 may be perceived to occur by the server following step 3 and prior to step 4. When the first updated triggering or periodicity condition occurs following step 4, the target sends an unsolicited LPP *ProvideLocationInformation* message to the server containing the periodic/triggered session ID S, an indication that this is periodic/triggered location information and LPPe data parameters containing the new location information confirmed or defined in step 4. The message continues to uses transaction ID T2.

6. The target may continue to send further LPP *ProvideLocationInformation* messages to the server containing the periodic/triggered session ID S and LPPe data parameters containing the new location information confirmed or redefined in step 4 when each additional triggering or periodicity condition occurs. If the duration or other conditions for ending the location information transfer occur, the last LPP *ProvideLocationInformation* message transferred indicates the end of transaction T2. If before this occurs the server needs to update the type of location information, triggering or periodicity conditions and/or duration or other conditions for terminating the transfer, steps 3 and 4 are repeated.

5.2.2.3 Target Update

Figure 7 shows how the target may update an ongoing a Periodic/Triggered Location Information Transfer that was started according to section 5.2.2.1.

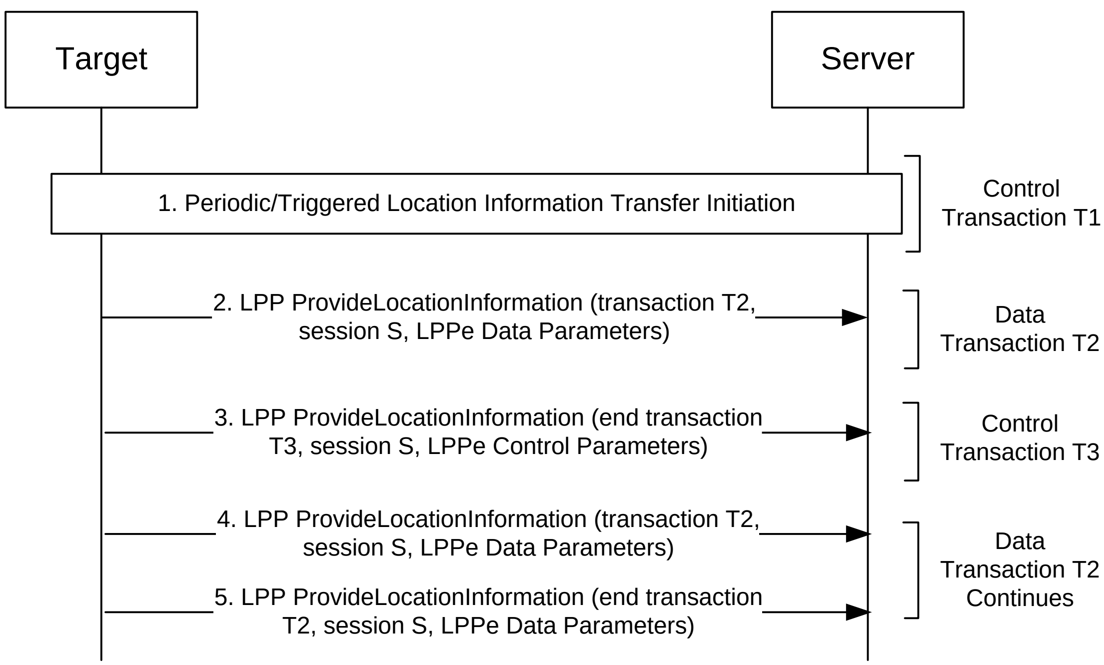


Figure 7 : LPPe Periodic/Triggered Location Information transfer procedure with Target Update

1. Steps 1 and 2 of Figure 5 are performed to start an LPPe Periodic/Triggered Location Information transfer procedure with Update and using a session ID S.

2. The target may send zero, one or more LPP *ProvideLocationInformation* messages to the server containing the location information agreed in step 1 and using a transaction ID T2.

3. If, before the delivery of location information has terminated, the target needs to update the type of location

information and/or the triggering and periodicity conditions and/or duration or conditions for termination, the target sends an unsolicited LPP *ProvideLocationInformation* message to the server using some available transaction ID T3. The ID T3 SHALL be different to T2 (if T2 has been started). The message contains the periodic/triggered session ID S, an indication that this is a target update for a Periodic/Triggered Location Information transfer and LPPe control parameters identifying any new type of location information to be provided, any new triggering or periodicity conditions for sending it and any new duration or specific conditions for ending the location information transfer. After sending this message, the target ceases to transfer location information according to step 2.

4. When the first updated triggering or periodicity condition occurs (as defined in step 3) following step 3, the target sends an unsolicited LPP *ProvideLocationInformation* message to the server containing the periodic/triggered session ID S, an indication that this is periodic/triggered location information and LPPe data parameters containing the new location information defined in step 3. The message continues to uses transaction ID T2. 5.The target may continue to send further LPP ProvideLocationInformation messages to the server containing the periodic/triggered session ID S and LPPe data parameters containing the new location information defined in step 3 when each additional triggering or periodicity condition occurs. If the duration or other conditions for ending the location information transfer occur, the last LPP ProvideLocationInformation message transferred indicates the end of transaction T2. If before this occurs the target needs to update the type of location information, triggering or periodicity conditions and/or duration or other conditions for terminating the transfer, step 3 is repeated.

5.2.3 Segmented Assistance Data Transfer

This procedure enables a server to transfer a large volume of assistance data (e.g. several Mbytes or more) in separate LPP/LPPe messages at a rate convenient to both the server and target. The procedure may be used to avoid target and server congestion including avoiding interference with other location activities being performed by the target and server. The procedure may be optionally used by a server to transfer any type of assistance data to a target and applies to both solicited and unsolicited transfer. The procedure may be used to transfer assistance data when the amount of assistance data would otherwise result in an LPPe message too large to transfer using the underlying transport protocol or location protocol. For example, the maximum message size for SUPL is restricted to less than 65535 octets. The maximum positioning payload carried within a SUPL message is limited to a size of 60,000 octets. For an LPP/LPPe message larger than this and to be transferred in a SUPL message, segmented assistance data transfer can be used. The procedure makes use of the LPP reliable transport capabilities defined in [LPP].

5.2.3.1 Basic Procedure

The basic procedure supports transfer of assistance data using a connection and, where applicable, a location session between the target and server that remain established during the whole transfer procedure.

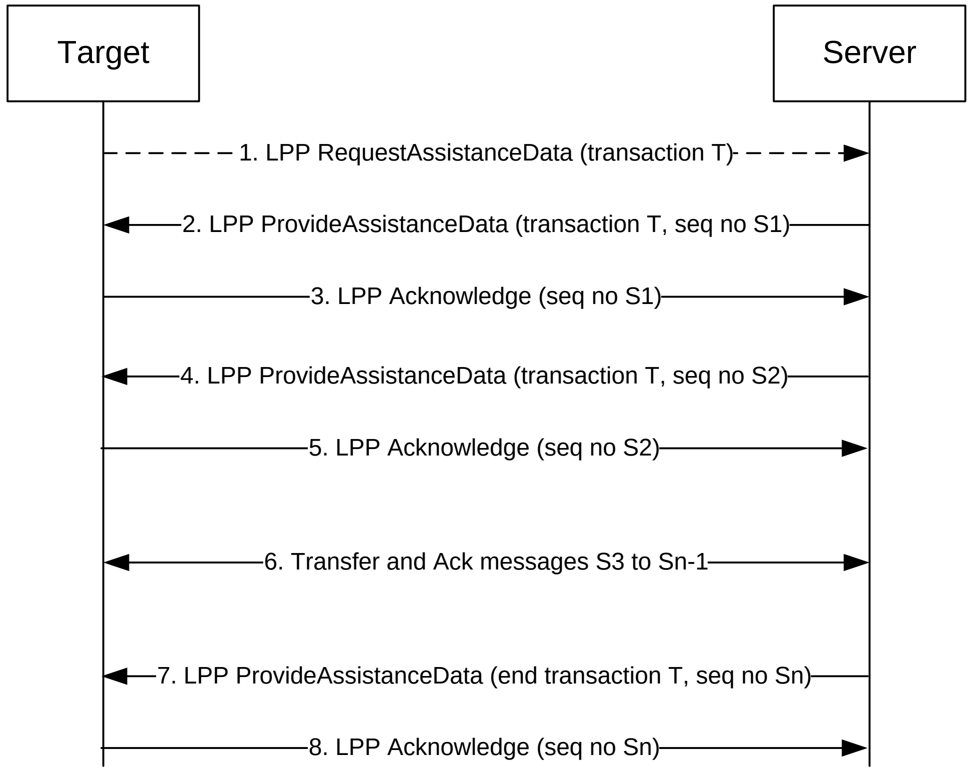


Figure 8: LPPe Segmented Assistance Data Transfer

1. Optionally, the target sends an LPP request for assistance data to the server as part of a new transaction with transaction ID T. The target may include a preference to transfer the assistance data in a segmented form. Note that such a preference is not mandatory on the server (i.e. can be ignored).

2. The server divides the assistance data to be transferred to the target into n portions. If step 1 was performed, the assistance data comprises everything requested by the target that is available to the server. Each portion of assistance data MUST be capable of being transferred in a well formed LPP/LPPe Provide Assistance Data message (i.e. a message that can be decoded and interpreted independently of any other message). Assistance data that is part of an octet string can be split between consecutive messages with the target required to concatenate the different portions received into a single octet string. Some assistance data may be duplicated in two or more messages if portions of assistance data that are transferred in different messages MUST be accompanied by the same mandatory parameters. In that case all appearances of the same mandatory parameter MUST contain identical data. Optional parameters that appear in more than one segment SHALL include the same values in each appearance. Other assistance data may need to be split into different messages carrying the same parameters but with different data – e.g. assistance data related to different GNSS SVs. The server sends the first portion of assistance data in an LPP message carrying a reliable transport sequence number S1. The message includes a transaction ID T that is the same as in step 1 if step 1 occurred and does not indicate that transaction T is ended. The message requests an LPP reliable transport acknowledgment.

3. The target recognizes that the assistance data will be transferred in a sequence of LPP messages from the indication in step 2 that the transaction T is not ended. The target acknowledges receipt of the message in step 2 by returning an LPP reliable transport acknowledgment (which SHALL NOT be piggybacked on a normal LPP message). The target may use the LPP acknowledgment to flow control the server – e.g. may delay sending the acknowledgment until the target is ready to receive the next message. Note, that the LPP acknowledgment only confirms receipt of the message in step 2 and does not confirm that the message was necessarily correct (e.g. decodable).

4. After and only after receiving the acknowledgment in step 3, the server sends the second portion of assistance data in an LPP message carrying a new sequence number S2 and requesting acknowledgment. If the server does not receive the acknowledgment in step 3 after some timeout period, the server may retransmit the LPP message in step 2 as described in [LPP]. The target discards any duplicate LPP messages (recognized by use of the same sequence number) but still returns an acknowledgment.

5. The target acknowledges receipt of the message in step 4 with an LPP acknowledgment.

6. The server transfers and the target acknowledges assistance data contained in LPP messages with sequence numbers S3 to Sn-1 by repeating steps 4 and 5. At any time during the transfer, either end may abort the transfer by sending an LPP Abort message to the other end. If the target detects an error in any received LPP message from the server, it may return an LPP Error message indicating the error. This SHALL also terminate the transfer.

7. The server transfers the last (nth) portion of assistance data in an LPP message with sequence number Sn and requesting an acknowledgment. The server includes an indication that this message ends transaction T.

8. The target acknowledges the message in step 7.

5.2.3.2 Procedure with Resume Capability

With the resume capability, segmented assistance data transfer can be successful even when the connection and/or session between the target and server are released and later reestablished before the transfer is complete.

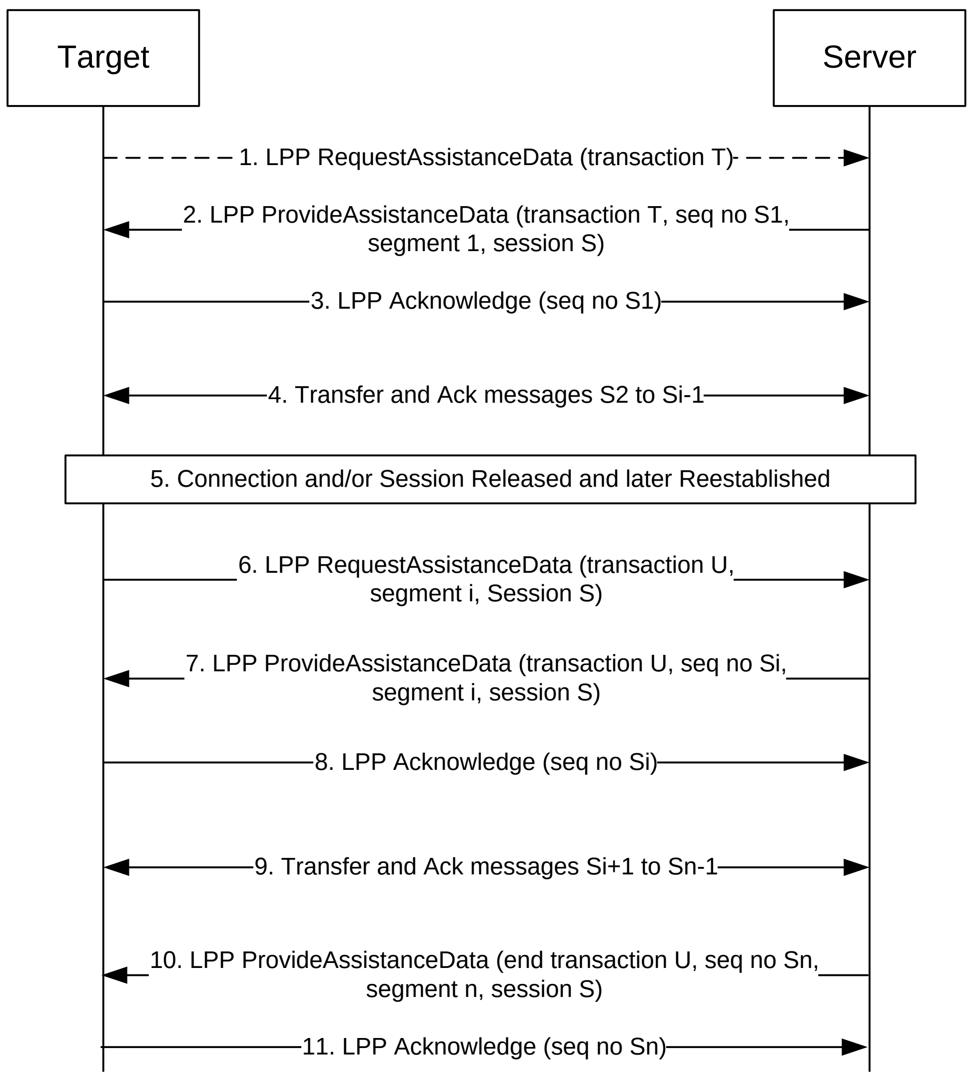


Figure 9: LPPe Segmented Assistance Data Transfer with Resume Capability

1. Optionally, the target sends an LPP request for assistance data to the server as part of a new transaction with transaction ID T. The target may include a preference to transfer the assistance data in a segmented form with resume capability.

2. This step is the same as step 2 for Figure 8 except that the server assigns a unique session ID S and includes this in the first LPP Provide Assistance Data message together with an indication that this is the first segment of assistance data.
3. This step is the same as step 3 for Figure 8.
4. The server continues to transfer more assistance data to the target as described for Figure 8. The server SHALL include the session ID S and the segment number in each subsequent Provide Assistance Data message. The server sends segments 2 to i-1. Note that if retransmission occurs, message contents remain the same as for the first transmission (including the sequence number and segment number).
5. The connection (e.g. secure IP connection) and/or session (e.g. SUPL session) between the target and server are released or fail prematurely. The connection and/session are later re-established – e.g. in order to complete the assistance data transfer or for other reasons.
6. When the target recognizes that the session and/or connection have been restored, it sends an LPP Request Assistance Data message to the server containing the session ID S and the segment number i of the next expected LPP Provide Assistance Data message. The message SHALL contain no request for other assistance data. The transaction ID U for this message need not be the same as the previous transaction ID T.
7. The server resumes the assistance data transfer interrupted by step 5 by sending the i.th portion of assistance data in an LPP Provide Assistance Data message carrying the transaction ID U, a sequence number Si, the session ID S and an indication that this is the i.th segment. The message also requests an acknowledgment. If the server does not receive the request in step 6 (e.g. because the target is not aware that the connection and/or session have been restored to the same server), it may resume the assistance transfer unsolicited. In that case, the server SHALL begin by sending or resending either LPP message i if message i-1 was acknowledged before step 5 or message i-1 if the acknowledgment for i-1 did not reach the server before step 5. If the server had aborted the transfer (e.g. due to a long timeout period during step 5), it returns an LPP Error message instead of the next assistance data segment and the remaining steps are omitted. If steps 6 and 7 occur in parallel, the server returns an LPP Error for step 6 and the target continues from step 7.
8. The target returns an acknowledgment for the message in step 7 and discards the message if this was already received just before step 5. If the target had aborted the transfer (e.g. due to a long timeout period in step 5), it instead returns an LPP Error message to the server and the remaining steps are omitted.
9. The server transfers segments i+1 to n-1 to the target as in step 4.
10. This step is the same as step 7 for Figure 8 except that the server may include the session ID S and the segment number n.
11. The target acknowledges the message in step 10.

5.2.4 Segmented Location Information Transfer

This procedure enables a target to transfer a large volume of location information in separate LPP/LPPe messages at a rate convenient to both the target and server. The procedure may be used to avoid server and target congestion including avoiding interference with other location activities being performed by the server and target. The procedure may be optionally used by a target to transfer any type of location information to a server and applies to both solicited and unsolicited transfer. The procedure may be used to transfer location information when the amount of location information would otherwise result in an LPPe message too large to transfer using the underlying transport protocol or location protocol. For example, the maximum message size for SUPL is restricted to less than 65335 octets. For an LPP/LPPe message larger than this and to be transferred in a SUPL message, segmented location information transfer can be used. The procedure makes use of the LPP reliable transport capabilities defined in [LPP].

5.2.4.1 Basic Procedure

The basic procedure supports transfer of Location information using a connection and, where applicable, a location session between the server and target that remain established during the whole transfer procedure.

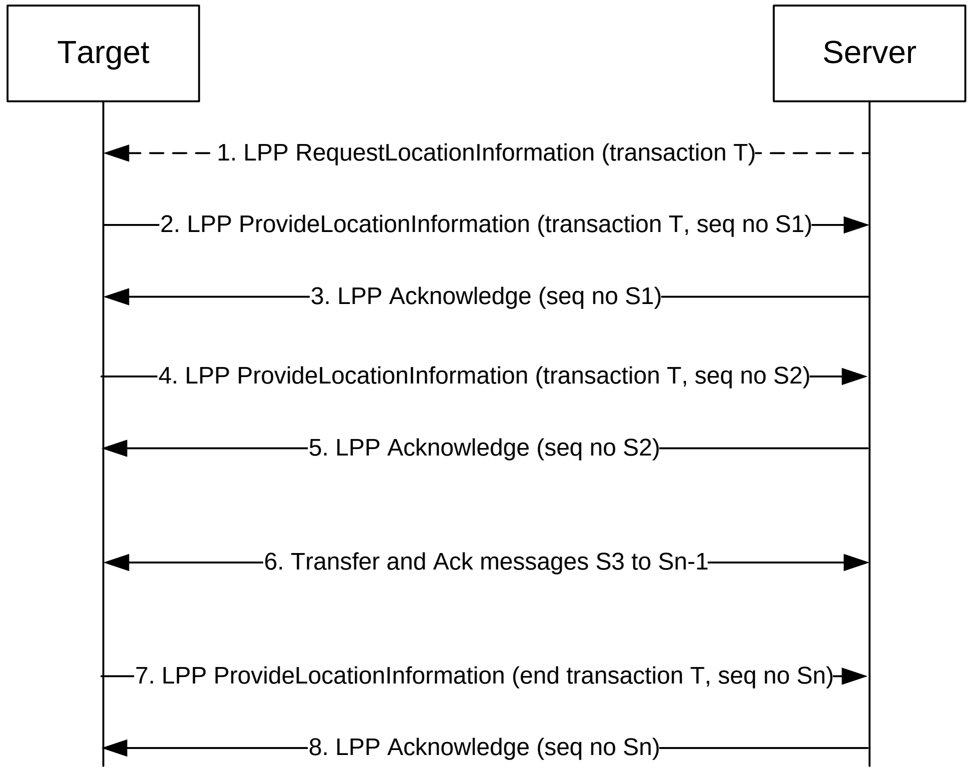


Figure 10: LPPe Segmented Location Information Transfer

1. Optionally, the server sends an LPP request for Location information to the target as part of a new transaction with transaction ID T. The server may include a preference to transfer the location information in a segmented form. Note that such a preference is not mandatory on the target (i.e. can be ignored).

2. The target divides the location information to be transferred to the server into n portions. If step 1 was performed, the location information comprises everything requested by the server that is available to the target Each portion of location information MUST be capable of being transferred in a well formed LPP/LPPe Provide Location information message (i.e. a message that can be decoded and interpreted independently of any other message). Location information that is part of an octet string can be split between consecutive messages with the server required to concatenate the different portions received into a single octet string. Some location information may be duplicated in two or more messages if portions of location information that are transferred in different messages MUST be accompanied by the same mandatory parameters. In that case all appearances of the same mandatory parameter MUST contain identical data. Optional parameters that appear in more than one segment SHALL include the same values in each appearance. Other location information may need to be split into different messages carrying the same parameters but with different data – e.g. location information related to different GNSS SVs. The target sends the first portion of location information in an LPP message carrying a reliable transport sequence number S1. The message includes a transaction ID T that is the same as in step 1 if step 1 occurred and does not indicate that transaction T is ended. The message requests an LPP reliable transport acknowledgment.

3. The server recognizes that the location information will be transferred in a sequence of LPP messages from the indication in step 2 that the transaction T is not ended. The server acknowledges receipt of the message in step 2 by returning an LPP reliable transport acknowledgment (which SHALL NOT be piggybacked on a normal LPP message). The server may use the LPP acknowledgment to flow control the target – e.g. may delay sending the acknowledgment until the server is ready to receive the next message. Note, that the LPP acknowledgment only confirms receipt of the message in step 2 and does not confirm that the message was necessarily correct (e.g. decodable).

4. After and only after receiving the acknowledgment in step 3, the target sends the second portion of location information in an LPP message carrying a new sequence number S2 and requesting acknowledgment. If the target does not receive the acknowledgment in step 3 after some timeout period, the target may retransmit the LPP message in step 2 as described in [LPP]. The server discards any duplicate LPP messages (recognized by use of the same

sequence number) but still returns an acknowledgment.

5. The server acknowledges receipt of the message in step 4 with an LPP acknowledgment.
6. The target transfers and the server acknowledges location information contained in LPP messages with sequence numbers S3 to Sn-1 by repeating steps 4 and 5. At any time during the transfer, either end may abort the transfer by sending an LPP Abort message to the other end. If the server detects an error in any received LPP message from the target, it may return an LPP Error message indicating the error. This SHALL also terminate the transfer.
7. The target transfers the last (nth) portion of location information in an LPP message with sequence number Sn and requesting an acknowledgment. The target includes an indication that this message ends transaction T.
8. The server acknowledges the message in step 7.

5.2.4.2 Procedure with Resume Capability

With the resume capability, segmented location information transfer can be successful even when the connection and/or session between the server and target are released and later reestablished before the transfer is complete.

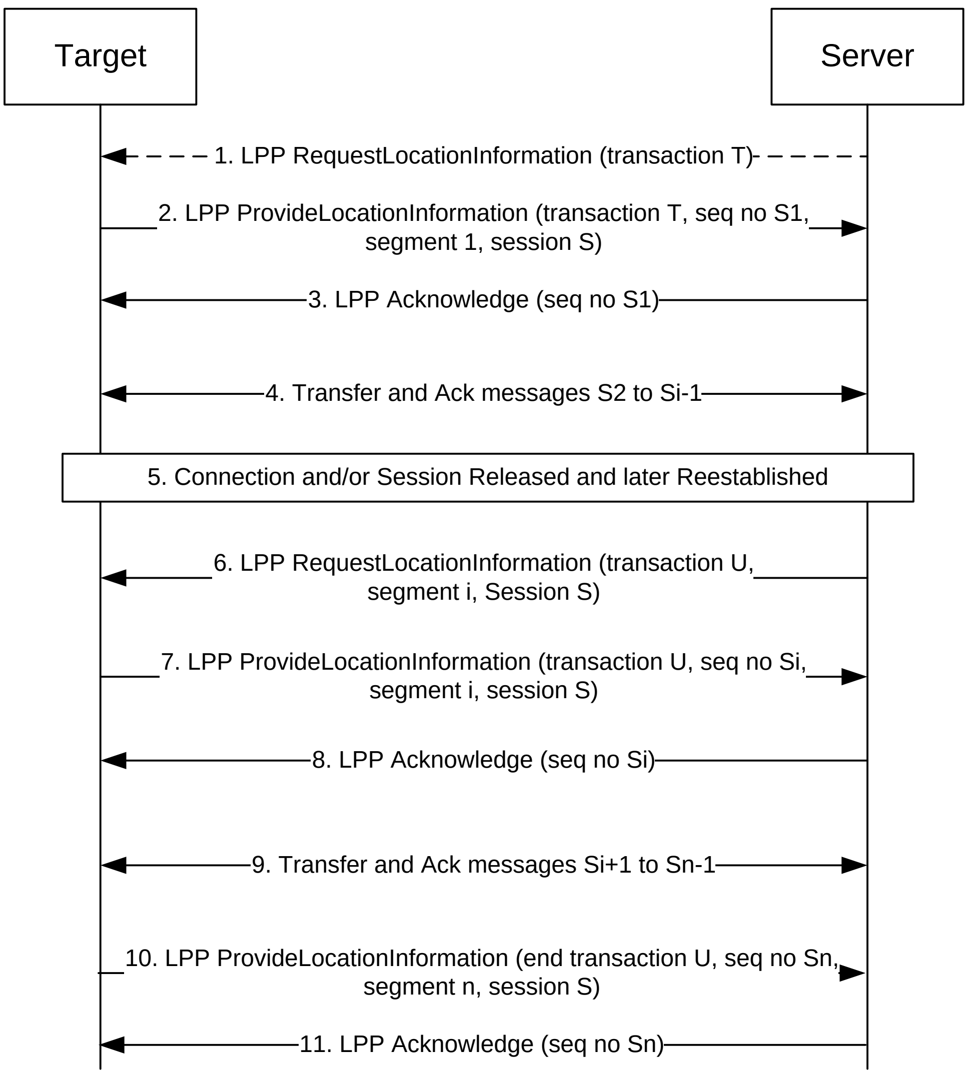


Figure 11: LPPe Segmented Location information Transfer with Resume Capability

1. Optionally, the server sends an LPP request for location information to the target as part of a new transaction with transaction ID T. The server may include a preference to transfer the location information in a segmented form with

resume capability.

2. This step is the same as step 2 for Figure 10except that the target assigns a unique session ID S and includes this in the first LPP Provide Location information message together with an indication that this is the first segment of location information.
3. This step is the same as step 3 for Figure 10.
4. The target continues to transfer more location information to the server as described for Figure 10. The target SHALL include the session ID S and the segment number in each subsequent Provide Location information message. The target sends segments 2 to i-1. Note that if retransmission occurs, message contents remain the same as for the first transmission (including the sequence number and segment number).
5. The connection (e.g. secure IP connection) and/or session (e.g. SUPL session) between the server and target are released or fail prematurely. The connection and/session are later re-established – e.g. in order to complete the location information transfer or for other reasons.
6. When the server recognizes that the session and/or connection have been restored, it sends an LPP Request Location information message to the target containing the session ID S and the segment number i of the next expected LPP Provide Location information message. The message SHALL contain no request for other location information. The transaction ID U for this message need not be the same as the previous transaction ID T.
7. The target resumes the location information transfer interrupted by step 5 by sending the i.th portion of location information in an LPP Provide Location information message carrying the transaction ID U, a sequence number Si, the session ID S and an indication that this is the i.th segment. The message also requests an acknowledgment. If the target does not receive the request in step 6 (e.g. because the server is not aware that the connection and/or session have been restored to the same target), it may resume the location information transfer unsolicited. In that case, the target SHALL begin by sending or resending either LPP message i if message i-1 was acknowledged before step 5 or message i-1 if the acknowledgment for i-1 did not reach the target before step 5. If the target had aborted the transfer (e.g. due to a long timeout period during step 5), it returns an LPP Error message instead of the next location information segment and the remaining steps are omitted. If steps 6 and 7 occur in parallel, the target returns an LPP Error for step 6 and the server continues from step 7.
8. The server returns an acknowledgment for the message in step 7 and discards the message if this was already received just before step 5. If the server had aborted the transfer (e.g. due to a long timeout period in step 5), it instead returns an LPP Error message to the target and the remaining steps are omitted.
9. The target transfers segments i+1 to n-1 to the server as in step 4.
10. This step is the same as step 7 for Figure 10 except that the target includes the session ID S and the segment number n.
11. The server acknowledges the message in step 10.

5.2.5 Broadcast of Assistance Data (version 1.1)

5.2.5.1 Broadcast Assistance Data Messages

A broadcast assistance data message may comprise any one of the following messages:

(a) An unencapsulated and unciphered LPP Provide Assistance Data message

(b) An unencapsulated and unciphered LPP/LPPe Provide Assistance Data message

(c) An encapsulated LPP Provide Assistance Data message that may optionally be ciphered and/or digitally signed

(d) An encapsulated LPP/LPPe Provide Assistance Data message that may optionally be ciphered and/or digitally signed

An unencapsulated message consists of either an LPP message without an LPPe extension in case (a) or an LPP message with an LPPe extension in case (b). Unencapsulated broadcast messages are not ciphered or digitally signed and do not contain the additional message portions shown in Figure 12. An encapsulated LPP or LPP/LPPe message may or may not be ciphered and may or may not be digitally signed and contains additional message portions as illustrated in Figure 12.

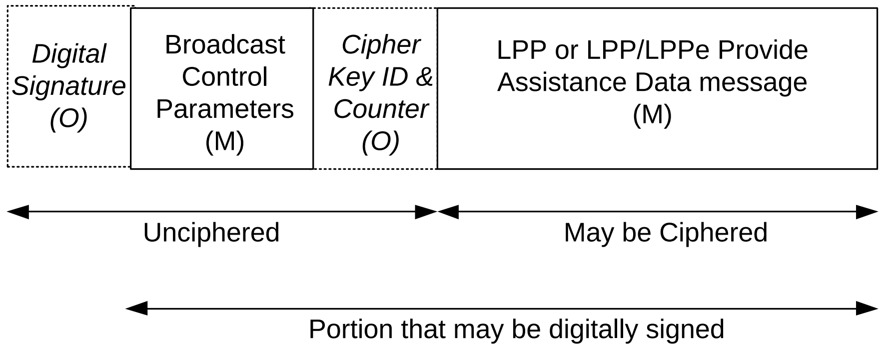


Figure 12: An encapsulated LPP(/LPPe) Broadcast Message with Mandatory (M) and Optional (O) portions

The broadcast control parameters enable detection of an already received broadcast message and contain information on the geographic and time applicability of the message and the types of assistance data included. The cipher key ID and counter value are included when ciphering is used. The message portion contains an LPP or LPP/LPPe Provide Assistance Data message and may be ciphered. A digital signature may be included and, if so, is computed over the entire succeeding message content. The digital signature portion contains the associated public key identifier and appears at the beginning of the message so that a target can determine as soon as reception begins whether it has the correct public key and, if so, can begin the authentication process while message reception is in progress.

A particular broadcast system should, if possible, offer either the unencapsulated variant (cases (a) and (b)) or the encapsulated variant (cases (c) and (d)) but not both over its entire coverage area to enable targets to employ the correct decoding in a consistent manner. LPPe 1.1 capable targets can be informed of the variant being used by a server. Any LPPe 1.0 capable but not LPPe 1.1 capable targets which support broadcast reception will assume the unencapsulated variant and will encounter decoding errors if the encapsulated variant is used. It is expected that a reasonably robust LPPe 1.0 implementation would cease making use of a particular broadcast system once a certain number of consecutive decoding errors were encountered.

5.2.5.2 Broadcast Procedure

Figure 13 shows how the server may broadcast location assistance data to one or more targets. Details of the Broadcast Subsystem including whether it comprises a single entity or multiple entities and its interfaces to the Target and Server are outside the scope of this specification.

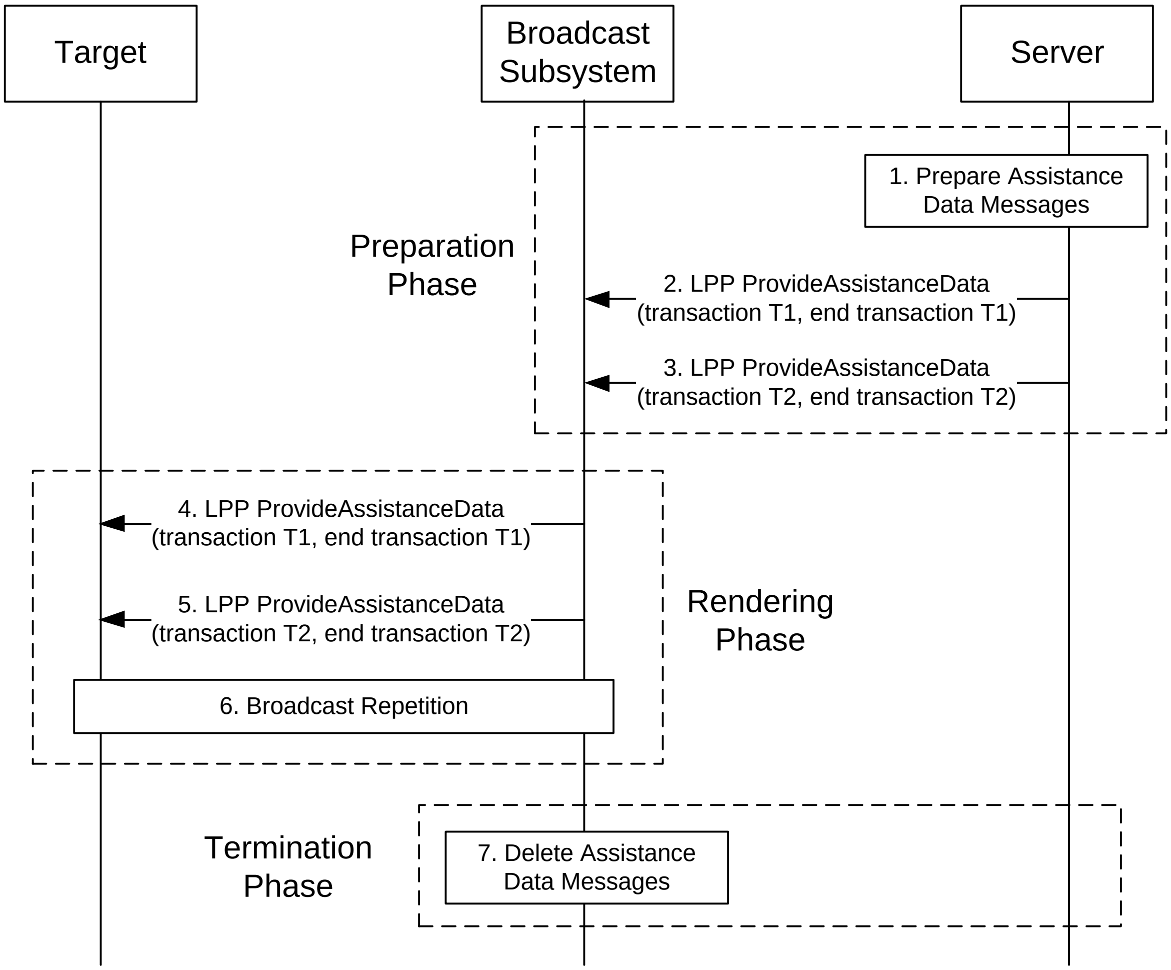


Figure 13: Broadcast of LPP/LPPe Assistance Data

5.2.5.2.1 Preparation Phase

During the preparation phase, LPP/LPPe assistance data is transferred from the server to the Broadcast Subsystem. Depending on the Broadcast Subsystem, the preparation phase may include additional steps not shown in Figure 13 – e.g. exchange of broadcast capabilities between the Broadcast Subsystem and server, a request for specific assistance data from the Broadcast Subsystem to the server, an indication from the Broadcast Subsystem to the server on the current or future available broadcast capacity, an acknowledgment for assistance data successfully transferred to the Broadcast Subsystem from the server. Such additional steps are outside the scope of this specification.

1. The server packages the assistance data to be broadcast into one or more LPP/LPPe Provide Assistance Data messages which may or may not be encapsulated, ciphered and digitally signed as described above. Each LPP/LPPe Provide Assistance Data message is well formed (i.e. can be decoded by a target independently of other messages). The content of each message may be location and/or time specific – i.e. may be applicable to a specific geographic area and/or to a specific period of time. Each message includes an end of transaction indication. Different messages may or may not carry different transaction IDs. Messages SHALL NOT include an LPP sequence number or LPP acknowledgment request. The server may include in each message a unique message ID and the validity time and/or the validity area for the included assistance data. The server may optionally cipher some or all messages.

2. The server transports an LPP/LPPe Provide Assistance Data message to the Broadcast Subsystem. The server may include additional information such as broadcast triggering conditions (e.g. periodicity), priority, applicable geographic area and time period. This additional information and the means of transport are outside the scope of this specification.

3. The server may repeat step 2 to transport one or more additional LPP/LPPe Provide Assistance Data messages to the Broadcast Subsystem. Depending on the interface to the Broadcast Subsystem, some or all of the messages in steps 2 and 3 may be sent together as a single package.

5.2.5.2.2 Rendering Phase

During the rendering phase, LPP/LPPe assistance data is broadcast to the target audience. Depending on the Broadcast Subsystem, the rendering phase may include additional steps not shown in Figure 13 – e.g. advance notification by the Broadcast Subsystem to the target audience of the type or types of assistance data to be later broadcast together with scheduling information, requests by interested targets to the Broadcast Subsystem for information to enable subsequent broadcast reception. Such additional steps are outside the scope of this specification.

4. The Broadcast Subsystem broadcasts the LPP/LPPe Provide Assistance Data message received in step 2 without modification. The broadcast may occur from multiple nodes (e.g. multiple base stations) and may be accompanied by additional information identifying, for example, the type of assistance data and use of ciphering. The broadcasting may also employ segmentation with reassembly at the target. Such additional information and use of segmentation is outside the scope of this specification. A target that is both able to and chooses to receive the broadcast may decipher the message if ciphering was employed and decode the message contents. If the message includes a message ID, the target SHALL discard the message if a broadcast message with the same message ID was received and stored within a period either less than the validity time if a validity time was included or less than 24 hours otherwise. Otherwise, the target should store the assistance data within the message, overwriting any previous assistance data of the same type if needed. The target may use the assistance data to support positioning until such time as the validity time (if included) has expired or the target recognizes it is no longer in the validity area (if included).

NOTE 1: The server is responsible for ensuring that any message ID assigned to an LPPe message A is not reused for a new LPPe message B before the message validity time for the message A, if included, or 24 hours otherwise have expired since the final broadcast of the message A.

NOTE 2: Detection of message duplication using a unique message ID does not apply to unencapsulated LPP/LPPe messages. However, message duplication may be recognized in other ways (e.g. via a CRC on the message contents). In the event that message duplication is not recognized, the same assistance data will be re-stored which is inefficient but should not harm target operation.

5. The Broadcast Subsystem broadcasts the one or more additional LPP/LPPe Provide Assistance Data messages received in step 3 in a similar manner to step 4.

6. Broadcast of each message in steps 4 and 5 may be repeated and the periodicity or other triggering conditions for broadcasting may be the same or different for each message.

5.2.5.2.3 Termination Phase

During the termination phase, LPP/LPPe assistance data that no longer needs to be broadcast is removed from the Broadcast Subsystem. Depending on the Broadcast Subsystem, the termination phase may include additional steps not shown in Figure 13 – e.g. notification by the Broadcast Subsystem to the server concerning the actual number of broadcasts for each LPP/LPPe Provide Assistance Data message, the areas in which and/or nodes from which the broadcasts occurred and, if known, the size of the target audience. Such additional steps are outside the scope of this specification.

1. The Broadcast Subsystem ceases broadcasting any message received in step 2 or 3 and deletes it either when instructed by the server or when dictated by scheduling information originally received in step 2 or step 3.

5.2.5.3 Ciphering of Assistance Data

Assistance data that is broadcast may be optionally ciphered using the Advanced Encryption Standard (AES) algorithm [AES] with a 128 bit key and using Counter mode [NIST-800-38A]. An informative description of these algorithms is provided in Appendix F.

The algorithms require specific conventions for bit ordering. The convention followed here is that the bit order applicable to ciphering for an ASN.1 BIT STRING is the bit order defined by ASN.1 (e.g. ITU X.680) where the first bit is the leading bit number zero, the second bit is bit one etc. The bit order applicable to ciphering for an OCTET STRING starts with the highest order bit of the first octet and follows the bit ordering in each octet (high followed by low bits) and the octet ordering in the OCTET STRING (first octet to last octet). These conventions align with those used in [AES]. The bit ordering applicable to ciphering for a PER encoded LPP/LPPe message is the bit ordering produced by the PER encoding. The same conventions for bit ordering also apply to authentication in section 5.2.5.4.

The initial counter C1 used to cipher an entire LPP/LPPe message is provided to a target by a server in two portions. The first portion, denoted C0, is provided using point to point mode along with the 128 bit ciphering key and an identifier for both of these values. The second portion, denoted D0, is provided in unciphered form as part of the overall encapsulated message as shown in Figure 11A. A target then obtains C1 as:

C1 = (C0 + D0) mod 2**128 (where all values are treated as non-negative integers)

To obtain any subsequent counter Ci from the previous counter Ci-1 for any message, the following operation is used:

Ci = (Ci-1 + 1) mod 2**128

The value for D0 SHALL be different for different broadcast messages and SHALL ensure that the counters derived from C1 for any message are different to the counters for any other message.

5.2.5.4 Authentication of Assistance Data

Assistance data that is broadcast may be optionally digitally signed using the RSASSA-PSS variant of the PKCS#1 v.2.1 RSA method defined in [PKCS#1] and [RFC3447] where [RFC3447] takes precedence in case of any conflict. These references define a set of fixed procedures and some options. The method for LPPe uses as input the procedures and options shown in Table 2.

Authentication Input	**Procedure or Option Used**	**[PKCS#1] and [RFC3447] section**
Encoding method	EMSA-PSS	9.1
Hash Function	SHA-256 [NIST 180-4]	9.1.1, 9.1.2
Mask Generation Function	MGF1 with SHA-1 [NIST 180-4]	B.2.1
Encoding salt length	0 to 32 octets (exact value is provided by the server)	9.1
RSA modulus n (and signature length)	2048 bits	8.1
Signature Generation	RSASSA-PSS-SIGN	8.1.1
Signature Verification	RSASSA-PSS-VERIFY	8.1.2

Table 2: Applicable Authentication Procedures and Options

At a server, a digital signature is computed over an entire broadcast message (that has already been ciphered if ciphering is used) by first hashing and masking the message to yield a message representation of length 2047 bits and then generating a signature of length 2048 bits for the message representation using an RSA private key. At a target, the signature is converted to an expected message representation using the RSA public key and then compared to the actual message representation derived from the received message.

The public key and salt length are provided to a target by a server and assigned a unique ID. This transfer occurs using point to point LPPe before the target begins to receive broadcast assistance data. The server identifies the public key and salt length to be used to authenticate any received broadcast LPPe message by including the unique identifier that was sent earlier point to point.

A target SHALL authenticate any broadcast message received that contains a digital signature if the target already has the identified public key and salt length. If a server has earlier indicated by point to point means that authentication SHALL be used for a particular broadcast system, a target SHALL ignore any broadcast message received that does not contain a digital signature. Broadcast messages that fail authentication SHALL also be discarded and a target may cease using the associated broadcast system for some implementation dependent time period. When receiving a new broadcast message, a target should perform verification and decoding in the following order.

(1) Verification from broadcast control parameters that the message is not a duplicate and has a valid time and geographic area applicability.

(2) Verification from broadcast control parameters that the message contains (or may contain) types of assistance data of interest to the target.

(3) Verification that the target has the correct key or keys to perform authentication and deciphering when either or both of these are required.

(4) Verification of any digital signature if included.

(5) Deciphering of message content if ciphering was used.

(6) ASN.1 decoding of message content.

5.2.6 Crowdsourcing (version 2.0)

5.2.6.1 Crowdsourcing Principles

Crowdsourcing involves instigating and subsequently receiving measurements at a server from one or more target devices for one or more types of terrestrial transmitter. A server (or a surrogate to which the measurements may be forwarded) may subsequently use the measurements for one or more purposes outside the scope of LPPe. For example, a server may determine location related information (e.g. estimated locations and/or transmission characteristics) for terrestrial transmitters which may be used at the server to support positioning and/or may be sent to target devices as assistance data. In another example, the measurements may be used for network optimization – e.g. to help plan deployment or redeployment of transmitters and/or adjust transmission capabilities of existing transmitters.

The crowdsourcing procedures enable a server to request a target to send crowdsourcing measurements for a limited or unlimited period to a designated data server. The server instigating the crowdsourcing is referred to as the control server and may differ from the data server to which measurements are sent in order to limit the influx of data at the control server, loadshare crowdsourcing data over several data servers and/or provide the measurement data to a server dedicated to processing of crowdsourcing data. The control server provides control parameters to the target defining when the measurements are to be obtained and when they are to be returned to the data server. The control parameters are divided into four groups comprising activation triggers, measurement triggers, reporting triggers and duration parameters. Activation triggers define the conditions for activating and deactivating crowdsourcing measurements and may be used to avoid obtaining measurements in conditions where measurements may be difficult or not needed, thereby saving on target resource usage (e.g. battery, memory, signaling) and reducing load on the data server. When crowdsourcing is deactivated, a target does not obtain new crowdsourcing measurements but continues to report any previously obtained measurements, if not already sent, according to the reporting triggers. Measurement triggers define when and how often measurements should be made when crowdsourcing measurements have been activated. Reporting triggers define when and how often measurements should be returned and include a reporting mode which may be any of: real time where measurements are sent as soon as they are made or are discarded otherwise; quasi-real time where measurements are sent in real time if possible but in batch mode otherwise; and batch where measurements are sent infrequently in batches.

A target is enabled to confirm whether or not it will fulfil a crowdsourcing request from the control server and may include agreed control parameters and agreed measurement types that may each be the same as those requested by the server or may each differ. In the latter case, a target SHALL employ a subset policy in which agreed measurements are a subset of those requested and agreed control parameters either omit requested control parameters or include requested parameters set to values that will reduce the frequency and/or duration of crowdsourcing deactivation, measurements and/or reporting. In the case of the reporting mode (real time, quasi-real time and batch reporting), a target SHALL NOT change the mode requested by the server.

A control server or data server may query a target at a later time to verify whether crowdsourcing is still active in the target and what are the measurements and control parameters assumed by the target. This may enable detection of conditions where crowdsourcing has stopped at a target before a designated end time – e.g. due to user intervention, a power off or lack of resources (e.g. low battery level). A query may also enable a control server or data server to periodically poll targets regarding crowdsourcing when a control server or data server does not maintain records of the crowdsourcing ongoing in targets. Targets for which crowdsourcing is not active may then be requested by the server to start crowdsourcing.

A control server or data server may abort an ongoing crowdsourcing session in a particular target – e.g. because measurements are no longer needed or to reduce load on the data server. A target may also abort an ongoing crowdsourcing session – e.g. due to user intervention or because a target has insufficient resources (e.g. battery level is low). A server abort is always signaled to the target. A target abort is not signaled to either the control server or data server. However, a target may indicate the end of crowdsourcing when reporting crowdsourcing measurements to the data server in the case that crowdsourcing is stopped in a controlled manner,

Crowdsourcing may be identified or may be anonymous. With identified crowdsourcing, crowdsourcing reports carry a unique session ID assigned by the control server. With anonymous crowdsourcing, a reserved session ID of zero is included in crowdsourcing reports which may prevent tracking of the target and thereby ensure user privacy. A target has the ability to set the session ID to zero to indicate that crowdsourcing will be anonymous when confirming crowdsourcing to the control server if the control server had assigned a unique session ID.

Only one crowdsourcing session is allowed to be ongoing for any target with respect to any server regardless of whether the server acts as a control server or data server. This restriction simplifies crowdsourcing and reduces the possibility of loss of synchronization between a server and a target with respect to ongoing crowdsourcing sessions. If a control server that is already the control server or data server for an ongoing crowdsourcing session with a target requests a new crowdsourcing session from the target, the target SHALL abort the ongoing session and then process the request for the new session. Should the new session be rejected, the previous session is still aborted. This can help overcome loss of synchronization between a server and a target. If a control server that is neither the control server nor data server for an ongoing crowdsourcing session with a target requests a new crowdsourcing session from the target and specifies a data server for which there is an ongoing crowdsourcing session, the target SHALL reject the request. This prevents a control server from interfering with crowdsourcing invoked by another control server. Within the limits of these restrictions, a target may support multiple crowdsourcing sessions for different control and data servers.

Mixing of crowdsourcing and positioning support in the same LPP Request Location Information and Provide Location Information messages is not allowed. Thus, LPP messages related to crowdsourcing SHALL NOT contain location information related to positioning. However, crowdsourcing capabilities may be requested and provided in the same LPP Request Capabilities and LPP Provide Capabilities messages used to request and provide positioning capabilities. The LPP Request Assistance Data and LPP Provide Assistance Data messages are not used directly for crowdsourcing although assistance data may be requested by a target and provided by a server to support crowdsourcing without indicating this explicitly.

Since crowdsourcing relies on receipt of measurement data from a large number of different target devices, there is no especial premium on ensuring that all requested crowdsourcing measurements are made and successfully transferred to the server. It is thus allowable for a congested target or a target with reduced battery charge to miss some measurements and not to expend excessive resources in reconnecting to a server when radio conditions or network support are faulty. Furthermore, a target may choose not to send measurements to a server if the user will be charged for this by a network operator – e.g. if a cellular network is being used instead of say a WiFi network. In this case, any withheld measurements may be sent later if batch or quasi-real time reporting was agreed.

Please note that a target measurement system (e.g. WLAN AP) may indicate that some measurements should not be crowdsourced. If so, then this SHALL be respected.

5.2.6.2 Crowdsourcing Procedure

Figure 14 illustrates and provides more details for the crowdsourcing procedure.

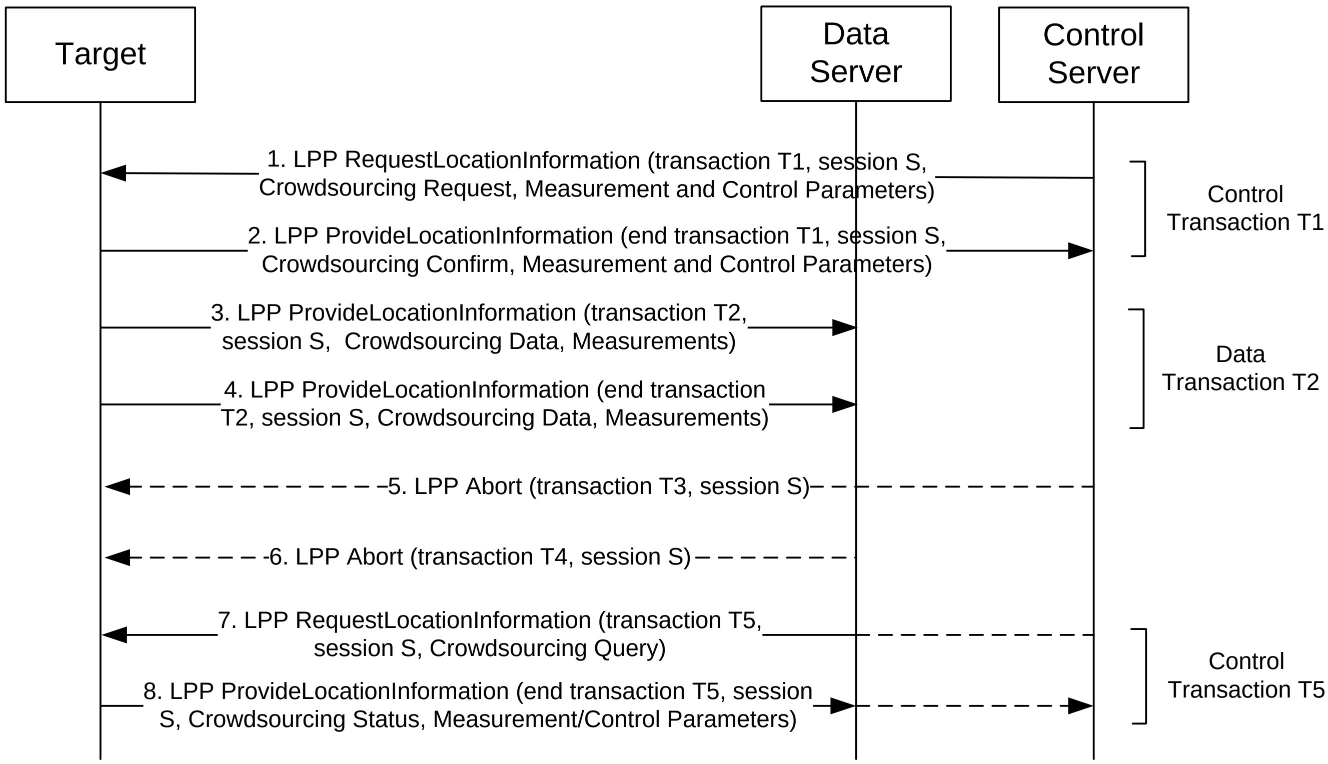


Figure 14: LPPe Crowdsourcing Procedure

1. The control server sends an *LPP RequestLocationInformation* message to the target using some available transaction ID T1. The message contains a crowdsourcing session ID S which may either be unique to the target or may be set to an anonymous value of zero, an indication that this is a request for crowdsourcing and an indication of the crowdsourcing measurements requested and the control parameters for obtaining and reporting the measurements. The message may also contain the address of a data server to which crowdsourcing measurements SHALL be sent. If a data server is not indicated, the data server is the same as the control server.

2. The target responds with an LPP ProvideLocationInformation message to the control server. The message uses the transaction ID T1 in step 1 and indicates the end of this transaction. The message contains a session ID S which SHALL either be the same as in step 1 or zero to indicate anonymous reporting, an indication that this is a confirmation of crowdsourcing, and an indication of the measurements to be crowdsourced and the control parameters for obtaining and reporting the measurements. The indicated measurements and control parameters SHALL either be the same as in step 1 or a subset of those in step 1 where a subset of control parameters omits certain parameters in step 1 and/or contains certain parameters from step 1 indicating a lower frequency and/or lower duration of measurement and/or reporting than in step 1. If the crowdsourcing procedure cannot be supported, an indication of a rejection of crowdsourcing is included instead in the LPP ProvideLocationInformation message in step 2 as well as an error reason and an indication of measurements and control parameters is not included. In this case, subsequent steps are not performed.

3. The target obtains crowdsourcing measurements as defined by the control and measurement parameters in step 2. When the first set of measurements needs to be sent as determined by the control parameters, the target assembles the measurement data into one or more LPP ProvideLocationInformation messages. If there is only one message, the target proceeds to step 4. Otherwise, the target sends the first batch of measurement data to the data server indicated in step 1 in an LPP ProvideLocationInformation message which SHALL indicate crowdsourcing data and comprise measurement data obtained at the earliest time(s). The message SHALL include an available transaction ID T2 which may differ from T1 and the session ID S in step 2. The target SHALL repeat step 3 to send each successive set of measurement data, except for the last, as obtained at progressively later times to the data server.

4. For the last set of measurement data, the target SHALL send an LPP ProvideLocationInformation message to the data server as in step 3 but with an end of transaction also indicated. In addition, the target may indicate the end of the

crowdsourcing session if any duration agreed in step 2 has ended or if the target needs to end the session for other reasons (e.g. lack of resources or user intervention). Steps 3 and 4 are repeated at later reporting times to send subsequent sets of measurements as determined by the control parameters in step 2. If a session or connection between the target and the data server fails or is released while crowdsourcing transfer according to step 3 and 4 is still in progress, the target should attempt to re-establish the session or connection and resume the transfer. In this case, the target SHALL NOT resend any LPP ProvideLocationInformation message that was previously completely sent in step 3 or step 4 even if there was no confirmation of receipt at the transport level but SHALL instead resume sending of LPP messages that were not yet sent or not completely sent to the server. This may result in the loss of one LPP ProvideLocationInformation message but avoids undetected message duplication which may occur with anonymous crowdsourcing or where a server does not maintain a record of crowdsourcing messages that were received from each target.

5. If an error related condition occurs at the control server that requires the session to end, the control server sends an LPP Abort to the target using any available transaction ID T3 and includes the session ID S from step 2.

6. If an error related condition occurs at the data server that requires the session to end, the data server sends an LPP Abort to the target using any available transaction ID T4 and includes the session ID S received in step 3 or step 4.

7. If the control server or data server needs to query the status of crowdsourcing in the target, the control server or data sever sends an LPP RequestLocationInformation message to the target using some available transaction ID T5. The message may contain a crowdsourcing session ID S if the control server or data server is aware of an active session with the target. Otherwise, the session ID S is omitted.

8. If the target is able to match an included session ID S in step 7 to an active crowdsourcing session for this control server or data server or, if that is not possible, if the target is able to determine an active crowdsourcing session for this control server or data server with any session ID, the target returns an LPP ProvideLocationInformation message to the control server or data server. The message uses the transaction ID T5 in step 7 and indicates the end of this transaction. The message indicates a crowdsourcing status response and contains the session ID S for the active crowdsourcing session with the control server or data server which may not be the same as the session ID S received in step 7. The message SHALL also indicate the measurements being obtained and the control parameters in use as returned in step 2. The message SHALL also provide statistics on the crowdsourcing session if available to the target. If the target is unable to find an active crowdsourcing session for this control server or data server, the target returns an LPP ProvideLocationInformation message to the control server or data server with the transaction ID T5 from step 7, an end of transaction indication, an indication of a crowdsourcing status response and an indication that no active session was found.

In the case of a receiver detecting protocol errors where a transaction related to crowdsourcing is still open, the receiver SHALL return an LPP ERROR message and consider the transaction as closed. The message that caused the error SHALL be discarded and any request contained in it SHALL be ignored except in the case of an abort or termination request where any ongoing crowdsourcing session SHALL be terminated. Except for the latter case, any crowdsourcing session to which the message in error may have referred SHALL continue.

5.2.6.3 Basic and Advanced Crowdsourcing

Two types of crowdsourcing are supported in LPPe version 2.0: "basic crowdsourcing" using request location information and provide location information parameters for positioning methods normally used to locate a target and "advanced crowdsourcing" using separate parameters applicable only to crowdsourcing. Basic crowdsourcing reuses existing LPP and LPPe positioning parameters and thus may reduce implementation but is not efficient for a large number of measurements. Advanced crowdsourcing uses parameters dedicated to crowdsourcing and can be more efficient particularly for batch reporting. Only one type of crowdsourcing (basic or advanced) may be requested by a server and used by a target throughout a crowdsourcing session. It is recommended that basic crowdsourcing only be used for coarse infrequent data acquisition with a server or target that cannot support advanced crowdsourcing and that advanced crowdsourcing be used for any precise or frequent data acquisition if supported by both a server and target.

Figure 15 summarizes the different portions of an LPP/LPPe message and their applicability to basic versus advanced crowdsourcing.

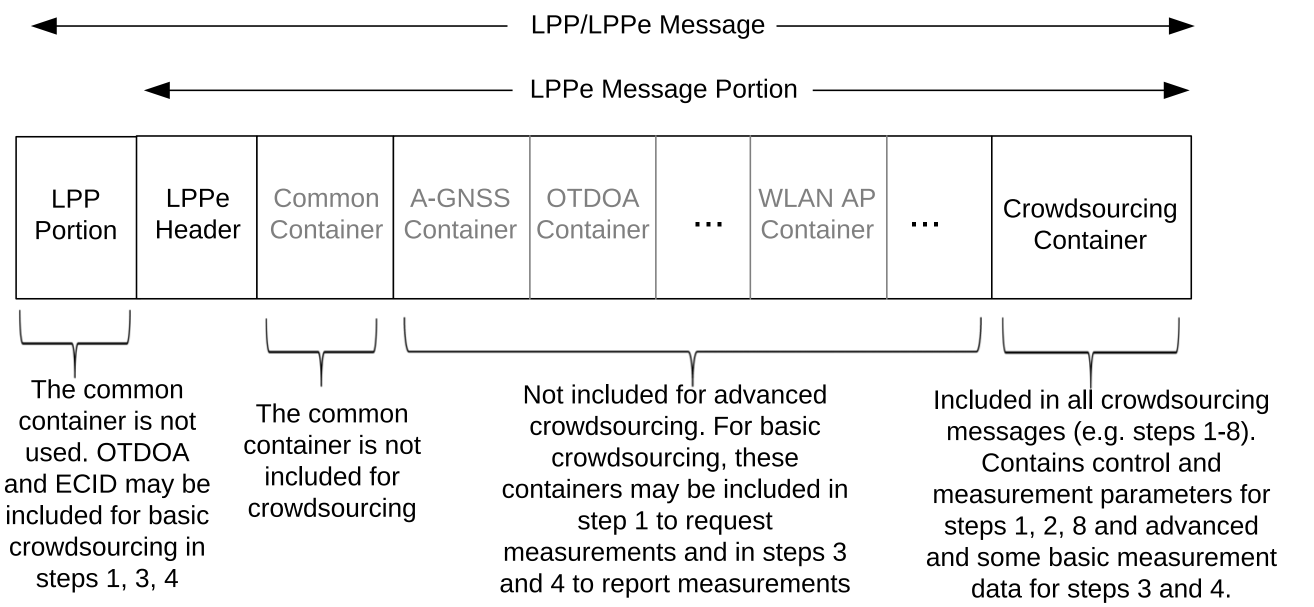


Figure 15: LPP/LPPe Message Structure for Crowdsourcing (where steps refer to Figure 14)

For basic crowdsourcing, control parameters (e.g. as used in steps 1, 2 and 8 in Figure 14) are contained in an LPPe crowdsourcing parameter container. An indication of the basic crowdsourcing measurements requested (e.g. in step 1 in Figure 14) is contained in the same parameters used to request these measurements when used for positioning of a target. These parameters appear in LPP and LPPe parameter containers associated with different positioning methods as illustrated in Figure 15. Basic crowdsourcing measurement data (e.g. for steps 3 and 4 in Figure 14) is mainly contained in the same LPP and LPPe parameters that are used to report these measurements in the case of positioning. These parameters thus appear in the LPP and LPPe parameter containers for LPP and LPPe positioning methods. For basic crowdsourcing, a detailed confirmation of the measurements to be crowdsourced by a target is not provided to a server (e.g. in steps 2 and 8 of Figure 14). Instead, a summary indication is provided of the position methods for which measurements will be provided.

For advanced crowdsourcing, requested measurements (for step 1 of Figure 14), confirmed measurements (for steps 2 and 8 of Figure 14) and measurement data (for steps 3 and 4 of Figure 14) are all provided using the LPPe crowdsourcing parameter container as shown in Figure 15. For advanced crowdsourcing, LPP and LPPe parameter containers associated with normal positioning methods are not included.

Table 3 summarizes the different parts of an LPP and LPPe message that are applicable to basic and advanced crowdsourcing.

LPP Message Type	Crowdsourcing Information Type	Container for Basic Crowdsourcing	Container for Advanced Crowdsourcing
Request/Provide Capabilities	Crowdsourcing capabilities	Crowdsourcing Container	Crowdsourcing Container
Request Location Information	Requested Control Parameters	Crowdsourcing Container	Crowdsourcing Container
	Requested Measurements	Position method specific containers	Crowdsourcing Container
Provide Location Information	Accepted Control Parameters	Crowdsourcing Container	Crowdsourcing Container
	Accepted Measurements	Crowdsourcing Container (in an abbreviated form)	Crowdsourcing Container
	Reported Measurements	Position method specific containers plus a few measurements (e.g. date/time and target location) in the Crowdsourcing Container.	Crowdsourcing Container

Table 3: Summary of LPP/LPPe Message Containers applicable to Basic and Advanced Crowdsourcing

5.2.6.4 Measurement Sets and Measurement Subsets

A crowdsourcing measurement set comprises all measurements that were obtained by a target as a result of a particular instigation of measurements by measurement triggers (e.g. a particular timeout instance of a 20 minute periodic measurement timer). A measurement set may need to be obtained over a short period of time (e.g. a few seconds or even a few minutes) depending on the number of measurements and the time needed for each one. During this period, the target may move in which case a precise single location cannot be reported for all measurements. Therefore, it is allowed to divide each measurement set into a sequence of subsets obtained at successively later times where each subset contains measurements that were obtained by a target at the same location or almost the same location.

If a target is not required to obtain any measurements when a particular measurement set is triggered in the case of advanced crowdsourcing, the target does not provide any information to the server concerning the measurement set. If a target is required to but is unable to obtain any measurements when a particular measurement set is triggered, the target may either send no information to the server concerning the measurement set or send error information. It is recommended to send error information only sparingly – e.g. when an inability to obtain measurements persists over many measurement sets.

For basic crowdsourcing, each measurement subset (or each measurement set that comprises just one subset) is contained in a separate LPP Provide Location Information message. For advanced crowdsourcing, a single LPP Provide Location Information message may contain up to 512 separate measurement subsets which may all belong to the same measurement set or to two or more consecutive measurement sets. Optionally, a server may indicate the maximum distance that a target is allowed to move while obtaining crowdsourcing measurements to be included in the same measurement subset as a means of controlling the precision of the reported target location for each measurement subset. If the target moves while a measurement set is being obtained (e.g. moves by more than any maximum distance allowed by the server), the measurement set should be reported using more than one subset. Each measurement subset should indicate the time or relative time at which the included measurements were obtained and the target location. Target location can be provided as an absolute location and/or as a location relative to a previous measurement subset. Certain measurement subsets, preferably those for which an absolute location is provided, can be designated as anchor points and used to provide relative locations for one or more subsequent measurement subsets, thereby allowing the absolute locations for the subsequent measurement subsets to be obtained from any absolute locations provided or derivable for the anchor points.

In addition to allowing measurements for the same measurement set that were made at different locations to be reported, multiple measurement subsets may also be used to increase the number of measurements that can be reported by a target when a single measurement subset cannot include them all. As an example, this may be used to enable a target to report measurements for multiple channels for the same WLAN AP or to report measurements for multiple frequencies for the same cell.

5.3 LPPe Mode

According to 3GPP TS 36.355 [LPP], LPP is always used between a target device and a server and supports three types of procedures each with a specific directionality. Thus, capabilities may only be requested by a server from a target and are only sent from the target to the server; assistance data may only be requested by a target from a server and is only sent from a server to a target; and location information may only be requested by a server from a target and is only sent from a target to a server. These limitations are compatible with a control plane solution between a network server and wireless terminal device but become restrictive for a user plane solution between arbitrary end points. In order to retain compliance to the procedures in [LPP] but enable wider flexibility among LPPe supporting endpoints, a mode is introduced that qualifies how a particular LPP/LPPe procedure is being used. In this version of LPPe, the following modes are supported.

Mode	**Description**	**Applicable LPP Procedures**
Normal (default)	The server and target roles are as defined in the LPP transaction ID	All
Reversed	The server and target roles are temporarily reversed in the LPP transaction. Thus, the real server indicates it is the target in the LPP transaction ID and the real target indicates it is the server. Normal LPP rules are then followed concerning the directionality of transactions – e.g. the real server may send an LPP Provide Capabilities to the real target because at an LPPe level the real server appears to be the target for which such a transfer is allowed.	Solicited and Unsolicited Provide Capabilities. Solicited and Unsolicited Provide Location Information

Table 4: LPPe Modes

In this version of LPPe, the reversed mode is applicable to a solicited or unsolicited provision of capabilities from a real server to a real target and to a solicited or unsolicited provision of location information from a real server to a real target. In the first case, the capabilities being requested or provided are those of the server to support the corresponding capabilities in the target (e.g. if the real server indicates a capability C, it means the target can make use of C if the target supports C). In the second case, the location being requested or provided is that of the real target device. Since in LPP and LPPe, the Request and Provide Location Information messages can indicate measurements as well as a location estimate, some restrictions are needed for reversed mode usage as shown in Table 5 and Table 6.

LPP/LPPe Parameter Type	**Parameter(s)**	**Restrictions**
LPP Position Method Parameters (A-GNSS, OTDOA, ECID)	All	Not Allowed
LPP Common Parameters	Location Information Type	Shall indicate "Location Estimate Required"
	QoS	Allowed (if not included server may assume any QoS unless high accuracy AGNSS is requested)
	Location Coordinate Types	Allowed
	Velocity Types	Allowed

	All other parameters	Not Allowed
LPPe Position Method Parameters	AGNSS: High Accuracy Method Requested (Boolean set to TRUE)	Allowed
	All other parameters	Not Allowed
LPPe Common Parameters	All	Not Allowed

Table 5: Restriction on use of an LPP/LPPe Request Location Information in Reversed Mode

LPP/LPPe Parameter Type	**Parameter(s)**	**Restrictions**
LPP Position Method Parameters (A-GNSS, OTDOA, ECID)	All	Not Allowed
LPP Common Parameters	Location Estimate	Allowed
	Velocity Estimate	Allowed
	Location Error	Allowed
	All other parameters	Not Allowed
LPPe Position Method Parameters	All	Not Allowed
LPPe Common Parameters	High Accuracy Location Estimate	Allowed
	High Accuracy Velocity Estimate	Allowed
	All other parameters	Not Allowed

Table 6: Restriction on use of an LPP/LPPe Provide Location Information in Reversed Mode

An endpoint may only use the Reversed mode when it is known that the other end also supports LPPe. This is to avoid LPP errors for an endpoint receiver that supports LPP but not LPPe.

6. Information Element Abstract Syntax Definition (Normative)

6.1 General

The contents of each LPPe payload and message extensions are specified in Chapters 6.2 and 6.3, respectively, using ASN.1 to specify the syntax and using tables, when needed, to provide information on the fields and parameters in the message. The information elements carried within the message extensions are specified as type definitions in Chapters 6.4 and 6.5.

When necessary, appendices are used to provide further information, such as formulae, on the usage of the data content.

LPPe re-uses as far as possible the data definitions from [LPP] in order to avoid duplication.

The ASN.1 in this section uses the same format and coding conventions as described in [LPP].

New ASN.1 data types and new parameters within LPPe 1.0 data types that are added in LPPe 1.1 are identified by including a ‘ver1-1” tag in their names. New ASN.1 data types and new parameters within LPPe 1.0 and LPPe 1.1 data types that are added in LPPe 2.0 are identified by including a ‘ver2-0” tag in their names. Parameters applicable to LPPe 1.1 or LPPe 2.0 that are included within LPPe 1.1 or LPPe 2.0 data types, respectively, do not include such a tag as they implicitly apply to LPPe 1.1 or LPPe 2.0, respectively from their context. It should be noted that some parameters within LPPe 1.1 and LPPe 2.0 data types may be defined using data types from a previous version of LPPe or from LPP.

6.2 LPPe Message Extension

6.2.1 LPP data type imports

LPPe uses as far as possible the data definitions from the [LPP] in order to avoid duplication. This ASN.1 snippet defines the imports from [LPP].

```
-- ASN1START

OMA-LPPE DEFINITIONS AUTOMATIC TAGS ::=
BEGIN

IMPORTS GNSS-ID, GNSS-SignalID, GNSS-SignalIDs, GNSS-SystemTime, SV-ID,
ECID-SignalMeasurementInformation, CellGlobalIdGERAN, CellGlobalIdEUTRA-AndUTRA,
OTDOA-ReferenceCellInfo, OTDOA-NeighbourCellInfoElement, maxFreqLayers, ARFCN-ValueEUTRA,
Ellipsoid-Point, EllipsoidPointWithAltitude, EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
NetworkTime, GNSS-ID-Bitmap, ARFCN-ValueUTRA, GNSS-ReferenceTime, LPP-Message,
Ellipsoid-PointWithUncertaintyCircle, EllipsoidPointWithUncertaintyEllipse, EllipsoidArc, Polygon,
ARFCN-ValueEUTRA-v9a0, Velocity
FROM LPP-PDU-Definitions;

-- ASN1STOP
```

6.2.2 Message extension definitions

6.2.2.1 Extension of LPP

The IE *OMA-LPPe-MessageExtension* carries version information and the actual data carried in the extension. A single *OMA-LPPe-MessageExtension* carries one extension message and all the LPPe information associated with that type. One *OMA-LPPe-MessageExtension* data type is carried within one EPDU-Body OCTET STRING parameter in an LPP message. Note that PER encoding rules in ITU X.691 [X.691] ensure that the encoded data type will be an integer number of octets.

```
-- ASN1START

OMA-LPPe-MessageExtension ::= SEQUENCE {
    lppeCompatibilityLevel          OMA-LPPe-LPPeCompatibilityLevel,
    lppeVersion                     OMA-LPPe-LPPeVersion,
    lppeMode                        OMA-LPPe-LPPeMode,
    messageExtensionBody            OMA-LPPe-MessageExtensionBody,
    ...
}

OMA-LPPe-LPPeCompatibilityLevel ::= INTEGER (0..15)

OMA-LPPe-LPPeVersion ::= SEQUENCE {
    majorVersion        INTEGER(0..255),
    minorVersion        INTEGER(0..255)
}

OMA-LPPe-LPPeMode ::= ENUMERATED {
    normal,
    reversed,
    ...
}


OMA-LPPe-MessageExtensionBody ::= CHOICE {
        requestCapabilities         OMA-LPPe-RequestCapabilities,
                                    --Shall only be used in the EPDU in LPP RequestCapabilities
        provideCapabilities         OMA-LPPe-ProvideCapabilities,
                                    --Shall only be used in the EPDU in LPP ProvideCapabilities
        requestAssistanceData       OMA-LPPe-RequestAssistanceData,
                                    --Shall only be used in the EPDU in LPP RequestAssistanceData
        provideAssistanceData       OMA-LPPe-ProvideAssistanceData,
                                    --Shall only be used in the EPDU in LPP ProvideAssistanceData
        requestLocationInformation  OMA-LPPe-RequestLocationInformation,
                                    --Shall only be used in the EPDU in LPP RequestLocationInformation
        provideLocationInformation  OMA-LPPe-ProvideLocationInformation,
                                    --Shall only be used in the EPDU in LPP ProvideLocationInformation
        error                       OMA-LPPe-Error, --Shall only be used in the EPDU in LPP Error
        abort                       OMA-LPPe-Abort, --Shall only be used in the EPDU in LPP Abort
        ...
}

-- ASN1STOP
```

***LPPe-Message Extension* field descriptions**
lppeCompatibilityLevel This field provides the compatibility level of the OMA LPP Extensions Release. The compatibility level in this version of LPPe is zero.
lppeVersion This field provides the version of OMA LPPe Release that includes majorVersion and minorVersion • majorVersion is x element in the x,y version notation. The major version in this LPPe release is 2 • minorVersion is y element in the x,y version notation. The minor version in this LPPe release is 0
messageExtensionBody This parameter provides the body of the message extension for all LPP messages
lppeMode This field qualifies the server and target roles defined in the LPP transaction ID.

6.2.2.2 Broadcast Message Extension (version 1.1)

The IE *OMA-LPPe-ver1-1-BroadcastContainer* is used to encapsulate ciphered or unciphered LPP and LPP/LPPe Provide Assistance Data messages for delivery via broadcast. The use of this container enables transfer of information needed for ciphering support (e.g. cipher key identifier), message authentication (e.g. public key identifier and digital signature) and information that a target can use to quickly identify the types of information being broadcast, the applicable area and time period and whether the data duplicates data already received. A target that identifies a duplicate broadcast message or assistance data that is not of interest, not applicable or not supported can cease reception without the need to receive, decipher, decode and possibly authenticate the encapsulated LPP or LPP/LPPe message. Except for the encapsulated LPP or LPP/LPPe message, the parameters in an *OMA-LPPe-ver1-1-Broadcast-Container* are not ciphered.

```
-- ASN1START


OMA-LPPe-ver1-1-BroadcastContainer ::= SEQUENCE {
    digitalSignature        OMA-LPPe-ver1-1-DigitalSignature    OPTIONAL,
    messageContents         OCTET STRING,
    ...
}
-- the messageContents octet string contains the encoded content of data type OMA-LPPe-ver1-1-
BroadcastMessage


OMA-LPPe-ver1-1-BroadcastMessage ::= SEQUENCE {
    broadcastControlIEs     OMA-LPPe-ver1-1-BroadcastControlIEs,
    cipheringIEs            OMA-LPPe-ver1-1-CipheringIEs            OPTIONAL,
    broadcastMessage        OCTET STRING,
    ...
}
-- broadcastMessage contains an unciphered LPP-Message as defined in [LPP] or a ciphered LPP-Message

OMA-LPPe-ver1-1-BroadcastControlIEs ::= SEQUENCE {
    serverID                    OMA-LPPe-ver1-1-ServerID,
    messageID                   OCTET STRING (SIZE (4))         OPTIONAL,
    validity-time               OMA-LPPe-ValidityPeriod         OPTIONAL,   --Cond DigitalSignature
    validity-area               OMA-LPPe-ValidityArea           OPTIONAL,
    broadcastADTypes            OMA-LPPe-ver1-1-BroadcastADTypes    OPTIONAL,
    ...
}


OMA-LPPe-ver1-1-CipheringIEs ::= SEQUENCE {
    cipherSetID                 OMA-LPPe-ver1-1-CipherSetID,
    d0                          BIT STRING (SIZE (1..128)),
    ...
}


OMA-LPPe-ver1-1-DigitalSignature ::= SEQUENCE {
    authenticationSetID         OMA-LPPe-ver1-1-AuthenticationSetID,
    signature                   BIT STRING (SIZE (2048)),
    ...
}


-- ASN1STOP
```

Conditional presence	Explanation
DigitalSignature	The field is mandatory present if the IE digitalSignature is included in order to protect against replay attacks. Otherwise, the field is optional.

OMA-LPPe-ver1-1-Broadcast-Container field descriptions
digitalSignature This parameter applies to LPPe version 1.1 and contains a digital signature for the octet string composing the messageContents. This parameter is optional and is included only when a target needs to authenticate the message contents. The parameter contains the following fields: authenticationSetID identifies the public key authentication set to be used to authenticate the signature signature the digital signature to be authenticated

OMA-LPPe-ver1-1-Broadcast-Container **field descriptions**
messageContents This parameter applies to LPPe version 1.1 and contains the broadcast assistance data and control parameters in the form of an octet string.
broadcastControlIEs This parameter applies to LPPe version 1.1 and provides the following parameters applicable to broadcast of an LPP or LPP/LPPe Provide Assistance Data message. serverID defines the server that broadcast the message. This parameter is mandatory. messageID a message ID unique to the server. This parameter is optional and when included can be used together with the serverID to identify receipt of a duplicate message. validity-time the validity time for the broadcast assistance data. This parameter is conditional. validity-area the valid geographic area for the broadcast assistance data. This parameter is optional. broadcastADTypes provides a list of the assistance data types in the message referred to by their labels. This parameter is optional. Assistance data that is associated with its own validity time and /or validity area SHALL be considered as no longer valid when either this validity time/area or the validity time/area for the whole message no longer apply
cipheringIEs This parameter applies to LPPe version 1.1 and SHALL be included if and only if ciphering is used. The parameter contains the following fields: cipherSetID this field identifies a cipher set comprising a cipher key value and the first component C0 of the initial counter C1 d0 this field provides the second component for the initial ciphering counter C1. This field is defined as a bit string with a length of 1 to 128 bits. A target SHALL first pad out the bit string if less than 128 bits with zeroes in more significant bit positions to achieve 128 bits. C1 is then obtained from D0 and C0 (defined by the cipherSetID) as: C1 = (D0 + C0) mod 2**128 (with all values treated as non-negative integers)
broadcastMessage This parameter applies to LPPe version 1.1 and is encoded as an octet string that contains either a ciphered or unciphered LPP or LPP/LPPe Provide Assistance Data message. Ciphering is used when and only when the parameter cipheringIEs is included. When ciphering is not used, broadcastMessage contains either an unciphered LPP Provide Assistance Data message as defined in [LPP] or an unciphered LPP/LPPe Provide Assistance Data message as defined in this specification. The LPP or LPP/LPPe Provide Assistance Data message is coded using the LPP-Message definition in [LPP]. When ciphering is used, broadcastMessage contains a ciphered LPP or LPP/LPPe Provide Assistance Data message in the form of an octet string with the bit and octet order corresponding to the output bit order from the ciphering operation as described in section 5.2.5.3. The message that is ciphered corresponds to a complete message as defined by the data type LPP-Message in [LPP].

6.3 Message extension IEs

The present chapter details the message extensions provided by LPPe for the 3GPP-defined LPP.

6.3.1 Request Capabilities

The *OMA-LPPe-RequestCapabilities* message extension requests capability information on LPPe-defined assistance data and individual positioning methods.

```
-- ASN1START
```

```
OMA-LPPe-RequestCapabilities ::= SEQUENCE {
    commonIEsRequestCapabilities            OMA-LPPe-CommonIEsRequestCapabilities   OPTIONAL,
    agnss-RequestCapabilities               OMA-LPPe-AGNSS-RequestCapabilities      OPTIONAL,
    otdoa-RequestCapabilities               OMA-LPPe-OTDOA-RequestCapabilities      OPTIONAL,
    eotd-RequestCapabilities                OMA-LPPe-EOTD-RequestCapabilities       OPTIONAL,
    otdoa-utra-RequestCapabilities          OMA-LPPe-OTDOA-UTRA-RequestCapabilities OPTIONAL,
    ecid-lte-RequestCapabilities            OMA-LPPe-ECID-LTE-RequestCapabilities   OPTIONAL,
    ecid-gsm-RequestCapabilities            OMA-LPPe-ECID-GSM-RequestCapabilities   OPTIONAL,
    ecid-utra-RequestCapabilities           OMA-LPPe-ECID-UTRA-RequestCapabilities  OPTIONAL,
    wlan-ap-RequestCapabilities             OMA-LPPe-WLAN-AP-RequestCapabilities    OPTIONAL,
    ecid-wimax-RequestCapabilities          OMA-LPPe-ECID-WiMax-RequestCapabilities OPTIONAL,
    sensor-RequestCapabilities              OMA-LPPe-Sensor-RequestCapabilities     OPTIONAL,
    srn-RequestCapabilities                 OMA-LPPe-SRN-RequestCapabilities        OPTIONAL,
    ...,
-- version 2.0 extension elements
    ver2-0-pdr-RequestCapabilities          OMA-LPPe-ver2-0-PDR-RequestCapabilities OPTIONAL,
    ver2-0-irb-RequestCapabilities          OMA-LPPe-ver2-0-IRB-RequestCapabilities OPTIONAL,
    ver2-0-crowdsourcing-RequestCapabilities    OMA-LPPe-ver2-0-Crowdsourcing-RequestCapabilities
    OPTIONAL
}

-- ASN1STOP
```

6.3.2 Provide Capabilities

The *OMA-LPPe-ProvideCapabilities* message extension provides capability information on LPPe-defined assistance data and individual positioning methods.

```
-- ASN1START

OMA-LPPe-ProvideCapabilities::= SEQUENCE {
    commonIEsProvideCapabilities            OMA-LPPe-CommonIEsProvideCapabilities       OPTIONAL,
    agnss-ProvideCapabilities               OMA-LPPe-AGNSS-ProvideCapabilities          OPTIONAL,
    otdoa-ProvideCapabilities               OMA-LPPe-OTDOA-ProvideCapabilities          OPTIONAL,
    eotd-ProvideCapabilities                OMA-LPPe-EOTD-ProvideCapabilities           OPTIONAL,
    otdoa-utra-ProvideCapabilities          OMA-LPPe-OTDOA-UTRA-ProvideCapabilities     OPTIONAL,
    ecid-lte-ProvideCapabilities            OMA-LPPe-ECID-LTE-ProvideCapabilities       OPTIONAL,
    ecid-gsm-ProvideCapabilities            OMA-LPPe-ECID-GSM-ProvideCapabilities       OPTIONAL,
    ecid-utra-ProvideCapabilities           OMA-LPPe-ECID-UTRA-ProvideCapabilities      OPTIONAL,
    wlan-ap-ProvideCapabilities             OMA-LPPe-WLAN-AP-ProvideCapabilities        OPTIONAL,
    ecid-wimax-ProvideCapabilities          OMA-LPPe-ECID-WiMax-ProvideCapabilities     OPTIONAL,
    sensor-ProvideCapabilities              OMA-LPPe-Sensor-ProvideCapabilities         OPTIONAL,
    srn-ProvideCapabilities                 OMA-LPPe-SRN-ProvideCapabilities            OPTIONAL,
    ...,
-- version 2.0 extension elements
    ver2-0-pdr-ProvideCapabilities          OMA-LPPe-ver2-0-PDR-ProvideCapabilities     OPTIONAL,
    ver2-0-irb-ProvideCapabilities          OMA-LPPe-ver2-0-IRB-ProvideCapabilities     OPTIONAL,
    ver2-0-crowdsourcing-ProvideCapabilities    OMA-LPPe-ver2-0-Crowdsourcing-ProvideCapabilities
    OPTIONAL
}

-- ASN1STOP
```

6.3.3 Request Assistance Data

The *OMA-LPPe-RequestAssistanceData* message extension requests assistance data for the individual positioning methods.

```
-- ASN1START

OMA-LPPe-RequestAssistanceData ::= SEQUENCE {
    commonIEsRequestAssistanceData          OMA-LPPe-CommonIEsRequestAssistanceData     OPTIONAL,
    agnss-RequestAssistanceData             OMA-LPPe-AGNSS-RequestAssistanceData        OPTIONAL,
    otdoa-RequestAssistanceData             OMA-LPPe-OTDOA-RequestAssistanceData        OPTIONAL,
    eotd-RequestAssistanceData              OMA-LPPe-EOTD-RequestAssistanceData         OPTIONAL,
    otdoa-utra-RequestAssistanceData        OMA-LPPe-OTDOA-UTRA-RequestAssistanceData   OPTIONAL,
    ecid-lte-RequestAssistanceData          OMA-LPPe-ECID-LTE-RequestAssistanceData     OPTIONAL,
    ecid-gsm-RequestAssistanceData          OMA-LPPe-ECID-GSM-RequestAssistanceData     OPTIONAL,
    ecid-utra-RequestAssistanceData         OMA-LPPe-ECID-UTRA-RequestAssistanceData    OPTIONAL,
    wlan-ap-RequestAssistanceData           OMA-LPPe-WLAN-AP-RequestAssistanceData      OPTIONAL,
    sensor-RequestAssistanceData            OMA-LPPe-Sensor-RequestAssistanceData       OPTIONAL,
    srn-RequestAssistanceData               OMA-LPPe-SRN-RequestAssistanceData          OPTIONAL,
```

```
    ...,
-- version 2.0 extension elements
    ver2-0-pdr-RequestAssistanceData        OMA-LPPe-ver2-0-PDR-RequestAssistanceData   OPTIONAL,
    ver2-0-irb-RequestAssistanceData        OMA-LPPe-ver2-0-IRB-RequestAssistanceData   OPTIONAL
}

-- ASN1STOP
```

6.3.4 Provide Assistance Data

The *OMA-LPPe-ProvideAssistanceData* message extension provides assistance data for the individual positioning methods.

```
-- ASN1START

OMA-LPPe-ProvideAssistanceData ::= SEQUENCE {
    commonIEsProvideAssistanceData          OMA-LPPe-CommonIEsProvideAssistanceData     OPTIONAL,
    agnss-ProvideAssistanceData             OMA-LPPe-AGNSS-ProvideAssistanceData        OPTIONAL,
    otdoa-ProvideAssistanceData             OMA-LPPe-OTDOA-ProvideAssistanceData        OPTIONAL,
    eotd-ProvideAssistanceData              OMA-LPPe-EOTD-ProvideAssistanceData         OPTIONAL,
    otdoa-utra-ProvideAssistanceData        OMA-LPPe-OTDOA-UTRA-ProvideAssistanceData   OPTIONAL,
    ecid-lte-ProvideAssistanceData          OMA-LPPe-ECID-LTE-ProvideAssistanceData     OPTIONAL,
    ecid-gsm-ProvideAssistanceData          OMA-LPPe-ECID-GSM-ProvideAssistanceData     OPTIONAL,
    ecid-utra-ProvideAssistanceData         OMA-LPPe-ECID-UTRA-ProvideAssistanceData    OPTIONAL,
    wlan-ap-ProvideAssistanceData           OMA-LPPe-WLAN-AP-ProvideAssistanceData      OPTIONAL,
    sensor-ProvideAssistanceData            OMA-LPPe-Sensor-ProvideAssistanceData       OPTIONAL,
    srn-ProvideAssistanceData               OMA-LPPe-SRN-ProvideAssistanceData          OPTIONAL,
    ...,
-- version 2.0 extension elements
    ver2-0-pdr-ProvideAssistanceData        OMA-LPPe-ver2-0-PDR-ProvideAssistanceData   OPTIONAL,
    ver2-0-irb-ProvideAssistanceData        OMA-LPPe-ver2-0-IRB-ProvideAssistanceData   OPTIONAL
}

-- ASN1STOP
```

6.3.5 Request Location Information

The *OMA-LPPe-RequestLocationInformation* requests position estimates and measurements.

```
-- ASN1START

OMA-LPPe-RequestLocationInformation ::= SEQUENCE {
    commonIEsRequestLocationInformation     OMA-LPPe-CommonIEsRequestLocationInformation    OPTIONAL,
    agnss-RequestLocationInformation        OMA-LPPe-AGNSS-RequestLocationInformation       OPTIONAL,
    otdoa-RequestLocationInformation        OMA-LPPe-OTDOA-RequestLocationInformation       OPTIONAL,
    eotd-RequestLocationInformation         OMA-LPPe-EOTD-RequestLocationInformation        OPTIONAL,
    otdoa-utra-RequestLocationInformation   OMA-LPPe-OTDOA-UTRA-RequestLocationInformation  OPTIONAL,
    ecid-lte-RequestLocationInformation     OMA-LPPe-ECID-LTE-RequestLocationInformation    OPTIONAL,
    ecid-gsm-RequestLocationInformation     OMA-LPPe-ECID-GSM-RequestLocationInformation    OPTIONAL,
    ecid-utra-RequestLocationInformation    OMA-LPPe-ECID-UTRA-RequestLocationInformation   OPTIONAL,
    wlan-ap-RequestLocationInformation      OMA-LPPe-WLAN-AP-RequestLocationInformation     OPTIONAL,
    ecid-wimax-RequestLocationInformation   OMA-LPPe-ECID-WiMax-RequestLocationInformation  OPTIONAL,
    sensor-RequestLocationInformation       OMA-LPPe-Sensor-RequestLocationInformation      OPTIONAL,
    srn-RequestLocationInformation          OMA-LPPe-SRN-RequestLocationInformation         OPTIONAL,
    ...,
-- version2.0 extension element
    ver2-0-irb-RequestLocationInformation   OMA-LPPe-ver2-0-IRB-RequestLocationInformation  OPTIONAL,
    ver2-0-pdr-RequestLocationInformation   OMA-LPPe-ver2-0-PDR-RequestLocationInformation  OPTIONAL,
    ver2-0-crowdsourcing-RequestLocationInformation     OMA-LPPe-ver2-0-Crowdsourcing-
RequestLocationInformation  OPTIONAL
}

-- ASN1STOP
```

6.3.6 Provide Location Information

The *OMA-LPPe-ProvideLocationInformation* provides position estimates and measurements.

```
-- ASN1START

OMA-LPPe-ProvideLocationInformation ::= SEQUENCE {
```



```
    commonIEsProvideLocationInformation     OMA-LPPe-CommonIEsProvideLocationInformation    OPTIONAL,
    agnss-ProvideLocationInformation        OMA-LPPe-AGNSS-ProvideLocationInformation       OPTIONAL,
    otdoa-ProvideLocationInformation        OMA-LPPe-OTDOA-ProvideLocationInformation       OPTIONAL,
    eotd-ProvideLocationInformation         OMA-LPPe-EOTD-ProvideLocationInformation        OPTIONAL,
    otdoa-utra-ProvideLocationInformation   OMA-LPPe-OTDOA-UTRA-ProvideLocationInformation  OPTIONAL,
    ecid-lte-ProvideLocationInformation     OMA-LPPe-ECID-LTE-ProvideLocationInformation    OPTIONAL,
    ecid-gsm-ProvideLocationInformation     OMA-LPPe-ECID-GSM-ProvideLocationInformation    OPTIONAL,
    ecid-utra-ProvideLocationInformation    OMA-LPPe-ECID-UTRA-ProvideLocationInformation   OPTIONAL,
    wlan-ap-ProvideLocationInformastion     OMA-LPPe-WLAN-AP-ProvideLocationInformation     OPTIONAL,
    ecid-wimax-ProvideLocationInformastion  OMA-LPPe-ECID-WiMax-ProvideLocationInformation  OPTIONAL,
    sensor-ProvideLocationInformation       OMA-LPPe-Sensor-ProvideLocationInformation      OPTIONAL,
    srn-ProvideLocationInformation          OMA-LPPe-SRN-ProvideLocationInformation         OPTIONAL,
    ...,
-- version2.0 extension element
    ver2-0-irb-ProvideLocationInformation   OMA-LPPe-ver2-0-IRB-ProvideLocationInformation OPTIONAL,
    ver2-0-pdr-ProvideLocationInformation   OMA-LPPe-ver2-0-PDR-ProvideLocationInformation  OPTIONAL,
    ver2-0-crowdsourcing-ProvideLocationInformation     OMA-LPPe-ver2-0-Crowdsourcing-
ProvideLocationInformation  OPTIONAL
}

-- ASN1STOP
```

6.3.7 Abort

The *OMA-LPPe-Abort* carries a request to abort the on-going LPPe procedure.

```
-- ASN1START

OMA-LPPe-Abort ::= SEQUENCE {
    commonIEsAbort      OMA-LPPe-CommonIEsAbort     OPTIONAL,
    agnssAbort          OMA-LPPe-AGNSS-Abort        OPTIONAL,
    ...,
-- version 2.0 extension elements
    ver2-0-crowdsourcing-Abort  OMA-LPPe-ver2-0-Crowdsourcing-Abort OPTIONAL
}


-- ASN1STOP
```

6.3.8 Error

The *OMA-LPPe-Error* carries information regarding the error in the received LPPe message.

```
-- ASN1START

OMA-LPPe-Error ::= SEQUENCE {
    commonIEsError      OMA-LPPe-CommonIEsError     OPTIONAL,
    ...
}


-- ASN1STOP
```

6.4 LPPe common IEs

The present chapter defines common IEs that are applicable to more than one LPP positioning methods.

6.4.1 LPPe Common low level IEs

– *OMA-LPPe-AssistanceContainer-DataSerialNumber*

The *OMA-LPPe-AssistanceContainer-DataSerialNumber* is used to identify the version of the vendor-/operator-specific assistance data.

```
-- ASN1START
```



```
OMA-LPPe-AssistanceContainer-DataSerialNumber ::= SEQUENCE {
    dataSerialNumber        INTEGER(0..4294967295),
    ...
}

-- ASN1STOP
```

– OMA-LPPe-AssistanceContainerID

The *OMA-LPPe-AssistanceContainerID* is used to identify vendor-/operator-specific assistance data.

```
-- ASN1START

OMA-LPPe-AssistanceContainerID ::= SEQUENCE {
    containerID         INTEGER (0..65535),
    ...
}

-- ASN1STOP
```

– OMA-LPPe-AssistanceContainerProvideList

The *OMA-LPPe-AssistanceContainerProvideList* is a black-box data container meant for carrying vendor-/operator-specific assistance data.

```
-- ASN1START

OMA-LPPe-AssistanceContainerProvideList ::= SEQUENCE (SIZE(1.. maxAssistanceContainerList)) OF
                                                                    OMA-LPPe-AssistanceContainerProvide

maxAssistanceContainerList INTEGER ::= 16
OMA-LPPe-AssistanceContainerProvide ::= SEQUENCE  {
    dataIdentifier          OMA-LPPe-VendorOrOperatorAssistanceDataIdentifier,
    checkOrUpdateOrError    ENUMERATED  {
                                targetHasLatestData,
                                targetDataNotLatest,
                                targetDataNotLatestButServerCannotProvideLatestData,
                                targetHasValidData,
                                targetDataInvalidButServerCannotProvideValidData,
                                serverHasRequestedDataButUnableToProvideTemporarily,
                                serverDoesNotHaveRequestedData,
                                serverDoesNotRecognizeRequestedData,
                                undefined,
                                ... }                           OPTIONAL,    --Cond CheckorUpdate
    dataResult              CHOICE      {
                                simulationResult    INTEGER(0..5000),
                                data                OMA-LPPe-AssistanceContainerData,
                                 ...
                                 }  OPTIONAL,
    errorCode               OMA-LPPe-AssistanceContainerProvideError    OPTIONAL,
    ...
}

OMA-LPPe-AssistanceContainerData ::= SEQUENCE {
    dataSerialNumber        OMA-LPPe-AssistanceContainer-DataSerialNumber           OPTIONAL,
    data                    OCTET STRING,
    validityPeriod          OMA-LPPe-ValidityPeriod         OPTIONAL,
    validityArea            OMA-LPPe-ValidityArea           OPTIONAL,
    ...
}

OMA-LPPe-AssistanceContainerProvideError ::= SEQUENCE {
    serverError     ENUMERATED { assistanceContainerUnknownDataIdentifier,
                                 assistanceContainerUnknownDataSerialNumber,
                                 assistanceContainerDataTemporarilyUnavailable,
                                 assistanceContainerDataNoLongerSupported,
                                 assistanceContainerVendorOrOperatorNotSupported,
```

```
                                ...} OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
CheckOrUpdate	The field is mandatory present if the target requested *CheckOrUpdate*, otherwise it is not present.

***OMA-LPPe-AssistanceContainerProvideList* field descriptions**
dataIdentifier This field identifies the data being provided.
checkOrUpdateOrError This field is used to carry the result of comparison between the ***dataSerialNumber*** of the target's data and of the server's data. In case updated data SHALL be provided to the target, the field SHALL be set either to "`targetDataNotLatest`" or "`targetDataInvalid`" depending upon the request parameters.
dataResult This field carries either the size of data (in simulated case) or the actual data (in data-request case). In case of simulated case, the approximate size of the payload rounded upwards is returned. The scale factor is 1024 OCTETS. Thus in case the payload size is x octets, the number to be returned is ceil(x/1024). A value 5000 means >= 5 120 000 OCTETS. In case simulation was requested together with Check-Or-Update, the '*simulationResult*' parameter is used to carry information on the payload size in case the check-or-update request would be fulfilled. Thus, for instance in case the target has the latest data, then the *checkOrUpdat**e*** field indicates '*targetHasLatestData*' and the payload size is 0 octets. On the other hand, for example, in case the target data is invalid, the *checkOrUpdat**e*** field indicates '*targetDataInvalid*' and the '*simulationResult*' indicates the would-be payload size. In a special case that the target requests for updated data and the target data is not the latest, but the server only knows that the data is not the latest but does not have it, the server SHALL indicate '*targetDataNotLatestButServerCannotProvideLatestData*' in *checkOrUpdate* field and does not provide *dataResult*. Similarly, in case the target requests for updated data in case the target data is invalid, but the server only knows the data is invalid but does not have valid data, the server SHALL indicate '*`targetDataInvalidButServerCannotProvideValidData`*' in *checkOrUpdate* field and does not provide *dataResult***.**
dataSerialNumber This field is used to indicate the version of the assistance data. When the server updates the assistance data, it labels the data with a new serial number. The combination of *OMA-LPPe-VendorOrOperatorID* , *dataIdentifier* and *dataSerialNumber* should uniquely and precisely identify the assistance data.
data This field contains the actual data.
validityPeriod This field is used to indicate when (in time) the assistance data is valid.
validityArea This field is used to indicate the geographical area where the assistance data is valid. If this field is missing, the validity area is either self-evident from the data (e.g. a local map) or the data is global.

– *OMA-LPPe-AssistanceContainerRequestList*

The *OMA-LPPe-AssistanceContainerRequestList* is used by the target to request for vendor-/operator-specific assistance data.

```
-- ASN1START


OMA-LPPe-AssistanceContainerRequestList ::= SEQUENCE (SIZE(1..maxAssistanceContainerList)) OF
                                                                  OMA-LPPe-AssistanceContainerRequest

OMA-LPPe-AssistanceContainerRequest ::= SEQUENCE  {
    dataIdentifier                  OMA-LPPe-VendorOrOperatorAssistanceDataIdentifier,
    simulatedReq                    BOOLEAN,
    checkOrUpdateReq                OMA-LPPe-AssistanceContainerCheckOrUpdateReq    OPTIONAL,
    validityTimeRequest             OMA-LPPe-ValidityPeriod                         OPTIONAL,
    proprietaryRequestParameters    OCTET STRING                                    OPTIONAL,
    ...
}

OMA-LPPe-AssistanceContainerCheckOrUpdateReq ::= SEQUENCE {
    dataSerialNumber    OMA-LPPe-AssistanceContainer-DataSerialNumber,
    checkLatest         ENUMERATED  {returnLatestIfCurrentNotLatest,
                                     returnUpdateOnlyIfCurrentInvalid,
                                     ... },
    ...
}


-- ASN1STOP
```

***OMA-LPPe-AssistanceContainerRequestList* field descriptions**
dataIdentifier This field identifies the data being requested.
simulatedReq This field is used for indicating if the target only requests information of the approximate size of the generic assistance data instead of requesting the actual data set. TRUE means request for data size and FALSE means request for the actual data.
checkOrUpdateReq This field can be used to request comparison of the ***dataSerialNumbe****r* of the target's current data with the ***dataSerialNumber*** of the server's data.
validityTimeRequest This field can be used for requesting the desired validity period for the data. This field may only be included for assistance data that has limited validity (e.g. SHALL NOT be included for a map data request).
proprietaryRequestParameters This field can be used to carry non-standardized extensions to the request parameters. These are vendor/operator-specific and are associated with the ***dataIdentifier***.
dataSerialNumber This field is used to indicate the version of the assistance data. When the server updates the assistance data, it labels the data with a new serial number. The combination of OMA-LPPe-VendorOrOperatorID , dataIdentifier and dataSerialNumber should uniquely and precisely identify the assistance data.
checkLatest This field can be used to indicate action when comparing the data version of the target's current data with the server's data. The target can choose the option *ReturnLatestIfCurrentNotLatest* to indicate that if there is more recent data available than that of the target's, that latest data SHALL be returned. On the other hand, option *ReturnUpdateOnlyIfCurrentInvalid* indicates that if the target's data is still valid, no update should be returned, even if the server would have a new issue of the data.

– *OMA-LPPe-CellLocalIdGERAN*

The IE *OMA-LPPe-CellLocalIdGERAN* specifies the local identity of a cell in GERAN.

```
-- ASN1START

OMA-LPPe-CellLocalIdGERAN ::= SEQUENCE {
    locationAreaCode        BIT STRING (SIZE (16)),
    cellIdentity            BIT STRING (SIZE (16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-CellLocalIdGERAN **field descriptions**
locationAreaCode This field is a fixed length code identifying the location area within a PLMN.
cellIdentity This field specifies the cell identifier which is unique within the context of the GERAN location area.

– *OMA-LPPe-CellNonUniqueIdGERAN*

The IE *OMA-LPPe-CellNonUniqueIdGERAN* specifies a non-unique Cell Identifier for GERAN.

```
-- ASN1START

OMA-LPPe-CellNonUniqueIDGERAN ::= SEQUENCE {
    bsic        INTEGER (0..63),
    bcch        INTEGER (0..1023),
    ...
}


-- ASN1STOP
```

OMA-LPPe-CellNonUniqueIdGERAN **field descriptions**
bsic This field identifies the Base Station Identity Code of the cell.
bcch This field identifies the Absolute Radio Frequency Channel Number (ARFCN) for the Broadcast Control Channel of the cell.

– *OMA-LPPe-CharArray*

The IE *OMA-LPPe-CharArray* is used to specify a character array.

```
-- ASN1START

OMA-LPPe-CharArray ::= VisibleString(FROM ("a".."z" | "A".."Z" | "0".."9" | ".-"))(SIZE (1..31))

-- ASN1STOP
```


OMA-LPPe-CharArray IE **field descriptions**
charArray This type defines a character array.

– *OMA-LPPe-CivicLocation*

The IE *OMA-LPPe-CivicLocation* provides a civic location based on [RFC4776].

```
-- ASN1START

OMA-LPPe-CivicLocation ::= SEQUENCE {
    countryCode                 OCTET STRING (SIZE (2)),
    civicAddressElementList     OMA-LPPe-CivicAddressElementList,
    ...
}

OMA-LPPe-CivicAddressElementList ::= SEQUENCE (SIZE (1..128)) OF OMA-LPPe-CivicAddressElement

OMA-LPPe-CivicAddressElement ::= SEQUENCE {
    caType      INTEGER(0..511),
    caValue     OCTET STRING (SIZE (1..256)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-CivicLocation **field descriptions**
countryCode This parameter provides the two-letter ISO 3166 country code in capital ASCII letters, e.g., DE or US.
caType This field defines the civic address type. Values 0 to 255 are defined in [RFC4776], and values greater than 255 are OMA defined civic address types.
caValue This field defines the civic address value, as described in [RFC4776]. As defined in [RFC4776], this SHALL be encoded as UTF-8 and may employ mixed case.

– OMA-LPPe-CivicLocation-pidf-lo

The IE *OMA-LPPe-CivicLocation-pidf-lo* provides a civic location based on a UTF-8 encoded PIDF-LO XML document.

```
-- ASN1START

OMA-LPPe-CivicLocation-pidf-lo ::= SEQUENCE {
    civicLocation                   OCTET STRING,
    ...
}

-- ASN1STOP
```

OMA-LPPe-CivicLocation-pidf-lo **field descriptions**
civicLocation This parameter contains a UTF-8 encoded PIDF-LO XML document as defined in [RFC4119]. The document shall only contain a civic address using the namespaces "urn:ietf:params:xml:ns:pidf:geopriv10:civicAddr" defined in [RFC5139] and "urn:ietf:params:xml:ns:pidf:geopriv10:civicAddr:ext" defined in [RFC6848].

– *OMA-LPPe-Duration*

The *OMA-LPPe-Duration* is used to provide information on / request the duration.


```
-- ASN1START

OMA-LPPe-Duration ::= SEQUENCE {
    duration        INTEGER (1..63),
    durationLSB     INTEGER (1..89) OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-Duration* field descriptions**
duration The scale factor is 15 min. Range [15, 945 min], i.e. upto 16 hours.
durationLSB Finer granularity duration. The scale factor is 10 seconds. Range [10, 890] seconds.

– *OMA-LPPe-FixedAccessTypes*

The IE *OMA-LPPe-FixedAccessTypes* provides a list of fixed access types.

```
-- ASN1START

OMA-LPPe-FixedAccessTypes ::= BIT STRING {  cable       (0),
                                            dsl         (1),
                                            lan         (2),
                                            pstn        (3),
                                            other       (4) } (SIZE(1..16))

-- ASN1STOP
```

***OMA-LPPe-FixedAccessTypes* field descriptions**
OMA-LPPe-FixedAccessTypes This field provides a list of one or more fixed access types. A type is present if the associated bit is set one and absent if set to zero.

– *OMA-LPPe-ver1-1-GroundMorphologyModel*

The *OMA-LPPe-ver1-1-GroundMorpholgyModel* is used to provide models for ground altitude and buildings height. Altitude model and buildings height model are encoded in a grid of points, one grid for each kind of information.

```
-- ASN1START

OMA-LPPe-ver1-1-GroundMorphologyModel  ::= SEQUENCE {
    altitudeModel               OMA-LPPe-ver1-1-AltitudeModel                   OPTIONAL,
    buildingsProfileModel       OMA-LPPe-ver1-1-BuildingsHeightModel                OPTIONAL,
    ...
    }



OMA-LPPe-ver1-1-AltitudeModel  ::= SEQUENCE {
    northWestCorner             Ellipsoid-Point, -- coordinates of North West corner of rectangle
    northWestCornerAltitude     INTEGER (-500..9000), -- altitude of North West corner of rectangle
    nrows                       INTEGER (2..1012), -- number of rows along West-East direction
    ncols                       INTEGER (2..1012), -- number of columns along North-South direction
    spanX                       INTEGER (6..14),
    spanY                       INTEGER (6..14),
    deltaAltUnits               INTEGER (1..128), -- units in meter
    altitudeGrid                SEQUENCE SIZE (1..10000) OF DeltaAltitudes,
    ...
    }


OMA-LPPe-ver1-1-BuildingsHeightModel  ::= SEQUENCE {
    northWestCorner             Ellipsoid-Point, -- coordinates of North West corner of rectangle
    northWestCornerHeight       INTEGER (0..500), -- hight of North West corner of rectangle
    nrows                       INTEGER (2..1012), -- number of rows along West-East direction
    ncols                       INTEGER (2..1012), -- number of columns along North-South direction
    spanX                       INTEGER (6..14),
```



```
    spanY                       INTEGER (6..14),
    deltaHeightUnits            INTEGER (1..16), -- units in meter
    buildingsHeightGrid         SEQUENCE SIZE(1..10000) OF DeltaHeight,
    ...
    }


DeltaAltitudes ::= SEQUENCE {
    deltaAlt            INTEGER (-15..16), -- in units of deltaAltUnits
    numGridPoints       INTEGER (0..255),
    ...
    }


DeltaHeight ::= SEQUENCE {
    deltaHeight         INTEGER (-15..16), -- in units of deltaHeightUnits
    numGridPoints       INTEGER (0..255),
    ...
    }


-- ASN1STOP
```

OMA-LPPe-ver1-1-GroundMorphologyModelReq field descriptions
altitudeModel This structures describes the behavior of ground altitude information in the selected area
buildingsHeightModel This structures describes the behavior of buildings height information in the selected area
northWestCorner This field specifies the coordinates of the North-West corner of the rectangular grid of points.
northWestCornerAltitude This field specifies the altitude [in meters above sea level] of the North-West corner of the rectangular grid of points.
northWestCornerHeight This field specifies the building height [in meters above street level] of the North-West corner of the rectangular grid of points**.**
spanX, spanY These fields specify the width of the rectangular grid for which ground morphology assistance data (altitude or building height) is provided: The grid is oriented according to W-E and N-S directions, *spanX* defines the width in W-E direction, *spanY* defines the width in N-S direction, The North West corner of the grid is centered in *northWestCorner* point. The width of the rectangular grid in both directions expressed in meters is given by the expression $\dim_x[m] = 2^{spanX}\, m$ $\dim_y[m] = 2^{spanY}\, m$ Admitted values of the grid sides width are comprised between 64 m and 16384 m

nrows, ncols The ***nrows*** and ***nclos*** fields define the number of points of the ground morphology grid (altitude or building height). Columns of the ground morphology grids are evenly spaced straight lines in a N-S direction and rows are evenly spaced straight lines in an E-W direction with the most extreme east and west columns and the most extreme north and south rows aligned with the perimeter of the rectangle defined by ***northWestCorner, spanX*** and ***spanY***. Grid points are then defined by the intersection of rows and columns. The resolution in N-S and W-E directions of the grid is given, in meters, by dividing the width of the rectangle by (ncols-1) and the height of the rectangle by (nrows-1), respectively. The range of values for ***nrows*** and ***ncols*** is between 2 and 1012.
deltaAltUnits This field represents the units of deltaAlt in meters. The value range is from 1 to 128.
deltaHeightUnits This field represents the units of deltaHeight in meters. The value range is from 1 to 16.
altitudeGrid, deltaAlt, numGridPoints The **altitudeGrid** structure contains altitude information for the defined grid of points. In the proposed encoding scheme the points are ordered from west to east along rows followed by north to south along columns. For such ordered points, altitude information is encoded with a sequence of pairs **(D,N)** *(**deltaAlt**, **numGridPoints**)*, where: • ***deltaAlt*** represents the increment of altitude expressed in multiples of ***deltaAltUnits*** with respect to the previous (or initial) altitude value, admitted multiple values are integer numbers in the interval between -15 and 16. • ***numGridPoint*** represents the number of consecutive points of the grid with the same defined altitude value; Admitted value for ***numGridPoint*** are integer number in the interval between 0 and 255. For the first grid point of the grid (i.e., the north-west corner), the altitude is defined by the value of ***northWestCornerAltitude***. Within each row of the grid, the altitude values for the point sequence in the interval [n, n +NumGridPoints-1] are given by the expression $$alt_{[n,n+NumGridPo\text{int}-1]} = alt_{n-1} + deltaAltUnits * deltaAlt$$ A new (D,N) pair is provided at the beginning (most westerly grid point) of each row, the ***deltaAlt*** for the initial pair in each row is relative to the altitude of the first point in the row just above. In the case of the first row, the first increment value is relative to the NW corner altitude value and it provides information starting from the second point of the first row (as the first one is provided by ***northWestCornerAltitude*** field). If the difference between two consecutive points is greater than the maximum allowed increment value, then one or more pairs (+16/-15, 0), with maximum incremental value for a sequence of zero points, is added before the final pair (D,N). If the number of point in the sequence, assuming the same value, is greater than 255 one or more pairs (0, 255), with increment value equal to zero and number of points D equal to 255, is added before the final pair (N,D) .

buildingHeightGrid, deltaHeight*, *numGridPoints   Building height is defined relative to ground level where a height of zero means the absence of a building at that point. Ground level altitude is given by OMA-LPPe-ver1-1-AltitudeModel when this is provided. The **buildingHeightGrid** structure contains buildings height information for the defined grid of points. In the proposed encoding schema the points are ordered from west to east along rows followed by north to south along columns.   For such ordered points, building height information is encoded with a sequence of pairs **(D,N)** (***deltaHeight***, ***numGridPoints***), where: • ***deltaHeight*** represents the increment of building height expressed in multiples of ***deltaHeightUnits*** with respect to the previous (or initial) altitude value, admitted multiple values are integer numbers in the interval between -15 and 16   • ***numGridPoint*** represents the number of consecutive points of the grid with the same defined altitude value; Admitted value for ***numGridPoint*** are integer number in the interval between 0 and 255.   For the first grid point of the grid (i.e., the north-west corner), the building height is defined by the value of ***northWestCornerHeight***. Within each row of the grid, the height values for the point sequence in the interval [n, n +NumGridPoints-1] are given by expression $$height_{[n,n+NumGridPo\text{int}-1]} = height_{n-1} + deltaHeightUnits * deltaHeight$$ A new (D,N) pair is provided at the beginning (most westerly grid point) of each row, this ***deltaHeight*** for the initial pair of each row is relative to the building height for the first point in the row just above. In the case of the first row, the first increment value is relative to the NW corner height value and it provides information starting from the second point of the first row (as the first one is provided by ***northWestCornerHeight*** field).   If the jump between two consecutive points is grater then the maximum allowed increment value, then one or more pairs (+16/-15, 0), with maximum incremental value for a sequence of zero points, is added before the final pair (D,N). If the number of point in the sequence, assuming the same value, is greater than 255 one or more pairs (0, 255), with increment value equal to zero and number of points D equal to the maximum value, is added before the final pair (N,D) .

- OMA-LPPe-ver1-1-CellGlobalID

The IE *OMA-LPPe-ver1-1-CellGlobalID* applies only to LPPe 1.1 and provides a global cell ID for GSM, WCDMA or LTE.

```
-- ASN1START

OMA-LPPe-ver1-1-CellGlobalID ::=    CHOICE {
                                eUTRA       CellGlobalIdEUTRA-AndUTRA,
                                uTRA        CellGlobalIdEUTRA-AndUTRA,
                                gSM         CellGlobalIdGERAN,
                                ...
}

-- ASN1STOP
```

***OMA-LPPe-CellGlobalID* field descriptions**
OMA-LPPe-CellGlobalID
This parameter provides a global cell ID for a GSM, WCDMA or LTE cell.

– *OMA-LPPe-HighAccuracy3Dposition*

The *OMA-LPPe-HighAccuracy3Dposition* provides the IE to carry high accuracy 3D position information.

```
-- ASN1START

OMA-LPPe-HighAccuracy3Dposition ::= SEQUENCE {
    latitude                INTEGER(-2147483648..2147483647),
```



```
    longitude               INTEGER(-2147483648..2147483647),
    cep                     INTEGER(0..255)                      OPTIONAL,   --Cond NoEllipse
    uncertainty-semimajor   INTEGER(0..255)                      OPTIONAL,   --Cond NoCEP
    uncertainty-semiminor   INTEGER(0..255)                      OPTIONAL,   --Cond NoCEP
    offset-angle            INTEGER(0..179)                      OPTIONAL,   --Cond NoCEP
    confidenceHorizontal    INTEGER(0..99)                       OPTIONAL,
    altitude                INTEGER(-64000..1280000),
    uncertainty-altitude    INTEGER(0..255),
    confidenceVertical      INTEGER(0..99)                       OPTIONAL,
    ...,
    extUncertRange          BOOLEAN                              OPTIONAL
}


-- ASN1STOP
```

Conditional presence	Explanation
NoEllipse	The field is mandatory present, if no uncertainty ellipse is present. The field SHALL NOT be present, if uncertainty ellipse present.
NoCEP	The field is mandatory present, if no CEP is present. The field SHALL NOT be present, if CEP present.

***OMA-LPPe-HighAccuracy3Dposition* field descriptions**
latitude Latitude based on WGS84 [GPS-ICD-200D] datum. The relation between the latitude X in range [-90°, 90°] and the coded number N is $$N = floor(\frac{X}{90^\circ}2^{31}),$$ where value $N=2^{31}$ is coded as $N=2^{31}-1$. Resolution 4.7 mm.
longitude Longitude based on WGS84 [GPS-ICD-200D] datum. The relation between the longitude X in range [-180°, 180°) and the coded number N is $$N = floor(\frac{X}{180^\circ}2^{31}).$$ Worst-case resolution (at the Equator) 9.3 mm.

OMA-LPPe-HighAccuracy3Dposition field descriptions
cep   *Default* uncertainty range: Horizontal uncertainty expressed as Circular Error Probable expressed as the coded number N (with N from 0..255). The relation between the CEP and N is given by: $CEP = 0.3*((1+0.02)^N-1)$ meters with N=255 meaning CEP > 45.6,   Range [0, 45.6) meters. The following table shows exemplary mappings from the coded number N to the component:

N	component-value, m
0	0
1	0.006
2	0.121
...	...
100	1.8734
...	...
200	15.4455
...	...
254	45.6
255	>45.6

Extended uncertainty range:

Horizontal uncertainty expressed as Circular Error Probable expressed as the coded number N (with N from 0..255). The relation between the CEP and N is given by:

$CEP = 0.3*((1+0.02594)^N-1)$ meters with N=255 meaning CEP > 200m,

Range [0, 200) meters. The following table shows exemplary mappings from the coded number N to the component:

N	component-value, m
0	0
1	0.008
2	0.016
...	...
100	3.58
...	...
200	50.0
...	...
254	200
255	> 200

OMA-LPPe-HighAccuracy3Dposition **field descriptions**
uncertainty-semimajor *Default* uncertainty range: The semi-major axis of the horizontal uncertainty ellipse expressed as the coded number N (with N from 0..255). The relation between the semi-major axis and N is given by: semi-major axis = $0.3*((1+0.02)^N-1)$ meters with N=255 meaning semi-major axis uncertainty > 45.6m, Range [0, 45.6) meters. *Extended* uncertainty range: The semi-major axis of the horizontal uncertainty ellipse expressed as the coded number N (with N from 0..255). The relation between the semi-major axis and N is given by: semi-major axis = $0.3*((1+0.02594)^N-1)$ meters with N=255 meaning semi-major axis uncertainty > 200m, Range [0, 200) meters.
uncertainty-semiminor *Default* uncertainty range: The semi-minor axis of the horizontal uncertainty ellipse expressed as the coded number N (with N from 0..255). The relation between the semi-minor axis and N is given by: semi-minor axis = $0.3*((1+0.02)^N-1)$ meters with N=255 meaning semi-minor axis uncertainty > 45.6m, Range [0, 45.6) meters. *Extended* uncertainty range: The semi-minor axis of the horizontal uncertainty ellipse expressed as the coded number N (with N from 0..255). The relation between the semi-minor axis and N is given by: semi-minor axis = $0.3*((1+0.02594)^N-1)$ meters with N=255 meaning semi-minor axis uncertainty > 200m, Range [0, 200) meters.
offset-angle The angle of semi-major axis measured clockwise with respect to True North in steps of 1 degree.
confidenceHorizontal This field specifies the horizontal confidence percentage associated with the CEP or Uncertainty Ellipse depending upon which is included. In case horizontal confidence is not included, the confidence is either 68% (in case of CEP) or 39% (in case of ellipse). Note that in case the ellipse represents Gaussian 2D error distribution, 39% corresponds to 1σ confidence. Confidence is encoded as a truncated percentage. An encoded value of 0 therefore represents a confidence C where 0% <=C <1% percent. An encoded value of 1 represents a confidence C where 1%<=C<2%, and so on. An encoded value of 99 represents a confidence C where 99%<=C<100%.
altitude Altitude with respect to WGS84 [GPS-ICD-200D] ellipsoid. Scale factor 2^{-7} meters. Range [-500, 10000] meters,

OMA-LPPe-HighAccuracy3Dposition **field descriptions**
uncertainty-altitude *Default* uncertainty range: The altitude uncertainty expressed as the coded number N (with N from 0..255). The relation between the altitude uncertainty and N is given by: altitude uncertainty= 0.3*($(1+0.02)^N$-1) meters with N=255 meaning altitude uncertainty is unknown and unlimited, Range [0, 45.6) meters. *Extended* uncertainty range: The altitude uncertainty expressed as the coded number N (with N from 0..255). The relation between the altitude uncertainty and N is given by: altitude uncertainty= 0.3*($(1+0.02594)^N$-1) meters, with N=255 meaning altitude uncertainty is unknown and unlimited Range [0, 200) meters.
confidenceVertical This field specifies the confidence percentage associated with the altitude uncertainty. In case vertical confidence is not included, the confidence is 68% corresponding to 1σ value in case of 1D Gaussian error distribution. Confidence is encoded as a truncated percentage. An encoded value of 0 therefore represents a confidence C where 0% <=C <1% percent. An encoded value of 1 represents a confidence C where 1%<=C<2%, and so on. An encoded value of 99 represents a confidence C where 99%<=C<100%.
extUncertRange This field indicates whether the extended uncertainty range is used (TRUE). This field is optional. Absence of this field indicates that the default uncertainty range is used.

– *OMA-LPPe-HighAccuracy3Dvelocity*

The *OMA-LPPe-HighAccuracy3Dvelocity* provides the IE to carry high accuracy 3D velocity information.

```
-- ASN1START

OMA-LPPe-HighAccuracy3Dvelocity ::= SEQUENCE {
    enu-origin                  OMA-LPPe-HighAccuracy3Dposition     OPTIONAL,
    east-component              INTEGER(0..511),
    negative-sign-east          NULL                                OPTIONAL,   --Cond West
    north-component             INTEGER(0..511),
    negative-sign-north         NULL                                OPTIONAL,   --Cond South
    up-component                INTEGER(0..511),
    negative-sign-up            NULL                                OPTIONAL,   --Cond Down
    cep                         INTEGER(0..255)                     OPTIONAL,   --Cond NoEllipse
    uncertainty-semimajor       INTEGER(0..255)                     OPTIONAL,   --Cond NoCEP,
    uncertainty-semiminor       INTEGER(0..255)                     OPTIONAL,   --Cond NoCEP,
    offset-angle                INTEGER(0..179)                     OPTIONAL,   --Cond NoCEP,
    confidenceHorizontal        INTEGER(0..99)                      OPTIONAL,
    uncertainty-up-component    INTEGER(0..255),
    confidenceUp                INTEGER(0..99)                      OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
West	The field is mandatory present, if the speed component is towards West.
South	The field is mandatory present, if the speed component is towards South.
Down	The field is mandatory present, if the speed component is down.
NoEllipse	The field is mandatory present, if no uncertainty ellipse is present. The field SHALL NOT be present, if uncertainty ellipse present.
NoCEP	The field is mandatory present, if no CEP is present. The field SHALL NOT be present, if CEP present.

***OMA-LPPe-HighAccuracy3Dvelocity* field descriptions**

enu-origin

Origin of the east-north-up coordinate system, in which the velocity is represented.

east-component

Eastward-speed expressed as the coded number N. The relation between the component and the coded number is given by

$$\text{component} = 0.04*((1+0.016)^N-1) \text{ m/s},$$

Range [0, 133.24) m/s. The following table shows exemplary mappings from the coded number N to the speed component:

N	component-value, m/s
0	0
1	0.00064
2	0.0013
...	...
100	0.1556
...	...
200	0.9168
...	...
300	4.6392
....	...
400	22.8446
...	...
500	111.8816
...	...
509	129.0692
510	131.1350
511	133.2338

north-component

Northward-speed expressed as the coded number N. The relation between the component and the coded number is given by

$$\text{component} = 0.04*((1+0.016)^N-1) \text{ m/s},$$

Range [0, 133.24) m/s.

up-component

Upward-speed expressed as the coded number N. The relation between the component and the coded number is given by

$$\text{component} = 0.04*((1+0.016)^N-1) \text{ m/s},$$

Range [0, 133.24) m/s.

OMA-LPPe-HighAccuracy3Dvelocity field descriptions
cep Uncertainty of the horizontal speed expressed as Circular Error Probable expressed as the coded number N. The relation between the CEP and the coded number is given by $$CEP = 0.02*((1+0.025)^N-1) \text{ m/s},$$ Range [0, 10.84) m/s.
uncertainty-semimajor The semi-major axis of the horizontal speed uncertainty ellipse expressed as the coded number N. The relation between the semi-major axis and the coded number is given by $$\text{semi-major axis} =0.02*((1+0.025)^N-1) \text{ m/s},$$ Range [0, 10.84) m/s.
uncertainty-semiminor The semi-minor axis of the horizontal speed uncertainty ellipse expressed as the coded number N. The relation between the semi-minor axis and the coded number is given by $$\text{semi-minor axis} =0.02*((1+0.025)^N-1) \text{ m/s},$$ Range [0, 10.84) m/s.
offset-angle The clock-wise angle of the semi-major axis with respect to True North in steps of 1 degree.
confidenceHorizontal This field specifies the horizontal confidence percentage associated with the speed CEP or Velocity Uncertainty Ellipse depending upon which is included. In case horizontal confidence is not included, the confidence is either 68% (in case of CEP) or 39% (in case of ellipse). Note that in case the ellipse represents Gaussian 2D error distribution, 39% corresponds to 1σ confidence. Confidence is encoded as a truncated percentage. An encoded value of 0 therefore represents a confidence C where 0% <=C <1% percent. An encoded value of 1 represents a confidence C where 1%<=C<2%, and so on. An encoded value of 99 represents a confidence C where 99%<=C<100%.
uncertainty-up-component The upward speed uncertainty expressed as the coded number N. The relation between the uncertainty and the coded number is given by $$\text{uncertainty}=0.02*((1+0.025)^N-1) \text{ m/s},$$ Range [0, 10.84) m/s.
confidenceUp This field specifies the confidence percentage associated with the upward speed uncertainty. In case upward confidence is not included, the confidence is 68% corresponding to 1σ value in case of 1D Gaussian error distribution. Confidence is encoded as a truncated percentage. An encoded value of 0 therefore represents a confidence C where 0% <=C <1% percent. An encoded value of 1 represents a confidence C where 1%<=C<2%, and so on. An encoded value of 99 represents a confidence C where 99%<=C<100%.

– *OMA-LPPe-LocationInformationContainerID*

The *OMA-LPPe-LocationInformationContainerID* is used to identify vendor-/operator-specific location information.

```
-- ASN1START

OMA-LPPe-LocationInformationContainerID ::= SEQUENCE {
    containerID         INTEGER (0..65535),
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-LocationInformationContainer*

The *OMA-LPPe-LocationInformationContainer* is a black-box data container meant for carrying vendor-/operator-specific location information.

```
-- ASN1START

OMA-LPPe-LocationInformationContainer ::= SEQUENCE {
    vendorOrOperatorID                      OMA-LPPe-VendorOrOperatorID,
    locationInformationContainerDataList    OMA-LPPe-LocationInformationContainerDataList,
    ...
}

OMA-LPPe-LocationInformationContainerDataList ::= SEQUENCE
        (SIZE(1..maxLocationInformationContainerDataList)) OF OMA-LPPe-LocationInformationContainerData

OMA-LPPe-LocationInformationContainerData ::= SEQUENCE {
    containerID         OMA-LPPe-LocationInformationContainerID,
    containerData       OCTET STRING,
    ...
}

-- ASN1STOP
```

OMA-LPPe-LocationInformationContainer field descriptions
vendorOrOperatorID This field defines the vendor/operator providing the location data definition.
locationInformationContainerDataList This parameter specifies a list of location information containers for the specified vendor or operator containing proprietary location information.
containerID This field defines the vendor/operator specific location data.
containerData This field contains proprietary location information.

– *OMA-LPPe-LocationInformationContainerRequest*

The *OMA-LPPe-LocationInformationContainerRequest* is used by the server to request for vendor-/operator-specific location information.

```
-- ASN1START

OMA-LPPe-LocationInformationContainerRequest ::= SEQUENCE {
    vendorOrOperatorID                          OMA-LPPe-VendorOrOperatorID,
    locationInformationContainerRequestList     OMA-LPPe-LocationInformationContainerRequestList,
    ...
}

OMA-LPPe-LocationInformationContainerRequestList ::= SEQUENCE
                                                (SIZE (1.. maxLocationInformationContainerDataList)) OF
                                                        OMA-LPPe-LocationInformationContainerRequestItem

maxLocationInformationContainerDataList INTEGER ::= 10

OMA-LPPe-LocationInformationContainerRequestItem ::= SEQUENCE {
    containerID             OMA-LPPe-LocationInformationContainerID,
    additionalInformation   OCTET STRING                        OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-LocationInformationContainerRequest field descriptions
vendorOrOperatorID This field defines the vendor/operator providing the location data definition.
containerID This field defines the vendor/operator specific location data.
additionalInformation This field contains optional additional and proprietary positioning instructions.

– *OMA-LPPe-MapDataReference*

The IE *OMA-LPPe-Map-Data-Reference* provides a reference to map data that can be obtained from the server using the *OMA-LPPe-AssistanceContainerRequest*.

```
-- ASN1START

OMA-LPPe-MapDataReference ::= SEQUENCE {
    dataID                  OMA-LPPe-AssistanceContainerID,
    mapReference            OCTET STRING (SIZE (1..64)),
    mapSize                 INTEGER (1..5000)       OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-MapDataReference field descriptions
dataID This field provides the value for the *assistanceDataID* parameter in *OMA-LPPe-VendorOrOperatorAssistanceDataIdentifier*. The value may be used to indicate that map data is being requested.
mapReference This field indicates the precise map data being requested and provides either the entire content or the first set of octets in the proprietaryRequestParameters field in the *OMA-LPPe-AssistanceContainerRequest*.
mapSize This field indicates the total size of the map data in units of 1024 octets after rounding up to a multiple of 1024. This field SHALL be provided if available. Value 5000 denotes that the data size ≥ 5 120 000 octets.

– *OMA-LPPe-Orientation*

The *OMA-LPPe-Orientation* is used to provide information on the object orientation in space.

```
-- ASN1START

OMA-LPPe-Orientation ::= CHOICE {
    eulerAngles     SEQUENCE {
                        alpha   INTEGER (0..359),
                        beta    INTEGER (0..180),
                        gamma   INTEGER (0..359),
                        ...
                        },
    ...
}

-- ASN1STOP
```

***OMA-LPPe-Orientation* field descriptions**
alpha, beta, gamma The three Euler angles specifying the object orientation with respect to the global coordinate system. See Appendix C.9 for further information.

– *OMA-LPPe-ReferencePoint*

The IE *OMA-LPPe-ReferencePoint* provides a well defined location and set of associated attributes relative to which other locations may be defined both in indoor and outdoor environments.

```
-- ASN1START

OMA-LPPe-ReferencePoint ::= SEQUENCE {
    referencePointUniqueID              OMA-LPPe-ReferencePointUniqueID     OPTIONAL,
    referencePointGeographicLocation    CHOICE {
        location3D                              EllipsoidPointWithAltitude,
        location3DwithUncertainty               EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
        locationwithhighaccuracy                OMA-LPPe-HighAccuracy3Dposition,
        ...
        }                                                                           OPTIONAL,
    referencePointCivicLocation         OMA-LPPe-CivicLocation                      OPTIONAL,
    referencePointFloorLevel            INTEGER (-20..235)                          OPTIONAL,
    relatedReferencePoints              SEQUENCE (SIZE (1..8)) OF
                                            OMA-LPPe-ReferencePointRelationship     OPTIONAL,
    mapDataInformation                  OMA-LPPe-MapDataInformation                 OPTIONAL,
    ...
}

OMA-LPPe-MapDataInformation ::= SEQUENCE (SIZE (1..16)) OF OMA-LPPe-MapDataReferenceElement

OMA-LPPe-MapDataReferenceElement ::= SEQUENCE {
    mapDataUrl      CHOICE {
        mapDataUrl                  OMA-LPPe-Uri,
        mapDataRef                  OMA-LPPe-MapDataReference
    },
    mapProvider     CHOICE {
        sameAsRefPointProvider      NULL,
        notSameAsRefPointProvider   OMA-LPPe-VendorOrOperatorID,
        ...
    }                                                                           OPTIONAL,
    mapAssociation  CHOICE {
        referencePointUniqueID      NULL,
        otherID                     VisibleString (SIZE (1..64)),
        mapOffset                   OMA-LPPe-RelativeLocation,
        origin                      NULL,
        ...
    },
    mapHorizontalOrientation                INTEGER (0..359)                    OPTIONAL,
    ...
}

OMA-LPPe-ReferencePointRelationship ::= SEQUENCE {
    referencePointUniqueID      OMA-LPPe-ReferencePointUniqueID,
    relativeLocation            OMA-LPPe-RelativeLocation,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ReferencePoint* field descriptions**
referencePointUniqueID This field provides a unique ID for the reference point, which allows reference points to be referred to in different messages and different parts of the same message without repeating the complete definition. This also allows target devices and servers to reliably indicate the same reference point (e.g. when several reference points have almost the same location).
referencePointGeographicLocation This field provides the geodetic location of the reference point. Either *referencePointGeographicLocation* or *referencePointCivicLocation* or both SHALL be present unless either *referencePointUniqueID* or *relatedReferencePoints* is present and can be used to determine location (e.g. using a separate definition provided or available for the *referencePointUniqueID* or by making use of information provided for another reference point in *relatedReferencePoints*).
referencePointCivicLocation This field provides a civic location information description of the reference point. Either *referencePointGeographicLocation* or *referencePointCivicLocation* or both SHALL be present unless either *referencePointUniqueID* or relatedReferencePoints is present and can be used to determine location (e.g. using a separate definition provided or available for the *referencePointUniqueID* or by making use of information provided for another reference point in *relatedReferencePoints*).
referencePointFloorLevel This field provide the floor level or basement level of a reference point that is inside a building or other man made structure (e.g. parking garage) that has well defined floor levels. A value of zero corresponds to ground level, positive values are above ground level and negative values below ground level. Note that this information may duplicate part of *referencePointCivicLocation* (if this is provided) for the benefit of a recipient unable to decode the latter.
relatedReferencePoints This parameter provides a list of other reference points that are related to the reference point being defined. For each related reference point, the unique ID is provided and the relative location with respect to the location of the reference point being defined. Related reference points can be used to relate different sets of assistance data that are each provided in association with a distinct reference point or points.
mapDataInformation This field provides a map reference for the reference point. The reference can include one or more URLs.
mapDataUrl This field is formatted in accordance with [RFC3986] and provides a reference to map data information. The map data information could be an image or dataset that represents a map, floor plan, layout of a building or buildings, layout of a town or city, or any other form of representation/data understood by both the sender and recipient. Map data may be 2D or 3D.
mapDataRef This field provides a map reference specific to a particular map provider that may be used to obtain the map directly from the LPPe server.
mapProvider This parameter identifies the map provider which may be the same as the provider of the reference point or not the same. This parameter is optional. If absent, the map provider is not explicitly defined – e.g. but may be provided as part of the map data or may be inferred from the mapDataUrl.
mapAssociation This parameter provides an exact association between the reference point and a particular location on the map. The choices are: **referencePointUniqueID**: a location identified by the unique ID is defined within the map. Note that the conventions for such identification may be specific to the map provider **otherID**: a location corresponding to the provided visible string is defined within the map. The conventions for such identification may be specific to the map provider. **mapOffset**: the relative location is provided of the origin of the map coordinate system from the reference point. **origin**: the reference point coincides with the map origin.
mapHorizontalOrientation This field specifies the orientation (in degrees clockwise from North) of the map coordinate system with respect to North. If this field is absent, the North direction at the reference point coincides with the North direction of the map coordinate system.

– *OMA-LPPe-ReferencePointUniqueID*

The IE *OMA-LPPe-ReferencePointUniqueID* provides a unique ID for a reference point.

```
-- ASN1START

OMA-LPPe-ReferencePointUniqueID ::= SEQUENCE {
    providerID          OMA-LPPe-VendorOrOperatorID,
    providerAssignedID  OCTET STRING,
    version             INTEGER (1..64),
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ReferencePointUniqueID* field descriptions**
providerID This field identifies the vendor or operator or other service provider with jurisdiction over the reference point.
providerAssignedID This field provides a unique ID relative to the particular provider.
version This field provides the version of the reference point. The initial version of any reference point SHALL be 1. In case data associated with a given reference point is updated, the version SHALL be incremented by 1. A target device SHALL delete all data associated with any previous version of a particular reference point when receiving data associated with a more recent version. For reference points without a unique ID, versioning is not applicable and the reference point cannot be uniquely referred to in any context where it is not completely defined.

– *OMA-LPPe-RelativeLocation*

The *OMA-LPPe-RelativeLocation* IE provides a location, referred to here as the subject location, relative to some known reference location. This can be used to define any of the following:

(a) a fixed location (e.g. of a base station) relative to some other known fixed location

(b) a temporary location (e.g. of a target device) relative to a known fixed or known temporary location (e.g. of another target device)

(c) the change in location of a target device in moving from an initial known reference location to a new subject location.

```
-- ASN1START

OMA-LPPe-RelativeLocation ::= SEQUENCE {
    units                   ENUMERATED {cm,dm, m10, ...}                          OPTIONAL,
    arc-second-units        ENUMERATED {as0-0003, as0-003, as0-03, as0-3, ...}  OPTIONAL,
    relativeNorth           INTEGER (-524288..524287),
    relativeEast            INTEGER (-524288..524287),
    relativeAltitude        OMA-LPPe-RelativeAltitude                             OPTIONAL,
    horizontalUncertainty   OMA-LPPe-HorizontalUncertaintyAndConfidence         OPTIONAL,
    ...
}

OMA-LPPe-HorizontalUncertaintyAndConfidence ::= SEQUENCE {
    uncShape    CHOICE {
                        circle          INTEGER (0..127),
                        ellipse         SEQUENCE {
                            semimajor       INTEGER (0..127),
                            semiminor       INTEGER (0..127),
                            offsetAngle     INTEGER (0..179)
                        },
                        ...
    },
```



```
    confidence INTEGER (0..99) OPTIONAL,
    ...
}

OMA-LPPe-RelativeAltitude ::= SEQUENCE {
    geodeticRelativeAltitude    OMA-LPPe-GeodeticRelativeAltitude   OPTIONAL,
    civicRelativeAltitude       OMA-LPPe-CivicRelativeAltitude      OPTIONAL,
    ...
}

OMA-LPPe-GeodeticRelativeAltitude ::= SEQUENCE {
    geodetic-height-depth       INTEGER (-32768..32767),
    geodetic-uncertainty-and-confidence OMA-LPPe-GeodeticUncertaintyAndConfidence   OPTIONAL,
    ...
}

OMA-LPPe-GeodeticUncertaintyAndConfidence ::= SEQUENCE {
    uncertainty     INTEGER (0..127),
    confidence      INTEGER (0..99)         OPTIONAL,
    ...
}

OMA-LPPe-CivicRelativeAltitude ::= SEQUENCE {
    civic-floors        INTEGER (-255..256),
    civic-uncertainty-and-confidence    OMA-LPPe-CivicUncertaintyAndConfidence OPTIONAL,
    ...
}

OMA-LPPe-CivicUncertaintyAndConfidence ::= SEQUENCE {

    uncertainty     INTEGER (0..127),

    confidence      INTEGER (0..99)         OPTIONAL,

    ...
}

-- ASN1STOP
```

***OMA-LPPe-RelativeLocation* field descriptions**
units This field specifies the units for vertical and optionally horizontal distances. The choices are 1 cm, 1 dm, 1 meter and 10 meters. This field is optional. A unit of 1 meter is specified by the absence of the field.
arc-second-unit] If arc-second-units is present, this field provides the difference in the latitude coordinates of the reference and subject locations. Otherwise, the field provides the equivalent distance along any line of longitude over the surface of the WGS 84 ellipsoid between the reference and subject latitude circles. Note that for distances less than 20 kilometers, a straight line approximation may be used since the error will be less than 2 centimeters. A positive value indicates the subject is north of the reference
relativeNorth If arc-second-units is present, this field provides the difference in the latitude coordinates of the reference and subject locations. Otherwise, the field provides the equivalent distance along any line of longitude over the surface of the WGS 84 ellipsoid between the reference and subject latitude circles. Note that for distances less than 20 kilometers, a straight line approximation may be used since the error will be less than 2 centimeters. A positive value indicates the subject is north of the reference.
relativeEast If arc-second-units is present, this field provides the difference in the longitude coordinates of the reference and subject locations. Otherwise, the field provides the equivalent distance along the line of latitude for the reference location over the surface of the WGS 84 ellipsoid between the reference and subject longitude circles. Note that for distances less than 10 kilometers, a straight line approximation may be used except near the poles (e.g. greater than 80º latitude). A positive value indicates the subject is east of the reference.

OMA-LPPe-RelativeLocation **field descriptions**
units This field specifies the units for vertical and optionally horizontal distances. The choices are 1 cm, 1 dm, 1 meter and 10 meters. This field is optional. A unit of 1 meter is specified by the absence of the field.
arc-second-unit] If arc-second-units is present, this field provides the difference in the latitude coordinates of the reference and subject locations. Otherwise, the field provides the equivalent distance along any line of longitude over the surface of the WGS 84 ellipsoid between the reference and subject latitude circles. Note that for distances less than 20 kilometers, a straight line approximation may be used since the error will be less than 2 centimeters. A positive value indicates the subject is north of the reference
OMA-LPPe-horizontalUncertaintyAndConfidence This parameter provides the uncertainty in the relative horizontal location and is expressed either as a circle with given radius or as an ellipse with given semi major axis, semi minor axis and offset angle (0-179 degrees) subtended clockwise from North to the semi major axis. The center of the circle or ellipse is given by a location with the provided relative location to the reference location and the area enclosed defines possible values of the actual subject location. The encoded value N for the length L of the radius of the circle or the semi major axis or semi minor axis of the ellipse satisfies: L = $5*(1.1^N-1)$ units (range is 0-903314 units for N in the range 0-127) e.g. for 1 meter units, (N=1, L=0.5m), (N=2, L=1.05m), (N=10, L=8.0m), (N=20, L=28.6m), (N=40, L=221m), (N=60, L=1517m) Associated with the uncertainty is an optional confidence parameter which gives the confidence that the actual subject location lies within the circle or ellipse defined by the horizontalUncertainty. The default value if confidence is absent is 68 %. Horizontal uncertainty and confidence SHALL be provided if available. Confidence is encoded as a truncated percentage. An encoded value of 0 therefore represents a confidence C where 0% <=C <1% percent. An encoded value of 1 represents a confidence C where 1%<=C<2%, and so on. An encoded value of 99 represents a confidence C where 99%<=C<100%.
geodeticRelativeAltitude This parameter provides the difference in the altitude coordinates of the reference and subject locations and contains these fields. geodetic-height-depth (GH): altitude of subject less altitude of reference in the given units uncertainty (U): uncertainty in GH encoded as an integer N (0-127) with: U = $10*(1.05^N-1)$ units (range is 0-4900 units for N in the range 0-127) e.g. for 1 meter units, (N=1, U=0.5m), (N=2, U=1.025m), (N=10, U=6.3m), (N=20, U=16.5m), (N=40, U=60.4m), (N=60, U=176.8m) confidence: confidence that the actual difference GD of altitude is in the range GH-U ≤ GD ≤ GH+U. The default if confidence is absent is 68%. A confidence value SHALL be provided if available. Confidence is encoded as a truncated percentage. An encoded value of 0 therefore represents a confidence C where 0% <=C <1% percent. An encoded value of 1 represents a confidence C where 1%<=C<2%, and so on. An encoded value of 99 represents a confidence C where 99%<=C<100%.
civicRelativeAltitude This parameter provides the difference in the floor levels between the reference and subject locations and may only be present for a reference location that contains an explicit floor level (either as part of a civic location or as defined separately). It contains these fields. civic-floors (CF): floor level of subject less floor level of reference in the given units uncertainty (U): uncertainty in CF in units of floors confidence: confidence (1-99%) that the actual difference CD of floor level is in the range CF-U ≤ CD ≤ CF+U. The default if confidence is absent is 68%. A confidence value SHALL be provided if available.

– OMA-LPPe-Session-ID

The *OMA-LPPe-Session-ID* is used to identify a Periodic/Triggered Assistance Data Transfer with Update procedure.

```
-- ASN1START

OMA-LPPe-Session-ID ::= SEQUENCE {
    provider-ID         OMA-LPPe-VendorOrOperatorID,
    server-ID           OCTET STRING (SIZE(4)),
    session-ID          OCTET STRING (SIZE(4)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-Session-ID field descriptions
provider-ID Vendor or operator who owns or operates the server.
server-ID Server ID unique to the provider.
session-ID Session ID unique to the server.

– OMA-LPPe-Uri

The IE *OMA-LPPe-Uri* defines a Uniform Resource Identifier (URI) according to [RFC3986]

```
-- ASN1START

OMA-LPPe-Uri ::= VisibleString (FROM ( "a".."z" | "A".."Z" | "0".."9" | ":" | "/" | "?" | "#" | "[" |
"]" | "@" | "!" | "$" | "&" | "'" | "(" | ")" | "*" | "+" | "," | ";" | "=" | "-" | "." | "_" | "~" |
"%"  ))

-- ASN1STOP
```

– OMA-LPPe-ver1-1-BroadcastSystemID

The IE *OMA-LPPe-ver1-1-BroadcastSystemID* is used only in LPPe 1.1 and defines a specific broadcast system.

```
-- ASN1START

OMA-LPPe-ver1-1-BroadcastSystemID ::= CHOICE {
    standardSystemID        INTEGER (1..16),
    proprietarySystemID     SEQUENCE    {
                                vendorOrOperator        OMA-LPPe-VendorOrOperatorID,
                                proprietarySystemID     INTEGER (1..16)
                            },
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver1-1-BroadcastSystemID field descriptions
standardSystemID This field identifies a standardized broadcast system using an integer between 1 and 16. Assignments may be included in a later version of this specification and/or in specifications for particular broadcast systems. Assignments will be unique and will be be allocated by OMNA. The up-to-date allocations are available at [OMNA].

OMA-LPPe-ver1-1-BroadcastSystemID field descriptions
proprietarySystemID This field identifies a broadcast system that is proprietary to a particular vendor or operator. Assignments will be made by the particular vendor or operator and will not be included in this specification.

– *OMA-LPPe-ver1-1-BroadcastADTypes*

The IE *OMA-LPPe-ver1-1-BroadcastADTypes* is used only in LPPe 1.1 and defines a set S of assistance data types associated with delivery via broadcast. The assistance data types are defined using the labels and nesting levels defined in Appendix E. The set S is specified by providing a set of labels for LPP and another set of labels for LPPe referred to here as the LPP and LPPe label sets, respectively. Each label set is composed of one or more label subsets where each label subset contain labels with common initial elements and different final elements – e.g. a label subset such as {L1.L2.X1, L1.L2.X2, L1.L2.X3} where L1 and L2 are common initial elements and X1, X2 and X3 are different final elements. The assistance data items D referred to by the labels in any label subset may or may not contain data items at a deeper nesting level. In the former case, to avoid specifying these additional data items using additional label subsets, it is allowed as an option to indicate whether none or all of the additional data items contained within the data items in D are to be included in S. As an example and referring to the previous example above, if there are additional data items with labels {L1.L2.X2.Y1, L1.L2.X2.Y2, L1.L2.X3.Y3}, it can be specified whether none or all of these data items are to be included in S. As a further convention to reduce the number of label subsets that need to be provided, all assistance data items that are parents of assistance data items explicitly included in S are also included by default in S. As an example and referring to the first example above, data items with labels L1 and L1.L2 would then be included in S.

```
-- ASN1START

OMA-LPPe-ver1-1-BroadcastADTypes ::= SEQUENCE {
    lppLabels       SEQUENCE (SIZE (1..maxLPPLabelSets)) OF OMA-LPPe-ver1-1-LabelSet,
    lppeLabels      SEQUENCE (SIZE (1..maxLPPeLabelSets)) OF OMA-LPPe-ver1-1-LabelSet,
    ...
}

OMA-LPPe-ver1-1-LabelSet ::= SEQUENCE {
    level1-element  SEQUENCE {
                    level1-element-value    INTEGER (1..maxLevel1-element),
                    level2-element  SEQUENCE {
                                    level2-element-value    INTEGER (1..maxLevel2-element),
                                    level3-element  SEQUENCE {
                                                    level3-element-value    INTEGER        (1..maxLevel3-
element),
                                                    ...
                                                    }   OPTIONAL,
                    ...
                    }   OPTIONAL,
    ...
    }   OPTIONAL,
    lastElements    BIT STRING (SIZE (1..maxFinal-element)),
    additionalElements  ENUMERATED { none, all, ... }       OPTIONAL,
    ...
}

maxLevel1-element       INTEGER ::= 32

maxLevel2-element       INTEGER ::= 32

maxLevel3-element       INTEGER ::= 32

maxFinal-element        INTEGER ::= 32

maxLPPLabelSets         INTEGER ::= 64

maxLPPeLabelSets        INTEGER ::= 128

-- ASN1STOP
```

OMA-LPPe-ver1-1-BroadcastADTypes **field descriptions**
lppLabels This parameter defines the LPP label set representing assistance data types for LPP.
lppeLabels This parameter defines the LPPe label set representing assistance data types for LPPe.
OMA-LPPe-ver1-1-LabelSet This parameter defines a label subset containing labels that differ only in their last elements. This parameter contains the following fields: Level1-element-value defines the common first (level 1) element for each label in the label subset; this field SHALL only be included when defining labels at nesting level 2 or higher Level2-element-value defines the common second (level 2) element for each label in the label subset; this field SHALL only be included when defining labels at nesting level 3 or higher Level3-element-value defines the common third (level 3) element for each label in the label subset; this field SHALL only be included when defining labels at nesting level 4 lastElements defines the final elements for the labels in the label subset using a bit string where a one value at bit position n (n = 1 to 32) indicates that element n is present and a zero value or absence of bit n indicates the element is absent. The nesting level for the final label elements is 1 if level1-element is not included and is otherwise 1 greater than highest level element (1, 2 or 3) included within label1-element. additionalElements in the case that the labels specified by the preceding fields can be suffixed with additional elements to create further valid labels, this field specifies whether none or all of these further labels are to be included in the final label set (and thus whether none or all of the associated data items are to be included in the set S). If this field is not included and if further label subsets do not indicate which of the further labels are to be included and not included, the inclusion of the further labels is undefined in any context where the associated assistance data types refer to target capabilities or broadcast system support. This field SHALL NOT be included when the further labels are specified in additional label subsets. To enable forward compatibility with later versions of LPP and LPPe, a receiver SHALL ignore any labels containing elements values that it does not recognize and SHALL act as if these labels were not included.

– *OMA-LPPe-ver1-1-AccessNetworkID*

The IE *OMA-LPPe-ver1-1-AccessNetworkID* is used only in LPPe 1.1 and defines a particular access network.

```
-- ASN1START

OMA-LPPe-ver1-1-AccessNetworkID ::= CHOICE {
    gSMAccess       OMA-LPPe-ver1-1-MCC-MNC,
    wCDMAAccess     OMA-LPPe-ver1-1-MCC-MNC,
    lTEAccess       OMA-LPPe-ver1-1-MCC-MNC,
    wiMaxAccess     OMA-LPPe-ver1-1-BSID,
    wLANAccess      OMA-LPPe-WLAN-AP-ID,
    ...
}

OMA-LPPe-ver1-1-MCC-MNC ::= SEQUENCE {
    mcc     SEQUENCE (SIZE (3)) OF INTEGER (0..9),
    mnc     SEQUENCE (SIZE (2..3)) OF INTEGER (0..9),
    ...
}
```

```
OMA-LPPe-ver1-1-BSID ::= SEQUENCE {
    bsID-MSB      BIT STRING (SIZE(24)),
    bsID-LSB      BIT STRING (SIZE(24)),
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ver1-1-AccessNetworkID* field descriptions**
gsmAccess This parameter provides the operator MCC and MNC values for GSM access.
wCDMAAccess This parameter provides the operator MCC and MNC values for WCDMA access.
lTEAccess This parameter provides the operator MCC and MNC values for LTE access.
wiMaxAccess This parameter provides the operator BSID value for WiMax access.
wLAnAccess This parameter provides the operator WLAN AP ID for WLAN access.

– *OMA-LPPe-ver1-1-AuthenticationSetID*

The IE *OMA-LPPe-ver1-1-AuthenticationSetID* is used only in LPPe 1.1 and uniquely identifies an authentication set comprising an RSA public key value. A server SHALL NOT reuse a particular authentication set ID for a new authentication set for a period of at least 24 hours following usage for the last broadcast for a previous authentication set. Note that because authentication public-private key pairs can be expensive to establish, a small number of IDs can suffice.

```
-- ASN1START

OMA-LPPe-ver1-1-AuthenticationSetID ::= INTEGER (0..255)

-- ASN1STOP
```

***OMA-LPPe-ver1-1-AuthenticationSetID* field descriptions**
OMA-LPPe-ver1-1-AuthenticationSetID This parameter provides an authentication set ID as an integer between 0 and 255.

– *OMA-LPPe-ver1-1-AuthenticationSet*

The IE *OMA-LPPe-ver1-1-AuthenticationSet* is used only in LPPe 1.1 and defines an authentication set comprising an authentication ID, an RSA public key value and a salt length for encoding.

```
-- ASN1START

OMA-LPPe-ver1-1-AuthenticationSet ::= SEQUENCE {
    authenticationSetID     OMA-LPPe-ver1-1-AuthenticationSetID,
    rsaPublicKey            SEQUENCE    {
                                modulus         BIT STRING (SIZE (2048)),
                                exponent        BIT STRING (SIZE (2..2048))
                            },
    saltLength              INTEGER (0..32),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver1-1-AuthenticationSet field descriptions
authenticationSetID This parameter provides the authentication set ID.
rsaPublicKey This parameter provides an RSA public key consisting of a 2048 bit modulus and a 2 to 2048 bit exponent. Integer versions of the modulus and exponent are obtained by truncating any leading zero bits and treating the remaining bits as the binary representation of a positive integer.
saltLength This parameter provides the length in octets of the salt value used for the EMSA-PSS encoding method defined in [PKCS#1].

– *OMA-LPPe-ver1-1-CipherSetID*

The IE *OMA-LPPe-ver1-1-CipherSetID* is used only in LPPe 1.1 and uniquely identifies a cipher set comprising a ciphering key value and first component C0 for the initial ciphering counter C1. A server SHALL NOT reuse a particular cipher set ID for a new cipher set for a period of at least 24 hours following usage for the last broadcast for a previous cipher set.

```
-- ASN1START

OMA-LPPe-ver1-1-CipherSetID ::= INTEGER (0..65535)

-- ASN1STOP
```

OMA-LPPe-ver1-1-CipherSetID field descriptions
OMA-LPPe-ver1-1-CipherSetID This parameter provides a cipher set ID as an integer between 0 and 65535.

– *OMA-LPPe-ver1-1-CipherSet*

The IE *OMA-LPPe-ver1-1-CipherSet* is used only in LPPe 1.1 and defines a cipher set comprising a cipher set ID, a ciphering key value and first component C0 for the initial ciphering counter C1.

```
-- ASN1START

OMA-LPPe-ver1-1-CipherSet ::= SEQUENCE {
    cipherSetID             OMA-LPPe-ver1-1-CipherSetID,
    cipherKey               BIT STRING (SIZE (128)),
    c0                      BIT STRING (SIZE (1..128)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver1-1-CipherSet field descriptions
cipherSetID This parameter provides the cipher set ID.
cipherKey This parameter provides a cipher key as a bit string of size 128 bits.
c0 This parameter provides the first component of the initial ciphering counter C1. If less than 128 bits, c0 is padded out with zeroes in more significant bit positions to achieve 128 bits.

– *OMA-LPPe-ver1-1-ServerID*

The IE *OMA-LPPe-ver1-1-ServerID* is used only in LPPe 1.1 and defines the identity of a server.

```
-- ASN1START

OMA-LPPe-ver1-1-ServerID ::= SEQUENCE {
    provider-ID         OMA-LPPe-VendorOrOperatorID,
    server-ID           OCTET STRING (SIZE(4)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver1-1-ServerID field descriptions
provider-ID This parameter defines the vendor or operator ID.
server-ID This parameter defines the server ID for the particular vendor or operator.

– *OMA-LPPe-ver2-0-XYZ-CoordinateFrame*

The IE *OMA-LPPe-ver2-0-XYZ-CoordinateFrame* is used only in LPPe 2.0 and defines a reference frame for providing X,Y,Z coordinates – e.g. for an indoor environment – where the Z coordinate is vertical and the X,Y coordinates are horizontal.

```
-- ASN1START

OMA-LPPe-ver2-0-XYZ-CoordinateFrame ::= SEQUENCE {
    origin              Origin,
    orientation-y-axis  SEQUENCE {
                        integer-degrees         INTEGER (0..359),
                        fractional-degrees      INTEGER (0..16383)      OPTIONAL
                        }       OPTIONAL,
    ...
}

Origin ::= SEQUENCE {
    reference-point         OMA-LPPe-ReferencePointUniqueID,
    relative-location       OMA-LPPe-RelativeLocation               OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-XYZ-CoordinateFrame field descriptions
Origin This parameter defines the origin of the X,Y,Z coordinate frame using a reference point and optional relative location. The location of the origin is given by the location of the reference point plus any relative location displacement if present. If an altitude for the origin is not included in the reference point definition, local ground level SHALL be assumed for the origin.

OMA-LPPe-ver2-0-XYZ-CoordinateFrame **field descriptions**
orientation-y-axis This parameter defines the clockwise angle at the origin from true North to the positive Y axis and contains the following fields: integer-degrees: integer number of degrees in the range 0-359 fractional-degrees: fractional degrees in the range 0-16383 expressing a fraction n/16384 for an encoded value n. This field is optional.

– *OMA-LPPe-ver2-0-ReferenceGrid*

The IE *OMA-LPPe-ver2-0-ReferenceGrid* is used only in LPPe 2.0 and defines a horizontal 2-dimensional reference grid of points that may be used to provide RF heat map related information. A common reference grid may be used to provide RF heat map information for many RF transmitters (e.g. WiFi APs). The use of a common reference grid enables different RF heat maps to be aligned to the same set of grid points – e.g. enabling a target to obtain RSSI and/or RTT values for different transmitters at the same location points. Refer to Appendix G for more information concerning definition and encoding.

```
-- ASN1START

OMA-LPPe-ver2-0-ReferenceGrid ::= SEQUENCE {
    xyz-coordinateframe     OMA-LPPe-ver2-0-XYZ-CoordinateFrame,
    grid-spacing            Grid-Spacing,
    ...
}

Grid-Spacing ::= SEQUENCE {
    units           ENUMERATED {decameters (0), meters (1), decimeters (2), centimeters (3), ...},
    value           INTEGER (1..1024),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-ReferenceGrid **field descriptions**
xyz-coordinateframe This parameter defines the X,Y,Z coordinate frame for the reference grid.
grid-spacing This parameter defines the common unit of length for integer X and Y coordinates for the reference grid. The common unit is an integer number, in the range 1 to 1024, of decameters, meters, decimeters or centimeters.

– *OMA-LPPe-ver2-0-RF-HeatMap*

The IE *OMA-LPPe-ver2-0-RF-HeatMap* is used only in LPPe 2.0 and provides RF heat map information for a single transmitter. Refer to Appendix G for more information.

```
-- ASN1START

OMA-LPPe-ver2-0-RF-HeatMap ::= SEQUENCE {
    heatMap-ID              OMA-LPPe-ver2-0-RF-HeatMap-ID,
    validity-period         OMA-LPPe-ValidityPeriod             OPTIONAL,
    referenceGrid           OMA-LPPe-ver2-0-ReferenceGrid       OPTIONAL,
    heatMap-Source          OMA-LPPe-ver2-0-HeatMap-Source      OPTIONAL,
    x-offset                INTEGER (-32768..32767)             OPTIONAL,
    y-offset                INTEGER (-32768..32767)             OPTIONAL,
```



```
    x-length                INTEGER (1..4096),
    y-length                INTEGER (1..4096),
    compression             ENUMERATED {none (0), jpeg (1), ...},
    reorientation           SEQUENCE {
                            orientation-angle       INTEGER (-900..900),
                            shifting                ENUMERATED {x-direction (0), y-direction (1)},
                            ...
                            }       OPTIONAL,
    run-lengths             OMA-LPPe-RleList    OPTIONAL,
    updateReqGridPoints     OMA-LPPe-RleList    OPTIONAL,
    rssi-map                SEQUENCE {
                            rssi-mean-value         OCTET STRING,
                            rssi-standard-deviation OCTET STRING        OPTIONAL,
                            range                   SEQUENCE {
                                                    rssi-minimum        INTEGER (-150..-10),
                                                    rssi-range          INTEGER (10..256)
                                                    }                   OPTIONAL,
                            ...
                            }       OPTIONAL,
    rtt-map                 SEQUENCE {
                            units           ENUMERATED {ns5 (0), ns10 (1), ns20 (2), ns50 (3), ...},
                            rtt-mean-value          OCTET STRING,
                            rtt-standard-deviation  OCTET STRING        OPTIONAL,
                            ...
                            }       OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ver2-0-RF-HeatMap* field descriptions**
heatmap-ID
This parameter provides a unique ID for the heat map.
validity-period
This parameter defines the validity period for a heat map and, if present, overrides any other validity period provided by a server for any assistance data that may contain the heat map. A target that receives a heat map should only make use of the heat map during the validity period. This parameter is optional.
referenceGrid
This parameter defines the origin, orientation and grid spacing for a reference grid relative to which the heat map is defined. This parameter is optional. If included, the provided reference grid overrides any default reference grid provided by means of common group parameters (e.g. for a WLAN AP or SRN AP). If absent, a reference grid is taken from common group parameters (e.g. for a WLAN AP or SRN AP),
heatMap-Source
This parameter defines the source of the heat map and may provide information associated with the source. This parameter is optional. If absent, the source is undefined.
x-offset
This parameter provides the x coordinate offset relative to the reference frame origin for the corner of the heat map rectangular area that has minimum X and Y coordinates. This parameter is encoded as an integer with range -32768 to 32767 which expresses a length in units of the grid spacing. This parameter is optional. If not present, the x-offset is zero.
y-offset
This parameter provides the y coordinate offset relative to the reference frame origin for the corner of the heat map rectangular area that has minimum X and Y coordinates. This parameter is encoded as an integer with range -32768 to 32767 which expresses a length in units of the grid spacing. This parameter is optional. If not present, the y-offset is zero.
x-length
This parameter defines the length of the rectangular area for the heat map in the X direction in units of the grid spacing. This is encoded as an integer in the range 1 to 4096.

***OMA-LPPe-ver2-0-RF-HeatMap* field descriptions**
y-length
This parameter defines the length of the rectangular area for the heat map in the Y direction in units of the grid spacing. This is encoded as an integer in the range 1 to 4096.
compression
This parameter defines the method used to compress the included heat maps. Possible values are none (meaning no compression) and JPEG (meaning JPEG compression).
reorientation
This parameter enables a heat map area to be reoriented at an angle θ (-90° ≤ θ ≤ 90°) to the local Y axis as described in Appendix G.4.1. The reorientation is defined by the following fields: orientation-angle gives the angle θ in units of one tenth of a degree shifting defines whether rows of grid points are shifted in the positive X direction or columns of grid points are shifted in the positive Y direction as defined in Appendix G.4.1 This parameter is optional and is only included when reorientation is used.
run-lengths
This parameter enables a heat map area to fit an arbitrary shape by defining alternating run lengths of excluded and included grid points as defined in Appendix G.4.2. The parameter contains a sequence of integers I1, I2, I3, I4 etc. with values between 0 and 255 where integers in odd positions (I1, I3, I5 etc.) define a consecutive sequence of excluded grid points and integers in even positions (I2, I4 etc.) define a consecutive sequence of included grid points. The total number of all included and excluded grid points SHALL be less than or equal to the total number of original grid points. When the former is less than the latter, all remaining grid points (not so far included or excluded) SHALL be assumed by a receiver to be excluded. This parameter is optional and SHALL only be included when run lengths are used to create an arbitrary heat map area.
updateReqGridPoints
This parameter provides a set of grid points for triggering a request for new transmitter assistance data from a target if the target estimates its position near to one of these grid points. This parameter is optional, but if this parameter is provided by the server, the server may send this information only for one of the grouped transmitter heat maps (and not for all of the heap maps). The parameter contains a sequence of integers I1, I2, I3, I4 etc. with values between 0 and 255 where integers in odd positions (I1, I3, I5 etc.) define a consecutive sequence of grid points that do not trigger updates and integers in even positions (I2, I4 etc.) define a consecutive sequence of grid points that do trigger updates. The total number of all included and excluded grid points SHALL be less than or equal to the total number of original grid points. When the former is less than the latter, all remaining grid points (not so far included or excluded) SHALL be assumed by a receiver to not trigger an update. The selection of update grid points is out-of-scope of this specification. Refer to Appendix G.5 for more information.

OMA-LPPe-ver2-0-RF-HeatMap **field descriptions**
rssi-map This parameter provides a sequence of mean signal strength values and an optional sequence of signal strength standard deviations for successive included grid points within the heat map area as defined in Appendix G. Mean signal strength values are encoded as integers in the range 0 to 255 as follows: encoded value = 0 : mean signal strength <= rssi-minimum encoded value = 1-254 : mean signal strength = (rssi-minimum + (encoded value / 255)*rssi-range) encoded value = 255 : mean signal strength >= (rssi-minimum + rssi-range) where: rssi-minimum = minimum RSSI in units of dBm (default is -117.5 dBm for WLAN and -128 dBm for SRN) rssi-range = range of RSSI in units of dB (default is 127.5 dB for WLAN and 148 dB for SRN) Signal strength standard deviations are encoded as integers in the range 0 to 255 as follows: signal strength standard deviation = (encoded value / 2) dBm (note: the standard deviation applies to the signal strength level on a linear scale and is then converted to dBm) Note that signal strength refers to the expected Received Channel Power of a Beacon frame, probe response frame or measurement pilot frame in the case of WLAN, or the RSSI of the received signal from the SRN in dBm, as defined by the specifications applicable to the particular SRN. Successive RSSI values appear according to a scan order of grid points as defined in Appendix G. When JPEG compression is used, this parameter contains an octet string that results from JPEG compression of the original encoded RSSI values. When JPEG compression is used with run-lengths, dummy RSSI values are included for all grid points defined to be excluded by the run-lengths parameter.
rtt-map This parameter provides a sequence of mean RTT values and an optional sequence of RTT standard deviations for successive included grid points within the heat map area as defined in Appendix G. RTT values define round trip propagation time between any grid point and a particular transceiver (e.g. WLAN AP). Mean RTT values and RTT standard deviations are each encoded as integers in the range 0 to 255 in units of 5 ns, 10 ns, 20 ns or 50 ns. Use of JPEG compression is as defined for the rssi-map parameter.

– *OMA-LPPe-ver2-0-HeatMap-Source*

The IE *OMA-LPPe-ver2-0-HeatMap-Source* is used only in LPPe 2.0 and provides information concerning the source of a particular RF heat map.

```
-- ASN1START

OMA-LPPe-ver2-0-HeatMap-Source ::= CHOICE {
    propagationModel        OMA-LPPe-ver2-0-PropagationModel-HeatMap,
    measurements            OMA-LPPe-ver2-0-Measurements-HeatMap,
    ...
}

OMA-LPPe-ver2-0-PropagationModel-HeatMap ::= SEQUENCE {
    ...
}

OMA-LPPe-ver2-0-Measurements-HeatMap ::= SEQUENCE {
    measurementSource       BIT STRING {crowdsourcing       (0),
                                        driveBy             (1),
                                        propagationModel    (2) } (SIZE (1..8)),
    referenceDevice         OMA-LPPe-ver2-0-DeviceType      OPTIONAL,
    rssiCalibrationModel    SEQUENCE {
                            rssi-calibration-slope-param        INTEGER (-4096..4095),
                            rssi-calibration-constant-param     INTEGER (-4096..4095),
                            ...
                            }                               OPTIONAL,
    ...
}
```



```
-- ASN1STOP
```

OMA-LPPe-ver2-0-HeatMap-Source field descriptions
propagationModel This parameter indicates that a heat map was computed based on known map information (e.g. floorplan, building plan, street map) using a hypothetical reference transmitter with 10 dBm transmission power, 0 dBi antenna gain and 0 internal contribution to RTT.
measurements This parameter indicates that a heat map was obtained from measurements of RSSI and/or RTT from one or more collection devices.
measurementSource This parameter indicates the measurement source or sources for a heat map derived using measurements. The sources are indicated using a bit string where a binary one indicates that a particular measurement source was used and a binary zero indicates a measurement source was not used. The possible sources comprise the the following: crowdsourcing indicates multiple target devices supplied measurements driveBy indicates measurements were obtained from one or just a few collection devices propagationModel indicates measurements were validated, corrected and/or extrapolated using a propagation model
referenceDevice This parameter provides information about a reference device or collection device used or assumed for a heat map derived from measurements. A target device may assume that the RSSI and/or RTT values provided in the heatmap would be those measured by the indicated reference device in the absence of any calibration. This parameter is optional.
rssiCalibrationModel This parameter identifies parameters for an RSSI calibration model as defined in Appendix G.6. This model enables signal strength values measured by a target device to be recalibrated to correspond to signal strength values in the RF heatmap associated with specific reference device. The following fields are included: rssi-calibration-slope-param: describes the slope of a linear function which transforms RSSI from a target device into RSSI for a reference device (scale factor : 0.01) rssi-calibration-constant-param decribes the constant of a linear function which transforms RSSI from a target device into RSSI for a reference device (scale factor : 0.01). This parameter is optional.

– *OMA-LPPe-ver2-0-RF-HeatMap-ID*

The IE *OMA-LPPe-ver2-0-RF-HeatMap-ID* is used only in LPPe 2.0 and provides a unique ID for an RF heat map.

```
-- ASN1START

OMA-LPPe-ver2-0-RF-HeatMap-ID ::= SEQUENCE {
    vendorOrOperator        OMA-LPPe-VendorOrOperatorID,
    heatmap-ID              OCTET STRING (SIZE (1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-RF-HeatMap-ID **field descriptions**
vendorOrOperator This parameter defines the vendor or operator who has assigned the heat map ID. This parameter is mandatory,
heatmap-ID This parameter defines the heat map ID for the particular vendor or operator. The heat map ID may identify a particular transmitter (e.g. a WLAN or SRN AP) and may contain a version or timestamp using proprietary encoding. The heatmap-ID should change whenever a heatmap is updated and should differ for different transmitters. The heatmap-ID is encoded as an octet string of length 1 to 16 octets. This parameter is mandatory.

– *OMA-LPPe-ver2-0-WLAN-Group-Data*

The IE *OMA-LPPe-ver2-0-WLAN-Group-Data* is used only in LPPe 2.0 and provides common data for a group of WLAN APs.

```
-- ASN1START

OMA-LPPe-ver2-0-WLAN-Group-Data ::= SEQUENCE {
    group-ID                OMA-LPPe-ver2-0-WLAN-GroupID,
    version                 INTEGER (0..255),
    validity-period         OMA-LPPe-ValidityPeriod             OPTIONAL,
    groupType               CHOICE {
                            referenceGrid           OMA-LPPe-ver2-0-ReferenceGrid,
                            location-area           OMA-LPPe-ver2-0-LocationAreaData,
                            wlan-properties         OMA-LPPe-ver2-0-Transmitter-Properties,
                            ...
                            },
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-WLAN-Group-Data
group-ID This parameter defines a unique ID for the group data,
version This parameter defines the version of group data. The provider of group data may increment the version (modulo 256) each time that group data (for a given group ID) is updated. The version is encoded as an integer in the range 0 to 255.
validity-period This parameter defines the validity period for group data and overrides any validity period provided for any broader set of WLAN data that includes the group data. This parameter is optional.
groupType This parameter indicates the type of group data and provides data specific to this type. The following mutually exclusive types are allowed: referenceGrid: group data comprises a common reference grid applicable to RF heat maps location-area group data comprises common location characteristics wlan-properties group data comprises common properties of WLAN APs A WLAN AP may belong to multiple groups. However, a server SHALL ensure that each WLAN AP belongs to at most one referenceGrid group and at most one wlan-properties group. For any WLAN AP, a target may ignore any group data that violates this restriction.

– *OMA-LPPe-ver2-0-WLAN-GroupID*

The IE *OMA-LPPe-ver2-0-WLAN-GroupID* is used only in LPPe 2.0 and identifies particular group data for a number of WLAN APs.

```
-- ASN1START

OMA-LPPe-ver2-0-WLAN-GroupID ::= SEQUENCE {
    vendorOrOperator        OMA-LPPe-VendorOrOperatorID,
    groupID                 INTEGER (0..65535),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-WLAN-GroupID
vendorOrOperator This parameter defines the vendor or operator who assigns the group data.
groupID This parameter defines a group ID assigned by the vendor or operator.

– *OMA-LPPe-ver2-0-LocationAreaData*

The IE *OMA-LPPe-ver2-0-LocationAreaData* is used only in LPPe 2.0 and provides common location characteristics for transmitters in the same local area and whose coverage areas may overlap with one another. A server should ensure that transmitters identified as being in the same location area group share a common altitude or common floor level.

A transmitter that is a WLAN AP may belong to more than one location area group – e.g. if location areas partially overlap. A target and server may each use location area groups to help determine when assistance data for additional WLAN APs needs to be sent to a target. For example, if a target reports visible APs belonging to certain location groups, a server may provide assistance data for these APs and other APs in the same location area groups. If a target detects APs that do not belong to any known location groups, the target may request assistance data for these APs and may expect to receive data for these APs and possibly for other APs in the same location groups as these APs.

```
-- ASN1START


OMA-LPPe-ver2-0-LocationAreaData ::= SEQUENCE {
    geographiclocationArea      CHOICE {
                                circle      Ellipsoid-PointWithUncertaintyCircle,
                                ellipse     EllipsoidPointWithUncertaintyEllipse,
                                ...
                                }                                   OPTIONAL,
    civicLocationArea           OMA-LPPe-CivicLocation              OPTIONAL,
    locationAreaType            OMA-LPPe-ver2-0-LocationAreaType            OPTIONAL,
    horizontalCoverage          INTEGER (1..100)        OPTIONAL,
    verticalCoverage            INTEGER (1..100)        OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-LocationAreaType ::= SEQUENCE {
    areaType                    ENUMERATED {undefined (0), walled-rooms (1), cubicle-office (2), high-
ceiling-large-area (3), parking-garage (4), outdoor (5), ...},
    exterior-Access             ENUMERATED {yes (1), no (2), ...}       OPTIONAL,
    altitude-change             ENUMERATED {yes (1), no (2), ...}       OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-LocationAreaData **field descriptions**
geographicLocationArea This parameter defines the location area geographically. The area may approximately coincide with certain well defined features (e.g., the exterior of a building, a terminal in an airport). The geographic area should encompass the locations of all transmitters that belong to the location area group and should minimize the number of transmitters whose locations are encompassed that do not belong to the group. This parameter contains the following choices: circle: the area is defined by the uncertainty area for an ellipsoid point with uncertainty circle; the altititude is assumed to be local ground level ellipse: the area is defined by the uncertainty area for an ellipsoid point with uncertainty ellipse; the altititude is assumed to be local ground level; the confidence value is ignored
civicLocationArea This parameter provide a civic address for the location area (e.g. the address or name of a building and a floor level). This parameter is optional.
locationAreaType This parameter provides characteristics of the location area of significance to RF propagation.
areaType This parameter defines the type of location area. The following choices are available. undefined: the type of location area is unknown or includes several different types walled-rooms: describes a building with separate walled rooms such as offices, hotel rooms, apartments cubicle-office: describes an office building with predominantly cubicle offices high-ceiling-large-area: describes an auditorium, shopping mall, airport or other large area with a high ceiling parking-garage: describes an indoor parking structure outdoor: describes an area where WLAN APs can typically be received outdoors as well as indoors – e.g. an open air shopping mall or suburban housing area
exterior-Access This parameter defines whether an indoor location area has exterior access – e.g. via a doorway, opening or bridge to another building. The choices are yes (exterior access exists) or no (exterior access does not exist).
altitude-change This parameter defines whether an indoor location area contains means (e.g. stairs, an elevator, an escalator or ramp) by which a user can exit the location area by changing altitude (e.g. floor level). The choices are yes (altitude change is possible) and no (altitude change is not possible).
horizontalCoverage This parameter provides the size of the location area as a percentage of the total contiguous horizontal area (e.g. a floor in a building) of which this location area is a part and for which the server has assistance data. A target may use this parameter to determine the likelihood of needing and being able to obtain additional assistance data for transmitters from the server when the user moves outside the location area. This parameter is provided as an integer in the range 1 to 100 where a value of n indicates coverage in the range n-1% to n%.
verticalCoverage This parameter provides the reciprocal, expressed as a percentage, of the total number of floors or levels in a building or structure (including sub levels) of which this location area is a part and for which the server has assistance data. A target may use this parameter to determine the likelihood of needing and being able to obtain additional assistance data for transmitters from the server when a user moves up or down to another floor or level. This parameter is provided as an integer in the range 1 to 100 where a value of n indicates coverage in the range n-1% to n%.

– *OMA-LPPe-ver2-0-Transmitter-Properties*

The IE *OMA-LPPe-ver2-0-Transmitter-Properties* is used only in LPPe 2.0 and provides common properties for a group of transmitters.

```
-- ASN1START

OMA-LPPe-ver2-0-Transmitter-Properties ::= SEQUENCE {
    ap-deviceType       OMA-LPPe-ver2-0-DeviceType          OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Transmitter-Properties
ap-deviceType This parameter defines one or more of the vendor and model for a transmitter and the vendor and model for each wireless baseband chip in the transmitter.

– *OMA-LPPe-ver2-0-DeviceType*

The IE *OMA-LPPe-ver2-0-DeviceType* is used only in LPPe 2.0 and provides information about a wireless device.

```
-- ASN1START

OMA-LPPe-ver2-0-DeviceType ::= SEQUENCE {
    vendor          OMA-LPPe-VendorOrOperatorID,
    model           OMA-LPPe-CharArray                          OPTIONAL,
    version         OMA-LPPe-CharArray                          OPTIONAL,
    chip            SEQUENCE (SIZE (1..5)) OF OMA-LPPe-Chip     OPTIONAL,
    ...
}

OMA-LPPe-Chip ::= SEQUENCE {
                    vendor      OMA-LPPe-VendorOrOperatorID,
                    model       OMA-LPPe-CharArray              OPTIONAL,
                    version     OMA-LPPe-CharArray              OPTIONAL,
                    ...
                    }

-- ASN1STOP
```

OMA-LPPe-ver2-0-DeviceType
vendor This parameter defines the vendor for a device.
model This parameter defines the device model or type.
version This parameter defines the version for a particular model or type.
chip This parameter defines the vendor and optionally the model or type and the version of the model or type for each wireless baseband chip in the device. More than one chip may be applicable for a device that supports more than one type of wireless interface.

– *OMA-LPPe-ValidityArea*

The IE *OMA-LPPe-ValidityArea* is used to define the area in which the given data (e.g. a local troposphere model or a local ionosphere model) are valid. The validity area is constructed with grid regions using Run-Length Encoding as specified in Appendix C.1. The parameters *areaWidth* and *rleList* are optional. If these parameters are left out, the validity area gets its simplest form: a rectangle in spherical coordinates.

```
-- ASN1START

OMA-LPPe-ValidityArea ::= SEQUENCE {
    regionSizeInv           INTEGER (1..255),
    areaWidth               INTEGER (2..9180)       OPTIONAL,
    codedLatOfNWCorner      INTEGER (0..4589),
    codedLonOfNWCorner      INTEGER (0..9179),
    rleList                 OMA-LPPe-RleList        OPTIONAL,
    ...
}

OMA-LPPe-RleList ::= SEQUENCE (SIZE(1..65535)) OF INTEGER (0..255)

-- ASN1STOP
```

***OMA-LPPe-ValidityArea* field descriptions**
regionSizeInv This field specifies the inverse of the size of each side of the region in degrees. For value N the size is 10/N degrees.
areaWidth This field specifies the number of regions in the area in East-West direction. If the field is not present, the value is 1.
codedLatOfNWCorner This field specifies the latitude of the North-West corner of the area, encoded as explained in Appendix C.1.
codedLonOfNWCorner This field specifies the longitude of the North-West corner of the area, encoded as explained in Appendix C.1.
rleList This field lists the regions in which the data is valid. If the field is not present, the data is valid in all the regions in the area. The field is not valid (not included or ignored), when the IE *OMA-LPPe-ValidityArea* is included in the IE *OMA-LPPe-AGNSS-IonoStormIndication*.

– *OMA-LPPe-ValidityPeriod*

The IE *OMA-LPPe-ValidityPeriod* is used to define the validity time of the given assistance data.

```
-- ASN1START

OMA-LPPe-ValidityPeriod ::= SEQUENCE {
    beginTime       GNSS-SystemTime,
    beginTimeAlt    INTEGER (0..2881)   OPTIONAL,
    duration        INTEGER (1..2881),
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ValidityPeriod* field descriptions**
beginTime This field specifies the start time of the validity period.
beginTimeAlt This field specifies the alternative start time. It may be used by target if it lacks information of the current GNSS-SystemTime. The start time is is relative the time the message was received. The scale factor is 15 min. Range from 0 minutes to 43215 min = 30 days.

OMA-LPPe-ValidityPeriod field descriptions
duration This field specifies the duration of the validity period after the beginTime. The scale factor is 15 min. Range from 15 minutes to 43215 min = 30 days.

– *OMA-LPPe-VendorOrOperatorAssistanceDataIdentifier*

The *OMA-LPPe-VendorOrOperatorAssistanceDataIdentifier* is used to identify vendor-/operator-specific assistance data.

```
-- ASN1START

OMA-LPPe-VendorOrOperatorAssistanceDataIdentifier ::= SEQUENCE {
    vendorOrOperatorID      OMA-LPPe-VendorOrOperatorID,
    assistanceDataID        OMA-LPPe-AssistanceContainerID,
    ...
}

-- ASN1STOP
```

OMA-LPPe-VendorOrOperatorAssistanceDataIdentifier field descriptions
vendorOrOperatorID This field specifies the identification of the vendor/operator of the proprietary data.
assistanceDataID This field identifies the proprietary data. Data IDs are managed by the vendor/operator.

– *OMA-LPPe-VendorOrOperatorID*

The *OMA-LPPe-VendorOrOperatorID* is used to identify the vendor/operator using the proprietary data content. Two methods are provided. The first is a method, in which the vendor/operator identifier is standardized. The alternative method is not to use the standardized vendor/operator identifier, but the generalized method based on the CRC sum of the vendor/operator name.

```
-- ASN1START

OMA-LPPe-VendorOrOperatorID ::= CHOICE {
    standard-VendorOrOperatorID         INTEGER(1..1024),
    nonStandard-VendorOrOperatorID      OMA-LPPe-NonStandard-VendorOrOperatorID,
    ...,
-- version 2.0 extension elements
    ver2-0-extended-VendorOrOperatorID      OMA-LPPe-extended-VendorOrOperatorID
}


OMA-LPPe-NonStandard-VendorOrOperatorID ::= SEQUENCE {
    encodedID                   INTEGER(0..65535),
    visibleIdentification       OMA-LPPe-CharArray  OPTIONAL,
    ...
}

OMA-LPPe-extended-VendorOrOperatorID ::= SEQUENCE {
    extended-standard-VendorOrOperatorID    INTEGER (1..4096),
    venueID                                 INTEGER (1..16384)              OPTIONAL,
    ...
}

-- ASN1STOP
```


OMA-LPPe-VendorOrOperatorID field descriptions
standard-VendorOrOperatorID This field identifies the vendor/operator of the proprietary data. The ID allocations are maintained by OMNA [OMNA] and the up-to-date allocations are available at http://www.openmobilealliance.org/Tech/OMNA/OMNA-vendor-operator-ID.aspx
nonStandard-VendorOrOperatorID This field provides one method of identifying the vendor/operator in the absence of the standard ID.
encodedID This field specifies the CRC-16 IBM encoded name of the vendor written in lower case. CRC-16 IBM is described in Appendix C.8.
visibleIdentification This field specifies the vendor/operator visible identification.
ver2-0-extended-VendorOrOperatorID This parameter applies only to LPPe 2.0 and identifies the vendor or operator using an extension of the standard-VendorOrOperatorID that may include the following fields: extended-standard-VendorOrOperatorID: this field identifies a vendor or operator using the standard ID allocations maintained by OMNA. The field allows for IDs in the range 1 to 4096. venueID; this field identifies an optional venue or site for a particular vendor or operator and allows a venue or operator to distinguish assistance data used at different venues and sites. This field is an integer in the range 1 to 16384 and may be encoded by each vendor and operator in a proprietary manner. This field is optional.

– *OMA-LPPe-WirelessAccessTypes*

The IE *OMA-LPPe-WirelessAccessTypes* provides a list of wireless access types.

```
-- ASN1START

OMA-LPPe-WirelessAccessTypes ::= BIT STRING {   gsm         (0),
                                                utra        (1),
                                                lte         (2),
                                                wimax       (3),
                                                wifi        (4),
                                                other       (5),
                                                nr          (6) } (SIZE(1..16))

-- ASN1STOP
```

OMA-LPPe-WirelessAccessTypes field descriptions
OMA-LPPe-WirelessAccessTypes This field provides a list of one or more wireless access types. A type is present if the associated bit is set to one and absent if set to zero.

– *OMA-LPPe-WLAN-AP-ID*

The IE *OMA-LPPe-WLAN-AP-ID* defines the identity of a WLAN access point.

```
-- ASN1START

OMA-LPPe-WLAN-AP-ID ::= SEQUENCE {
    apMacAddress            BIT STRING ( SIZE (48) ),
    ...
}
```

```
-- ASN1STOP
```

***OMA-LPPe-WLAN-AP-ID* field descriptions**
apMacAddress This field provides the 48-bit MAC address of the WLAN AP.

– *OMA-LPPe-WLAN-AP-Type*

The IE *OMA-LPPe-WLAN-AP-Type* defines the type of a particular WLAN access point.

```
-- ASN1START

OMA-LPPe-WLAN-AP-Type ::= ENUMERATED {
    ieee802-11a,
    ieee802-11b,
    ieee802-11g,
    ieee802-11n,
    ...,
    ieee802-11ac,
    ieee802-11ad
}

-- ASN1STOP
```

– *OMA-LPPe-WLAN-AP-Type-List*

The IE *OMA-LPPe-WLAN-AP-Type-List* provides a list of one or more WLAN AP types.

```
-- ASN1START

OMA-LPPe-WLAN-AP-Type-List ::= BIT STRING {
    ieee802-11a (0),
    ieee802-11b (1),
    ieee802-11g (2),
    ieee802-11n (3),
    ieee802-11ac (4),
    ieee802-11ad (5)} (SIZE (1..16))

-- ASN1STOP
```

***OMA-LPPe-WLAN-AP-Type-List* field descriptions**
OMA-LPPe-WLAN-AP-Type-List This field provides a list of one or more WLAN AP types. A type is present if the associated bit is set one and absent if set to zero.

– *OMA-LPPe -WLANFemtoCoverageArea*

The IE *OMA-LPPe-WLANFemtoCoverageArea* provides information on the coverage area of a WLAN AP or Femto. The coverage area may be the coverage area of radio signals from the WLAN AP or Femto or may be defined according to the expected distribution of users within the coverage area.

```
-- ASN1START

OMA-LPPe-WLANFemtoCoverageArea ::= SEQUENCE {
    truncation          INTEGER(-127..128)                                  OPTIONAL,
    areaType            ENUMERATED { gaussian, binaryDistribution, ...}     OPTIONAL,
```

```
    confidence          INTEGER (0..99),
    componentList       SEQUENCE (SIZE (1..16)) OF OMA-LPPe-WLANFemtoCoverageAreaElement,
    ...
}

OMA-LPPe-WLANFemtoCoverageAreaElement ::= SEQUENCE {
    refPointAndArea     SEQUENCE {
        referenceLocation   ENUMERATED  {antenna,
                                         referencePoint,
                                         ... },
        referencePoint      OMA-LPPe-ReferencePointUniqueID     OPTIONAL,
        locationAndArea     OMA-LPPe-RelativeLocation,
        ...
        },
    type                    ENUMERATED  {indoor (0),
                                         outdoor (1),
                                         mixed (2),
                                         ... }                  OPTIONAL,
    weight                  INTEGER (0..100)                    OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-WLANFemtoCoverageArea field descriptions
truncation This field specifies if the coverage area is truncated using a specified signal strength level (i.e. with any point within the area experiencing a signal level greater than or equal to the truncation level). This field SHALL be included if a truncation condition has been used. Scale factor 1 dBm.
areaType This field specifies, if the coverage area is described in terms of a bivariate (gaussian) distribution or as a hard boundary (binary) for which no particular distribution of signal strength can be assumed.The default value (if missing) is a uniform binary distribution.
confidence This field gives the confidence level as a percentage that a target device that can detect signals from the WLAN AP or Femto is within the defined coverage area. Confidence is encoded as a truncated percentage. An encoded value of 0 therefore represents a confidence C where 0% <=C <1% percent. An encoded value of 1 represents a confidence C where 1%<=C<2%, and so on. An encoded value of 99 represents a confidence C where 99%<=C<100%.
componentList This field specifies the coverage area components. Each coverage area component is a 2 dimensional area. Different coverage area components may have the same or different altitudes.
refPointAndArea This field provides the coverage area component description in terms of a relative location and area **referenceLocation** indicates if location is relative to the WLAN AP or Femto antenna or relative to a reference point **referencePoint** provides a reference point for location relative to a reference point; if absent, the reference point is the same one used to define the WLAN AP or Femto location **locationAndArea** provides the location of a center point for the area relative to the reference point. The area is defined by the horizontal uncertainty in *OMA-LPPe-RelativeLocation*; horizontal confidence, uncertainty of altitude and confidence of altitude SHALL NOT be included.
type This field specifies if the coverage area component is indoors, outdoors or mixed. This field SHALL be included if available.

OMA-LPPe-WLANFemtoCoverageArea field descriptions
weight This field specifies the weight of the coverage area component in percent and provides the probability that a target is within the area component given that it is within one of the area components. The sum of the weights over all the coverage area components for a given AP MUST be 100%. A weight of 0% signifies a probability of <1% and a weight of 99% signifies a probability of >99%. If weight is missing, an equal weight is assumed for all the components.

6.4.2 LPPe Common Positioning IEs

Common positioning information elements are IEs that are included in the corresponding message extensions.

– *OMA-LPPe-CommonIEsRequestCapabilities*

The *OMA-LPPe-CommonIEsRequestCapabilities* carries common IEs for a Request Capabilities message extension.

```
-- ASN1START

OMA-LPPe-CommonIEsRequestCapabilities ::= SEQUENCE {
    iP-Address-RequestCapabilities              OMA-LPPe-IP-Address-RequestCapabilities     OPTIONAL,
    assistanceContainerSupportReq               OMA-LPPe-AssistanceContainerSupportReq      OPTIONAL,
    locationInformationContainerSupportReq      OMA-LPPe-LocationInformationContainerSupportReq
                                                                                            OPTIONAL,
    relativeLocationChange-RequestCapabilities  OMA-LPPe-RelativeLocationChange-RequestCapabilities
                                                                                            OPTIONAL,
    highAccuracyFormatCapabilitiesReq           OMA-LPPe-HighAccuracyFormatCapabilitiesReq  OPTIONAL,
    segmentedAssistanceData-ReqCapabilities     OMA-LPPe-SegmentedAssistanceData-ReqCapabilities
                                                                                            OPTIONAL,
    referencePointCapabilitiesReq               OMA-LPPe-ReferencePointCapabilitiesReq      OPTIONAL,
    scheduledLocation-RequestCapabilities       OMA-LPPe-ScheduledLocation-RequestCapabilities
                                                                                            OPTIONAL,
    accessCapabilitiesReq                       OMA-LPPe-AccessCapabilitiesReq              OPTIONAL,
    segmentedLocationInformation-ReqCapabilities
                                                OMA-LPPe-SegmentedLocationInformation-ReqCapabilities
                                                                                            OPTIONAL,
    ...,
-- version 1.1 extension elements
    ver1-1-localCellInformation-ReqCapabilities     OMA-LPPe-ver1-1-localCellInformation-ReqCapabilities
    OPTIONAL,
    ver1-1-broadcast-ReqCapabilities                OMA-LPPe-ver1-1-broadcast-ReqCapabilities
    OPTIONAL,
-- version 2.0 extension elements
    ver2-0-deviceType-Request                       OMA-LPPe-ver2-0-deviceType-Request      OPTIONAL
}

OMA-LPPe-IP-Address-RequestCapabilities ::= SEQUENCE {
    ...
}

OMA-LPPe-AssistanceContainerSupportReq ::= SEQUENCE {
    vendorOrOperatorIDList                      OMA-LPPe-VendorOrOperatorIDList             OPTIONAL,
    ...
}

OMA-LPPe-LocationInformationContainerSupportReq ::= SEQUENCE {
    vendorOrOperatorIDList                      OMA-LPPe-VendorOrOperatorIDList             OPTIONAL,
    ...
}

OMA-LPPe-VendorOrOperatorIDList ::= SEQUENCE (SIZE(1..maxVendorOrOperatorIDList)) OF
                                                                            OMA-LPPe-VendorOrOperatorID

maxVendorOrOperatorIDList   INTEGER ::= 32

OMA-LPPe-RelativeLocationChange-RequestCapabilities ::= SEQUENCE {
    ...
}
```



```
OMA-LPPe-HighAccuracyFormatCapabilitiesReq ::= SEQUENCE {
    ...
}
OMA-LPPe-SegmentedAssistanceData-ReqCapabilities ::= SEQUENCE {
    ...
}

OMA-LPPe-ReferencePointCapabilitiesReq ::= SEQUENCE {
    referencePointProviderSupportListReq   SEQUENCE (SIZE (1..128)) OF
                                                OMA-LPPe-VendorOrOperatorID             OPTIONAL,
    ...
}

OMA-LPPe-ScheduledLocation-RequestCapabilities ::= SEQUENCE {
    ...
}

OMA-LPPe-AccessCapabilitiesReq ::= SEQUENCE {
    ...
}

OMA-LPPe-SegmentedLocationInformation-ReqCapabilities ::= SEQUENCE {
    ...
}

OMA-LPPe-ver1-1-localCellInformation-ReqCapabilities ::= SEQUENCE {
    ...
}

OMA-LPPe-ver1-1-broadcast-ReqCapabilities ::= SEQUENCE {
    broadcastSystems        SEQUENCE (SIZE (1..16)) OF OMA-LPPe-ver1-1-BroadcastSystemID
    OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-deviceType-Request ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

***OMA-LPPe-CommonIEsRequestCapabilities* field descriptions**
iP-Address-RequestCapabilities This parameter is included by the server to request the target capabilities to report its local IP address(es).
assistanceContainerSupportReq This field is used to request for the proprietary data capabilities. The following parameters may be optionally included with this request: vendorOrOperatorIDList This parameter provides a list of vendor or operators IDs. If present, the target SHALL only report its capabilities to support assistance containers associated with these vendors and operators. If absent, the target SHALL report its capabilities to support assistance containers for all vendors and operators.

OMA-LPPe-CommonIEsRequestCapabilities **field descriptions**
iP-Address-RequestCapabilities This parameter is included by the server to request the target capabilities to report its local IP address(es).
locationInformationContainerSupportReq This presence of this parameter indicates a request for the level of support by the target for the Location Information Container. The following parameters may be optionally included with this request: vendorOrOperatorIDList This parameter provides a list of vendor or operators IDs. If present, the target SHALL only report its capabilities to support location information containers associated with these vendors and operators. If absent, the target SHALL report its capabilities to support location information containers for all vendors and operators.
relativeLocationChange-RequestCapabilities This parameter is included by the server to request the target capabilities to report relative change of location.
highAccuracyFormatCapabilitiesReq This parameter is included by the server to request the target capabilities to report position in high accuracy or civic format.
segmentedAssistanceData-ReqCapabilities This parameter is included by the server to request the target capabilities to support segmented transfer of assistance data.
referencePointCapabilitiesReq This parameter is included by the server to request the reference point capabilities of the target.
scheduledLocation-RequestCapabilities This parameter is included by the server to request the target capabilities to support scheduled location**.**
accessCapabilitiesReq This parameter is included by the server to request the access type capabilities of the target.
segmentedLocationInformation-ReqCapabilities This parameter is included by the server to request the target capabilities to support segmented transfer of location information.
vendorOrOperatorIDList This parameter is used to request vendor-/operator-specific assistance data / location information capabilties.
referencePointProviderSupportListReq This field lists the reference point provider IDs for which the support indication is requested. If absent, a support indication is requested for all reference point provider IDs that are supported by the target.
ver1-1-localCellInformation-ReqCapabilities This parameter applies only to LPPe 1.1 and is included by the server to request the target capabilities to support assistance data containing information for local cells.
ver1-1-broadcast-ReqCapabilities This parameter applies only to LPPe 1.1 and is included by a server to request the target capabilities to support reception of assistance data via broadcast. A server may indicate that it wishes to receive capabilities for certain broadcast systems. In this case, a target SHALL return its capabilities only for the requested broadcast systems. If the server does not indicate particular broadcast systems, a target should report its capabilities for standard broadcast systems and may report its capabilities for proprietary broadcast systems.
ver2-0-deviceType-Request This parameter applies only to LPPe 2.0 and is included by a server to request information about the OEM and chip vendor for a target device.

– *OMA-LPPe-CommonIEsProvideCapabilities*

The *OMA-LPPe-CommonIEsProvideCapabilities* carries common IEs for a Provide Capabilities message extension.

```
-- ASN1START

OMA-LPPe-CommonIEsProvideCapabilities ::= SEQUENCE {
    iP-Address-Capabilities                OMA-LPPe-IP-Address-Capabilities                OPTIONAL,
    assistanceContainerSupport             OMA-LPPe-AssistanceContainerSupport             OPTIONAL,
    locationInformationContainerSupport    OMA-LPPe-LocationInformationContainerSupport    OPTIONAL,
```



```
    relativeLocationChange-Capabilities     OMA-LPPe-RelativeLocationChange-Capabilities    OPTIONAL,
    highAccuracyFormatCapabilities          OMA-LPPe-HighAccuracyFormatCapabilities         OPTIONAL,
    segmentedAssistanceData-ProvideCapabs   OMA-LPPe-SegmentedAssistanceData-ProvideCapabs  OPTIONAL,
    referencePointCapabilities              OMA-LPPe-ReferencePointCapabilities             OPTIONAL,
    scheduledLocation-Capabilities          OMA-LPPe-ScheduledLocation-Capabilities         OPTIONAL,
    accessCapabilities                      OMA-LPPe-AccessCapabilities                     OPTIONAL,
    segmentedLocationInformation-ProvideCapabs
                                            OMA-LPPe-SegmentedLocationInformation-ProvideCapabs
                                                                                            OPTIONAL,
    ...,
-- version 1.1 extension elements
    ver1-1-localCellInformation-ProvideCapabilities OMA-LPPe-ver1-1-localCellInformation-
ProvideCapabilities OPTIONAL,
    ver1-1-broadcast-ProvideCapabilities        OMA-LPPe-ver1-1-broadcast-ProvideCapabilities
    OPTIONAL,
-- version 2.0 extension elements
    ver2-0-deviceType                           OMA-LPPe-ver2-0-DeviceType              OPTIONAL
}

OMA-LPPe-IP-Address-Capabilities ::= SEQUENCE {
    iP-Address-support      BIT STRING {    iPv4        (0),
                                            iPv6        (1),
                                            nat         (2) } (SIZE(1..8))      OPTIONAL,
    ...
}


OMA-LPPe-AssistanceContainerSupport     ::=     SEQUENCE     (SIZE(1..maxVendorOrOperatorIDList))     OF
                                                    OMA-LPPe-VendorOrOperatorAssistanceContainerList


OMA-LPPe-VendorOrOperatorAssistanceContainerList ::= SEQUENCE {
    vendorOrOperatorID          OMA-LPPe-VendorOrOperatorID,
    assistanceContainerList     OMA-LPPe-AssistanceContainerList,
    ...
}

OMA-LPPe-AssistanceContainerList ::= SEQUENCE (SIZE(1.. maxAssistanceContainerList))OF
                                                                    OMA-LPPe-AssistanceContainerID

OMA-LPPe-LocationInformationContainerSupport   ::=   SEQUENCE   (SIZE(1..maxVendorOrOperatorIDList))   OF
                                            OMA-LPPe-VendorOrOperatorLocationInformationContainerList

OMA-LPPe-VendorOrOperatorLocationInformationContainerList ::= SEQUENCE {
    vendorOrOperatorID                  OMA-LPPe-VendorOrOperatorID,
    locationInformationContainerList    OMA-LPPe-LocationInformationContainerList,
    ...
}

OMA-LPPe-LocationInformationContainerList  ::=  SEQUENCE  (SIZE(1..maxLocationInformationContainerList))OF
                                                                OMA-LPPe-LocationInformationContainerID

maxLocationInformationContainerList INTEGER ::= 64
OMA-LPPe-RelativeLocationChange-Capabilities ::= SEQUENCE {
    numberOfChanges     INTEGER (1..5)          OPTIONAL,
    ...
}

OMA-LPPe-HighAccuracyFormatCapabilities ::= BIT STRING {    hAposition(0),
                                                            hAvelocity(1),
                                                            pidf-lo (2) } (SIZE(1..8))

OMA-LPPe-SegmentedAssistanceData-ProvideCapabs ::= SEQUENCE {
    maxSegments     INTEGER (2..4096)       OPTIONAL,
    maxSize         INTEGER (1..5000)       OPTIONAL,
    minSize         INTEGER (1..5000)       OPTIONAL,
    resume          NULL                    OPTIONAL,
    ...
}

OMA-LPPe-ReferencePointCapabilities ::= SEQUENCE {
    relativeLocationReportingSupport    BIT STRING {    geo             (0),
                                                        civic           (1),
```



```
                                                        otherProviders  (2)  } (SIZE (1..8)),
    referencePointProviderSupportList   SEQUENCE (SIZE (1..128)) OF
                                            OMA-LPPe-ReferencePointProviderSupportElement   OPTIONAL,
    ...
}

OMA-LPPe-ReferencePointProviderSupportElement ::= SEQUENCE {
    referencePointProvider          OMA-LPPe-VendorOrOperatorID,
    mapDataSupport                  SEQUENCE {
                                        mapDataFormat       OCTET STRING        OPTIONAL,
                                        ...
                                        }       OPTIONAL,
    ...
}

OMA-LPPe-ScheduledLocation-Capabilities ::= SEQUENCE {
    minimumWindow           INTEGER (1..1024)       OPTIONAL,
    gnssTimeReference       GNSS-ID-Bitmap          OPTIONAL,
    networkTimeReference    ENUMERATED {serving,
                                        servingOrNonServing,
                                        ... }       OPTIONAL,
    ...
}

OMA-LPPe-AccessCapabilities ::= SEQUENCE {
    accessTypeUnknown           NULL                            OPTIONAL,
    fixedAccessTypes            OMA-LPPe-FixedAccessTypes       OPTIONAL,
    wirelessAccessTypes         OMA-LPPe-WirelessAccessTypes    OPTIONAL,
    ...
}

OMA-LPPe-SegmentedLocationInformation-ProvideCapabs ::= SEQUENCE {
    maxSegments     INTEGER (2..4096)       OPTIONAL,
    maxSize         INTEGER (1..5000)       OPTIONAL,
    minSize         INTEGER (1..5000)       OPTIONAL,
    resume          NULL                    OPTIONAL,
    ...
}

OMA-LPPe-ver1-1-localCellInformation-ProvideCapabilities ::= SEQUENCE {
    localCellInformation-Support        BIT STRING {gnssTiming          (0),
                                                    networkTiming       (1),
                                                    coverage            (2),
                                                    coordinates         (3),
                                                    frequencyAccuracy   (4)} (SIZE (1..16)),
    ...
}


OMA-LPPe-ver1-1-broadcast-ProvideCapabilities ::= SEQUENCE (SIZE (1..16)) OF OMA-LPPe-ver1-1-
BroadcastSystem-Capabs

OMA-LPPe-ver1-1-BroadcastSystem-Capabs ::= SEQUENCE {
    broadcastSystemID       OMA-LPPe-ver1-1-BroadcastSystemID,
    broadcastADTypes        OMA-LPPe-ver1-1-BroadcastADTypes        OPTIONAL,
    point2pointAD           OMA-LPPe-ver1-1-point2pointAD           OPTIONAL,
    ciphering               OMA-LPPe-ver1-1-Ciphering               OPTIONAL,
    authentication          OMA-LPPe-ver1-1-Authentication          OPTIONAL,
    ...
}

OMA-LPPe-ver1-1-point2pointAD ::= SEQUENCE {
    ...
}

OMA-LPPe-ver1-1-Ciphering ::= SEQUENCE {
    ...
}

OMA-LPPe-ver1-1-Authentication ::= SEQUENCE {
    ...
```



```
}


-- ASN1STOP
```

OMA-LPPe-CommonIEsProvideCapabilities **field descriptions**
iP-Address-Capabilities This parameter is included to report the capabilities of a target to provide its local IP addresses. The parameter is not included if the target does not support IP address reporting. The parameter contains a bit string, with a one-value at any bit position meaning a particular capability is supported and a zero-value meaning not supported. The assigned bits and corresponding capabilities are as follows. iPv4: the target supports and can report IPv4 addresses iPv6: the target supports and can report IPv6 addresses nat: the target may be able to determine and then report whether an IP address is subject to NAT
assistanceContainerSupport This field lists the vendor-/operator-specific data IDs for the vendor-/operator-specific assistance data sets that the target supports.
locationInformationContainerSupport This field lists the vendor-/operator-specific data IDs for the vendor-/operator-specific location information types that the target supports.

OMA-LPPe-CommonIEsProvideCapabilities **field descriptions**
relativeLocationChange-Capabilities This parameter is included by the target to indicate its capabilities to report relative change of location.
highAccuracyFormatCapabilities This parameter is included by the target to provide the target capabilities to report position in high accuracy or civic format. The assigned bits and corresponding capabilities are: hAposition: the target supports and can report *OMA-LPPe-HighAccuracy3Dposition* hAvelocity: the target supports and can report *OMA-LPPe-HighAccuracy3Dvelocity* pidf-lo: the target supports and can report *OMA-LPPe-CivicLocation-pidf-lo* A bit is set to one to indicate support and is set to zero or omitted to indicate lack of support.
segmentedAssistanceData-ProvideCapabs This parameter is included by the target to indicate support of segmented transfer of assistance data. The target may optionally include the following fields: maxSegments maximum number of separate LPP messages into which assistance data should be segmented by the server maxSize maximum overall size of all assistance data that is transferred for segmented transfer that is supported by the target in multiples of 1024 octets after rounding up to a multiple of 1024. A value of 5000 for maxSize indicates that the maximum overall size is not limited. minSize minimum overall size of all assistance data for which segmented assistance data transfer should be used by the server in preference to sending all assistance data in a single LPP message resume included if the target can support segmented transfer with the resume capability
referencePointCapabilities This parameter is included if the target supports assistance data or location reporting relative to a reference point.
scheduledLocation-Capabilities This parameter is included by the target to indicate its capabilities to schedule location at a requested time. The following fields can be provided: minimumWindow minimum time window in units of 10 ms within which the target is capable of scheduling location measurements gnssTimeReference indicates the target can use GNSS time to schedule location measurements and provides the GNSS IDs that can be supported for this networkTimeReference indicates the target can use network time to schedule location measurements and indicates whether network time can be supported only relative to a serving cell or relative to a serving or non-serving cell
accessCapabilities This parameter provides the access capabilities of the target device. The following fields can be included: accessTypeUnknown this field SHALL be included if the target cannot determine the access types it supports – e.g. if the target is using a separate wireless or wireline modem of unknown type. fixedAccessTypes this field indicates the fixed access types supported by the target and SHALL be included if the target can support one or more fixed access types. wirelessAccessTypes this field indicates the wireless access types supported by the target and SHALL be included if the target can support one or more wireless access types. Note that the capabilities refer to access types that can be supported by the target device as opposed to access types that may currently be in use.

OMA-LPPe-CommonIEsProvideCapabilities field descriptions
segmentedLocationInformation-ProvideCapabs This parameter is included by the target to indicate support of segmented transfer of location information. The target may optionally include the following fields: maxSegments — maximum number of separate LPP messages into which location information can be segmented maxSize — maximum overall size of all location information that can be transferred using segmented transfer in multiples of 1024 octets after rounding up to a multiple of 1024. A value of 5000 for maxSize indicates that the maximum overall size is not limited. minSize — minimum overall size of all location information for which segmented transfer is preferred by the target in preference to sending all location information in a single LPP message resume — included if the target can support segmented transfer with the resume capability
assistanceContainerList This parameter provides a list of the assistance data containers that a target supports for a particular vendor or operator. Each location assistance data container is identified by an integer in the range 0 to 65535. The identification is vendor or operator specific and may refer to a particular type of assistance data, a particular version of assistance data or to a combination of these or to some other characteristics.
locationInformationContainerList This parameter provides a list of the location information containers that a target supports for a particular vendor or operator. Each location information container is identified by an integer in the range 0 to 65535. The identification is vendor or operator specific and may refer to a particular type of location information, a particular version of location information or to a combination of these or to some other characteristics.
numberOfChanges This field indicates the maximum number of relative changes of location that can be reported by the target. The default if absent is one.
relativeLocationReportingSupport This parameter indicates that the target supports location reporting relative to a reference point. The bit map indicates the reference point location type (geographic, or civic) supported for relative location reporting and whether the target is able to support location reporting relative to other reference point providers not listed in referencePointProviderSupportList. A one value at the bit position indicates support and a zero value no support. NOTE: location reporting relative to other providers includes the ability to report information associated with a reference point that is not dependent on proprietary assistance data from the provider of the reference point (e.g. includes an ability to use a reference point simply to report relative location).
referencePointProviderSupportList This parameter provides a list of reference point provider IDs that the target supports for location reporting and associated attributes that the target supports within reference point assistance data for these provider IDs. This parameter SHALL NOT be included if no reference point provider IDs are specifically supported.
mapDataSupport This field, if present, indicates whether the target supports map data information for this reference point provider and may include additional information specific to the provider in mapDataFormat about the supported map data format(s). If this field is absent, no map data information is supported for this reference point provider.

OMA-LPPe-CommonIEsProvideCapabilities **field descriptions**
ver1-1-localCellInformation-ProvideCapabilities This parameter applies only to LPPe 1.1 and provides the target capabilities to support assistance data containing information for local cells. This is signified using a bit string with the following bit assignments. A bit value of one indicates a capability is supported and a bit value of zero indicates it is not supported. gnssTiming — indicates whether the target supports receipt of cell GNSS timing information without network timing networkTiming — indicates whether the target supports receipt of cell GNSS timing information with network timing coverage — indicates whether the target supports receipt of cell coverage area coordinates — indicates whether the target supports receipt of cell coordinates frequencyAccuracy — indicates whether the target supports receipt of cell frequency accuracy
ver1-1-broadcast-ProvideCapabilities This parameter applies only to LPPe 1.1 and is included by a target to provide its capabilities to receive assistance data via broadcast.
broadcastSystemID This parameter applies only to LPPe 1.1 and specifies a particular broadcast system that is supported by a target.
broadcastADTypes This parameter applies only to LPPe 1.1 and specifies the types of assistance data a target can receive via broadcast using a particular broadcast system.
point2pointAD This parameter applies only to LPPe 1.1 and is included when a target can support receipt of assistance data sent point to point that provides information on a broadcast system used by the server.
ciphering This parameter applies only to LPPe 1.1 and SHALL be included when the target supports ciphering of LPP/LPPe broadcast messages. The absence of this parameter implies that a target does not support ciphering.
authentication This parameter applies only to LPPe 1.1 and SHALL be included when the target supports authentication of LPP/LPPe broadcast messages. The absence of this parameter implies that a target does not support authentication.
ver2-0-deviceType This parameter applies only to LPPe 2.0 and provides information about a target device OEM and chip vendor. The parameter SHALL be included if available when requested by a server and should be included if available when a target sends its capabilities unsolicited.

– *OMA-LPPe-CommonIEsRequestAssistanceData*

The *OMA-LPPe-CommonIEsRequestAssistanceData* carries common IEs for a Request Assistance Data message extension.

```
-- ASN1START

OMA-LPPe-CommonIEsRequestAssistanceData ::= SEQUENCE  {
    approximate-location            EllipsoidPointWithAltitudeAndUncertaintyEllipsoid   OPTIONAL,
    assistanceContainerRequestList  OMA-LPPe-AssistanceContainerRequestList             OPTIONAL,
    requestPeriodicADwithUpdate     OMA-LPPe-RequestPeriodicADwithUpdate                OPTIONAL,
```



```
                                                                    --Cond RequestPeriodicADWithUpdate
    segmentedADpreference           ENUMERATED {useBasic, useResume, ...}               OPTIONAL,
    segmentedADResume               OMA-LPPe-SegmentedADResume                          OPTIONAL,
                                                                    --Cond segmentedTransferResume
    referencePointAssistanceReq     OMA-LPPe-ReferencePointAssistanceReq                OPTIONAL,
    ...,
-- version 1.1 extension elements
    ver1-1-localCellInformationReq  OMA-LPPe-ver1-1-LocalCellInformationReq         OPTIONAL,
    ver1-1-BroadcastAssistanceDataReq       OMA-LPPe-ver1-1-BroadcastAssistanceDataReq      OPTIONAL,
    ver1-1-AccessNetwork                    OMA-LPPe-ver1-1-AccessNetworkID             OPTIONAL,
    ver1-1-groundMorphologyModelReq         OMA-LPPe-ver1-1-GroundMorphologyModelReq    OPTIONAL
}

OMA-LPPe-RequestPeriodicADwithUpdate ::= SEQUENCE {
    periodicAD-session-ID           OCTET STRING (SIZE(4)),
    typeOfADRequest     TypeOfADRequest,
    ...
}

TypeOfADRequest ::= ENUMERATED {
    initialRequest,
    updateAndContinueIfUpdateFails,
    updateAndAbortIfUpdateFails,
    ...
}

OMA-LPPe-SegmentedADResume ::= SEQUENCE {
    segmentedAD-session-ID              OMA-LPPe-Session-ID,
    next-segment-number     INTEGER (1..4096)
}

OMA-LPPe-ReferencePointAssistanceReq ::= SEQUENCE {
    referencePointReq           SEQUENCE (SIZE (1..16)) OF OMA-LPPe-ReferencePointAssistanceReqElement,
    ...
}

OMA-LPPe-ReferencePointAssistanceReqElement ::= SEQUENCE {
    referencePointProvider      OMA-LPPe-VendorOrOperatorID,
    mapDataReq                  OCTET STRING                        OPTIONAL,
    ...
}

OMA-LPPe-ver1-1-GroundMorphologyModelReq ::= SEQUENCE {
    modelsReq BIT STRING {altitude(0), buildings(1)}    (SIZE  (1..8)),
    refAreaParam            SEQUENCE {
        northWestCorner     Ellipsoid-Point OPTIONAL,
        spanX               INTEGER (6..14),
        spanY               INTEGER (6..14),
        ...
        }           OPTIONAL,
    ...
}


OMA-LPPe-ver1-1-LocalCellInformationReq ::= SEQUENCE {
    localCellInformationReq         BIT STRING {gnssTiming          (0),
                                                networkTiming       (1),
                                                coverage            (2),
                                                coordinates         (3),
                                                frequencyAccuracy   (4)} (SIZE (1..16)),
    localCellID                     OMA-LPPe-ver1-1-CellGlobalID        OPTIONAL,    --    Cond    ver1-1
cellVisible
    numberOfCells                   INTEGER (0..7)          OPTIONAL,
    ...
}

OMA-LPPe-ver1-1-BroadcastAssistanceDataReq ::= SEQUENCE {
    broadcastSystem     OMA-LPPe-ver1-1-BroadcastSystem     OPTIONAL,
    ...
```



```
}

OMA-LPPe-ver1-1-BroadcastSystem ::= SEQUENCE {
    broadcastSystemID       OMA-LPPe-ver1-1-BroadcastSystemID,
    cipherSets              SEQUENCE (SIZE (1..16)) OF OMA-LPPe-ver1-1-CipherSetID  OPTIONAL,
    authenticationSets      SEQUENCE (SIZE(1..4)) OF OMA-LPPe-ver1-1-AuthenticationSetID    OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
RequestPeriodicADWithUpdate	The parameter SHALL be present in a new request or modified request for Periodic/Triggered Assistance Data Transfer with Target Update. The field SHALL be omitted in other cases.
segmentedTransfeResume	This parameter SHALL be included when the target requests resumption of a segmented transfer of assistance data. No other assistance data SHALL then be requested.
ver1-1-cellVisible	This parameter SHALL be included when the target has a serving cell, or is able to receive and decode signals in a cell, that is either GSM, WCDMA or LTE.

***OMA-LPPe-CommonIEsRequestAssistanceData* field descriptions**
approximate-location This parameter provides an approximate location for the target device.
assistanceContainerRequestList This field is used by the target to request proprietary assistance data.

***OMA-LPPe-CommonIEsRequestAssistanceData* field descriptions**
requestPeriodicADwithUpdate This field is used to request periodic/triggered assistance data session (accompanied by the request for the actual data).
periodicAD-session-ID This field provides the periodic/triggered session ID assigned to the Periodic/Triggered Assistance Data Transfer with Update procedure.
segmentedADpreference This field SHALL be included if the target prefers the server to use segmented transfer of assistance data. Values can indicate "use the basic method" or "use the basic method with resume capability".
segmentedADResume The parameter is used to request resumption of an LPPe segmented transfer of assistance data following realease or failure and later restoration of the connection and any location session between the server and the target. The parameter includes the following fields: segmentedAD-session-ID — session ID assigned by the server for the segmented transfer next-segment-number — segment number of next expected LPP Provide Assistance Data
referencePointAssistanceReq This field is used by the target to specify the target preference for particular types of reference point in any subsequent assistance data sent by the server that includes one or more reference points.
typeOfADRequest This field indicates whether this is an initial request for a new procedure, an update request where the previously agreed assistance delivery will continue if the request cannot be supported or an update request where the previously agreed assistance data delivery will be aborted if the request cannot be supported.
referencePointReq This field provides a list of reference point types, in the order of preference. The first reference point type in the list is the most preferred type, etc.
referencePointProvider This field defines the preferred reference point provider.
mapDataReq This field, if present, indicates that map data is requested for any reference point assistance data provided later by the server to the target for the indicated provider. The content of the field is specific to the reference point provider and may indicate additional information on the map format or data requested.

OMA-LPPe-CommonIEsRequestAssistanceData **field descriptions**
ver1-1-localCellInformationReq This parameter applies only to LPPe 1.1 and is included by the target to request information for local cells. The requested types of information are indicated using a bit string with the following bit assignments. A bit value of one indicates the information type is requested and a bit value of zero indicates it is not requested. gnssTiming — indicates whether the target requests receipt of GNSS timing information without network timing networkTiming — indicates whether the target requests receipt of GNSS timing information with cell network timing. Note that when gnssTiming and networkTiming are both requested, a server SHALL provide network timing if available and supported. coverage — indicates whether the target requests receipt of cell coverage area coordinates — indicates whether the target requests receipt of cell coordinates frequencyAccuracy — indicates whether the target requests receipt of cell frequency accuracy Other fields that may be included in this parameter are: localCellID — this field provides the global cell ID for the serving cell or primary serving cell for the target if this is GSM, WCDMA or LTE. If the target is not served by a GSM, WCDMA or LTE network, the field provides the global cell ID of the GSM, WCDMA or LTE cell with the strongest signal that the target can receive and decode. This field SHALL be omitted when the target cannot receive and decode signals from a local GSM, WCDMA or LTE cell. numberOfCells — number of cells for which information is requested coded as an exponent N in the range 0 to 7, where the number of cells is 2**N. Information is always assumed to be requested for the cell identified by localCellID when included.
ver1-1-BroadcastAssistanceDataReq This parameter applies only to LPPe 1.1 and is included by the target to request assistance data associated with broadcast of (other) assistance data. The target may include information related to a particular broadcast system of interest in which case the server SHALL return information for this broadcast system if supported including an updated list of cipher sets for any target that supports ciphering and that the target is authorized to receive according to any subscription or service agreement. If the target does not specify a broadcast system, the server may return information for any supported broadcast system consistent with the target capabilities, location and serving network.
broadcastSystem This parameter applies only to LPPe 1.1 and identifies a particular broadcast system. A target SHALL include in this parameter the IDs for the most recent list of cipher sets and/or authentication sets previously received from the server for this broadcast system if any of the cipher sets and/or authentication sets, respectively, are currently being used (e.g. have not yet expired). A server may use the list to deduce service previously provided to the target without the need to keep records which may assist charging.
ver1-1-AccessNetwork This parameter applies only to LPPe 1.1. and provides the identity of the access network that the target is currently using or wishes to be associated with the assistance data being requested.

OMA-LPPe-CommonIEsRequestAssistanceData **field descriptions**
ver1-1-groundMorphologyModelReq This field is used to request ground morphology model assistance. Ground morphology information includes ground altitude and building heights information; this information can be used to increase accuracy of position estimation. The morphology information is provided for a 2D grid of points.
refAreaParam This structure is used by the target to define the rectangular area for which ground morphology assistance data is requested. This field may be omitted if the target has no information on its reference location.
northWestCorner This field specifies the North-West corner of the rectangular area for which the morphology information is requested. If the target does not know its reference location this parameter is not included.
spanX, spanY These fields specify the width of the rectangular area for which ground morphology assistance is requested : The rectangle is oriented according to W-E and N-S directions, *spanX* defines the width in W-E direction, *spanY* defines the width in N-S direction, The North West corner of the rectangle is centered in *northWestCorner* point. The width of the rectangle in both directions expressed in meters is given by the expression $\dim_x[m] = 2^{spanX}\ m$ $\dim_y[m] = 2^{spanY}\ m$ Admitted values of the grid width in both dimensions are comprised between 64 m and 16384 m.

– *OMA-LPPe-CommonIEsProvideAssistanceData*

The *OMA-LPPe-CommonIEsProvideAssistanceData* carries common IEs for a ProvideAssistance Data message extension.

```
-- ASN1START

OMA-LPPe-CommonIEsProvideAssistanceData ::= SEQUENCE  {
    assistanceContainerList             OMA-LPPe-AssistanceContainerProvideList     OPTIONAL,
    providePeriodicADwithUpdate         OMA-LPPe-ProvidePeriodicADwithUpdate        OPTIONAL,
                                                                --Cond ProvidePeriodicADWithUpdate,
    segmentedADTransfer                 OMA-LPPe-SegmentedADTransfer                OPTIONAL,
                                                                --Cond segmentedTransferWithResume
    default-reference-point             OMA-LPPe-ReferencePoint                     OPTIONAL,
    ...,
-- version 1.1 extension element
    ver1-1-localCellInformation         OMA-LPPe-ver1-1-LocalCellInformation        OPTIONAL,
    ver1-1-BroadcastAssistanceData      OMA-LPPe-ver1-1-BroadcastAssistanceData     OPTIONAL,
    ver1-1-groundMorphologyModel        OMA-LPPe-ver1-1-GroundMorphologyModel           OPTIONAL
}

OMA-LPPe-ProvidePeriodicADwithUpdate ::= SEQUENCE {
    periodicAD-session-ID           OCTET STRING (SIZE(4)),
    typeOfADProvide     OMA-LPPe-TypeOfADProvide,
    ...
}

OMA-LPPe-TypeOfADProvide ::= ENUMERATED {
    responseToInitialRequest,
    providePeriodicAD,
    responseToTargetUpdateRequest,
    serverUpdate,
    ...
}

OMA-LPPe-SegmentedADTransfer ::= SEQUENCE {
    segmentedAD-session-ID          OMA-LPPe-Session-ID,
    segment-number      INTEGER (1..4096),
    ...
```

```
}

OMA-LPPe-ver1-1-LocalCellInformation ::= SEQUENCE {
    ver1-1-timingInformation            SEQUENCE (SIZE (1..maxCellSets)) OF GNSS-ReferenceTime
    OPTIONAL,
    ver1-1-other-CellInformation        SEQUENCE (SIZE (1..maxCells)) OF OMA-LPPe-ver1-1-CellInformation
    OPTIONAL,
    ...
}

maxCellSets INTEGER ::= 8

maxCells INTEGER ::= 128

OMA-LPPe-ver1-1-CellInformation ::= SEQUENCE {
    cellID                  OMA-LPPe-ver1-1-CellGlobalID,
    coverage                CHOICE {
                            circle      Ellipsoid-PointWithUncertaintyCircle,
                            ellipse     EllipsoidPointWithUncertaintyEllipse,
                            arc         EllipsoidArc,
                            polygon     Polygon,
                            ...
                            }                       OPTIONAL,
    coordinates             EllipsoidPointWithAltitudeAndUncertaintyEllipsoid   OPTIONAL,
    frequencyAccuracy       INTEGER (1..6)          OPTIONAL,
    ...
}

OMA-LPPe-ver1-1-BroadcastAssistanceData ::= SEQUENCE {
    broadcastSystem         OMA-LPPe-ver1-1-BroadcastSystemID,
    accessNetworks          SEQUENCE (SIZE (1..16)) OF OMA-LPPe-ver1-1-AccessNetworkID,
    coverageArea            CHOICE {
                                    circle      Ellipsoid-PointWithUncertaintyCircle,
                                    ellipse     EllipsoidPointWithUncertaintyEllipse,
                                    polygon     Polygon,
                                    ...
                                    }       OPTIONAL,
    broadcastADTypes        OMA-LPPe-ver1-1-BroadcastADTypes        OPTIONAL,
    broadcastMode               CHOICE {
                                        unencapsulated      NULL,
                                        encapsulated        OMA-LPPe-ver1-1-EncapsulatedMode,
                                        ...
                                        },
    ...
}

OMA-LPPe-ver1-1-EncapsulatedMode ::= SEQUENCE {
    serverID                    OMA-LPPe-ver1-1-ServerID,
    cipherSets                  SEQUENCE (SIZE (1..16)) OF OMA-LPPe-ver1-1-CipherSet    OPTIONAL,
    authentication              SEQUENCE (SIZE (1..4)) OF OMA-LPPe-ver1-1-AuthenticationSet OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
ProvidePeriodicADWithUpdate	The parameter SHALL be present in a Provide Assistance Data for Periodic/Triggered Assistance Data Transfer with Update. The field SHALL be omitted in other cases.
segmentedTransferWithResume	This parameter SHALL be present in each LPP Provide Assistance Data message sent to a target when a segmented transfer of assistance data with resume capability is either started or resumed.

***OMA-LPPe-CommonIEsProvideAssistanceData* field descriptions**
assistanceContainerList This field is used to deliver the requested vendor-/operator-specific assistance data.

OMA-LPPe-CommonIEsProvideAssistanceData field descriptions
providePeriodicADwithUpdate This field is used in the periodic/triggered assistance data procedure to provide the session ID and the reason for providing the assistance data.
segmentedADTransfer This parameter provides the following fields to support segmented transfer of assistance data with a resume capability. segmentedAD-session-ID session ID assigned by the server which should be unique across all servers segment-number segment number starting from 1 and incremented by 1 in each successive LPP Provide Assistance Data message
default-reference-point This field includes a default reference point applicable to other assistance data for which a reference point is associated. Usage of the default reference point is specified in the description of other applicable assistance data. The default reference point can also be provided to support location reporting relative to a reference point.
periodicAD-session-ID This field provides the session ID assigned to the Periodic/Triggered Assistance Data Transfer with Update procedure.
typeOfADProvide This field indicates whether this is a response to an initial request for a new procedure, normal delivery of periodic/triggered assistance data, a response to an update request from the target or an unsolicited server update.
ver1-1-localCellInformation This field applies only to LPPe 1.1 and provides timing and other information for up to 128 GSM, WCDMA and/or LTE cells,
ver1-1-timingInformation This field applies only to LPPe 1.1 and provides either GNSS timing information alone or GNSS timing associated with network timing for up to 8 sets of cells. For each set of cells in the latter case, GNSS timing information is provided for up to 16 individual cells according to the data type GNSS-ReferenceTime defined for LPP [LPP].
ver1-1-other-cellInformation This field applies only to LPPe 1.1 and provides the following information for one cell: cellID Global Cell ID and cell type (GSM, WCDMA or LTE) coverage Engineered coverage area of the cell as given by the location uncertainty area for a particular geographic shape. Confidence if included for a geographic shape SHALL be ignored coordinates Location coordinates and accuracy for the cell tower antenna frequencyAccuracy Frequency accuracy for the cell encoded as follows: 1: <= 25 ppb 2: 50 ppb 3: 100 ppb 4: 250 ppb 5: 500 ppb 6: >=1000 ppb

OMA-LPPe-CommonIEsProvideAssistanceData **field descriptions**
OMA-LPPe-ver1-1-BroadcastAssistanceData This parameter applies only to LPPe 1.1 and provides information on assistance data available via broadcast for a particular broadcast system. The following information can be included. broadcastSystem — the broadcast system for which information is provided accessNetworks — the access network or networks supporting this broadcast system in the vicinity of the target coverageArea — a continuous broadcast coverage area that includes or is close to the location of the target broadcastADTypes — the types of assistance data being broadcast broadcastMode — identifies whether unencapsulated or encapsulated LPP and LPP/LPPe messages are broadcast
cipherSets This parameter applies only to LPPe 1.1 and to encapsulated mode and provides a list of 1 to 16 cipher sets each containing information relevant to ciphering for some or all assistance data being broadcast using a particular broadcast system. A target SHALL replace any previous cipher sets from a particular server with any new sets from the same server. A cipher set may refer to ongoing ciphering or to ciphering that is scheduled for a later time as well as to ciphering applicable to the target location or to other locations. A target that supports ciphering should request new assistance data from a server when it detects use of a cipher set by the server that it does not possess. To help avoid periods when a target does not have the right cipher set, a target may request new broadcast assistance data once it detects that a particular cipher set used previously has not been used for a period of one hour. A server should, if possible, use a cipher set over the entire area supported by the server for a period of at least 2 hours and should stagger the change to a new cipher set by introducing the new set over the entire area a piece at a time in order to avoid all targets in the area requesting new assistance data all at the same time. When this parameter is not included, a target may continue to use any cipher sets previously received from the server.
authentication This parameter applies only to LPPe 1.1 and is included when a server requires a target to authenticate every assistance data broadcast message received via the indicated broadcast system. Any broadcast assistance data message received via the indicated broadcast system that cannot be authenticated (e.g. that does include a digital signature) or that fails authentication or that is received after the end of its validity period SHALL be discarded by a target. This parameter provides protection to a target against broadcast messages that may be unauthorized or fraudulent. This parameter provides a list of 1 to 4 authentication sets each containing information relevant to authentication for some or all assistance data being broadcast using a particular broadcast system. A target SHALL replace any previous authentication sets from a particular server with any new sets from the same server. An authentication set may refer to ongoing authentication or to authentication that is scheduled for a later time as well as to authentication applicable to the target location or to other locations. A target that supports authentication should request new assistance data from a server for any broadcast system for which authentication has been mandated when it detects use of an authentication set by the server that it does not possess. To help avoid periods when a target does not have the right authentication set, a target may request new broadcast assistance data once it detects that a particular authentication set used previously has not been used for a period of one hour. A server should, if possible, use an authentication set over the entire area supported by the server for a period of at least 24 hours and should stagger the change to a new cipher set by introducing the new set over the entire area a piece at a time in order to avoid all targets in the area requesting new assistance data all at the same time. When this parameter is not included, a target may continue to use any authentication sets previously received from the server.

– *OMA-LPPe-CommonIEsRequestLocationInformation*

The *OMA-LPPe-CommonIEsRequestLocationInformation* carries common IEs for a Request Location Information message extension.

```
-- ASN1START

OMA-LPPe-CommonIEsRequestLocationInformation ::= SEQUENCE  {
    iP-Address-Request                 OMA-LPPe-IP-Address-Request                         OPTIONAL,
    locationInformationContainerRequest OMA-LPPe-LocationInformationContainerRequest        OPTIONAL,
    requestPeriodicLocInfoWithUpdate    OMA-LPPe-RequestPeriodicLocInfoWithUpdate           OPTIONAL,
                                                    --Cond RequestPeriodicLocInfoWithUpdate
    relativeLocationChange-Request      OMA-LPPe-RelativeLocationChange-Request             OPTIONAL,
    localPositionRequest                OMA-LPPe-LocalPositionRequest                       OPTIONAL,
    scheduledLocation-Request           OMA-LPPe-ScheduledLocation-Request                  OPTIONAL,
    accessTypeRequest                   OMA-LPPe-AccessTypeRequest                          OPTIONAL,
    segmentedLIpreference               ENUMERATED {useBasic, useResume, ...}               OPTIONAL,
    segmentedLIResume                   OMA-LPPe-SegmentedLIResume                          OPTIONAL,
                                                    --Cond segmentedTransferResume
    ...,
    civicLocation-Request               OMA-LPPe-CivicLocation-Request                      OPTIONAL
}

OMA-LPPe-IP-Address-Request ::= SEQUENCE {
    ...
}

OMA-LPPe-RequestPeriodicLocInfoWithUpdate ::= SEQUENCE {
    session-ID                  OCTET STRING (SIZE(4)),
    typeOfLocInfoRequest        OMA-LPPe-TypeOfLocInfoRequest,
    ...
}

OMA-LPPe-TypeOfLocInfoRequest ::= ENUMERATED {
    initialRequest,
    updateAndContinueIfUpdateFails,
    updateAndAbortIfUpdateFails,
    ...
}

OMA-LPPe-RelativeLocationChange-Request ::= SEQUENCE {
    numberOfChanges     INTEGER (1..5)          OPTIONAL,
    ...
}

OMA-LPPe-LocalPositionRequest ::= SEQUENCE {
    typeOfRequest                   ENUMERATED { localOptional, localMandatory, localOnly, ... },
    referencePointReq               SEQUENCE (SIZE (1..8)) OF
                                            OMA-LPPe-ReferencePointUniqueID         OPTIONAL,
    ...
}

OMA-LPPe-ScheduledLocation-Request ::= SEQUENCE {
    gnssTime            GNSS-SystemTime         OPTIONAL,       --Cond AtLeastOne
    networkTime         NetworkTime             OPTIONAL,       --Cond AtLeastOne
    relativeTime        INTEGER (1..1024)       OPTIONAL,       --Cond AtLeastOne
    windowSize          INTEGER (1..1024)       OPTIONAL,
    ...
}

OMA-LPPe-AccessTypeRequest ::= SEQUENCE {
    ...
}

OMA-LPPe-SegmentedLIResume ::= SEQUENCE {
    segmentedLI-session-ID      INTEGER (1..256),
    next-segment-number         INTEGER (1..4096)}

OMA-LPPe-CivicLocation-Request ::= SEQUENCE {
    format              ENUMERATED {pidf-lo, ... },
```



```
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
RequestPeriodicLocInfoWithUpdate	The parameter SHALL be present in a new request or modified request for Periodic/Triggered Location Information Transfer with Target Update. The field SHALL be omitted in other cases.
AtLeastOne	At least one of these parameters SHALL be present
segmentedTransferResume	This parameter SHALL be included when the server requests resumption of a segmented transfer of location information. No other location information SHALL then be requested.

***OMA-LPPe-CommonIEsRequestLocationInformation* field descriptions**
iP-Address-Request This parameter is included by the server to request the target to report its local IP addresses.
locationInformationContainerRequest This parameter specifies the list of location information containers for a specified vendor or operator that the target should provide.

OMA-LPPe-CommonIEsRequestLocationInformation **field descriptions**
requestPeriodicLocInfoWithUpdate This field is used to request periodic/triggered location information session (accompanied by the request for the actual location information).
relativeLocationChange-Request This parameter is included by the server to request the target to report its relative change of location.
localPositionRequest This field is included by the server to request or permit the target to report its location relative to a reference point. This request only applies when the target has information on one or more reference points and is reporting a location estimate and SHALL be ignored by the target when the target has no information on reference points or reports location measurements but not a location estimate.
scheduledLocation-Request This parameter is included by the server to request the target to perform all requested location measurements and obtain any other requested location information (except for information that can be computed from other information) within a scheduled time window (see note) defined by the following parameters: gnssTime absolute GNSS time of the start of the time window networkTime network time of the start of the time window relativeTime relative Time in seconds from current time to the start of the time window. Current time is defined as the time the message was received. windowSize width of the time window in units of 10 ms; absence of this parameter implies best effort to perform all measurements as close to the start time as possible This parameter should not be included by the server and SHALL if present be ignored by the target if other LPP or LPPe parameters are present that require repeated (e.g. periodic or triggered) location information reporting by the target or if qos is present containing responseTime in *CommonIEsRequestLocationInformation* in the LPP Request Location Information. When gnssTime and networkTime are both present, the target SHALL give precedence to gnssTime if the referenced GNSS time is known to within 1ms but SHALL other otherwise give precedence to networkTime. The target SHALL give lowest preference to relativeTime when another start time is present that can be used (e.g. gnssTime is present and the target knows the associated GNSS time). NOTE: it is required that measurement time be within the scheduled window. Measurement time refers to the time or times at which a measurement is valid – e.g. the time a measurement was completed or the time to which a measurement can reliably and accurately be adjusted.
accessTypeRequest This parameter is included by the server to request the access type or types currently in use by the target device.
segmentedLIpreference This field SHALL be included if the server prefers the target to use segmented transfer of location information. Values can indicate "use the basic method" or "use the basic method with resume capability".
segmentedLIResume The parameter is used to request resumption of an LPPe segmented transfer of location information following realease or failure and later restoration of the connection and any location session between the server and the target. The parameter includes the following fields: segmentedLI-session-ID session ID assigned by the target for the segmented transfer next-segment-number segment number of next expected LPP Provide Location Information
session-ID This field provides the periodic/triggered session ID assigned to the Periodic/Triggered Location information Transfer with Update procedure.
typeOfLocInfoRequest This field indicates whether this is an initial request for a new procedure, an update request where the previously agreed location information delivery will continue if the request cannot be supported or an update request where the prevuiously agreed location information delivery will be aborted if the request cannot be supported.
numberOfChanges This field indicates the number of relative changes of location to be reported by the target. The default if absent is one. The target SHALL report the indicated number of changes if available or, if not available, the number of changes that are available.

OMA-LPPe-CommonIEsRequestLocationInformation **field descriptions**
typeOfRequest This field indicates whether local position reporting is an optional addition to reporting of absolute location, a mandatory addition to reporting of absolute location, or a mandatory alternative to absolute location (which SHALL then not be reported).
referencePointReq This field, if included, specifies a list of desired reference points relative to which the subject location is requested in the order of preference. The first reference point in the list is the most preferred reference point, etc. Details of the reference points would have been provided to the target in previous assistance data. If no reference points are specified, the target may reports its location using any available reference point.
civicLocation-Request This field, if included, indicates a request for the civic location of the target. The format field indicates the requested format as follows: pidf-lo the requested format is OMA-LPPe-CivicLocation-pidf-lo

– *OMA-LPPe-CommonIEsProvideLocationInformation*

The *OMA-LPPe-CommonIEsProvideLocationInformation* carries common IEs for a Provide Location Information message extension.

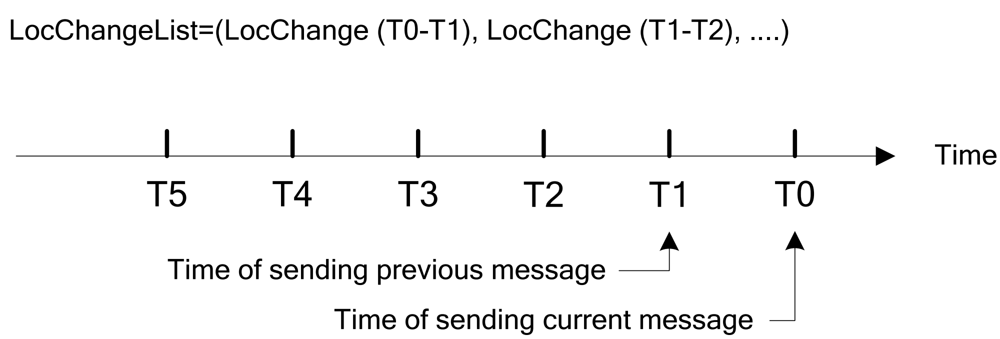
```
-- ASN1START

OMA-LPPe-CommonIEsProvideLocationInformation ::= SEQUENCE {
    highAccuracy3Dposition              OMA-LPPe-HighAccuracy3Dposition             OPTIONAL,
                                                                --Cond HighAccuracy
    localPosition                       OMA-LPPe-LocalPosition                      OPTIONAL,
    highAccuracy3Dvelocity              OMA-LPPe-HighAccuracy3Dvelocity             OPTIONAL,
                                                                --Cond HighAccuracy
    iP-Address-List                     OMA-LPPe-IP-Address-List                    OPTIONAL,
    locationInformationContainer        OMA-LPPe-LocationInformationContainer       OPTIONAL,
    providePeriodicLocInfoWithUpdate    OMA-LPPe-ProvidePeriodicLocInfowithUpdate   OPTIONAL,
                                                                 --Cond ProvidePeriodicLocInfoWithUpdate
    relativeLocationChangeList          OMA-LPPe-RelativeLocationChangeList         OPTIONAL,
    scheduledLocation                   OMA-LPPe-ScheduledLocation                  OPTIONAL,
                                                                --Cond ScheduledLocationRequested
    accessTypes                         OMA-LPPe-AccessTypes                        OPTIONAL,
    segmentedLITransfer                 OMA-LPPe-SegmentedLITransfer                OPTIONAL,
                                                                --Cond segmentedTransferWithResume
    locationInformationTimeStamp        OMA-LPPe-TimeStamp                          OPTIONAL,
    ...,
    locationSource                      OMA-LPPe-LocationSource OPTIONAL, --Cond LocationSource
    civicLocation-pidf-lo               OMA-LPPe-CivicLocation-pidf-lo              OPTIONAL
                                                                --Cond CivicLocationRequest-pidf-lo
}

OMA-LPPe-LocalPosition ::= SEQUENCE {
    referencePoint              OMA-LPPe-ReferencePointUniqueID,
    subjectLocation             OMA-LPPe-RelativeLocation                       OPTIONAL,
    ...
}

OMA-LPPe-IP-Address-List ::= SEQUENCE (SIZE (1..maxIPAddress)) OF OMA-LPPe-IP-Address

maxIPAddress INTEGER ::= 5

OMA-LPPe-IP-Address ::= SEQUENCE {
    local-IP-Address    CHOICE  {
        iPv4    BIT STRING (SIZE(32)),
        iPv6    BIT STRING (SIZE(128)),
        ...
        },
    bearer      OMA-LPPe-Bearer,
    nat         BOOLEAN             OPTIONAL,
    ...
```

```
}

OMA-LPPe-Bearer ::= ENUMERATED {
    unknown,
    gsm,
    utran,
    lte,
    wlan,
    wimax,
    dsl,
    pktcable,
    other,
    ....
    nr
}

OMA-LPPe-ProvidePeriodicLocInfowithUpdate ::= SEQUENCE {
    session-ID                  OCTET STRING (SIZE(4)),
    typeOfLocInfoProvide        OMA-LPPe-TypeOfLocInfoProvide,
    ...
}

OMA-LPPe-TypeOfLocInfoProvide ::= ENUMERATED {
    responseToInitialRequest,
    providePeriodicLocInfo,
    responseToServerUpdateRequest,
    targetUpdate,
    ...
}

OMA-LPPe-RelativeLocationChangeList ::= SEQUENCE (SIZE (1..maxRelativeLocation)) OF
                                                                   OMA-LPPe-RelativeLocationChange

OMA-LPPe-RelativeLocationChange ::= SEQUENCE {
    relativeTime                INTEGER (0..65535)      OPTIONAL,
    transactionID               INTEGER (0..255)        OPTIONAL,
    relativeLocation            OMA-LPPe-RelativeLocation,
    ...
}

maxRelativeLocation     INTEGER ::= 5

OMA-LPPe-ScheduledLocation ::= SEQUENCE {
    disposition     ENUMERATED {withinWindow,
                                outsideWindowOrNoWindow,
                                notSupportedDueToNoCapability,
                                notSupportedDueToNoTimeReference,
                                notSupportedDueToConflictWithAnotherRequest,
                                notSupportedForOtherReasons,
                                ... },
    actualWindow    SEQUENCE {
        start       INTEGER (-512..511),
        duration    INTEGER (0..2047)
    }                                       OPTIONAL,
    ...
}

OMA-LPPe-AccessTypes ::= SEQUENCE {
    accessTypeUnknown           NULL                            OPTIONAL,
    fixedAccessTypes            OMA-LPPe-FixedAccessTypes       OPTIONAL,
    wirelessAccessTypes         OMA-LPPe-WirelessAccessTypes    OPTIONAL,
    ...
}

OMA-LPPe-SegmentedLITransfer ::= SEQUENCE {
    segmentedLI-session-ID          INTEGER (1..256),
    segment-number      INTEGER (1..4096),
    ...
}

OMA-LPPe-TimeStamp ::= CHOICE {
    gnssTime            GNSS-SystemTime,
    networkTime         NetworkTime,
```

```
    relativeTime        INTEGER (0..1024),
    ...
}

OMA-LPPe-LocationSource ::= SEQUENCE {
    agnss               NULL    OPTIONAL,
    otdoa               NULL    OPTIONAL,
    eotd                NULL    OPTIONAL,
    otdoaUTRA           NULL    OPTIONAL,
    ecidLTE             NULL    OPTIONAL,
    ecidGSM             NULL    OPTIONAL,
    ecidUTRA            NULL    OPTIONAL,
    wlanAP              NULL    OPTIONAL,
    srn                 NULL    OPTIONAL,
    sensors             NULL    OPTIONAL,
    ...,
    nr-dl-tdoa          NULL    OPTIONAL,
    nr-dl-aod           NULL    OPTIONAL,
    ecidNR              NULL    OPTIONAL,
    bt                  NULL    OPTIONAL,
    mbs                 NULL    OPTIONAL,
    baro-sensor         NULL    OPTIONAL,
    motion-sensor       NULL    OPTIONAL
}

-- ASN1STOP
```

Conditional presence	Explanation
HighAccuracy	This field SHALL be present, when providing high accuracy position/velocity, i.e. when the *highAccuracyMethodRequested* is set true in *AGNSS-PositioningInstructions*.
ProvidePeriodicLocInfoWithUpdate	The parameter SHALL be present in a Provide Location Information for Periodic/Triggered Assistance Data Transfer with Target Update. The field SHALL be omitted in other cases.
ScheduledLocationRequested	The parameter SHALL be present in the first or only response to an LPP Request Location Information if *scheduledLocation-Request* was included by the server in *OMA-LPPe-CommonIEsRequestLocationInformation*.
segmentedTransferWithResume	This parameter SHALL be present in each LPP Provide Location Information message sent to a server when a segmented transfer of location information with resume capability is either started or resumed.
LocationSource	This parameter SHALL be present in each LPP Provide Location Information message sent to a server when a location estimate is sent in either low accuracy format in LPP (as part of LPP *CommonIEsProvideLocationInformation*) or in high accuracy format in LPPe (as part of LPPe *OMA-LPPe-CommonIEsProvideLocationInformation*).
CivicLocationRequest-pidf-lo	This parameter shall be present if available when the civic location of the target is requested by the server with the format pidf-lo. This parameter is optional in other cases.

OMA-LPPe-CommonIEsProvideLocationInformation **field descriptions**
highaccuracy3Dposition This field provides a high accuracy location estimate. This field SHALL be used to deliver the location estimate in case the server requested high accuracy GNSS method.
localPosition This field provides a subject location in a local coordinate system, whose origin is defined by a reference point. This field may only be included when a target provides a location estimate (e.g. SHALL NOT be provided when a target provides location measurements). The field may be provided in addition to or instead of an absolute location estimate as specified in an *OMA-LPPe-CommonIEsRequestLocationInformation* message in the case of a solicited response.
highaccuracy3Dvelocity This field provides a high accuracy velocity estimate. This field SHALL be used to deliver the velocity estimate in case the server requested high accuracy GNSS method.
iP-Address-List This parameter provides a list of one or more local IP addresses assigned to the target for a particular bearer.
locationInformationContainer This parameter carries vendor-/operator-specific location information.
providePeriodicLocInfoWithUpdate This field is used to provide periodic/triggered location information session (accompanied by the provide for the actual data).
relativeLocationChangeList This parameter provides a list of one or more consecutive relative changes in the location of the target device. The changes are relative to the times T0, T1, T2, T3 etc. when the target previously sent LPP Provide Location Information messages to the server. Here T0 represents the time of sending of the most recent LPP Provide Location Information message – i.e. the one carrying the relative changes in location; T1 represents the time of sending of the previous LPP Provide Location Information message – i.e. the one sent by the target immediately prior to T0; T2 represents the time of sending of the LPP Provide Location message sent by the target immediately prior to T1 etc. A segmented series of LPP Location Information messages sent by the target at almost the same time counts as one message and one time. The list of location changes sent by the target is ordered with the first change giving the target location at T0 relative to the reference location of the target at T1, the second change giving the target location at T1 relative to the reference location of the target at T2 etc. This information can be used by the server to obtain or improve the absolute location of the target – e.g. when the target is unable to provide other location information for some temporary duration.



OMA-LPPe-CommonIEsProvideLocationInformation field descriptions
scheduledLocation This parameter indicates the degree to which a scheduled location request was supported and contains the following fields. disposition indicates whether all returned location information was obtained within the requested time window or was obtained outside the window (including the case where no window was provided) or whether the request could not be supported due to no capability, no available time reference, conflict with another request or for some other reason. actualWindow indicates the precise window within which all measurements and location were actually obtained when a disposition value of "outsideWindowOrNoWindow" is provided. The window is defined by a start time relative to the requested start time in units of 10 ms and a duration rounded up to a multiple of 10 ms with zero indicating interpolation or extrapolation to the exact start time. This field SHALL be provided if applicable and available and if the actual window can be accurately encoded. The field SHALL be omitted if the window start time or duration falls outside the allowed range.
accessTypes This parameter provides the access type or types currently being used by the target device. The following fields can be included: accessTypeUnknown this field SHALL be included if the target cannot determine the access type in use – e.g. if the target is using a separate wireless or wireline modem of unknown type. fixedAccessTypes this field indicates the fixed access type or types currently in use by the target and SHALL be included if the target is using one or more fixed access types wirelessAccessTypes this field indicates the wireless access type or types currently in use by the target and SHALL be included if the target is using one or more wireless access types
segmentedLITransfer This parameter provides the following fields to support segmented transfer of location information with a resume capability. segmentedLI-session-ID session ID assigned by the target which should be unique within the target segment-number segment number starting from 1 and incremented by 1 in each successive LPP Provide Location Information message
referencePoint This field identifies the reference point for the subject location.
subjectLocation This field defines the subject location relative to the reference point. If this field is absent, the subject location coincides with the reference point location.
local-IP-Address This parameter provides a local IPv4 or IPv6 address assigned to the target.
bearer This parameter provides the bearer associated with a particular IP address.
nat This parameter indicates whether Network Address Translation (NAT) is used or may be used for a particular IP address (TRUE) or whether NAT is not used (FALSE). The default if not included is FALSE.
session-ID This field provides the periodic/triggered session ID assigned to the Periodic/Triggered Location Information Transfer with Update procedure.
typeOfLocInfoProvide This field indicates whether this is a response to an initial request for a new procedure, normal delivery of periodic/triggered location information, a response to an update request from the server or a unsolicited target update.
relativeTime This field indicates the timespan in units of 0.1 seconds over which a reported relative change in location is measured. When multiple relative changes in location are reported, the corresponding timespans SHALL be contiguous (i.e. each time span SHALL begin at the instant that the previous timespan ends).

OMA-LPPe-CommonIEsProvideLocationInformation field descriptions
transactionID This field provides the LPP transaction ID that was used for the first or only LPP Provide Location Information message that was sent by the target when it occupied the reference location for a reported relative change in location. The indicated LPP Provide Location Information may have provided the server with the absolute value of this reference location (either directly or via measurements). Providing the transaction ID may help the server identify the particular Provide Location Information message (and hence the reference location) if there may otherwise be ambiguity. This parameter is optional and SHALL be provided if available.
relativeLocation This parameter provides the relative change in location,
locationInformationTimestamp This parameter provides the time or, when a time period is applicable, the most recent time for which the provided measurements or location estimate are valid. The parameter allows the following alternatives listed in priority order (highest priority first) with the highest priority alternative that is available being provided: gnssTime absolute GNSS time networkTime network time for network known by the target to be associated with the server. In all other cases network time SHALL have lowest priority. relativeTime time interval in seconds between the measurement(s) and the transmission of this information by the target This parameter should not be included when all the included measurements and/or location estimate include their own timestamp(s). If the parameter is included and an included measurement or location estimate has its own timestamp, the latter SHALL have precedence. If the parameter is not included and an included measurement or location estimate does not have its own timestamp, the timestamp SHALL be assumed to be the time of location information transmission from the target.
locationSource This parameter indicates the positioning technologies involved in calculating a UE-based position estimate sent by the target to the server. The parameter is encoded as a bitmap and lists the following positioning technologies: agnss: Assisted-GNSS otdoa: OTDOA on LTE eotd: E-OTD (GSM) otdoaUTRA: OTDOA on UTRA ecidLTE: E-CID on LTE ecidGSM: E-CID on GSM ecidUTRA: E-CID on UTRA wlanAP: WLAN AP srn: SRN sensors: Sensors nr-dl-tdoa: DL-TDOA for NR nr-dl-aod: DL-AoD for NR ecidNR: E-CID on NR bt: BT mbs: MBS baro-sensor: Barometric sensor motion-sensor: Motion sensor If more than one positioning technology is indicated, the target calculated a final position result reported to the server by appropriately combining individual position results (hybrid positioning). NOTE: sensors can refer to barometric sensors and motion sensors for backward compatibility and should be included whenever baro-sensor, motion-sensor or both are included.
civicLocation-pidf-lo This parameter provides the civic location of the target with the format pidf-lo.

– *OMA-LPPe-CommonIEsAbort*

The *OMA-LPPe-CommonIEsAbort* carries common IEs for an Abort message extension.

```
-- ASN1START

OMA-LPPe-CommonIEsAbort ::= SEQUENCE {
    abortCause ENUMERATED   {periodicADsessionStop,
                        periodicADprocedureNotSupported,
                        periodicADprocedureNotAccepted,
                        periodicLocInfoSessionStop,
                        periodicLocInfoProcedureNotSupported,
                        periodicLocInfoProcedureNotAccepted,
                        ...
                        }                                       OPTIONAL,
    periodicSessionIDtoAbort    OCTET STRING (SIZE(4))          OPTIONAL,   --Cond periodicWithUpdate
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
periodicWithUpdate	The parameter SHALL be present when a procedure for either Periodic/Triggered Transfer of Assistance Data with Update or Periodic/Triggered Transfer of Location Information with Update is aborted.

– *OMA-LPPe-CommonIEsError*

The *OMA-LPPe-CommonIEsError* carries common IEs for an Error message extension.

```
-- ASN1START

OMA-LPPe-CommonIEsError ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5 Positioning method IEs

Positioning method information elements are IEs included in the positioning method specific IEs in the corresponding messages.

6.5.1 AGNSS Positioning

6.5.1.1 AGNSS Assistance Data

– *OMA-LPPe-AGNSS-ProvideAssistanceData*

The *OMA-LPPe-AGNSS-ProvideAssistanceData* is used to provide assistance for UE-based and UE-assisted AGNSS-based methods.

```
-- ASN1START

OMA-LPPe-AGNSS-ProvideAssistanceData ::= SEQUENCE {
    commonAssistData        OMA-LPPe-AGNSS-CommonAssistData         OPTIONAL,
    genericAssistData       OMA-LPPe-AGNSS-GenericAssistData        OPTIONAL,
```



```
    error                   OMA-LPPe-AGNSS-Error                    OPTIONAL,
    ...
}

-- ASN1STOP
```

– OMA-LPPe-AGNSS-CommonAssistData

The *OMA-LPPe-AGNSS-CommonAssistData* is used to provide GNSS-independent assistance for UE-based and UE-assisted AGNSS-based methods.

```
-- ASN1START

OMA-LPPe-AGNSS-CommonAssistData::= SEQUENCE {
    ionosphericModel            OMA-LPPe-AGNSS-IonosphericModel         OPTIONAL,
    troposphereModel            OMA-LPPe-AGNSS-TroposphereModel         OPTIONAL,
    altitudeAssistance          OMA-LPPe-AGNSS-AltitudeAssistanceList   OPTIONAL,
    solarRadiation              OMA-LPPe-AGNSS-SolarRadiation           OPTIONAL,
    ccpAssistCommonProvide      OMA-LPPe-AGNSS-CCPassistCommonProvide   OPTIONAL,
    ...
}

-- ASN1STOP
```

– OMA-LPPe-AGNSS-GenericAssistData

The *OMA-LPPe-AGNSS-GenericAssistanceData* is used to provide GNSS-dependent assistance for UE-based and UE-assisted AGNSS-based methods.

```
-- ASN1START

OMA-LPPe-AGNSS-GenericAssistData ::= SEQUENCE (SIZE (1..16)) OF OMA-LPPe-AGNSS-GenericAssistDataElement

OMA-LPPe-AGNSS-GenericAssistDataElement ::= SEQUENCE {
    gnss-ID                         GNSS-ID,
    wideAreaIonoSurfacePerSVlist    OMA-LPPe-AGNSS-WideAreaIonoSurfacePerSVlist OPTIONAL,
    mechanicsForAllSVs              OMA-LPPe-AGNSS-MechanicsForAllSVs           OPTIONAL,
    dcbsForAllSVs                   OMA-LPPe-AGNSS-DCBsForAllSVs                OPTIONAL,
    navModelDegradationModel        OMA-LPPe-AGNSS-NavModelDegradationModelList OPTIONAL,
    ccpAssistProvide                OMA-LPPe-AGNSS-CCPassistGenericProvide      OPTIONAL, --Cond CCP
    navModelList                    OMA-LPPe-AGNSS-NavModelList             OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
CCP	The field is mandatory present, when providing continuous carrier phase assistance and reference time is included in the IE *AGNSS-CCPassistCommonProvide*. Otherwise the field SHALL NOT be present.

OMA-LPPe-AGNSS-GenericAssistData field descriptions
gnss-ID This field specifies the GNSS ID of the satellite system for which data is being provided.

6.5.1.2 AGNSS Assistance Data Elements

– *OMA-LPPe-AGNSS-IonosphericModel*

The IE *OMA-LPPe-AGNSS-IonosphericModel* is used by the location server to provide local parameters to model the propagation delay of the GNSS signals through the ionosphere. Proper use of these fields allows a single-frequency GNSS receiver to remove parts of the ionospheric delay from the pseudorange measurements. The well-known Klobuchar ionospheric model is supported with the fields for the spatial and temporal validity. The parameters of the model can be localized where appropriate. The ionospheric storm indication reports the level of ionospheric activity in the region.

Periodic models, on the other hand, are based on the real-time GNSS observations and thus updated frequently to the target. The supported models include Wide Area Ionosphere Surface corrections that are provided to the target using the periodic AD procedure.

```
-- ASN1START

OMA-LPPe-AGNSS-IonosphericModel ::= CHOICE {
    staticModels     SEQUENCE {
                        localKlobucharModelList OMA-LPPe-AGNSS-LocalKlobucharModelList      OPTIONAL,
                        ionoStormIndication     OMA-LPPe-AGNSS-IonoStormIndication          OPTIONAL,
                        ...
                        },
    waIono           CHOICE {
                        controlParameters   OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersProvide,
                        commonProvide       OMA-LPPe-AGNSS-WideAreaIonoSurfaceCommon,
                        ...
                        },
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-IonosphericModel **field descriptions**
localKlobucharModelList This field carries parameters related to localized Klobuchar model.
ionoStormIndication This field carries information on the ionosphere conditions in the area.
waIono This field carries the periodic wide area ionosphere corrections. The field carries controlParameters: Control parameters of the periodic wide area ionosphere correction surface. This is a response to the IE *OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersRequest* or a server-side update to the control parameters. commonProvide: Common part of the WA Iono assistance data

– *OMA-LPPe-AGNSS-LocalKlobucharModelList*

The *OMA-LPPe-AGNSS-LocalKlobucharModelList* consists of multiple local Klobuchar models. The list can consist of up to 16 models. For instance, seven subsequent models, each with validity time of one hour, would result in totally seven hours of valid ionospheric model.

The local ionospheric model is given for the last known location of the target. It's possible that there are several valid models for the target location, or that the target location uncertainty area is so large that the area includes more than one model. In this case, the server can provide the target with multiple models, and the target makes the decision which model to use.

```
-- ASN1START

OMA-LPPe-AGNSS-LocalKlobucharModelList ::= SEQUENCE (SIZE(1..16)) OF
```



```
                                                        OMA-LPPe-AGNSS-LocalKlobucharModelElement

OMA-LPPe-AGNSS-LocalKlobucharModelElement ::= SEQUENCE {
    validityArea    OMA-LPPe-ValidityArea,
    klobucharModel  SEQUENCE (SIZE(1..8)) OF OMA-LPPe-AGNSS-LocalKlobucharModel,
    ...
}

OMA-LPPe-AGNSS-LocalKlobucharModel ::= SEQUENCE {
    validityPeriod  OMA-LPPe-ValidityPeriod,
    alfa0           INTEGER (-128..127),
    alfa1           INTEGER (-128..127),
    alfa2           INTEGER (-128..127),
    alfa3           INTEGER (-128..127),
    beta0           INTEGER (-128..127),
    beta1           INTEGER (-128..127),
    beta2           INTEGER (-128..127),
    beta3           INTEGER (-128..127),
    ...
}


-- ASN1STOP
```

***OMA-LPPe-AGNSS-LocalKlobucharModel* field descriptions**
validityArea This field specifies the validity area of the local Klobuchar model parameters. Representation of the validity area is described in Appendix C.1. The interpretation of the validity area is such that in case the target is within the validity area, the target may utilize the model.
validityPeriod This field specifies the start time and duration of the model validity period.
alpha0 This field specifies the α_0 parameter of the Klobuchar model. Scale factor 2^{-30} seconds.
alpha1 This field specifies the α_1 parameter of the Klobuchar model. Scale factor 2^{-27} seconds/semi-circle.
alpha2 This field specifies the α_2 parameter of the Klobuchar model. Scale factor 2^{-24} seconds/semi-circle^2.
alpha3 This field specifies the α_3 parameter of the Klobuchar model. Scale factor 2^{-24} seconds/semi-circle^3.
beta0 This field specifies the β_0 parameter of the Klobuchar model. Scale factor 2^{11} seconds.
beta1 This field specifies the β_1 parameter of the Klobuchar model. Scale factor 2^{14} seconds/semi-circle.
beta2 This field specifies the β_2 parameter of the Klobuchar model. Scale factor 2^{16} seconds/semi-circle^2.
beta3 This field specifies the β_3 parameter of the Klobuchar model. Scale factor 2^{16} seconds/semi-circle^3.

– *OMA-LPPe-AGNSS-IonoStormIndication*

The IE *OMA-LPPe-AGNSS-IonoStormIndication* provides the capability to carry ionospheric activity warnings to the target. In the IE *OMA-LPPe-AGNSS-IonoStormIndication* the area is given as a grid, coded in the same way as the IE *OMA-LPPe-ValidityArea*, but instead of valid/non-valid –indications for the regions, the level of ionospheric activity in the region is indicated. The usage and the NOAA scale are explained in Appendix C.2. The ionospheric storm indication should be given for a sufficiently large area around the target.

In case the server provides several models, each for a different time period, the validity area stays the same.

```
-- ASN1START

OMA-LPPe-AGNSS-IonoStormIndication ::= SEQUENCE {
    area        OMA-LPPe-ValidityArea,
                                --rleList SHALL NOT be included and is replaced by the stormList below
    stormList   OMA-LPPe-AGNSS-StormList,
    ...
}

OMA-LPPe-AGNSS-StormList ::= SEQUENCE (SIZE(1..16)) OF OMA-LPPe-AGNSS-StormElement

OMA-LPPe-AGNSS-StormElement ::= SEQUENCE {
    validityPeriod                  OMA-LPPe-ValidityPeriod,
    rleListIono                     OMA-LPPe-AGNSS-RleListIono,
    ...
}

OMA-LPPe-AGNSS-RleListIono ::= SEQUENCE (SIZE(1..65535)) OF OMA-LPPe-AGNSS-RleIonoElement

OMA-LPPe-AGNSS-RleIonoElement ::= SEQUENCE {
    regionCount     INTEGER (0..255),
    ionoIndex       CHOICE {
                            noaaScales      OMA-LPPe-AGNSS-NoaaScales,
                            ...
                            },
    ...
}

OMA-LPPe-AGNSS-NoaaScales ::=   ENUMERATED{ g1,g2, g3, g4, g5, unknown, none, ... }

-- ASN1STOP
```

***OMA-LPPe-AGNSS-IonoStormIndication* field descriptions**
area This field specifies the area for which ionosphere storm indications are given. See Appendix C.1. and C.2 for further information.
stormlist This field provides information on the ionospheric activity in the area defined by ***area***.
validityPeriod This field specifies the time interval over which the storm data is valid.
rleListIono This field specifies the ionospheric activity in the region.
ionoIndex This field specifies the level of ionospheric activity as explained in Appendix C.2.
regionCount This field indicates the number of subsequent regions with the same level of ionospheric activity. See Appendix C.2 for further information.

– *OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersProvide*

The IE *OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersProvide* carries the control parameters of the periodic Wide Area ionosphere surface corrections.

Wide Area Ionosphere correction surface is another approach for providing ionosphere correction data to the target. Here real time ionosphere corrections are estimated by, say, a wide area reference station network. Ionosphere delay is calculated for each satellite by all the stations and a second-order interpolation model is estimated. The model is exploited by the target to estimate the ionosphere delay at the target position. The wide area corrections approach reduces the ionosphere residual to the decimetre-level.

The wide area ionosphere corrections are provided using the periodic AD framework. The framework handles the periodic AD session control by the inclusion of periodic AD session ID in each LPPe provide/request AD message that carries periodic AD. The WA Iono level control, on the other hand, provides the request mechanism as well the provision of the duration of the session, rate of the deliveries, the model reference position and the validity area.

The model is provided to the vicinity of the target so that the model reference position is as close to the last known location of the target as possible. The target location MUST at least lie within the validity area of the model. In case the target is moving out of the validity area, the target may update its location to the server, in which case the server may update the WA iono model control parameters to the target using the update procedure.

```
-- ASN1START

OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersProvide ::= SEQUENCE {
    duration                OMA-LPPe-Duration       OPTIONAL,   --Cond FirstOrDurModify
    rate                    INTEGER(1..64)          OPTIONAL,   --Cond FirstOrRateModify
    referencePosition       Ellipsoid-Point         OPTIONAL,   --Cond FirstOrPosModify
    validityArea            OMA-LPPe-ValidityArea   OPTIONAL,   --Cond FirstOrAreaModify
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
FirstOrDurModify	This field is mandatory present, when providing a first message of a new WA Iono AD session or when providing the modification of the duration. Otherwise it is not present.
FirstOrRateModify	This field is mandatory present, when providing a first message of a new WA Iono AD session or when providing the modification of the rate. Otherwise it is not present.
FirstOrPosModify	This field is mandatory present, when providing a first message of a new WA Iono AD session or when providing the modification of the reference position. Otherwise it is not present.
FirstOrAreaModify	This field is mandatory present, when providing a first message of a new WA Iono AD session or when providing the modification of the validity area. Otherwise it is not present.

***OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersProvide* field desccription**
duration This field specifies the length of the continuous periodic assistance session.
rate This field specifies the interval between the assistance data deliveries in seconds.
referencePosition This field specifies the reference postion of ionospheric delay model according to WGS84 coordinates system
validityArea This field specifies the validity area of the ionospheric interpolation model estimated by a wide area reference network. The interpretation of the validity area is such that in case the target is within the validity area, the target may utilize the model.

– *OMA-LPPe-AGNSS-WideAreaIonoSurfaceCommon*

The IE *OMA-LPPe-AGNSS-WideAreaIonoSurfaceCommon* carries the common parameters of the periodic Wide Area ionosphere surface AD.


```
-- ASN1START

OMA-LPPe-AGNSS-WideAreaIonoSurfaceCommon ::= SEQUENCE {
    validityPeriod                  OMA-LPPe-ValidityPeriod,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-WideAreaIonoSurfaceCommon* field desccription**
validityPeriod This field defines the validity period of the widea area ionosphere correction.

– *OMA-LPPe-AGNSS-WideAreaIonoSurfacePerSVlist*

The *OMA-LPPe-AGNSS-WideAreaIonoSurfacePerSVlist* consist of second order correction surface coefficients for each visible SV. The use of the model is explained in Appendix C.3. For more information on the usage, refer to *OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersProvide*. Calculating the delay using the parameters and the formula presented in Appendix C.3, yields the slant delay directly, i.e. there is no need to apply further scaling factors.

Wide Area Ionosphere Correction Surface is provided for each visible SV in each GNSS constellation for which corrections are requested. Visible in this context means an SV that can be observed within the validity area of the correction surface.

This IE is always accompanied by the IE *OMA-LPPe-AGNSS-WideAreaIonoSurfaceCommon* in the common part of the AGNSS AD delivery.

```
-- ASN1START

OMA-LPPe-AGNSS-WideAreaIonoSurfacePerSVlist ::=
                            SEQUENCE (SIZE (1..64)) OF OMA-LPPe-AGNSS-WideAreaIonoSurfacePerSVelement

OMA-LPPe-AGNSS-WideAreaIonoSurfacePerSVelement ::= SEQUENCE {
    svID    SV-ID,
    a0      INTEGER (0..8191),
    e1      INTEGER (-4096..4095),
    n1      INTEGER (-4096..4095),
    e2      INTEGER (-4096..4095) OPTIONAL, --Cond SecondOrder
    n2      INTEGER (-4096..4095) OPTIONAL, --Cond SecondOrder
    en      INTEGER (-4096..4095) OPTIONAL, --Cond SecondOrder
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
SecondOrder	The field is mandatory present if the 2nd-order model is being provided, otherwise it is not present.

***OMA-LPPe-AGNSS-WideAreaIonoSurfacePerSVelement* field desccription**
svID This field specifies the SV for which correction is applicable.
a0 This parameter specifies the ionospheric delay for the SVat the reference position. Scale factor 0.1 TECU.

OMA-LPPe-AGNSS-WideAreaIonoSurfacePerSVelement **field desccription**
e1 This parameter describes the ionosphere first order dependency eastward from the origin. Scale factor 0.001 TECU/km.
n1 This parameter describes the ionosphere first order dependency northward from the origin. Scale factor 0.001 TECU/km.
e2 This parameter describes the ionosphere second order dependency eastward from the origin. Scale factor 10^{-5} TECU/km^2.
n2 This parameter describes the ionosphere second order dependency northward from the origin. Scale factor 10^{-5} TECU/km^2.
en This parameter describes the ionosphere second order dependency cross-term. Scale factor 10^{-5} TECU/km^2.

– *OMA-LPPe-AGNSS-TroposphereModel*

The IE *OMA-LPPe-AGNSS-TroposphereModel* is used by the location server to provide local parameters to model the propagation delay of the GNSS signals through the troposphere. Proper use of these fields allows a GNSS receiver to remove parts of the tropospheric delay from the pseudorange measurements.

There are two different parameter set options: One that provides the zenith troposphere delay components determined in a given location and the needed parameters to adjust the delay to the target's altitude. The other parameter set provides the surface pressure and optionally temperature that allow the target to compute the tropospheric delay using one of the known atmosphere models, such as the Hopfield or Saastamoinen model. Both parameter sets include the mapping function parameters that are used to map the zenith delay into the slant delay according to the satellite elevation angle.

Up to 64 parameter sets can be provided. For instance, if the target indicates that it supports multiple grid points, data can be provided for four different grid points around the target, and for four different time periods for each of the locations. If only one grid point is provided, it SHALL be the grid point that is closest to the last known position of the target. For the case of multiple grid points, the server chooses the points in the order of growing distance from the last known position.

```
-- ASN1START

OMA-LPPe-AGNSS-TroposphereModel ::= SEQUENCE {
    troposphereDelayList            OMA-LPPe-AGNSS-LocalTroposphereDelayList        OPTIONAL,
    surfaceParametersList           OMA-LPPe-AGNSS-LocalSurfaceParametersList       OPTIONAL,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-AGNSS-LocalTroposphereDelayList*

The IE *OMA-LPPe-AGNSS-LocalTropospherDelayList* is used to remove the troposphere delay from the pseudorange measurements. The main component of the local troposphere delay is the hydrostatic zenith delay. Optionally, also wet zenith delay and parameters to adjust these delay components to the user level can be given to provide a higher accuracy. Also gradients to North- and East- directions can be provided to compensate for azimuthal asymmetry of the tropospheric delay. The use of the parameters and of the mapping function are explained in Appendix C.4.

```
-- ASN1START

OMA-LPPe-AGNSS-LocalTroposphereDelayList ::= SEQUENCE (SIZE(1..8)) OF
                                                       OMA-LPPe-AGNSS-LocalTroposphereDelayAreaElement

OMA-LPPe-AGNSS-LocalTroposphereDelayAreaElement ::= SEQUENCE {
```



```
    validityArea                OMA-LPPe-ValidityArea,
    refAltitude                 INTEGER (-1000..8192)   OPTIONAL,
    gradientReferencePosition   Ellipsoid-Point         OPTIONAL,

    delayList                   SEQUENCE (SIZE(1..8)) OF

                                        OMA-LPPe-AGNSS-LocalTroposphereDelayTimeElement,
    ...
}


OMA-LPPe-AGNSS-LocalTroposphereDelayTimeElement ::= SEQUENCE {
    validityPeriod              OMA-LPPe-ValidityPeriod,
    zh0                         INTEGER (0..4095),
    eh                          INTEGER (0..4095)       OPTIONAL,
    zw0                         INTEGER (0..4095)       OPTIONAL,
    ew                          INTEGER (0..4095)       OPTIONAL,
    gN                          INTEGER (-8192..8191)   OPTIONAL,
    gE                          INTEGER (-8192..8191)   OPTIONAL,
    mappingFunctionParameters   OMA-LPPe-AGNSS-MappingFunctionParameters,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-LocalTroposphereDelayList* field descriptions**
validityArea This field specifies the geographical validity area of the local troposphere model parameters.
refAltitude This field specifies the reference altitude (from nominal sea level, [EGM96EGM96EGM96EGM96EGM96]) at which the delay measurements are made. The field is optional, and if it is not included, the reference altitude is the zero nominal sea level. The scale factor is 1m.
gradientReferencePosition This field specifies the origion for the spatial gradients *gN* and *gE*. If absent, the origin is taken as the middle point of the validity area.
delayList This field species the troposphere delays.
validityPeriod This field specifies the start time and duration of the local troposphere parameters validity period.
zh0 Parameter Z_{h0} is the hydrostatic zenith delay (meters), measured at the reference altitude level. The scale factor is 2^{-10} m.
eh Parameter e_h is the exponential fit parameter (1/m) for scaling Z_{h0} to the target altitude. The scale factor is 2^{-20} (1/m).
zw0 Parameter Z_{w0} is the wet zenith delay (meters), measured at the reference altitude level. The scale factor is 2^{-10} m.
ew Parameter e_w is the exponential fit parameter (1/m) for scaling Z_{w0} to the target altitude. The scale factor is 2^{-20} (1/m).
gN G_N is the gradient parameter (m) in North direction of the azimuthally asymmetric part of the tropospheric slant delay. The scale factor is 2^{-7} m.
gE G_E is the gradient parameter (m) in East direction of the azimuthally asymmetric part of the tropospheric slant delay. The scale factor is 2^{-7} m.
mappingFunctionParameters Coefficients of the mapping functions.

– *OMA-LPPe-AGNSS-LocalSurfaceParametersList*

The IE *OMA-LPPe-AGNSS-LocalSurfaceParametersList* is used for providing the target with the surface atmospheric pressure and optionally temperature at a location close to the target. These parameters are the input to a chosen troposphere delay model, such as the Hopfield or Saastamoinen model, to calculate the zenith tropospheric delay. The mapping function parameters are used as described in Appendix C.4.

```
-- ASN1START

OMA-LPPe-AGNSS-LocalSurfaceParametersList ::= SEQUENCE (SIZE(1..8)) OF
                                                        OMA-LPPe-AGNSS-LocalSurfaceParametersAreaElement

OMA-LPPe-AGNSS-LocalSurfaceParametersAreaElement ::= SEQUENCE {
    validityArea                OMA-LPPe-ValidityArea,
    refAltitude                 INTEGER (-1000..8192)   OPTIONAL,
    gradientReferencePosition   Ellipsoid-Point         OPTIONAL,
    parameterList               SEQUENCE (SIZE(1..8)) OF
                                        OMA-LPPe-AGNSS-LocalSurfaceParametersTimeElement,
    ...
}

OMA-LPPe-AGNSS-LocalSurfaceParametersTimeElement ::= SEQUENCE {
    validityPeriod              OMA-LPPe-ValidityPeriod,
    pressure                    INTEGER (-1024..1023),
    pressureRate                INTEGER (-128..127),
    gN-pressure                 INTEGER (-128..127)     OPTIONAL,
    gE-pressure                 INTEGER (-128..127)     OPTIONAL,
    temperature                 INTEGER (-64..63)       OPTIONAL,
    temperatureRate             INTEGER (-16..16)       OPTIONAL,
    gN-temperature              INTEGER (-8..7)         OPTIONAL,
    gE-temperature              INTEGER (-8..7)         OPTIONAL,
    mappingFunctionParameters   OMA-LPPe-AGNSS-MappingFunctionParameters,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-LocalSurfaceParametersList **field descriptions**
validityArea This field specifies the geographical validity area of the local troposphere model parameters.
refAltitude This field specifies the reference altitude (from nominal sea level, [EGM96]) at which the surface measurements are made. The field is optional, and if it is not included, the reference altitude is the zero nominal sea level [EGM96]. The scale factor is 1m.
gradientReferencePosition This field specifies the origion for the spatial gradients gN and gE. If absent, the origin is taken as the middle point of the validity area.
parameterList This field species the surface parameters.
validityPeriod This field specifies the start time and duration of the surface parameter validity period.
pressure Local atmospheric pressure measurement (hPa) at the altitude given by *refAltitude*. The scale factor is 0.1 hPa. The value is added to the nominal pressure of 1013hPa.
pressureRate Rate of change of pressure. When calculating the pressure, the origin of time is the begin time of the validity period. The scale factor is 10 Pa/hour,

OMA-LPPe-AGNSS-LocalSurfaceParametersList field descriptions
gN-pressure This field specifies the northward gradient of the atmospheric pressure. If this field is present, but gE is not given, the Eastward gradient is zero. Scale factor 10 Pa/km.
gE-pressure This field specifies the eastward gradient of the atmospheric pressure. If this field is present, but gN is not given, the Nothward gradient is zero. Scale factor 10 Pa/km.
temperature Local temperature measurement at the reference altitude *refAltitude*. The scale factor 1K. The value is added to 273K.
temperatureRate Local temperature change rate. The scale factor 1K/hour.
gN-temperature This field specifies the northward gradient of the temperature. If this field is present, but gE is not given, the Eastward gradient is zero. Scale factor 1 K/km.
gE-temperature This field specifies the eastward gradient of the temperature. If this field is present, but gN is not given, the Nothward gradient is zero. Scale factor 1 K/km.
mappingFunctionParameters Coefficients of the mapping functions.

– *OMA-LPPe-AGNSS-MappingFunctionParameters*

The IE *OMA-LPPe-AGNSS-MappingFunctionParameters* is used for scaling the tropospheric zenith delay to the slant delay given by the satellite elevation angle. The mapping function parameters are used as described in Appendix C.4.2.

```
-- ASN1START

OMA-LPPe-AGNSS-MappingFunctionParameters ::= SEQUENCE {
    ah                          INTEGER (0..16383),
    bh                          INTEGER (0..16383)      OPTIONAL,
    ch                          INTEGER (0..16383)      OPTIONAL,
    aw                          INTEGER (0..16383)      OPTIONAL,
    bw                          INTEGER (0..16383)      OPTIONAL,
    cw                          INTEGER (0..16383)      OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-MappingFunctionParameters field descriptions
ah a_h is the a-coefficient of the hydrostatic mapping function. Scale factor 2^{-14}.
bh b_h is the b-coefficient of the hydrostatic mapping function. Scale factor 2^{-14}.
ch c_h is the c-coefficient of the hydrostatic mapping function. Scale factor 2^{-14}.

OMA-LPPe-AGNSS-MappingFunctionParameters field descriptions
aw a_w is the a-coefficient of the wet mapping function. Scale factor 2^{-14}.
bw b_w is the b-coefficient of the wet mapping function. Scale factor 2^{-14}.
cw c_w is the c-coefficient of the wet mapping function. Scale factor 2^{-14}.

– *OMA-LPPe-AGNSS-AltitudeAssistanceList*

The IE *OMA-LPPe-AGNSS-AltitudeAssistanceList* is used for providing the target device with the surface atmospheric pressure and reference altitude measured in a location close to the target. A target device equipped with a barometer can use these values to deduce its own altitude. When multiple Area Elements are provided, they SHALL all have different validity areas (overlap of validity areas is allowed, though) or SHALL carry pressure assistance for different validity periods.

```
-- ASN1START

OMA-LPPe-AGNSS-AltitudeAssistanceList ::= SEQUENCE (SIZE(1..8)) OF
                                                        OMA-LPPe-AGNSS-AltitudeAssistanceAreaElement

OMA-LPPe-AGNSS-AltitudeAssistanceAreaElement ::= SEQUENCE {
    validityArea                OMA-LPPe-ValidityArea,
    gradientReferencePosition   EllipsoidPointWithAltitudeAndUncertaintyEllipsoid   OPTIONAL,
    refAltitude                 INTEGER (-1000..8192)                               OPTIONAL,
    pressureAssistanceList      SEQUENCE (SIZE(1..16)) OF OMA-LPPe-AGNSS-PressureAssistanceElement,
    ...
}

OMA-LPPe-AGNSS-PressureAssistanceElement ::= SEQUENCE{
    validityPeriod              OMA-LPPe-ValidityPeriod,
    pressure                    INTEGER (-1024..1023),
    pressureRate                INTEGER (-128..127)     OPTIONAL,
    gN                          INTEGER (-128..127)     OPTIONAL,
    gE                          INTEGER (-128..127)     OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-AltitudeAssistanceList field descriptions
validityArea This field specifies the geographical validity area of the altitude assistance.
gradientReferencePosition This field specifies the origin for the spatial gradients gN and gE. If absent, the origin is taken as the middle point of the validity area.
refAltitude This field specifies the reference altitude (from nominal sea level, [EGM96]) at which the surface measurements are made. The field is optional, and if it is left out, the reference altitude is the zero nominal sea level. The scale factor is 1m.
pressureAssistanceList This field specifies the set of pressure assistance elements for different periods of time.
validityPeriod This field specifies the start time and duration of the altitude assistance validity period.
pressure Local atmospheric pressure measurement (hPa) at the altitude given by ***refAltitude***. The scale factor is 10 Pa. The value is added to the nominal pressure of 1013hPa.

OMA-LPPe-AGNSS-AltitudeAssistanceList field descriptions
pressureRate Rate of change of pressure. When calculating the pressure, the origin of time is the begin time of the validity period. The scale factor is 10 Pa/hour,
gN This field specifies the northward gradient of the atmospheric pressure. Scale factor 10 Pa/km.
gE This field specifies the eastward gradient of the atmospheric pressure. Scale factor 10 Pa/km.

– *OMA-LPPe-AGNSS-SolarRadiation*

The IE *OMA-LPPe-AGNSS-SolarRadiation* is used to provide information on the solar radiation intensity.

```
-- ASN1START

OMA-LPPe-AGNSS-SolarRadiation ::= SEQUENCE {
    solarRadiation              INTEGER(1000..2000),
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-SolarRadiation field descriptions
solarRadiation This field specifies the solar radiation at one AU from the Sun. Scale factor 1 Wm^{-2}.

– *OMA-LPPe-AGNSS-MechanicsForAllSVs*

The *OMA-LPPe-AGNSS-MechanicsForAllSVs* information element lists the satellite antenna phase center offsets for each of the SVs in the GNSS defined by *GNSS-ID*. Information on the use of phase center offsets can be found in Appendix C.5. The SV mass and effective combined reflectivity-area may be used for the orbit prediction purposes. Further information can be found in Appendix C.7.

```
-- ASN1START

OMA-LPPe-AGNSS-MechanicsForAllSVs::= SEQUENCE (SIZE(1..64)) OF OMA-LPPe-AGNSS-MechanicsElement


OMA-LPPe-AGNSS-MechanicsElement ::= SEQUENCE {
    svid                        SV-ID,
    mass                        INTEGER(1..4095)            OPTIONAL,
    effectiveReflectivityArea   INTEGER(1..511)             OPTIONAL,
    pco                         OMA-LPPe-AGNSS-PCOelement   OPTIONAL,
    svInfo                      SEQUENCE {
                                    svType      OMA-LPPe-AGNSS-SVtype,
                                    svNumber    INTEGER(0..1000),
                                    ...
                                    } OPTIONAL,
    ...
}

OMA-LPPe-AGNSS-PCOelement ::= SEQUENCE{
    xOffsetSBF                  INTEGER(-30000..30000),
    yOffsetSBF                  INTEGER(-30000..30000),
    zOffsetSBF                  INTEGER(-30000..30000),
    ...
```

```
}

OMA-LPPe-AGNSS-SVtype ::= ENUMERATED {
                                    gpsIIR, gpsIIRM, gpsIIF, gpsIII,
                                    glonassM, glonassK1, glonassK2, glonassKM,
                                    unknown,
                                    ...}


-- ASN1STOP
```

***OMA-LPPe-AGNSS-MechanicsForAllSVs* field descriptions**
svid This field indicates the satellite id for which the information provided applies.
mass This field specifies the SV mass. Scale factor 1 kg. See Appendix C.7 for further information.
effectiveReflectivityArea This field specifies the effective combined SV solar panel reflectivity and area. Scale factor 0.1 m^2. See Appendix C.7 for further information.
pco This field specifies the SV phase center offset. See Appendix C.5 for further information.
svInfo This field carries information on the satellite.
svType This field carries information on the satellite type.
svNumber This field carries information on the SV number. The change in the number is interpreted as the change of satellite. For GPS SVs the number is the SVN (SV Number). For GLONASS SVs the number is the GLONASS Number.
xOffsetSBF This field specifies the x-coordinate offset from the SV center of mass to the SV antenna phace center in satellite body fixed coordinate frame. The coordinate frame is described in Appendix C.5. The scale factor is 0.0001 m.
yOffsetSBF This field specifies the y-coordinate offset from the SV center of mass to the SV antenna phace center in satellite body fixed coordinate frame. The coordinate frame is described in Appendix C.5. The scale factor is 0.0001 m.
zOffsetSBF This field specifies the z-coordinate offset from the SV center of mass to the SV antenna phace center in satellite body fixed coordinate frame. The coordinate frame is described in Appendix C.5. The scale factor is 0.0001 m.

– *OMA-LPPe-AGNSS-DCBsForAllSVs*

The *OMA-LPPe-AGNSS-DCBsForAllSVs* lists the differential code biases for each of the SVs in the GNSS. For each satellite, one of the signals is chosen as a reference, and the differential code biases are given with respect to this reference.

```
-- ASN1START

OMA-LPPe-AGNSS-DCBsForAllSVs ::= SEQUENCE (SIZE(1..64)) OF OMA-LPPe-AGNSS-DCBlistElement


OMA-LPPe-AGNSS-DCBlistElement ::= SEQUENCE {
    svid            SV-ID,
    reference       SEQUENCE{
                        signal  GNSS-SignalID,
                        pd      ENUMERATED { pilot, data, notapplicable, ... },
                        ...
                        },
    dcbList         OMA-LPPe-AGNSS-DCBlist,
```



```
    ...
}

OMA-LPPe-AGNSS-DCBlist ::= SEQUENCE (SIZE(1..16)) OF OMA-LPPe-AGNSS-DCBelement

OMA-LPPe-AGNSS-DCBelement ::= SEQUENCE {
    signal                  GNSS-SignalID,
    pd                      ENUMERATED{ pilot, data, notapplicable, ... },
    dcb                     INTEGER (-4096..4095),
    ...
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-DCBsForAllSVs* field descriptions**
svid This field indicates the satellite id for which the information provided applies.
reference The signal with respect to which the differential code biases of the other signals are given.
dcbList The list of differential code biases of the signals with respect to the reference signal.
signal This field indicates the signal id. The interpretation of the signal id depends on the GNSS as explained in 3GPP TS 36.355.
pd This field indicates whether the signal is pilot signal, data signal or if this indication is not applicable in this case.
dcb This field specifies the differential code bias of the signal with respect to the reference signal. The scale factor is 2^{-35} seconds.

– *OMA-LPPe-AGNSS-NavModelDegradationModelList*

The *OMA-LPPe-AGNSS-NavModelDegradationModelList* information element contains a list of elements that each have two degradation models: clock model degradation model and orbit model degradation model. Each of the elements is related to a specific SV. Navigation model degradation model is requested and provided only if the LPP message *GNSS-NavigationModel* is also requested. The degradation models are provided to the same set of satellites for which navigation models are provided in the LPP proper in the IE *GNSS-NavigationModel*. These degradation models are applicable to the navigation models delivered in the LPP simultaneously with the degradation models. The degradation models characterize the 1-sigma error.

```
-- ASN1START

OMA-LPPe-AGNSS-NavModelDegradationModelList ::= SEQUENCE (SIZE(1..64)) OF
                                                        OMA-LPPe-AGNSS-NavModelDegradationModelElement

OMA-LPPe-AGNSS-NavModelDegradationModelElement ::= SEQUENCE {
    svid                            SV-ID,
    clockDegradationModel           OMA-LPPe-AGNSS-ClockModelDegradationModel,
    orbitDegradationModel           OMA-LPPe-AGNSS-OrbitModelDegradationModel,
    ...
}

OMA-LPPe-AGNSS-ClockModelDegradationModel ::= SEQUENCE {
    clockRMS0                       INTEGER(0..31),
    clockRMS1                       INTEGER(0..7)               OPTIONAL,
    ...
}

OMA-LPPe-AGNSS-OrbitModelDegradationModel ::= SEQUENCE {
    orbitRMS0                       INTEGER(0..31),
    orbitRMS1                       INTEGER(0..7)               OPTIONAL,
    ...
```



```
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-NavModelDegradationModelList* field descriptions**
svid Specifies the SV for which degradation models are provided.
clockDegradationModel This field provides the degradation model for the clock model.
orbitDegradationModel This field provides the degradation model for the orbit model.
clockRMS0 This field specifies the constant term of the clock model degradation model by $cRMS_0=((1+0.1)^{clockRMS0}-1)$ meters, where ***clockRMS0*** = 31 denotes 'Use At Own Risk'. The range is [0, 16.45) meters. Exemplary values: <table><tr><td>clockRMS0</td><td>$cRMS_0$ (meters)</td></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>0.10</td></tr><tr><td>2</td><td>0.21</td></tr><tr><td>...</td><td>...</td></tr><tr><td>5</td><td>0.61</td></tr><tr><td>...</td><td>...</td></tr><tr><td>10</td><td>1.59</td></tr><tr><td>...</td><td>...</td></tr><tr><td>20</td><td>5.73</td></tr><tr><td>...</td><td>...</td></tr><tr><td>30</td><td>16.45</td></tr><tr><td>31</td><td>N/A</td></tr></table> The clock model polynomial is described in Appendix C.6.1. The clock model degradation polynomial is used as described in Appendix C.6.1.
clockRMS1 This field specifies the first order term of the clock model degradation model, $cRMS_1$. Scale factor 2^{-14} m/s. Range [0, 4.3e-4) m/s. The clock model degradation polynomial is used as described in Appendix C.6.1.
orbitRMS0 This field specifies the constant term of the orbit model degradation model by $oRMS_0=((1+0.1)^{orbitRMS0}-1)$ meters, where ***orbitRMS0*** = 31 denotes 'Use At Own Risk'. The range is [0, 16.45) meters. The orbit model degradation polynomial is used as described in Appendix C.6.2.
orbitRMS1 This field specifies the first order term of the orbit model degradation model, $oRMS_1$. Scale factor 2^{-14} m/s. Range [0, 4.3e-4) m/s. The orbit model degradation polynomial is used as described in Appendix C.6.2.

– *OMA-LPPe-AGNSS-CCPassistCommonProvide*

The *OMA-LPPe-AGNSS-CCPassistCommonProvide* is used to provide information that is common to the CCP assistance data for all the GNSSs. This includes alternatively the CCP AD reference time (provided always together with CCP Generic AD) or CCP Control Parameters.

The CCP support area may be provided to the target based on the request or based on the server decision unsolicitedly, in case the CCP is not supported in the target area. Similarly to the neighbour list, it may be provided upon request or unsolicitedly. Before requesting the neighbour list the target should update its location to the server using unsolicited LPP Provide Location Information -procedure.

The CCP Reference Station list carries information on all the reference stations for which CCP assistance is provided. The server SHALL provide an updated reference station list, whenever there is a change to the set of reference stations for which AD is being provided for.

```
-- ASN1START

OMA-LPPe-AGNSS-CCPassistCommonProvide ::= CHOICE {
    ccpProvideCommonParameters      OMA-LPPe-AGNSS-CCPprovideCommonParameters,
    ccpProvideControlParameters     OMA-LPPe-AGNSS-CCPprovideControlParameters,
    ...
}

OMA-LPPe-AGNSS-CCPprovideCommonParameters ::= SEQUENCE {
    ccpReferenceTime                GNSS-SystemTime,
    ...
}

OMA-LPPe-AGNSS-CCPprovideControlParameters ::= SEQUENCE {
    ccpSupportArea          OMA-LPPe-AGNSS-CCPsupportArea           OPTIONAL,
    ccpNeighborList         OMA-LPPe-AGNSS-CCPreferenceStationList  OPTIONAL,
    duration                OMA-LPPe-Duration                       OPTIONAL, --Cond FirstOrDurModify
    rate                    INTEGER(1..64)                          OPTIONAL, --Cond FirstOrRateModify
    ccpReferenceStationList OMA-LPPe-AGNSS-CCPreferenceStationList  OPTIONAL, --Cond FirstOrRefModify
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
FirstOrDurModify	This field is mandatory present, when initiating a new CCP AD session or when modifying the duration. Otherwise it is not present.
FirstOrRateModify	This field is mandatory present, when initiating a new CCP AD session or when modifying the rate. Otherwise it is not present.
FirstOrRefModify	This field is mandatory present, when initiating a new CCP AD session or when modifying the list of the active reference stations (new reference stations or after stopping CCP AD for a set of reference stations). This field is included always, when there are changes to the active set of reference stations for which CCP AD is provided. Otherwise it is not present.

OMA-LPPe-AGNSS-CCPassistCommonProvide **field descriptions**
ccpProvideCommonParameters This field defines the CCP-specific common parameters.
ccpProvideControlParameters This field defines the CCP-specific control parameters.
ccpReferenceTime This field defines the reference time for the CCP assistance data delivery. This field SHALL be accompanied by ccpAssistProvide in the generic part of the AGNSS AD for at least one GNSS.
ccpSupportArea This field provides information on the area, in which CCP is supported.
ccpNeighborList This field provides information on the possible neighbour reference stations.
duration This field specifies the length of the continuous periodic assistance session.
rate This field specifies the interval between the assistance data deliveries in seconds.
ccpReferenceStationList This field provides the locations of the reference stations for which CCP assistance is being provided. The set of reference stations SHALL be static during the CCP AD session unless the target explicitly requests for new reference stations or requests removing stations from the active set. The reference stations SHALL be static.

– *OMA-LPPe-AGNSS-CCPsupportArea*

The *OMA-LPPe-AGNSS-CCPsupportArea* is used to provide information on the area to which CCP assistance can be provided and for which GNSS signals in the area the assistance can be provided.

```
-- ASN1START

OMA-LPPe-AGNSS-CCPsupportArea ::= SEQUENCE {
    areaDescription     OMA-LPPe-ValidityArea,
    signalSupport       SEQUENCE (SIZE(1..8)) OF OMA-LPPe-AGNSS-CCPsignalSupport,
    ...
}

OMA-LPPe-AGNSS-CCPsignalSupport ::= SEQUENCE {
    gnss        GNSS-ID,
    signals     GNSS-SignalIDs,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-CCPsupportArea **field descriptions**
areaDescription This field provides the description of the area.
signalSupport This field provides the GNSS signal support information.
gnss This field specifies the GNSS.
signals This field specifies the GNSS signal types for which CCP assistance can be provided in the area. This is represented by a bit string in *GNSS-SignalIDs*, with a one-value at the bit position means CCP assistance for the particular GNSS signal type is supported; a zero-value means not supported.

– *OMA-LPPe-AGNSS-CCPreferenceStationList*

The *OMA-LPPe-AGNSS-CCPreferenceStationList* is used to provide the locations and ID numbers of the reference stations for which CCP assistance is provided or information on the nearby reference stations for the purposes of reference station change.

In order to receive a valid neighbour list the target should update its location to the server in case the target moves. The server SHALL generate the neighbour list based on the last known location of the target.

Note that the empty neighbour list does not imply the server being unable to change the reference station (there might not be neighbour list in case the server generates reference stations dynamically). Neither does the non-empty neighbour list imply the server being able to provide CCP AD for multiple reference station to the target simultaneously (required for the reference station change).

```
-- ASN1START

OMA-LPPe-AGNSS-CCPreferenceStationList ::= SEQUENCE (SIZE(0..maxReferenceStations)) OF
                                                            OMA-LPPe-AGNSS-CCPreferenceStationElement

OMA-LPPe-AGNSS-CCPreferenceStationElement ::= SEQUENCE {
    referenceStationID          OMA-LPPe-AGNSS-CCPreferenceStationID,
    referenceStationLocation    OMA-LPPe-HighAccuracy3Dposition,
    antennaDescription          OMA-LPPe-AGNSS-AntennaDescription       OPTIONAL, --Cond IfPhysical
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
IfPhysical	The field is mandatory present, if the reference station is a physical one. It is not present, if the reference station is a virtual one.

***OMA-LPPe-AGNSS-CCPreferenceStationList* field descriptions**
referenceStationID This field defines the ID of the reference station.
referenceStationLocation This field defines the location of the reference station, of which ID is *referenceStationID*.
antennaDescription This field specifies the antenna type used at the reference station.

– *OMA-LPPe-AGNSS-CCPassistGenericProvide*

The IE *OMA-LPPe-AGNSS-CPPassistGenericProvide* is used by the location server to provide continuous carrier phase reference measurement assistance to the target device for a specific GNSS. Reference assistance can be provided for multiple reference stations (for the purposes of multi-baseline solution or reference station change, see Appendix D.1.5) and for up to 8 signals per GNSS and for up to 64 SVs in each constellation. CCP Assistance is provided only for the visible satellites. The IE supports a straightforward mapping from RTCM 10403.1.

```
-- ASN1START

OMA-LPPe-AGNSS-CCPassistGenericProvide ::= SEQUENCE (SIZE(1..maxReferenceStations)) OF
                                                        OMA-LPPe-AGNSS-CCPassistGenericProvideElement

OMA-LPPe-AGNSS-CCPassistGenericProvideElement::= SEQUENCE {
    referenceStationID  OMA-LPPe-AGNSS-CCPreferenceStationID,
    ccpPerSignalList    SEQUENCE (SIZE(1..8)) OF OMA-LPPe-AGNSS-CCPperSignalElement,
    ...
```



```
}

OMA-LPPe-AGNSS-CCPperSignalElement ::= SEQUENCE {
    signal-ID       GNSS-SignalID,
    ccpPerSVlist    SEQUENCE (SIZE(1..64)) OF OMA-LPPe-AGNSS-CCPperSVelement,
    ...
}

OMA-LPPe-AGNSS-CCPperSVelement::= SEQUENCE {
    svID                SV-ID,
    integerCodePhase    INTEGER(0..255)                  OPTIONAL, --Cond IfAvailable
    codePhase           INTEGER(0.. 14989622),
    codePhaseError      OMA-LPPe-AGNSS-CodePhaseError    OPTIONAL, --Cond IfAvailable
    phaseRangeDelta     INTEGER(-524288.. 524287),
    phaseRangeRMSerror  INTEGER(0..127)                  OPTIONAL, --Cond IfAvailable
    lockIndicator       BOOLEAN,
    ...
}

OMA-LPPe-AGNSS-CodePhaseError ::= CHOICE {
    codePhaseRMSError   INTEGER(0..63),
    cnr                 INTEGER(0..255),
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
IfAvailable	The server SHALL make the best effort to include the information.

***OMA-LPPe-AGNSS-CCPassistGenericProvide* field descriptions**
referenceStationID This field defines the ID of the reference station to which the CCP assistance is provided. The ID SHALL match with one of the reference station IDs provided in cc*pReferenceStationList* in *OMA-LPPe-AGNSS-CCPassistCommonProvide*.
svID This field identifies the SV for which CCP assistance is being provided.
integerCodePhase This field indicates the integer milli-second part of the code phase.
codePhase This field contains the sub-millisecond part of the code phase observation for the particular satellite signal at the reference time (in *AGNSS-CCPassistCommonProvide*). Scale factor 0.02 meters. Range [0, 299792.44] meters, The target SHALL reconstruct the full pseudorange by Pseudorange = (Integer Code Phase) + (Code Phase) after the appropriate scaling. If (Integer Code Phase) is not available, the target SHALL reconstruct the integer code phase using the knowledge on the reference station location.
phaseRangeDelta This field defines the (Phase Range – Pseudorange). Scale factor 0.5 mm. Range [-262.144, 262.1435] meters.
phaseRangeRMSerror This field contains the RMS error of the continuous carrier phase. Scale factor 2^{-10} meters, in the range [0, 0.12403) meters.
lockIndicator This field is set to true if the carrier phase tracking has been continuous between the previous and the current assistance data delivery. If false, a cycle slip has occurred.
codePhaseRMSError This field contains the pseudorange RMS error value. This parameter is specified according to a floating-point representation defined in the corresponding table in 3GPP TS 36.355 in section "*GNSS-MeasurementList*".

OMA-LPPe-AGNSS-CCPassistGenericProvide field descriptions
cnr Carrier-to-noise ratio. Scale factor 0.25 dB-Hz. Range [0, 63.75] dB-Hz.

– *OMA-LPPe-AGNSS-NavModelList*

The IE *OMA-LPPe-AGNSS-NavModelList* provides navigation models for SVs.

```
-- ASN1START

OMA-LPPe-AGNSS-NavModelList ::= SEQUENCE {
    coordinateBased     OMA-LPPe-AGNSS-NavModel-CoordinateBased OPTIONAL, --Cond ModelId-1
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
ModelId-1	This field SHALL be included, if the target requests Navigation Model with ID=1 and the server can provide that. Otherwise it is not present.

– *OMA-LPPe-AGNSS-NavModel-CoordinateBased*

The *OMA-LPPe-AGNSS-NavModel-CoordinateBased* is used to provide the SV position, velocity and clock information at discrete points in time. The format supports a straightforward mapping from [RFC3986]. Up to 97 discrete PVT records may be provided – given 15-minute spacing between the records, 97 records are sufficient for providing information for 24 hours. The server SHALL provide velocity and clock rate records to the target, if the server has the records available. However, the availability cannot be guaranteed and, thus, the target MUST also be capable of autonomously deriving the velocity and clock rate information from the position and clock records.

```
-- ASN1START

OMA-LPPe-AGNSS-NavModel-CoordinateBased ::= SEQUENCE {
    fixedInterval   SEQUENCE {
                        beginTime   GNSS-SystemTime,
                        interval    INTEGER(1..30),
                        ...
                        } OPTIONAL, --Cond FixedInterval
    bases           SEQUENCE {
                        baseForPosVel   INTEGER(-100000000..100000000)      OPTIONAL,
                        baseForCcRate   OMA-LPPe-AGNSS-NavModel-BigNumber   OPTIONAL,
                        ...
                        }   OPTIONAL, --Cond DefaultsNotApplicable
    referencedTo    ENUMERATED { centerOfMass, antennaPhaseCenter, ... },
    pointList       SEQUENCE (SIZE (1..97)) OF OMA-LPPe-AGNSS-NavModel-CoordinateBasedElement,
    ...
}

OMA-LPPe-AGNSS-NavModel-CoordinateBasedElement::= SEQUENCE {
    time-of-record  GNSS-SystemTime     OPTIONAL, --Cond NoFixedInterval
    svIdList        SEQUENCE (SIZE (1..64)) OF OMA-LPPe-AGNSS-NavModel-PVTelement,
    ...
}

OMA-LPPe-AGNSS-NavModel-PVTelement ::= SEQUENCE {
    svID                SV-ID,
    svClockOffset       OMA-LPPe-AGNSS-NavModel-BigNumber,
    ecefPositionX       OMA-LPPe-AGNSS-NavModel-BigNumber,
    ecefPositionY       OMA-LPPe-AGNSS-NavModel-BigNumber,
    ecefPositionZ       OMA-LPPe-AGNSS-NavModel-BigNumber,
```



```
    clockPosSTD         OMA-LPPe-AGNSS-NavModel-STDmatrix,
    rateRecord          SEQUENCE {
                                svClockRate         OMA-LPPe-AGNSS-NavModel-BigNumber,
                                ecefVelocityX       OMA-LPPe-AGNSS-NavModel-BigNumber,
                                ecefVelocityY       OMA-LPPe-AGNSS-NavModel-BigNumber,
                                ecefVelocityZ       OMA-LPPe-AGNSS-NavModel-BigNumber,
                                clockRateVelSTD     OMA-LPPe-AGNSS-NavModel-STDmatrix,
                                ...
                                } OPTIONAL, --Cond RateAvailable
    ...
}

OMA-LPPe-AGNSS-NavModel-BigNumber::= SEQUENCE {
    msb     INTEGER(-1000000000..1000000000),
    lsb     INTEGER(1..100)                     OPTIONAL,
    ...
}

OMA-LPPe-AGNSS-NavModel-STDmatrix ::= SEQUENCE {
    e11     INTEGER(0..1000),
    e22     INTEGER(0..1000),
    e33     INTEGER(0..1000),
    e44     INTEGER(0..1000000),
    e12     INTEGER(0..10000000)    OPTIONAL, --Cond CrossTermAvailable
    e13     INTEGER(0..10000000)    OPTIONAL, --Cond CrossTermAvailable
    e14     INTEGER(0..10000000)    OPTIONAL, --Cond CrossTermAvailable
    e23     INTEGER(0..10000000)    OPTIONAL, --Cond CrossTermAvailable
    e24     INTEGER(0..10000000)    OPTIONAL, --Cond CrossTermAvailable
    e34     INTEGER(0..10000000)    OPTIONAL, --Cond CrossTermAvailable
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
FixedInterval	This field SHALL be included, when the records are distributed evenly in time. Otherwise it is not present.
NoFixedInterval	This field SHALL be included, when the records are not distributed evenly in time. Otherwise it is not present.
DefaultsNotApplicable	This field SHALL be included, in case the default scaling factors need to be overridden. Otherwise it is not present.
RateAvailable	This field SHALL be included, in case the server can provide velocity and clock rate records to the target. Otherwise it is not present.
CrossTermAvailable	This field SHALL be included, in case the server can provide the non-diagonal components. Otherwise it is not present.

***OMA-LPPe-AGNSS-NavigationModelCoordinateBased* field descriptions**

OMA-LPPe-AGNSS-NavigationModelCoordinateBased **field descriptions**
beginTime In case the position-velocity records have constant intervals, this field is used to provide the time of the first record.
interval In case the position-velocity records have constant intervals, this field is used to provide the interval between the records. Scale factor 1 minute. In case the records are given at fixed temporal intervals, the time of the record can be deduced by time-of-record = begin time + (index of the record in the point list sequence) * interval, where it has been assumed that the indexing begins from zero.
baseForPosVel The default scaling factors for position and velocity are 10^{-6} km (mm) and 10^{-6} dm/s, respectively. This field can be used to override the default scaling factors. In case the field is included, scaling the value with 10^{-7} results in the scaling factor for position records in millimetres. Likewise scaling the value with 10^{-7} results in the scaling factor for velocity records in the units of 10^{-6} dm/s. For instance, if the value in the ***baseForPosVel*** field is 1250000, scaling the value with 10^{-7} results in 1.25. Thus the scaling factor for position records will be 1.25 mm and 1.25 * 10^{-6} dm/s for the velocity records, respectively.
baseForCcRate The default scaling factors for clock and clock rate are 10^{-6} µs (ps) and 10^{-10} µs/s (10^{-4} ps/s), respectively. This field can be used to override the default scaling factors. In case the field is included, the new scaling factors for clock and clock rate are given by clock: (value_MSB *10^{-7} + value_LSB * 10^{-9}) 10^{-6} µs (ps) clock rate: (value_MSB *10^{-7} + value_LSB * 10^{-9}) 10^{-10} µs/s (10^{-4} ps/s) For instance, if the value in the ***baseForCcRate*** field is 1250000 (only MSB part used), scaling the value with 10^{-7} results in 1.25. Thus the scaling factor for the clock record will be 1.25 ps and 1.25 * 10^{-4} ps/s for the clock rate record,
referencedTo Indicated, if the navigation model is referenced to the SV center-of-mass or the antenna phase center.
time-of-record In case the records do not have constant intervals, this field is used to indicate the epoch time.
svID Identifies the satellite for which data is being provided.
svClockOffset This field specifies the SV clock offset. The default scaling factor for the MSB part is 10^{-4} µs and for the LSB part 10^{-6} µs. The total clock offset is given by value_MSB * 10^{-4} µs + value_LSB * 10^{-6} µs. The scaling factors are affected by ***baseForCcRate***.
ecefPositionX, ecefPositionY, ecefPositionZ This field specifies the satellite position in the WGS84 ECEF system. The default scaling factor for the MSB part is 10^{-4} km and for the LSB part 10^{-6} km. The position is given by value_MSB * 10^{-4} km + value_LSB * 10^{-6} km. The scaling factors are affected by ***baseForPosVel***.

OMA-LPPe-AGNSS-NavigationModelCoordinateBased **field descriptions**
clockPosSTD This field specifies the Clock-Position STD Matrix in the following manner: $$\begin{bmatrix} & \text{x pos} & \text{y pos} & \text{z pos} & \text{clock} \\ \text{x pos} & e_{11} & e_{12} & e_{13} & e_{14} \\ \text{y pos} & e_{12} & e_{22} & e_{23} & e_{24} \\ \text{z pos} & e_{13} & e_{23} & e_{33} & e_{34} \\ \text{clock} & e_{14} & e_{24} & e_{34} & e_{44} \end{bmatrix}$$ Scaling factor for positioning components is mm and for clock component ps. The scaling factor for the cross-components is mm*ps, respectively. Scaling factors are not affected by ***baseForPosVel*** and ***baseForCcRate***.
svClockRate This field specifies the rate of the SV clock offset. The default scaling factor for the MSB part is 10^{-8} μs/s and for the LSB part 10^{-10} μs/s. The total clock offset is given by $$\text{value\_MSB} * 10^{-8}\ \mu s/s + \text{value\_LSB} * 10^{-10}\ \mu s/s.$$ The scaling factors are affected by ***baseForCcRate***.
ecefVelocityX, ecefVelocityY, ecefVelocityZ This field specifies the satellite position in the WGS84 ECEF system. The default scaling factor for the MSB part is 10^{-4} dm/s and for the LSB part 10^{-6} dm/s. The velocity is given by $$\text{value\_MSB} * 10^{-4}\ \text{dm/s} + \text{value\_LSB} * 10^{-6}\ \text{dm/s}.$$ The scaling factors are affected by ***baseForPosVel***.
clockRateVelSTD This field specifies the Clock Rate - Velocity STD Matrix in the following manner: $$\begin{bmatrix} & \text{x vel} & \text{y vel} & \text{z vel} & \text{clock rate} \\ \text{x vel} & e_{11} & e_{12} & e_{13} & e_{14} \\ \text{y vel} & e_{12} & e_{22} & e_{23} & e_{24} \\ \text{z vel} & e_{13} & e_{23} & e_{33} & e_{34} \\ \text{clock rate} & e_{14} & e_{24} & e_{34} & e_{44} \end{bmatrix}$$ Scaling factor for velocity components is 10^{-4} mm/s and for clock component 10^{-4} ps/s. The scaling factor for the cross-components is 10^{-4} mm/s *10^{-4} ps/s, respectively. Scaling factors are not affected by ***baseForPosVel*** and ***baseForCcRate***.

6.5.1.3 AGNSS Assistance Data Request

– *OMA-LPPe-AGNSS-RequestAssistanceData*

The *OMA-LPPe-AGNSS-RequestAssistanceData* is used to request assistance for UE-based and UE-assisted AGNSS-based methods.

```
-- ASN1START

OMA-LPPe-AGNSS-RequestAssistanceData ::= SEQUENCE {
    commonAssistDataReq     OMA-LPPe-AGNSS-CommonAssistanceDataReq      OPTIONAL,
    genericAssistDataReq    OMA-LPPe-AGNSS-GenericAssistanceDataReq     OPTIONAL,
```



```
    ...
}

-- ASN1STOP
```

– OMA-LPPe-AGNSS-CommonAssistanceDataReq

The *OMA-LPPe-AGNSS-CommonAssistanceDataReq* is used to request GNSS-independent assistance for UE-based and UE-assisted AGNSS-based methods.

```
-- ASN1START

OMA-LPPe-AGNSS-CommonAssistanceDataReq ::= SEQUENCE {
    ionosphericModelReq             OMA-LPPe-AGNSS-IonosphericModelReq           OPTIONAL,
    troposphereModelReq             OMA-LPPe-AGNSS-TroposphereModelReq           OPTIONAL,
    altitudeAssistanceReq           OMA-LPPe-AGNSS-AltitudeAssistanceReq         OPTIONAL,
    solarRadiationRequest           OMA-LPPe-AGNSS-SolarRadiationReq             OPTIONAL,
    ccpRequestControlParameters     OMA-LPPe-AGNSS-CCPrequestControlParameters   OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-CommonAssistanceDataReq **field descriptions**
ionosphereModelReq This field is used to request for ionosphere models.
troposphereModelReq This field is used to request troposphere models.
altitudeAssistanceReq This field is used to request altitude assistance for improved availability.
solarRadiationReq This field is used to request for solar radiation intensity.
ccpRequestControlParameters This field is used to request for the control parameters of the CCP AD session. The field SHALL be accompanied by the field ccpAssistGenericReq in the generic part of the AGNSS request.

– OMA-LPPe-AGNSS-GenericAssistanceDataReq

The *OMA-LPPe-AGNSS-GenericAssistanceDataReq* is used to request GNSS-dependent assistance for UE-based and UE-assisted AGNSS-based methods.

```
-- ASN1START

OMA-LPPe-AGNSS-GenericAssistanceDataReq ::= SEQUENCE (SIZE (1..16)) OF
                                                            OMA-LPPe-AGNSS-GenericAssistDataReqElement

OMA-LPPe-AGNSS-GenericAssistDataReqElement ::= SEQUENCE {
    gnss-ID                         GNSS-ID,
    waIonoSurfaceReq                OMA-LPPe-AGNSS-WaIonoSurfaceRequest OPTIONAL, --Cond WAiono
    mechanicsReq                    OMA-LPPe-AGNSS-MechanicsReq                     OPTIONAL,
    dcbReq                          OMA-LPPe-AGNSS-DCBreq                           OPTIONAL,
    navModelDegradationModelReq     OMA-LPPe-AGNSS-NavModelDegradationModelReq      OPTIONAL,
    ccpAssistGenericReq             OMA-LPPe-AGNSS-CCPassistGenericReq  OPTIONAL, --Cond CCPreq
    navigationModelReq              OMA-LPPe-AGNSS-NavigationModelReq               OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
WAiono	The field SHALL be present only, when initiating the periodic AD session for WA Ionosphere Corrections, i.e. it is not possible to change the GNSSs for which corrections are provided intra-session.
CCPreq	The field SHALL be present, when requesting a new CCP assistance data session, i.e. when requesting a reference station (based on position or ID) for the first time during the AD session. The field SHALL NOT be present, when requesting an update to the AD session or CCP control parameters, i.e. it is not possible to change the requested GNSSs and signals during the CCP session.

OMA-LPPe-AGNSS-GenericAssistanceDataReq **field descriptions**
waIonoSurfaceReq This field specifies, if wide area ionosphere correction surface is requested for the SVs of this GNSS. The GNSS-independent request parameters for the wide area model are carried in *OMA-LPPe-AGNSS-IonosphericModelReq*.
mechanicsReq This field is used for requesting the SV mechanics information.
dcbReq This field is used for requesting the differential code biases to gain higher accuracy.
navModelDegradationModelReq This field is used for requesting the accuracy models for the SV orbit and clock models to get a better understanding of the accuracy of the computed position.
ccpAssistGenericReq This field is used to request for the CCP reference assistance data for high accuracy.
navigationModelReq This field is used to request for the navigation models defined in LPPe.

6.5.1.4 AGNSS Assistance Data Request Elements

– *OMA-LPPe-AGNSS-IonosphericModelReq*

The IE *OMA-LPPe-AGNSS-IonosphericModelReq* is used by the target device to request for the ionospheric model from the location server.

```
-- ASN1START

OMA-LPPe-AGNSS-IonosphericModelReq ::=  CHOICE {
    staticModels    SEQUENCE {
        ionoreq             BIT STRING  {klobucharModel (0),
                                         ionoStormWarning (1) } (SIZE  (1..8)),
        requestBeginTime    GNSS-SystemTime         OPTIONAL,
        duration            OMA-LPPe-Duration,
        ...
    },
    periodicModels  SEQUENCE {
        waIonoSurface       OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersRequest,
        ...
    },
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-IonosphericModelReq **field descriptions**
staticModels This field is used to request for the one-shot ionosphere models.

ionoreq This field specifies, which ionosphere models are being requested for. If bit 0 is set, the local Klobuchar model, as specified in *OMA-LPPe-AGNSS-LocalKlobucharModel*, is requested. If bit 1 is set, ionosphere storm warnings, as specified in *OMA-LPPe-AGNSS-IonoStormIndication*, are requested.
requestBeginTime This field specifies the first time instant when an ionosphere model is needed. The field is optional, and if it is missing, the begin time is the current time.
duration This field specifies for how long period the ionospheric model is requested.
periodicModels This field is used to request for periodic ionosphere models. These ionosphere model types utilizes the periodic AD procedure and thus their use mandates the inclusion of periodic AD control parameters in the common part of the AD request.
waIonoSurface This field is used for requesting Wide Area ionosphere surface corrections as specified in Appendix C.3. When initiating the WA Ionosphere session, the field is accompanied by the corrections request for specific GNSSs in the generic part of the AGNSS AD request. WA Ionosphere AD is periodic AD type and is thus also accompanied by periodic/triggered session ID in the common AD request parameters.

– *OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersRequest*

The IE *OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersRequest* is used by the target device to request for the periodic ionosphere corrections from the location server.

```
-- ASN1START

OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersRequest ::=  SEQUENCE {
    duration            OMA-LPPe-Duration   OPTIONAL,   --Cond FirstOrDurModify
    rate                INTEGER(1..64)      OPTIONAL,   --Cond FirstOrRateModify
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
FirstOrDurModify	This field is mandatory present, when initiating a new WA Iono AD session or when requesting for the modification of the duration. Otherwise it is not present.
FirstOrRateModify	This field is mandatory present, when initiating a new WA Iono AD session or when requesting for the modification of the rate. Otherwise it is not present.

OMA-LPPe-AGNSS-WideAreaIonoSurfaceControlParametersRequest field descriptions
duration This field specifies the length of the continuous periodic assistance session.
rate This field specifies the interval between the assistance data deliveries in seconds.

– *OMA-LPPe-AGNSS-TroposphereModelReq*

The IE *OMA-LPPe-AGNSS-TroposphereModelReq* is used by the target device to request the local *OMA-LPPe-AGNSS-TroposphereModel* assistance from the location server.

```
-- ASN1START
```

```
OMA-LPPe-AGNSS-TroposphereModelReq ::=  SEQUENCE {
    troposphereModelReq              BIT STRING  {delay (0),
                                                  surface (1) }      (SIZE (1..8)),
    supportForMultipleGridPoints     BOOLEAN,
    requestBeginTime                 GNSS-SystemTime         OPTIONAL,
    duration                         OMA-LPPe-Duration,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-TroposphereModelReq field descriptions
troposphereModelReq This bit string field specifies the desired model or models. One-value at bit position 0 indicates that the *OMA-LPPe-AGNSS-TroposphereDelayList* -model is requested, and one-value at bit position 1 indicates the request for the *OMA-LPPe-AGNSS-LocalSurfaceParameterList* –model.
supportForMultipleGridPoints This field indicates if the target is requesting parameter sets originating from multiple locations around it (value 1). Value 0 means that only the nearest grid point parameters are requested.
requestBeginTime This field specifies the first time instant when a valid troposphere model is needed. The field is optional, and if it is missing, the begin time is the current time.
duration This field specifies how long time the tropospheric model is requested for.

– *OMA-LPPe-AGNSS-AltitudeAssistanceReq*

The IE *OMA-LPPe-AGNSS-AltitudeAssistanceReq* is used by the target device to request the local *OMA-LPPe-AGNSS-AltitudeAssistanceList* from the location server.

```
-- ASN1START

OMA-LPPe-AGNSS-AltitudeAssistanceReq ::=    SEQUENCE {
    requestBeginTime                 GNSS-SystemTime         OPTIONAL,
    duration                         OMA-LPPe-Duration       OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-AltitudeAssistanceReq field descriptions
requestBeginTime This field specifies the first time instant when altitude assistance is needed. The field is optional, and if it is missing, the begin time is the current time.
duration This field specifies how long time the altitude assistance is requested for. In case the parameter is omitted,altitude assistance is requested for the current moment.

– *OMA-LPPe-AGNSS-SolarRadiationReq*

The IE *OMA-LPPe-AGNSS-SolarRadiation* is used by the target device to request the Solar radiation intensity.

```
-- ASN1START
```



```
OMA-LPPe-AGNSS-SolarRadiationReq ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-AGNSS-WaIonoSurfaceRequest*

The IE *OMA-LPPe-AGNSS-WaIonoSurfaceRequest* is used by the target device to request the wide area ionosphere correction surface.

```
-- ASN1START

OMA-LPPe-AGNSS-WaIonoSurfaceRequest ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-AGNSS-NavModelDegradationModelReq*

The IE *OMA-LPPe-AGNSS-NavModelDegradationModelReq* is used by the target device to request the navigation model degradation models for the SVs.

```
-- ASN1START

OMA-LPPe-AGNSS-NavModelDegradationModelReq ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-AGNSS-DCBreq*

The *OMA-LPPe-AGNSS-DCBreq* is used to request differential code bias assistance.

```
-- ASN1START

OMA-LPPe-AGNSS-DCBreq ::= SEQUENCE {
    reference       SEQUENCE{
                        signal  GNSS-SignalID,
                        pd      ENUMERATED { pilot, data, notapplicable, ... },
                        ...
                        }           OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-DCBreq* field descriptions**
reference The signal with respect to which the differential code biases of the other signals are requested.
signal This field indicates the signal id. The interpretation of the signal id depends on the GNSS as explained in 3GPP TS 36.355 [LPP].
pd This field indicates whether the signal is pilot signal, data signal or if this indication is not applicable in this case.

– OMA-LPPe-AGNSS-MechanicsReq

The *OMA-LPPe-AGNSS-MechanicsReq* is used to request SV mechanical information including phase-center offset, mass and effective area-reflectivity information. The SVs mechanics information can be used for extending the orbit information applicability in the target. See Appendix C.7 for further information.

```
-- ASN1START

OMA-LPPe-AGNSS-MechanicsReq::= SEQUENCE {
    massRequest                         BOOLEAN,
    effectiveReflectivityAreaRequest    BOOLEAN,
    pcoRequest                          BOOLEAN,
    svInfoRequest                       BOOLEAN,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-MechanicsReq **field descriptions**
massRequest This field is used to request for the mass information for all the SVs.
effectiveReflectivityAreaRequest This field is used to request for the effective combined reflectivity-area information for all the SVs.
pcoRequest This field is used to request for the phase-center offset information for all the SVs.
svInfoRequest This field is used to request for the satellite type information for all the SVs.

– OMA-LPPe-AGNSS-CCPrequestControlParameters

The *OMA-LPPe-AGNSS-CCPrequestControlParameters* is used to request continuous carrier phase assistance or an update to the CCP control parameters. Continuous carrier phase information together with the knowledge on the reference station position allows for deducing the high accuracy baseline between the target and the reference station by solving the full cycle integer ambiguities. Using the control parameters the target may request for the information on the area, in which CCP is supported, information on the neighbouring reference stations and request for a new reference station or stopping a CCP assistance data delivery to a given reference station.

The periodic AD procedures related to the CCP AD are illustrated in Appendix D.1 for reference.

```
-- ASN1START

OMA-LPPe-AGNSS-CCPrequestControlParameters ::= SEQUENCE {
    ccpSupportAreaRequest       NULL                OPTIONAL,
    ccpNeighborListRequest      NULL                OPTIONAL,
    ccpCommonRequest            SEQUENCE {
                duration            OMA-LPPe-Duration   OPTIONAL,   --Cond FirstOrDurModify
                rate                INTEGER(1..64)      OPTIONAL,   --Cond FirstOrRateModify
                refStation          CHOICE {
                    posBasedReferenceStationRequest     SEQUENCE {
                        requestedReferenceStationLocation   OMA-LPPe-HighAccuracy3Dposition,
                        qor                                 OMA-LPPe-AGNSS-QoR,
                        ...
                        },
                    idBasedReferenceStationRequest      OMA-LPPe-AGNSS-ReferenceStationIDlist,
                    referenceStationKillList            OMA-LPPe-AGNSS-ReferenceStationIDlist,
                    ...
                    } OPTIONAL, --Cond FirstOrRefModify
        ...
        },
    ...
}
```

```
OMA-LPPe-AGNSS-ReferenceStationIDlist ::= SEQUENCE (SIZE(1..maxReferenceStations)) OF
                                                            OMA-LPPe-AGNSS-CCPreferenceStationID

OMA-LPPe-AGNSS-QoR ::=  ENUMERATED {m10, km1,km10,km100, ...}

-- ASN1STOP
```

Conditional presence	Explanation
FirstOrDurModify	This field is mandatory present, when initiating a new CCP AD session or when requesting for the modification of the duration. Otherwise it is not present.
FirstOrRateModify	This field is mandatory present, when initiating a new CCP AD session or when requesting for the modification of the rate. Otherwise it is not present.
FirstOrRefModify	This field is mandatory present, when initiating a new CCP AD session or when requesting for the modification of the active reference station list (new reference stations or stopping CCP AD for a set of reference stations). Otherwise it is not present.

OMA-LPPe-AGNSS-CCPRequestControlParameters field descriptions
ccpSupportAreaRequest This field specifies, if the target requests for the information on the CCP assistance availability in the target area.
ccpNeighborListRequest This field specifies, if the target requests for the information on the reference stations in the vicinity of the target. The neighbour list information is used for the purposes of changing the reference station.
ccpCommonRequest This field is used to request for a new reference station or stopping CCP AD delivery for a reference station.
duration This field specifies the length of the continuous periodic assistance session.
rate This field specifies the interval between the assistance data deliveries in seconds.
refStation This field specifies the request/modification of the active reference station set. The modification is used, when requesting CCP assistance for a new reference station for the reference station change and, after the reference station change, stopping the CCP assistance for the old reference station.
requestedReferenceStationLocation This field is used to request for a new reference station based on the position. The position may or may not be the target position.
qor This field (Quality-of-Reference station) defines how close to the requested location the closest reference station MUST be. In case the closest reference station is within the uncertainty area of the target location, the QoR parameter is neglected. Note: Fulfilling QoR=10 m requires that a virtual reference receiver is generated at the requested location. Baselines up to 10 km are feasible with single frequency receivers and longer baselines require multi-frequency receivers
idBasedReferenceStationRequest This field allows for requesting CCP AD for a new reference station based on the reference station ID.
referenceStationKillList This field allows the target to terminate CCP AD deliveries for selected reference stations based on their reference station IDs.

– *OMA-LPPe-AGNSS-CCPassistGenericReq*

The *OMA-LPPe-AGNSS-CCPassistGenericReq* is used to request Continuous Carrier Phase assistance for the set of signals for a specified GNSS.


```
-- ASN1START

OMA-LPPe-AGNSS-CCPassistGenericReq ::= SEQUENCE {
    ccpAssist-SignalsReq            GNSS-SignalIDs,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-CCPassistGenericReq field descriptions
ccpAssist-SignalsReq This field specifies the GNSS signal types for which the CCP assistance is requested by the target device. This is represented by a bit string in *GNSS-SignalIDs*, with a one-value at the bit position means CCP assistance for the particular GNSS signal type is requested; a zero-value means not requested.

– *OMA-LPPe-AGNSS-NavigationModelReq*

The *OMA-LPPe-AGNSS-NavigationModelReq* is used to request SV navigation models.

```
-- ASN1START

OMA-LPPe-AGNSS-NavigationModelReq ::= SEQUENCE {
    navModelID-PrefList     SEQUENCE (SIZE(1..8)) OF INTEGER(1..8) OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-NavigationModelReq* field descriptions**
navModelID-PrefList This field is used to request the navigation models in the order of decreasing preference, i.e. the model-ID in the first slot is the most preferred one. The server SHALL respect the preference list. Model-ID 1: Coordinate-based In case preference lists are also included in the LPP proper, they SHALL be handled first. Only if the target cannot be served based on request in the LPP proper, the preference list in LPPe SHALL be considered. The LPPe side navigation model delivery SHALL also obey the list of the SVs, for which navigation models are being requested, in the LPP proper.

Model-ID	Type
1	Coordinate-based

6.5.1.5 AGNSS Location Information

– *OMA-LPPe-AGNSS-ProvideLocationInformation*

The *OMA-LPPe-AGNSS-ProvideLocationInformation* is used to provide AGNSS-based position estimate (UE-based) and measurements (UE-assisted).

```
-- ASN1START

OMA-LPPe-AGNSS-ProvideLocationInformation ::= SEQUENCE {
    highAccuracyReferenceTime   GNSS-SystemTime                         OPTIONAL, --Cond HighAccuracy
    highAccuracyMeasurements    OMA-LPPe-AGNSS-HAgnssProvide            OPTIONAL,
    ionosphereMeasurements      OMA-LPPe-AGNSS-IonosphereMeasurements   OPTIONAL,
    localSurfaceMeasurements    OMA-LPPe-AGNSS-LocalSurfaceMeasurements OPTIONAL,
    error                       OMA-LPPe-AGNSS-Error                    OPTIONAL,
    ...
```

```
}

-- ASN1STOP
```

Conditional presence	Explanation
HighAccuracy	This field SHALL be present, when providing high accuracy position/velocity estimates. Otherwise it is not present.

OMA-LPPe-AGNSS-ProvideLocationInformation **field descriptions**
highAccuracyReferenceTime This field indicates the GNSS system time at which the high accuracy position/velocity estimate provided in the IE *OMA-LPPe-CommonIEsProvideLocationInformation* is valid.

6.5.1.6 AGNSS Location Information Elements

– *OMA-LPPe-AGNSS-HAgnssProvide*

The *OMA-LPPe-AGNSS-HAgnssProvide* is used to provide periodic high accuracy AGNSS measurements from the target device to the server. Unless otherwise instructed in LPP proper *CommonIEsRequestLocationInformation*, the target SHALL report its position and reference time information. However, in case the target is allowed to report only measurements (locationMeasurementsRequired and onlyReturnInformationRequested in LPP proper *CommonIEsRequestLocationInformation)*, position and reference time are not included. Appendix D.1 shows a few examples of periodic HA GNSS sessions.

```
-- ASN1START

OMA-LPPe-AGNSS-HAgnssProvide ::= CHOICE {
    controlParameters   SEQUENCE {
        duration                OMA-LPPe-Duration,
        rate                    INTEGER(1..64),
        antennaDescription      OMA-LPPe-AGNSS-AntennaDescription       OPTIONAL, --Cond HAantenna
        ...
    },
    measurements    SEQUENCE {
        position        EllipsoidPointWithAltitudeAndUncertaintyEllipsoid   OPTIONAL,
                                                                                --Cond NotForbidden
        referenceTime   GNSS-SystemTime,
        localPressure   SEQUENCE {
                            pressure                INTEGER(-1024..1023),
                            pressureUncertainty     INTEGER(0..127),
                            ...
                        } OPTIONAL, --Cond HApressure
        antennaOrientation      OMA-LPPe-Orientation    OPTIONAL, --Cond HAantOrientation
        signalMeasurements      SEQUENCE (SIZE(1..16)) OF OMA-LPPe-AGNSS-HAgnssMeasurementElement,
        ...
        },
    ...
}

OMA-LPPe-AGNSS-HAgnssMeasurementElement::= SEQUENCE {
    gnss-ID                 GNSS-ID,
    haGNSSperSignalList     SEQUENCE (SIZE(1..8)) OF OMA-LPPe-HAgnssPerSignalElement,
    ...
}

OMA-LPPe-HAgnssPerSignalElement ::= SEQUENCE {
    signal-ID               GNSS-SignalID,
    haGNSSperSVlist         SEQUENCE (SIZE(1..64)) OF OMA-LPPe-HAgnssPerSVelement,
    ...
}


OMA-LPPe-HAgnssPerSVelement ::= SEQUENCE {
    svID                SV-ID,
```



```
    integerCodePhase    INTEGER (0..255)    OPTIONAL, --Cond IfAvailable
    codePhase           INTEGER (0..14989622),
    codePhaseRMSError   INTEGER (0..63),
    multipathDetection  ENUMERATED  {low,
                                     moderate,
                                     high,
                                     notMeasured,
                                     ...},
    cnr                 INTEGER(0..255),
    adr                 INTEGER (0..536870911),
    adrRMSerror         INTEGER (0..127),
    lockIndicator       BOOLEAN,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
HAantenna	This field SHALL be included in case the server requested for the antenna description information in the HA GNSS measurement session request and antenna description information is supported. Otherwise it is not present.
NotForbidden	This field SHALL be present unless otherwise instructed in LPP proper.
HApressure	This field SHALL be included in case the server requested for pressure measurements in the HA GNSS measurement session request and pressure information is supported. Otherwise it is not present.
HAantOrientation	This field SHALL be present, if the server requests for the antenna orientation information and such can be provided. Otherwise the field SHALL NOT be present.
IfAvailable	This field SHALL be present, if the target has position fix and can report millisecond ambiguity. Otherwise the target SHALL NOT be present.

OMA-LPPe-AGNSS-HAgnssProvide field descriptions
controlParameters This field specifies the control parameters of the HA GNSS session
duration This field specifies the length of the HA GNSS measurement session.
rate This field specifies the rate of delivery of the HA GNSS measurements. Scale factor 1 second.
antennaDescription This field species the GNSS antenna in the target device.
measurements This field species the HA GNSS measurements.
position This field species the position of the target device.
referenceTime This field specifies the time, when the measurements included are applicable.
localPressure This field specifies the local atmospheric pressure measurement at the target’s altitude for improved altitude or delta-altitude performance.
pressure Local atmospheric pressure measurement (hPa) at the target’s altitude. The scale factor is 0.1 hPa. The value is added to the average pressure 1013hPa.
pressureUncertainty The 1-sigma standard deviation of the pressure measurement. The scale factor is 0.1 hPa.
antennaOrientation This field specifies the orientation of the antenna with respect to the earth-fixed coordinate system.
signalMeasurements This field carries the HA GNSS signal measurements.

gnss-ID This field defines the ID of the GNSS for which measurements are being provided.
haGNSSperSignalList This field carries the HA GNSS measurements for the given signals.
signal-ID This field defines the ID of the GNSS signal for which measurements are being provided.
haGNSSperSVlist This field carries the HA GNSS measurements for specific satellites.
svID This field identifies the SV for which HA GNSS measurements are provided.
integerCodePhase This field indicates the integer milli-second part of the code phase.
codePhase This field contains the sub-millisecond part of the code phase observation for the particular satellite signal at the reference time. The target SHALL reconstruct the full pseudorange by Pseudorange = (Integer Code Phase) + (Code Phase). Scale factor 0.02 meters. Range [0, 299792.44] meters,
codePhaseRMSError This field contains the pseudorange RMS error value. This parameter is specified according to a floating-point representation defined in the corresponding table in 3GPP in section "*GNSS-MeasurementList*".
multipathDetection This field contains an estimate of the multipath environment.
cnr This field contains an estimate of the carrier-to-noise ratio. Scale factor 0.25 dB-Hz. Range [0, 63.75] dB-Hz.
adr This field contains the continuous carrier phase with direct data polarity. Scale factor 2^{-10} meters, in the range [0, 524287.999023438) meters.
adrRMSerror This field contains the RMS error of the continuous carrier phase. Scale factor 2^{-10} meters, in the range [0, 0.12403) meters.
lockIndicator This field is set to true if the carrier phase tracking has been continuous between the previous and the current measurement delivery. If false, a cycle slip has occurred.

– *OMA-LPPe-AGNSS-IonosphereMeasurements*

The *OMA-LPPe-AGNSS-IonosphereMeasurements* is used by the target to deliver ionosphere measurements to the location server. The measurements may consist either of a set of TEC values towards each of the SVs seen by the target, or a single zenith TEC value at the target's location. The location server can use the values collected from several targets to model the local ionospheric conditions.

```
-- ASN1START

OMA-LPPe-AGNSS-IonosphereMeasurements ::= SEQUENCE {
    gnssTime                GNSS-SystemTime,
    position                EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
    tecPerSV                OMA-LPPe-AGNSS-TECPerSV             OPTIONAL,       --Cond TecPerSV
    tecAtZenith             OMA-LPPe-AGNSS-TECAtZenith          OPTIONAL,       --Cond ZenithTec
    ...
}

OMA-LPPe-AGNSS-TECPerSV ::= SEQUENCE (SIZE(1..64)) OF OMA-LPPe-AGNSS-TECPerSVElement

OMA-LPPe-AGNSS-TECPerSVElement ::= SEQUENCE {
    azimuth         INTEGER(0..359),
    elevation       INTEGER(0..90),
    tecValue        INTEGER(0..511),
    tecUncertainty  INTEGER(0..63),
```

```
    ...
}

OMA-LPPe-AGNSS-TECAtZenith ::= SEQUENCE {
    tecValueAtZenith            INTEGER(0..511),
    tecUncertaintyAtZenith      INTEGER(0..63),
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
TecPerSV	The field is mandatory present if the location server requests *TecPerSV*; otherwise it is not present.
ZenithTec	The field is mandatory present if the location server requests *ZenithTEC*; otherwise it is not present.

***OMA-LPPe-AGNSS-IonosphereMeasurements* field descriptions**
gnssTime This field indicates the measurement time.
position This field indicates the measurement location.
tecPerSV This field contains the list of TEC values from the target towards each of the SVs seen by the target.
tecAtZenith This field contains the target's estimate of the zenith TEC value at the target's position.
azimuth This field indicates the azimuth angle of the ionosphere measurement, i.e. the direction from the user where the TEC values are observed. The azimuth angle is defined as the clockwise angle from the true North. The scale factor is 1 degree.
elevation This field indicates the elevation angle of the ionosphere measurement, i.e. how high or low in the sky the TEC value is observed. The scale factor is 1 degree.
tecValue This field indicates the measured TEC value towards the SV concerned. The scale factor is 1 TEC unit, 10^{16} e^-/m^2.
tecUncertainty This field indicates the 1-sigma standard deviation of the TEC measurement. The scale factor is 1 TEC unit, 10^{16} e^-/m^2.
tecValueAtZenith This field indicates the measured vertical TEC value. The scale factor is 1 TEC unit, 10^{16} e^-/m^2.
tecUncertaintyAtZenith This field indicates the 1-sigma standard deviation of the TEC measurement. The scale factor is 1 TEC unit 10^{16} e^-/m^2.

– *OMA-LPPe-AGNSS-LocalSurfaceMeasurements*

The *OMA-LPPe-AGNSS-LocalSurfaceMeasurements* information element is used to deliver the target's surface measurements to the server. Collecting the pressure-altitude –measurement combinations allows the server to model the current local atmospheric circumstances and generate altitude assistance for targets equipped with a barometer.

```
-- ASN1START

OMA-LPPe-AGNSS-LocalSurfaceMeasurements ::= SEQUENCE {
```



```
    gnssTime                 GNSS-SystemTime,
    position                 EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
    pressure                 INTEGER(-1024..1023),
    pressureUncertainty      INTEGER(0..127),
    temperatureMeasurement   SEQUENCE {
                                 temperature              INTEGER(-64..63)     OPTIONAL,
                                 temperatureUncertainty   INTEGER(0..7)        OPTIONAL,
                                 ...
                                 } OPTIONAL, --Cond TemperatureAvailable
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
TemperatureAvailable	The field is mandatory present if the target is able to provide temperature measurement with the pressure measurement, otherwise it is not present.

***OMA-LPPe-AGNSS-LocalSurfaceMeasurements* field descriptions**
gnssTime This field indicates the measurement time.
position This field indicates the measurement location.
pressure Local atmospheric pressure measurement (hPa) at the target's altitude. The scale factor is 0.1 hPa. The value is added to the nominal pressure of 1013hPa.
pressureUncertainty The 1-sigma standard deviation of the pressure measurement. The scale factor is 0.1 hPa.
temperature Local temperature measured by the target. The value is added to 273K. The scale factor is 1K.
temperatureUncertainty The 1-sigma standard deviation of the temperature measurement. The scale factor is 1 K.

6.5.1.7 AGNSS Location Information Request

– *OMA-LPPe-AGNSS-RequestLocationInformation*

The *OMA-LPPe-AGNSS-RequestLocationInformation* is used to request AGNSS-based position estimate (UE-based) and measurements (UE-assisted).

```
-- ASN1START

OMA-LPPe-AGNSS-RequestLocationInformation ::= SEQUENCE {
    positioningInstructions     OMA-LPPe-AGNSS-PositioningInstructions      OPTIONAL,
    ionosphereMeasurementsReq   BIT STRING  {tecPerSV(0),
                                             zenithTEC(1) }(SIZE(1..8))     OPTIONAL,
    localSurfaceMeasurementReq  OMA-LPPe-AGNSS-LocalSurfaceMeasurementReq   OPTIONAL,
    ...
}

-- ASN1STOP
```


OMA-LPPe-AGNSS-RequestLocationInformation **field descriptions**
ionosphereMeasurementsReq This field is used by the location server to request the target's ionosphere measurements. This is represented by a bit string with a one value at bit position 0 meaning that a TEC value per each satellite is requested and a one value at bit position 1 meaning that a zenith TEC value at the target's position is requested.
localSurfaceMeasurementReq This field is used by the location server to request the targets local surface measurements such as atmospheric pressure and temperature.

6.5.1.8 AGNSS Location Information Request Elements

– *OMA-LPPe-AGNSS-PositioningInstructions*

The *OMA-LPPe-AGNSS-PositioningInstructions* is used to provide AGNSS positioning and measuring instructions to the target device.

```
-- ASN1START

OMA-LPPe-AGNSS-PositioningInstructions ::= SEQUENCE {
    highAccuracyMethodRequested     BOOLEAN,
    haGNSSreq               OMA-LPPe-AGNSS-HAgnssRequestControlParameters   OPTIONAL, --Cond HAgnssReq
    ...,
    extUncertRange               BOOLEAN OPTIONAL
}

-- ASN1STOP
```

Conditional presence	Explanation
HAgnssReq	This field SHALL be present, when requesting for continuous high accuracy GNSS measurements or an update to the currently ongoing periodic Location Information session. The request SHALL be accompanied by *RequestPeriodicLocInfoWithUpdate* in *OMA-LPPe-CommonIEsRequestLocationInformation*. Otherwise the field is not present.

OMA-LPPe-AGNSS-PositioningInstructions **field descriptions**
highAccuracyMethodRequested This field indicates that the server requests the target to use UE-based high accuracy AGNSS method. Note that this implies using the CCP assistance and performing positioning in the UE-based mode. Thus, the *highAccuracyMethodRequested* SHALL be accompanied by the setting *locationEstimateRequired* in the 3GPP LPP proper in the *LocationInformationType* of *CommonIEsRequestLocationInformation*. In case the high accuracy AGNSS method is requested, the target is expected to return the location information using the High Accuracy 3D Position information element. Likewise, in case velocity is requested (in the 3GPP LPP proper in the *QoS* information element in the *CommonIEsRequestLocationInformation* information element), the velocity SHALL be returned using the High Accuracy 3D Velocity information element. Thus *locationCoordinateTypes* and velocityTypes in the 3GPP LPP proper in the *CommonIEsRequestLocationInformation* information element are not applicable, when requesting High Accuracy AGNSS method. Note that since high accuracy location estimate IE carry a full 3D representation, such full 3D information SHALL be returned even in case the vertical coordinate was not requested in the 3GPP LPP proper in the *QoS* information element in the *CommonIEsRequestLocationInformation* information element and providing additional information was forbidden in the 3GPP LPP proper in the *additionalInformation* information element in the *CommonIEsRequestLocationInformation* information element. Response time defined in the 3GPP LPP proper in the *QoS* information element SHALL be obeyed, when the high accuracy AGNSS method has been requested. In case the requested response time cannot be met, the target SHALL report the failure using the appropriate error codes in the 3GPP LPP proper. The target SHALL also obey the IE *gnss-Methods*, i.e. instructions to use only allowed GNSSs in positioning, in the *GNSS-PositioningInstructions* in *A-GNSS-RequestLocationInformation* in the 3GPP LPP proper. In case the target does not support high accuracy method, the target SHALL return AGNSS Target Device Error “HighAccuracyMethodNotSupported”.
haGNSSreq This field is used by the server to request for the High Accuracy GNSS measurements for UE-assisted HA GNSS
extUncertRange This field is used by the server to indicate whether a high accuracy position with extended uncertainty range is allowed (TRUE). This field is optional and if not present or set to FALSE, only the default uncertainty range is allowed.

– *OMA-LPPe-AGNSS-LocalSurfaceMeasurementsReq*

The *OMA-LPPe-AGNSS-LocalSurfaceMeasurementsReq* is used to request local surface measurements (pressure, temperature) from the target.

```
-- ASN1START

OMA-LPPe-AGNSS-LocalSurfaceMeasurementReq ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-AGNSS-HAgnssRequestControlParameters*

The *OMA-LPPe-AGNSS-HAgnssRequestControlParameters* is used to request for periodic high accuracy AGNSS measurements from the target device or to request modification to the session parameters of the on-going session. Note that the requested GNSSs and signals cannot be modified intra-session.

```
-- ASN1START
```

```
OMA-LPPe-AGNSS-HAgnssRequestControlParameters ::= SEQUENCE {
    duration                    OMA-LPPe-Duration   OPTIONAL,   --Cond FirstOrModify
    rate                        INTEGER(1..63)      OPTIONAL,   --Cond FirstOrModify
    antennaInformationReq       ENUMERATED {antennaDescriptionOnly,
                                            antennaDescriptionAndOrientation,
                                            ...}    OPTIONAL,
    pressureInformationReq      BOOLEAN,                        --Cond FirstOrModify
    signalReqList               SEQUENCE (SIZE(1..16)) OF
                                        OMA-LPPe-AGNSS-HAgnssSignalReqElement   OPTIONAL, --Cond First
    ...
}

OMA-LPPe-AGNSS-HAgnssSignalReqElement ::= SEQUENCE {
    gnssID      GNSS-ID,
    signals     GNSS-SignalIDs,
    ...
}


-- ASN1STOP
```

Conditional presence	Explanation
FirstOrModify	This field SHALL be present in the first message or when requesting for periodic HA GNSS measurements. Otherwise it SHALL NOT be present.
First	This field SHALL be present in the first message in the HA GNSS session. Otherwise it SHALL NOT be present.

OMA-LPPe-AGNSS-HAgnssRequestControlParamaters **field descriptions**
duration This field specifies the length of the HA GNSS measurement session.
rate This field specifies the rate of delivery of the HA GNSS measurements. Scale factor 1 second.
antennaInformationReq This field is used to request for the target antenna information,
pressureInformationReq This field is used to request for the pressure information at the target site. TRUE means requested, FALSE means not requested.
signalReqList This field is used to request HA GNSS measurements for specific GNSS signals.
gnssID This field carries the ID of the GNSS for which HA GNSS measurements are requested.
signals This field specifies the GNSS signal types for which HA GNSS measurements are requested by the server. This is represented by a bit string in *GNSS-SignalIDs*, with a one-value at the bit position means HA GNSS measurements for the particular GNSS signal type is requested; a zero-value means not requested.

6.5.1.9 AGNSS Capability Information

– *OMA-LPPe-AGNSS-ProvideCapabilities*

The *OMA-LPPe-AGNSS-ProvideCapabilities* is used by the target to provide its LPPe AGNSS capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-ProvideCapabilities ::= SEQUENCE {
    assistanceDataSupportList           OMA-LPPe-AGNSS-AssistanceDataSupportList            OPTIONAL,
    environmentObservationSupportList   OMA-LPPe-AGNSS-EnvironmentObservationSupportList    OPTIONAL,
    haGNSSsupport                       OMA-LPPe-AGNSS-HAgnssSupport                        OPTIONAL,
    ...
}
```



```
OMA-LPPe-AGNSS-AssistanceDataSupportList ::= SEQUENCE {
    commonAssistanceDataSupport     OMA-LPPe-AGNSS-CommonAssistanceDataSupport,
    genericAssistanceDataSupport    OMA-LPPe-AGNSS-GenericAssistanceDataSupport,
    ...
}

-- ASN1STOP
```

6.5.1.10 AGNSS Capability Information Element

– *OMA-LPPe-AGNSS-EnvironmentObservationSupportList*

The *OMA-LPPe-AGNSS-EnvironmentObservationSupportList* is used by the target to provide its environment observation capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-EnvironmentObservationSupportList ::= SEQUENCE{
    ionosphereMeasurementSupport        BIT STRING {tecPerSVsupport(0),
                                                    zenithTecSupport(1) } (SIZE (1..8)),
    pressureMeasurementSupported        BOOLEAN,
    temperatureMeasurementSupported     BOOLEAN,
    ...
}


-- ASN1STOP
```

– *OMA-LPPe-AGNSS-CommonAssistanceDataSupport*

The *OMA-LPPe-AGNSS-CommonAssistanceDataSupport* is used by the target to provide its GNSS-independent LPPe AGNSS capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-CommonAssistanceDataSupport ::= SEQUENCE {
    ionosphericModelSupport     OMA-LPPe-AGNSS-IonosphericModelSupport  OPTIONAL, --Cond IonoSupport
    troposphereModelSupport     OMA-LPPe-AGNSS-TroposphereModelSupport  OPTIONAL, --Cond TropoSupport
    altitudeAssistanceSupport   OMA-LPPe-AGNSS-AltitudeAssistanceSupport
                                                                OPTIONAL, --Cond AltAssistSupport
    solarRadiationSupport       OMA-LPPe-AGNSS-SolarRadiationSupport
                                                                OPTIONAL, --Cond SolarRadiationSupport
    ccpSupport                  OMA-LPPe-AGNSS-CCPsupport       OPTIONAL, --CCPsupport
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
IonoSupport	The field is mandatory present if the target supports LPPe ionosphere models, otherwise it is not present.
TropoSupport	The field is mandatory present if the target device supports LPPe troposphere models, otherwise it is not present.
AltAssistSupport	The field is mandatory present if the target device supports altitude assistance, otherwise it is not present.
SolarRadiationSupport	The field is mandatory present if the target device supports Solar Radiation information. Otherwise the field is not present.
CCPsupport	This field is mandatory present, if the target supports CCP. Otherwise it is not present.

– *OMA-LPPe-AGNSS-IonosphericModelSupport*

The *OMA-LPPe-AGNSS-IonosphericModelSupport* information element is used by the target to specify to the server which ionospheric model or models the target supports.

```
-- ASN1START

OMA-LPPe-AGNSS-IonosphericModelSupport ::=  SEQUENCE {
    ionoModel       BIT STRING {    localKlobuchar          (0),
                                    ionoStormWarning        (1),
                                    wideAreaIonoSurface     (2) } (SIZE (1..8)),
    ...
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-IonosphericModelSupport* field descriptions**
ionoModel This field specifies the ionospheric model(s) supported by the target device. This is represented by a bit string, with a one-value at the bit position means the particular ionospheric model is supported; a zero-value means not supported. If bit 2 for wide area ionosphere correction surface is set, the target SHALL support the corrections for all the supported GNSSs.

– *OMA-LPPe-AGNSS-TroposphereModelSupport*

The *OMA-LPPe-AGNSS-TroposphereModelSupport* information element is used by the target to specify to the server which troposphere model or models the target supports.

```
-- ASN1START

OMA-LPPe-AGNSS-TroposphereModelSupport ::=  SEQUENCE {
    tropoModel                      BIT STRING { localTroposphereDelay (0),
                                                 surfaceParameters     (1) } (SIZE (1..8)),
    supportForMultipleGridPoints    BOOLEAN,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-TroposphereModelSupport* field descriptions**
tropoModel This field specifies the troposphere model(s) supported by the target device. This is represented by a bit string, with a one-value at the bit position means the particular troposphere model is supported; a zero-value means not supported.
supportForMultipleGridPoints This field specifies, if the target supports combining troposphere information from several grid points surrounding the target.

– *OMA-LPPe-AGNSS-AltitudeAssistanceSupport*

The *OMA-LPPe-AGNSS-AltitudeAssistaceSupport* is used by the target to provide its altitude assistance capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-AltitudeAssistanceSupport ::= SEQUENCE {
    ...
}
```

```
-- ASN1STOP
```

– OMA-LPPe-AGNSS-SolarRadiationSupport

The *OMA-LPPe-AGNSS-SolarRadiationSupport* is used by the target to provide its solar radiation assistance capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-SolarRadiationSupport ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– OMA-LPPe-AGNSS-CCPsupport

The *OMA-LPPe-AGNSS-CCPsupport* is used by the target to provide its CCP capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-CCPsupport ::= SEQUENCE {
    supportAreaAssistanceSupported      BOOLEAN,
    multiReferenceStationSupported      BOOLEAN,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-CCPsupport* field descriptions**
supportAreaAssistanceSupported This field indicates, if the target supports the CCP Support Area assistance.
multiReferenceStationSupported This field indicates, if the target supports multibaseline solution.

– OMA-LPPe-AGNSS-GenericAssistanceDataSupport

The *OMA-LPPe-AGNSS-GenericAssistanceDataSupport* is used by the target to provide its GNSS-dependent LPPe AGNSS assistance data capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-GenericAssistanceDataSupport ::=
                        SEQUENCE (SIZE (1..16)) OF OMA-LPPe-AGNSS-GenericAssistDataSupportElement

OMA-LPPe-AGNSS-GenericAssistDataSupportElement ::= SEQUENCE {
    gnss-ID                                     GNSS-ID,
    mechnanicsSupport                           OMA-LPPe-AGNSS-MechanicsSupport OPTIONAL,
                                                                                --Cond MechSupport
    dcbSupport                                  OMA-LPPe-AGNSS-DCBsupport       OPTIONAL,

                                                                            --Cond DCBsupport
    navModelAccuracyModelDegradationSupport     OMA-LPPe-AGNSS-NavModelAccuracyModelDegradationSupport
                                                OPTIONAL,                       --Cond NavModDegrSupport
    ccpAssistanceSuppport                           GNSS-SignalIDs  OPTIONAL,   --Cond CCPsupport
    navModelSupport             OMA-LPPe-AGNSS-NavModelSupport      OPTIONAL,   --Cond NavModSupport
    ...
```



```
}

-- ASN1STOP
```

Conditional presence	Explanation
MechSupport	The field is mandatory present if the target device supports SV mechanics assistance. Otherwise the field is not present.
DCBsupport	The field is mandatory present if the target device supports differential code bias assistance. Otherwise the field is not present.
NavModDegrSupport	The field is mandatory present if the target device supports navigation model degradation model assistance. Otherwise the field is not present.
CCPsupport	This field is mandatory present, if the target supports CCP assistance for at least one signal of the GNSS. Otherwise it is not present.
NavModSupport	This field SHALL be included, if the target supports one or more LPPe navigation model types. Otherwise it is not present.

***OMA-LPPe-AGNSS-GenericAssistanceDataSupport* field descriptions**
ccpAssistanceSupport This field specifies the GNSS signal types for which CCP assistance is supported by the target device. This is represented by a bit string in *GNSS-SignalIDs*, with a one-value at the bit position means CCP assistance for the particular GNSS signal type is supported; a zero-value means not supported.

– *OMA-LPPe-AGNSS-MechanicsSupport*

The *OMA-LPPe-AGNSS-MechanicsSupport* is used by the target to provide its mechanics assistance capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-MechanicsSupport ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-AGNSS-DCBsupport*

The *OMA-LPPe-AGNSS-MechanicsSupport* is used by the target to provide its Differential Code Bias assistance capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-DCBsupport ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-AGNSS-NavModelAccuracyModelDegradationSupport*

The *OMA-LPPe-AGNSS- NavModelAccuracyModelDegradationSupport* is used by the target to provide its navigation model degradation model assistance capabilities to the server.


```
-- ASN1START

OMA-LPPe-AGNSS-NavModelAccuracyModelDegradationSupport ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– OMA-LPPe-AGNSS-NavModelSupport

The *OMA-LPPe-AGNSS- NavModelSupport* is used by the target to provide its navigation model assistance capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-NavModelSupport ::= SEQUENCE {
    navModelSupport     SEQUENCE (SIZE(1..8)) OF INTEGER(1..8)  OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-NavModelSupport* field descriptions**
navModelSupport This field is used to indicate the navigation model support to the server. The sequence carries within the Model-IDs of the supported navigation mode types. IDs are specified in the description of *OMA-LPPe-AGNSS-NavigationModelReq*.

– OMA-LPPe-AGNSS-HAgnssSupport

The *OMA-LPPe-AGNSS-HAgnssSupport* is used by the target to provide its HA GNSS capabilities to the server.

```
-- ASN1START

OMA-LPPe-AGNSS-HAgnssSupport ::= SEQUENCE {
    modeSupport                         BIT STRING {ueBased (0), ueAssisted (1) } (SIZE(2)),
    haGNSSpressureInformationSupport    BOOLEAN,
    haGNSSantennaInformationSupport     BIT STRING { antennaDescriptionSupported (0),
                                                     antennaOrientationSupported (1)
                                                     }  (SIZE(8)),

    haGNSSperGNSSsupport                SEQUENCE (SIZE(1..8)) OF OMA-LPPe-AGNSS-HAgnssPerGNSSsupport,
    ...
}

OMA-LPPe-AGNSS-HAgnssPerGNSSsupport::= SEQUENCE {
    gnss-ID                 GNSS-ID,
    haGNSSsignalSupport     GNSS-SignalIDs,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-HAgnssSupport field descriptions
modeSupport This field is used to indicate If bit 0 set, UE-based supported. If bit 1 set, UE-assisted supported.
haGNSSpressureInformationSupport This field is used to provide information, if the target is capable of providing absolute pressure information for improved delta-altitude performance.
haGNSSantennaInformationSupport This field is used to carry the antenna information support.
haGNSSperGNSSsupport This field is used to carry the HA GNSS signal measurement capabilities of the target.
gnss-ID This field specifies the ID of the GNSS for which HA GNSS capabilities are provided.
haGNSSsignalSupport This field specifies the GNSS signal types for which HA GNSS signal measurements are supported by the target device. This is represented by a bit string in *GNSS-SignalIDs*, with a one-value at the bit position means HA GNSS measurements for the particular GNSS signal type is supported; a zero-value means not supported.

6.5.1.11 AGNSS Capability Information Request

– *OMA-LPPe-AGNSS-RequestCapabilities*

The IE *OMA-LPPe-AGNSS-RequestCapabilities* is used to request LPPe AGNSS capabilities information from the target.

```
-- ASN1START

OMA-LPPe-AGNSS-RequestCapabilities ::= SEQUENCE {
    assistanceDataSupportListReq                NULL    OPTIONAL,
    environmentObservationSupportListReq        NULL    OPTIONAL,
    haGNSSsupportReq                            NULL    OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-AGNSS-RequestCapabilities field descriptions
assistanceDataSupportListReq This field is used to request the common and generic assistance data capabilities of the target.
environmentObservationSupportListReq This field is used to request environment observation capabilities.
haGNSSsupportReq This field is used to request HA GNSS capabilities of the target.

6.5.1.12 AGNSS Error Elements

– *OMA-LPPe-AGNSS-Error*

The IE *OMA-LPPe-AGNSS-Error* is used by the target or server to provide GNSS Error Reasons.

```
-- ASN1START

OMA-LPPe-AGNSS-Error ::= CHOICE {
    agnss-locationServerErrorCauses     OMA-LPPe-AGNSS-LocationServerErrorCauses,
    agnss-targetDeviceErrorCauses       OMA-LPPe-AGNSS-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-AGNSS-LocationServerErrorCauses*

The IE *OMA-LPPe-AGNSS-LocationServerErrorCauses* is used by the server to provide GNSS Error Reasons to the target. The IE *OMA-LPPe-AGNSS-LocationServerErrorCauses* is used, when the IE *OMA-LPPe-AGNSS-Error* is included in the LPP Provide Assistance Data message extension by the server.

```
-- ASN1START

OMA-LPPe-AGNSS-LocationServerErrorCauses ::= SEQUENCE {
     waIonoErrorCauses  ENUMERATED {    undefined,
                                        waIonoNotSupportedByServer,
                                        waIonoNotSupportedInTargetArea,
                                        waIonoNotSupportedForAnyRequestedGNSS,
                                        ...} OPTIONAL,
     ccpErrorCauses     ENUMERATED {    undefined,
                                        ccpNotSupportedByServer,
                                        ccpNotSupportedInTargetArea,
                                        ccpNotSupportedForAnyRequestedSignal,
                                        ccpQorCannotBeMet,
                                        ccpUnableToModifyControlParameters,
                                        ccpMultiReferenceStationNotSupported,
                                        ccpNeighborListNotSupported,
                                        ccpSupportAreaAssistanceNotSupported,
                                        ...} OPTIONAL,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-AGNSS-TargetDeviceErrorCauses*

The IE *OMA-LPPe-AGNSS-TargetDeviceErrorCauses* is used by the target to provide GNSS Error Reasons to the server. In addition, the target may return an additional error reason in the LPP proper. The IE *OMA-LPPe-AGNSS-TargetDeviceErrorCauses* is used, when the IE *OMA-LPPe-AGNSS-Error* is included in the LPP Provide Location Information message extension by the target.

```
-- ASN1START

OMA-LPPe-AGNSS-TargetDeviceErrorCauses ::= SEQUENCE {
    highAccuracyErrorCauses             ENUMERATED {    undefined,
                                                        highAccuracyMethodNotSupported,
                                                        ...} OPTIONAL,
    ionosphereMeasurementErrorCauses    ENUMERATED  {   undefined,
                                                        ionosphereMeasurementsNotSupported,
                                                        ionosphereMeasurementsNotAvailable,
                                                        ...}    OPTIONAL,
    environmentObservationErrorCauses   ENUMERATED  {   undefined,
                                                        surfaceMeasurementsNotSupported,
                                                        surfaceMeasurementsNotAvailable,
                                                        ...}    OPTIONAL,
    haGNSSerrorCauses                   ENUMERATED {    undefined,
                                                        haGNSSnotSupportedByTarget,
                                                        haGNSSunavailableForAllRequestedSignals,
                                                        haGNSSantennaInformationNotSupported,
                                                        haGNSSantennaInformationNotAvailable,
                                                        haGNSSpressureInformationNotSupported,
                                                        haGNSSpressureInformationNotAvailable,
                                                        haGNSSunableToModifyControlParameters,
                                                        ...} OPTIONAL,
    ...
}

-- ASN1STOP
```

6.5.1.13 Common AGNSS Information Elements

– *OMA-LPPe-AGNSS-CCPreferenceStationID*

The *OMA-LPPe-AGNSS-CCPreferenceStationID* IE defines a GNSS reference station.

```
-- ASN1START

OMA-LPPe-AGNSS-CCPreferenceStationID ::= SEQUENCE {
    stationID   INTEGER(0..65535),
    ...
}

maxReferenceStations INTEGER ::= 8

-- ASN1STOP
```

***OMA-LPPe-AGNSS-CCPreferenceStationID* field descriptions**
stationID Defines the ID of the reference station. Reference stations IDs are used to link the CCP assistance to the correct reference station. IDs are allocated by the server. One reference station SHALL have one ID. The ID SHALL NOT change during the CCP assistance session.
maxReferenceStations This field species the maximum number of reference stations that can be provided to the target at a time.

– *OMA-LPPe-AGNSS-AntennaDescription*

The *OMA-LPPe-AGNSS-AntennaDescription* is used to provide the target information on the antenna at the reference station.

The IE supports a straightforward mapping from RTCM 10403.1.

```
-- ASN1START

OMA-LPPe-AGNSS-AntennaDescription ::= SEQUENCE {
    antennaDescription      CHOICE {
                                igsAntennaName      OMA-LPPe-CharArray,
                                proprietaryName     OMA-LPPe-CharArray,
                                ...
                                },
    antennaSetupID          INTEGER(0..255)         OPTIONAL,
    antennaSerialNumber     OMA-LPPe-CharArray      OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-AGNSS-AntennaDescription* field descriptions**
igsAntennaName This field specifies the antenna equipment name as specified in RTCM 10403.1.
proprietaryName This field carries proprietary antenna information.
antennaSetupId Antenna setup information as specified in RTCM 10403.1.
antennaSerialNumber Antenna serial number as issued by the antenna manufacturer.

6.5.1.14 AGNSS Abort Elements

– *OMA-LPPe-AGNSS-Abort*

The IE *OMA-LPPe-AGNSS-Abort* is used by the target or server to provide GNSS Abort Reasons.

```
-- ASN1START

OMA-LPPe-AGNSS-Abort::= SEQUENCE {
    targetDeviceAbortCauses     SEQUENCE {
        ccpAbort    ENUMERATED  {   undefined,
                                    ccpNotSupported,
                                    ccpNotSupportedForProvidedSignals,
                                    ... }      OPTIONAL,
        waIonoAbort ENUMERATED  {   undefined,
                                    waIonoNotSupported,
                                    waIonoNotSupportedForProvidedGNSSs,
                                    ... } OPTIONAL,
        ...
        } OPTIONAL,
    ...
}

-- ASN1STOP
```

6.5.2 OTDOA Positioning

6.5.2.1 OTDOA Assistance Data

– *OMA-LPPe-OTDOA-ProvideAssistanceData*

The IE *OMA-LPPe-OTDOA-ProvideAssistanceData* is used to provide assistance for UE-based OTDOA (E-UTRAN).

```
-- ASN1START

OMA-LPPe-OTDOA-ProvideAssistanceData ::= SEQUENCE {
    otdoa-ReferenceCellInfo             OMA-LPPe-OTDOA-ReferenceCellInfo            OPTIONAL,
    otdoa-NeighbourCellInfo             OMA-LPPe-OTDOA-NeighbourCellInfoList        OPTIONAL,
    otdoa-Error                         OMA-LPPe-OTDOA-Error                        OPTIONAL,
    ...
}

-- ASN1STOP
```

6.5.2.2 OTDOA Assistance Data Elements

– *OMA-LPPe-OTDOA-ReferenceCellInfo*

The IE *OMA-LPPe-OTDOA-ReferenceCellInfo* is used by the location server to provide reference cell information for OTDOA assistance data.

```
-- ASN1START

OMA-LPPe-OTDOA-ReferenceCellInfo ::= SEQUENCE {
    referenceCellInfo           OTDOA-ReferenceCellInfo,
    positionCalculationInfoRef  OMA-LPPe-OTDOA-PositionCalculationInfoRef,
    ...
}

-- ASN1STOP
```

OMA-LPPe-OTDOA-ReferenceCellInfo field descriptions
referenceCellInfo This field provides OTDOA reference cell information as specified in [LPP].
positionCalculationInfoRef This field provides position calculation assistance data for the reference cell.

– *OMA-LPPe-OTDOA-PositionCalculationInfoRef*

The IE *OMA-LPPe-OTDOA-PositionCalculationInfoRef* is used by the location server to provide location and other information of the reference cell useful for UE-based OTDOA.

```
-- ASN1START

OMA-LPPe-OTDOA-PositionCalculationInfoRef ::= SEQUENCE {
    systemFrameNumber       BIT STRING (SIZE(10))               OPTIONAL, --Cond driftRate
    rtdReferenceStd         OMA-LPPe-OTDOA-RTDquality           OPTIONAL,
    cellLocation            SEQUENCE {
                                reference-point     OMA-LPPe-ReferencePoint         OPTIONAL,
                                relative-location   OMA-LPPe-RelativeLocation       OPTIONAL,
                                ...
                                },
    femtoCellInfo           SEQUENCE {
                                    location-reliability    INTEGER(1..100) OPTIONAL,
                                    ...
                                    }                           OPTIONAL,   --Cond femto

    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
driftRate	The field is mandatory present if *fineRTDdriftRate* is included in *OMA-LPPe-OTDOA-NeighbourCellInfoList*.
femto	This field is mandatory present if the reference cell is a HeNB femto cell; otherwise it is not present.

OMA-LPPe-OTDOA-PositionCalculationInfoRef field descriptions
systemFrameNumber This field specifies the E-UTRA system frame number of the reference cell at which the *rtdInfo* included in *OMA-LPPe-OTDOA-NeighbourCellInfoList* is valid.
rtdReferenceStd This field specifies the standard deviation of the timing of the reference cell, used to determine the RTD values provided in *OMA-LPPe-OTDOA-NeighbourCellInfoList*. This field SHALL be provided if available.
cellLocation This field defines the antenna location of the reference cell.
reference-point This field provides the reference point used to define the cell location. If this field is absent the reference point is the default reference point provided in LPPe common IEs.

***OMA-LPPe-OTDOA-PositionCalculationInfoRef* field descriptions**
relative-location This field provides the location of the cell relative to the reference point. If this field is absent the cell location coincides with the reference point location.
location-reliability The field provides the reliability R of the HeNB location. The probability that the HeNB location has not changed is given as a percentage. R may be based on historic change or persistence of the HeNB location over a period of time and the time interval since the HeNB location was last provided to or verified by the server. Note that location reliability is distinct from location accuracy and refers to the possibility of an HeNB having been moved to a new location. This field SHALL be provided if available.

– *OMA-LPPe-OTDOA-NeighbourCellInfoList*

The IE *OMA-LPPe-OTDOA-NeighbourCellInfoList* is used by the location server to provide neighbour cell information for OTDOA assistance data.

```
-- ASN1START

OMA-LPPe-OTDOA-NeighbourCellInfoList ::= SEQUENCE (SIZE (1..maxFreqLayers)) OF
                                                OMA-LPPe-OTDOA-NeighbourFreqCellInfoList

OMA-LPPe-OTDOA-NeighbourFreqCellInfoList ::= SEQUENCE {
    neighbourCellInfoList-eNB   SEQUENCE (SIZE (1..maxLTEeNBs))  OF
                                            OMA-LPPe-OTDOA-NeighbourCellInfoElement-eNB     OPTIONAL,
    neighbourCellInfoList-HeNB  SEQUENCE (SIZE (1..maxLTEHeNBs)) OF
                                            OMA-LPPe-OTDOA-NeighbourCellInfoElement-HeNB    OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-OTDOA-NeighbourCellInfoList* field descriptions**
neighbourCellInfoList-eNB This field provides OTDOA neighbour cell information for eNodeBs. Either *neighbourCellInfoList-eNB* or *neighbourCellInfoList-HeNB* or both SHALL be present.
neighbourCellInfoList-HeNB This field provides OTDOA neighbour cell information for Home eNodeBs. Either *neighbourCellInfoList-eNB* or *neighbourCellInfoList-HeNB* or both SHALL be present.

– *OMA-LPPe-OTDOA-NeighbourCellInfoElement-eNB*

The IE *OMA-LPPe-OTDOA-NeighbourCellInfoElement-eNB* is used by the location server to provide neighbour cell information for one eNodeB or several co-located eNodeBs as part of OTDOA assistance data.

```
-- ASN1START

OMA-LPPe-OTDOA-NeighbourCellInfoElement-eNB ::= SEQUENCE {
    relative-Location               OMA-LPPe-RelativeLocation,
    otdoa-eNB-CellDataList          SEQUENCE (SIZE (1..maxLTEMacroCells)) OF OMA-LPPe-OTDOA-CellData,
    ...
}

-- ASN1STOP
```


OMA-LPPe-OTDOA-NeighbourCellInfoElement-eNB **field descriptions**
relative-Location This field provides the location and optional uncertainty in location of the antenna of the eNodeB relative to the reference point used to define the location of the reference cell. For an eNodeB with multiple antennas or a set of co-located eNodeBs, the location may be averaged.
otdoa-eNB-CellDataList This field provides OTDOA neighbour cell information for one or more eNodeBs sharing a common eNodeB antenna, or using antennas in close proximity to one another.

– *OMA-LPPe-OTDOA-NeighbourCellInfoElement-HeNB*

The IE *OMA-LPPe-OTDOA-NeighbourCellInfoElement-HeNB* is used by the location server to provide neighbour cell information for one Home eNodeB as part of OTDOA assistance data.

```
-- ASN1START

OMA-LPPe-OTDOA-NeighbourCellInfoElement-HeNB ::= SEQUENCE {
    relative-Location               OMA-LPPe-RelativeLocation,
    location-reliability            INTEGER (1..100)                OPTIONAL,
    otdoa-HeNB-CellDataList         OMA-LPPe-OTDOA-CellData,
    ...
}

-- ASN1STOP
```

OMA-LPPe-OTDOA-NeighbourCellInfoElement-HeNB **field descriptions**
relative-Location This field provides the location and optional uncertainty in location of the antenna of the Home eNodeB relative to the reference point used to define the location of the reference cell.
location-reliability The field provides the reliability R of the HeNB location. The probability that the HeNB location has not changed is given as a percentage. R may be based on historic change or persistence of the HeNB location over a period of time and the time interval since the HeNB location was last provided to or verified by the server. Note that location reliability is distinct from location accuracy and refers to the possibility of an HeNB having been moved to a new location. This field SHALL be provided if available.
otdoa-HeNB-CellDataList This field provides OTDOA neighbour cell information for the Home eNodeB.

– *OMA-LPPe-OTDOA-CellData*

The IE *OMA-LPPe-OTDOA-CellData* is used by the location server to provide neighbour cell information for one eNodeB or Home eNodeB as part of OTDOA assistance data.

```
-- ASN1START

OMA-LPPe-OTDOA-CellData  ::= SEQUENCE {
    otdoa-NeighbourCellInfoElement  OTDOA-NeighbourCellInfoElement,
    rtdInfo                         SEQUENCE {
                                            subframeOffset      INTEGER(0..10229)       OPTIONAL,
                                            fineRTD             INTEGER(0..99999),
                                            fineRTDstd          OMA-LPPe-OTDOA-RTDquality,
                                            fineRTDdriftRate    INTEGER(-100..100)      OPTIONAL,
                                            ...
                                    },
    ...
}
```

```
-- ASN1STOP
```

***OMA-LPPe-OTDOA-NeighbourCellData* field descriptions**
otdoa-NeighbourCellInfoElement This field provides OTDOA neighbour cell information as specified in [LPP].
rtdInfo This field specifies the real time difference between this neighbour cell and the reference cell.
subframeOffset This field specifies the subframe offset between this cell and the reference cell. Define T_{ref} as the time of beginning of frame with SFN_{ref}=0 of the reference cell; define T_{nc} as the time of beginning of frame with SFN_{nc}=0 of this neighbour cell occuring immediately after the time T_{ref}. Then *subframeOffset* = T_{nc} - T_{ref} in units of 1-subframe (1ms). In other words, SFN_{nc} = SFN_{ref} + (*subframeOffset*/10). This field SHALL be provided if available.
fineRTD This field specifies the Real Time Difference between this cell and the reference cell in units of 10 ns. Define t_{ref} as the time of beginning of a subframe of the reference cell; define t_{nc} as the time of beginning of the subframe of this neighbour cell occuring immediately after the time t_{ref}. Then *fineRTD* = t_{nc} - t_{ref} in units of 10 ns.
fineRTDstd This field specifies the standard deviation of the *fineRTD* value.
fineRTDdriftRate This field specifies the drift rate of the RTD between this cell and the reference cell in units of 1 nano-second per second. A positive value indicates that the reference cell clock is running at a greater frequency than the neighbouring cell clock. This field SHALL be provided if available.

– *OMA-LPPe-OTDOA-RTDquality*

The IE *OMA-LPPe-OTDOA-RTDquality* is used by the location server to provide the quality of the Real Time Difference (RTD) information.

```
-- ASN1START

OMA-LPPe-OTDOA-RTDquality ::= SEQUENCE {
    resolution          ENUMERATED { ns-5, ns-10, ns-50, ns-100, ... },
    quality             INTEGER (0..127),
    ...
}

-- ASN1STOP
```

***OMA-LPPe-OTDOA-RTDquality* field descriptions**
resolution This field specifies the resolution of the provided *quality* field. Enumerated values correspond to 5, 10, 50, and 100 ns, respectively.
quality This field specifies the standard deviation of the RTD (or of the timing of the reference cell).

6.5.2.3 OTDOA Assistance Data Request

– *OMA-LPPe-OTDOA-RequestAssistanceData*

The *OMA-LPPe-OTDOA-RequestAssistanceData* is used to request assistance for UE-based OTDOA.

```
-- ASN1START

OMA-LPPe-OTDOA-RequestAssistanceData ::= SEQUENCE {
    lteCell                 SEQUENCE {
                                physCellId      INTEGER(0..503),
                                eARFCN          ARFCN-ValueEUTRA,
                                ecgi            CellGlobalIdEUTRA-AndUTRA           OPTIONAL,
```

```
                                ...,
                                eARFCN-ext      ARFCN-ValueEUTRA-v9a0   OPTIONAL -- Cond EARFCN-ext
                            },
    requestedCells          BIT STRING {
                                    eNBs    (0),
                                    heNBs   (1) }   (SIZE (1..8)),
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
EARFCN-ext	This field is mandatory present if the value of E-UTRA ARFCN is greater than 65535. Otherwise this field is not present.

***OMA-LPPe-OTDOA-RequestAssistanceData* field descriptions**
lteCell This field specifies the Cell-ID of the serving or non-serving but visible LTE cell of the target device.
eARFCN This parameter represents E-UTRA ARFCN. If the value of E-UTRA ARFCN is greater than 65535, this parameter SHALL be set to 65535. eARFCN range: (0..65535).
eARFCN-ext This field specifies the value of E-UTRA ARFCN of the cell as defined in [36.101], if an extended value is used i.e., if the value of E-UTRA ARFCN is > 65535. In this case, this parameter SHALL be sent and set to the value of E-UTRA ARFCN. eARFCN-ext range: (65536..262143)
requestedCells This field specifies whether OTDOA assistance data is requested for eNodeBs, Home eNodeBs, or both. A one value at the bit position means requested.

6.5.2.4 OTDOA Location Information

– *OMA-LPPe-OTDOA-ProvideLocationInformation*

The *OMA-LPPe-OTDOA-ProvideLocationInformation* is used to provide OTDOA-based position estimate (UE-based). It may also be used to provide UE-based OTDOA positioning specific error reason. The actual location estimate is provided in the LPP proper (CommonIEsProvideLocationInformation).

```
-- ASN1START

OMA-LPPe-OTDOA-ProvideLocationInformation ::= SEQUENCE {
    otdoaLocationInformation            OMA-LPPe-OTDOA-LocationInformation          OPTIONAL,
    otdoaError                          OMA-LPPe-OTDOA-Error                        OPTIONAL,
    ...
}

-- ASN1STOP
```

6.5.2.5 OTDOA Location Information Elements

– *OMA-LPPe-OTDOA-LocationInformation*

The IE *OMA-LPPe-OTDOA-LocationInformation* is used by the target device to provide OTDOA location information to the location server. Note that in the event that the target device is unable to calculate a location estimate using UE-based OTDOA, it may still return OTDOA measurements to the server using LPP if permitted by the server in the LPP common IEs in the Request Location Information message.

```
-- ASN1START
```



```
OMA-LPPe-OTDOA-LocationInformation ::= SEQUENCE {
    systemFrameNumber       BIT STRING (SIZE (10)),
    physCellId              INTEGER (0..503),
    cellGlobalId            CellGlobalIdEUTRA-AndUTRA           OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-OTDOA-LocationInformation* field descriptions**
systemFrameNumber This field specifies the SFN for which the location Estimate (provided in the LPP common IEs) is valid.
physCellId This field specifies the physical cell identity of the cell for which the *systemFrameNumber* is provided.
cellGlobalId This field specifies the ECGI, the globally unique identity of a cell in E-UTRA, of the cell for which the *systemFrameNumber* is provided.

6.5.2.6 OTDOA Location Information Request

– *OMA-LPPe-OTDOA-RequestLocationInformation*

The *OMA-LPPe-OTDOA-RequestLocationInformation* is used to request OTDOA-based position estimate (UE-based).

```
-- ASN1START

OMA-LPPe-OTDOA-RequestLocationInformation ::= SEQUENCE {
        assistanceAvailability                  BOOLEAN,
        ...
}

-- ASN1STOP
```

***OMA-LPPe-OTDOA-RequestLocationInformation* field descriptions**
assistanceAvailability This field indicates whether the target device may request additional OTDOA assistance data from the server. TRUE means allowed and FALSE means not allowed.

6.5.2.7 OTDOA Capability Information

– *OMA-LPPe-OTDOA-ProvideCapabilities*

The *OMA-LPPe-OTDOA-ProvideCapabilities* is used by the target to provide its OTDOA capabilities to the server.

```
-- ASN1START

OMA-LPPe-OTDOA-ProvideCapabilities ::= SEQUENCE {
    eNodeB-AD-sup               SEQUENCE { ... }                OPTIONAL,
    home-eNodeB-AD-sup          SEQUENCE { ... }                OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-OTDOA-ProvideCapabilities* field descriptions**
eNodeB-AD-sup This field, if present, indicates that the target supports OTDOA assistance data for eNodeBs.
home-eNodeB-AD-sup This field, if present, indicates that the target supports OTDOA assistance data for Home eNodeBs.

6.5.2.8 OTDOA Capability Information Request

– *OMA-LPPe-OTDOA-RequestCapabilities*

The *OMA-LPPe-OTDOA-RequestCapabilities* is used to request OTDOA capabilities information from the target.

```
-- ASN1START

OMA-LPPe-OTDOA-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.2.9 OTDOA Error Elements

– *OMA-LPPe-OTDOA-Error*

The IE *OMA-LPPe-OTDOA-Error* is used by the location server or target device to provide OTDOA error reasons to the target device or location server, respectively.

```
-- ASN1START

OMA-LPPe-OTDOA-Error ::= CHOICE {
    locationServerErrorCauses       OMA-LPPe-OTDOA-LocationServerErrorCauses,
    targetDeviceErrorCauses         OMA-LPPe-OTDOA-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-OTDOA-LocationServerErrorCauses*

The IE *OMA-LPPe-OTDOA-LocationServerErrorCauses* is used by the location server to provide OTDOA error reasons to the target device.

```
-- ASN1START

OMA-LPPe-OTDOA-LocationServerErrorCauses ::= SEQUENCE {
    cause       ENUMERATED  {   undefined,
                                locationCalculationAssistanceDataNotSupported,
                                locationCalculationAssistanceDataSupportedButCurrentlyNotAvailable,
                                ...
                            },
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-OTDOA-TargetDeviceErrorCauses*

The IE *OMA-LPPe-OTDOA-TargetDeviceErrorCauses* is used by the target device to provide OTDOA error reasons to the location server.

```
-- ASN1START

OMA-LPPe-OTDOA-TargetDeviceErrorCauses ::= SEQUENCE {
    cause       ENUMERATED {    undefined,
                                there-were-not-enough-signals-received-for-ueBased-otdoa,
                                location-calculation-assistance-data-missing,
                                ...
                            },
    ...
}
```

```
-- ASN1STOP
```

6.5.3 EOTD Positioning

6.5.3.1 EOTD Assistance Data

– *OMA-LPPe-EOTD-ProvideAssistanceData*

The IE *OMA-LPPe-EOTD-ProvideAssistanceData* is used to provide assistance for UE-based and UE-assisted EOTD-based methods.

```
-- ASN1START

OMA-LPPe-EOTD-ProvideAssistanceData ::= SEQUENCE {
    referenceBTS                OMA-LPPe-EOTD-ReferenceBTSForAssistance     OPTIONAL,   --Cond NotError
    msrAssistDataList           OMA-LPPe-EOTD-MsrAssistDataList             OPTIONAL,
    systemInfoAssistDataList    OMA-LPPe-EOTD-SystemInfoAssistDataList      OPTIONAL,
    eotdError                   OMA-LPPe-EOTD-Error                         OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
NotError	The field is mandatory present unless the IE *OMA-LPPe-EOTD-ProvideAssistanceData* contains an error message.

OMA-LPPe-EOTD-ProvideAssistanceData field descriptions
referenceBTS This field defines the reference BTS for E-OTD positioning.
msrAssistDataList This field identifies the BTSs that are used for E-OTD positioning.
systemInfoAssistDataList This field identifies the BTSs that are used for E-OTD positioning. This field is used in dedicated mode, packet idle mode, packet transfer mode, or dual transfer mode.
eotdError This field provides the E-OTD assistance data error.

6.5.3.2 EOTD Assistance Data Elements

– *OMA-LPPe-EOTD-ReferenceBTSForAssistance*

The IE *OMA-LPPe-EOTD-ReferenceBTSForAssistance* is used to define the reference BTS for E-OTD positioning. The RTD and 51 multiframe offset values in the *OMA-LPPe-EOTD-MsrAssistDataList* IE and in the *OMA-LPPe-EOTD-SystemInfoAssistDataList* are calculated relative to the BTS indicated in this element.

Inclusion of this parameter is mandatory for E-OTD since it is not possible to reliably default to the current serving BTS for the target, as there is a chance that the server does not know this. If the E-OTD *systemInfoAssistDataList* in IE *OMA-LPPe-EOTD-ProvideAssistData* is present, the current serving cell MUST be the same as reference BTS identified in this element.

```
-- ASN1START

OMA-LPPe-EOTD-ReferenceBTSForAssistance ::= SEQUENCE {
    bsicAndCarrier      OMA-LPPe-CellNonUniqueIDGERAN,
    timeSlotScheme      OMA-LPPe-EOTD-TimeSlotScheme,
    btsPosition         CHOICE {
            ellipsoidPoint                  Ellipsoid-Point,
            ellipsoidPointWithAltitudeAndUncertaintyEllipsoid
                                                    EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
```

```
            ...
            }       OPTIONAL,               --Cond UE-based
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
UE-based	The field is mandatory present if the assistance is for UE-based E-OTD, otherwise it is not present.

***OMA-LPPe-EOTD-ReferenceBTSForAssistance* field descriptions**
bsicAndCarrier This field includes the BSIC and BCCH of the reference BTS.
timeSlotScheme The time slot scheme field indicates the type of transmission scheme the particular BTS is using.
btsPosition In this field, the reference BTS position is given.

– *OMA-LPPe-EOTD-MsrAssistDataList*

This element identifies BTSs that are used for E-OTD measurements. This element helps the UE to make measurements from neighbor BTS (even below decoding level). This element is optional in the E-OTD assistance data. The presence of this element means that the UE should try to measure the E-OTD values between the reference BTS and the BTSs identified in this element.

This element is used to deliver E-OTD measurement assistance data for those BTSs, that are not included in the *systemInfoAssistDataList* of the reference BTS in the IE *OMA-LPPe-EOTD-ProvideAssistanceData*, if necessary.

The RTD and 51 multiframe offset values are calculated relative to the BTS indicated in the E-OTD Reference BTS in Provide Assistance Data.

```
-- ASN1START

OMA-LPPe-EOTD-MsrAssistDataList ::= SEQUENCE (SIZE (1..15)) OF OMA-LPPe-EOTD-MsrAssistBTS

OMA-LPPe-EOTD-MsrAssistBTS ::= SEQUENCE {
    bsicAndCarrier      OMA-LPPe-CellNonUniqueIDGERAN,
    multiFrameOffset    OMA-LPPe-EOTD-MultiFrameOffset,
    timeSlotScheme      OMA-LPPe-EOTD-TimeSlotScheme,
    roughRTD            OMA-LPPe-EOTD-RoughRTD,
    expectedOTD         OMA-LPPe-EOTD-ExpectedOTD,
    calcAssistanceBTS   OMA-LPPe-EOTD-CalcAssistanceBTS     OPTIONAL,   --Cond UE-based
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
UE-based	The field is mandatory present if the assistance is required for UE-based positioning.

***OMA-LPPe-EOTD-MsrAssistDataList* field descriptions**
bsicAndCarrier This field includes the BSIC and BCCH of the reference BTS.

OMA-LPPe-EOTD-MsrAssistDataList **field descriptions**
multiFrameOffset This field indicates the frame difference between the start of the 51 multiframes frames being transmitted from this BTS and the reference BTS.
timeSlotScheme The time slot scheme field indicates the type of transmission scheme the reference BTS is using.
roughRTD This field indicates the rough RTD value between this BTS and reference BTS.
expectedOTD This field indicates the OTD value that the target is expected to measure between this BTS and reference BTS in the estimated location of the target.
calcAssistanceBTS This field specifies the coordinates of the neighbour BTSs that are used for E-OTD measurements, and also fine RTD values. This information allows the target to calculate its own location. This IE is used for UE-based E-OTD positioning.

– *OMA-LPPe-EOTD-SystemInfoAssistDataList*

This element identifies those BTSs in the System Information Neighbor List that are used for E-OTD measurements. This list is sent in the dedicated mode, packet idle mode, packet transfer mode, or dual transfer mode. This element helps the target to make measurements from those neighbour BTSs (even below decoding level). This element is optional. The presence of this element means that the target should use the BTSs identified here to the E-OTD measurements.

The RTD and 51 multiframe offset values are calculated relative to the reference BTS.

```
-- ASN1START

OMA-LPPe-EOTD-SystemInfoAssistDataList ::= SEQUENCE (SIZE (1..32)) OF OMA-LPPe-EOTD-SystemInfoAssistBTS

OMA-LPPe-EOTD-SystemInfoAssistBTS ::= CHOICE{
    notPresent          NULL,
    present             OMA-LPPe-EOTD-AssistBTSData
}

OMA-LPPe-EOTD-AssistBTSData ::= SEQUENCE {
    bsic                INTEGER(0..63),
    multiFrameOffset    OMA-LPPe-EOTD-MultiFrameOffset,
    timeSlotScheme      OMA-LPPe-EOTD-TimeSlotScheme,
    roughRTD            OMA-LPPe-EOTD-RoughRTD,
    expectedOTD         OMA-LPPe-EOTD-ExpectedOTD           OPTIONAL,
    calcAssistanceBTS   OMA-LPPe-EOTD-CalcAssistanceBTS     OPTIONAL,   --Cond UE-based
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
UE-based	The field is mandatory present if the assistance is required for UE-based positioning.

OMA-LPPe-EOTD-SystemInfoAssistDataList **field descriptions**
notPresent This field indicates that assistance data related to the BTS corresponding to the current location in *OMA-LPPe-EOTD-SystemInfoAssistDataList* is not present.
present This field contains the assistance data related to the BTS corresponding to the current location in *OMA-LPPe-EOTD-SystemInfoAssistDataList.*
bsic This field indicates the BSIC (Base Station Identity Code) of the particular BTS.

OMA-LPPe-EOTD-SystemInfoAssistDataList field descriptions
multiFrameOffset This field indicates the frame difference between the start of the 51 multiframes frames being transmitted from this BTS and the reference BTS.
timeSlotScheme The time slot scheme field indicates the type of transmission scheme the reference BTS is using.
roughRTD This field indicates the rough RTD value between this BTS and reference BTS.
expectedOTD This field indicates the OTD value that UE is expected to measure between this BTS and reference BTS in its current estimated location.
calcAssistanceBTS This field specifies the coordinates of neighbour BTSs that are used for E-OTD measurements, and also fine RTD values. This information allows the UE to calculate its own location. This field is used in UE-based E-OTD positioning.

– *OMA-LPPe-EOTD-CalcAssistanceBTS*

The *OMA-LPPe-EOTD-CalcAssistanceBTS* tells the coordinates of neighbour BTSs that are used for E-OTD measurements, and also fine RTD values. This information allows the target to calculate its own location.

```
-- ASN1START

OMA-LPPe-EOTD-CalcAssistanceBTS ::= SEQUENCE {
    fineRTD             OMA-LPPe-EOTD-FineRTD,
    relativePos         OMA-LPPe-EOTD-relativePos,
    ...
}

OMA-LPPe-EOTD-relativePos ::= SEQUENCE {
    relativeNorth       OMA-LPPe-EOTD-RelDistance,
    relativeEast        OMA-LPPe-EOTD-RelDistance,
    relativeAlt         OMA-LPPe-EOTD-RelativeAlt       OPTIONAL,
    ...
}

OMA-LPPe-EOTD-FineRTD ::= INTEGER(0..255)

OMA-LPPe-EOTD-RelDistance ::= INTEGER(-200000..200000)

OMA-LPPe-EOTD-RelativeAlt ::= INTEGER(-4000..4000)

-- ASN1STOP
```

OMA-LPPe-EOTD-CalcAssistanceBTS field descriptions
fineRTD This field indicates the fine RTD value between this BTS and reference BTS. It provides the 1/256 bit duration resolution to the value expressed in the corresponding Rough RTD field. This RTD value is the RTD value of TS0s (i.e. the difference in starting of TS0), not only the RTD between starts of bursts. The RTD is defined as T_{BTS} - T_{Ref}, where T_{BTS} is the time of the start of TS0 in the BTS in question, and T_{Ref} is the time of the start of the TS0 in the reference BTS. Scale factor 1/256 GSM bits. Range [0..1-2^{-8}] GSM bits.
relativePos This field specifies the position of the cell with respect to the reference cell.
relativeNorth This field indicates the distance of the neighbour BTS from the reference BTS in North (negative values mean South) direction. The used reference ellipsoid is WGS 84 ellipsoid. Scale factor 0.03/3600 degrees, range [-6000..6000] 1/3600 degrees.

OMA-LPPe-EOTD-CalcAssistanceBTS field descriptions
relativeEast This field indicates the distance of the neighbour BTS from the reference BTS in East (negative values mean West) direction. The used reference ellipsoid is WGS 84 ellipsoid. Scale factor 0.03/3600 degrees, range [-6000..6000] 1/3600 degrees.
relativeAlt This field indicates the altitude of the neighbor BTS relative to the reference BTS in meters. This field is optional. Scale factor 1 m, range [-4000, 4000] meters.

6.5.3.3 EOTD Assistance Data Request

– *OMA-LPPe-EOTD-RequestAssistanceData*

The *OMA-LPPe-EOTD-RequestAssistanceData* is used to request assistance for UE-based and UE-assisted EOTD-based methods.

```
-- ASN1START

OMA-LPPe-EOTD-RequestAssistanceData ::= SEQUENCE {
    eotdAssistanceReq       BIT STRING { ueAssisted (0), ueBased (1) },
    ...
}

-- ASN1STOP
```

OMA-LPPe-EOTD-RequestAssistanceData field descriptions
eotdAssistanceReq This field specifies, which kind of assistance data is requested for. If bit 0 is set, assistance for UE-assisted E-OTD positioning is requested. If bit 1 is set, assistance for UE-based E-OTD positioning is requested.

6.5.3.4 EOTD Location Information

– *OMA-LPPe-EOTD-ProvideLocationInformation*

The purpose of the *OMA-LPPe-EOTD-ProvideLocationInformation* element is to provide OTD measurements of signals sent from the reference and neighbor base stations. The length of this element depends on the number of neighbor cells for which OTD measurements have been collected. BTSs which cannot be measured or whose measurements are excessively inaccurate need not be reported. The target may include measurements for other BTSs not given in the assistance data by the server.

```
-- ASN1START

OMA-LPPe-EOTD-ProvideLocationInformation ::= SEQUENCE {
    eotdMsrElement          OMA-LPPe-EOTD-MsrElement        OPTIONAL,
    eotdError               OMA-LPPe-EOTD-Error             OPTIONAL,
    ...
}

-- ASN1STOP
```

6.5.3.5 EOTD Location Information Elements

– *OMA-LPPe-EOTD-MsrElement*

The *OMA-LPPe-EOTD-MsrElement* consists of the EOTD location information measurements provided by the target to the server.

```
-- ASN1START
```

```
OMA-LPPe-EOTD-MsrElement ::= SEQUENCE {
    refFrameNumber          INTEGER(0..42431),
    referenceTimeSlot       OMA-LPPe-EOTD-ModuloTimeSlot,
    toaMeasurementsOfRef    OMA-LPPe-EOTD-TOA-MeasurementsOfRef                     OPTIONAL,
    stdResolution           BIT STRING(SIZE(2)),
    taCorrection            INTEGER(0..960)                                         OPTIONAL,
    otd-FirstSetMsrs        SEQUENCE (SIZE(1..15)) OF OMA-LPPe-EOTD-MeasurementWithID   OPTIONAL,
    ...
}


OMA-LPPe-EOTD-TOA-MeasurementsOfRef ::= SEQUENCE {
    refQuality              BIT STRING(SIZE(5)),
    numOfMeasurements       BIT STRING(SIZE(3)),
    ...
}

-- ASN1STOP
```

***OMA-LPPe-EOTD-MsrElement* field descriptions**
refFrameNumber This field indicates the frame number of the last measured burst from the reference BTS modulo 42432. This information can be used as a time stamp for the measurements. Scale factor 1 frame.
referenceTimeSlot Reference Time Slot indicates the time slot modulo 4 relative to which the target reports the reference BTS measurements. NOTE: If target does not know timeslot scheme, the target reports the used timeslot. Target can only report results based on one time slot (N) or two time slots (N and N+4). If the target knows the timeslot scheme, it can make measurements from several timeslots and reports that the used timeslot is zero (and makes correction).
toaMeasurementsOfRef This field consists of reference quality and number of measurements.
stdResolution Std Resolution field includes the resolution used in Reference Quality field and Std of EOTD Measurements field. Encoding on 2 bits as follows: '00' 10 meters; '01' 20 meters; '10' 30 meters; '11' Reserved.
taCorrection This field indicates the estimate of the time difference between the moment that the target uses to adjust its internal timing for reception and transmission (e.g. corresponding to maximum energy) and the estimate of the reception of the first arriving component from the serving BTS. This value can be used as a correction by the server to the Timing Advance (TA) value when the distance between the target and the serving BTS is estimated based on TA. The value *TACorrection* in this field corresponds to the TA Correction in bit periods as follows: - TA Correction in bit periods = *TACorrection*/64 -8. Scale factor 1/64 bit period, range [-8..+7] bit periods. Negative TA Correction in bits indicates that the first signal component from the serving BTS is estimated to arrive before the moment used for communication.
otd-FirstSetMsrs Measured neighbors in OTD measurements.

OMA-LPPe-EOTD-MsrElement **field descriptions**
refQuality Reference Quality field includes the standard deviation of the TOA measurements from the reference BTS with respect to T_{Ref} (where T_{Ref} is the time of arrival of signal from the reference BTS used to calculate the OTD values). This field is optional. The Reference Quality field can be used to evaluate the reliability of E-OTD measurements in the server and in weighting of the E-OTD values in the location calculation. Following linear 5 bit encoding is used: '00000' 0 - (R*1-1) meters; '00001' R*1 - (R*2-1) meters; '00010' R*2 - (R*3-1) meters; … '11111' R*31 meters or more. where R is the resolution defined by Std Resolution field. For example, if R=20 meters, corresponding values are 0 - 19 meters, 20 - 39 meters, 40 - 59 meters, …, 620+ meters.
numOfMeasurements Number of Measurements for the Reference Quality field is used together with Reference Quality to define quality of the reference base site TOA. The field indicates how many measurements have been used in the target to define the standard deviation of the measurements. The following 3 bit encoding is used: '000': 2-4; '001': 5-9; '010': 10-14 '011': 15-24; '100': 25-34; '101': 35-44; '110': 45-54; '111': 55 or more.

– *OMA-LPPe-EOTD-MeasurementWithID*

The *OMA-LPPe-EOTD-MeasurementWithID* defines the EOTD measurement for BTS with known ID.

```
-- ASN1START


OMA-LPPe-EOTD-MeasurementWithID ::= SEQUENCE {
    neighborIdentity        OMA-LPPe-EOTD-NeighborIdentity,
    nborTimeSlot            OMA-LPPe-EOTD-ModuloTimeSlot,
    eotdQuality             OMA-LPPe-EOTD-EOTDQuality,
    otdValue                OMA-LPPe-EOTD-OTDValue,
    ...
}


OMA-LPPe-EOTD-NeighborIdentity ::= CHOICE {
    bsicAndCarrier      OMA-LPPe-CellNonUniqueIDGERAN,
    ci                  OMA-LPPe-EOTD-CellID,
    multiFrameCarrier   OMA-LPPe-EOTD-MultiFrameCarrier,
    requestIndex        OMA-LPPe-EOTD-RequestIndex,
    systemInfoIndex     OMA-LPPe-EOTD-SystemInfoIndex,
    ciAndLac            OMA-LPPe-CellLocalIdGERAN,
    ...
}

OMA-LPPe-EOTD-EOTDQuality ::= SEQUENCE {
    nbrOfMeasurements           BIT STRING(SIZE(3)),
    stdOfEOTD                   BIT STRING(SIZE(5)),
    ...
}
```

```
OMA-LPPe-EOTD-OTDValue ::= INTEGER (0..39999)

OMA-LPPe-EOTD-CellID ::= INTEGER (0..65535)

OMA-LPPe-EOTD-RequestIndex ::= INTEGER (1..16)
OMA-LPPe-EOTD-SystemInfoIndex ::= INTEGER (1..32)

OMA-LPPe-EOTD-MultiFrameCarrier ::= SEQUENCE {
    bcchCarrier         OMA-LPPe-EOTD-BCCHCarrier,
    multiFrameOffset    OMA-LPPe-EOTD-MultiFrameOffset,
    ...
}

OMA-LPPe-EOTD-BCCHCarrier ::= INTEGER (0..1023)

-- ASN1STOP
```

***OMA-LPPe-EOTD-MeasurementWithID* field descriptions**
neighborIdentity This field identifies the neighbour cell.
nborTimeSlot Neighbor Time Slot indicates the time slot modulo 4 relative to which the UE reports the neighbor BTS measurements. NOTE: If the UE does not know the timeslot scheme, the target reports the used timeslot. Target can only report a result based on one time slot (N) or two time slots (N and N+4). If the target knows the timeslot scheme, the target can make measurements from several timeslots and reports that the used timeslot is zero (and makes the correction).
eotdQuality This field includes the number of measurements and the standard deviation of EOTD measurements.
otdValue This field indicates the measured OTD value between the receptions of signals from the reference and the neighbour BTS. The OTD is defined as T_{Nbor} - T_{Ref} (modulo burst length) where T_{Nbor} is the time of arrival of signal from the neighbour BTS, and T_{Ref} is the time of arrival of signal from the reference BTS. The scale factor is 1/256 GSM bits. Range [0..156.2461] GSM bits.
bsicAndCarrier Cell identity is specified using BSIC and BCCH carrier.
ci Cell identity is told using CI, and the LAC is the same as the current serving BTS.
multiFrameCarrier Cell identity is specified using 51 Multiframe offset and BCCH carrier.
requestIndex Cell identity is specified using an index referring to the BTS listed in the assistance data component *OMA-LPPe-EOTD-MsrAssistdDataList*.
systemInfoIndex Cell identity is specified using an index referring to the BTS listed in the BCCH allocation list of the serving BTS, *OMA-LPPe-EOTD-SystemInfoAssistDataList* component of assistance data. This type of neighbor identity SHALL NOT be used by the target unless it has received the "E-OTD Measurement Assistance Data for System Information List Element" from the server for this cell.
ciAndLac Cell identity is specified using CI and the LAC.

OMA-LPPe-EOTD-MeasurementWithID field descriptions
nbrOfMeasurements Number of Measurements field is used together with Std of EOTD Measurements field to define quality of a reported EOTD measurement. The field indicates how many EOTD measurements have been used in the target to define the standard deviation of these measurements. The following 3 bit encoding is used. '000': 2-4; '001': 5-9; '010': 10-14; '011': 15-24; '100': 25-34; '101': 35-44; '110': 45-54; '111': 55 or more.
stdOfEOTD Std of EOTD Measurements field includes standard deviation of EOTD measurements. It can be used to evaluate the reliability of EOTD measurements in the server and in weighting of the OTD values in location calculation. Following linear 5 bit encoding is used: '00000' 0 - (R*1-1) meters; '00001' R*1 - (R*2-1) meters; '00010' R*2 - (R*3-1) meters; … '11111' R*31 meters or more. where R is the resolution defined by Std Resolution field. For example, if R=20 meters, corresponding values are 0 - 19 meters, 20 - 39 meters, 40 - 59 meters, …, 620+ meters.
multiFrameOffset This field indicates the frame difference between the start of the 51 multiframes frames arriving from this BTS and the reference BTS. The multiframe offset is defined as T_{BTS} - T_{Ref}, where T_{BTS} is the time of the start of the 51 multiframe in the BTS in question, and T_{Ref} is the time of the start of the 51 multiframe in the reference BTS. The scale factor is 1 frame.

6.5.3.6 EOTD Location Information Request – *OMA-LPPe-EOTD-RequestLocationInformation*

The *OMA-LPPe-EOTD-RequestLocationInformation* is used to request EOTD-based position estimate (UE-based) and measurements (UE-assisted).

```
-- ASN1START

OMA-LPPe-EOTD-RequestLocationInformation ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.3.7 EOTD Capability Information – *OMA-LPPe-EOTD-ProvideCapabilities*

The *OMA-LPPe-EOTD-ProvideCapabilities* is used by the target to provide its EOTD capabilities to the server.

```
-- ASN1START

OMA-LPPe-EOTD-ProvideCapabilities ::= SEQUENCE {
    eotdSupport BIT STRING{ ueBased(0), ueAssisted(1) },
```

```
    ...
}

-- ASN1STOP
```

6.5.3.8 EOTD Capability Information Request

– *OMA-LPPe-EOTD-RequestCapabilities*

The *OMA-LPPe-EOTD-RequestCapabilities* is used to request EOTD capabilities information from the target.

```
-- ASN1START

OMA-LPPe-EOTD-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.3.9 EOTD Error Elements

– *OMA-LPPe-EOTD-Error*

The *OMA-LPPe-EOTD-Errors* is used by the location server or target device to provide E-OTD error reasons to the target device or location server, respectively.

```
-- ASN1START

OMA-LPPe-EOTD-Error ::= CHOICE {
    locationServerErrorCauses       OMA-LPPe-EOTD-LocationServerErrorCauses,
    targetDeviceErrorCauses         OMA-LPPe-EOTD-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-EOTD-LocationServerErrorCauses*

The *OMA-LPPe-EOTD-LocationServerErrorCauses* is used by the location server to provide E-OTD error reasons to the target device.

```
-- ASN1START

OMA-LPPe-EOTD-LocationServerErrorCauses ::= SEQUENCE {
    cause           ENUMERATED{ undefined,
                                assistanceDataForUEbasedEOTDnotAvailable,
                                assistanceDataForUEassistedEOTDnotAvailable,
                                ...},
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-EOTD-TargetDeviceErrorCauses*

The *OMA-LPPe-EOTD-TargetDeviceErrorCauses* is used by the target device to provide E-OTD error reasons to the location server.

```
-- ASN1START
```



```
OMA-LPPe-EOTD-TargetDeviceErrorCauses ::= SEQUENCE {
    cause           ENUMERATED{ undefinedError,
                                notEnoughBTsforEOTD,
                                assistanceDataMissing,
                                referenceCellNotServingCell,
                                eotdMeasurementsNotSupported,
                                eotdMeasurementsNotAvailable,
                                uebasedEOTDnotSupported,
                                ...},
    ...
}

-- ASN1STOP
```

6.5.3.10 EOTD Common Information

– *OMA-LPPe-EOTD-TimeSlotScheme*

```
-- ASN1START

OMA-LPPe-EOTD-TimeSlotScheme ::= ENUMERATED {
    equalLength (0),
    variousLength (1)
}

-- ASN1STOP
```

OMA-LPPe-EOTD-TimeSlotScheme **field descriptions**
OMA-LPPe-EOTD-TimeSlotScheme The time slot scheme field indicates the type of transmission scheme the reference BTS is using. If the target measures BTSs signals from time slots other than 0 or 4 and the target is informed about the burst length schemes used by BTSs, the target can compensate for the possible error. (This is necessary if the target averages bursts from different time slots, and the BTS uses varying lengths of bursts.) '0' = all time slots are 156,25 bits long. '1' = time slots 0 and 4 are 157 bits long and other time slots are 156 bits long.

– *OMA-LPPe-EOTD-MultiFrameOffset*

```
-- ASN1START

OMA-LPPe-EOTD-MultiFrameOffset ::= INTEGER (0..51)

-- ASN1STOP
```


***OMA-LPPe-EOTD-MultiFrameOffset* field descriptions**
OMA-LPPe-EOTD-MultiFrameOffset This field indicates the frame difference between the start of the 51 multiframes frames being transmitted from this BTS and the reference BTS. The multiframe offset is defined as T_{BTS} - T_{Ref}, where T_{BTS} is the time of the start of the 51 multiframe in the BTS in question, and T_{Ref} is the time of the start of the 51 multiframe in the reference BTS. This field is mandatory. Multiframe Offset may be used to calculate the Expected Multiframe Offset (the Multiframe Offset value that the target is expected to measure between this BTS and reference BTS in its current estimated location). Expected Multiframe Offset = (Multiframe Offset + Adjustment) modulo 51 Adjustment = 1 if Rough RTD - Expected OTD >= 850 Adjustment = -1 if Rough RTD - Expected OTD =< -850 Adjustment = 0 if -400 =< Rough RTD - Expected OTD =< 400 If the Rough RTD - Expected OTD is not within any of the ranges above, an error has occurred and the Expected OTD should be ignored and no Expected Multiframe Offset can be calculated. Usable range of Multiframe Offset value is 0 - 50. The Multiframe Offset value 51 SHALL NOT be encoded by the transmitting entity and SHALL be treated by the receiving entity as 0.

– *OMA-LPPe-EOTD-RoughRTD*

```
-- ASN1START

OMA-LPPe-EOTD-RoughRTD ::= INTEGER (0..1250)

-- ASN1STOP
```

***OMA-LPPe-EOTD-RoughRTD* field descriptions**
OMA-LPPe-EOTD-RoughRTD This field indicates the rough RTD value between this BTS and reference BTS. The used resolution is 1 bit. This RTD value is the RTD value of TS0s (i.e. the difference in starting of TS0), not only the RTD between starts of bursts. The RTD is defined as T_{BTS} - T_{Ref}, where T_{BTS} is the time of the start of TS0 in the BTS in question, and T_{Ref} is the time of the start of the TS0 in the reference BTS. This field is mandatory. Usable range of Rough RTD value is 0 - 1249. The Rough RTD value 1250 SHALL NOT be encoded by the transmitting entity and SHALL be treated by the receiving entity as 0. Accurate RTD values are needed for UE-based E-OTD, i.e. when the target calculates its own position. The scale factor is 1 GSM bit.

– *OMA-LPPe-EOTD-ExpectedOTD*

```
-- ASN1START

OMA-LPPe-EOTD-ExpectedOTD ::= SEQUENCE {
    expectedOTD         INTEGER(0..1250),
    expOTDUncertainty   INTEGER(0..7),
    ...
}

-- ASN1STOP
```


OMA-LPPe-EOTD-ExpectedOTD field descriptions
expectedOTD This field indicates the OTD value that the target is expected to measure between this BTS and reference BTS in its current estimated location. The server can estimate target's location roughly e.g. based on serving BTS coordinates, TA, and possibly some other information. This OTD value is the OTD value of TS0s (i.e. the difference in starting of TS0), not only the OTD between starts of bursts. The OTD is defined as T_{BTS} - T_{Ref}, where T_{BTS} is the time of the start of TS0 in the BTS in question, and T_{Ref} is the time of the start of the TS0 in the reference BTS. The server SHALL send this element to the target supporting UE-Assisted or UE-Based E-OTD. Usable range of Expected OTD value is 0 - 1249. The Expected OTD value 1250 SHALL NOT be encoded by the transmitting entity and SHALL be treated by the receiving entity as 0. The scale factor is 1 GSM bit.
expOTDUncertainty This field indicates the uncertainty in Expected OTD value. The uncertainty is related to server's estimation of target's location. The uncertainty defines following search window for the target, which window the target can use to speed up the OTD measurements: Expected OTD - Uncertainty < measured OTD < Expected OTD + Uncertainty. Range is 0 - 7 with following encoding: '0' 0 < uncertainty <= 2 bits; '1' 2 < uncertainty <= 4 bits; '2' 4 < uncertainty <= 8 bits; '3' 8 < uncertainty <= 12 bits; '4' 12 < uncertainty <= 16 bits; '5' 16 < uncertainty <= 22 bits; '6' 22 < uncertainty <= 30 bits; '7' uncertainty > 30 bits. NOTE: If uncertainty in UE's location is x bits, uncertainty in Expected OTD is 2*x (in the worst case). When the uncertainty is given with value '7' no upper bound exists for the uncertainty.

– *OMA-LPPe-EOTD-ModuloTimeSlot*

```
-- ASN1START

OMA-LPPe-EOTD-ModuloTimeSlot ::= INTEGER(0..3)

-- ASN1STOP
```

OMA-LPPe-EOTD-ModuloTimeSlot field descriptions
OMA-LPPe-EOTD-ModuloTimeSlot This field indicates the time slot modulo 4.

6.5.4 OTDOA-UTRA Positioning

6.5.4.1 OTDOA-UTRA Assistance Data

– *OMA-LPPe-OTDOA-UTRA-ProvideAssistanceData*

The *OMA-LPPe-OTDOA-UTRA-ProvideAssistanceData* is used to provide assistance for UE-based and UE-assisted

OTDOA-UTRA -based methods.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-ProvideAssistanceData ::= SEQUENCE {
    referenceCellInfo       OMA-LPPe-OTDOA-UTRA-ReferenceCellInfo   OPTIONAL,
    neigborCellList         OMA-LPPe-OTDOA-UTRA-NeighborCellList    OPTIONAL,
    otdoaUtraError          OMA-LPPe-OTDOA-UTRA-Error               OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-OTDOA-UTRA-ProvideAssistanceData field descriptions
referenceCellInfo This field defines the reference cell information.
neighborCellList This field lists the neighbor cells.
otdoaUtraError This field provides the OTDOA-UTRA assistance data error.

6.5.4.2 OTDOA-UTRA Assistance Data Elements

– *OMA-LPPe-OTDOA-UTRA-ReferenceCellInfo*

The *OMA-LPPe-OTDOA-UTRA-ReferenceCellInfo* information element contains the data related to the reference cell.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-ReferenceCellInfo ::= SEQUENCE {
    sfn                     INTEGER(0..4095)            OPTIONAL,
    modeSpecificInfo    CHOICE {
        fdd                 SEQUENCE {
            primaryCPICH-info           OMA-LPPe-OTDOA-UTRA-PrimaryCPICH-Info
            },
        tdd                 SEQUENCE {
            cellAndChannelIdentity      OMA-LPPe-OTDOA-UTRA-CellAndChannelIdentity
            }
        },
    frequencyInfo           OMA-LPPe-UTRA-FrequencyInfo             OPTIONAL,
    refPosAssist            OMA-LPPe-OTDOA-UTRA-RefPosAssist        OPTIONAL,   --Cond UE-based
    ipdl-parameters         OMA-LPPe-OTDOA-UTRA-IPDL-Parameters     OPTIONAL,
    ...
}



OMA-LPPe-OTDOA-UTRA-RefPosAssist ::= SEQUENCE {
    cellPosition                CHOICE {
            ellipsoidPoint              Ellipsoid-Point,
            ellipsoidPointWithAltitude  EllipsoidPointWithAltitude,
            ...
            },
    roundTripTime               INTEGER (0..32766)          OPTIONAL,
    roundTripTimeExtension      INTEGER (0..70274)          OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
UE-based	The field is mandatory present if UE-based OTDOA positioning is used.

***OMA-LPPe-OTDOA-UTRA-ReferenceCellInfo* field descriptions**
sfn Time stamp (SFN of Reference Cell) of the SFN-SFN relative time differences and SFN-SFN drift rates. Included if any SFN-SFN drift value is included in IE *OMA-LPPe-OTDOA-UTRA-NeighborCellInfo.*
primaryCPICH-info Primary scrambling code for FDD.
cellAndChannelIdentity Identifies the channel to be measured on (TDD).
frequencyInfo Default value is the existing value of frequency information.
refPosAssist This field contains the information related to the reference cell, needed for the UE-based OTDOA positioning.
ipdl-parameters If this element is not included there are no idle periods present.
cellPosition Defines the reference cell antenna position.
roundTripTime Round trip time in chips. Scale factor 0.0625 chips. The actual value of the round-trip-time is given by: RTT = IE value * 0.0625 + 876 chips.
roundTripTimeExtension Round trip time extension in chips. Default =0. Round trip time = IE “roundTripTime” + IE “roundTripTimeExtension” Scale factor 0.0625 chips. Range [0..4392.125] chips.

– *OMA-LPPe-OTDOA-UTRA-NeighborCellList*

The *OMA-LPPe-OTDOA-UTRA-NeighborCellList* IE lists the neighbor cell information.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-NeighborCellList ::= SEQUENCE (SIZE (1..utra-maxCellMeas)) OF
                                                                OMA-LPPe-OTDOA-UTRA-NeighborCellInfo

OMA-LPPe-OTDOA-UTRA-NeighborCellInfo ::= SEQUENCE {
    modeSpecificInfo    CHOICE {
        fdd                 SEQUENCE {
            primaryCPICH-info           OMA-LPPe-OTDOA-UTRA-PrimaryCPICH-Info
            },
        tdd                 SEQUENCE {
            cellAndChannelIdentity      OMA-LPPe-OTDOA-UTRA-CellAndChannelIdentity
            }
        },
    frequencyInfo                   OMA-LPPe-UTRA-FrequencyInfo                     OPTIONAL,
    ipdl-parameters                 OMA-LPPe-OTDOA-UTRA-IPDL-Parameters             OPTIONAL,
    sfn-SFN-relTimeDifference       OMA-LPPe-OTDOA-UTRA-SFN-SFN-RelTimeDifference1,
    sfn-offsetValidity              OMA-LPPe-OTDOA-UTRA-SFN-OffsetValidity          OPTIONAL,
    sfn-SFN-drift                   OMA-LPPe-OTDOA-UTRA-SFN-SFN-Drift               OPTIONAL,
    searchWindowSize                OMA-LPPe-OTDOA-UTRA-SearchWindowSize,
    positioningAssistance           OMA-LPPe-OTDOA-UTRA-PositioningAssistance   OPTIONAL, --Cond UEbased
    ...
}

OMA-LPPe-OTDOA-UTRA-SFN-SFN-RelTimeDifference1 ::= SEQUENCE {
    sfn-offset                  INTEGER (0..4095),
```

```
    sfn-sfn-relTimeDifference   INTEGER (0..38399)
}

OMA-LPPe-OTDOA-UTRA-PositioningAssistance ::= SEQUENCE {
    relativeNorth               INTEGER (-20000..20000),
    relativeEast                INTEGER (-20000..20000),
    relativeAltitude            INTEGER (-4000..4000)               OPTIONAL,
    fineSFN-SFN                 OMA-LPPe-OTDOA-UTRA-fineSFN-SFN,
    roundTripTime               INTEGER (0..32766)                  OPTIONAL,
    roundTripTimeExtension      INTEGER (0..70274)                  OPTIONAL,
    ...
}

utra-maxCellMeas    INTEGER ::= 32

OMA-LPPe-OTDOA-UTRA-SFN-OffsetValidity ::= ENUMERATED { false }

OMA-LPPe-OTDOA-UTRA-SFN-SFN-Drift ::= ENUMERATED {
            sfnsfndrift0, sfnsfndrift1, sfnsfndrift2,
            sfnsfndrift3, sfnsfndrift4, sfnsfndrift5,
            sfnsfndrift8, sfnsfndrift10, sfnsfndrift15,
            sfnsfndrift25, sfnsfndrift35, sfnsfndrift50,
            sfnsfndrift65, sfnsfndrift80, sfnsfndrift100,
            sfnsfndrift-1, sfnsfndrift-2, sfnsfndrift-3,
            sfnsfndrift-4, sfnsfndrift-5, sfnsfndrift-8,
            sfnsfndrift-10, sfnsfndrift-15, sfnsfndrift-25,
            sfnsfndrift-35, sfnsfndrift-50, sfnsfndrift-65,
            sfnsfndrift-80, sfnsfndrift-100,
            ... }

OMA-LPPe-OTDOA-UTRA-SearchWindowSize ::= ENUMERATED { c20, c40, c80, c160, c320,
                                                     c640, c1280, moreThan1280, ... }

OMA-LPPe-OTDOA-UTRA-fineSFN-SFN ::= INTEGER (0..15)

-- ASN1STOP
```

Conditional presence	Explanation
UEbased	The field is mandatory present if the UE-based OTDOA positioning is used. Otherwise it is not present.

***OMA-LPPe-OTDOA-UTRA-NeighborCellList* field descriptions**
primaryCPICH-info Primary scrambling code for FDD.
cellAndChannelIdentity Identifies the channel to be measured on for TDD.
frequencyInfo Default value is the existing value of frequency information.
ipdl-parameters If this element is not included there are no idle periods present.
sfn-SFN-relTimeDifference Consists of SFN offset and SFN-SFN relative time difference.
sfn-offsetValidity Absence of this element means SFN offset is valid. FALSE means SFN offset is not valid.
sfn-sfn-drift Drift value in 1/256 chips per second.
searchWindowSize Search window size in chips. If the value is X then the expected SFN-SFN observed time difference is in the range [RTD-X, RTD+X] where RTD is the value of the field SFN-SFN relative time difference.
positioningAssistance This field contains the information related to the neighbor cell, needed for the UE-based OTDOA positioning.

***OMA-LPPe-OTDOA-UTRA-NeighborCellList* field descriptions**
sfnOffset Define SFNref as the system frame number of the reference cell. Let the system frame number of the neighbour cell be SFNnc. Then SFNnc=SFNref-SFNoffset modulo 4096.
sfn-sfnRelTimeDifference Gives the relative timing compared to the reference cell. Equal to floor ((Tnc – Tref)*(3.84*10^6)). In chips, Tnc = the time of beginning of a system frame from the neighbour cell, Tref = the time of beginning of a system frame from the reference cell.
relativeNorth Relative position compared to reference cell. Scale factor 0.03/3600 degrees, range [-600..600] 1/3600 degrees.
relativeEast Relative position compared to reference cell. Scale factor 0.03/3600 degrees, range [-600..600] 1/3600 degrees.
relativeAltitude Relative altitude compared to reference cell. Scale factor 1m, range [-4000..4000] meters
fineSFN-SFN Gives finer resolution. Scale factor 0.0625 chips, range [0..0.9375] chips.
roundTripTime Round trip time in chips. Included if cell is in active set. The round-trip-time may be recovered from the IE value by: RTT = IE value * 0.0625 + 876 chips. Scale factor 0.0625 chips, range [876.00..2923.875] chips.
roundTripTimeExtension Round trip time extension in chips. Included if cell is in active set. Default =0. Round trip time = IE “roundTripTime” + IE “roundTripTimeExtension” Scale factor 0.0625 chips, range [0..4392.125] chips.

– *OMA-LPPe-OTDOA-UTRA-IPDL-parameters*

The *OMA-LPPe-OTDOA-UTRA-IPDL-parameters* introduces the IPDL parameters. For reference on all the fields, see [25.214] and [25.224].

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-IPDL-Parameters ::= SEQUENCE {
    modeSpecificInfo        CHOICE {
        fdd                     SEQUENCE {
            ip-spacing              OMA-LPPe-OTDOA-UTRA-IP-Spacing,
            ip-length               OMA-LPPe-OTDOA-UTRA-IP-Length,
            ip-Offset               INTEGER (0..9),
            seed                    INTEGER (0..63),
            burstModeParameters     OMA-LPPe-OTDOA-UTRA-BurstModeParameters     OPTIONAL
        },
        tdd                     SEQUENCE {
            ip-spacing-tdd          OMA-LPPe-OTDOA-UTRA-IP-Spacing-TDD,
            ip-slot                 INTEGER (0..14),
            ip-start                INTEGER (0..4095),
            ip-PCCPCH               OMA-LPPe-OTDOA-UTRA-IP-PCCPCH               OPTIONAL,
            burstModeParameters     OMA-LPPe-OTDOA-UTRA-BurstModeParameters
        }
    }
}

OMA-LPPe-OTDOA-UTRA-IP-Spacing ::= ENUMERATED { e5, e7, e10, e15, e20, e30, e40, e50}

OMA-LPPe-OTDOA-UTRA-IP-Length ::= ENUMERATED {ipl5, ipl10}

OMA-LPPe-OTDOA-UTRA-IP-Spacing-TDD ::= ENUMERATED { e30, e40, e50, e70, e100 }
```



```
OMA-LPPe-OTDOA-UTRA-IP-PCCPCH ::= BOOLEAN

OMA-LPPe-OTDOA-UTRA-BurstModeParameters ::= SEQUENCE {
    burstStart          INTEGER (0..15),
    burstLength         INTEGER (10..25),
    burstFreq           INTEGER (1..16)
}

-- ASN1STOP
```

6.5.4.3 OTDOA-UTRA Assistance Data Request

– *OMA-LPPe-OTDOA-UTRA-RequestAssistanceData*

The *OMA-LPPe-OTDOA-UTRA-RequestAssistanceData* is used to request assistance for UE-based and UE-assisted OTDOA-UTRA-based methods.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-RequestAssistanceData ::= SEQUENCE {
    otdoaUtraAssistanceReq      BIT STRING { ueAssisted (0), ueBased (1) } (SIZE(1..8)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-OTDOA-UTRA-RequestAssistanceData **field descriptions**
otdoaUtraAssistanceReq If bit 0 is set, assistance for UE-assisted OTDOA-UTRA positioning is requested. If bit 1 is set, assistance for UE-based OTDOA-UTRA positioning is requested.

6.5.4.4 OTDOA-UTRA Location Information

– *OMA-LPPe-OTDOA-UTRA-ProvideLocationInformation*

The purpose of the *OMA-LPPe-OTDOA-UTRA-ProvideLocationInformation* element is to provide measurements of signals sent from the reference and neighbor base stations.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-ProvideLocationInformation ::= SEQUENCE {
    otdoaUtraMeasurement            OMA-LPPe-OTDOA-UTRA-Measurement         OPTIONAL,
    otdoaUtraError                  OMA-LPPe-OTDOA-UTRA-Error               OPTIONAL,
    timeStampData                   OMA-LPPe-OTDOA-UTRA-TimeStampData       OPTIONAL, --Cond UE-based
    ...
}

-- ASN1STOP
```

Conditional presence	**Explanation**
UEbased	The field is mandatory present if the UE-based OTDOA positioning is used. Otherwise it is not present.

OTDOA-UTRA-ProvideLocatioInformation **field descriptions**
otdoaUtraMeasuruement This field specifies the UTRA OTDOA measurements.
otdoaUtraError This field specifies the UTRA OTDOA errors.

OTDOA-UTRA-ProvideLocatioInformation field descriptions
timeStampData This field specifies the time of the location estimate.

6.5.4.5 OTDOA-UTRA Location Information Elements

– *OMA-LPPe-OTDOA-UTRA-Measurement*

The *OMA-LPPe-OTDOA-UTRA-Measurement* consists of the OTDOA-UTRA location information measurements provided by the target to the server.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-Measurement ::= SEQUENCE {
    sfn                     INTEGER (0..4095),
    modeSpecificInfoMeas    CHOICE {
        fdd                     SEQUENCE {
            referenceCellIdentity              OMA-LPPe-OTDOA-UTRA-PrimaryCPICH-Info,
            ue-RX-TX-TimeDifferenceType2Info    OMA-LPPe-OTDOA-UTRA-UE-RX-TX-TimeDifferenceType2Info,
            ...
            },
        tdd                     SEQUENCE {
            cellAndChannelIdentity             OMA-LPPe-OTDOA-UTRA-CellAndChannelIdentity,
            ...
            }
    },
    neighborList            OMA-LPPe-OTDOA-UTRA-NeighborList        OPTIONAL,
    ...
}

OMA-LPPe-OTDOA-UTRA-UE-RX-TX-TimeDifferenceType2Info ::= SEQUENCE {
    ue-RX-TX-timeDifferenceType2        OMA-LPPe-OTDOA-UTRA-TimeDifferenceType2,
    neighborQuality                     OMA-LPPe-OTDOA-UTRA-NeighborQuality
}

OMA-LPPe-OTDOA-UTRA-TimeDifferenceType2 ::= INTEGER(0..8191)

OMA-LPPe-OTDOA-UTRA-NeighborList ::= SEQUENCE (SIZE (1..utra-maxCellMeas)) OF
                                            OMA-LPPe-OTDOA-UTRA-Neighbor

OMA-LPPe-OTDOA-UTRA-Neighbor ::= SEQUENCE {
    modeSpecificInfo    CHOICE {
        fdd                 SEQUENCE {
            neighborIdentity                   OMA-LPPe-OTDOA-UTRA-PrimaryCPICH-Info   OPTIONAL,
            ue-RX-TX-timeDifferenceType2Info
                                OMA-LPPe-OTDOA-UTRA-UE-RX-TX-TimeDifferenceType2Info    OPTIONAL,
            ... },
        tdd                 SEQUENCE {
            cellAndChannelIdentity      OMA-LPPe-OTDOA-UTRA-CellAndChannelIdentity  OPTIONAL,
            uarfcn                      ARFCN-ValueUTRA                             OPTIONAL,
            ... }
    },
    neighborQuality                 OMA-LPPe-OTDOA-UTRA-NeighborQuality,
    sfn-sfn-ObsTimeDifference2      OMA-LPPe-OTDOA-UTRA-SFN-SFN-ObsTimeDifference2,
    ...
}

OMA-LPPe-OTDOA-UTRA-NeighborQuality ::= SEQUENCE {
    quality             OMA-LPPe-OTDOA-UTRA-Quality,
    ...
}

OMA-LPPe-OTDOA-UTRA-SFN-SFN-ObsTimeDifference2 ::= INTEGER (0..65535)

OMA-LPPe-OTDOA-UTRA-Quality ::= SEQUENCE {
    stdResolution                   BIT STRING (SIZE (2)),
    numberOfOTDOA-Measurements      BIT STRING (SIZE (3)),
    stdOfOTDOA-Measurements         BIT STRING (SIZE (5)),
    ...
```

```
}

-- ASN1STOP
```

OMA-LPPe-OTDOA-UTRA-Measurement **field descriptions**
sfn SFN during which the last measurement was performed.
modeSpecificInfoMeas This field contains TDD- and FDD- specific information.
referenceCellIdentity Identifies reference cell.
ue-RX-TX-TimeDifferenceType2Info The difference in time between the uplink and downlink and the quality of measurements.
cellAndChannelIdentity Identifies the channel to be measured.
neighborList Lists the neighbor cell measurements.
ue-RX-TX-TimeDifferenceType2 The difference in time between the UE uplink DPCCH/DPDCH frame transmission and the first detected path (in time), of the downlink DPCH or F-DPCH frame from the measured radio link.
neighborQuality Quality of the SFN-SFN observed time difference type 2 measurement from the reference cell.
modeSpecificInfo This field contains TDD- and FDD- specific information.
neighborIdentity Identifies neighbour cell.
sfn-sfn-ObsTimeDifference2 This field specifies the timing relative to the reference cell.For further information see [25.214] and [25.224]
quality Specifies standard deviation and resolution of standard deviation of the measurements and number of measurements.
stdResolution Std Resolution field includes the resolution used in Std of OTDOA Measurements field. Encoding on two bits as follows: ‘00’ 10 meters ‘01’ 20 meters ‘10’ 30 meters ‘11’ Reserved
numberOfOTDOA-Measurements This field indicates how many OTDOA measurements have been used in the UE to determine the sample standard deviation of the measurements. Following 3 bit encoding is used: ‘001’ 5-9 ‘002’ 10-14 ‘011’ 15-24 ‘100’ 25-34 ‘101’ 35-44 ‘110’ 45-54 ‘111’ 55 or more Special case: '000': In this case the field 'Std of OTDOA measurements' contains the std of the reported SFN-SFN otd value = sqrt(E[(x-μ)2]), where x is the reported value and μ = E[x] is the expectation value (i.e. the true value) of x. This std can be used irrespective of the number of measurements and reporting of the number of measurements is not needed. Also other measurements such as Ec/No or Rx levels can be utilised in this case to evaluate the 'Std of OTDOA measurements'

OMA-LPPe-OTDOA-UTRA-Measurement **field descriptions**
stdOfOTDOA-Measurements Std of OTDOA Measurements field includes sample standard deviation of OTDOA measurements (when number of measurements is reported in 'Number of OTDOA measurements field') or standard deviation of the reported SFN-SFN otd value = sqrt(E[(x-μ)2]), where x is the reported value and μ = E[x] is the expectation value (i.e. the true value) of x (when '000' is given in 'Number of OTDOA measurements' field). Following linear 5 bit encoding is used: '00000' 0 - (R*1-1) meters '00001' R*1 – (R*2-1) meters '00010' R*2 – (R*3-1) meters … '11111' R*31 meters or more where R is the resolution defined by Std Resolution field. E.g. R=20 m corresponds to 0-19 m, 20-39 m,…,620+ m.

– *OMA-LPPe-OTDOA-UTRA-TimeStampData*

The *OMA-LPPe-OTDOA-UTRA-TimeStampData* consists of the OTDOA-UTRA frame information that can be used to time stamp the position estimate in UE-based case.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-TimeStampData ::= SEQUENCE {
    sfn                     INTEGER(0..4095),
    utraCellGlobalID        CellGlobalIdEUTRA-AndUTRA,
    frequencyInfo           OMA-LPPe-UTRA-FrequencyInfo                 OPTIONAL,
    nonUniqueCellID         CHOICE {
        primaryScramblingCode   OMA-LPPe-OTDOA-UTRA-PrimaryScramblingCode,  --FDD
        cellParametersId        OMA-LPPe-OTDOA-UTRA-CellParametersID,   --TDD
        ...},
    ...
}

-- ASN1STOP
```

OMA-LPPe-OTDOA-UTRA-TimeStampData **field descriptions**
sfn SFN during which the measurement was performed.
utraCellGlobalID This field identifies the UTRAN cell ID to which the SFN refers to.
frequencyInfo This field gives information on the frequency.
nonUniqueCellID This field identifies the primary scrambling code for FDD or cell parameters ID for TDD.

6.5.4.6 OTDOA-UTRA Location Information Request

– *OMA-LPPe-OTDOA-UTRA-RequestLocationInformation*

The *OMA-LPPe-OTDOA-UTRA-RequestLocationInformation* is used to request OTDOA-UTRA-based position estimate (UE-based) and measurements (UE-assisted).

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-RequestLocationInformation ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.4.7 OTDOA-UTRA Capability Information

– *OMA-LPPe-OTDOA-UTRA-ProvideCapabilities*

The *OMA-LPPe-OTDOA-UTRA-ProvideCapabilities* is used by the target to provide its OTDOA-UTRA capabilities to the server.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-ProvideCapabilities ::= SEQUENCE {
    ueBasedSupported    BOOLEAN,
    ueAssistedSupported BOOLEAN,
    ipdlSupported       BOOLEAN,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-OTDOA-UTRA-ProvideCapabilities* field descriptions**
ueBasedSupported This field indicates whether the UE supports UE based OTDOA (TRUE) or not (FALSE)
ueAssistedSupported This field indicates whether the UE supports UE assisted OTDOA (TRUE) or not (FALSE)
ipdlSupported This field indicates whether the UE supports IPDL (TRUE) or not (FALSE)

6.5.4.8 OTDOA-UTRA Capability Information Request

– *OMA-LPPe-OTDOA-UTRA-RequestCapabilities*

The *OMA-LPPe-OTDOA-UTRA-RequestCapabilities* is used to request OTDOA-UTRA capabilities information from the target.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.4.9 OTDOA-UTRA Error Elements

– *OMA-LPPe-OTDOA-UTRA-Error*

The *OMA-LPPe-OTDOA-UTRA-Errors* is used by the location server or target device to provide OTDOA-UTRA error reasons to the target device or location server, respectively.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-Error ::= CHOICE {
    locationServerErrorCauses       OMA-LPPe-OTDOA-UTRA-LocationServerErrorCauses,
    targetDeviceErrorCauses         OMA-LPPe-OTDOA-UTRA-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-OTDOA-UTRA-LocationServerErrorCauses*

The *OMA-LPPe-OTDOA-UTRA-LocationServerErrorCauses* is used by the location server to provide OTDOA-UTRA error reasons to the target device.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-LocationServerErrorCauses ::= SEQUENCE {
    cause           ENUMERATED{ undefinedError,
                                assistanceDataForUEbasedOTDOAnotAvailable,
                                assistanceDataForUEassistedOTDOAnotAvailable,
                                ...},
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-OTDOA-UTRA-TargetDeviceErrorCauses*

The *OMA-LPPe-OTDOA-UTRA-TargetDeviceErrorCauses* is used by the target device to provide OTDOA-UTRA error reasons to the location server.

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-TargetDeviceErrorCauses ::= SEQUENCE {
    cause           ENUMERATED{ undefinedError,
                                notEnoughOTDOA-cells,
                                assistanceDataMissing,
                                referenceCellNotServingCell,
                                otdoaMeasurementsNotSupported,
                                otdoaMeasurementsNotAvailable,
                                uebasedOTDOAnotSupported,
                                ...},
    ...
}

-- ASN1STOP
```

6.5.4.10 OTDOA-UTRA Common Elements

– *OMA-LPPe-OTDOA-UTRA-PrimaryCPICH-Info*

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-PrimaryCPICH-Info ::= SEQUENCE {
    primaryScramblingCode       OMA-LPPe-OTDOA-UTRA-PrimaryScramblingCode
}

-- ASN1STOP
```

– *OMA-LPPe-OTDOA-UTRA-PrimaryScramblingCode*

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-PrimaryScramblingCode ::= INTEGER (0..511)

-- ASN1STOP
```

– *OMA-LPPe-OTDOA-UTRA-CellAndChannelIdentity*

```
-- ASN1START

OMA-LPPe-OTDOA-UTRA-CellAndChannelIdentity ::= SEQUENCE {
    burstType           OMA-LPPe-OTDOA-UTRA-BurstType,
    midambleShift       OMA-LPPe-OTDOA-UTRA-MidambleShiftLong,
    timeslot            OMA-LPPe-OTDOA-UTRA-TimeSlotNumber,
    cellParametersID    OMA-LPPe-OTDOA-UTRA-CellParametersID,
    ...
}

OMA-LPPe-OTDOA-UTRA-BurstType ::= ENUMERATED { type1, type2 }

OMA-LPPe-OTDOA-UTRA-MidambleShiftLong ::= INTEGER (0..15)

OMA-LPPe-OTDOA-UTRA-TimeSlotNumber ::= INTEGER (0..14)

OMA-LPPe-OTDOA-UTRA-CellParametersID ::= INTEGER (0..127)

-- ASN1STOP
```

***OMA-LPPe-OTDOA-UTRA-CellAndChannelIdentity* field descriptions**
burstType Identifies the channel in combination with the midamble shift and slot number. It is not used in 1.28 Mcps TDD and may be set to either value. This IE should be ignored by the receiver for 1.28Mcps TDD.
midambleShift This shift, when present, applies to all the HS-PDSCH resources assigned to the target.
timeSlot This IE is present only if no IPDL scheme is configured in the reference cell. Otherwise the slot is defined by the IPDL configuration.
cellParametersID Identifies the cell.

6.5.5 LTE Enhanced Cell ID Positioning

6.5.5.1 LTE ECID Assistance Data

– *OMA-LPPe-ECID-LTE-ProvideAssistanceData*

The *OMA-LPPe-ECID-LTE-ProvideAssistanceData* is used to provide assistance for UE-based and UE-assisted LTE ECID based methods.

```
-- ASN1START

OMA-LPPe-ECID-LTE-ProvideAssistanceData ::= SEQUENCE {
    ecid-LTE-NetworkData    SEQUENCE (SIZE (1..maxLTENetworks)) OF
                                    OMA-LPPe-ECID-LTE-NetworkData       OPTIONAL,
    ecid-LTE-Error          OMA-LPPe-ECID-LTE-Error                     OPTIONAL,
    ...
}

maxLTENetworks  INTEGER ::= 8

-- ASN1STOP
```

6.5.5.2 LTE ECID Assistance Data Elements

– *OMA-LPPe-ECID-LTE-NetworkData*

The IE *OMA-LPPe-ECID-LTE-NetworkData* is used by the location server to provide eNodeB and HeNB information for one LTE network as part of LTE ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-LTE-NetworkData ::= SEQUENCE {
    plmn-Identity            SEQUENCE {
                                 mcc     SEQUENCE (SIZE (3))     OF INTEGER (0..9),
                                 mnc     SEQUENCE (SIZE (2..3))  OF INTEGER (0..9),
                                 ...
                             },
    multiple-PLMNs           BOOLEAN,
    reference-location       OMA-LPPe-ReferencePoint     OPTIONAL,   --Cond eNBlocations
    ecid-lte-eNodeB-list     SEQUENCE (SIZE (1..maxLTEeNBs)) OF OMA-LPPe-ECID-LTE-eNodeBData,
    ecid-lte-HeNB-list       SEQUENCE (SIZE (1..maxLTEHeNBs)) OF OMA-LPPe-ECID-LTE-HeNBData  OPTIONAL,
    ...
}

maxLTEeNBs  INTEGER ::= 32

maxLTEHeNBs INTEGER ::= 128

-- ASN1STOP
```

Conditional presence	Explanation
eNBlocations	The field is mandatory when one or more eNodeB or HeNB locations are provided for the network and a default reference point is not provided in LPPe common IEs.

***OMA-LPPe-ECID-LTE-NetworkData* field descriptions**
plmn-Identity   This field identifies the PLMN as defined in [23.003]. For a network supporting multiple PLMNs, this field identifies the first listed (i.e. primary) PLMN.
multiple-PLMNs   This field indicates whether the network supports multiple PLMNs (true) or not (false).
reference-location   This field specifies an arbitrary reference location for the LTE network. If this field is absent, the reference location is provided by the default reference point in LPPe common IEs.
ecid-lte-eNodeB-list   This parameter provides information for one or more eNodeBs belonging to the indicated LTE network. Either ecid-lte-eNodeB-list or ecid-lte-HeNB-list or both SHALL be included.
ecid-lte-HeNB-list   This parameter provides information for one or more HeNBs belonging to the indicated LTE network. Either ecid-lte-eNodeB-list or ecid-lte-HeNB-list or both SHALL be included.

– *OMA-LPPe-ECID-LTE-eNodeBData*

The IE *OMA-LPPe-ECID-LTE-eNodeBData* is used by the location server to provide information for one LTE eNodeB or several collocated eNodeBs as part of LTE ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-LTE-eNodeBData ::= SEQUENCE {
    relative-location              OMA-LPPe-RelativeLocation       OPTIONAL,
    ecid-lte-eNodeB-CellData       SEQUENCE (SIZE (1..maxLTEMacroCells)) OF OMA-LPPe-ECID-LTE-CellData,
    ...
}

maxLTEMacroCells    INTEGER ::= 8

-- ASN1STOP
```

***OMA-LPPe-ECID-LTE-eNodeBData* field descriptions**
relative-location This field provides the location and optional uncertainty in location of the antenna of the eNodeB relative to the reference location for the network. For an eNodeB with multiple antennas or a set of collocated eNodeBs, the location can be averaged. This field SHALL be provided if requested and available.
ecid-lte-eNodeB-CellData This field provides information for one or more LTE macro or pico cells sharing a common eNodeB antenna or using antennas in close proximity to one another.

– *OMA-LPPe-ECID-LTE-HeNBData*

The IE *OMA-LPPe-ECID-LTE-HeNBData* is used by the location server to provide information for one LTE HeNB as part of LTE ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-LTE-HeNBData ::= SEQUENCE {
    relative-location               OMA-LPPe-RelativeLocation       OPTIONAL,
    location-reliability            INTEGER (1..100)                OPTIONAL,
    coverageArea                    OMA-LPPe-WLANFemtoCoverageArea  OPTIONAL,
    ecid-lte-HeNB-CellData          OMA-LPPe-ECID-LTE-CellData,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ECID-LTE-HeNBData* field descriptions**
relative-location This field provides the location and optional uncertainty in location of the antenna of the HeNB relative to the reference location for the network.
location-reliability The field provides the reliability R of the HeNB location. The probability that the HeNB location has not changed is given as a percentage. R may be based on historic change or persistence of the HeNB location over a period of time and the time interval since the HeNB location was last provided to or verified by the server. Note that location reliability is distinct from location accuracy and refers to the possibility of an HeNB having been moved to a new location. This field SHALL be provided if requested and available.
coverageArea This parameter provides the coverage area of the HeNB. This parameter SHALL be provided if requsted and available.
ecid-lte-HeNB-CellData This field provides information for the HeNB femtocell.

– *OMA-LPPe-ECID-LTE-CellData*

The IE *OMA-LPPe-ECID-LTE-CellData* is used by the location server to provide information for one LTE macro, pico or femto cell as part of LTE ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-LTE-CellData ::= SEQUENCE {
    physCellId                      INTEGER (0..503)                OPTIONAL, --Cond AtLeastOne
    cellIdentity                    BIT STRING (SIZE (28))          OPTIONAL, --Cond AtLeastOne
    dl-CarrierFreq                  ARFCN-ValueEUTRA,
    rs-transmit-power               INTEGER (-127..128)                         OPTIONAL,
    antennaPortConfig               ENUMERATED {port1, ports2, ports4, ... }    OPTIONAL,
    antenna-gain                    INTEGER (-127..128)                         OPTIONAL,
    beam-width                      INTEGER (1..360)                            OPTIONAL,
```

```
    transmit-direction              INTEGER (0..360)                           OPTIONAL,
    frequency-accuracy              INTEGER (0..100),
    ...,
    dl-CarrierFreq-ext              ARFCN-ValueEUTRA-v9a0   OPTIONAL -- Cond EARFCN-ext
}

-- ASN1STOP
```

Conditional presence	Explanation
EARFCN-ext	This field is mandatory present if the value of E-UTRA ARFCN is greater than 65535. Otherwise this field is not present.
AtLeastOne	At least one of the fields with the condition “AtLeastOne” MUST be present.

***OMA-LPPe-ECID-LTE-CellData* field descriptions**
physCellId This field specifies the physical cell identity, as defined in [36.331].
cellIdentity This field defines the identity of the cell within the context of the PLMN as defined in [36.331].
dl-CarrierFreq This field specifies the value of E-UTRA ARFCN of the cell as defined in [36.101]. If the value of E-UTRA ARFCN is greater than 65535, this field SHALL be set to 65535. ***dl-CarrierFreq*** range: (0..65535).
rs-transmit-power This field specifies the downlink reference signal transmit power for the cell in dBm as defined in [36.314]. The RS EPRE can be derived from this as defined in [36.213]. This field SHALL be provided if requested and available.
antennaPortConfig This field specifies whether 1, 2 or 4 antenna ports are used for downlink cell reference signals. This field SHALL be provided if requested and available.
antenna-gain This field specifies the antenna gain in dBi. This field is applicable to a macro or pico cell only and SHALL be provided if requested and available.
beam-width This field specifies the engineered horizontal width of the antenna beam in degrees. This field is applicable to a macro or pico cell only and SHALL be provided if requested and available.
transmit-direction This field specifies the direction of the center of the main downlink transmission lobe in degrees clockwise from true north (0-359). A value of 360 indicates omnidirectional transmission. This field is applicable to a macro or pico cell only and SHALL be provided if requested and available.
frequency-accuracy This field specifies the minimum frequency accuracy of the cell in units of 0.005 ppm. A value of zero indicates frequency accuracy is outside the provided range.
dl-CarrierFreq-Ext This field specifies the value of E-UTRA ARFCN of the cell as defined in [36.101], if an extended value is used i.e., if the value of E-UTRA ARFCN is > 65535. In this case, this parameter SHALL be sent and set to the value of E-UTRA ARFCN. ***dl-CarrierFreq-Ext*** t range: (65536..262143).

6.5.5.3 LTE ECID Assistance Data Request

– *OMA-LPPe- ECID-LTE-RequestAssistanceData*

The *OMA-LPPe- ECID-LTE-RequestAssistanceData* is used to request assistance for UE-based and UE-assisted LTE ECID based methods.

```
-- ASN1START
```



```
OMA-LPPe-ECID-LTE-RequestAssistanceData ::= SEQUENCE {
    eNBrequestedAD      BIT STRING  {   bslist              (0),
                                        bslocation          (1),
                                        transmit-power      (2),
                                        antennaPortConfig   (3),
                                        antenna-gain        (4),
                                        beam-width          (5),
                                        transmit-direction  (6),
                                        frequency-accuracy  (7),
                                        non-serving         (8) } (SIZE(1..16)) OPTIONAL,
    heNBrequestedAD     BIT STRING  {   bslist              (0),
                                        bslocation          (1),
                                        locationreliability (2),
                                        transmit-power      (3),
                                        antennaPortConfig   (4),
                                        frequency-accuracy  (5),
                                        coveragearea        (6),
                                        non-serving         (7) } (SIZE(1..16)) OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ECID-LTE-RequestAssistanceData* field descriptions**
eNBrequestedAD This parameter specifies the LTE E-CID assistance data requested for eNodeBs associated with macro and pico cells. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested. If this parameter is absent, no assistance data is requested for macro or pico cells. The following assistance data types are included: bslist: include mandatory eNodeB and cell information bslocation: include the location of each eNodeB if available transmit-power: include the downlink transmit power for each cell if available antennaPortConfig: include the antenna port configuration for the downlink RS antenna-gain: include the antenna gain for each cell if available beam-width: include the beam width for each cell if available transmit-direction: include the transmit direction for each cell if available frequency-accuracy: include the frequency accuracy for each cell if available non-serving: include information for non-serving LTE networks in addition to the serving LTE network (or include information for multiple LTE networks if the serving network is either unknown or not LTE)
heNBrequestedAD This parameter specifies the LTE E-CID assistance data requested for HeNBs associated with femto cells. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested. If this parameter is absent, no assistance data is requested for femto cells. The following assistance data types are included: bslist: include mandatory HeNB and cell information bslocation: include the location of each HeNB if available locationreliability: include the reliability of HeNB location if available transmit-power: include the transmit power for each cell if available antennaPortConfig: include the antenna port configuration for the downlink RS frequency-accuracy: include the frequency accuracy for each cell if available coveragearea: include the coverage area for each HeNB if available non-serving: include information for non-serving LTE networks in addition to the serving LTE network (or include information for multiple LTE networks if the serving network is either unknown or not LTE)

6.5.5.4 LTE ECID Location Information

– *OMA-LPPe-ECID-LTE-ProvideLocationInformation*

The *OMA-LPPe-ECID-LTE -ProvideLocationInformation* is used to provide ECID measurements (UE-assisted) for LTE access networks at both current and historic times. Assuming the target device supports LPP E-CID measurement reporting, the target device SHALL use LPP and not LPPe to report LTE E-CID measurements to the server if either of the following conditions apply:

(a) The server sends an LPP Request Location Information message to the target containing an LPP request for E-CID measurements and the target is served by an LTE network.

(b) The target sends an unsolicited LPP Provide Location Information message to the server carrying current but not historic E-CID measurements for a serving LTE network and the target is either aware that the server supports LPP E-CID location information or is both not aware of the level of server LPP E-CID support and not aware that the server supports LPPe E-CID location information.

For all other cases of E-CID reporting for LTE, the target SHALL use LPPe and not LPP.

```
-- ASN1START

OMA-LPPe-ECID-LTE-ProvideLocationInformation ::= SEQUENCE {
    ecid-LTE-CombinedLocationInformation    SEQUENCE (SIZE (1..maxLTEECIDSize))
                                            OF OMA-LPPe-ECID-LTE-LocationInformationList    OPTIONAL,
    ecid-LTE-Error                          OMA-LPPe-ECID-LTE-Error OPTIONAL,
    ...
}

OMA-LPPe-ECID-LTE-LocationInformationList ::= SEQUENCE {
    ecid-LTE-LocationInformation    OMA-LPPe-ECID-LTE-LocationInformation,
    relativeTimeStamp               INTEGER (0..65535)                      OPTIONAL,
    servingFlag                     BOOLEAN,
    ...
}

maxLTEECIDSize  INTEGER ::= 64

-- ASN1STOP
```

***OMA-LPPe-ECID-LTE-ProvideLocationInformation* field descriptions**
ecid-LTE-CombinedLocationInformation This parameter provides E-CID measurements for one or more LTE access networks at the current time and/or for historic times. This parameter supports part of the Location ID and Multiple Location IDs parameters in SUPL 2.0.
ecid-LTE-Error This parameter provides error information when not all requested LTE E-CID measurements can be reported. This parameter should be included when some but not all requested measurements are reported and SHALL be included when no requested measurements are reported.
relativeTimeStamp This parameter SHALL be included for historic LTE E-CID measurements and provides the time of the historic measurements relative to current time in units of 0.01 seconds. If absent, current time is implied which is equivalent to a relativeTimeStamp of zero. Current time refers to the time when the target sends LTE E-CID measurements to the server.
servingFlag This parameter indicates whether a set of E-CID measurements were obtained for a serving LTE access network (TRUE) or non-serving LTE access network (FALSE). A target device with multiple radio support may indicate more than one type of serving access network for the same time instant.

6.5.5.5 LTE ECID Location Information Elements

– *OMA-LPPe-ECID-LTE-LocationInformation*

The IE *OMA-LPPe-ECID-LTE-LocationInformation* is used by the target device to provide E-CID measurements for a serving or non-serving LTE network to the server.


```
-- ASN1START

OMA-LPPe-ECID-LTE-LocationInformation ::= SEQUENCE {
    lpp-ECID-SignalMeasurementInformation       ECID-SignalMeasurementInformation,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ECID-LTE-LocationInformation* field descriptions**
lpp-ECID-SignalMeasurementInformation This parameter provides E-CID measurements for a serving or non-serving LTE access network.

6.5.5.6 LTE ECID Location Information Request

– *OMA-LPPe-ECID-LTE-RequestLocationInformation*

The *OMA-LPPe-ECID-LTE-RequestLocationInformation* is used to request ECID measurements (UE-assisted).

```
-- ASN1START

OMA-LPPe-ECID-LTE-RequestLocationInformation ::= SEQUENCE {
    requestedMeasurements   BIT STRING {    rsrp        (0),
                                            rsrq        (1),
                                            ueRxTx      (2),
                                            non-serving (3),
                                            historic    (4) } (SIZE(1..8)),
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ECID-LTE-RequestLocationInformation* field descriptions**
requestedMeasurements This field specifies the LTE E-CID measurements requested. This is represented by a bit string, with a one-value at the bit position means the particular measurement is requested; a zero-value means not requested. The following measurement requests can be included. rsrp: RSRP rsrq: RSRQ ueRxTx: UE Rx-Tx time difference measurement non-serving: E-CID measurements for non-serving LTE networks (in addition to a serving LTE network) historic: historic LTE E-CID measurements (in addition to current measurements)

6.5.5.7 LTE ECID Capability Information

– *OMA-LPPe-ECID-LTE-ProvideCapabilities*

The *OMA-LPPe-ECID-LTE-ProvideCapabilities* is used by the target to provide its ECID capabilities to the server.

```
-- ASN1START

OMA-LPPe-ECID-LTE-ProvideCapabilities ::= SEQUENCE {
    ecid-lte-MeasSupported  BIT STRING  {rsrp       (0),
                                         rsrq       (1),
                                         ueRxTx     (2),
                                         non-serving (3),
                                         historic    (4) } (SIZE(1..8)),
    ecid-lte-eNodeB-ADSupported BIT STRING  {bslist             (0),
```



```
                                              bslocation         (1),
                                              transmit-power     (2),
                                              antennaPortConfig  (3),
                                              antenna-gain       (4),
                                              beam-width         (5),
                                              transmit-direction (6),
                                              frequency-accuracy (7),
                                              non-serving        (8) } (SIZE(1..16)),
    ecid-utra-HeNB-ADSupported  BIT STRING  {bslist                  (0),
                                              bslocation              (1),
                                              locationreliability     (2),
                                              transmit-power          (3),
                                              antennaPortConfig       (4),
                                              frequency-accuracy      (5),
                                              coveragearea            (6),
                                              non-serving             (7) } (SIZE(1..16)),
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ECID-LTE-ProvideCapabilities* field descriptions**
ecid-lte-MeasSupported This field specifies the E-CID measurements supported by the target device for LTE using LPPe. This is represented by a bit string, with a one-value at the bit position means the particular measurement is supported; a zero-value means not supported. A zero-value in all bit positions in the bit string means only the basic Cell ID positioning method is supported by the target device for LTE using LPPe. The following bits are assigned for the indicated measurements. rsrp: RSRP rsrq: RSRQ ueRxTx: UE Rx-Tx time difference measurement non-serving: E-CID measurements for non-serving LTE networks (in addition to a serving LTE network) historic: historic LTE E-CID measurements
ecid-lte-eNodeB-ADSupported This field specifies the E-CID assistance data supported by the target device for LTE eNodeBs. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is supported; a zero-value means not supported. A zero-value in all bit positions or absence of this field means no assistance data is supported. The following bits are assigned for the indicated assistance data. bslist: mandatory eNodeB and cell information bslocation: location of each eNodeB transmit-power: transmit power for each cell antennaPortConfig: antenna port configuration for downlink RS antenna-gain: antenna gain for each cell beam-width: beam width for each cell transmit-direction: transmit direction for each cell frequency-accuracy: frequency accuracy for each cell non-serving: information for non-serving LTE networks in addition to the serving LTE network (or information for multiple LTE networks if the serving network is not LTE)

OMA-LPPe-ECID-LTE-ProvideCapabilities **field descriptions**
ecid-lte-HeNB-ADSupported This field specifies the E-CID assistance data supported by the target device for LTE HeNBs. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is supported; a zero-value means not supported. A zero-value in all bit positions or absence of this field means no assistance data is supported. The following bits are assigned for the indicated assistance data. bslist: mandatory HeNB and cell information bslocation: location of each HeNB locationreliability: location reliability of each HeNB transmit-power: transmit power for each cell antennaPortConfig: antenna port configuration for downlink RS frequency-accuracy: frequency accuracy for each cell coveragearea: coverage area for each HeNB non-serving: information for non-serving LTE networks in addition to the serving LTE network (or information for multiple LTE networks if the serving network is not LTE)

6.5.5.8 LTE ECID Capability Information Request

– *OMA-LPPe-ECID-LTE-RequestCapabilities*

The *OMA-LPPe-ECID-LTE-RequestCapabilities* is used to request ECID capabilities information from the target.

```
-- ASN1START

OMA-LPPe-ECID-LTE-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.5.9 LTE ECID Error Element

– *OMA-LPPe-ECID-LTE-Error*

The IE *OMA-LPPe-ECID-LTE-Error* is used by the location server or target device to provide LTE E-CID error reasons to the target device or location server, respectively.

```
-- ASN1START

OMA-LPPe-ECID-LTE-Error ::= CHOICE {
    locationServerErrorCauses       OMA-LPPe-ECID-LTE-LocationServerErrorCauses,
    targetDeviceErrorCauses         OMA-LPPe-ECID-LTE-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-ECID-LTE-LocationServerErrorCauses*

The IE *OMA-LPPe-ECID-LTE-LocationServerErrorCauses* is used by the location server to provide LTE E-CID error reasons to the target device.

```
-- ASN1START

OMA-LPPe-ECID-LTE-LocationServerErrorCauses ::= SEQUENCE {
    cause       ENUMERATED  {   undefined,
                                requestedADNotAvailable,
                                notAllrequestedADAvailable,
```



```
                                ...
                            },
    eNodeBMandatoryDataUnavailable          NULL        OPTIONAL,
    eNodeBLocationsUnavailable              NULL        OPTIONAL,
    eNodeBcellTransmitPowerUnavailable      NULL        OPTIONAL,
    eNodeBcellAntennaPortConfigUnavailable  NULL        OPTIONAL,
    eNodeBcallAntennaGainUnavailable        NULL        OPTIONAL,
    eNodeBcellBeamWidthUnavailable          NULL        OPTIONAL,
    eNodeBcellTransmitDirectionUnavailable  NULL        OPTIONAL,
    eNodeBcellFrequencyAccuracyUnavailable  NULL        OPTIONAL,
    eNodeBnonservingADUnavailable           NULL        OPTIONAL,
    heNBMandatoryDataUnavailable            NULL        OPTIONAL,
    heNBLocationUnavailable                 NULL        OPTIONAL,
    heNBLocationReliabilityUnavailable      NULL        OPTIONAL,
    heNBcellTransmitPowerUnavailable        NULL        OPTIONAL,
    heNBcellAntennaPortConfigUnavailable    NULL        OPTIONAL,
    heNBcellFrequencyAccuracyUnavailable    NULL        OPTIONAL,
    heNBCoverageAreaUnavailable             NULL        OPTIONAL,
    heNBnonservingADUnavailable             NULL        OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ECID-LTE-LocationServerErrorCauses* field descriptions**
cause This field provides a LTE ECID specific error cause for the server applicable to provision of assistance data. If the cause value is '*requestedADNotAvailable*', none of the requested assistance data could be provided and no further information needs to be included. If the cause value is '*notAllRequestedADAvailable*', the server was able to provide some but not all requested LTE ECID assistance data. In this case, the server should include any of the specific error indications as applicable. Note that inclusion of these fields is applicable when some of the associated information can be provided for some base stations or cells but not for all base stations and cells.

– *OMA-LPPe-ECID-LTE-TargetDeviceErrorCauses*

The IE *OMA-LPPe-ECID-LTE-TargetDeviceErrorCauses* is used by the target device to provide LTE E-CID error reasons to the location server.

```
-- ASN1START

OMA-LPPe-ECID-LTE-TargetDeviceErrorCauses ::= SEQUENCE {
    cause       ENUMERATED {undefined,
                            requestedMeasurementsNotAvailable,
                            notAllrequestedMeasurementsPossible,
                            ...
                            },
    rsrpMeasurementNotPossible          NULL        OPTIONAL,
    rsrqMeasurementNotPossible          NULL        OPTIONAL,
    ueRxTxMeasurementNotPossible        NULL        OPTIONAL,
    non-servingMeasurementsNotAvailable NULL        OPTIONAL,
    historicMeasurementsNotAvailable    NULL        OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ECID-LTE-TargetDeviceErrorCauses* field descriptions**
cause This field provides an LTE ECID specific error cause. If the cause value is '*requestedMeasurementsNotAvailable*', none of the requested measurements could be provided and no further information needs to be included. If the cause value is '*notAllRequestedMeasurementsPossible*', the target device was able to provide some but not all requested LTE ECID measurements. In this case, the target device should include any of the other fields, as applicable.

6.5.6 GSM Enhanced Cell ID Positioning

This section defines support for GSM ECID.

6.5.6.1 GSM ECID Assistance Data

– *OMA-LPPe-ECID-GSM-ProvideAssistanceData*

The *OMA-LPPe-ECID-GSM-ProvideAssistanceData* is used to provide assistance for UE-based and UE-assisted GSM ECID based methods.

```
-- ASN1START

OMA-LPPe-ECID-GSM-ProvideAssistanceData ::= SEQUENCE {
    ecid-gsm-NetworkData    SEQUENCE (SIZE (1..maxGSMNetworks))
                                                    OF OMA-LPPe-ECID-GSM-NetworkData        OPTIONAL,
    ecid-gsm-Error          OMA-LPPe-ECID-GSM-Error OPTIONAL,
    ...
}

maxGSMNetworks  INTEGER ::= 8

-- ASN1STOP
```

6.5.6.2 GSM ECID Assistance Data Elements

– *OMA-LPPe-ECID-GSM-NetworkData*

The IE *OMA-LPPe-ECID-GSM-NetworkData* is used by the location server to provide base station information for one GSM network as part of GSM ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-GSM-NetworkData ::= SEQUENCE {
    plmn-Identity       SEQUENCE {
                            mcc     SEQUENCE (SIZE (3))     OF INTEGER (0..9),
                            mnc     SEQUENCE (SIZE (2..3))  OF INTEGER (0..9)
                            },
    reference-location  OMA-LPPe-ReferencePoint     OPTIONAL,   --Cond BSlocations
    base-station-list   SEQUENCE (SIZE (1..maxGSMBaseStations)) OF OMA-LPPe-ECID-GSM-BaseStationData,
    ...
}

maxGSMBaseStations  INTEGER ::= 32

-- ASN1STOP
```

Conditional presence	Explanation
BSlocations	The field is mandatory when one or more base station locations are provided for the network and a default reference point is not provided in LPPe common IEs.

OMA-LPPe-ECID-GSM-NetworkData field descriptions
plmn-Identity This field identifies the PLMN as defined in [23.003].
reference-Location This field defines an arbitrary reference location for the GSM network. If this field is absent, the reference location is provided by the default reference point in LPPe common IEs.
base-station-list This parameter provides information for one or more base stations belonging to the indicated GSM network.

– *OMA-LPPe-ECID-GSM-BaseStationData*

The IE *OMA-LPPe-ECID-GSM-BaseStationData* is used by the location server to provide information for one GSM base station as part of GSM ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-GSM-BaseStationData ::= SEQUENCE {
    relative-location               OMA-LPPe-RelativeLocation       OPTIONAL,
    ecid-gsm-CellData               SEQUENCE (SIZE (1..maxGSMCells)) OF OMA-LPPe-ECID-GSM-CellData,
    ...
}

maxGSMCells INTEGER ::= 8

-- ASN1STOP
```

***OMA-LPPe-ECID-GSM-BaseStationData* field descriptions**
relative-location This field provides the location and optional uncertainty in location of the antenna of the GSM base station relative to the reference location for the network. For a base station with multiple antennas or a set of collocated base stations, the location can be averaged. This field SHALL be provided if requested and available.
ecid-gsm-CellData This field provides information for one or more GSM cells sharing a common base station antenna or using antennas in close proximity to one another.

– *OMA-LPPe-ECID-GSM-CellData*

The IE *OMA-LPPe-ECID-GSM-CellData* is used by the location server to provide information for one GSM Cell as part of GSM ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-GSM-CellData ::= SEQUENCE {
    cellNonUniqueIDGERAN            OMA-LPPe-CellNonUniqueIDGERAN   OPTIONAL, --Cond AtLeastOne
    cellLocalIDGERAN                OMA-LPPe-CellLocalIdGERAN       OPTIONAL, --Cond AtLeastOne
    transmit-power                  INTEGER (-127..128)             OPTIONAL,
    antenna-gain                    INTEGER (-127..128)             OPTIONAL,
    beam-width                      INTEGER (1..360)                OPTIONAL,
    transmit-direction              INTEGER (0..360)                OPTIONAL,
    frequency-accuracy              INTEGER (0..100)                OPTIONAL,
    ...
}


-- ASN1STOP
```

Conditional presence	Explanation
AtLeastOne	At least one of the fields with the condition “AtLeastOne” MUST be present.

***OMA-LPPe-ECID-GSM-CellData* field descriptions**
cellNonUniqueIDGERAN This field provides the BCCH and BSIC for the GSM cell, as defined in [23.003] and [45.001].
cellLocalIDGERAN This field provides the location area and cell ID of the GSM cell. This field SHALL be provided if available.

OMA-LPPe-ECID-GSM-CellData field descriptions
transmit-power This field specifies the transmit power used for the BCCH in dBm. This field SHALL be provided if requested and available.
antenna-gain This field specifies the antenna gain in dBi. This field SHALL be provided if requested and available.
beam-width This field specifies the engineered horizontal width of the antenna beam in degrees. This field SHALL be provided if requested and available.
transmit-direction This field specifies the direction of the center of the main transmission lobe in degrees clockwise from true north (0-359). A value of 360 indicates omnidirectional transmission. This field SHALL be provided if requested and available.
frequency-accuracy This field specifies the minimum frequency accuracy of the cell in units of 0.005 ppm. A value of zero indicates frequency accuracy is outside the provided range.

6.5.6.3 GSM ECID Assistance Data Request

– *OMA-LPPe-ECID-GSM-RequestAssistanceData*

The *OMA-LPPe-ECID-GSM-RequestAssistanceData* is used to request assistance for UE-based and UE-assisted GSM ECID based methods.

```
-- ASN1START


OMA-LPPe-ECID-GSM-RequestAssistanceData ::= SEQUENCE {
    requestedAD     BIT STRING  {   bslist              (0),
                                    bslocation          (1),
                                    transmit-power      (2),
                                    antenna-gain        (3),
                                    beam-width          (4),
                                    transmit-direction  (5),
                                    frequency-accuracy  (6),
                                    non-serving         (7)
                                     } (SIZE(1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ECID-GSM-RequestAssistanceData field descriptions
requestedAD This parameter specifies the GSM E-CID assistance data requested. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested. The following assistance data types are included: bslist: include base station and cell information bslocation: include the location of each base station if available transmit-power: include the transmit power for each cell if available antenna-gain: include the antenna gain for each cell if available beam-width: include the beam width for each cell if available transmit-direction: include the transmit direction for each cell if available frequency-accuracy: include the frequency accuracy for each cell if available non-serving: include information for non-serving GSM networks in addition to the serving GSM network (or include information for multiple GSM networks if the serving network is either unknown or not GSM)

6.5.6.4 GSM ECID Location Information

– *OMA-LPPe-ECID-GSM-ProvideLocationInformation*

The *OMA-LPPe-ECID-GSM-ProvideLocationInformation* is used to provide ECID measurements (UE-assisted) for one or more GSM access types and at both current and historic times.

```
-- ASN1START

OMA-LPPe-ECID-GSM-ProvideLocationInformation ::= SEQUENCE {
    ecid-GSM-CombinedLocationInformation    SEQUENCE (SIZE (1..maxGSMECIDSize))
                                            OF OMA-LPPe-ECID-GSM-LocationInformationList    OPTIONAL,
    ecid-GSM-Error                          OMA-LPPe-ECID-GSM-Error                         OPTIONAL,
    ...
}

OMA-LPPe-ECID-GSM-LocationInformationList ::= SEQUENCE {
    ecid-GSM-LocationInformation    OMA-LPPe-ECID-GSM-LocationInformation,
    relativeTimeStamp               INTEGER (0..65535)  OPTIONAL,
    servingFlag                     BOOLEAN,
    ...
}

maxGSMECIDSize  INTEGER ::= 64

-- ASN1STOP
```

OMA-LPPe-ECID-GSM-ProvideLocationInformation **field descriptions**
ecid-GSM-CombinedLocationInformation
This parameter provides E-CID measurements for one or more GSM networks at the current time and/or for historic times. This parameter supports part of the Location ID and Multiple Location IDs parameters in SUPL 2.0.
ecid-GSM-Error
This parameter provides error information when not all requested GSM E-CID measurements can be reported. This parameter should be included when some but not all requested measurements are reported and SHALL be included when no requested measurements are reported.
relativeTimeStamp
This parameter SHALL be included for historic GSM E-CID measurements and provides the time of the historic measurements relative to current time in units of 0.01 seconds. If absent, current time is implied which is equivalent to a relativeTimeStamp of zero. Current time refers to the time when the target sends GSM E-CID measurements to the server.
servingFlag
This parameter indicates whether a set of E-CID measurements were obtained for a serving GSM access network (TRUE) or a non-serving GSM access network (FALSE). A target device capable of multiple radio support may indicate more than one type of serving access network for the same time instant.

6.5.6.5 GSM ECID Location Information Elements

– *OMA-LPPe-ECID-GSM-LocationInformation*

The IE *OMA-LPPe-ECID-GSM-LocationInformation* is used by the target device to provide E-CID measurements for a serving or non-serving GSM network to the server.

```
-- ASN1START


OMA-LPPe-ECID-GSM-LocationInformation ::= SEQUENCE {
    cellGlobalIdGERAN       CellGlobalIdGERAN,
    rxLevel                 INTEGER (0..63)                 OPTIONAL,
    tA                      INTEGER(0..255)                 OPTIONAL,
```



```
    nMR-GERAN               OMA-LPPe-NMR-GERAN              OPTIONAL,
    ...
}

OMA-LPPe-NMR-GERAN ::= SEQUENCE (SIZE (1..15)) OF SEQUENCE {
    cellNonUniqueIDGERAN    OMA-LPPe-CellNonUniqueIDGERAN,
    cellLocalIDGERAN        OMA-LPPe-CellLocalIdGERAN               OPTIONAL,
    rxLevel                 INTEGER (0..63),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ECID-GSM-LocationInformation **field descriptions**
cellGlobalIdGERAN This field provides the GERAN global cell ID of the measured cell which is either the serving cell or a cell in a non-serving GSM network that is treated like a serving cell for the purpose of reporting measurements.
rxLevel This field specifies the received signal level for a measured cell. Rx-level is encoded according to [45.008] as: 0: < -110 dBm. 1: -110 dBm to -109 dBm. 2: -109 dBm to -108 dBm. … 62: -49 dBm to -48 dBm. 63: >= -48 dBm.
tA This field specifies the timing advance of the measured cell in units of 48/13µs (length of a GSM bit). This provides an approximation for the round trip propagation time between the target and the base station of the measured cell.
nMR-GERAN This field provides the GERAN Network Measurements Report for up to 15 cells.
cellNonUniqueIDGERAN This field provides the BSIC and BCCH for a measured cell.
cellLocalIDGERAN This field provides the location area and cell ID of a measured cell and SHALL be included if available.

– *OMA-LPPe-ECID-GSM-RequestLocationInformation*

The *OMA-LPPe-ECID-GSM-RequestLocationInformation* is used to request GSM ECID measurements (UE-assisted).

```
-- ASN1START

OMA-LPPe-ECID-GSM-RequestLocationInformation ::= SEQUENCE {
    requestedMeasurements   BIT STRING {    rxLevel     (0),
                                            tA          (1),
                                            nMR-GERAN   (2),
                                            non-serving (3),
                                            historic    (4) } (SIZE(1..8)),
    ...
}

-- ASN1STOP
```


OMA-LPPe-ECID-GSM-RequestLocationInformation field descriptions
requestedMeasurements This field specifies the GSM E-CID measurements requested. This is represented by a bit string, with a one-value at the bit position means the particular measurement is requested; a zero-value means not requested. The following measurement requests can be included. rxLevel: RX level tA: timing advance nMR-GERAN: network measurement report for neighboring cells non-serving: E-CID measurements for non-serving GSM networks (in addition to a serving GSM network) historic: historic GSM E-CID measurements (in addition to current measurements)

6.5.6.6 GSM ECID Capability Information

– *OMA-LPPe-ECID-GSM-ProvideCapabilities*

The *OMA-LPPe-ECID-GSM-ProvideCapabilities* is used by the target to provide its GSM ECID capabilities to the server.

```
-- ASN1START

OMA-LPPe-ECID-GSM-ProvideCapabilities ::= SEQUENCE {
    ecid-gsm-MeasSupported  BIT STRING {    rxLevel     (0),
                                            tA          (1),
                                            nMR-GERAN   (2),
                                            non-serving (3),
                                            historic    (4) } (SIZE(1..8)),
    ecid-gsm-ADSupported    BIT STRING  { bslist               (0),
                                          bslocation           (1),
                                          transmit-power       (2),
                                          antenna-gain         (3),
                                          beam-width           (4),
                                          transmit-direction   (5),
                                          frequency-accuracy   (6),
                                          non-serving          (7) } (SIZE(1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ECID-GSM-ProvideCapabilities field descriptions
ecid-gsm-MeasSupported This field specifies the E-CID measurements supported by the target device for GSM. This is represented by a bit string, with a one-value at the bit position means the particular measurement is supported; a zero-value means not supported. A zero-value in all bit positions in the bit string means only the basic Cell ID positioning method is supported by the target device for GSM. The following bits are assigned for the indicated measurements. rxLevel: RX level tA: timing advance nMR-GERAN: network measurement report for neighboring cells non-serving: E-CID measurements for non-serving GSM networks (in addition to a serving GSM network) historic: historic GSM E-CID measurements

OMA-LPPe-ECID-GSM-ProvideCapabilities **field descriptions**
ecid-gsm-ADSupported This field specifies the E-CID assistance data supported by the target device for GSM. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is supported; a zero-value means not supported. A zero-value in all bit positions or absence of this field means no assistance data is supported. The following bits are assigned for the indicated assistance data. bslist: base station and cell information bslocation: location of each base station transmit-power: transmit power for each cell antenna-gain: antenna gain for each cell beam-width: beam width for each cell transmit-direction: transmit direction for each cell frequency-accuracy: frequency accuracy for each cell non-serving: information for non-serving GSM networks in addition to the serving GSM network (or information for multiple GSM networks if the serving network is not GSM)

6.5.6.7 GSM ECID Capability Information Request

– *OMA-LPPe-ECID-GSM-RequestCapabilities*

The *OMA-LPPe-ECID-GSM-RequestCapabilities* is used to request GSM ECID capabilities information from the target.

```
-- ASN1START

OMA-LPPe-ECID-GSM-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.6.8 GSM ECID Error Element

– *OMA-LPPe-ECID-GSM-Error*

The IE *OMA-LPPe-ECID-GSM-Error* is used by the location server or target device to provide GSM E-CID error reasons to the target device or location server, respectively.

```
-- ASN1START

OMA-LPPe-ECID-GSM-Error ::= CHOICE {
    locationServerErrorCauses       OMA-LPPe-ECID-GSM-LocationServerErrorCauses,
    targetDeviceErrorCauses         OMA-LPPe-ECID-GSM-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-ECID-GSM-LocationServerErrorCauses*

The IE *OMA-LPPe-ECID-GSM-LocationServerErrorCauses* is used by the location server to provide GSM E-CID error reasons to the target device.

```
-- ASN1START

OMA-LPPe-ECID-GSM-LocationServerErrorCauses ::= SEQUENCE {
    cause       ENUMERATED  {   undefined,
                                requestedADNotAvailable,
                                notAllrequestedADAvailable,
```



```
                                ...
                            },
    mandatoryDataUnavailable            NULL        OPTIONAL,
    bsLocationsUnavailable              NULL        OPTIONAL,
    cellTransmitPowerUnavailable        NULL        OPTIONAL,
    callAntennaGainUnavailable          NULL        OPTIONAL,
    cellBeamWidthUnavailable            NULL        OPTIONAL,
    cellTransmitDirectionUnavailable    NULL        OPTIONAL,
    cellFrequencyAccuracyUnavailable    NULL        OPTIONAL,
    nonservingADUnavailable             NULL        OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ECID-GSM-LocationServerErrorCauses* field descriptions**
cause This field provides a GSM ECID specific error cause for the server applicable to provision of assistance data. If the cause value is '*requestedADNotAvailable*', none of the requested assistance data could be provided and no further information needs to be included. If the cause value is '*notAllRequestedADAvailable*', the server was able to provide some but not all requested GSM ECID assistance data. In this case, the server should include any of the specific error indications as applicable. Note that inclusion of these fields is applicable when some of the associated information can be provided for some base stations or cells but not for all base stations and cells.

– *OMA-LPPe-ECID-GSM-TargetDeviceErrorCauses*

The IE *OMA-LPPe-ECID-GSM-TargetDeviceErrorCauses* is used by the target device to provide GSM E-CID error reasons to the location server.

```
-- ASN1START

OMA-LPPe-ECID-GSM-TargetDeviceErrorCauses ::= SEQUENCE {
    cause       ENUMERATED {    undefined,
                                requestedMeasurementsNotAvailable,
                                notAllrequestedMeasurementsPossible,
                                ...
                            },
    rxLevelMeasurementNotPossible       NULL        OPTIONAL,
    taMeasurementNotPossible            NULL        OPTIONAL,
    nMRMeasurementNotPossible           NULL        OPTIONAL,
    non-servingMeasurementsNotAvailable NULL        OPTIONAL,
    historicMeasurementsNotAvailable    NULL        OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ECID-GSM-TargetDeviceErrorCauses* field descriptions**
cause This field provides a GSM ECID specific error cause. If the cause value is '*requestedMeasurementsNotAvailable*', none of the requested measurements could be provided and no further information needs to be included. If the cause value is '*notAllRequestedMeasurementsPossible*', the target device was able to provide some but not all requested GSM ECID measurements. In this case, the target device should include any of the '*rxLevelMeasurementNotPossible*', '*taMeasurementNotPossible*', '*nMRMeasurementNotPossible*', '*non-servingMeasurementsNotAvailable*' or '*historicMeasurementsNotAvailable*' fields, as applicable.

6.5.7 UTRA Enhanced Cell ID Positioning

This section defines support for UTRA ECID.

6.5.7.1 UTRA ECID Assistance Data

– *OMA-LPPe-ECID-UTRA-ProvideAssistanceData*

The IE *OMA-LPPe-ECID-UTRA-ProvideAssistanceData* is used to provide assistance for UE-based and UE-assisted UTRA ECID based methods.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-ProvideAssistanceData ::= SEQUENCE {
    ecid-UTRA-NetworkData   SEQUENCE (SIZE (1..maxUTRANetworks))
                                                    OF OMA-LPPe-ECID-UTRA-NetworkData       OPTIONAL,
    ecid-UTRA-Error         OMA-LPPe-ECID-UTRA-Error                                        OPTIONAL,
    ...
}

maxUTRANetworks INTEGER ::= 8

-- ASN1STOP
```

6.5.7.2 UTRA ECID Assistance Data Elements

– *OMA-LPPe-ECID-UTRA-NetworkData*

The IE *OMA-LPPe-ECID-UTRA-NetworkData* is used by the location server to provide Node B and/or HNB information for one UTRA network as part of UTRA ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-NetworkData ::= SEQUENCE {
    plmn-Identity           SEQUENCE {
                                mcc     SEQUENCE (SIZE (3))     OF INTEGER (0..9),
                                mnc     SEQUENCE (SIZE (2..3))  OF INTEGER (0..9)
                            },
    multiple-PLMNs          BOOLEAN,
    reference-location      OMA-LPPe-ReferencePoint     OPTIONAL,   --Cond nodeBlocations
    ecid-utra-nodeB-list    SEQUENCE (SIZE (1..maxUTRAnodeBs))
                                                            OF OMA-LPPe-ECID-UTRA-NodeBData OPTIONAL,
    ecid-utra-HNB-list      SEQUENCE (SIZE (1..maxUTRAHNBs)) OF OMA-LPPe-ECID-UTRA-HNBData  OPTIONAL,
    ...
}

maxUTRAnodeBs   INTEGER ::= 32

maxUTRAHNBs     INTEGER ::= 128

-- ASN1STOP
```

Conditional presence	Explanation
nodeBlocations	The field is mandatory when one or more Node B or HNB locations are provided for the network and a default reference point is not provided in LPPe common IEs.

***OMA-LPPe-ECID-UTRA-NetworkData* field descriptions**
plmn-Identity This field identifies the PLMN as defined in [23.003]. For a network supporting multiple PLMNs, this field identifies the first listed (i.e. primary) PLMN.
multiple-PLMNs This field indicates whether the network supports multiple PLMNs (true) or not (false).
reference-Location This field specifies an arbitrary reference location for the UTRA network. If this field is absent, the reference location is provided by the default reference point in LPPe common IEs.

OMA-LPPe-ECID-UTRA-NetworkData **field descriptions**
ecid-utra-nodeB-list This parameter provides information for one or more Node Bs belonging to the indicated UTRA network. Either ecid-utra-nodeB-list or ecid-utra-HNB-list or both SHALL be included.
ecid-utra-HNB-list This parameter provides information for one or more HNBs belonging to the indicated UTRA network. Either ecid-utra-nodeB-list or ecid-utra-HNB-list or both SHALL be included.

– *OMA-LPPe-ECID-UTRA-NodeBData*

The IE *OMA-LPPe-ECID-UTRA-NodeBData* is used by the location server to provide information for one UTRA Node B or several collocated Node Bs as part of UTRA ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-NodeBData ::= SEQUENCE {
    relative-location               OMA-LPPe-RelativeLocation       OPTIONAL,
    ecid-utra-nodeB-CellData        SEQUENCE (SIZE (1..maxUTRAMacroCells)) OF
                                                                    OMA-LPPe-ECID-UTRA-CellData,
    ...
}

maxUTRAMacroCells   INTEGER ::= 8

-- ASN1STOP
```

OMA-LPPe-ECID-UTRA-NodeBData **field descriptions**
relative-location This field provides the location and optional uncertainty in location of the antenna of the UTRA Node B relative to the reference location for the network. For a Node B with multiple antennas or a set of collocated Node Bs, the location can be averaged. This field SHALL be provided if requested and available.
ecid-utra-nodeB-CellData This field provides information for one or more UTRA macro or pico cells sharing a common Node B antenna or using antennas in close proximity to one another.

– *OMA-LPPe-ECID-UTRA-HNBData*

The IE *OMA-LPPe-ECID-UTRA-HNBData* is used by the location server to provide information for one UTRA HNB as part of UTRA ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-HNBData ::= SEQUENCE {
    relative-location               OMA-LPPe-RelativeLocation       OPTIONAL,
    location-reliability            INTEGER (1..100)                OPTIONAL,
    coverageArea                    OMA-LPPe-WLANFemtoCoverageArea  OPTIONAL,
    ecid-utra-HNB-CellData          OMA-LPPe-ECID-UTRA-CellData,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ECID-UTRA-HNBData field descriptions
relative-location This field provides the location and optional uncertainty in location of the antenna of the HNB relative to the reference location for the network.
location-reliability The field provides the reliability R of the HNB location. The probability that the HNB location has not changed is given as a percentage. R may be based on historic change or persistence of the HNB location over a period of time and the time interval since the HNB location was last provided to or verified by the server. Note that location reliability is distinct from location accuracy and refers to the possibility of an HNB having been moved to a new location. This field SHALL be provided if requested and available.
coverageArea This parameter provides the coverage area of the HNB. This parameter SHALL be provided if requested and available.
ecid-utra-HNB-CellData This field provides information for the HNB femtocell.

– *OMA-LPPe-ECID-UTRA-CellData*

The IE *OMA-LPPe-ECID-UTRA-CellData* is used by the location server to provide information for one UTRA macro, pico or femto cell as part of UTRA ECID assistance data.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-CellData ::= SEQUENCE {
    cellIdentity                    BIT STRING (SIZE (32))  OPTIONAL, --Cond AtLeastOne
    modeSpecificInfo                CHOICE {
                    fdd
                        SEQUENCE {
                            primaryCPICH-Scrambling-Code    OMA-LPPe-OTDOA-UTRA-PrimaryScramblingCode,
                            primaryCPICH-Tx-Power           INTEGER (-127..128)     OPTIONAL,
                            uarfcn-dl                       ARFCN-ValueUTRA,
                            ...
                            },
                    tdd
                        SEQUENCE {
                            cellParametersID            OMA-LPPe-OTDOA-UTRA-CellParametersID,
                            primaryCCPCH-Tx-Power       INTEGER (-127..128)         OPTIONAL,
                            uarfcn-nt                   ARFCN-ValueUTRA,
                            ...
                            }
        }   OPTIONAL, --Cond AtLeastOne
    antenna-gain                    INTEGER (-127..128)             OPTIONAL,
    beam-width                      INTEGER (1..360)                OPTIONAL,
    transmit-direction              INTEGER (0..360)                OPTIONAL,
    frequency-accuracy              INTEGER (0..100)                OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
AtLeastOne	At least one of the fields with the condition “AtLeastOne” MUST be present.

OMA-LPPe-ECID-UTRA-CellData field descriptions
cellIdentity This field defines the identity of the cell within the context of the PLMN as defined in [25.331]. The size of the bit string allows for the 32-bit extended UTRAN cell ID; in case the cell ID is shorter, the first bits of the string are set to 0.

OMA-LPPe-ECID-UTRA-CellData **field descriptions**
primaryCPICH-Scrambling-Code This field provides the scrambling code for the primary CPICH and is applicable to FDD only.
primaryCPICH-Tx-Power This field specifies the transmit power for the primary CPICH in dBm and is applicable to FDD only. This field SHALL be provided if requested and available.
uarfcn-dl This field provides the downlink UARFCN for FDD and is encoded as defined in [25.101].
cellParametersID This field provides the cell parameter ID (0-127) for TDD as defined in [25.331].
primaryCCPCH-Tx-Power This field provides the transmit power for the primary CCPCH for TDD as defined in [25.331]. This field SHALL be provided if requsted and available.
uarfcn-nt This field provides the UARFCN for TDD and is encoded as defined in [25.102].
antenna-gain This field specifies the antenna gain in dBi. This field is applicable to a macro or pico cell only and SHALL be provided if requested and available.
beam-width This field specifies the engineered horizontal width of the antenna beam in degrees. This field is applicable to a macro or pico cell only and SHALL be provided if requested and available.
transmit-direction This field specifies the direction of the center of the main transmission lobe in degrees clockwise from north (0-359). A value of 360 indicates omnidirectional transmission. This field is applicable to a macro or pico cell only and SHALL be provided if requested and available.
frequency-accuracy This field specifies the minimum frequency accuracy of the cell in units of 0.005 ppm. A value of zero indicates frequency accuracy is outside the provided range.

6.5.7.3 UTRA ECID Assistance Data Request

– *OMA-LPPe-ECID-UTRA-RequestAssistanceData*

The *OMA-LPPe-ECID-UTRA-RequestAssistanceData* is used to request assistance for UE-based and UE-assisted UTRA ECID based methods.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-RequestAssistanceData ::= SEQUENCE {
    nBrequestedAD       BIT STRING  {   bslist              (0),
                                        bslocation          (1),
                                        transmit-power      (2),
                                        antenna-gain        (3),
                                        beam-width          (4),
                                        transmit-direction  (5),
                                        frequency-accuracy  (6),
                                        non-serving         (7) } (SIZE(1..16)) OPTIONAL,
    hNBrequestedAD      BIT STRING  {   bslist              (0),
                                        bslocation          (1),
                                        locationreliability (2),
                                        transmit-power      (3),
                                        frequency-accuracy  (4),
                                        coveragearea        (5),
                                        non-serving         (6) } (SIZE(1..16)) OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ECID-UTRA-RequestAssistanceData field descriptions
nBrequestedAD This parameter specifies the UTRA E-CID assistance data requested for node Bs associated with macro and pico cells. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested. If this parameter is absent, no assistance data is requested for macro or pico cells. The following assistance data types are included: bslist: include mandatory Node B and cell information bslocation: include the location of each Node B if available transmit-power: include the transmit power for each cell if available antenna-gain: include the antenna gain for each cell if available beam-width: include the beam width for each cell if available transmit-direction: include the transmit direction for each cell if available frequency-accuracy: include the frequency accuracy for each cell if available non-serving: include information for non-serving UTRA networks in addition to the serving UTRA network (or include information for multiple UTRA networks if the serving network is either unknown or not UTRA)
hNBrequestedAD This parameter specifies the UTRA E-CID assistance data requested for HNBs associated with femto cells. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested. If this parameter is absent, no assistance data is requested for femto cells. The following assistance data types are included: bslist: include mandatory HNB and cell information bslocation: include the location of each HNB if available locationreliability: include the reliability of HNB location if available transmit-power: include the transmit power for each cell if available frequency-accuracy: include the frequency accuracy for each cell if available coveragearea: include the coverage area for each HNB if available non-serving: include information for non-serving UTRA networks in addition to the serving UTRA network (or include information for multiple UTRA networks if the serving network is either unknown or not UTRA)

6.5.7.4 UTRA ECID Location Information

– *OMA-LPPe-ECID-UTRA-ProvideLocationInformation*

The *OMA-LPPe-ECID-UTRA-ProvideLocationInformation* is used to provide ECID measurements (UE-assisted) for one or more UTRA access networks and at both current and historic times.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-ProvideLocationInformation ::= SEQUENCE {
    ecid-UTRA-CombinedLocationInformation       SEQUENCE (SIZE (1..maxECIDUTRASize))
                                            OF OMA-LPPe-ECID-UTRA-LocationInformationList   OPTIONAL,
    ecid-Error      OMA-LPPe-ECID-UTRA-Error    OPTIONAL,
    ...
}

OMA-LPPe-ECID-UTRA-LocationInformationList ::= SEQUENCE {
    ecid-utra-LocationInformation       OMA-LPPe-ECID-UTRA-LocationInformation,
    relativeTimeStamp                   INTEGER (0..65535)  OPTIONAL,
    servingFlag                         BOOLEAN,
    ...
}

maxECIDUTRASize INTEGER ::= 64

-- ASN1STOP
```


OMA-LPPe-ECID-UTRA-ProvideLocationInformation **field descriptions**
ecid-UTRA-CombinedLocationInformation This parameter provides E-CID measurements for one or more UTRA access networks at the current time and/or for historic times. This parameter supports part of the Location ID and Multiple Location IDs parameters in SUPL 2.0.
ecid-Error This parameter provides error information when not all requested UTRA E-CID measurements can be reported. This parameter should be included when some but not all requested measurements are reported and SHALL be included when no requested measurements are reported.
relativeTimeStamp This parameter SHALL be included for historic UTRA E-CID measurements and provides the time of the historic measurements relative to current time in units of 0.01 seconds. If absent, current time is implied which is equivalent to a relativeTimeStamp of zero. Current time refers to the time when the target sends UTRA E-CID measurements to the server.
servingFlag This parameter indicates whether a set of E-CID measurements were obtained for a serving UTRA access network (TRUE) or non-serving access network (FALSE). A target device with multiple radio support may indicate more than one type of serving access network for the same time instant.

6.5.7.5 UTRA ECID Location Information Elements

– *OMA-LPPe-ECID-UTRA-LocationInformation*

The IE *OMA-LPPe-ECID-UTRA-LocationInformation* is used by the target device to provide E-CID measurements for a serving or non-serving UTRA network to the server.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-LocationInformation ::= SEQUENCE {
    cellGlobalIdUTRA        CellGlobalIdEUTRA-AndUTRA,
    frequencyInfo           OMA-LPPe-UTRA-FrequencyInfo                     OPTIONAL,
    primaryScramblingCode   OMA-LPPe-OTDOA-UTRA-PrimaryScramblingCode       OPTIONAL,   --Cond FDD
    measuredResultsList     OMA-LPPe-ECID-UTRA-MeasuredResultsList          OPTIONAL,
    cellParametersId        OMA-LPPe-OTDOA-UTRA-CellParametersID            OPTIONAL,   --Cond TDD
    utratimingAdvance       OMA-LPPe-ECID-UTRA-UTRATimingAdvance            OPTIONAL,   --Cond TDD
    ...
}

OMA-LPPe-ECID-UTRA-UTRATimingAdvance ::= SEQUENCE {
    tA                      INTEGER (0..8191),
    tAResolution            OMA-LPPe-ECID-UTRA-TAResolution             OPTIONAL,
    chipRate                OMA-LPPe-ECID-UTRA-ChipRate                 OPTIONAL,
    ...
}

OMA-LPPe-ECID-UTRA-TAResolution ::= ENUMERATED {
    res1-0chip,
    res0-5chip,
    res0-125chip,
    ...
}

OMA-LPPe-ECID-UTRA-ChipRate ::= ENUMERATED {
    tdd128,
    tdd384,
    tdd768,
    ...
}


OMA-LPPe-UTRA-FrequencyInfo ::= SEQUENCE {
    modeSpecificInfo        OMA-LPPe-UTRA-ModeSpecificInfo,
    ...
```



```
}

OMA-LPPe-UTRA-ModeSpecificInfo ::= CHOICE {
    fdd         OMA-LPPe-UTRA-FrequencyInfoFDD,
    tdd         OMA-LPPe-UTRA-FrequencyInfoTDD,
    ...
}

OMA-LPPe-UTRA-FrequencyInfoFDD ::= SEQUENCE {
    uarfcn-UL       ARFCN-ValueUTRA     OPTIONAL,
    uarfcn-DL       ARFCN-ValueUTRA,
    ...}

OMA-LPPe-UTRA-FrequencyInfoTDD ::= SEQUENCE {
    uarfcn-Nt       ARFCN-ValueUTRA,
    ...
}

OMA-LPPe-ECID-UTRA-MeasuredResultsList ::= SEQUENCE (SIZE (1..maxFreq)) OF
                                                                    OMA-LPPe-ECID-UTRA-MeasuredResults

OMA-LPPe-ECID-UTRA-MeasuredResults ::= SEQUENCE {
    frequencyInfo               OMA-LPPe-UTRA-FrequencyInfo,
    utra-CarrierRSSI            OMA-LPPe-ECID-UTRA-CarrierRSSI                  OPTIONAL,
    cellMeasuredResultsList     OMA-LPPe-ECID-UTRA-CellMeasuredResultsList      OPTIONAL,
    ...
}

OMA-LPPe-ECID-UTRA-CellMeasuredResultsList ::= SEQUENCE (SIZE (1..utra-maxCellMeas)) OF
                                                                OMA-LPPe-ECID-UTRA-CellMeasuredResults

OMA-LPPe-ECID-UTRA-CarrierRSSI ::= INTEGER(0..127)

OMA-LPPe-ECID-UTRA-CellMeasuredResults ::= SEQUENCE {
    cellIdentity        BIT STRING (SIZE (32))      OPTIONAL,
    modeSpecificInfo    CHOICE
    {
        fdd
                SEQUENCE {
                        primaryCPICH-Info   OMA-LPPe-OTDOA-UTRA-PrimaryScramblingCode,
                        cpich-Ec-N0         OMA-LPPe-ECID-UTRA-CPICH-Ec-N0          OPTIONAL,
                        cpich-RSCP          OMA-LPPe-ECID-UTRA-CPICH-RSCP           OPTIONAL,
                        pathloss            OMA-LPPe-ECID-UTRA-Pathloss             OPTIONAL,
                        ...
                },
        tdd
                SEQUENCE {
                        cellParametersID    OMA-LPPe-OTDOA-UTRA-CellParametersID,
                        primaryCCPCH-RSCP   OMA-LPPe-ECID-UTRA-PrimaryCCPCH-RSCP    OPTIONAL,
                        pathloss            OMA-LPPe-ECID-UTRA-Pathloss             OPTIONAL,
                        ...
                }
    },
    ...
}

OMA-LPPe-ECID-UTRA-PrimaryCCPCH-RSCP ::= INTEGER(0..127)

OMA-LPPe-ECID-UTRA-CPICH-Ec-N0 ::= INTEGER(0..63)

OMA-LPPe-ECID-UTRA-CPICH-RSCP ::= INTEGER(0..127)

OMA-LPPe-ECID-UTRA-Pathloss ::= INTEGER(46..173)

maxFreq INTEGER ::= 8

-- ASN1STOP
```


Conditional presence	Explanation
FDD	The field may optionally be included for FDD. The field SHALL be omitted for TDD.
TDD	The field may optionally be included for TDD. The field SHALL be omitted for FDD.

***OMA-LPPe-ECID-UTRA-LocationInformation* field descriptions**
cellGlobalIdUTRA This field provides the UTRAN global cell ID of the measured cell which is either the serving cell or a cell in a non-serving UTRA network that is treated like a serving cell for the purpose of reporting measurements.
frequencyInfo For FDD, this parameter provides the downlink and optionally the uplink UARFCN which is encoded as defined in [25.101]. For TDD, this parameter provides the UARFCN which is encoded as defined in [25.102]. This information should be provided if available.
primaryScramblingCode This field provides the scrambling code for the primary CPICH and is applicable to FDD only. This information should be provided if applicable.
measuredResultsList This parameter provides the inter-frequency measured results list information as defined in [25.331]. It contains the following information. List of 1 to 8 frequencies with the following optional parameters included for each frequency: frequencyInfo: if missing this is the same as reported for the measured cell in *OMA-LPPe-ECID-UTRA-LocationInformation* utra-CarrierRSSI: UTRA Carrier RSSI level value in the range 0-76 as defined and encoded in [25.133] for FDD and [25.123] for TDD. Values over 76 are spare (not used). cellMeasuredResultsList: measurement results for 1 to 32 other cells

OMA-LPPe-ECID-UTRA-LocationInformation field descriptions
cellMeasuredResultsList This parameter provides trhe following measurements for one UTRA cell. Cell identity (28 or 32 bits, first 4 bits set to zero for a 28 bit cell ID) For FDD the following: primaryCPICH-Info: scrambling code (0-511) of the primary CPICH cpich-Ec-N0: encoded value for CPICH_Ec/Io. This is the ratio of the received energy per PN chip for the CPICH to the total received power spectral density at the UE antenna connector. For a UE that is able to simultaneously receive signals from more than 1 carrier, CPICH_Ec/Io is defined for each carrier individually. The encoding is as defined in [25.133]. The value range for this field is 0-63, but values over 49 are not used. This field is optional. cpich-RSCP: encoded value for the CPICH RSCP. Encoding is based on [25.331] and [25.133] as follows: cpich-RSCP = 123 CPICH RSCP < -120 dBm cpich-RSCP = 124 -120 ≤ CPICH RSCP < -119 dBm cpich-RSCP = 125 -119 ≤ CPICH RSCP < -118 dBm cpich-RSCP = 126 -118 ≤ CPICH RSCP < -117 dBm cpich-RSCP = 127 -117 ≤ CPICH RSCP < -116 dBm cpich-RSCP = 0 -116 ≤ CPICH RSCP < -115 dBm cpich-RSCP = 1 -115 ≤ CPICH RSCP < -114 dBm … … … cpich-RSCP = 89 -27 ≤ CPICH RSCP < -26 dBm cpich-RSCP = 90 -26 ≤ CPICH RSCP < -25 dBm cpich-RSCP = 91 -25 ≤ CPICH RSCP dB Value range of this field is 0-127 with values in the range 92-122 not used. This parameter is optional. Pathloss: path loss in the range 46-158 dB. Values above 158 are spare. This field is optional. For TDD the following: cellParametersID: the cell parameter ID (0-127) as defined in [25.331] primaryCCPCH-RSCP: encoded value for the primary CCPCH RSCP. Encoding is based on [25.331] and [25.123] as follows: cpich-RSCP = 123 CPICH RSCP < -120 dBm cpich-RSCP = 124 -120 ≤ CPICH RSCP < -119 dBm cpich-RSCP = 125 -119 ≤ CPICH RSCP < -118 dBm cpich-RSCP = 126 -118 ≤ CPICH RSCP < -117 dBm cpich-RSCP = 127 -117 ≤ CPICH RSCP < -116 dBm cpich-RSCP = 0 -116 ≤ CPICH RSCP < -115 dBm cpich-RSCP = 1 -115 ≤ CPICH RSCP < -114 dBm … … … cpich-RSCP = 89 -27 ≤ CPICH RSCP < -26 dBm cpich-RSCP = 90 -26 ≤ CPICH RSCP < -25 dBm cpich-RSCP = 91 -25 ≤ CPICH RSCP dB Value range of this field is 0-127 with values in the range 92-122 not used. This parameter is optional. pathloss: path loss in the range 46-158 dB. Values above 158 are spare. This field is optional.

OMA-LPPe-ECID-UTRA-LocationInformation field descriptions
cellParametersId This field provides the cell parameter ID (0-127) as defined in [25.331]. This is optional for TDD and not applicable for FDD.
utraTimingAdvance This field may only be included for TDD and provides the timing advance used by the UE. This is measured as defined in [25.225] for 1.28Mcps TDD (though applies also to 3.84 and 7.68 Mcps). Encoding uses the following fields: tA: timing advance in the range 0-8191 tAResolution: units for tA res1-0chip: 1.0 chips res0-5chip: 0.5 chips res0-125chip: 0.125 chips (default value if absent) chipRate : chip rate tdd128: 1.28 Mcps (default if absent) tdd384: 3.84 Mcps tdd768: 7.68 Mcps

6.5.7.6 UTRA ECID Location Information Request – *OMA-LPPe-ECID-UTRA-RequestLocationInformation*

The *OMA-LPPe-ECID-UTRA-RequestLocationInformation* is used to request UTRA ECID measurements (UE-assisted).

```
-- ASN1START

OMA-LPPe-ECID-UTRA-RequestLocationInformation ::= SEQUENCE {
    requestedMeasurements       BIT STRING {    measuredResultsList         (0),
                                                tdd-timingAdvance           (1),
                                                mRL-utra-CarrierRSSI        (2),
                                                mRL-FDD-cpich-Ec-N0         (3),
                                                mRL-FDD-cpich-RSCP          (4),
                                                mRL-FDD-pathloss            (5),
                                                mRL-TDD-primaryCCPCH-RSCP   (6),
                                                mRL-TDD-pathloss            (7),
                                                non-serving                 (8),
                                                historic                    (9) } (SIZE(1..16)),
        ...
}

-- ASN1STOP
```

OMA-LPPe-ECID-UTRA-RequestLocationInformation field descriptions
requestedMeasurements This field specifies the UTRA E-CID measurements requested. This is represented by a bit string, with a one-value at the bit position means the particular measurement is requested; a zero-value means not requested. The following measurement requests can be included. measuredResultsList: inter-frequency measured results list information as defined in [25.331] tdd-timingAdvance: timing advance for TDD mRL-utra-CarrierRSSI: UTRA Carrier RSSI level in the measured results list mRL-FDD-cpich-Ec-N0: CPICH Ec/Io value for FDD in the measured results list mRL-FDD-cpich-RSCP: CPICH RSCP for FDD in the measured results list mRL-FDD-pathloss: pathloss for FDD in the measured results list mRL-TDD-primaryCCPCH-RSCP: primary CPICH RSCP for TDD in the measured results list mRL-TDD-pathloss: pathloss for TDD in the measured results list non-serving: E-CID measurements for non-serving UTRA networks (in addition to a serving network) historic: historic UTRA E-CID measurements (in addition to current measurements)

6.5.7.7 UTRA ECID Capability Information

– *OMA-LPPe-ECID-UTRA-ProvideCapabilities*

The *OMA-LPPe-ECID-UTRA-ProvideCapabilities* is used to provide the UTRA ECID capabilities of the target.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-ProvideCapabilities ::= SEQUENCE {
    ecid-utra-MeasSupported BIT STRING {    measuredResultsList             (0),
                                                tdd-timingAdvance           (1),
                                                mRL-utra-CarrierRSSI        (2),
                                                mRL-FDD-cpich-Ec-N0         (3),
                                                mRL-FDD-cpich-RSCP          (4),
                                                mRL-FDD-pathloss            (5),
                                                mRL-TDD-primaryCCPCH-RSCP   (6),
                                                mRL-TDD-pathloss            (7),
                                                non-serving                 (8),
                                                historic                    (9) } (SIZE(1..16)),
    ecid-utra-nodeB-ADSupported BIT STRING  { bslist                (0),
                                              bslocation            (1),
                                              transmit-power        (2),
                                              antenna-gain          (3),
                                              beam-width            (4),
                                              transmit-direction    (5),
                                              frequency-accuracy    (6),
                                              non-serving           (7) } (SIZE(1..16)),
    ecid-utra-HNB-ADSupported   BIT STRING  { bslist                (0),
                                              bslocation            (1),
                                              locationreliability   (2),
                                              transmit-power        (3),
                                              frequency-accuracy    (4),
                                              coveragearea          (5),
                                              non-serving           (6) } (SIZE(1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ECID-UTRA-ProvideCapabilities field descriptions
ecid-utra-MeasSupported This field specifies the E-CID measurements supported by the target device for UTRA. This is represented by a bit string, with a one-value at the bit position means the particular measurement is supported; a zero-value means not supported. A zero-value in all bit positions in the bit string means only the basic Cell ID positioning method is supported by the target device for UTRA. The following bits are assigned for the indicated measurements. measuredResultsList: inter-frequency measured results list information as defined in [25.331] tdd-timingAdvance: timing advance for TDD mRL-utra-CarrierRSSI: UTRA Carrier RSSI level in the measured results list mRL-FDD-cpich-Ec-N0: CPICH Ec/Io value for FDD in the measured results list mRL-FDD-cpich-RSCP: CPICH RSCP for FDD in the measured results list mRL-FDD-pathloss: pathloss for FDD in the measured results list mRL-TDD-primaryCCPCH-RSCP: primary CPICH RSCP for TDD in the measured results list mRL-TDD-pathloss: pathloss for TDD in the measured results list non-serving: E-CID measurements for non-serving UTRA networks (in addition to a serving network) historic: historic UTRA E-CID measurements
ecid-utra-nodeB-ADSupported This field specifies the E-CID assistance data supported by the target device for UTRA node Bs. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is supported; a zero-value means not supported. A zero-value in all bit positions or absence of this field means no assistance data is supported. The following bits are assigned for the indicated assistance data. bslist: mandatory node B and cell information bslocation: location of each node B transmit-power: transmit power for each cell antenna-gain: antenna gain for each cell beam-width: beam width for each cell transmit-direction: transmit direction for each cell frequency-accuracy: frequency accuracy for each cell non-serving: information for non-serving UTRA networks in addition to the serving UTRA network (or information for multiple UTRA networks if the serving network is not UTRA)
ecid-utra-HNB-ADSupported This field specifies the E-CID assistance data supported by the target device for UTRA HNBs. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is supported; a zero-value means not supported. A zero-value in all bit positions or absence of this field means no assistance data is supported. The following bits are assigned for the indicated assistance data. bslist: mandatory HNB and cell information bslocation: location of each HNB locationreliability: location reliability of each HNB transmit-power: transmit power for each cell frequency-accuracy: frequency accuracy for each cell coveragearea: coverage area for each HNB non-serving: information for non-serving UTRA networks in addition to the serving UTRA network (or information for multiple UTRA networks if the serving network is not UTRA)

6.5.7.8 UTRA ECID Capability Information Request

– *OMA-LPPe-ECID-UTRA-RequestCapabilities*

The *OMA-LPPe-ECID-UTRA-RequestCapabilities* is used to request UTRA ECID capabilities information from the target.

```
-- ASN1START
```

```
OMA-LPPe-ECID-UTRA-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.7.9 UTRA ECID Error Element

– *OMA-LPPe-ECID-UTRA-Error*

The IE *OMA-LPPe-ECID-UTRA-Error* is used by the location server or target device to provide UTRA E-CID error reasons to the target device or location server, respectively.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-Error ::= CHOICE {
    locationServerErrorCauses       OMA-LPPe-ECID-UTRA-LocationServerErrorCauses,
    targetDeviceErrorCauses         OMA-LPPe-ECID-UTRA-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-ECID-UTRA-LocationServerErrorCauses*

The IE *OMA-LPPe-ECID-UTRA-LocationServerErrorCauses* is used by the location server to provide UTRA E-CID error reasons to the target device.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-LocationServerErrorCauses ::= SEQUENCE {
    cause       ENUMERATED  {   undefined,
                                requestedADNotAvailable,
                                notAllrequestedADAvailable,
                                ...
                            },
    nodeBMandatoryDataUnavailable           NULL        OPTIONAL,
    nodeBLocationUnavailable                NULL        OPTIONAL,
    nodeBcellTransmitPowerUnavailable       NULL        OPTIONAL,
    nodeBcallAntennaGainUnavailable         NULL        OPTIONAL,
    nodeBcellBeamWidthUnavailable           NULL        OPTIONAL,
    nodeBcellTransmitDirectionUnavailable   NULL        OPTIONAL,
    nodeBcellFrequencyAccuracyUnavailable   NULL        OPTIONAL,
    nodeBnonservingADUnavailable            NULL        OPTIONAL,
    hNBMandatoryDataUnavailable             NULL        OPTIONAL,
    hNBLocationUnavailable                  NULL        OPTIONAL,
    hNBLocationReliabilityUnavailable       NULL        OPTIONAL,
    hNBcellTransmitPowerUnavailable         NULL        OPTIONAL,
    hNBcellFrequencyAccuracyUnavailable     NULL        OPTIONAL,
    hNBCoverageAreaUnavailable              NULL        OPTIONAL,
    hNBnonservingADUnavailable              NULL        OPTIONAL,
    ...
}

-- ASN1STOP
```


OMA-LPPe-ECID-UTRA-LocationServerErrorCauses field descriptions
cause This field provides a UTRA ECID specific error cause for the server applicable to provision of assistance data. If the cause value is '*requestedADNotAvailable*', none of the requested assistance data could be provided and no further information needs to be included. If the cause value is '*notAllRequestedADAvailable*', the server was able to provide some but not all requested UTRA ECID assistance data. In this case, the server should include any of the specific error indications as applicable. Note that inclusion of these fields is applicable when some of the associated information can be provided for some node Bs or HNBs but not for all node Bs and HNBs.

– *OMA-LPPe-ECID-UTRA-TargetDeviceErrorCauses*

The IE *OMA-LPPe-ECID-UTRA-TargetDeviceErrorCauses* is used by the target device to provide UTRA E-CID error reasons to the location server.

```
-- ASN1START

OMA-LPPe-ECID-UTRA-TargetDeviceErrorCauses ::= SEQUENCE {
    cause       ENUMERATED {    undefined,
                                requestedMeasurementsNotAvailable,
                                notAllrequestedMeasurementsPossible,
                                ...
                            },
    mRLMeasurementsNotPossible                          NULL        OPTIONAL,
    tdd-timingAdvanceMeasurementNotPossible             NULL        OPTIONAL,
    mRL-utra-CarrierRSSIMeasurementNotPossible          NULL        OPTIONAL,
    mRL-FDD-cpich-Ec-N0MeasurementNotPossible           NULL        OPTIONAL,
    mRL-FDD-cpich-RSCPMeasurementNotPossible            NULL        OPTIONAL,
    mRL-FDD-pathlossMeasurementNotPossible              NULL        OPTIONAL,
    mRL-TDD-primaryCCPCH-RSCPMeasurementNotPossible     NULL        OPTIONAL,
    mRL-TDD-pathlossMeasurementNotPossible              NULL        OPTIONAL,
    non-servingMeasurementsNotAvailable                 NULL        OPTIONAL,
    historicMeasurementsNotAvailable                    NULL        OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ECID-UTRA-TargetDeviceErrorCauses field descriptions
cause This field provides a UTRA ECID specific error cause. If the cause value is '*requestedMeasurementsNotAvailable*', none of the requested measurements could be provided and no further information needs to be included. If the cause value is '*notAllRequestedMeasurementsPossible*', the target device was able to provide some but not all requested UTRA ECID measurements. In this case, the target device should include any of the other fields as applicable. An error cause SHALL NOT be included for omission of TDD measurements for an FDD cell or omission of FDD measurements for a TDD cell since these are not considered to be errors.

6.5.8 WLAN Enhanced Cell ID Positioning

This section defines support for positioning using measurements related to a WLAN AP.

6.5.8.1 WLAN AP Assistance Data

– *OMA-LPPe-WLAN-AP-ProvideAssistanceData*

The *OMA-LPPe-WLAN-AP-ProvideAssistanceData* is used to provide assistance for UE-based and UE-assisted WLAN AP based methods.

```
-- ASN1START
```

```
OMA-LPPe-WLAN-AP-ProvideAssistanceData ::= SEQUENCE {
    wlan-DataSet    SEQUENCE (SIZE (1..maxWLANDataSets)) OF OMA-LPPe-WLAN-DataSet   OPTIONAL,
    wlan-AP-Error   OMA-LPPe-WLAN-AP-Error                                          OPTIONAL,
    ...,
-- version 2.0 extension elements
   ver2-0-WLAN-Group-Data   SEQUENCE  (SIZE  (1..ver2-0-maxWLANGroups))  OF  OMA-LPPe-ver2-0-WLAN-Group-Data
OPTIONAL,
    ver2-0-server-tracking  NULL    OPTIONAL
}

maxWLANDataSets INTEGER ::= 8

ver2-0-maxWLANGroups  INTEGER ::=  64

-- ASN1STOP
```

OMA-LPPe-AP-ProvideAssistanceData field descriptions
wlan-DataSet   This parameter provides data for up to 8 sets of WLAN APs, This parameter is optional.
wlan-AP-Error   This parameter provides error information and may be included when an LPPe Provide Assistance Data is sent in response to an LPPe Request Assistance Data. It is allowed to include both a wlan-DataSet parameter and a wlan-AP-Error parameter (e.g. when only some requested WLAN assistance data is provided). This parameter is optional.
ver2-0-WLAN-Group-Data   This parameter applies only to LPPe 2.0 and provides one or more sets of WLAN group data. The provided WLAN group data may apply to one or more WLAN APs provided via the wlan-DataSet parameter as indicated by inclusion of one or WLAN group IDs in the data provided for these APs. This parameter is optional. A target SHALL use the included WLAN group ID in each set of group data to identify whether it already has group data with the same WLAN Group ID. Any previous group data with the same WLAN group ID SHALL be deleted.
ver2-0-server-tracking   This parameter indicates whether the server tracks WLAN assistance data sent to a target. A target need not indicate to a server its possession of any assistance data received previously that is tracked when sending an LPPe Request Assistance Data for WLAN APs. This parameter is optional and encoded as a null value. Inclusion of the parameter indicates the server tracks data for WLAN APs and omission indicates the server does not.

6.5.8.2 WLAN AP Assistance Data Elements

– *OMA-LPPe-WLAN-DataSet*

The IE *OMA-LPPe-WLAN-DataSet* is used by the location server to provide WLAN AP information for one set of WLAN APs.

```
-- ASN1START

OMA-LPPe-WLAN-DataSet ::= SEQUENCE {
    plmn-Identity               SEQUENCE {
                                    mcc     SEQUENCE (SIZE (3))     OF INTEGER (0..9),
                                    mnc     SEQUENCE (SIZE (2..3))  OF INTEGER (0..9)
                                    }   OPTIONAL,
    reference-point             OMA-LPPe-ReferencePoint     OPTIONAL,   --Cond APlocations
    supported-channels-11a      Supported-Channels-11a  OPTIONAL,
    supported-channels-11bg     Supported-Channels-11bg OPTIONAL,
    wlan-ap-list                SEQUENCE (SIZE (1..maxWLANAPs)) OF OMA-LPPe-WLAN-AP-Data,
    ...,
-- version 2.0 extension elements
    ver2-0-defaultVendorOrOperator  OMA-LPPe-VendorOrOperatorID            OPTIONAL,
    ver2-0-WLAN-Group-IDs           SEQUENCE (SIZE (1..ver2-0-maxWLANGroupIDs)) OF OMA-LPPe-ver2-0-WLAN-
GroupID OPTIONAL,
    ver2-0-validity-period          OMA-LPPe-ValidityPeriod                OPTIONAL,
    ver2-0-purge-time               INTEGER (1..4096)                      OPTIONAL
```



```
}

maxWLANAPs  INTEGER ::= 128

ver2-0-maxWLANGroupIDs      INTEGER ::= 16

Supported-Channels-11a ::= SEQUENCE {
    ch34    BOOLEAN,
    ch36    BOOLEAN,
    ch38    BOOLEAN,
    ch40    BOOLEAN,
    ch42    BOOLEAN,
    ch44    BOOLEAN,
    ch46    BOOLEAN,
    ch48    BOOLEAN,
    ch52    BOOLEAN,
    ch56    BOOLEAN,
    ch60    BOOLEAN,
    ch64    BOOLEAN,
    ch149   BOOLEAN,
    ch153   BOOLEAN,
    ch157   BOOLEAN,
    ch161   BOOLEAN
}

Supported-Channels-11bg ::= SEQUENCE {
    ch1  BOOLEAN,
    ch2  BOOLEAN,
    ch3  BOOLEAN,
    ch4  BOOLEAN,
    ch5  BOOLEAN,
    ch6  BOOLEAN,
    ch7  BOOLEAN,
    ch8  BOOLEAN,
    ch9  BOOLEAN,
    ch10 BOOLEAN,
    ch11 BOOLEAN,
    ch12 BOOLEAN,
    ch13 BOOLEAN,
    ch14 BOOLEAN
}

-- ASN1STOP
```

Conditional presence	Explanation
APlocations	The field is mandatory when one or more WLAN AP locations are provided for the WLAN AP set and a default reference point is not provided in LPPe common IEs.

***OMA-LPPe-WLAN-DataSet* field descriptions**
plmn-Identity This field identifies any PLMN operator who manages the WLAN APs via any wide area PLMN owned by the operator and accessible from each of the WLAN APs. PLMN ID is defined in [23.003]. This field is optional.
reference-point This field specifies a reference location for the locations of the WLAN APs in the data set. If this field is absent, the reference location is provided by the default reference point in LPPe common IEs.
supported-Channels-11a This parameter defines the superset of all channels supported by all WLAN APs in the data set of type 801.11a. This parameter is optional.
supported-Channels-11bg This parameter defines the superset of all channels supported by all WLAN APs in the data set of type 801.11b or 802.11g. This parameter is optional.
wlan-ap-list This parameter provides information for one or more WLAN APs in the data set.

***OMA-LPPe-WLAN-DataSet* field descriptions**
ver2-0-defaultVendorOrOperator This parameter applies only to LPPe 2.0 and provides the vendor or operator who is the source for all WLAN related data provided by the OMA-LPPe-WLAN-DataSet. This parameter is optional.
ver2-0-WLAN-Group-IDs This parameter applies only to LPPe 2.0 and provides up to 16 WLAN group IDs identifying corresponding sets of WLAN group data that apply to all WLAN APs identified in the wlan-ap-list parameter. The different sets of WLAN group data may have been provided in the OMA-LPPe-WLAN-AP-ProvideAssistanceData and/or may already be known to a target from previous WLAN assistance data. This parameter is optional.
ver2-0-validityPeriod This parameter applies only to LPPe 2.0 and provides the validity period for the provided WLAN data.
ver2-0-purgePeriod This parameter applies only to LPPe 2.0 and provides a period after which all WLAN data provided in the OMA-LPPe-WLAN-DataSet data type SHALL be purged from the target. The period starts at receipt of the data and is defined in units of 15 minutes in the range 1 to 4096 (corresponding to just over 39 days).

– *OMA-LPPe-WLAN-AP-Data*

The IE *OMA-LPPe-WLAN-AP-Data* is used by the location server to provide information for one WLAN AP as part of WLAN AP assistance data.

```
-- ASN1START

OMA-LPPe-WLAN-AP-Data ::= SEQUENCE {
    wlan-ap-id                      OMA-LPPe-WLAN-AP-ID,
    relative-location               OMA-LPPe-RelativeLocation       OPTIONAL,
    location-reliability            INTEGER (1..100)                OPTIONAL,
    wlan-ap-Type-Data               SEQUENCE (SIZE (1..maxWLANTypes)) OF OMA-LPPe-WLAN-AP-Type-Data,
    coverageArea                    OMA-LPPe-WLANFemtoCoverageArea  OPTIONAL,   --Cond Oneonly
    ...,
-- version 2.0 extension elements
    ver2-0-propagation              OMA-LPPe-ver2-0-RF-Propagation    OPTIONAL,    -- Cond Oneonly
    ver2-0-locationSource       OMA-LPPe-ver2-0-AP-LocationSource       OPTIONAL,
    ver2-0-WLAN-Group-IDs       SEQUENCE  (SIZE  (1..ver2-0-maxWLANGroupIDs))  OF  OMA-LPPe-ver2-0-WLAN-
GroupID OPTIONAL
}

maxWLANTypes    INTEGER ::= 5

-- ASN1STOP
```

Conditional presence	Explanation
Oneonly	The field SHALL be provided when requested and available but SHALL be provided once only – either in *OMA-LPPe-WLAN-AP-*Data (applicable to all WLAN types) or in *OMA-LPPe-WLAN-AP-Type-Data* (applicable to each distinct WLAN type) but not in both

***OMA-LPPe-WLAN-AP-Data* field descriptions**
relative-location This field provides the location and optional uncertainty in location of the WLAN AP relative to the reference point for this data set. This field SHALL be provided if requested and available.
location-reliability The field provides the reliability R of the WLAN AP location. The probability that the WLAN AP location has not changed given as a percentage. R may be based on both historic change or persistence of the AP location over a period of time and the time interval since the AP location was last provided to or verified by the server. Note that location reliability is distinct from location accuracy and refers to the possibility of a WLAN AP having been moved to a new location. This field SHALL be provided if requested and available.

OMA-LPPe-WLAN-AP-Data field descriptions
wlan-ap-Type-Data This field provides information for one or more WLAN AP types (e.g. for a multi-band and/or multimode device) sharing a common physical AP.
coverageArea This parameter provides the coverage area of the WLAN AP for each WLAN type supported
ver2-0-propagation This field applies only to LPPe 2.0 and indicates the radio propagation characteristics of the WLAN AP for a particular WLAN type.
ver2-0-locationSource This parameter applies only to LPPe 2.0 and provides the source of the AP location and an indication (via the locationType) of its reliability and accuracy. sourceVendorOrOperator: this field identifies the source vendor or operator for the AP location.
ver2-0-WLAN-Group-IDs This parameter applies only to LPPe 2.0 and provides up to 16 WLAN group IDs identifying corresponding sets of WLAN group data that apply to the particular WLAN AP identified by the wlan-ap-id parameter. The different sets of WLAN group data may have been provided in the OMA-LPPe-WLAN-AP-ProvideAssistanceData and/or may already be known to a target from previous WLAN assistance data. This parameter is optional.

– *OMA-LPPe-ver2-0-AP-LocationSource*

The IE OMA-LPPe-ver2-0-AP-LocationSource applies only to LPPe 2.0 and is used by a location server to provide the source of an AP location and an indication of its reliability and accuracy.

```
-- ASN1START

OMA-LPPe-ver2-0-AP-LocationSource ::= SEQUENCE {
    locationType    ENUMERATED {undefined (0), survey (1), crowdsourcing (2), drive-by (3), mixed (4), 
...},
    sourceVendorOrOperator      OMA-LPPe-VendorOrOperatorID     OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-AP-LocationSource field descriptions
locationType This field indicates how an AP location was obtained. Permitted values are: undefined, survey (accuracy may be high but also subject to human error), crowdsourcing, drive-by and mixed (meaning 2 or more methods and likely to be of high accuracy).
sourceVendorOrOperator This field identifies the source vendor or operator for an AP location.

– *OMA-LPPe-WLAN-AP-Type-Data*

The IE *OMA-LPPe-WLAN-AP-Type-Data* is used by the location server to provide information for a particular type of WLAN AP.

```
-- ASN1START
```



```
OMA-LPPe-WLAN-AP-Type-Data ::= SEQUENCE {
    wlan-AP-Type                    OMA-LPPe-WLAN-AP-Type,
    transmit-power                  INTEGER (-127..128)         OPTIONAL,
    antenna-gain                    INTEGER (-127..128)         OPTIONAL,
    coverageArea                    OMA-LPPe-WLANFemtoCoverageArea  OPTIONAL,   --Cond Oneonly
    ...,
-- version 2.0 extension elements
    ver2-0-propagation              OMA-LPPe-ver2-0-RF-Propagation    OPTIONAL,    -- Cond Oneonly
    ver2-0-operatingClass           INTEGER (0..255)            OPTIONAL,
    ver2-0-channelNumber            INTEGER (0..255)            OPTIONAL,
    ver2-0-rf-heatmap               OMA-LPPe-ver2-0-RF-HeatMap  OPTIONAL
}

-- ASN1STOP
```

Conditional presence	Explanation
Oneonly	The field SHALL be provided when requested and available but SHALL be provided once only – either in *OMA-LPPe-WLAN-AP-Data* (applicable to all WLAN types) or in *OMA-LPPe-WLAN-AP-Type-Data* (applicable to each distinct WLAN type) but not in both

***OMA-LPPe-WLAN-AP-Type-Data* field descriptions**
wlan-AP-Type This field provides the type of the WLAN AP.
transmit-power This field specifies the transmit power of the WLAN AP for a beacon frame, probe response frame or measurement pilot frame in dBm. This field SHALL be provided if requested and available.
antenna-gain This field specifies the antenna gain in dBi. This field SHALL be provided if requested and available.
coverageArea This parameter provides the coverage area of the WLAN AP for a particular WLAN type
ver2-0-propagation This parameter applies only to LPPe 2.0. This field indicates the propagation characteristics of the WLAN AP for a particular WLAN type.
ver2-0-operatingClass This parameter applies only to LPPe 2.0 and defines the Operating Class for this type of WLAN AP as defined in [IEEE 802.11 Rev. MC]. This parameter SHALL be provided if available.
ver2-0-channelNumber This parameter apples only to LPPe 2.0 and provides the channel number for which the transmit-power parameter applies. This parameter may be included by a server if transmit-power is included. If this parameter is not included, a target may assume that transmit-power applies to all channels supported by the AP for the operating class (if included) and AP type.
ver2-0-rf-heatmap This parameter applies only to LPPe 2.0 and provides RF heat map data for the WLAN AP in the form of signal strength and/or RTT data. This parameter is optional. A target that receives new RSSI or RTT heat map data for an AP of a particular type SHALL delete any previously received RSSI or RTT heat map data, respectively, for this AP and AP type.

– *OMA-LPPe-ver2-0-RF-Propagation*

The IE *OMA-LPPe-ver2-0-RF-Propagation* is used by the location server to provide the propagation model for a particular type of transmitter.

```
-- ASN1START

OMA-LPPe-ver2-0-RF-Propagation ::= CHOICE {
    propModel-1                     OMA-LPPe-ver2-0-RF-CircularPropagation,
    ...
}
```

```
-- ASN1STOP
```

OMA-LPPe-ver2-0-RF-Propagation field descriptions
propModel-1 Selected propagation model of type 1

– *OMA-LPPe-ver2-0-RF-CircularPropagation*

The IE *OMA-LPPe-ver2-0-RF-CircularPropagation* is used by the location server to provide the propagation model for a particular transmitter expressed using circular contours with a window of applicability that defines where the model applies.

```
-- ASN1START

OMA-LPPe-ver2-0-RF-CircularPropagation ::= SEQUENCE {
    propModelx              INTEGER (-1024..1023) OPTIONAL,
    propModely              INTEGER (-1024..1023) OPTIONAL,
    applicability                   OMA-LPPe-ver2-0-RF-ApplicabilityWindow OPTIONAL,
    startRssi                       INTEGER (-128..127),
    stepSize                        INTEGER (1..16),
    propagationModel                SEQUENCE (SIZE(1.. ver2-0-maxPropContours))
                                       OF OMA-LPPe-ver2-0-RF-PropContourModel,
    stddev                          INTEGER(1..8) OPTIONAL,
    ...
}

ver2-0-maxPropContours INTEGER ::= 10

-- ASN1STOP
```

OMA-LPPe-ver2-0-RF-CircularPropagation field descriptions
propModelx This field gives the x (easterly) offset of the location of the transmitter assumed by the propagation model for this transmitter, with respect to the reference transmitter location (metres). Zero is assumed if this field is omitted.
propModely This field gives the y (northerly) offset of the location of the transmitter assumed by the propagation model for this transmitter, with respect to the reference transmitter location (metres), Zero is assumed if this field is omitted.
applicability This field defines the area over which the model is applicable. If this field is omitted, the model is applied everywhere.
startRssi the received signal strength represented by the first contour, in dBm
stepSize the received signal strength difference between each successive contour, in dB
propagationModel This field defines the propagation model itself
stddev standard deviation of fit of contour pattern to estimated propogation pattern (<2*n dB for values 1 to 7 or 8 for 14 dB or more)

– *OMA-LPPe-ver2-0-RF-ApplicabilityWindow*

The IE *OMA-LPPe-ver2-0-RF-ApplicabilityWindow* gives the window of applicability of a propagation model for a transmitter.

```
-- ASN1START
```

```
OMA-LPPe-ver2-0-RF-ApplicabilityWindow ::= SEQUENCE {
    cornerx                         INTEGER (-1024..1023),
    cornery                         INTEGER (-1024..1023),
    directiononly                   BOOLEAN OPTIONAL,
    baseMagnitude                   INTEGER (1..512),
    baseAngle                       INTEGER (0..359),
    width                           INTEGER (0..511),
    zoneSizexPrime                  INTEGER (1..512),
    zoneSizeyPrime                  INTEGER (1..512),
    rleList                         OMA-LPPe-ApplRleList OPTIONAL,
    ...
}

OMA-LPPe-ApplRleList ::= SEQUENCE (SIZE(1..65535)) OF INTEGER (0..511)

-- ASN1STOP
```

***OMA-LPPe-ver2-0-RF-ApplicabilityWindow* field descriptions**
cornerx This field gives the x (easterly) offset of the location of applicability window, with respect to the point represented by (*propModelx*, *propModely*) (metres)
cornery This field gives the y (northerly) offset of the location of applicability window, with respect to the point represented by (*propModelx*, *propModely*) (metres)
directiononly If this value is included and set to true, the contours are treated as straight lines perpendicular to the (cornerx, cornery) vector (see Figure 24).
baseMagnitude Length of base vector of applicability window (metres).
baseAngle Angle (α) of base vector of applicability window (metres), wrt. W-E axis (in units of degrees).
width Width of applicability window (metres) in the direction perpendicular (90 degrees anticlockwise) to the base vector
zoneSizexprime This parameter defines the width of the zones used in the applicability window (expressed as number per base vector length), along the base vector
zoneSizeyprime This parameter defines the width of the zones used in the applicability window (expressed as number per width), in the direction perpendicular (90 degrees anticlockwise) to the base vector
rleList This parameter indicates the zones within the window that are applicable to the propagation model using the run-length encoding scheme as described in C1, except that in this case the coding runs in the direction of the base vector, from the top left of the rectangle to the bottom right (i.e. with increasing rle number) and the zones are in units of zoneSize metres, has a range up to 511. A valid rle region indicates a good zone (e.g. large number of training samples have been used to confirm the coverage model; a non-valid rle region indicates a bad zone (e.g. where very few training samples have verified the coverage model)

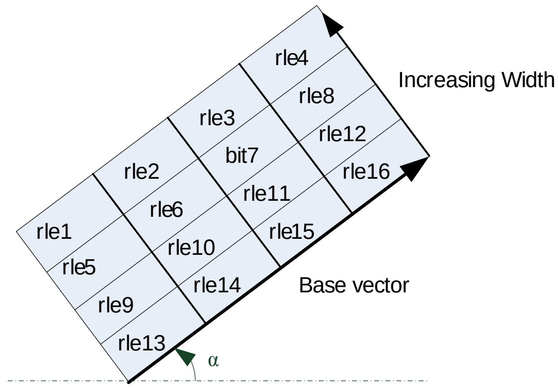


Figure 16 Example mapping of applicability bits for 4x4 rectangle

– *OMA-LPPe-ver2-0-RF-PropContourModel*

The IE *OMA-LPPe-ver2-0-RF-PropModel* gives the propagation model that is applicable to the transmitter, expressed as a set of contours of equal mean RSSI.

```
-- ASN1START

OMA-LPPe-ver2-0-RF-PropContourModel ::= SEQUENCE {
    contourRadius   INTEGER(0..2047),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-RF-PropContourModel field descriptions
contourRadius Estimated mean radial distance (in metres) from (propmodelx, propmodely) where the signal strength is equal to startRSSI-(stepSize*numCntr) dBm, where numCntr is the index (starting from 0) of the contour within the propagation model array

6.5.8.3 WLAN AP Assistance Data Request

– *OMA-LPPe-WLAN-AP-RequestAssistanceData*

The *OMA-LPPe-WLAN-AP-RequestAssistanceData* is used to request assistance for UE-based and UE-assisted WLAN AP location methods.

```
-- ASN1START

OMA-LPPe-WLAN-AP-RequestAssistanceData ::= SEQUENCE {
    requestedAD     BIT STRING  {     aplist                (0),
                                      aplocation            (1),
                                      locationreliability   (2),
                                      transmit-power        (3),
                                      antenna-gain          (4),
                                      coveragearea          (5),
                                      non-serving           (6),
                                      ver2-0-propagation    (7),
                                      ver2-0-rssiHeatMap    (8),
```

```
                                    ver2-0-rttHeatMap     (9),
                                    ver2-0-locationAreaGroup  (10),
                                    ver2-0-transmitterPropertiesGroup (11)} (SIZE(1..16)),
    requestedAPTypes    OMA-LPPe-WLAN-AP-Type-List,
    ...,
-- version 2.0 extension elements
    ver2-0-propModel        OMA-LPPe-ver2-0-RF-PropagationTypes     OPTIONAL,
    ver2-0-visible-APs      SEQUENCE (SIZE (1..ver2-0-maxVisibleAPs)) OF OMA-LPPe-WLAN-AP-ID OPTIONAL,
    ver2-0-AP-Data          SEQUENCE (SIZE (1..ver2-0-maxKnownAPs)) OF OMA-LPPe-WLAN-AP-ID OPTIONAL,
    ver2-0-AP-Group-Data    SEQUENCE (SIZE (1..ver2-0-maxGroups)) OF SEQUENCE {
                            group-ID    OMA-LPPe-ver2-0-WLAN-GroupID,
                            version     INTEGER (0..255)
                            }   OPTIONAL,
    ver2-0-AP-HeatMaps      SEQUENCE  (SIZE  (1..ver2-0-maxHeatMaps))  OF  OMA-LPPe-ver2-0-RF-HeatMap-ID
    OPTIONAL,
    ver2-0-AP-HeatMapUpdateReq  SEQUENCE    {
                                heatMap-ID          OMA-LPPe-ver2-0-RF-HeatMap-ID,
                                updatingIndex       INTEGER (1..16777216),
                                targetHeading       OMA-LPPe-HighAccuracy3Dvelocity     OPTIONAL,
                                ...
    }   OPTIONAL
}

ver2-0-maxVisibleAPs    INTEGER ::= 32
ver2-0-maxKnownAPs      INTEGER ::= 2048
ver2-0-maxGroups        INTEGER ::= 128
ver2-0-maxHeatMaps      INTEGER ::= 4096

OMA-LPPe-ver2-0-RF-PropagationTypes ::= SEQUENCE {
    propModel-1             NULL OPTIONAL, -- Circular Propoagtion Model
    ...
}

-- ASN1STOP
```

***OMA-LPPe-WLAN-AP-RequestAssistanceData* field descriptions**
requestedAD This parameter specifies the WLAN AP assistance data requested. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested. The following assistance data types are included: aplist: include mandatory WLAN AP information aplocation: include the location of each WLAN AP if available locationreliability: include the reliability of the WLAN AP location if available transmit-power: include the transmit power for each WLAN AP if available antenna-gain: include the antenna gain for each WLAN AP if available coveragearea: include the coverage area for each WLAN AP if available non-serving: include information for WLAN APs belonging to different operators than the serving WLAN AP in addition to WLAN APs belonging to the same operator (or include information for multiple WLAN AP data sets if the serving WLAN AP is not associated with a PLMN operator or if the target device is not served by a WLAN AP) ver2-0-propagation: include propagation estimation for each WLAN AP if available. This bit only applies to LPPe 2.0. ver2-0-rssiHeatMap: include an RSSI heat map for each WLAN AP if available and, optionally, group data containing a reference grid. This bit only applies to LPPe 2.0. ver2-0-rttHeapMap: include an RTT heat map for each WLAN AP if available and, optionally, group data containing a reference grid. This bit only applies to LPPe 2.0. ver2-0-locationAreaGroup: include location area group information if available. This bit only applies to LPPe 2.0 ver2-0-transmitterPropertiesGroup: include transmitter propeties group information if available. This bit only applies to LPPe 2.0
requestedAPTypes This parameter lists the WLAN AP types for which assistance data is requested.

OMA-LPPe-WLAN-AP-RequestAssistanceData **field descriptions**
ver2-0-propModel This parameter applies only to LPPe 2.0 and specifies the propagation estimation model required, when propagation estimation is requested.
ver2-0-visible-APs This parameter applies only to LPPe 2.0 and enables a target to indicate to a server the identities of up to 16 currently visible WLAN APs. This may assist a server to provide assistance data for WLAN APs nearby to the target. A target SHALL provide visible APs in order of received signal strength with the AP with the highest signal strength provided first. This parameter is optional.
ver2-0-AP-Data This parameter applies only to LPPe 2.0 and enables a target to indicate to a server the identities of WLAN APs for which the target has assistance data received previously from this server. This may enable a server to avoid resending data for the same APs. This parameter is optional. A target need not include this parameter if a server included the ver2-0-server-tracking field in the OMA-LPPe-WLAN-AP-ProvideAssistanceData data type for all AP data provided by this server. Otherwise, a target should include this parameter for any APs for which data was previously received and indicated as not tracked by the server if the target is requesting data for additional APs.
ver2-0-AP-Group-Data This parameter applies only to LPPe 2.0 and enables a target to indicate to a server the identities of WLAN groups for which group assistance data was previously received from this server. This may enable a server to avoid resending data for the same WLAN groups. This parameter is optional. A target need not include this parameter if a server included the ver2-0-server-tracking field in the OMA-LPPe-WLAN-AP-ProvideAssistanceData data type for all group data provided by this server. Otherwise, a target should include this parameter for any previously received group data indicated as not tracked by the server if the target is requesting additional group data from the server.
ver2-0-AP-HeatMaps This parameter applies only to LPPe 2.0 and enables a target to indicate to a server the identities of all RF heap maps previously received from this server for WLAN APs. This may enable a server to avoid resending the same heat maps. This parameter is optional. A target need not include this parameter if a server included the ver2-0-server-tracking field in the OMA-LPPe-WLAN-AP-ProvideAssistanceData data type for all RF heat maps provided by this server for WLAN APs. Otherwise, a target should include this parameter for any previously received RSSI or RTT heat maps for WLAN APs that were indicated as not tracked by the server if the target is requesting additional RSSI or RTT heatmaps, respectively, from the server for WLAN APs.
ver2-0-AP-HeatMapUpdateReq This parameter applies only to LPPe 2.0 and provides the ID of a heat map and an index of a reference grid point within the heat map that has triggered an update request for new assistance data when the target estimates its position at or near to this grid point. The heat map and the reference grid point would have been provided earlier to the target via the *updateReqGridPoints* parameter in the *OMA-LPPe-ver2-0-RF-HeatMap* IE. Appendix G.5 contains more information on this update request. Optionally, the target may also send its heading and velocity information. This parameter is optional.

6.5.8.4 WLAN AP Location Information

– *OMA-LPPe-WLAN-AP-ProvideLocationInformation*

The *OMA-LPPe-WLAN-AP-ProvideLocationInformation* is used to provide measurements (UE-assisted) for one or more WLAN APs and at both current and historic times.

```
-- ASN1START

OMA-LPPe-WLAN-AP-ProvideLocationInformation ::= SEQUENCE {
    wlan-AP-CombinedLocationInformation SEQUENCE (SIZE (1..maxWLANAPSize)) OF
                                            OMA-LPPe-WLAN-AP-LocationInformationList    OPTIONAL,
    wlan-AP-Error                       OMA-LPPe-WLAN-AP-Error                          OPTIONAL,
    ...
}

OMA-LPPe-WLAN-AP-LocationInformationList ::= SEQUENCE {
    wlan-AP-LocationInformation         OMA-LPPe-WLAN-AP-LocationInformation,
    relativeTimeStamp                   INTEGER (0..65535)  OPTIONAL,
    servingFlag                         BOOLEAN,
    ...
```

```
}

maxWLANAPSize   INTEGER ::= 64


-- ASN1STOP
```

***OMA-LPPe-WLAN-AP-ProvideLocationInformation* field descriptions**
wlan-AP-CombinedLocationInformation This parameter provides measurements for one or more WLAN APs at the current time and/or for historic times. This parameter supports part of the Location ID and Multiple Location IDs parameters in SUPL 2.0.
wlan-AP-Error This parameter provides error information when not all requested WLAN AP measurements can be reported. This parameter should be included when some but not all requested measurements are reported and SHALL be included when no requested measurements are reported.
relativeTimeStamp This parameter SHALL be included for historic WLAN AP measurements and provides the time of the historic measurements relative to current time in units of 0.01 seconds. If absent, current time is implied which is equivalent to a relativeTimeStamp of zero. Current time refers to the time when the target sends WLAN AP measurements to the server.
servingFlag This parameter indicates whether a set of WLAN AP measurements were obtained for a serving WLAN AP (TRUE) or a non-serving WLAN AP (FALSE). A target device with multiple radio support may indicate more than one type of serving access for the same time instant.

6.5.8.5 WLAN AP Location Information Elements

– *OMA-LPPe-WLAN-AP-LocationInformation*

The IE *OMA-LPPe-WLAN-AP-LocationInformation* is used by the target device to provide measurements to the server for a serving or non-serving WLAN AP. Measurements are based on those defined in [IEEE 802.11].

```
-- ASN1START

OMA-LPPe-WLAN-AP-LocationInformation ::= SEQUENCE {
    apMACAddress            OMA-LPPe-WLAN-AP-ID,
    apSSID                  OCTET STRING (SIZE (1..32))     OPTIONAL,
    apSignaltoNoise         INTEGER(-127..128)              OPTIONAL,
    apDeviceType            OMA-LPPe-WLAN-AP-Type           OPTIONAL,
    apPHYtype               OMA-LPPe-WLAN-AP-PHY-Type       OPTIONAL,
    apSignalStrength        INTEGER(-127..128)              OPTIONAL,
    apChannelFrequency      INTEGER(0..256)                 OPTIONAL,
    apRoundTripDelay        OMA-LPPe-WLAN-RTD               OPTIONAL,
    ueTransmitPower         INTEGER(-127..128)              OPTIONAL,
    ueAntennaGain           INTEGER (-127..128)             OPTIONAL,
    apReportedLocation      OMA-LPPe-WLAN-ReportedLocation  OPTIONAL,
    ...,
apTransmitPower         INTEGER (-127..128) OPTIONAL,
    apAntennaGain           INTEGER (-127..128) OPTIONAL,
    ueSignaltoNoise         INTEGER (-127..128) OPTIONAL,
    ueSignalStrength        INTEGER (-127..128) OPTIONAL,
    apSignalStrengthDelta   INTEGER (0..1) OPTIONAL, -- Cond APSSDelta
    ueSignalStrengthDelta   INTEGER (0..1) OPTIONAL, -- Cond UESSDelta
    apSignaltoNoiseDelta    INTEGER (0..1) OPTIONAL, -- Cond APSNDelta
    ueSignaltoNoiseDelta    INTEGER (0..1) OPTIONAL, -- Cond UESNDelta
    operatingClass          INTEGER (0..255) OPTIONAL,
    ueMacAddress            BIT STRING (SIZE (48)) OPTIONAL
}

OMA-LPPe-WLAN-AP-PHY-Type ::= ENUMERATED {  unknown, any, fhss, dsss, irbaseband, ofdm, hrdsss, erp,
                                            ht, ihv, ... }
```

```
OMA-LPPe-WLAN-RTD ::= SEQUENCE {
    rTDValue      INTEGER(0..16777215),
    rTDUnits      OMA-LPPe-WLAN-RTDUnits,
    rTDAccuracy   INTEGER(0..255)         OPTIONAL,
    ...
}

OMA-LPPe-WLAN-RTDUnits ::= ENUMERATED {
    microseconds,
    hundredsofnanoseconds,
    tensofnanoseconds,
    nanoseconds,
    tenthsofnanoseconds,
    ...
}

OMA-LPPe-WLAN-ReportedLocation ::= SEQUENCE {

    locationDataLCI                 OMA-LPPe-WLAN-LocationDataLCI           OPTIONAL,
    ...
}


OMA-LPPe-WLAN-LocationDataLCI ::= SEQUENCE {
    latitudeResolution       BIT STRING (SIZE (6)),
    latitude                 BIT STRING (SIZE (34)),
    longitudeResolution      BIT STRING (SIZE (6)),
    longitude                BIT STRING (SIZE (34)),
    altitudeType             BIT STRING (SIZE (4)),
    altitudeResolution       BIT STRING (SIZE (6)),
    altitude                 BIT STRING (SIZE (30)),
    datum                    BIT STRING (SIZE (8)),
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
APSSDelta	This parameter is conditional and may be used if the apSignalStrength IE is used. Otherwise this parameter MUST NOT be used.
UESSDelta	This parameter is conditional and may be used if the ueSignalStrength IE is used. Otherwise this parameter MUST NOT be used.
APSNDelta	This parameter is conditional and may be used if the apSignaltoNoiseIE is used. Otherwise this parameter MUST NOT be used.
UESNDelta	This parameter is conditional and may be used if the ueSignaltoNoise IE is used. Otherwise this parameter MUST NOT be used.

***OMA-LPPe-WLAN-AP-LocationInformation* field descriptions**
apMACAddress This field provides the 48 bit MAC address of the reported WLAN AP (which is identical to the BSSID of the AP).
apSSID This field provides the SSID of the wireless network served by the AP.
apSignaltoNoise This field provides the AP signal to noise ratio of a beacon, probe response or measurement pilot frame in dB as measured at the target.
apDeviceType This field provides the AP device type – 802.11a, 802.11b, 802.11g, 802.11n 802.11ac or 802.11ad. The AP device type refers to the device type being used for signalling as opposed to the capability of the AP (for instance an 802.11n capable AP in e.g., 802.11a signalling mode).

OMA-LPPe-WLAN-AP-LocationInformation **field descriptions**
apPHYtype This field provides the IEEE 802.11 PHY and media type. The enumerated values are as follows: *unknown* specifies an unknown or uninitialized PHY type. *any* specifies any PHY type. *fhss* specifies a frequency-hopping spread-spectrum (FHSS) PHY. *dsss* specifies a direct sequence spread spectrum (DSSS) PHY type. *irbaseband* specifies an infrared (IR) baseband PHY type. *ofdm* specifies an orthogonal frequency division multiplexing (OFDM) PHY type. *hrdsss* specifies a high-rate DSSS (HRDSSS) PHY type. *erp* specifies an extended rate PHY type (ERP). *ht* specifies the 802.11n PHY type. *ihv* specifies a PHY type that is developed by an independent hardware vendor (IHV).
apSignalStrength This field provides the AP signal strength (RSSI) of a beacon frame, probe response frame or measurement pilot frame measured at the target in dBm on the channel indicated by *apChannelFrequency* field.
apChannelFrequency This field provides the AP channel number identification of the reported WLAN AP.
apRoundTripDelay This field provides the measured round trip delay between the target and WLAN AP and optionally the accuracy expressed as the standard deviation of the delay. Units for each of these are 1000ns, 100ns, 10ns, 1ns or 0.1ns.
ueTransmitPower This field provides the transmit power used by the target to access the WLAN AP in dBm
.ueAntennaGain This field provides the antenna gain of the target in dBi for transmission to the WLAN AP
apReportedLocation This field provides the location of the WLAN AP,

OMA-LPPe-WLAN-AP-LocationInformation **field descriptions**
locationDataLCI This field provides the reported location of the AP in form of the Location Configuration Information (LCI) defined in [IEEE 802.11][RFC 3825] and includes the following subfields: *latitudeResolution*: 6-bits indicating the number of valid bits in the fixed-point value of *latitude*. (This value is the number of high-order Latitude bits that should be considered valid. Any bits entered to the right of this limit should not be considered valid. Values above decimal 34 are undefined and reserved.) *latitude*: A 34-bits fixed point value consisting of 9-bits of integer and 25-bits of fraction indicating the Latitude (+/- 90 degrees) of the AP. *longitudeResolution*: 6-bits indicating the number of valid bits in the fixed-point value of *longitude*. (This value is the number of high-order Longitude bits that should be considered valid. Any bits entered to the right of this limit should not be considered valid. Values above decimal 34 are undefined and reserved.) *longitude*: A 34-bits fixed point value consisting of 9-bits of integer and 25-bits of fraction indicating the Longitude (+/- 180 degrees) of the AP. *altitudeType*: Defines the altitude type. Codes defined are: 1:Meters of altitude. 2: Building floors of altitude. *altitude* value 0.0 represents the floor level associated with ground level. *altitudeResolution*: 6-bits indicating the number of valid bits in the *altitude*. (This value is the number of high-order Altitude bits that should be considered valid. Any bits entered to the right of this limit should not be considered valid. Values above decimal 30 are undefined and reserved.) *altitude*: A 30-bit fixed point value consiting of 22-bits of integer and 8-bits of fraction indicating the Altitude of the AP in units defined by *altitudeType*. *datum*: Defines the map datum used for the coordinates. Codes defined are: 1: World Geodetic System 1984 (WGS-84) 2: North American Datum 1983 (NAD-83) with North American Vertical Datum 1988 (NAVD-88) 3: North American Datum 1983 (NAD-83) with Mean Lower Low Water (MLLW) vertical datum.
apTransmitPower This field provides the power the AP transmits on a beacon, probe response or measurement pilot frame in dBm.
apAntennaGain This field provides the antenna gain of the AP in dBi
ueSignaltoNoise This field provides the target's signal to noise ratio measured at the AP in dB.
ueSignalStrength This field provides the target's signal strength (RSSI) measured at the AP on the channel indicated by the *apChannelFrequency* field in dBm.
apSignalStrengthDelta This parameter is used when the AP's signal strength (measured at the target) resolution is 0.5 dB (as opposed to 1.0 dB when this parameter is not used). Range: INTEGER (0..1), Units: 0.5 dB The AP signal strength is then: (*apSignalStrength* + *apSignalStrengthDelta*).
ueSignalStrengthDelta This parameter is used when the target's signal strength (measured at the AP) resolution is 0.5 dB (as opposed to 1.0 dB when this parameter is not used). Range: INTEGER (0..1), Units: 0.5 dB The target signal strength is then: (*ueSignalStrength* + *ueSignalStrengthDelta*).

OMA-LPPe-WLAN-AP-LocationInformation **field descriptions**
apSignaltoNoiseDelta This parameter is used when the AP's signal to noise ratio (measured at the target) resolution is 0.5 dB (as opposed to 1.0 dB when this parameter is not used). Range: INTEGER (0..1), Units: 0.5 dB The AP signal to noise ratio is then: (*apSignaltoNoise* + *apSignaltoNoiseDelta*).
ueSignaltoNoiseDelta This parameter is used when the target's signal to noise ratio (measured at the AP) resolution is 0.5 dB (as opposed to 1.0 dB when this parameter is not used). Range: INTEGER (0..1), Units: 0.5 dB The target signal to noise ratio is then: (*ueSignaltoNoise* + *ueSignaltoNoiseDelta*).
operatingClass This parameter defines the Operating Class as defined in [IEEE 802.11].
ueMacAddress This parameter defines the target's MAC address.

6.5.8.6 WLAN AP Location Information Request – *OMA-LPPe-WLAN-AP-RequestLocationInformation*

The IE *OMA-LPPe-WLAN-AP-RequestLocationInformation* is used to request WLAN AP measurements (UE-assisted).

```
-- ASN1START

OMA-LPPe-WLAN-AP-RequestLocationInformation ::= SEQUENCE {
    requestedMeasurements   BIT STRING {
                                            apSSID      (0),
                                            apSN        (1),
                                            apDevType   (2),
                                            apPhyType   (3),
                                            apRSSI      (4),
                                            apChanFreq  (5),
                                            apRTD       (6),
                                            ueTP        (7),
                                            ueAG        (8),
                                            apRepLoc    (9),
                                            non-serving (10),
                                            historic    (11),
                                            apTP        (12),
                                            apAG        (13),
                                            ueSN        (14),
                                            ueRSSI      (15)} (SIZE(1..16)),
    ...,
    additionalRequestedMeasurements BIT STRING {
                                            oc          (0),
                                            ueMacAddr   (1)} (SIZE(1..16)) OPTIONAL
}

-- ASN1STOP
```

OMA-LPPe-WLAN-AP-RequestLocationInformation field descriptions
requestedMeasurements This field specifies the WLAN AP measurements requested. This is represented by a bit string, with a one-value at the bit position means the particular measurement is requested; a zero-value means not requested. The following measurement requests can be included. apSSID: SSID of the WLAN apSN: AP S/N received at the target apDevType: AP Device type apPhyType: AP PHY type apRSSI: AP signal strength at the target apChanFreq: AP channel/frequency of Tx/Rx apRTD: Round Trip Delay between target and AP ueTP: target transmit power ueAG: target antenna gain apRepLoc: AP Location as reported by AP non-serving: measurements for non-serving WLAN APs (in addition to a serving WLAN AP) historic: historic WLAN AP measurements (in addition to current measurements) apTP: AP transmit power apAG: AP antenna gain ueSN: UE S/N received at the AP ueRSSI: target signal strength at the AP
additionalRequestedMeasurements This field specifies additional WLAN AP measurements that are requested. This is represented by a bit string, with a one-value at the bit position means the particular measurement is requested; a zero-value means not requested. The following measurement requests can be included. oc: operating class ueMacAddr: UE MAC address

6.5.8.7 WLAN AP Capability Information

– *OMA-LPPe-WLAN-AP-ProvideCapabilities*

The IE *OMA-LPPe-WLAN-AP-ProvideCapabilities* is used by the target to provide its capabilities for WLAN AP positioning to the server.

```
-- ASN1START

OMA-LPPe-WLAN-AP-ProvideCapabilities ::= SEQUENCE {
    wlan-ecid-MeasSupported BIT STRING  {
                                        apSSID      (0),
                                        apSN        (1),
                                        apDevType   (2),
                                        apPhyType   (3),
                                        apRSSI      (4),
                                        apChanFreq  (5),
                                        apRTD       (6),
                                        ueTP        (7),
                                        ueAG        (8),
                                        apRepLoc    (9),
                                        non-serving (10),
                                        historic    (11),
                                        apTP        (12),
                                        apAG        (13),
                                        ueSN        (14),
                                        ueRSSI      (15)}   (SIZE(1..16)),
    wlan-types-Supported        OMA-LPPe-WLAN-AP-Type-List      OPTIONAL,
    ap-Capability               OMA-LPPe-WLAN-AP-Capability     OPTIONAL,
    wlan-ap-ADSupported BIT STRING  {aplist                 (0),
                                     aplocation             (1),
```

```
                                   locationreliability    (2),
                                   transmit-power         (3),
                                   antenna-gain           (4),
                                   coveragearea           (5),
                                   non-serving            (6),
                                   ver2-0-propagation     (7),
                                   ver2-0-rssiHeatMap     (8),
                                   ver2-0-rttHeatMap      (9),
                                   ver2-0-jpeg                (10),
                                   ver2-0-reorientation       (11),
                                   ver2-0-run-lengths         (12),
                                   ver2-0-update-required-grid-points (13),
                                   ver2-0-locationAreaGroup   (14),
                                   ver2-0-transmitterPropertiesGroup  (15)} (SIZE(1..16)),
    ...,
-- version 2.0 extension elements

    additional-wlan-ecid-MeasSupported  BIT STRING {
                                          oc           (0),
                                          ueMacAddr    (1)} (SIZE(1..16)) OPTIONAL,
    ver2-0-propModel-Capability     OMA-LPPe-ver2-0-RF-Propagation-Capability       OPTIONAL,
    ver2-0-sta-Capability           OMA-LPPe-WLAN-AP-Capability     OPTIONAL
}

OMA-LPPe-WLAN-AP-Capability ::= SEQUENCE {
    apMACAddress            OMA-LPPe-WLAN-AP-ID,
    apTypes                 OMA-LPPe-WLAN-AP-Type-List,
    ...
}

OMA-LPPe-ver2-0-RF-Propagation-Capability ::= SEQUENCE {
    propModel-1             NULL OPTIONAL, -- Circular Propagation Model
    ...
}

-- ASN1STOP
```

OMA-LPPe-WLAN-AP-ProvideCapabilities **field descriptions**
wlan-ecid-MeasSupported This field specifies the E-CID measurements supported by the target device when accessing a WLAN AP. This is represented by a bit string, with a one-value at the bit position means the particular measurement is supported; a zero-value means not supported. A zero-value in all bit positions in the bit string means only the basic WLAN positioning method is supported by the target device which is reporting of the WLAN AP identity. The following bits are assigned for the indicated measurements. apSSID: SSID of the WLAN apSN: AP S/N received at the target apDevType: AP Device type apPhyType: AP PHY type apRSSI: AP signal strength at the target apChanFreq: AP channel/frequency of Tx/Rx apRTD: Round Trip Delay between target and AP ueTP: target transmit power ueAG: target antenna gain apRepLoc: AP Location as reported by AP non-serving: measurements for a non-serving WLAN AP (in addition to a serving WLAN AP) historic: historic WLAN AP measurements apTP: AP transmit power apAG: AP antenna gain ueSN: UE S/N received at the AP ueRSSI: target signal strength at the AP

OMA-LPPe-WLAN-AP-ProvideCapabilities **field descriptions**
wlan-types-Supported This field provides the WLAN AP types supported by the target device when functioning as a WLAN station. This is represented by a bit string, with a one-value at the bit position means the particular WLAN type is supported; a zero-value means not supported. This field SHALL be provided if the supported WLAN AP types are available.
ap-Capability This parameter if present indicates that the target can function as a WLAN AP (e.g. as a mobile broadband router). The parameter provides the MAC address of the target and the WLAN types supported when functioning as an AP.
wlan-ap-ADSupported This field specifies the WLAN AP assistance data supported by the target device. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is supported; a zero-value means not supported. A zero-value in all bit positions or absence of this field means no assistance data is supported. The following bits are assigned for the indicated assistance data. aplist: mandatory WLAN AP data aplocation: location of each WLAN AP locationreliability: reliability of WLAN AP location transmit-power: transmit power for each WLAN AP antenna-gain: antenna gain for each WLAN AP coveragearea: coverage area for each WLAN AP non-serving: information for WLAN APs belonging to a different operator than the serving WLAN AP (or information for multiple WLAN AP data sets if the serving WLAN AP is not associated with a PLMN operator or if the target device is not served by a WLAN AP) ver2-0-propagation: propagation estimation for each WLAN AP ver2-0-rssiHeatMap: RSSI heat map for an AP and reference grid group data. This bit only applies to LPPe 2.0 ver2-0-rttHeatMap: RTT heat map for an AP and reference grid group data. This bit only applies to LPPe 2.0 ver2-0-jpeg: compression of a heat map using JPEG. This bit only applies to LPPe 2.0 ver2-0-reorientation: reorientation of a heat map as in Appendix G.4.1. This bit only applies to LPPe 2.0. ver2-0-run-lengths: heat maps with arbitrary shape via run lengths as in Appendix G.4.2. This bit only applies to LPPe 2.0. ver2-0-update-required-grid-points: heat maps containing grid points that trigger a target request for new assistance data when a target is near such a grid point. This bit only applies to LPPe 2.0. ver2-0-locationAreaGroup: location area group data for APs. This bit only applies to LPPe 2.0 ver2-0-transmitterPropertiesGroup: transmitter properties group data. This bit only applies to LPPe 2.0,
additional-wlan-ecid-MeasSupported This field specifies the additional E-CID measurements supported by the target device when accessing a WLAN AP. This is represented by a bit string, with a one-value at the bit position means the particular measurement is supported; a zero-value means not supported. A zero-value in all bit positions in the bit string means only the basic WLAN positioning method is supported by the target device which is reporting of the WLAN AP identity. The following bits are assigned for the indicated measurements. oc: operating class ueMacAddr: UE MAC address
ver2-0-propModel-Capability This parameter only applies to LPPe 2.0 and defines the types of RF propagation model supported by the target for WLAN APs.
ver2-0-sta-Capability This parameter only applies to LPPe 2.0 and provides the MAC address of the target and the WLAN types supported when functioning as an STA. This parameter is optional. If the target includes the ap-Capability parameter and uses the same MAC address and supports the same WLAN types when functioning as both an AP and an STA, then the ver2-0-sta-Capability parameter need not be included.

6.5.8.8 WLAN AP Capability Information Request

– *OMA-LPPe-WLAN-AP-RequestCapabilities*

The IE *OMA-LPPe-WLAN-AP-RequestCapabilities* is used to request WLAN AP positioning capabilities information from the target.

```
-- ASN1START

OMA-LPPe-WLAN-AP-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.8.9 WLAN AP Error Element

– *OMA-LPPe-WLAN-AP-Error*

The IE *OMA-LPPe-WLAN-AP-Error* is used by the location server or target device to provide error reasons for WLAN AP positioning to the target device or location server, respectively.

```
-- ASN1START

OMA-LPPe-WLAN-AP-Error ::= CHOICE {
    locationServerErrorCauses       OMA-LPPe-WLAN-AP-LocationServerErrorCauses,
    targetDeviceErrorCauses         OMA-LPPe-WLAN-AP-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– *WLAN-AP-LocationServerErrorCauses*

The IE *WLAN-AP-LocationServerErrorCauses* is used by the location server to provide error reasons for WLAN AP positioning to the target device.

```
-- ASN1START

OMA-LPPe-WLAN-AP-LocationServerErrorCauses ::= SEQUENCE {
    cause                               ENUMERATED  {undefined,
                                                    requestedADNotAvailable,
                                                    notAllrequestedADAvailable,
                                                    ...
                                                    },
    apMandatoryDataUnavailable          NULL        OPTIONAL,
    apLocationsUnavailable              NULL        OPTIONAL,
    apLocationReliabilityUnavailable    NULL        OPTIONAL,
    apTransmitPowerUnavailable          NULL        OPTIONAL,
    apAntennaGainUnavailable            NULL        OPTIONAL,
    apCoverageAreaUnavailable           NULL        OPTIONAL,
    nonservingADUnavailable             NULL        OPTIONAL,
    ...,
-- version 2.0 extension elements
    ver2-0-propagationModelUnavailable      NULL        OPTIONAL,
    ver2-0-rssiHeatMapsUnavailable          NULL        OPTIONAL,
    ver2-0-rttHeatMapsUnavailable           NULL        OPTIONAL,
    ver2-0-locationAreaGroupsUnavailable    NULL        OPTIONAL,
    ver2-0-transmitterPropertiesGroupsUnavailable   NULL        OPTIONAL
}

-- ASN1STOP
```

OMA-LPPe-WLAN-AP-LocationServerErrorCauses field descriptions
cause This field provides a WLAN AP specific error cause for the server applicable to provision of assistance data. If the cause value is '*requestedADNotAvailable*', none of the requested assistance data could be provided and no further information needs to be included. If the cause value is '*notAllRequestedADAvailable*', the server was able to provide some but not all requested WLAN AP assistance data. In this case, the server should include any of the specific error indications as applicable. Note that inclusion of these fields is applicable when some of the associated information can be provided for some WLAN APs but not for all WLAN APs.

– *WLAN-AP-TargetDeviceErrorCauses*

The IE *WLAN-AP-TargetDeviceErrorCauses* is used by the target device to provide error reasons for WLAN AP positioning to the location server.

```
-- ASN1START

OMA-LPPe-WLAN-AP-TargetDeviceErrorCauses ::= SEQUENCE {
    cause                                   ENUMERATED {undefined,
                                                        requestedMeasurementsNotAvailable,
                                                        notAllrequestedMeasurementsPossible,
                                                        ...
                                                        },
    apSSIDnotAvailable                      NULL        OPTIONAL,
    apSNMeasurementNotPossible              NULL        OPTIONAL,
    apDevTypeNotAvailable                   NULL        OPTIONAL,
    apPhyTypeNotAvailable                   NULL        OPTIONAL,
    apRSSIMeasurementNotPossible            NULL        OPTIONAL,
    apChanFreqNotAvailable                  NULL        OPTIONAL,
    apRTDMeasurementNotPossible             NULL        OPTIONAL,
    ueTPNotAvailable                        NULL        OPTIONAL,
    ueAGNotAvailable                        NULL        OPTIONAL,
    apRecLocNotAvailable                    NULL        OPTIONAL,
    non-servingMeasurementsNotAvailable     NULL        OPTIONAL,
    historicMeasurementsNotAvailable        NULL        OPTIONAL,
    ...,
    apTPNotAvailable                        NULL        OPTIONAL,
    apAGNotAvailable                        NULL        OPTIONAL,
    ueSNNotAvailable                        NULL        OPTIONAL,
    ueRSSINotAvailable                      NULL        OPTIONAL,
    ocNotAvailable                          NULL        OPTIONAL,
    ueMACAddressNotAvailable                NULL        OPTIONAL
}

-- ASN1STOP
```

OMA-LPPe-WLAN-AP-TargetDeviceErrorCauses field descriptions
cause This field provides a WLAN AP specific error cause. If the cause value is '*requestedMeasurementsNotAvailable*', none of the requested measurements could be provided and no further information needs to be included. If the cause value is '*notAllRequestedMeasurementsPossible*', the target device was able to provide some but not all requested WLAN AP measurements. In this case, the target device should indicate those measurements that could not be obtained.

6.5.9 WiMax Enhanced Cell ID Positioning

This section defines support for WiMax ECID.

6.5.9.1 WiMax ECID Location Information

– *OMA-LPPe-ECID-WiMax-ProvideLocationInformation*

The *OMA-LPPe-ECID-WiMax-ProvideLocationInformation* is used to provide ECID measurements (UE-assisted) for one or more WiMax access networks and at both current and historic times.

```
-- ASN1START

OMA-LPPe-ECID-WiMax-ProvideLocationInformation ::= SEQUENCE {
    ecid-wimax-CombinedLocationInformation  SEQUENCE (SIZE (1..maxWiMaxECIDSize)) OF
                                                OMA-LPPe-ECID-WiMax-LocationInformationList OPTIONAL,
    ecid-wimax-Error                            OMA-LPPe-ECID-WiMax-Error                   OPTIONAL,
    ...
}

OMA-LPPe-ECID-WiMax-LocationInformationList ::= SEQUENCE {
    ecid-wimax-LocationInformation      OMA-LPPe-ECID-WiMax-LocationInformation,
    relativeTimeStamp                   INTEGER (0..65535)  OPTIONAL,
    servingFlag                         BOOLEAN,
    ...
}

maxWiMaxECIDSize    INTEGER ::= 1264

-- ASN1STOP
```

OMA-LPPe-ECID-WiMax-ProvideLocationInformation **field descriptions**
ecid-wimax-CombinedLocationInformation This parameter provides E-CID measurements for one or more WiMax networks at the current time and/or for historic times. This parameter supports part of the Location ID and Multiple Location IDs parameters in SUPL 2.0.
ecid-wimax-Error This parameter provides error information when not all requested WiMax E-CID measurements can be reported. This parameter should be included when some but not all requested measurements are reported and SHALL be included when no requested measurements are reported.
relativeTimeStamp This parameter SHALL be included for historic WiMax E-CID measurements and provides the time of the historic measurements relative to current time in units of 0.01 seconds. If absent, current time is implied which is equivalent to a relativeTimeStamp of zero. Current time refers to the time when the target sends WiMax E-CID measurements to the server.
servingFlag This parameter indicates whether a set of E-CID measurements were obtained for a serving WiMax access network (TRUE) or a non-serving WiMax access network (FALSE). A target device with multiple radio support may indicate more than one type of serving access network for the same time instant.

6.5.9.2 WiMax ECID Location Information Elements

– *OMA-LPPe-ECID-WiMax-LocationInformation*

The IE *OMA-LPPe-ECID-WiMax-LocationInformation* is used by the target device to provide E-CID measurements for a serving or non-serving WiMax network to the server.

```
-- ASN1START


OMA-LPPe-ECID-WiMax-LocationInformation ::= SEQUENCE {
    wimaxBsID       OMA-LPPe-ECID-WiMax-WimaxBsID,
    wimaxRTD        OMA-LPPe-ECID-WiMax-WimaxRTD        OPTIONAL,
    wimaxNMRList    OMA-LPPe-ECID-WiMax-WimaxNMRList    OPTIONAL,
    ...
}

OMA-LPPe-ECID-WiMax-WimaxBsID ::= SEQUENCE {
    bsID-MSB        BIT STRING (SIZE(24))       OPTIONAL,
```



```
    bsID-LSB        BIT STRING (SIZE(24)),
    ...
}

OMA-LPPe-ECID-WiMax-WimaxRTD ::= SEQUENCE {
    rTD             INTEGER (0..65535),
    rTDstd          INTEGER (0..1023)       OPTIONAL,
    ...
}

OMA-LPPe-ECID-WiMax-WimaxNMRList ::= SEQUENCE  (SIZE (1..maxWimaxBSMeas)) OF
                                                                            OMA-LPPe-ECID-WiMax-WimaxNMR

OMA-LPPe-ECID-WiMax-WimaxNMR ::= SEQUENCE {
    wimaxBsID       OMA-LPPe-ECID-WiMax-WimaxBsID,
    relDelay        INTEGER (-32768..32767)             OPTIONAL,
    relDelaystd     INTEGER (0..1023)                   OPTIONAL,
    rSSI            INTEGER (0..255)                    OPTIONAL,
    rSSIstd         INTEGER (0..63)                     OPTIONAL,
    bSTxPower       INTEGER (0..255)                    OPTIONAL,
    cINR            INTEGER (0..255)                    OPTIONAL,
    cINRstd         INTEGER (0..63)                     OPTIONAL,
    bSLocation      OMA-LPPe-WLAN-ReportedLocation      OPTIONAL,
    ...
}

maxWimaxBSMeas INTEGER ::= 32

-- ASN1STOP
```

***OMA-LPPe-ECID-WiMax-LocationInformation* field descriptions**
wimaxBsID This field provides the identifier for the primary WiMax base station for which measurements are being reported. The ID contains 48 bits. The least significant 24 bits (bsID-LSB) are provided and optionally the most significant 24 bits (bsID-MSB). If not provided, bsID-MSB is assumed to be identical to that for the current serving BS or camped on network value.
wimaxRTD This field provides the Round Trip Delay (rTD) between the target device and the WiMax BS in units of 10 ns and with a range of 0 -65535. The field also optionally includes the Standard deviation of the Round Trip Delay measurement (rTDstd) in units of 10 ns and with a range of 0-1023.

***OMA-LPPe-ECID-WiMax-LocationInformation* field descriptions**
wimaxNMRList This field provides a network measurement report for up to 32 other neighbour WiMax base stations. For each neighbour base station, the following parameters can be included: wimaxBsID: base station ID encoded as for wimaxBsID above. This parameter is mandatory. relDelay: Relative Delay as measured by the target device between the neighboring BS and the primary BS in units of 10 ns. This measurement is not applicable for the primary BS. The range is -32768 to 32767. This parameter is optional. relDelaystd: Standard deviation of the Relative delay in units of 10 ns, range 0-1023. This parameter is optional. rSSI: received signal strength of the neighbour BS at the target device in dBm. This is expressed in steps of 0.25 dBm, starting from -103.75 dBm. Encoded range is 0 -255. This parameter is optional. rSSIstd: standard deviation of BS signal strength received at the target device in dB. Range is 0-63. bSTxPower: the equivalent isotropic transmit power of the neighbour BS in steps of 0.25 dBm and starting from -103.75 dBm. Encoded range is 0-255. This parameter is optional. cINR: Carrier to Noise and Interference Ratio in dB of the neighbour BS as received at the target device. Range is 0-255. This parameter is optional. cINRstd: standard deviation in dB of the BS Carrier to Noise and Interference Ratio as received at the target device. Range is 0-63. bSLocation: Location of the neighbour BS as reported by the neighbour BS. This is optional and contains the following fields. locationEncodingDescriptor: either LCI as in [RFC3825] or ASN.1 as in [X.694] locationData: location value in the format defined in locationEncodingDescriptor and optional location accuracy in units of 0.1 meters.

6.5.9.3 WiMax ECID Location Information Request

– *OMA-LPPe-ECID-WiMax-RequestLocationInformation*

The *OMA-LPPe-ECID-WiMax-RequestLocationInformation* is used to request WiMax ECID measurements (UE-assisted).

```
-- ASN1START

OMA-LPPe-ECID-WiMax-RequestLocationInformation ::= SEQUENCE {
    requestedMeasurements   BIT STRING {    rTD             (0),
                                            rTDstd          (1),
                                            nMR             (2),
                                            nMRrelDelay     (3),
                                            nMRrelDelaystd  (4),
                                            nMRrSSI         (5),
                                            nMRrSSIstd      (6),
                                            nMRbSTxPower    (7),
                                            nMRcINR         (8),
                                            nMRcINRstd      (9),
                                            nMRbSLocation   (10),
                                            non-serving     (11),
                                            historic        (12) } (SIZE(1..16)),
        ...
}

-- ASN1STOP
```


OMA-LPPe-ECID-WiMax-RequestLocationInformation field descriptions
requestedMeasurements This field specifies the WiMax E-CID measurements requested. This is represented by a bit string, with a one-value at the bit position means the particular measurement is requested; a zero-value means not requested. The following measurement requests can be included. rTD; round trip delay to a primary (e.g. serving) BS rTDstd: standard deviation of round trip delay nMR: network measurement report for neighbouring BSs nMRrelDelay: Relative Delay between the neighboring BS and the primary BS nMRrelDelaystd: Standard deviation of the Relative delay nMRrSSI: received signal strength of the neighbour BS nMRrSSIstd: standard deviation of BS signal strength nMRbSTxPower: transmit power of the neighbour BS nMRcINR: Carrier to Noise and Interference Ratio of the neighbour BS nMRcINRstd: standard deviation of the BS Carrier to Noise and Interference Ratio bSLocation: Location of the neighbour BS as reported by the neighbour BS non-serving: E-CID measurements for non-serving WiMax base stations (in addition to a serving base station) historic: historic WiMax E-CID measurements (in addition to current measurements)

6.5.9.4 WiMax ECID Capability Information

– *OMA-LPPe-ECID-WiMax-ProvideCapabilities*

The *OMA-LPPe-ECID-WiMax-ProvideCapabilities* is used by the target to provide its WiMax ECID capabilities to the server.

```
-- ASN1START

OMA-LPPe-ECID-WiMax-ProvideCapabilities ::= SEQUENCE {
    ecid-wimax-MeasSupported    BIT STRING {    rTD             (0),
                                                rTDstd          (1),
                                                nMR             (2),
                                                nMRrelDelay     (3),
                                                nMRrelDelaystd  (4),
                                                nMRrSSI         (5),
                                                nMRrSSIstd      (6),
                                                nMRbSTxPower    (7),
                                                nMRcINR         (8),
                                                nMRcINRstd      (9),
                                                nMRbSLocation   (10),
                                                non-serving     (11),
                                                historic        (12) } (SIZE(1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ECID-WiMax-ProvideCapabilities **field descriptions**
ecid-wimax- MeasSupported This field specifies the E-CID measurements supported by the target device for WiMax. This is represented by a bit string, with a one-value at the bit position means the particular measurement is supported; a zero-value means not supported. A zero-value in all bit positions in the bit string means only the basic Cell ID positioning method is supported by the target device for WiMax. The following bits are assigned for the indicated measurements. rTD; round trip delay to a primary (e.g. serving) BS rTDstd: standard deviation of round trip delay nMR: network measurement report for neighbouring BSs nMRrelDelay: Relative Delay between the neighboring BS and the primary BS nMRrelDelaystd: Standard deviation of the Relative delay nMRrSSI: received signal strength of the neighbour BS nMRrSSIstd: standard deviation of BS signal strength nMRbSTxPower: transmit power of the neighbour BS nMRcINR: Carrier to Noise and Interference Ratio of the neighbour BS nMRcINRstd: standard deviation of the BS Carrier to Noise and Interference Ratio nMRbSLocation: Location of the neighbour BS as reported by the neighbour BS non-serving: E-CID measurements for non-serving WiMax base stations (in addition to a serving base station) historic: historic WiMax E-CID measurements

6.5.9.5 WiMax ECID Capability Information Request

– *OMA-LPPe-ECID-WiMax-RequestCapabilities*

The *OMA-LPPe-ECID-WiMax-RequestCapabilities* is used to request WiMax ECID capabilities information from the target.

```
-- ASN1START

OMA-LPPe-ECID-WiMax-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.9.6 WiMax ECID Error Element

– *OMA-LPPe-ECID-WiMax -Error*

The IE *OMA-LPPe-ECID-WiMax-Error* is used by the location server or target device to provide WiMax E-CID error reasons to the target device or location server, respectively.

```
-- ASN1START

OMA-LPPe-ECID-WiMax-Error ::= CHOICE {
    locationServerErrorCauses       OMA-LPPe-ECID-WiMax-LocationServerErrorCauses,
    targetDeviceErrorCauses         OMA-LPPe-ECID-WiMax-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-ECID-WiMax-LocationServerErrorCauses*

The IE *OMA-LPPe-ECID-WiMax-LocationServerErrorCauses* is used by the location server to provide WiMax E-CID error reasons to the target device.

```
-- ASN1START

OMA-LPPe-ECID-WiMax-LocationServerErrorCauses ::= SEQUENCE {
    cause       ENUMERATED  {undefined,
                            ...
                            },
    ...
}

-- ASN1STOP
```

– OMA-LPPe-ECID-WiMax-TargetDeviceErrorCauses

The IE *OMA-LPPe-ECID-WiMax-TargetDeviceErrorCauses* is used by the target device to provide WiMax E-CID error reasons to the location server.

```
-- ASN1START

OMA-LPPe-ECID-WiMax-TargetDeviceErrorCauses ::= SEQUENCE {
    cause                                  ENUMERATED {    undefined,
                                                           requestedMeasurementsNotAvailable,
                                                           notAllrequestedMeasurementsPossible,
                                                           ...
                                                       },
    rTDMeasurementNotPossible              NULL        OPTIONAL,
    rTDstdMeasurementNotPossible           NULL        OPTIONAL,
    nMRMeasurementNotPossible              NULL        OPTIONAL,
    nMRrelDelayMeasurementNotPossible      NULL        OPTIONAL,
    nMRrelDelaystdMeasurementNotPossible   NULL        OPTIONAL,
    nMRrSSIMeasurementNotPossible          NULL        OPTIONAL,
    nMRrSSIstdMeasurementNotPossible       NULL        OPTIONAL,
    nMRbSTxPowerMeasurementNotPossible     NULL        OPTIONAL,
    nMRcINRMeasurementNotPossible          NULL        OPTIONAL,
    nMRcINRstdMeasurementNotPossible       NULL        OPTIONAL,
    nMRbSLocationNotAvailable              NULL        OPTIONAL,
    non-servingMeasurementsNotAvailable    NULL        OPTIONAL,
    historicMeasurementsNotAvailable       NULL        OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ECID-WiMax-TargetDeviceErrorCauses field descriptions
cause This field provides a WiMax ECID specific error cause. If the cause value is '*requestedMeasurementsNotAvailable*', none of the requested measurements could be provided and no further information needs to be included. If the cause value is '*notAllRequestedMeasurementsPossible*', the target device was able to provide some but not all requested WiMax measurements. In this case, the target device should indicate the requested measurements that could not be provided.

6.5.10 Sensor Positioning

6.5.10.1 Sensor Assistance Data

– OMA-LPPe-Sensor-ProvideAssistanceData

The *OMA-LPPe-Sensor-ProvideAssistanceData* is used to provide assistance for sensor-based methods.

```
-- ASN1START

OMA-LPPe-Sensor-ProvideAssistanceData ::= SEQUENCE {
```

```
    ...,
    atmosphericPressureAD   OMA-LPPe-AtmosphericPressureAD  OPTIONAL,
-- version 2.0 extension elements
    ver2-0-gmf-DataSet  SEQUENCE (SIZE (1..maxGMFDataSets)) OF OMA-LPPe-ver2-0-GMF-DataSet  OPTIONAL,
    ver2-0-sensorError  OMA-LPPe-Sensor-Error   OPTIONAL,
    ver2-0-server-tracking  NULL                OPTIONAL
}

maxGMFDataSets INTEGER ::= 8

-- ASN1STOP
```

***OMA-LPPe-Sensor-ProvideAssistanceData* field descriptions**
atmosphericPressureAD This field is used to provide reference atmospheric pressure at nominal sea level, [EGM96] to the target.
ver2-0-gmf-DataSet This parameter provides data for up to 8 sets of geomagnetic fields, This parameter is optional.
ver2-0-sensorError This field is used to provide Sensor error causes related to the assistance data requests.
ver2-0-server-tracking This parameter indicates whether the server tracks Sensor assistance data sent to a target. A target need not indicate to a server its possession of any assistance data received previously for Sensors that is tracked when sending an LPPe Request Assistance Data for Sensors. This parameter is optional and encoded as a null value. Inclusion of the parameter indicates the server tracks data for Sensors and omission indicates the server does not.

6.5.10.2 Sensor Assistance Data Elements

– *OMA-LPPe-AtmosphericPressureAD.*

The *OMA-LPPe-AtmosphericPressureAD* is used to provide reference atmospheric pressure at nominal sea level, [EGM96] to the target.

```
-- ASN1START

OMA-LPPe-AtmosphericPressureAD ::= SEQUENCE {
    referencePressure               INTEGER (-20000..10000),
    period      SEQUENCE {
                pressureValidityPeriod          OMA-LPPe-ValidityPeriod,
                referencePressureRate           INTEGER (-128..127)     OPTIONAL,
                ...
                }       OPTIONAL,
    area        SEQUENCE {
                pressureValidityArea            OMA-LPPe-PressureValidityArea,
                gN-pressure                     INTEGER (-128..127)     OPTIONAL,
                gE-pressure                     INTEGER (-128..127)     OPTIONAL,
                ...
                }       OPTIONAL,
    ...
}

OMA-LPPe-PressureValidityArea ::= SEQUENCE {
    centerPoint         Ellipsoid-Point, -- coordinates of the center of the rectangular validity area
    validityAreaWidth           INTEGER (1..128), -- units in Kilometers
    validityAreaHeight          INTEGER (1..128), -- units in Kilometers
    ...
}


-- ASN1STOP
```

***OMA-LPPe-AtmosphericPressureAD* field descriptions**

OMA-LPPe-AtmosphericPressureAD field descriptions
referencePressure This field specifies the atmospheric pressure (Pa) at nominal sea level, [EGM96] to the target. If *pressureValidityArea* is provided, the *referencePressure* applies to the center of the *pressureValidityArea*. The pressure within the *pressureValidityArea* outside the center can be calculated using the pressure gradients (*gN-pressure* and *gE-pressure*) if provided. If no northward and eastward pressure gradients are provided, the pressure is assumed to be constant throughout the pressureValidityArea. If no *referencePressureRate* is provided, the pressure is assumed to be constant at each location throughout the *pressureValidityPeriod*. The scale factor is 1 Pa. The value is added to the nominal pressure of 101325 Pa.
pressureValidityPeriod This field specifies the start time and duration of the reference pressure validity period. If this parameter is not present, the atmospheric pressure assistance data is valid only at precisely the time the assistance data is received at the target.
referencePressureRate This field specifies the rate of change of pressure. When this field is included, the referencePresssure applies only at the start of the pressureValidityPeriod. The scale factor is 10 Pa/hour,
pressureValidityArea This field specifies the area within which the provided atmospheric reference pressure is valid. If this field is not present, the provided atmospheric reference pressure is only valid at the target's position at the moment the atmospheric reference pressure is provided. The pressure validity area is a rectangle defined by its Center Point (*centerPoint*), width (*validityAreaWidth*) and height (*validityAreaHeight*). Width is measured from the center along the latitude and height is measured from the center along the longitude. Width and height are measured as the total width and height of the rectangle. The scale factor is Km.
gN-pressure This field specifies the northward gradient of the reference pressure calculated from the center of the *pressureValidityArea*. The scale factor is 10 Pa/Km. If this field is not provided, the gradient is assumed to be zero.
gE-pressure This field specifies the eastward gradient of the reference pressure calculated from the center of the *pressureValidityArea*. The scale factor is 10 Pa/Km. If this field is not provided, the gradient is assumed to be zero.

– *OMA-LPPe-ver2-0-GMF-DataSet*

The IE *OMA-LPPe-ver2-0-GMF-DataSet* is used by the location server to provide geomagnetic field information.

```
-- ASN1START

OMA-LPPe-ver2-0-GMF-DataSet ::= SEQUENCE {
    ver2-0-gmf-heatmap              OMA-LPPe-ver2-0-GMF-HeatMap OPTIONAL
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-GMF-DataSet field descriptions
ver2-0-gmf-heatmap This parameter applies only to LPPe 2.0 and provides GMF heat map data in the form of geomagnetic field strength and/or declination angle and/or inclination angle data. This parameter is optional. A target that receives new GMF heat map data SHALL delete any previously received GMF heat map data.

– *OMA-LPPe-ver2-0-GMF-HeatMap*

The IE *OMA-LPPe-ver2-0-GMF-HeatMap* is used only in LPPe 2.0 and provides geomagnetic field heat map information expressed by true northward, eastward and downward components. Refer to Appendix G for more information.

```
-- ASN1START

OMA-LPPe-ver2-0-GMF-HeatMap ::= SEQUENCE {
    heatMap-ID              OMA-LPPe-ver2-0-GMF-HeatMap-ID,
    validity-period         OMA-LPPe-ValidityPeriod             OPTIONAL,
    referenceGrid           OMA-LPPe-ver2-0-ReferenceGrid       OPTIONAL,
    heatMap-Source          OMA-LPPe-ver2-0-HeatMap-Source      OPTIONAL,
    x-offset                INTEGER (-32768..32767)             OPTIONAL,
    y-offset                INTEGER (-32768..32767)             OPTIONAL,
    x-length                INTEGER (1..4096),
    y-length                INTEGER (1..4096),
    compression             ENUMERATED {none (0), jpeg (1), ...},
    reorientation           SEQUENCE {
                            orientation-angle       INTEGER (-900..900),
                            shifting                ENUMERATED {x-direction (0), y-direction (1)},
                            ...
                            }       OPTIONAL,
    run-lengths             OMA-LPPe-RleList    OPTIONAL,
    updateReqGridPoints     OMA-LPPe-RleList    OPTIONAL,
    gmf-map                 SEQUENCE {
                            gmf-N-mean-value            OCTET STRING,
                            gmf-E-mean-value            OCTET STRING,
                            gmf-D-mean-value            OCTET STRING,
                            gmf-N-standard-deviation    OCTET STRING        OPTIONAL,
                            gmf-E-standard-deviation    OCTET STRING        OPTIONAL,
                            gmf-D-standard-deviation    OCTET STRING        OPTIONAL,
                            range                   SEQUENCE {
                                                    gmf-minimum         INTEGER (-128..-10),
                                                    gmf-range           INTEGER (10..256)
                                                    }                   OPTIONAL,
                            ...
                            }       OPTIONAL,
    declAngle-map           SEQUENCE {
                            declination-angle-mean-value            OCTET STRING,
                            declination-angle-standard-deviation    OCTET STRING        OPTIONAL,
                            range                   SEQUENCE {
                                                    da-minimum          INTEGER (-180..-10),
                                                    da-range            INTEGER (10..360)
                                                    }                   OPTIONAL,
                            ...
                            }       OPTIONAL,
    inclAngle-map           SEQUENCE {
                            inclination-angle-mean-value            OCTET STRING,
                            inclination-angle-standard-deviation    OCTET STRING        OPTIONAL,
                            range                   SEQUENCE {
                                                    ia-minimum          INTEGER (-90..-10),
                                                    ia-range            INTEGER (10..180)
                                                    }                   OPTIONAL,
                            ...
                            }       OPTIONAL
}

-- ASN1STOP
```

***OMA-LPPe-ver2-0-GMF-HeatMap* field descriptions**
heatmap-ID This parameter provides a unique ID for the heat map.
validity-period This parameter defines the validity period for a heat map and, if present, overrides any other validity period provided by a server for any assistance data that may contain the heat map. A target that receives a heat map should only make use of the heat map during the validity period. This parameter is optional.

OMA-LPPe-ver2-0-GMF-HeatMap **field descriptions**
referenceGrid
This parameter defines the origin, orientation and grid spacing for a reference grid relative to which the heat map is defined. This parameter is optional. If included, the provided reference grid overrides any default reference grid provided by means of common group parameters (e.g. for a WLAN AP or SRN AP). If absent, a reference grid is taken from common group parameters (e.g. for a WLAN AP or SRN AP),
heatMap-Source
This parameter defines the source of the heat map and may provide information associated with the source. This parameter is optional. If absent, the source is undefined.
x-offset
This parameter provides the x coordinate offset relative to the reference frame origin for the corner of the heat map rectangular area that has minimum X and Y coordinates. This parameter is encoded as an integer with range -32768 to 32767 which expresses a length in units of the grid spacing. This parameter is optional. If not present, the x-offset is zero.
y-offset
This parameter provides the y coordinate offset relative to the reference frame origin for the corner of the heat map rectangular area that has minimum X and Y coordinates. This parameter is encoded as an integer with range -32768 to 32767 which expresses a length in units of the grid spacing. This parameter is optional. If not present, the y-offset is zero.
x-length
This parameter defines the length of the rectangular area for the heat map in the X direction in units of the grid spacing. This is encoded as an integer in the range 1 to 4096.
y-length
This parameter defines the length of the rectangular area for the heat map in the Y direction in units of the grid spacing. This is encoded as an integer in the range 1 to 4096.
compression
This parameter defines the method used to compress the included heat maps. Possible values are none (meaning no compression) and JPEG (meaning JPEG compression).
reorientation
This parameter enables a heat map area to be reoriented at an angle θ (-90° ≤ θ ≤ 90°) to the local Y axis as described in Appendix G.7.1. The reorientation is defined by the following fields: orientation-angle gives the angle θ in units of one tenth of a degree shifting defines whether rows of grid points are shifted in the positive X direction or columns of grid points are shifted in the positive Y direction as defined in Appendix G.4.1. This parameter is optional and is only included when reorientation is used.
run-lengths
This parameter enables a heat map area to fit an arbitrary shape by defining alternating run lengths of excluded and included grid points as defined in Appendix G.4.2 The parameter contains a sequence of integers I1, I2, I3, I4 etc. with values between 0 and 255 where integers in odd positions (I1, I3, I5 etc.) define a consecutive sequence of excluded grid points and integers in even positions (I2, I4 etc.) define a consecutive sequence of included grid points. The total number of all included and excluded grid points SHALL be less than or equal to the total number of original grid points. When the former is less than the latter, all remaining grid points (not so far included or excluded) SHALL be assumed by a receiver to be excluded. This parameter is optional and SHALL only be included when run lengths are used to create an arbitrary heat map area.

OMA-LPPe-ver2-0-GMF-HeatMap **field descriptions**
updateReqGridPoints This parameter provides a set of grid points for triggering a request for new transmitter assistance data from a target if the target estimates its position near to one of these grid points. This parameter is optional, but if this parameter is provided by the server, the server may send this information only for one of the grouped transmitter heat maps (and not for all of the heap maps). The parameter contains a sequence of integers I1, I2, I3, I4 etc. with values between 0 and 255 where integers in odd positions (I1, I3, I5 etc.) define a consecutive sequence of grid points that do not trigger updates and integers in even positions (I2, I4 etc.) define a consecutive sequence of grid points that do trigger updates. The total number of all included and excluded grid points SHALL be less than or equal to the total number of original grid points. When the former is less than the latter, all remaining grid points (not so far included or excluded) SHALL be assumed by a receiver to not trigger an update. The selection of update grid points is out-of-scope of this specification. Refer to Appendix G.5 for more information.
gmf-map This parameter provides a sequence of true northward, eastward and downward mean geomagnetic field strength values and an optional sequence of true northward, eastward and downward geomagnetic field strength standard deviations for successive included grid points within the heat map area as defined in Appendix G. Each mean geomagnetic field strength values are encoded as integers in the range 0 to 2550 as follows: encoded value = 0 : true (northward, eastward or downward) mean geomagnetic field strength <= gmf-minimum encoded value = 1-2549 : true (northward, eastward or downward) mean geomagnetic field strength = (gmf-minimum + (encoded value / 2550)*gmf-range) encoded value = 2550 : true (northward, eastward or downward) mean geomagnetic field strength >= (gmf-minimum + gmf-range) where: gmf-minimum = minimum geomagnetic field strength in units of μT (default is -128 μT) gmf-range = range of geomagnetic field strength in units of μT (default is 255 μT) Each geomagnetic field strength standard deviations are encoded as integers in the range 0 to 2550 as follows: true (northward, eastward or downward) gmf strength standard deviation = (encoded value / 10) μT Successive geomagnetic field strength values appear according to a scan order of grid points as defined in Appendix G. When JPEG compression is used, this parameter contains an octet string that results from JPEG compression of the original encoded geomagnetic field strength values. When JPEG compression is used with run-lengths, dummy geomagnetic field strength values are included for all grid points defined to be excluded by the run-lengths parameter.
declAngle-map This parameter provides a sequence of mean declination angle values and an optional sequence of declination angle standard deviations for successive included grid points within the heat map area as defined in Appendix G. Declination angle is defined by the angle on the horizontal plane between magnetic north and true north. Mean declination angle values are encoded as integers in the range 0 to 3599 as follows: encoded value = 0 : mean declination angle <= da-minimum encoded value = 1-3598 : mean declination angle = (da-minimum + (encoded value / 3600)*da-range) encoded value = 3599 : mean declination angle>= (da-minimum + da-range) where: da-minimum = minimum declination angle in units of degree (default is -180 degree) da-range = range of declination angle in units of degree (default is 360 degree) Declination angle standard deviations are encoded as integers in the range 0 to 3599 as follows: Declination angle standard deviation = (encoded value / 10) degree Successive declination angle values appear according to a scan order of grid points as defined in Appendix G. When JPEG compression is used, this parameter contains an octet string that results from JPEG compression of the original encoded declination angle values. When JPEG compression is used with run-lengths, dummy declination angle values are included for all grid points defined to be excluded by the run-lengths parameter.

OMA-LPPe-ver2-0-GMF-HeatMap field descriptions
inclAngle-map This parameter provides a sequence of mean inclination angle values and an optional sequence of inclination angle standard deviations for successive included grid points within the heat map area as defined in Appendix G. Inclination angle is defined by the angle between the horizontal plane and the total geomagnetic field vector, measured positive into Earth. Mean inclination angle values are encoded as integers in the range 0 to 1799 as follows: encoded value = 0 : mean inclination angle <= ia-minimum encoded value = 1-1798 : mean inclination angle = (ia-minimum + (encoded value / 3600)*ia-range) encoded value = 1799 : mean inclination angle>= (ia-minimum + ia-range) where: ia-minimum = minimum inclination angle in units of degree (default is -90 degree) da-range = range of inclination angle in units of degree (default is 180 degree) Inclination angle standard deviations are encoded as integers in the range 0 to 1799 as follows: Inclination angle standard deviation = (encoded value / 10) degree Successive inclination angle values appear according to a scan order of grid points as defined in Appendix G. When JPEG compression is used, this parameter contains an octet string that results from JPEG compression of the original encoded inclination angle values. When JPEG compression is used with run-lengths, dummy inclination angle values are included for all grid points defined to be excluded by the run-lengths parameter.

– *OMA-LPPe-ver2-0-GMF-HeatMap-ID*

The IE *OMA-LPPe-ver2-0-GMF-HeatMap-ID* is used only in LPPe 2.0 and provides a unique ID for a geomagnetic field heat map.

```
-- ASN1START

OMA-LPPe-ver2-0-GMF-HeatMap-ID ::= SEQUENCE {
    vendorOrOperator        OMA-LPPe-VendorOrOperatorID,
    heatmap-ID              OCTET STRING (SIZE (1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-GMF-HeatMap-ID **field descriptions**
vendorOrOperator This parameter defines the vendor or operator who has assigned the heat map ID. This parameter is mandatory,
heatmap-ID This parameter defines the heat map ID for the particular vendor or operator. The heat map ID may contain a version or timestamp using proprietary encoding. The heatmap-ID should change whenever a heatmap is updated. The heatmap-ID is encoded as an octet string of length 1 to 16 octets. This parameter is mandatory.

6.5.10.3 Sensor Assistance Data Request

– *OMA-LPPe-Sensor-RequestAssistanceData*

The *OMA-LPPe-Sensor-RequestAssistanceData* is used to request assistance for sensor-based methods.

```
-- ASN1START

OMA-LPPe-Sensor-RequestAssistanceData ::= SEQUENCE {
    ...,
    pressureSensorAD                    OMA-LPPe-PressureSensorAD   OPTIONAL,
-- version 2.0 extension elements
    ver2-0-geoMagneticFieldAD   BIT STRING {    ver2-0-gmfHeatMap   (0),
                                            ver2-0-declAngleHeatMap     (1),
                                            ver2-0-inclAngleHeatMap     (2)} (SIZE(1..8)) OPTIONAL,
    ver2-0-GMF-HeatMaps     SEQUENCE (SIZE (1..ver2-0-maxGMFHeatMaps)) OF OMA-LPPe-ver2-0-GMF-HeatMap-ID
    OPTIONAL,
    ver2-0-GMF-HeatMapUpdateReq SEQUENCE    {
                                heatMap-ID          OMA-LPPe-ver2-0-GMF-HeatMap-ID,
                                updatingIndex       INTEGER (1..16777216),
                                targetHeading       OMA-LPPe-HighAccuracy3Dvelocity     OPTIONAL,
                                ...
    }   OPTIONAL
}

-- ASN1STOP
```

OMA-LPPe-Sensor-RequestAssistanceData **field descriptions**
ver2-0-geoMagneticFieldAD This parameter specifies the geomagnetic field assistance data requested. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested. The following assistance data types are included: ver2-0-gmfHeatMap: include an geomagnetic field strength heat map if available and, optionally, group data containing a reference grid. This bit only applies to LPPe 2.0. ver2-0-declAngleHeapMap: include a declination angle heat map if available and, optionally, group data containing a reference grid. This bit only applies to LPPe 2.0. ver2-0-inclAngleHeapMap: include an inclination angle heat map if available and, optionally, group data containing a reference grid. This bit only applies to LPPe 2.0.
ver2-0-GMF-HeatMaps This parameter applies only to LPPe 2.0 and enables a target to indicate to a server the identities of all GMF heap maps previously received from this server for geomagnetic field. This may enable a server to avoid resending the same heat maps. This parameter is optional. A target need not include this parameter if a server included the ver2-0-server-tracking field in the OMA-LPPe-Sensor-ProvideAssistanceData data type for all RF heat maps provided by this server for geomagnetic field. Otherwise, a target should include this parameter for any previously received GMF heat maps for geomagnetic field that were indicated as not tracked by the server if the target is requesting additional GMF heatmaps from the server for geomagnetic field.

OMA-LPPe-Sensor-RequestAssistanceData **field descriptions**
ver2-0-AP-HeatMapUpdateReq This parameter applies only to LPPe 2.0 and provides the ID of a heat map and an index of a reference grid point within the heat map that has triggered an update request for new assistance data when the target estimates its position at or near to this grid point. The heat map and the reference grid point would have been provided earlier to the target via the *updateReqGridPoints* parameter in the *OMA-LPPe-ver2-0-GMF-HeatMap* IE. Appendix G.5 contains more information on this update request. Optionally, the target may also send its heading and velocity information. This parameter is optional.

6.5.10.4 Sensor Assistance Data Request Elements

– *OMA-LPP-PressureSensorAD*

The *OMA-LPPe-PressureSensorAD* is used to request atmospheric reference pressure assistance data.

```
-- ASN1START

OMA-LPPe-PressureSensorAD ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.10.5 Sensor Location Information

– *OMA-LPPe-Sensor-ProvideLocationInformation*

The *OMA-LPPe-Sensor-ProvideLocationInformation* is used to provide location information for sensor-based methods.

```
-- ASN1START

OMA-LPPe-Sensor-ProvideLocationInformation ::= SEQUENCE {
    motionStateList         OMA-LPPe-Sensor-MotionStateList     OPTIONAL,
    sensorError             OMA-LPPe-Sensor-Error               OPTIONAL,
    ...,
    atmosphericPressure     OMA-LPPe-AtmosphericPressure        OPTIONAL
}

-- ASN1STOP
```

OMA-LPPe-Sensor-ProvideLocationInformation field descriptions
motionStateList This field is used to provide one or more motion states to the server. The motion state may indicate e.g. that the target is stationary or that it is moving in a car.
sensorError This field is used to provide error information on the sensor location information.
atmosphericPressure This field is used to provide the atmospheric pressure as measured by the target's pressure sensor. This field SHALL be included if requested and available.

6.5.10.6 Sensor Location Information Elements

– *OMA-LPPe-Sensor-MotionStateList*

The *OMA-LPPe-Sensor-MotionStateList* carries target motion state information. The list allows for reporting up to eight motion state elements. Each element contains one primary motion state (the one with the highest sustained velocity) and optionally multiple secondary motion states in order to be able to describe, say, that the person carrying the target is walking (secondary motion) in a train (primary motion). The confidence represents the confidence of the primary motion state if no secondary motion state is included or the combination of primary+secondary, in case the secondary motion state is included.

```
-- ASN1START


OMA-LPPe-Sensor-MotionStateList ::= SEQUENCE (SIZE(1..8)) OF OMA-LPPe-Sensor-MotionStateElement

OMA-LPPe-Sensor-MotionStateElement ::= SEQUENCE {
    primaryMotionState      ENUMERATED{
                                unknown,
                                stationary,
                                pedestrian,
                                running,
                                cycling,
                                car,
                                train,
                                aeroplane,
                                boat,
                                fidgeting,
                                ...
                                },
    confidence              INTEGER(0..99),
    secondaryMotionState    BIT STRING {
                                stationary  (0),
                                pedestrian  (1),
                                running     (2),
                                cycling     (3),
                                car         (4),
                                train       (5),
                                aeroplane   (6),
                                boat        (7),
                                fidgeting   (8),
-- version 2.0 extension elements
                                ver2-0-hold         (9),
                                ver2-0-onear        (10),
                                ver2-0-inpocket     (11),
                                ver2-0-swing        (12),
                                ver2-0-elevator     (13),
                                ver2-0-escalator    (14)} (SIZE(1..16)) OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-Sensor-MotionStateList **field descriptions**
primaryMotionState This field specifies the primary motion state, i.e. the one with the heighest sustained speed.
confidence This field specifies the confidence that the target is in the indicated motion state (primary+secondary). Confidence is encoded as a truncated percentage. An encoded value of 0 therefore represents a confidence C where 0% <=C <1% percent. An encoded value of 1 represents a confidence C where 1%<=C<2%, and so on. An encoded value of 99 represents a confidence C where 99%<=C<100%.
secondaryMotionState This field specifies one or more seconday motion states. Secondary motion states are indicated by the bit string, in which each bit position indicates a distinct secondary motion. The presence of two or more secondary motion states indicates that all occur simultaneously – e.g. fidgeting while stationary on a train. Note: a secondary motion state which is set to false implies that the target is asserting that the motion state is not in effect. Note: The following bits indicate secondary motion states applicable to the pedestrian primary motion state. hold: identifies a motion state where a pedestrian holds the UE while viewing the screen. onear: identifies a motion state where a pedestrian holds the UE to his ear. inpocket: identifies a motion state where a pedestrian has the UE close to his body (e.g. in his pocket). swing: identifies a motion state where a pedestrian swings the UE in his hands while walking. elevator: identifies a motion state where a pedestrian is in a moving elevator. escalator: identifies a motion state where a pedestrian is on a moving escalator.

– OMA-LPPe-AtmosphericPressure

The *OMA-LPPe-AtmosphericPressure* represents the atmospheric pressure measured by the target.

```
-- ASN1START


OMA-LPPe-AtmosphericPressure ::= SEQUENCE {
    pressureMeasurement             OMA-LPPe-PressureMeasurement,
    pressureStats                   PressureStats       OPTIONAL,
    calibrationPoints               CalibrationPoints   OPTIONAL,
    ...}


PressureStats ::= SEQUENCE {
    sensorMeanPressure      INTEGER     (30000..115000),
    sensorStddevPressure    INTEGER     (0..2000)       OPTIONAL,
    duration                INTEGER     (5..40),
...}

CalibrationPoints ::= SEQUENCE (SIZE (1..10)) OF SEQUENCE {
    pressure        OMA-LPPe-PressureMeasurement,
    time            UTCTime,
    location        EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
    motionState     OMA-LPPe-Sensor-MotionStateList     OPTIONAL,
    velocity        Velocity                            OPTIONAL,
    locationSource  OMA-LPPe-LocationSource             OPTIONAL,
    ...
}


-- ASN1STOP
```

OMA-LPPe-AtmosphericPressure **field descriptions**
pressureMeasurement This field provides an instantaneous current atmospheric pressure at the target.

OMA-LPPe-AtmosphericPressure field descriptions
pressureStats This field corresponds to the mean and (optional) standard deviation of the sensor(s) pressure measurement without any added or subtracted adjustment that prevailed for a time period (duration) immediately before the pressure measurement reported by the target was obtained. The scale factor for mean and standard deviation is 1 Pa. Time units are in seconds. For the pressureStats to be reported, the duration MUST be at least 5 seconds (maximum duration is 40 seconds). This field enables a server to remove noise from the current pressure measurement through averaging and evaluate the stability of the current pressure measurement (e.g. whether increasing or decreasing). A target may obtain the statistics while performing any other measurements requested by the server. The current pressure measurement (in *pressureMeasurement*) should be obtained exactly at the end of the duration for *pressureStats*.
calibrationPoints This parameter provides a sequence of up to 10 calibration points for the target where both a 3D location and a pressure measurement were obtained by the target. Each calibration point includes the following mandatory and conditional fields. pressure — the measured pressure in units of Pa (mandatory) time — UTC time (mandatory) location — location of the target which MUST have been obtained without use of either the pressure measurement or a terrain map (mandatory) motionState — the motion state of the target (mandatory if available) velocity — the velocity of the target (mandatory if available) locationSource — the source(s) of the reported location (mandatory if available) This parameter enables the server to calibrate the barometric sensor for the target and/or estimate its accuracy and stability. This parameter is compiled from historic pressure and location data stored in the target prior to reporting an atmospheric pressure measurement to the server. The parameter SHALL be included when calibration points are available. If possible, one calibration point should be reported for each of the last 10 days starting with the current day and should each correspond to the 3D location with minimum uncertainty volume obtained each day which may be approximated by the product of the X, Y and Z uncertainty values. A target that is unable to report 10 calibration points over a 10 day period should report up to 10 calibration points over a shorter or longer period in the same manner. If possible, a target that is environmentally aware (e.g. via use of other sensor data) should not report calibration points that appear to correspond to indoor or in vehicle locations when other calibration points are available that appear to correspond to outdoor locations.

– OMA-LPPe-PressureMeasurement

The *OMA-LPPe-PressureMeasurement* is used to define an atmospheric pressure measurement.

```
-- ASN1START


OMA-LPPe-PressureMeasurement ::= SEQUENCE {
    sensorMeasurement               INTEGER (30000..115000),
    adjustment                      INTEGER (-5000..5000)           OPTIONAL,
    uncertainty                     SEQUENCE {
                                    range       INTEGER (0..1000),
                                    confidence  INTEGER (1..100)
                                    }                               OPTIONAL,
    temperature                     INTEGER (-100..150)             OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-PressureMeasurement field descriptions
sensorMeasurement This field specifies the measured atmospheric pressure in units of Pa (corresponding to a numerical altitude resolution of about 0.1m at sea level). This field SHALL be obtained from the measured atmospheric pressure output of one or more sensors on the target prior to any adjustment made externally to the sensor(s).

OMA-LPPe-PressureMeasurement field descriptions
adjustment This field specifies any adjustment in units of Pa applied by a target to the output of the sensor(s) to produce a more accurate atmospheric pressure. The adjustment may be enabled by previous calibration by the target of the sensor output using a known reference atmospheric pressure for a known location and altitude, by more accurate temperature related calibration data from the vendor of the sensor or by other means. The more accurate atmospheric pressure is obtained as follows and is not reported directly but only via the measurement and adjustment components: accurate atmospheric pressure = sensorMeasurement + adjustment The adjustment SHALL be provided whenever applied. If there is no adjustment, a target may omit the adjustment field. When omitted, a server SHALL assume a value of zero for the adjustment.
uncertainty This field provides the expected range for the pressure measurement and the confidence as a percentage that the true pressure lies in a range of (measurement + adjustment – range) to (measurement + adjustment + range). This field is optional and SHALL be provided if available.
temperature This field provides the temperature in degrees Celsius associated with the sensor(s) used for the pressure measurement and SHALL be provided if available. Note that the sensor temperature is internal to the target and may differ from the temperature outside the target if a different sensor is used to measure outside temperature.

6.5.10.7 Sensor Location Information Request

– *OMA-LPPe-Sensor-RequestLocationInformation*

The *OMA-LPPe-Sensor-RequestLocationInformation* is used to request location information for sensor-based methods.

```
-- ASN1START

OMA-LPPe-Sensor-RequestLocationInformation ::= SEQUENCE {
    motionStateReq          OMA-LPPe-Sensor-MotionStateRequest  OPTIONAL, --Cond MotionSateReq
    ...,
    atmosphericPressureReq  OMA-LPPe-AtmosphericPressureRequest OPTIONAL --Cond AtmosphericPressureReq
}

-- ASN1STOP
```

Conditional presence	Explanation
MotionStateReq	The field is mandatory present if the server requests for primary motion state measurements; otherwise it is not present.
AtmosphericPressureReq	The field is mandatory present if the server requests for atmospheric pressure measurements; otherwise it is not present.

OMA-LPPe-Sensor-RequestLocationInformation field descriptions
motionStateReq This field is used to request the motion state of the target. The motion state may indicate e.g. that the target is stationary or that it is moving in a car.

6.5.10.8 Sensor Location Information Request Elements

– *OMA-LPPe-Sensor-MotionStateRequest*

The *OMA-LPPe-Sensor-MotionStateRequest* is used to request motion state information.

```
-- ASN1START

OMA-LPPe-Sensor-MotionStateRequest ::= SEQUENCE {
```

```
    secondaryMotionStateRequest     NULL    OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-Sensor-MotionStateRequest field descriptions
secondaryMotionStateRequest This field is used to request the secondary motion state of the target.

– *OMA-LPPe-AtmosphericPressureRequest*

The *OMA-LPPe-AtmosphericPressureRequest* is used to request atmospheric pressure (as measured by the target) information.

```
-- ASN1START

OMA-LPPe-AtmosphericPressureRequest ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.10.9 Sensor Capability Information

– *OMA-LPPe-Sensor-ProvideCapabilities*

The *OMA-LPPe-Sensor-ProvideCapabilities* is used to provide capabilities for sensor-based methods.

```
-- ASN1START

OMA-LPPe-Sensor-ProvideCapabilities ::= SEQUENCE {
    motionStateSupport                  NULL    OPTIONAL, --Cond MotionStateSupport
    secondarySupport                    NULL    OPTIONAL, --Cond SecondarySupport
    ...,
    atmosphericPressureADSupport        NULL    OPTIONAL, --Cond AtmosphericPressureADSupport
    atmosphericPressureSupport          NULL    OPTIONAL,  --Cond AtmosphericPressureSupport
-- version 2.0 extension elements
    ver2-0-geomagneticfieldADSupport    BIT STRING  {ver2-0-gmfHeatMap      (0),
                                                     ver2-0-declAngleHeatMap (1),
                                                     ver2-0-inclAngleHeatMap (2)}(SIZE(1..8))    OPTIONAL
}

-- ASN1STOP
```

Conditional presence	Explanation
MotionStateSupport	The field is mandatory present if the target supports motion state measurements; otherwise it is not present.
SecondarySupport	The field is mandatory present if the target supports secondary motion state measurements; otherwise it is not present.
AtmosphericPressureADSupport	The field is mandatory present if the target supports atmospheric pressure assistance data; otherwise it is not present.
AtmosphericPressureSupport	The field is mandatory present if the target supports atmospheric pressure measurements; otherwise it is not present.

OMA-LPPe-Sensor-ProvideCapabilities field descriptions

OMA-LPPe-Sensor-ProvideCapabilities field descriptions
ver2-0-geomagneticfieldADSupport This field specifies the geomagnetic field assistance data supported by the target device. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is supported; a zero-value means not supported. A zero-value in all bit positions or absence of this field means no assistance data is supported. The following bits are assigned for the indicated assistance data. ver2-0-gmfHeatMap: geomagnetic field heatmap ver2-0-declAngleHeatMap: declination angle heatmap ver2-0-inclAngleHeatMap: inclination angle heatmap

6.5.10.10 Sensor Capability Information Elements

Void.

6.5.10.11 Sensor Capability Information Request

– *OMA-LPPe-Sensor-RequestCapabilities*

The *OMA-LPPe-Sensor-RequestCapabilities* is used to provide capabilities for sensor-based methods.

```
-- ASN1START

OMA-LPPe-Sensor-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.10.12 Sensor Error Elements

– *OMA-LPPe-Sensor-Error*

The *OMA-LPPe-Sensor-Error* is used to provide Sensor Error Reasons to the server.

```
-- ASN1START


OMA-LPPe-Sensor-Error ::= CHOICE {
    targetError         OMA-LPPe-Sensor-TargetError,
    ...,
-- version 2.0 extension elements
    ver2-0-LocationServerError  OMA-LPPe-Sensor-LocationServerError
}

OMA-LPPe-Sensor-TargetError ::= SEQUENCE {
    motionStateError    ENUMERATED { primaryMotionStateNotAvailable,
                                     primaryMotionStateNotSupported,
                                     ... }  OPTIONAL,
    secondaryMotionStateError   ENUMERATED { secondaryMotionStateNotAvailable,
                                             secondaryMotionStateNotSupported,
                                     ... }  OPTIONAL,
    ...,
    atmosphericPressureError    ENUMERATED {pressureNotAvailable, pressureNotSupported,
                                    ...}    OPTIONAL,
-- version 2.0 extension elements
    ver2-0-gmfNotAvailable                      NULL    OPTIONAL,
    ver2-0-declAngleNotAvailable                NULL    OPTIONAL,
    ver2-0-inclAngleNotAvailable                NULL    OPTIONAL
}

OMA-LPPe-Sensor-LocationServerError ::= SEQUENCE {
    ver2-0-gmfHeatMapsUnavailable               NULL        OPTIONAL,
```

```
    ver2-0-declAngleHeatMapsUnavailable         NULL        OPTIONAL,
    ver2-0-inclAngleHeatMapsUnavailable         NULL        OPTIONAL
}

-- ASN1STOP
```

OMA-LPPe-Sensor-Error **field descriptions**
targetError This field is used to provide target error information to the server.
motionStateError This field is used to provide error information on the motion state measurement to the server.
ver2-0-gmfUnavailable This field applies to LPPe 2.0 only. When present it indicates that a geomagnetic field in a target device is not available.
ver2-0-declAngleUnavailable This field applies to LPPe 2.0 only. When present it indicates that a declination angle in a target device is not available.
ver2-0-inclAngleUnavailable This field applies to LPPe 2.0 only. When present it indicates that an inclination angle in a target device is not available.
ver2-0-gmfHeatMapsUnavailable This field applies to LPPe 2.0 only. When present it indicates that a geomagnetic field Heat Map assistance data is not available.
ver2-0-declAngleHeatMapsUnavailable This field applies to LPPe 2.0 only. When present it indicates that a declination angle Heat Map assistance data is not available.
ver2-0-inclAngleHeatMapsUnavailable This field applies to LPPe 2.0 only. When present it indicates that an inclination angle Heat Map assistance data is not available.

6.5.10.13 Common Sensor Information Elements

Void.

6.5.11 Short Range Node Positioning

This section defines support for positioning using measurements related to a Short Range Nodes (SRNs).

6.5.11.1 Short Range Node Assistance Data

– *OMA-LPPe-SRN-ProvideAssistanceData*

The *OMA-LPPe-SRN-ProvideAssistanceData* is used to provide assistance data for SRN (Short Range Node) UE-based and UE-assisted positioning.

```
-- ASN1START

OMA-LPPe-SRN-ProvideAssistanceData ::= SEQUENCE {
    srnGroup    CHOICE {
        srnGroupList            OMA-LPPe-SRN-SRNgroupList,
        srnGroupUpdateResponse  OMA-LPPe-SRN-SRNgroupUpdateResponse,
        ...
        }                                                   OPTIONAL,
    antennaPattern          OMA-LPPe-SRN-AntennaPattern     OPTIONAL,   --Cond AntennaPattReq
    srnError                OMA-LPPe-SRN-Error              OPTIONAL,
    ...,
-- version 2.0 extension elements
    ver2-0-server-tracking  NULL    OPTIONAL
}

-- ASN1STOP
```

Conditional presence	Explanation
AntennaPattReq	The field is mandatory present if the target device requests for antenna pattern information, otherwise the field is not present.

***OMA-LPPe-SRN-ProvideAssistanceData* field descriptions**
srnGroupList This field is used to provide information on the relative locations and optionally orientations of the SRNs. This choice SHALL be included, if the target device requests for SRN group information and this information is available at the server.
srnGroupUpdateResponse This field is used to provide response to the target's SRN group information update request. This choice SHALL be included if the target device requests for SRN group information update and this information is available at the server.
antennaResponse This field is used to provide the spatial response for a certain SRN antenna type.
srnError This field is used to provide SRN error causes related to the assistance data requests.
ver2-0-server-tracking This parameter indicates whether the server tracks SRN assistance data sent to a target. A target need not indicate to a server its possession of any assistance data received previously for SRN APs that is tracked when sending an LPPe Request Assistance Data for SRN. This parameter is optional and encoded as a null value. Inclusion of the parameter indicates the server tracks data for SRN APs and omission indicates the server does not.

6.5.11.2 Short Range Node Assistance Data Elements

– *OMA-LPPe-SRN-SRNgroupList*

The IE *OMA-LPPe-SRN-SRNgroupList* is used to provide assistance data for one or more groups of positioning SRNs in the local area. For example, one SRN group might consist of all the SRNs located in one floor of a building. Up to 64 groups can be provided in the same IE.

```
-- ASN1START

OMA-LPPe-SRN-SRNgroupList ::= SEQUENCE {
    incompleteFlag          BOOLEAN,
    defaultReferencePoint   OMA-LPPe-ReferencePoint                 OPTIONAL, --Cond IfNoRefPoint
    groupList               SEQUENCE (SIZE (1..64)) OF OMA-LPPe-SRN-SRNgroup,
    ...
    }

OMA-LPPe-SRN-SRNgroup ::= SEQUENCE {
    srnGroupID                      OMA-LPPe-SRN-SRNgroupUniqueID                       OPTIONAL,
    defaultSRNtype                  OMA-LPPe-SRN-SRNtype                                OPTIONAL,
    referencePoint                  OMA-LPPe-ReferencePoint                             OPTIONAL,
    globalOrientation               NULL                                                OPTIONAL,
    srnsInGroupList                 SEQUENCE (SIZE (1..1024)) OF OMA-LPPe-SRN-SRNinfo,
    ...,
-- version 2.0 extension elements
    ver2-0-referenceGrid            OMA-LPPe-ver2-0-ReferenceGrid                       OPTIONAL,
    ver2-0-location-area            OMA-LPPe-ver2-0-LocationAreaData                    OPTIONAL,
    ver2-0-srn-properties           OMA-LPPe-ver2-0-Transmitter-Properties              OPTIONAL
}

OMA-LPPe-SRN-SRNinfo ::= SEQUENCE {
    srnID                   OMA-LPPe-SRN-SRNid,
    srnType                 OMA-LPPe-SRN-SRNtype                OPTIONAL,   --Cond NotDefaultType
    relativePosition        OMA-LPPe-RelativeLocation,
    orientation             OMA-LPPe-Orientation                OPTIONAL,
    ...,
-- version 2.0 extension elements
    ver2-0-propagation      OMA-LPPe-ver2-0-RF-Propagation          OPTIONAL,
    ver2-0-locationSource   OMA-LPPe-ver2-0-AP-LocationSource       OPTIONAL,   ver2-0-rf-heatmap
    OMA-LPPe-ver2-0-RF-HeatMap                OPTIONAL
```

```
}

-- ASN1STOP
```

Conditional presence	Explanation
NotDefaultType	The field is mandatory present, if the SRN is of different type than the *defaultSRNtype* IE, otherwise the field is not present.
IfNoRefPoint	The field is mandatory present, if any of the groups is missing a reference point. Otherwise it is not present.

***OMA-LPPe-SRN-SRNgroupList* field descriptions**
incompleteFlag This field specifes, if the server was able to provide all the groups to the target the server would have wanted to (TRUE) or not (FALSE). For example, it might happen that when the target requests for groups near to a geographic position, there are more groups nearby than can be carried in a single message if AD segmentation is not supported.
defaultReferencePoint This field specifies the default reference location for the location of all SRNs in the *groupList* IE, if the *groupList* IE does not contain any reference point. If this field is absent, the default reference location is provided by the default reference point in LPPe common IEs.
groupList This field specifies the assistance data for one or more SRN goups.
srnGroupID This field identifies the SRN group.
defaultSRNType This field, if present, specifies the type of all SRNs in *srnsInGroupList* IE.
referencePoint This field, if present, specifies the reference point for this SRN group. If this field is absent, the *defaultReferencePoint* IE in *OMA-LPPe-SRN-SRNgroupList* defines the reference point.
globalOrientation This field, if present, indicates that the orientation given in the field orientation (in *OMA-LPPe-SRN-SRNInfo*) is with respect to the global coordinate system (see Appendix C.9.2). Otherwise, if this field is absent, the orientation information in *OMA-LPPe-SRN-SRNinfo* (if any) can only be used to deduce the relative orientation information of the SRNs.
srnsInGroupList This field is used to provide the relative positions and optionally orientations of the SRNs in the group.
ver2-0-referenceGrid This parameter applies only to LPPe 2.0 and provides a default reference grid applicable to RF heat maps for all SRNs APs in the SRN group.
ver2-0-location-area This parameter applies only to LPPe 2.0 and provides common location characteristics for all SRN APs in the SRN group.
ver2-0-srn-properties This parameter applies only to LPPe 2,.0 and provides common properties for all SRN APs in the SRN group.
srnID This field identifies the SRN.
srnType This field specifies the type of the SRNs.
relativePosition This field specifies the relative position of the SRN relative to the reference point.
orientation This field, if present, specifies the orientations of the SRN. In case the *orientation* field is missing in all the records of the *srnsInGroupList* sequence, the orientation is assumed to be the same for all the SRNs, or no orienation information is provided. In case *globalOrientation* is included and only the first item in the *srnsInGroupList* sequence includes the orientation, all the SRNs are assumed to have the same global orientation.

OMA-LPPe-SRN-SRNgroupList field descriptions
ver2-0-propagation This field applies only to LPPe 2.0 and indicates the radio propagation characteristics of the SRN AP.
ver2-0-locationSource This parameter applies only to LPPe 2.0 and provides the source of the SRN AP location and an indication of its reliability and accuracy.
ver2-0-rf-heatmap This parameter applies only to LPPe 2.0 and provides RF heat map data for the SRN AP in the form of signal strength and/or RTT data. This parameter is optional. A target that receives new RSSI or RTT heat map data for an SRN AP SHALL delete any previously received RSSI or RTT heat map data, respectively, for this AP.

– *OMA-LPPe-SRN-SRNgroupUpdateResponse*

The IE *OMA-LPPe-SRN-SRNgroupUpdateResponse* is used only as a response to the SRN group data update request.

```
-- ASN1START

OMA-LPPe-SRN-SRNgroupUpdateResponse ::= SEQUENCE (SIZE (1..8)) OF
                                                       OMA-LPPe-SRN-SRNgroupUpdateResponseElement

OMA-LPPe-SRN-SRNgroupUpdateResponseElement ::= SEQUENCE {
    srnGroupID          OMA-LPPe-SRN-SRNgroupUniqueID                           OPTIONAL,
    targetDataValidity  ENUMERATED{ targetDataValid,
                                    targetDataInValidAndUpdatedDataWillBeProvided,
                                    targetDataInValidButServerWillNotProvideNewData,
                                    ...},
    updatedSRNgroup     OMA-LPPe-SRN-SRNgroup OPTIONAL, --Cond InvalidAndNewDataAvailable
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
InvalidAndNewDataAvailable	The field is mandatory present if the target data is out-of-date and the server provides updated data, otherwise the field is not present.

OMA-LPPe-SRN-SRNgroupUpdateResponse field descriptions
srnGroupID This field specifies the group ID of which validity data is being provided. The group ID SHALL match with that in the request.
targetDataValidity This field indicates if the target data is valid (value 0) or that the data is out-of-date and new data will be provided (value 1). Value 2 indicates that data is invalid but no new data will be provided – this may be due to the server not having the new data or because in the request the target indicated that the target only wishes to receive an inidication that the data is invalid (*provideIndicationOnly*-field in the *IE OMA-LPPe-SRN-SRNGroupUpdateRequest*).
updatedSRNgroup This field provides the latest SRN group information in the case the target's current SRN group information is not valid and the server can provide up-to-date information. The updated group information overrides the previous group data. This may include replacing the previous *srnGroupID* parameter in the *OMA-LPPe-SRN-SRNgroup* with a new parameter (i.e. new group ID).

– *OMA-LPPe-SRN-AntennaPattern*

The IE *OMA-LPPe-SRN-AntennaPattern* is used for providing the target with the complex-valued antenna response. The coordinate system definition is SRN-specific.

```
-- ASN1START

OMA-LPPe-SRN-AntennaPattern ::= SEQUENCE (SIZE (1..8)) OF OMA-LPPe-SRN-AntennaPatternElement

OMA-LPPe-SRN-AntennaPatternElement::= SEQUENCE {
    identification      SEQUENCE {
                                    vendorOrOperator        OMA-LPPe-VendorOrOperatorID,
                                    antennaPatternID        INTEGER(0..65535),
                                    ...
                                },
    antennaData         CHOICE {
                                    antennaPattern      OMA-LPPe-SRN-AntennaPatternForChannels,
                                    antennaContainer    OCTET STRING,
                                    ...
                                },
    ...
}



OMA-LPPe-SRN-AntennaPatternForChannels ::= SEQUENCE {
    evenGrid            SEQUENCE {
                                    inAzimuth       INTEGER(1..200),
                                    inElevation     INTEGER(1..150)
                                } OPTIONAL, --Cond EvenGrid
    patternList         SEQUENCE (SIZE (1..maxChannels)) OF OMA-LPPe-SRN-ChannelResponse,
    ...
}

OMA-LPPe-SRN-ChannelResponse ::= SEQUENCE {
    channelNumber           INTEGER(1..maxChannels),
    responseInElevation     SEQUENCE (SIZE (7..901)) OF OMA-LPPe-SRN-ResponseInElevation,
    ...
}

OMA-LPPe-SRN-ResponseInElevation ::= SEQUENCE {
    elevation           INTEGER(0..900) OPTIONAL,   --Cond NotEven
    responseInAzimuth   SEQUENCE (SIZE (18..3601)) OF OMA-LPPe-SRN-ResponseInAzimuth,
    ...
}

OMA-LPPe-SRN-ResponseInAzimuth::= SEQUENCE {
    azimuth     INTEGER(0..3599)    OPTIONAL, --Cond NotEven
    response    OMA-LPPe-ComplexNumber,
    ...
    }

OMA-LPPe-ComplexNumber ::= SEQUENCE {
    amplitude   INTEGER(0..1000),
    phase       INTEGER(-1800..1799)
}

maxChannels INTEGER ::= 512

-- ASN1STOP
```

Conditional presence	Explanation
EvenGrid	The field is mandatory present if the antenna response grid spacing is even, otherwise the field is not present.
NotEven	The field is mandatory present if the antenna response grid spacing is not even, otherwise the field is not present.

***OMA-LPPe-SRN-AntennaResponse* field descriptions**

OMA-LPPe-SRN-AntennaResponse field descriptions
identification This field specifies for which SRN or group of SRNs the antenna pattern is given. It specifies the vendor specific unique antenna response ID. If the *OMA-LPPe-SRN-AntennaResponse* is provided as a response to a request, the identification SHALL match with the identification in the request.
antennaData This field specifies the antenna data for the given *identificatio*n IE.
evenGrid This field defines the antenna response grid in the case that an evenly-spaced grid is used for providind the spatial response.
inAzimuth This field defines the grid resolution in azimuth in case the antenna response is given in an evenly-spaced grid. Scale factor 0.1 degrees.
inElevation This field defines the grid resolution in elevation in case the antenna response is given in an evenly-spaced grid. Scale factor is 0.1 degrees.
patternList This field specifies the spatial antenna response.
channelNumber This field indicates the channel for which the response is given.
responseInElevation This field specifies the response at a given elevation angle.
elevation In the case of a non-even grid, this field defines the elevation angle of the antenna response. Scale factor 0.1 degrees. In case the field is not present, the first item in the *responseInElevation* sequence corresponds to the elevation angle zero with respect to the SRN axis. The second item corresponds to zero plus the elevation resolution defined in *inElevation* in *evenGrid*.
responseInAzimuth This field specifies the response at a given azimuth.
azimuth In the case of a non-even grid, this field defines the azimuth angle of the antenna response. Scale factor 0.1 degrees. In case the field is not present, the first item in the *responseInAzimuth* sequence corresponds to the azimuth angle zero with respect to the SRN axis. The second item corresponds to zero plus the azimuth resolution defined in *inAzimuth* in *evenGrid*.
response This field defines the complex-valued antenna response at the defined azimuth and elevation angles.
amplitude This field specifies the gain in the linear scale. Normalized so that the highest amplitude is 1000 over all the channels and spatial directions.
phase This field specifies the phase. The phase is normalized so that phase zero occurs coincides with the amplitude response of 1000 - all the other phase response values over all the channels and spatial directions are relative to this reference value. Scale factor 0.1 degrees.

6.5.11.3 Short Range Node Assistance Data Request – *OMA-LPPe-SRN-RequestAssistanceData*

The IE *OMA-LPPe-SRN-RequestAssistanceData* is used to request assistance for SRN-based positioning.

```
-- ASN1START

OMA-LPPe-SRN-RequestAssistanceData ::= SEQUENCE {
```

```
    srnGroup    CHOICE {
        srnGroupRequest         OMA-LPPe-SRN-SRNgroupRequest,
        srnGroupUpdateRequest   OMA-LPPe-SRN-SRNgroupUpdateRequest,
        ...
    }   OPTIONAL,
    antennaPatternRequest   OMA-LPPe-SRN-AntennaPatternRequest      OPTIONAL,
    ...,
-- version 2.0 extension elements
    ver2-0-requestedAD      BIT STRING  {   ver2-0-propagation          (0),
                                            ver2-0-rssiHeatMap          (1),
                                            ver2-0-rttHeatMap           (2) } (SIZE(1..16)),
    ver2-0-propModel        OMA-LPPe-ver2-0-RF-PropagationTypes     OPTIONAL,
    ver2-0-visible-SRN-APs  SEQUENCE (SIZE (1..ver2-0-maxVisibleAPs)) OF OMA-LPPe-SRN-SRNid OPTIONAL,
    ver2-0-SRN-Data         SEQUENCE (SIZE (1..ver2-0-maxKnownAPs)) OF OMA-LPPe-SRN-SRNid OPTIONAL,
    ver2-0-SRN-HeatMaps     SEQUENCE  (SIZE  (1..ver2-0-maxHeatMaps))  OF  OMA-LPPe-ver2-0-RF-HeatMap-ID
    OPTIONAL,
    ver2-0-SRN-HeatMapUpdateReq SEQUENCE    {
                                heatMap-ID          OMA-LPPe-ver2-0-RF-HeatMap-ID,
                                updatingIndex       INTEGER (1..16777216),
                                targetHeading       OMA-LPPe-HighAccuracy3Dvelocity     OPTIONAL,
                                ...
    }   OPTIONAL
}

-- ASN1STOP
```

***OMA-LPPe-SRN-RequestAssistanceData* field descriptions**
srnGroup This parameter indicates the type of SRN data request which can either be to receive new SRN group data or to verify and optionally update previously received SRN group data.
antennaPatternRequest This parameter indicates a request for SRN antenna data.
ver2-0-requestedAD This parameter only applies only to LPPe 2.0. It specifies the SRN assistance data requested. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested. The following assistance data types are included: ver2-0-propagation: include propagation estimation for each SRN AP if available ver2-0-rssiHeatMap: include an RSSI heat map for each SRN AP if available. ver2-0-rttHeatMap: include an RTT heat map for each SRN AP if available.
ver2-0-propModel This parameter applies only to LPPe 2.0 and specifies the propagation estimation model required, when propagation estimation is requested.
ver2-0-visible-SRN-APs This parameter applies only to LPPe 2.0 and enables a target to indicate to a server the identities of up to 16 currently visible SRN APs. This may assist a server to provide assistance data for SRN APs nearby to the target. A target SHALL provide visible SRN APs in order of received signal strength with the SRN AP with the highest signal strength provided first. This parameter is optional.
ver2-0-SRN-Data This parameter applies only to LPPe 2.0 and enables a target to indicate to a server the identities of SRN APs for which the target has assistance data received previously from this server. This may enable a server to avoid resending data for the same APs. This parameter is optional. A target need not include this parameter if a server included the ver2-0-server-tracking field in the OMA-LPPe-SRN-ProvideAssistanceData data type for all SRN AP data provided by this server. Otherwise, a target should include this parameter for any SRN APs for which data was previously received and indicated as not tracked by the server if the target is requesting data for additional APs.

OMA-LPPe-SRN-RequestAssistanceData field descriptions
srnGroup This parameter indicates the type of SRN data request which can either be to receive new SRN group data or to verify and optionally update previously received SRN group data.
antennaPatternRequest This parameter indicates a request for SRN antenna data.
ver2-0-SRN-HeatMaps This parameter applies only to LPPe 2.0 and enables a target to indicate to a server the identities of all RF heap maps previously received from this server for SRN APs. This may enable a server to avoid resending the same heat maps. This parameter is optional. A target need not include this parameter if a server included the ver2-0-server-tracking field in the OMA-LPPe-SRN-ProvideAssistanceData data type for all RF heat maps provided by this server for SRN APs. Otherwise, a target should include this parameter for any previously received RSSI or RTT heat maps for SRN APs that were indicated as not tracked by the server if the target is requesting additional RSSI or RTT heatmaps, respectively, from the server for SRN APs.
ver2-0-SRN-HeatMapUpdateReq This parameter applies only to LPPe 2.0 and provides the ID of a heat map and an index of a reference grid point within the heat map that has triggered an update request for new assistance data when the target estimates its position at or near to this grid point. The heat map and the reference grid point would have been provided earlier to the target via the *updateReqGridPoints* parameter in the *OMA-LPPe-ver2-0-RF-HeatMap* IE. Appendix G.5 contains more information on this update request. Optionally, the target may also send its heading and velocity information. This parameter is optional.

6.5.11.4 Short Range Node Assistance Data Request Elements

– *OMA-LPPe-SRN-SRNgroupRequest*

The *OMA-LPPe-SRN-SRNgroupRequest* is used to request the relative positions and optionally orientations of the SRNs in the local SRN group. For the assistance data request purposes the target may (a) provide its approximate location to the server in either the *OMA-LPPe-CommonIEsRequestAssistanceData* parameter or in a separatethe Provide Location Information –message or (b) provide a list of observed SRN IDs in a Provide Location Information message. In case both the location and the observed SRN IDs are provided, the server SHALL primarily consider the SRN IDs. Note that it is recommended to provide the server information on the target SRN capabilities prior to the SRN assistance data request especially, if SRN assistance data is requested based on target position information.

```
-- ASN1START

OMA-LPPe-SRN-SRNgroupRequest ::= SEQUENCE {
    doNotProvideList    OMA-LPPe-SRN-SRNProvideList             OPTIONAL,
    doProvideList       OMA-LPPe-SRN-SRNProvideList             OPTIONAL,
    ...
}

OMA-LPPe-SRN-SRNProvideList ::= SEQUENCE {
    groupList       SEQUENCE (SIZE (1..256)) OF OMA-LPPe-SRN-SRNgroupUniqueID       OPTIONAL,
    categoryList    SEQUENCE (SIZE (1..16))  OF OMA-LPPe-SRN-Category               OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-SRNgroupRequest field descriptions
doNotProvideList This field specifies the list of SRN group IDs and/or SRN categories for which the target does not wish to receive assistance data. If this field and the *doProvideList* IE are both absent, the request is applicable to all groups available at the target location.
doProvideList This field specifies the list of SRN group IDs and/or SRN categories for which the target requests assistance data. If this field and the *doNotProvideList* IE are both absent, the request is applicable to all groups available at the target location.

– OMA-LPPe-SRN-SRNgroupUpdateRequest

The IE *OMA-LPPe-SRN-SRNgroupUpdateRequest* is used for checking if the target's current SRN group information is valid.

```
-- ASN1START

OMA-LPPe-SRN-SRNgroupUpdateRequest ::= SEQUENCE (SIZE (1..64)) OF
                                                    OMA-LPPe-SRN-SRNgroupUpdateRequestElement

OMA-LPPe-SRN-SRNgroupUpdateRequestElement ::= SEQUENCE {
    srnGroupID              OMA-LPPe-SRN-SRNgroupUniqueID,
    provideIndicationOnly   NULL    OPTIONAL,
    inTheGroup              SEQUENCE (SIZE (1..1024)) OF OMA-LPPe-SRN-SRNid     OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-SRNgroupUpdateRequest field descriptions
srnGroupID This field specifies the SRN group of interest.
provideIndicationOnly This field indicates, if included, that in case the target has out-of-date data, the target only wishes to receive an indication that the current target data is out-of-date, not updated data.
inTheGroup This field specifies a subset of the SRN IDs within the group. The field can be used in the server end to check that the group ID definitions in the target and server match.

– OMA-LPPe-SRN-AntennaPatternRequest

The *OMA-LPPe-SRN-AntennaPatternRequest* is used to request the complex-valued antenna response information.

```
-- ASN1START

OMA-LPPe-SRN-AntennaPatternRequest ::= SEQUENCE (SIZE (1..8)) OF
                                                    OMA-LPPe-SRN-AntennaPatternRequestElement

OMA-LPPe-SRN-AntennaPatternRequestElement ::= SEQUENCE {
    antennaPatternID    SEQUENCE {
                                vendorOrOperator        OMA-LPPe-VendorOrOperatorID,
                                antennaPatternID        INTEGER(0..65535),
                                ...
                            },
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-AntennaPatternRequest field descriptions
antennaPatternID This field specifies the ID of the antenna pattern requested.

6.5.11.5 Short Range Node Location Information – *OMA-LPPe-SRN-ProvideLocationInformation*

The *OMA-LPPe-SRN-ProvideLocationInformation* is used to provide positioning SRN measurements. Measurements can be provided for up to 64 SRNs.

```
-- ASN1START

OMA-LPPe-SRN-ProvideLocationInformation ::= SEQUENCE {
    srnMeasurementList       SEQUENCE (SIZE (1..64)) OF OMA-LPPe-SRN-MeasurementElement  OPTIONAL,
    srnError                 OMA-LPPe-SRN-Error                                          OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-ProvideLocationInformation field descriptions
srnMeasurementList This field provides the SRN measurements at the current time and/or for historic times.
srnError This field provides the SRN measurement error information when not all requested SRN measurements can be reported. This field should be included when some but not all requested measurements are reported and SHALL be included when no requested measurements are reported.

6.5.11.6 Short Range Node Location Information Elements – *OMA-LPPe-SRN-MeasurementElement*

The *OMA-LPPe-SRN-MeasurementElement* is used to provide the server with the SRN measurements made by the target. Target may provide up to 64 sets of data per SRN. The target may decide the number of sets, for example, based on the movement information.

```
-- ASN1START

OMA-LPPe-SRN-MeasurementElement ::= SEQUENCE {
    srnID               OMA-LPPe-SRN-SRNid,
    srnCategory         OMA-LPPe-SRN-Category               OPTIONAL, --Cond IfKnown
    srnGroupID          OMA-LPPe-SRN-SRNgroupUniqueID       OPTIONAL, --Cond IfKnown
    measurementList     SEQUENCE (SIZE (1..64)) OF OMA-LPPe-SRN-srnMeasurementElement   OPTIONAL,
    ...
}

OMA-LPPe-SRN-srnMeasurementElement ::= SEQUENCE {
    relativeTimeStamp   INTEGER(0..1000)        OPTIONAL,   --Cond IfNotFirst
    rssi                INTEGER(-128..127)      OPTIONAL,
    rtd                 OMA-LPPe-WLAN-RTD       OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
IfKnown	The field is mandatory present if the target has the information; otherwise the field is not present.
IfNotFirst	The field is mandatory present if the measurement is not the first of the sequence; otherwise the field is not present.

OMA-LPPe-SRN-MeasurementElement field descriptions

OMA-LPPe-SRN-MeasurementElement field descriptions
srnID This field identfies the SRN.
srnCategory This field specifies the category of the SRN being measured.
srnGroupID This field specifies the group of the SRN being measured.
measurementList This field includes up to 64 measurement sets.
relativeTimeStamp This parameter SHALL be included for historic SRN measurements and provides the time of the historic measurements relative to current time in units of 0.01 seconds. If absent, current time is implied which is equivalent to a relativeTimeStamp of zero.
rssi This field provides the Received Signal Strength Indicator. The interpretation and the scale are SRN-type specific.
rtd This field provides the measured round trip delay between the target and SRN, and optionally the accuracy expressed as the standard deviation of the delay.

6.5.11.7 Short Range Node Location Information Request – *OMA-LPPe-SRN-RequestLocationInformation*

The *OMA-LPPe-SRN-RequestLocationInformation* is used to request SRN measurements.

```
-- ASN1START

OMA-LPPe-SRN-RequestLocationInformation ::= SEQUENCE {
    requestInfo     SEQUENCE (SIZE (1..16)) OF OMA-LPPe-SRN-ReqLocInfo-Category,
    ...
}

OMA-LPPe-SRN-ReqLocInfo-Category ::= SEQUENCE {
    category                OMA-LPPe-SRN-Category,
    multipleMeasurements    ENUMERATED{ forbidden(0),
                                        allowed(1),
                                        requested(2), ... }                 OPTIONAL,
    allowedMeasurements     OMA-LPPe-SRN-MeasurementMask                    OPTIONAL,
    historicMeasurementsRequested   NULL                                    OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-RequestLocationInformation field descriptions
requestInfo This field specifies the requested measurement information, e.g., allowed SRN categories.
category This field specifies the SRN category.
multipleMeasurements This field specifies if the target is forbidded, allowed, or requested to provide multiple measurement sets per SRN.
allowedMeasurements This field specifies the allowed SRN measurements.
historicMeasurementsRequested This field indicates, if the target should return historic SRN measurements.

6.5.11.8 Short Range Node Location Information Request Elements

Void.

6.5.11.9 Short Range Node Capability Information – *OMA-LPPe-SRN-ProvideCapabilities*

The *OMA-LPPe-SRN-ProvideCapabilities* is used by the target to provide its LPPe SRN positioning capabilities to the server. Inclusion of an empty *OMA-LPPe-SRN-ProvideCapabilities* indicates the target does not support SRN positioning for either target assisted or target based mode.

```
-- ASN1START

OMA-LPPe-SRN-ProvideCapabilities ::= SEQUENCE {
    capabilitiesPerSRNCategory      SEQUENCE (SIZE (1..16)) OF
                                                OMA-LPPe-SRN-ProvideCapabilitiesElement OPTIONAL,
    ...
}

OMA-LPPe-SRN-ProvideCapabilitiesElement::= SEQUENCE {
    srnCategory                     OMA-LPPe-SRN-Category,
    supportedMeasurements           OMA-LPPe-SRN-MeasurementMask                        OPTIONAL,
    supportedAssistanceData         BIT STRING {
                                        srnGroup (0),
                                        antennaPattern (1),
                                        ver2-0-propagation                  (2),
                                        ver2-0-rssiHeatMap                  (3),
                                        ver2-0-rttHeatMap                   (4),
                                        ver2-0-jpeg                         (5),
                                        ver2-0-reorientation                (6),
                                        ver2-0-run-lengths                  (7),
                                        ver2-0-update-required-grid-points  (8),
                                        ver2-0-locationAreaData             (9),
                                        ver2-0-transmitterProperties        (10)
 } (SIZE(1..16)),
    historicMeasurementsSupported   NULL    OPTIONAL,
    ...,
-- version 2.0 extension elements
    ver2-0-propModel-Capability     OMA-LPPe-ver2-0-RF-Propagation-Capability       OPTIONAL
}

-- ASN1STOP
```

OMA-LPPe-SRN-ProvideCapabilitiesElement **field descriptions**
capabilitiesPerSRNCategory This field specifies the target capabilities for each supported SRN category.
srnCategory This field specifies the supported SRN category. When capabilities are provided for two SRN categories A and B where B is a subset of A (e.g. A defines SRN technology only and B defines the same SRN technology and a vendor ID), the capabilities for B prevail over those for A in the case of B.
supportedMeasurements This field specifies the SRN measurements the target can provide. The field SHALL be included in case target-assisted mode is supported for the SRN category.

OMA-LPPe-SRN-ProvideCapabilitiesElement field descriptions
supportedAssistanceData This field specifies the SRN assistance data types supported by the target device for target based mode. This is represented by a bit string, with a one value at the bit position means the particular assistance data type is supported; a zero value means not supported. The following bits are assigned for the indicated assistance data. srnGoup: SRN group data antennaPattern: SRN antenna pattern data ver2-0-propagation: propagation estimation for each SRN AP. This bit only applies to LPPe 2.0. ver2-0-rssiHeatMap: RSSI heat map for an SRN AP and default reference grid. This bit only applies to LPPe 2.0. ver2-0-rttHeatMap: RTT heat map for an SRN AP and default reference grid. This bit only applies to LPPe 2.0. ver2-0-jpeg: compression of a heat map using JPEG. This bit only applies to LPPe 2.0. ver2-0-reorientation: reorientation of a heat map as in Appendix G.4.1. This bit only applies to LPPe 2.0. ver2-0-run-lengths: heat maps with arbitrary shape via run lengths as in Appendix G.4.2. This bit only applies to LPPe 2.0. ver2-0-update-required-grid-points: heat maps containing grid points that trigger a target request for new assistance data when a target is near such a grid point. This bit only applies to LPPe 2.0. ver2-0-locationAreaData: location area data for SRN APs. This bit only applies to LPPe 2.0 ver2-0-transmitterProperties: transmitter properties for SRN APs. This bit only applies to LPPe 2.0.
historicMeasurementsSupported This field, if included, indicates support for reporting historic measurements.
ver2-0-propModel-Capability This parameter only applies to LPPe 2.0 and defines the types of RF propagation model supported by the target for SRN APs.

6.5.11.10 Short Range Node Capability Information Elements

Void.

6.5.11.11 Short Range Node Capability Information Request – *OMA-LPPe-SRN-RequestCapabilities*

The IE *OMA-LPPe-SRN-RequestCapabilities* is used to request LPPe SRN capabilities information from the target.

```
-- ASN1START

OMA-LPPe-SRN-RequestCapabilities ::= SEQUENCE {
    capabilitiesRequestedFor    SEQUENCE (SIZE (1..16)) OF OMA-LPPe-SRN-Category        OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-RequestCapabilitiesElement field descriptions
capabilitiesRequestedFor This field specifies the SRN categories for which the target capabilities are requested. If this field is absent, the capabilities for all SRN categories supported by the target are requested.

6.5.11.12 Short Range Node Error Elements

– *OMA-LPPe-SRN-Error*

The IE *OMA-LPPe-SRN-Error* is used by the target or server to provide SRN Error Reasons.

```
-- ASN1START

OMA-LPPe-SRN-Error ::= CHOICE {
    srnLocationServerErrorCauses    OMA-LPPe-SRN-LocationServerErrorCauses,
    srnTargetDeviceErrorCauses      OMA-LPPe-SRN-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-Error field descriptions
srnLocationServerErrorCause This field specifies the server error cause.
srnLocationTargetDeviceErrorCauses This field specifies the target error cause.

– *OMA-LPPe-SRN-LocationServerErrorCauses*

The IE *OMA-LPPe-SRN-LocationServerErrorCauses* is used by the server to provide SRN Error Reasons to the target in the IE *OMA-LPPe-SRN-ProvideAssistanceData.*

```
-- ASN1START

OMA-LPPe-SRN-LocationServerErrorCauses ::= SEQUENCE {
    groupErrors         ENUMERATED{     undefined,
                                        someGroupOrCategoryOrSRNidUnknownOrUnsupported,
                                        allGroupAndCategoryOrSRNidUnknownOrUnsupported,
                                        noSRNgroupsNearby,
                                        ...}                                        OPTIONAL,
    groupUpdateErrors   ENUMERATED {    undefined,
                                        allSRNgroupIDsUnknown,
                                        allSRNgroupIDsknownButSomeSRNgroupVersionsUnknown,
                                        allSRNgroupIDsknownAndAllSRNgroupVersionsUnknown,
                                        someSRNgroupIDsUnknown,
                                        someSRNgroupVersionsUnknownAndAllSRNGroupVersionsUnknown,
                                        someSRNgroupIDsAndSomeSRNgroupVersionsUnknown,
                                        inTheGroupInformationDoesNotMatchWithGroupID,
                                        ...}                                        OPTIONAL,
    srnAntennaErrors    ENUMERATED {    undefined,
                                        someAntennaPatternIDsUnknown,
                                        allAntennaPatternIDsUnknown,
                                        ... }                                       OPTIONAL,
    ...,
-- version 2.0 extension elements
    ver2-0-propagationModelUnavailable      NULL        OPTIONAL,
    ver2-0-rssiHeatMapsUnavailable          NULL        OPTIONAL,
    ver2-0-rttHeatMapsUnavailable           NULL        OPTIONAL
}

-- ASN1STOP
```

OMA-LPPe-SRN- LocationServerErrorCauses field descriptions
groupErrors This field specifies the server error causes related to the SRN group request.
groupUpdateErrors This field specifies the server error causes related to the SRN group update request.
srnAntennaErrors This field specifies the server error causes related to the SRN antenna pattern assistance.
ver2-0-propagationModelUnavailable This field applies to LPPe 2.0 only. When present it indicates that a propagation model for SRNs is not available
ver2-0-rssiHeatMapsUnavailable This field applies to LPPe 2.0 only. When present it indicates that an RSSI Heat Map for SRNs is not available.
ver2-0-rttHeatMapsUnavailable This field applies to LPPe 2.0 only. When present it indicates that an RTT Heat Map for SRNs is not available.

– *OMA-LPPe-SRN-TargetDeviceErrorCauses*

The IE *OMA-LPPe-SRN-TargetDeviceErrorCauses* is used by the target to provide SRN Error Reasons to the server in the IE *OMA-LPPe-SRN-ProvideLocationInformation*.

```
-- ASN1START

OMA-LPPe-SRN-TargetDeviceErrorCauses ::= SEQUENCE {
    srnErrorsPerCategory        SEQUENCE (SIZE (1..16)) OF OMA-LPPe-SRN-TargetDeviceError,
    ...
}

OMA-LPPe-SRN-TargetDeviceError ::= SEQUENCE {
    category        OMA-LPPe-SRN-Category,
    srnErrors       ENUMERATED{ undefined,
                            requestedMeasurementsNotAvailable,
                            notAllrequestedMeasurementsPossible,
                            categoryNotSupported,
                             ...},
    rssiNotAvailable                    NULL    OPTIONAL,
    rtdNotAvailable                     NULL    OPTIONAL,
    multipleSetsNotAvailable            NULL    OPTIONAL,
    historicMeasurementsNotAvailable    NULL    OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-LocationServerErrorCauses field descriptions
srnErrors This field specifies the target error cause. If the *srnErrors* value is '*requestedMeasurementsNotAvailable*', none of the requested measurements could be provided and no further information needs to be included. If the *srnErrors* value is '*notAllrequestedMeasurementsPossible*', the target device was able to provide some but not all requested SRN measurements. In this case, the target device should indicate those measurements that could not be obtained.

6.5.11.13 Short Range Node Common Elements

Specifies SRN common elements.

– *OMA-LPPe-SRN-SRNgroupUniqueID*

The IE *OMA-LPPe-SRN-SRNgroupUniqueID* provides a unique ID for a SRN group.

```
-- ASN1START

OMA-LPPe-SRN-SRNgroupUniqueID ::= SEQUENCE {
    providerID          OMA-LPPe-VendorOrOperatorID,
    providerAssignedID  OCTET STRING,
    srnDataVersion      INTEGER (0..4294967295)         OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-SRNgroupUniqueID field descriptions
providerID This field identifies the vendor or operator or other service provider for the SRN group.
providerAssignedID This field provides a unique ID relative to the particular provider.
srnDataVersion This field identifies the version of the SRN group data. The change in the version indicates the change in the group (removed SRNs, added SRNs, moved SRNs, modified SRNs).

– *OMA-LPPe-SRN-SRNtype*

The IE *OMA-LPPe-SRN-SRNtype* provides information about a particular SRN category and can be considered to be a specific instance of an SRN category.

```
-- ASN1START

OMA-LPPe-SRN-SRNtype ::= SEQUENCE {
    srnCategory             OMA-LPPe-SRN-Category,
    srnERP                  INTEGER(-300..500)                                  OPTIONAL,
    srnAntennaInfo          SEQUENCE {
                                    antennaPatternID        INTEGER(0..65535),
                                    switchingPatternID      INTEGER(0..65535)               OPTIONAL,
                                    ...
                                    }                                           OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-SRNtype field descriptions
srnCategory This field identifies the SRN category.
srnERP This field specifies the effective radiated power. Scale factor 0.1 dB ref 1 mW.
srnAntennaInfo This field provides information about the SRN antenna type.
antennaPatternID This field provides a unique ID relative to the *srnVendorInformation* for the antenna pattern.
switchingPatternID This field provides a unique ID relative to the *srnVendorInformation* for the antenna switching pattern.

– *OMA-LPPe-SRN-Category*

The IE *OMA-LPPe-SRN-Category* identifies a particular SRN technology and where relevant an associated vendor. Vendors associated information can be used to further qualify the SRN technology type (e.g. in the case of "other") or indicate a specific SRN technology type supported in SRNs supplied by a particular vendor.

```
-- ASN1START

OMA-LPPe-SRN-Category ::= SEQUENCE {
    srnTechnologyType       OMA-LPPe-SRN-Technologies,
    srnVendorInformation    SEQUENCE {
                                    vendor          OMA-LPPe-VendorOrOperatorID,
                                    vendorInfo      OCTET STRING            OPTIONAL,
                                    ...
                                    }                                       OPTIONAL,   --Cond other
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
other	The field is mandatory present if *srnTechnologyType* IE is set to value ‘other’. Otherwise it may optionally be present.

OMA-LPPe-OMA-LPPe-SRN-SRNtype **field descriptions**
srnTechnologyType This field identifies the SRN RF technology.
srnVendorInformation This field provides information about an associated SRN vendor.

– *OMA-LPPe-SRN-SRNid*

The IE *OMA-LPPe-SRN-SRNid* provides an identidity for a particular SRN.

```
-- ASN1START

OMA-LPPe-SRN-SRNid ::= SEQUENCE {
    srn-id      CHOICE {
                            mac         BIT STRING(SIZE(48)),
                            nfc         SEQUENCE {
                                                manufacturer            BIT STRING(SIZE(8)),
                                                uniqueNumber            BIT STRING(SIZE(48)),
                                                ...
                                                },
                            mobileCode  SEQUENCE {
                                                registryID              BIT STRING(SIZE(12)),
                                                remainingPart           OCTET STRING(SIZE(1..16)),
                                                resolutionIdentifier    OCTET STRING(SIZE(1..18)),
                                                ...
                                                },
                            other       OCTET STRING,
                            ...
                        },
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-SRNid **field descriptions**
srn-id This field defines the SRN ID for a particular SRN.

OMA-LPPe-SRN-SRNid field descriptions
mac This field defines the MAC address of the SRN for BT and BT LE as per [IEEE 802.15.1]
nfc This field defines the Manufacturer and Unique Number of the SRN for NFC as per [NFC1] and [NFC2].
mobileCode This field defines the Mobile Code Identifier (ICI) of the SRN for OMA Mobile Codes as defined in [OMA-MC].
other This field defines a vendor or operator specific SRN ID. The meaning of this field may be inferred from the SRN group ID (*OMA-LPPe-SRN-SRNgroupUniqueID*) and/or the SRN category (*OMA-LPPe-SRN-Category*).

– *OMA-LPPe-SRN-Technologies*

The IE *OMA-LPPe-SRN-Technologies* defines a particular SRN technology type.

```
-- ASN1START

OMA-LPPe-SRN-Technologies ::= SEQUENCE {
    srnTechnologies     ENUMERATED{ bt, btle, nfc, mobileCode, other, ... },
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-Technologies field descriptions
srnTechnologies This field spefies the particular SRN technology: bt: specifies the SRN technology is Bluetooth [IEEE 802.15.1]; btle: specifies the SRN technology is Bluetooth Low Energy [IEEE 802.15.1]; nfc: specifies the SRN technology is Near Field Communications [NFC1], [NFC2]; mobileCode: specifies the SRN technology is OMA Mobile Codes [OMA-MC]. other: specifies an vendor or operator specific SRN type that can be further defined in *OMA-LPPe-SRN-Category*

– *OMA-LPPe-SRN-MeasurementMask*

The IE *OMA-LPPe-SRN-MeasurementMask* defines SRN measurement types.

```
-- ASN1START

OMA-LPPe-SRN-MeasurementMask ::= SEQUENCE {
    srnMeasurements         BIT STRING {    rssi(0),
                                            rtd (1) } (SIZE(1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-SRN-MeasurementMask field descriptions
srnMeasurements This field specifies a particular SRN measurement type. This is represented by a bit string, with a one value at the bit position means the particular measurement type is addressed (e.g., requested or supported); a zero value means not addressed (e.g., not requested or not supported).

6.5.12 Pedestrian Dead Reckoning Positioning

This section defines support for positioning using assistance data and measurements related to Pedestrian Dead Reckoning Positioning (PDR).

6.5.12.1 PDR Assistance Data

– *OMA-LPPe-ver2-0-PDR -ProvideAssistanceData*

The *OMA-LPPe-ver2-0-PDR-ProvideAssistanceData* is used to provide assistance for PDR-based methods.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-ProvideAssistanceData ::= SEQUENCE {ver2-0-stepLengthEstimationModelAD  SEQUENCE
(SIZE(1.. maxStepLengthEstimationModelSets)) OF OMA-LPPe-ver2-0-PDR-StepLengthEstimationModelList
OPTIONAL,
ver2-0-pdrError OMA-LPPe-ver2-0-PDR-Error   OPTIONAL,
    ...
}

maxStepLengthEstimationModelSets    INTEGER ::= 16

-- ASN1STOP
```

OMA-LPPe-ver2-0-PDR-ProvideAssistanceData field descriptions
ver2-0-stepLengthEstimationModelAD This field is used to provide step length estimation model list to the target. The list can consist of up to 16 model lists.
ver2-0-pdrError This field provides the step length estimation model error information when not all requested step length estimation models can be reported. This field should be included when some but not all requested step length estimation models are reported and SHALL be included when no requested step length estimation models are reported.

6.5.12.2 PDR Assistance Data Elements

– *OMA-LPPe-ver2-0-PDR-StepLengthEstimationModelList*

The *OMA-LPPe-ver2-0-PDR-StepLengthEstimationModelList* is used by the location server to provide parameters to model the step length estimation. The step frequency-user's height model is supported with the fields for the parameters which relate variables to step length. This model is simple and appropriate for the target at which the step frequency information is only available.

The linear sensor combination model, on the other hand, is supported with the fields with the coefficients and nominal value of various sensors which related to step length. Proper use of this model allows the target to provide more accurate step length if the various sensors is supported.

```
-- ASN1START


OMA-LPPe-ver2-0-PDR-StepLengthEstimationModelList ::= CHOICE {

    sfHeightModel       OMA-LPPe-ver2-0-PDR-StepFrequencyHeightModelList,
    linearSensorCombiModel  OMA-LPPe-ver2-0-PDR-LinearSensorCombinationModelList,
    ...
}


-- ASN1STOP
```

– OMA-LPPe-ver2-0-PDR-StepFrequencyHeightModelList

The *OMA-LPPe-ver2-0-PDR-StepFrequencyHeightModelList* consists of each step length estimation model. Each step length estimation model set includes pedestrian state and assoicated step length estimation parameters. For instance, three subsequent models, each with different pedestrian state, would result in totally three different pedestrian applicable step length estimation models. For more detail, see the Appendix C.10

```
-- ASN1START


OMA-LPPe-ver2-0-PDR-StepFrequencyHeightModelList ::= SEQUENCE {
    pedestrianMotionState   OMA-LPPe-Sensor-MotionStateElement,

    modelParams SEQUENCE {
         alpha      INTEGER (-128..127),
         beta       INTEGER (-128..127),
         gamma      INTEGER (-128..127),
        ...
    },
    ...
}


-- ASN1STOP
```

OMA-LPPe-ver2-0-PDR-StepFrequencyHeightModelList **field descriptions**
pedestrianMotionState This field specifies the pedestrian motion state for which the step length estimation models are applicable.
alpha This field specifies the coefficient of step frequency times user's height which linearly relates the change of step frequency to the change of step length·user's height in the given pedestrian state. Scale factor 10^{-2} 1/Hz. Range [-1.28, 1.28) 1/Hz.
beta This field specifies the coefficient of step frequency which linearly relates the change of step frequency to the change of step length in the given pedestrian state. Scale factor 10^{-2} m/Hz. Range [-1.28, 1.28) m/Hz.
gamma This field specifies the coefficient of bias in the given pedestrian state. Scale factor 10^{-2} m. Range [-1.28, 1.28) m.

– OMA-LPPe-ver2-0-PDR-LinearSensorCombinationModelList

The *OMA-LPPe-ver2-0-PDR-LinearSensorCombinationModelList* consists of each step length estimation model. Each step length estimation model set includes pedestrian state and its assoicated step length estimation parameters. For instance, three subsequent models, each with different pedestrian state, would result in totally three different pedestrian applicable step length estimation models. For more detail, see the Appendix C.10.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-LinearSensorCombinationModelList ::= SEQUENCE {
    pedestrianMotionState   OMA-LPPe-Sensor-MotionStateElement,

    modelParams SEQUENCE {
        stepfreqCoeff           INTEGER (0..127),
        stepfreqNominalVal      INTEGER (0..511),
        peakdiffAccelCoeff      INTEGER (0..255)        OPTIONAL,
        peakdiffAccelNominalVal INTEGER (0..255)        OPTIONAL,
        varAccelCoeff           INTEGER (0..255)        OPTIONAL,
```

```
        varAccelNominalVal       INTEGER (0..255)    OPTIONAL,
        peakGyroCoeff            INTEGER (0..4095)       OPTIONAL,
        peakGyroNominalVal       INTEGER (0..511)    OPTIONAL,
        varGyroCoeff             INTEGER (0..1022)       OPTIONAL,
        varGyroNominalVal        INTEGER (0..1022)       OPTIONAL,
        ...
    },
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ver2-0-PDR-LineareSensorCombinationModelList* field descriptions**
pedestrianMotionState This field specifies the pedestrian motion state for which the step length estimation models are applicable.
stepfreqCoeff This field specifies the step frequency coefficient which linearly relates the change of step frequency to the change of step length from the nominal value of step frequency in the given pedestrian state. Scale factor 10^{-2} m/Hz. Range [0, 1.28) m/Hz.
stepfreqNominalVal This field specifies the nominal value of step frequency in the given pedestrian state. Scale factor 10^{-2} Hz. Range [0, 5.12) Hz.
peakdiffAccelCoeff This field specifies the peak difference of 3-axis acceleration norm coefficient which linearly relates the change of peak difference of 3-axis acceleration norm to the change of step length from the nominal value of peak difference of 3-axis acceleration norm in the given pedestrian state. The peak difference of 3-axis acceleration norm means the difference between maximum and minimum 3-axis acceleration norm values during each step. Scale factor 10^{-3} m/(m/s^2). Range [0, 0.256) m/(m/s^2).
peakdiffAccelNominalVal This field specifies the nominal value of peak difference of 3-axis acceleration norm in the given pedestrian state. Scale factor 10^{-1} m/s^2. Range [0, 25.6) m/s^2.
varAccelCoeff This field specifies the variance of 3-axis acceleration norm coefficient which linearly relates the change of the variance of 3-axis acceleration norm to the change of step length from the nominal value of the variance of 3-axis acceleration norm in the given pedestrian state. Scale factor 10^{-3} m/(m/s^2)^2. Range [0, 0.256) m/(m/s^2)^2.
varAccelNominalVal This field specifies the nominal value of the variance of 3-axis acceleration norm in the given pedestrian state. Scale factor 1 (m/s^2)^2. Range [0, 256) (m/s^2)^2.
peakGyroCoeff This field specifies the peak of 3-axis gyro norm coefficient which linearly relates the change of peak of 3-axis gyro norm to the change of step length from the nominal value of peak of 3-axis gyro norm in the given pedestrian state. Scale factor 10^{-3} m/(rad/s). Range [0, 4.096) m/(rad/s).
peakGyroNominalVal This field specifies the nominal value of peak of 3-axis gyro norm in the given pedestrian state. Scale factor 10^{-2} rad/s. Range [0, 5.12) rad/s.
varGyroCoeff This field specifies the variance of 3-axis gyro norm coefficient which linearly relates the change of the variance of 3-axis gyro norm to the change of step length from the nominal value of the variance of 3-axis gyro norm in the given pedestrian state. Scale factor 10^{-1} m/(rad/s)^2. Range [0, 102.3) m/(rad/s)^2.
varGyroNominalVal This field specifies the nominal value of the variance of 3-axis gyro norm in the given pedestrian state. Scale factor 10^{-2} (rad/s)^2. Range [0, 10.23) (rad/s)^2.

6.5.12.3 PDR Assistance Data Request

– *OMA-LPPe-ver2-0-PDR-RequestAssistanceData*

The *OMA-LPPe-ver2-0-PDR-RequestAssistanceData* is used to request assistance for PDR-based methods.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-RequestAssistanceData ::= SEQUENCE {

    ver2-0-stepLengthEstimationModelReq OMA-LPPe-ver2-0-PDR-StepLengthEstimationModelAD     OPTIONAL,
    ...

}

-- ASN1STOP
```

6.5.12.4 PDR Assistance Data Request Elements

– *OMA-LPPe-ver2-0-PDR-StepLengthEstimationModelAD*

The IE *OMA-LPPe-ver2-0-PDR-StepLengthEstimationModelAD* is used by the target to request for the step length estimation model which is available in the target.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-StepLengthEstimationModelAD ::= SEQUENCE {
    genderreq   ENUMERATED {male (0), female (1), ...}      OPTIONAL,
    weightreq   INTEGER (1..256)    OPTIONAL,
    agereq      INTEGER (1..128)    OPTIONAL,
    stepLengthEstModelreq               BIT STRING  {sfHeightModel (0),
                                                     linearSensorCombiModel (1) }   (SIZE  (1..8)),

    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-PDR -StepLengthEstimationModelAD **field descriptions**
genderreq This parameter defines the gender of a UE user. Possible values are male and female.
weightreq This parameter provides the weight of a UE user. The weight is encoded as integers in the range 1 to 256 in units of 1 kilogram.
agereq This parameter provides the age of a UE user. The age is encoded as integers in the range 1 to 128 in units of 1 year.
stepLengthEstModelreq This field specifies, which step length estimation models are being requested for. If bit 0 is set, the step frequency-user's height model, as specified in *OMA-LPPe-ver2-0-PDR-StepFrequencyHeightModelList***,** is requested. If bit 1 is set, the linear sensor combination model, as specified in *OMA-LPPe-ver2-0-PDR-LinearSensorCombinationModelList*, is requested.

6.5.12.5 PDR Location Information

– *OMA-LPPe-ver2-0-PDR-ProvideLocationInformation*

The *OMA-LPPe-ver2-0-PDR-ProvideLocationInformation* is used to provide location information for UE-assisted motion sub-state positioning and UE-assisted PDR.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-ProvideLocationInformation ::= SEQUENCE {
```

```
     ver2-0-pdrMeasurementList  SEQUENCE (SIZE(1..8)) OF
                           OMA-LPPe-ver2-0-PDR-MeasurementList     OPTIONAL,
     ver2-0-pdrMeasurementError OMA-LPPe-ver2-0-PDR-Error   OPTIONAL,

    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-PDR-ProvideLocationInformation **field descriptions**
ver2-0-pdrMeasurementList This field provides the sensor measurements for UE-assisted motion sub-state positioning and UE-assisted PDR at the current time and/or for historic times.
ver2-0-pdrMeasurementError This field provides the sensor measurement error information for UE-assisted motion sub-state positioning and UE-assisted PDR when not all requested sensor measurements can be reported. This field should be included when some but not all requested measurements are reported and SHALL be included when no requested measurements are reported.

6.5.12.6 PDR Location Information Elements

– *OMA-LPPe-ver2-0-PDR-MeasurementList*

The *OMA-LPPe-ver2-0-PDR-MeasurementList* is used to provide the server with the list of sensor measurements for UE-assisted motion sub-state positioning and UE-assisted PDR, made by the target. Target may provide up to 8 sets of each sensor data according to its axis (the combination of 3-axis).

```
-- ASN1START


OMA-LPPe-ver2-0-PDR-MeasurementList ::= SEQUENCE {
    sensorID                OMA-LPPe-ver2-0-PDR-Sensorid        OPTIONAL, --Cond IfKnown
    sensorCategory          OMA-LPPe-ver2-0-PDR-SensorCategory      OPTIONAL, --Cond IfKnown
    sensorMeasurement       SEQUENCE (SIZE (1..64)) OF  OMA-LPPe-ver2-0-PDR-sensorMeasurementElement
    OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-PDR-sensorMeasurementElement ::= SEQUENCE {
    stepFreq    INTEGER(0..63)      OPTIONAL, --Cond IfStep
    accelVal    SEQUENCE  (SIZE(1..8))  OF  OMA-LPPe-ver2-0-PDR-sensorMeasurementValue  OPTIONAL,  --Cond
IfAccel
    gyroVal     SEQUENCE  (SIZE(1..8))  OF  OMA-LPPe-ver2-0-PDR-sensorMeasurementValue  OPTIONAL,  --Cond
IfGyro
    magVal      SEQUENCE  (SIZE(1..8))  OF  OMA-LPPe-ver2-0-PDR-sensorMeasurementValue  OPTIONAL,  --Cond
IfMagneto
    baroVal     SEQUENCE  (SIZE(1..8))  OF  OMA-LPPe-ver2-0-PDR-sensorMeasurementValue  OPTIONAL,  --Cond
IfBaro
    inclVal     SEQUENCE  (SIZE(1..8))  OF  OMA-LPPe-ver2-0-PDR-sensorMeasurementValue  OPTIONAL,  --Cond
IfInclino
    proxVal     BOOLEAN     OPTIONAL, --Cond IfProx
    ...
}

OMA-LPPe-ver2-0-PDR-sensorMeasurementValue ::= SEQUENCE {
    relativeTimeStamp   INTEGER(0..1000)        OPTIONAL,
    usedAxis    BIT STRING {    x   (0),
                                y   (1),
                                z   (2),
                                xy  (3),
                                yz  (4),
                                zx  (5),
                                xyz (6) }   (SIZE(1..8 ))           OPTIONAL,
    maxValue    INTEGER(0..4095)    OPTIONAL,
    minValue    INTEGER(0..4095)    OPTIONAL,
    meanValue   INTEGER(0..4095)    OPTIONAL,
    stdValue    INTEGER(0..4095)    OPTIONAL,
```

```
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
IfKnown	The field is mandatory present if the target has the information; otherwise the field is not present.
IfStep	The field is mandatory present if the sensorTechnologies in *OMA-LPPe-ver2-0-PDR-SensorCategory* is accel or step and has the information on the step frequency; otherwise the field is not present.
IfAccel	The field is mandatory present if the sensorTechnologies in *OMA-LPPe-ver2-0-PDR-SensorCategory* is accel and has the information on accelerometer; otherwise the field is not present.
IfGyro	The field is mandatory present if the sensorTechnologies in *OMA-LPPe-ver2-0-PDR-SensorCategory* is gyro and has the information on gyroscope; otherwise the field is not present.
IfMagneto	The field is mandatory present if the sensorTechnologies in *OMA-LPPe-ver2-0-PDR-SensorCategory* is magneto and has the information on magnetometer; otherwise the field is not present.
IfBaro	The field is mandatory present if the sensorTechnologies in *OMA-LPPe-ver2-0-PDR-SensorCategory* is baro and has the information on barometer; otherwise the field is not present.
IfInclino	The field is mandatory present if the sensorTechnologies in *OMA-LPPe-ver2-0-PDR-SensorCategory* is inclino and has the information on inclinometer; otherwise the field is not present.
IfProx	The field is mandatory present if the sensorTechnologies in *OMA-LPPe-ver2-0-PDR-SensorCategory* is prox and has the information on proximity sensor; otherwise the field is not present.

OMA-LPPe-ver2-0-PDR-MeasurementList **field descriptions**
sensorID This field identfies the sensor.
sensorCategory This field specifies the category of the sensor being measured.
sensorMeasurement This field includes up to 64 sensor measurement sets.
stepFreq This field includes the step frequency of the target device's user. The value indicates the step frequency from multi-axis accelerometer and/or step sensor each sampling time between last successive steps at the current time. Scale factor:10^{-1} Hz. Range: [0, 6.4) Hz.
accelVal This field includes up to 8 measurement sets of multiple-axis accelerometer. Multiple-axis means one axis or any combination of up to 3-axis. The value indicates the norm of specific force from multiple-axis accelerometer each sampling time between last successive pedestrian steps at the current time. The statistic field of value sets is defined in the sensor measurement value (OMA-LPPe-ver2-0-PDR-sensorMeasurementValue). Scale factor and range of each field are described as follows. maxValue : the maximum of all accelerometer values [Scale factor: 5×10^{-2}. Bias: 0.Range: [-102.4, 102.4) (unit: m/s^2)] minValue : the minimum of all accelerometer values [Scale factor: 5×10^{-2}. Bias: 0. Range: [-102.4, 102.4) (unit: m/s^2)] meanValue : the mean of all accelerometer values [Scale factor: 5×10^{-2}. Bias: 0. Range: [-102.4, 102.4) (unit: m/s^2)] stdValue : the standard deviation of all accelerometer values [Scale factor: 2.5×10^{-2}. Bias: 0. Range: [0, 102.4) (unit: m/s^2)]

OMA-LPPe-ver2-0-PDR-MeasurementList **field descriptions**
gyroVal This field includes up to 8 measurement sets of multiple-axis gyroscope. Multiple-axis means one axis or any combination of up to 3-axis. The value indicates the norm of angular rate from multiple-axis gyroscope each sampling time between last successive pedestrian steps at the current time. A positive value of particular axis indicates that the device rotates in the counter-clockwise direction of the axis. The statistic field of value sets is defined in the sensor measurement value (OMA-LPPe-ver2-0-PDR-sensorMeasurementValue). Scale factor and range of each field are described as follows. maxValue : the maximum of all gyroscope values [Scale factor: $2.5\text{x}10^{-3}$.Bias:-5.12.Range: [-5.12, 5.12) (unit: rad/s)] minValue : the minimum of all gyroscope values [Scale factor: $2.5\text{x}10^{-3}$.Bias:-5.12. Range: [-5.12,5.12) (unit: rad/s)] meanValue : the mean of all gyroscope values [Scale factor: $2.5\text{x}10^{-3}$.Bias:-5.12. Range: [-5.12, 5.12) (unit: rad/s)] stdValue : the standard deviation of all gyroscope values [Scale factor: $1.25\text{x}10^{-3}$. Bias: 0. Range: [0, 5.12) (unit: rad/s)]
magVal This field includes up to 8 measurement sets of multiple-axis magnetometer. Multiple-axis means one axis or any combination of up to 3-axis. The value indicates the norm of magnetic field from multiple-axis magnetometer each sampling time between last successive pedestrian steps at the current time. A positive value of particular axis indicates that the device rotates in the counter-clockwiare direction of the axis. The statistic field of value sets is defined in the sensor measurement value (OMA-LPPe-ver2-0-PDR-sensorMeasurementValue). Scale factor and range of each field are described as follows. maxValue : the maximum of all magnetometer values [Scale factor:$5\text{x}10^{-2}$.Bias:-102.4. Range: [-102.4,102.4) (unit: µT)] minValue : the minimum of all magnetometer values [Scale factor:$5\text{x}10^{-2}$.Bias:-102.4.Range: [-102.4, 102.4) (unit: µT)] meanValue : the mean of all magnetometer values [Scale factor:$5\text{x}10^{-2}$, Bias:-102.4. Range: [-102.4, 102.4) (unit: µT)] stdValue : the standard deviation of all magnetometer values [Scale factor: $2.5\text{x}10^{-2}$. Bias: 0. Range: [0, 102.4) (unit: µT)] Informational Note: Magnetometer senses the Earth's magnetic field intensity and it can be used to estimate the orientation (roll, pitch and heading) of the target. If the magnetometer is aligned with the local horizontal plane (roll and pitch are zeros), the heading would be calculated as follows. heading = arctan (magY/magX) where magX and magY represent the horizontal magnetic field component of the Earth
baroVal This field includes up to 8 measurement sets of multiple-axis barometer. Multiple-axis means one axis or any combination of up to 3-axis. The value indicates the target's atmospheric pressure from multiple-axis barometer each sampling time between last successive pedestrian steps at the current time. The statistic field of value sets is defined in the sensor measurement value (OMA-LPPe-ver2-0-PDR-sensorMeasurementValue). Scale factor and range of each field are described as follows. maxValue : the maximum of all barometer values [Scale factor: $1.25\text{x}10^{-1}$. Bias: 588. Range: [588, 1100) (unit: hPa)] minValue : the minimum of all barometer values [Scale factor : $1.25\text{x}10^{-1}$. Bias: 588. Range : [588, 1100) (unit: hPa)] meanValue : the mean of all barometer values [Scale factor : $1.25\text{x}10^{-1}$. Bias: 588. Range : [588, 1100) (unit: hPa)] stdValue : the standard deviation of all barometer values [Scale factor:$6.25\text{x}10^{-2}$. Bias:0. Range:[0,256) (unit: hPa)] Informational Note: Standard atmospheric pressure at sea level is 1013.25 hPa. The highest atmospheric pressure recorded was 1084 hPa in Siberia. The lowest atmospheric pressure, 870 hPa, was recorded in a typhoon in the Pacific Ocean. Also the atmospheric pressure range from 588 hPa to 1100 hPa approximately covers altitude range from 0 to 4000m above mean sea level.

OMA-LPPe-ver2-0-PDR-MeasurementList field descriptions
inclVal This field includes up to 8 measurement sets of multiple-axis inclinometer. Multiple-axis means one axis or any combination of up to 3-axis. The value indicates the pedestrian's inclination angle from multiple-axis inclinometer each sampling time between last successive pedestrian steps at the current time. A positive value of particular axis indicates that the device goes up the incline toward its positive direction of the axis. The statistic field of value sets is defined in the sensor measurement value (OMA-LPPe-ver2-0-PDR-sensorMeasurementValue). Scale factor and range of each field are described as follows. maxValue : the maximum of all inclinometer values [Scale factor: $2.5x10^{-3}$. Bias: 0.Range: [-5.12, 5.12) (unit: rad)] minValue : the minimum of all inclinometer values [Scale factor : $2.5x10^{-3}$. Bias: 0.Range : [-5.12, 5.12) (unit: rad)] meanValue : the mean of all inclinometer values [Scale factor : $2.5x10^{-3}$. Bias: 0.Range : [-5.12, 5.12) (unit: rad)] stdValue : the standard deviation of all inclinometer values [Scale factor: $1.25x10^{-3}$. Bias: 0. Range:[0, 5.12) (unit: rad)]
proxVal This field is set to true if the proximity sensor detects the presence of a nearby target without any physical contact. If false, the presence of target is not detected. Informational Note: the proximity sensor measures the proximity of an object in cm relative to the view screen of a device. This sensor is typically used to determine whether a device is being held up to a user's ear.
relativeTimeStamp This parameter SHALL be included for historic sensor measurements and provides the time of the historic measurements relative to current time in units of 0.01 seconds. If absent, current time is implied which is equivalent to a relativeTimeStamp of zero.
usedAxis This field specifies one used axes from which sensor measurements are measured. A used axis is present if the associated bit is set to one and absent if set to zero.
maxValue This field specifies the maximum value of sensor measurements. The scale factor, bias and range of values depend on the sensor type.
minValue This field specifies the minimum value of sensor measurements. The scale factor, bias and range of values depend on the sensor type.
meanValue This field specifies the mean of sensor measurements. The scale factor, bias and range of values depend on the sensor type.
stdValue This field specifies the standard deviation of sensor measurements. The scale factor, bias and range of values depend on the sensor type.

6.5.12.7 PDR Location Information Request

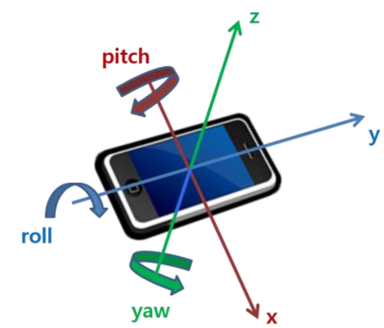
– *OMA-LPPe-ver2-0-PDR-RequestLocationInformation*

The *OMA-LPPe-ver2-0-PDR-RequestLocationInformation* is used to request location information for UE-assisted motion sub-state positioning and UE-assisted PDR.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-RequestLocationInformation ::= SEQUENCE {

    sensorMeasurementReq    SEQUENCE  (SIZE  (1..16))  OF  OMA-LPPe-ver2-0-PDR-SensorMeasurementRequest
    OPTIONAL,   --Cond SensorMeasurementReq
    ...
}

OMA-LPPe-ver2-0-PDR-SensorMeasurementRequest ::= SEQUENCE {
    category                OMA-LPPe-ver2-0-PDR-SensorCategory,
```

```
    requestedUsedAxis        BIT STRING {    x        (0),
                                             y        (1),
                                             z        (2),
                                             xy       (3),
                                             yz       (4),
                                             zx       (5),
                                             xyz      (6)
} (SIZE(1..8)),

    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
SensorMeasurementReq	The field is mandatory present if the server requests for sensor measurements; otherwise it is not present

***OMA-LPPe-ver2-0-PDR-RequestLocationInformation* field descriptions**
sensorMeasurementReq This field specifies the requested sensor measurement information.
category This field specifies the sensor category.
requestedUsedAxis This field specifies a list of one or more used axes requested. A used axis is present if the associated bit is set to one and absent if set to zero. The following figure shows the positive direction of x, y and z axis. The positive roll is defined when a UE starts by lying flat on a table and the positive z axis begins to tilt towards the positive x axis. The positive pitch is defined when a UE starts by lying flat on a table and the positive z axis begins to tilt towards the positive y axis. The positive yaw is defined by the angle from the magnetic north to the positive y axis. 

6.5.12.8 PDR Capability Information

– *OMA-LPPe-ver2-0-PDR-ProvideCapabilities*

The *OMA-LPPe-ver2-0-PDR-ProvideCapabilities* is used to provide capabilities for PDR-based methods.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-ProvideCapabilities ::= SEQUENCE {
    stepLengthEsimtationModelSupport    NULL    OPTIONAL, --Cond StepLengthEstimationModelSupport,
    accelMeasSupport                    NULL    OPTIONAL, --Cond AccelMeasSupport
    gyroMeasSupport                     NULL    OPTIONAL, --Cond GyroMeasSupport
    magnetoMeasSupport                  NULL    OPTIONAL, --Cond MagnetoMeasSupport
    baroMeasSupport                     NULL    OPTIONAL, --Cond BaroMeasSupport
    stepMeasSupport                     NULL    OPTIONAL, --Cond StepMeasSupport
    inclinoMeasSupport                  NULL    OPTIONAL, --Cond InclinoMeasSupport
    proxMeasSupport                     NULL    OPTIONAL, --Cond ProxMeasSupport
```

```
    ...}

-- ASN1STOP
```

Conditional presence	Explanation
StepLengthEstimationModelSupport	The field is mandatory present if the target supports step length estimation model assistance data; otherwise it is not present.
AccelMeasSupport	The field is mandatory present if the target supports accelerometer measurements; otherwise it is not present.
GyroMeasSupport	The field is mandatory present if the target supports gyroscope measurements; otherwise it is not present.
MagnetoMeasSupport	The field is mandatory present if the target supports magnetometer measurements; otherwise it is not present.
BaroMeasSupport	The field is mandatory present if the target supports barometer measurements; otherwise it is not present.
StepMeasSupport	The field is mandatory present if the target supports step sensor measurements; otherwise it is not present.
InclinoMeasSupport	The field is mandatory present if the target supports inclinometer measurements; otherwise it is not present.
ProxMeasSupport	The field is mandatory present if the target supports proximity sensor measurements; otherwise it is not present.

6.5.12.9 PDR Capability Information Elements

Void.

6.5.12.10 PDR Capability Information Request

– *OMA-LPPe-ver2-0-PDR-RequestCapabilities*

The *OMA-LPPe-ver2-0-PDR-RequestCapabilities* is used to provide capabilities for PDR-based methods.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.12.11 PDR Error Elements

– *OMA-LPPe-ver2-0-PDR-Error*

The *OMA-LPPe-ver2-0-PDR-Error* is used to provide PDR Error Reasons to the server.

```
-- ASN1START


OMA-LPPe-ver2-0-PDR-Error ::= CHOICE {
    locationServerError OMA-LPPe-ver2-0-PDR-LocationServerError,
    targetError         OMA-LPPe-ver2-0-PDR-TargetError,
    ...
}

OMA-LPPe-ver2-0-PDR-LocationServerError ::= SEQUENCE {
    stepLengthModelErrors   ENUMERATED {undefined,
                                        someStepLengthModelUnknown,
                                        allStepLengthModelUnknown,
                                        ... }       OPTIONAL,
    ...
```

```
}

OMA-LPPe-ver2-0-PDR-TargetError ::= SEQUENCE {
    ver2-0-sensorErrorsPerCategory      SEQUENCE (SIZE (1..16))
                                OF      OMA-LPPe-ver2-0-PDR-TargetDeviceError   OPTIONAL,
    ...
}


OMA-LPPe-ver2-0-PDR-TargetDeviceError ::= SEQUENCE {
    category        OMA-LPPe-ver2-0-PDR-SensorCategory,
    sensorErrors        ENUMERATED{ undefined,
                                requestedMeasurementsNotAvailable,
                                notAllrequestedMeasurementsPossible,
                                categoryNotSupported,
                                ...},
    historicMeasurementsNotAvailable    NULL    OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-PDR-Error field descriptions
stepLengthModelErrors This field specifies the server error causes related to the step length estimation model assistance.
ver2-0-sensorErrorsPerCategory This field is used to provide error information on the sensor measurement per sensor category to the server.
sensorErrors This field specifies the target's sensor error cause. If the *sensorErrors* value is '*requestedMeasurementsNotAvailable*', none of the requested measurements could be provided and no further information needs to be included. If the *sensorErrors* value is '*notAllrequestedMeasurementsPossible*', the target device was able to provide some but not all requested sensor measurements. In this case, the target device should indicate those measurements that could not be obtained.

6.5.12.12 Common PDR Information Elements

– *OMA-LPPe-ver2-0-PDR-SensorCategory*

The IE *OMA-LPPe-ver2-0-PDR-SensorCategory* identifies a particular Sensor technology and where relevant an associated vendor. Vendors associated information can be used to further qualify the Sensor technology type (e.g. in the case of "other") or indicate a specific Sensor technology type supported in Sensors supplied by a particular vendor.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-SensorCategory ::= SEQUENCE {
    sensorTechnologyType        OMA-LPPe-ver2-0-PDR-SensorTechnologies,
    sensorVendorInformation     SEQUENCE {
                                    vendor          OMA-LPPe-VendorOrOperatorID,
                                    vendorInfo      OCTET STRING            OPTIONAL,
                                    ...
                                    }                                       OPTIONAL,   --Cond other
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
other	The field is mandatory present if *sensorTechnologyType* IE is set to value 'other'. Otherwise it may optionally be present.

OMA-LPPe-ver2-0-PDR-Category field descriptions

OMA-LPPe-ver2-0-PDR-Category **field descriptions**
sensorTechnologyType This field identifies the Sensor technology.
sensorVendorInformation This field provides information about an associated Sensor vendor.

– *OMA-LPPe-ver2-0-PDR-Sensorid*

The IE *OMA-LPPe-ver2-0-PDR-Sensorid* provides an identity for a particular Sensor.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-Sensorid ::= SEQUENCE {
    sensor-id       CHOICE {
                            accelerometer       OCTET STRING,
                            gyroscope           OCTET STRING,
                            magnetometer        OCTET STRING,
                            barometer           OCTET STRING,
                            stepsensor          OCTET STRING,
                            inclinometer        OCTET STRING,
                            proximity           OCTET STRING,
                            other               OCTET STRING,
                            ...
                        },
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-PDR-Sensorid **field descriptions**
sensor-id This field defines the Sensor ID for a particular Sensor.
accelerometer This field defines a vendor or operator specific accelerometer ID. The meaning of this field may be inferred from the Sensor category (*OMA-LPPe-ver2-0-PDR-SensorCategory*).
gyroscope This field defines a vendor or operator specific gyroscope ID. The meaning of this field may be inferred from the Sensor category (*OMA-LPPe-ver2-0-PDR-SensorCategory*).
magnetometer This field defines a vendor or operator specific magnetometer ID. The meaning of this field may be inferred from the Sensor category (*OMA-LPPe-ver2-0-PDR-SensorCategory*).
barometer This field defines a vendor or operator specific barometer ID. The meaning of this field may be inferred from the Sensor category (*OMA-LPPe-ver2-0-PDR-SensorCategory*).
stepsensor This field defines a vendor or operator specific step sensor ID. The meaning of this field may be inferred from the Sensor category (*OMA-LPPe-ver2-0-PDR-SensorCategory*).
inclinometer This field defines a vendor or operator specific inclinometer ID. The meaning of this field may be inferred from the Sensor category (*OMA-LPPe-ver2-0-PDR-SensorCategory*).
proximity This field defines a vendor or operator specific proximity sensor ID. The meaning of this field may be inferred from the Sensor category (*OMA-LPPe-ver2-0-PDR-SensorCategory*).
other This field defines a vendor or operator specific other Sensor ID. The meaning of this field may be inferred from the Sensor category (*OMA-LPPe-ver2-0-PDR-SensorCategory*).

– *OMA-LPPe-ver2-0-PDR-SensorTechnologies*

The IE *OMA-LPPe-ver2-0-PDR-SensorTechnologies* defines a particular Sensor technology type.

```
-- ASN1START

OMA-LPPe-ver2-0-PDR-SensorTechnologies ::= SEQUENCE {
    sensorTechnologies  ENUMERATED{ accel, gyro, magneto, baro, step, inclino, prox, other, ... },
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-PDR-SensorTechnologies **field descriptions**
sensorTechnologies This field specifies the particular Sensor technology: accel: specifies the Sensor technology is accelerometer; gyro: specifies the Sensor technology is gyroscope; magneto: specifies the Sensor technology is magnetometer; baro: specifies the Sensor technology is barometer; step: specifies the Sensor technology is step sensor; inclino: specifies the Sensor technology is inclinometer; prox: specifies the Sensor technology is proximity; other: specifies an vendor or operator specific Sensor type that can be further defined in OMA-LPPe-ver2-0-PDR-SensorCategory

6.5.13 Image Recognition Based Positioning (Version 2.0)

This section defines the functional messaging format for positioning using measurements related to Image Recognition Based Positioning (IRB).

6.5.13.1 IRB Assistance Data

– *OMA-LPPe-ver2-0-IRB-ProvideAssistanceData*

The *OMA-LPPe-ver2-0-IRB-ProvideAssistanceData* is used to provide assistance for IRB-based methods.

```
-- ASN1START

OMA-LPPe-ver2-0-IRB-ProvideAssistanceData ::= SEQUENCE {
    ...
}
```

6.5.13.2 IRB Assistance Data Request

– *OMA-LPPe-ver2-0-IRB-RequestAssistanceData*

The *OMA-LPPe-ver2-0-IRB-RequestAssistanceData* is used to request assistance data for IRB UE-assisted method.

```
-- ASN1START

OMA-LPPe-ver2-0-IRB-RequestAssistanceData ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.13.3 IRB Location Information

– *OMA-LPPe-ver2-0-IRB-ProvideLocationInformation*

The *OMA-LPPe-ver2-0-IRB-ProvideLocationInformation* is used to provide IRB measurements (UE-assisted) at current and historic times. Assuming that the target device supports IRB measurement reporting, the target device uses LPPe to report IRB measurements to the server. As an option, the target can transmit the whole picture compressed according to jpeg standard, video mode compression and/or differential picture encoding schemas are FFS.

Note: IRB measurements can be a sequence of image key points that the target sends to the server. Images are taken in a photo mode, or video-shooting mode. Key points are tracked frame by frame, and image features from stable key points tracked in several frames are selected and sent to the server.

```
-- ASN1START

OMA-LPPe-ver2-0-IRB-ProvideLocationInformation ::= SEQUENCE {
    irb-MeasurementList      SEQUENCE (SIZE (1..300))
                             OF OMA-LPPe-ver2-0-IRB-MeasurementElement   OPTIONAL,
    irb-JpFile               OCTET STRING (SIZE (1..2000000)),
    irb-Error                OMA-LPPe-ver2-0-IRB-Error                   OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-IRB-ProvideLocationInformation field descriptions
irb-MeasurementList This field provides the IRB measurements at the current time and/or for historic times.
Irb-JpFile This field provides the image to be processed in the server for IRB positioning, compressed according to the jpeg file format [JPEG]
irb-Error This field provides the IRB measurement error information when not all requested IRB measurements can be reported. This field should be included when some but not all requested measurements are reported and SHALL be included when no requested measurements are reported.

6.5.13.4 IRB Location Information Elements

– *OMA-LPPe-ver2-0-IRB-MeasurementElement*

The *OMA-LPPe-ver2-0-IRB-MeasurementElement* is used to provide the server with the IRB measurements made by the target. The target may decide the number of sets, for example, based on the movement information or camera resolution.

```
-- ASN1START

OMA-LPPe-ver2-0-IRB-MeasurementElement ::= SEQUENCE {
    irbID                INTEGER(0...65535),
    xCoordinate          INTEGER(0..4095),
    yCoordinate          INTEGER(0..4095),
    irbTechnology        OMA-LPPe-ver2-0-IRB-TransferTechnology,
    relativeTimeStamp    INTEGER(0..1000)            OPTIONAL,
    vectorIndicator      BOOLEAN,
    irbFeatureVector     BIT STRING (SIZE (512))     OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-IRB-MeasurementElement **field descriptions**
irbID This field identifies the IRB Feature Point.
xCoordinate This field specifies x coordinate of the feature point in the image (this coordinate is relative to top-left origin and is in pixels).
yCoordinate This field specifies y coordinate of the feature point in the image (this coordinate is relative to top-left origin and is in pixels).
irbTechnology This field specifies the IRB technology being used for measurements.
relativeTimeStamp This parameter SHALL be included for historic IRB measurements and provides the time of the historic measurements relative to current time in units of 0.01 seconds. If absent, current time is implied which is equivalent to a relativeTimeStamp of zero.
vectorIndicator This field is set to true if a feature vector is present in this measurement. If false, there is no feature vector associated with this feature point.
irbFeatureVector This field provides a feature vector (Data Measurements) of 512-bit (64 Byte data consisting of 512 binary elements for BRIEF or ORB).

6.5.13.5 IRB Location Information Request

– *OMA-LPPe-ver2-0-IRB-RequestLocationInformation*

The *OMA-LPPe-ver2-0-IRB-RequestLocationInformation* is used to request location information for IRB UE-assisted method.

```
-- ASN1START

OMA-LPPe-ver2-0-IRB-RequestLocationInformation ::= CHOICE {
    featuresExtractionApproach      OMA-LPPe-ver2-0-IRB-FeaturesExtractionParameter,
    imageCompressionApproach        OMA-LPPe-ver2-0-IRB-CompressingParameter,
    ...
}

OMA-LPPe-ver2-0-IRB-FeaturesExtractionParameter ::= SEQUENCE {
    featuresType                    ENUMERATED {orb, brief, mpeg7_cdvs, ...},
    mode                            ENUMERATED {complete, difference, common, ...},
    ...
}


OMA-LPPe-ver2-0-IRB-CompressingParameter ::= SEQUENCE {
    compressionStd                  ENUMERATED {jpeg, jpeg2000, ...},
    dimPixelX                       INTEGER(1..3000),
    dimPixelY                       INTEGER(1..3000),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-IRB-RequestLocationInformation field descriptions
featuresExtractionApproach This field is present when the features extraction on the target approach is selected: the features technology and the mode (photo or video) are specified ***featuresType*** defines the technology used for features extraction. The following algorithms are defined: • ***ORB***, • ***BRIEF***, • ***MPEG7-CDVS*** ***mode*** specifies if image features are transmitted as a set, difference of features or common features of sequenced images • if mode is set to 'complete' for an image, the whole set of features of that image is transmitted to the server, • if mode is set to 'difference, for an image, image n, only features (descriptors and coordinates) not present in an earlier image, image n-1, are transmitted, • if mode is set to 'common', for common features in images n and n-1 only coordinates of common features are transmitted
imageCompressionApproach This field is present when the server requests from the target the whole image compressed according to JPEG or JPEG2000 standard ***compressionStd*** specifies if the image has to be compressed with JPEG or JPEG2000 standard, • JPEG • JPEG2000 ***dimPixelX*** this field represents the reference number of pixels in the horizontal axis ***dimPixelY*** this field represents the reference number of pixel in the vertical axis The reference dimension of the image provide information to the target how to compress the image, as the resolution of the reference DB image and the query image MUST be the same for optimal in image processing. The application will be aware of bandwidth availability and requested resolution and will set compressing parameter for the required approach (JPEG or JPEG2000).

6.5.13.6 IRB Capability

– *OMA-LPPe-ver2-0-IRB-ProvideCapabilities*

The *OMA-LPPe-ver2-0-IRB-ProvideCapabilities* is used to provide capabilities for IRB-based methods.

```
-- ASN1START

OMA-LPPe-ver2-0-IRB-ProvideCapabilities ::= SEQUENCE {
    irb-transferMode        OMA-LPPe-ver2-0-IRB-TransferTechnology,
    irb-featureExtractionMode               OMA-LPPe-ver2-0-IRB-CameraModes OPTIONAL,
    irb-cameraParameters                    OMA-LPPe-ver2-0-IRB-CameraParameters OPTIONAL,
    irb-minFeaturePerFrame      INTEGER (1..300)        OPTIONAL,
    irb-maxFeaturePerFrame      INTEGER (1..300)        OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-IRB-TransferTechnology ::= SEQUENCE {
            features-mode                   BIT STRING {
                                                brief       (0),
                                                orb         (1),
                                                mpeg-7      (2) } (SIZE (1..8)) OPTIONAL,
                compressing-mode                BIT STRING {
                                                jpeg        (0),
                                                jpeg2000    (1) } (SIZE (1..8)) OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-IRB-CameraModes ::= SEQUENCE {
```

```
            mode                    BIT STRING {
                                                photo-mode      (0),
                                                video-mode      (1)   } (SIZE (1..8)),
    ...
}

OMA-LPPe-ver2-0-IRB-CameraParameters    ::= SEQUENCE {
            sensor-param    SEQUENCE {
                                nPixelX             INTEGER(1..10000),
                                nPixelY             INTEGER(1..10000),
                                pixelSizeX          INTEGER(1..2000),
                                pixelSizeY          INTEGER(1..2000),
    ...
}       OPTIONAL,
            principal-distance          INTEGER(1..10000) OPTIONAL,
            principal-point-coordinates     SEQUENCE {
                                xCoordinate         INTEGER(0..10000),
                                yCoordinate         INTEGER(0..10000),

    ...
}       OPTIONAL,

            perspective-distortion  ENUMERATED  {
                                                wide-angle-distortion,
                                                narrow-angle-distortion},
            distortion-parameters   OMA-LPPe-ver2-0-IRB-Camera-Distortion-Parameters OPTIONAL,
    ...
}


OMA-LPPe-ver2-0-IRB-Camera-Distortion-Parameters    ::= SEQUENCE {
    ...
}


-- ASN1STOP
```

OMA-LPPe-ver2-0-IRB-ProvideCapabilities field descriptions
irb-transferMode This field specifies the image processing technology supported to transfer information from the target to the server. ***features-mode:*** for feature extraction, Orb, Brief, MPEG7 CDVS technologies can be used. ***compressing-mode :*** for whole image compression JPEG [JPEG] and JPEG2000 [JP2000] can be supported by the target.
irb-featureExtractionMode This parameter indicates which feature extraction mode the target supports. The bit map indicates the supported mode (photo, or video). ‘1’ value at the bit position indicates support and a ‘0’ value no support. This field is present only if ***irb-transferMode*** field is present.

irb-cameraParameters This parameter is needed to use a correct scale to correct object size on an image. The size depends on the characteristics of the lens used. Object sizes on a screen become small for wide-angle lenses and large for narrow-angle lenses. The size of objects is normalized by using the scale parameter so that the size becomes the same when the distance between cameras and objects are the same. • ***sensor-parameters*** – ***nPixelX, nPixelY*** represent the number of pixels of the sensor for each dimension respectively; – ***pixelSizeX, pixelSizeY***, represent the dimension of each pixel of the sensor expressed in hundredth of micron • ***principal-distance*** represents the distance between the centre of view and the sensor plane. It is expressed in micron • ***principal-point-coordinates*** – ***xCoordinate, yCoordinate*** represent the position of the Principal Point, that is the projection of the centre of view on the sensor plane, in the sensor coordinates system (coordinates are relative to top-left origin of the sensor). The coordinates are expressed in pixels with a resolution of a tenth of pixel. • ***perspective-distortion*** (PD): is determined by the relative distances at which the image is captured and viewed, and is due to the angle of view of the image (as captured) being either wider or narrower than the angle of view at which the image is viewed, hence the apparent relative distances differing from what is expected. The choices are wide-angle-distortion (with an angle of view wider than a normal lens) and narrow-angle-distortion (with an angle of view narrower than a normal lens). • ***distortion-parameters*** (DP): it is a parameter that represents the image distortion.
irb-minFeaturePerFrame This field represents the minimum number of feature points in a frame.
irb-maxFeaturePerFrame This field represents the maximum number of feature points in a frame.

6.5.13.7 IRB Capability Request

– *OMA-LPPe-ver2-0-IRB-RequestCapabilities*

The *OMA-LPPe-ver2-0-IRB-RequestCapabilities* is used to request capabilities for IRB-based methods.

```
-- ASN1START

OMA-LPPe-ver2-0-IRB-RequestCapabilities ::= SEQUENCE {
    featureSupportedReq             NULL    OPTIONAL,
    featureExtractionModeReq        NULL    OPTIONAL,
    cameraParametersReq             NULL    OPTIONAL,
    minMaxFeaturePerFrameReq        NULL    OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-IRB-RequestCapabilities **field descriptions**
featureSupportedReq This field is used to request the image processing approach available on the terminal, features extraction.
featureExtractionModeReq This field is used to request the supported mode.
cameraParametersReq This field is used to request camera parameters.
minMaxFeaturePerFrameReq This field is used to request the minimum-maximum number of frame feature.

6.5.13.8 IRB Error Elements

– *OMA-LPPe-ver2-0-IRB-Error*

The *OMA-LPPe-IRB-Error* is used to provide IRB Error causes to the server.

```
-- ASN1START


OMA-LPPe-ver2-0-IRB-Error ::= CHOICE {
    locationServerErrorCauses       OMA-LPPe-ver2-0-IRB-LocationServerErrorCauses,
    targetDeviceErrorCauses         OMA-LPPe-ver2-0-IRB-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-ver2-0-IRB-LocationServerErrorCauses*

The IE *OMA-LPPe-IRB-LocationServerErrorCauses* is used by the location server to provide IRB Positioning error reasons to the target device.

```
-- ASN1START

OMA-LPPe-ver2-0-IRB-LocationServerErrorCauses ::= SEQUENCE {
    cause       ENUMERATED  {undefined, queryImageWithInadequateNumberOfFeatures, refImageNotFound,
refDbImageWithLowLevelOfSimilarity, three-DSpatialInfoNotReliable, ...},
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-ver2-0-IRB-TargetDeviceErrorCauses*

The IE *OMA-LPPe-IRB-TargetDeviceErrorCauses* is used by the target device to provide IRB error reasons to the location server.

```
-- ASN1START

OMA-LPPe-ver2-0-IRB-TargetDeviceErrorCauses ::= SEQUENCE {
    cause       ENUMERATED {undefined,imageNotAvailable,queryImageWithInadequateNumberOfFeatures,  ...},
    ...
}

-- ASN1STOP
```

6.5.14 Crowdsourcing (version 2.0)

This section defines support for crowdsourcing of location measurements from a target to a server and is applicable only to LPPe version 2.0.

6.5.14.1 Crowdsourcing Location Information

– *OMA-LPPe-ver2-0-Crowdsourcing-ProvideLocationInformation*

The *OMA-LPPe-ver2-0-Crowdsourcing-ProvideLocationInformation* is used by a target to confirm or reject a request from a server to provide crowdsourcing measurements, to provide the status of crowdsourcing following a query from a server and to provide crowdsourcing measurements to a server.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-ProvideLocationInformation ::= CHOICE {
    crowdsourcingConfirm                    OMA-LPPe-ver2-0-CrowdsourcingConfirm,
    crowdsourcingReject                     OMA-LPPe-ver2-0-CrowdsourcingReject,
    crowdsourcingData                       OMA-LPPe-ver2-0-CrowdsourcingData,
    crowdsourcingStatus                     OMA-LPPe-ver2-0-CrowdsourcingStatus,
    ...
}

OMA-LPPe-ver2-0-CrowdsourcingConfirm ::= SEQUENCE {
    sessionID-Confirm                       OMA-LPPe-ver2-0-CrowdsourcingSessionID,
    crowdsourcingControlParameters          OMA-LPPe-ver2-0-CrowdsourcingControlParameters,
    measurementParameters                   CHOICE {
        basicCrowdsourcingParameters            OMA-LPPe-ver2-0-BasicCrowdsourcingParameters,
        advancedCrowdsourcingParameters         OMA-LPPe-ver2-0-AdvancedCrowdsourcingParameters
        },
    proprietaryCrowdsourcingParameters      OMA-LPPe-LocationInformationContainer       OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-CrowdsourcingReject ::= SEQUENCE {
    rejectCause                             OMA-LPPe-ver2-0-Crowdsourcing-TargetCause,
    ...
}

OMA-LPPe-ver2-0-CrowdsourcingData ::= SEQUENCE {
    sessionID-Data                          OMA-LPPe-ver2-0-CrowdsourcingSessionID,
    crowdsourcingMeasurements               OMA-LPPe-ver2-0-CrowdsourcingMeasurements   OPTIONAL,
    proprietaryCrowdsourcingMeasurements    OMA-LPPe-LocationInformationContainer       OPTIONAL,
    crowdsourcingTermination                OMA-LPPe-ver2-0-CrowdsourcingTermination    OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-CrowdsourcingStatus ::= CHOICE {
    sessionActive           SEQUENCE {
        sessionID-Status    OMA-LPPe-ver2-0-CrowdsourcingSessionID,
        controlServer       OMA-LPPe-ver2-0-ServerAddress,
        dataServer          OMA-LPPe-ver2-0-ServerAddress       OPTIONAL,       --Cond NotControlServer
        controlParameters                       OMA-LPPe-ver2-0-CrowdsourcingControlParameters,
        measurements                            CHOICE {
            basicCrowdsourcingMeasurements      OMA-LPPe-ver2-0-BasicCrowdsourcingParameters,
            advancedCrowdsourcingMeasurements   OMA-LPPe-ver2-0-AdvancedCrowdsourcingParameters
            },
        proprietaryCrowdsourcing                OMA-LPPe-LocationInformationContainer       OPTIONAL,
        statistics          SEQUENCE {
                            startTime                   UTCTime                 OPTIONAL,
                            numberOfMeasurementSets     INTEGER (0..16777215)   OPTIONAL,
                            numberOfReports             INTEGER (0..16777215)   OPTIONAL,
                            ...
                            }       OPTIONAL
        },
    sessionNotActive        SEQUENCE {
        ...
        },
```

```
    ...
}

OMA-LPPe-ver2-0-ServerAddress ::= CHOICE {
    ipv4Address             OCTET STRING (SIZE (4)),
    ipv6Address             OCTET STRING (SIZE (16)),
    fqdn                    VisibleString (FROM ("a".."z" | "A".."Z" | "0".."9" |".-")) (SIZE (1..256)),
    ...
}

OMA-LPPe-ver2-0-CrowdsourcingTermination ::= SEQUENCE {
    terminationCause                        OMA-LPPe-ver2-0-Crowdsourcing-TargetCause,
    ...
}

OMA-LPPe-ver2-0-CrowdsourcingSessionID ::= SEQUENCE {
    provider-ID         OMA-LPPe-VendorOrOperatorID         OPTIONAL,
    server-ID           OCTET STRING (SIZE(1..4))           OPTIONAL,
    session-code        OCTET STRING (SIZE(4)),
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
NotControlServer	This parameter is conditional and SHALL be included only when the data server for crowdsourcing is not the same as the control server.

***OMA-LPPe-ver2-0-Crowdsourcing-ProvideLocationInformation* field descriptions**
crowdsourcingConfirm This parameter provides a confirmation by a target of a request for crowdsourcing from a control server.
crowdsourcingReject This parameter indicates a rejection by a target of a request for crowdsourcing from a control server.
crowdsourcingData This parameter provides crowdsourcing measurements and/or an indication of the termination of crowdsourcing from a target to a data server.
crowdsourcingStatus This parameter provides the status of a crowdsourcing session in reply to a query from a control server or data server.
sessionID-Confirm This parameter provides the session ID for a confirmed crowdsourcing session and comprises an optional provider ID, an optional server ID and a mandatory session code. The sessionID-Confirm SHALL either contain the same session ID received from the control server in a crowdsourcing request or indicate anonymous crowdsourcing by omitting the provider and server IDs and setting the session code to a binary value of all zeroes.
crowdsourcingControlParameters This parameter provides the control parameters agreed to by a target. The control parameters SHALL either be the same as those requested by the control server or a subset. In the case of a subset, requested parameters may be omitted or may be set to values that reduce either the duration or the frequency of deactivation, measurement and/or reporting of crowdsourcing.
measurementParameters This parameter indicates the measurements the target agrees to provide for crowdsourcing. The measurements SHALL either be the same as those requested by the control server or a subset.
basicCrowdsourcingParameters This parameter indicates the measurements for basic crowdsourcing that the target agrees to provide. The granularity of agreement is on a position method basis – i.e. the target can indicate for which position methods basic crowdsourcing measurements will be provided but cannot indicate the specific measurements.

OMA-LPPe-ver2-0-Crowdsourcing-ProvideLocationInformation **field descriptions**
advancedCrowdsourcingParameters   This parameter indicates the measurements for advanced crowdsourcing that the target agrees to provide.
proprietaryCrowdsourcingParameters   This parameter provides proprietary control parameters agreed to by the target.
rejectCause   This parameter provides the reason for a crowdsourcing rejection.
sessionID-Data   This parameter provides the crowdsourcing session ID associated with reported crowdsourcing measurements.
crowdsourcingMeasurements   This parameter provides crowdsourcing measurement data obtained by the target.
proprietaryCrowdsourcingMeasurements   This parameter provides proprietary crowdsourcing measurements.
crowdsourcingTermination   This parameter may be included to indicate termination of a crowdsourcing session.
sessionActive   This parameter is included when the target is able to verify an active crowdsourcing session with a control server in response to a query.
sessionID-Status   This parameter provides the session ID for an active crowdsourcing session.
controlServer   This parameter provides the address of the control server for an active crowdsourcing session. The control server address can be an IP4v address, an IPv6 address or a fully qualified domain name.
dataServer   This parameter provides the address of the data server for an active crowdsourcing session. The data server address can be an IP4v address, an IPv6 address or a fully qualified domain name, This parameter is optional and is included only when the data and control servers are different.
controlParameters   This parameter provides the control parameters previously agreed by a target for an active crowdsourcing session.
measurements   This parameter provides the measurement parameters previously agreed by a target for an active crowdsourcing session.
proprietaryCrowdsourcing   This parameter provides any proprietary control parameters previously agreed by a target for an active crowdsourcing session.
statistics   This parameter provides statistics for an active crowdsourcing session comprising the start time, the number of separate measurement sets that have been obtained (where the occurrence of any trigger event for crowdsourcing measurements is counted as producing one measurement set if at least some measurements were obtained and reported to the data server) and the number of separate measurement reports that have been sent (where a single measurement report includes all Provide Location Information messages sent to a server within the same LPP transaction). This parameter and its sub-fields are optional and SHALL be included if available.
sessionNotActive   This parameter is included when the target is not able to verify an active crowdsourcing session with a control server or data server in response to a query.
terminationCause   This parameter provides the reason for terminating crowdsourcing at a target.

6.5.14.2 Crowdsourcing Location Information Request – *OMA-LPPe-ver2-0-Crowdsourcing-RequestLocationInformation*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-RequestLocationInformation* is used by a server to request or query crowdsourcing at a target and to provide measurement indications and control parameters related to obtaining and reporting measurements.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-RequestLocationInformation ::= CHOICE {
    crowdsourcingRequest                    OMA-LPPe-ver2-0-CrowdsourcingRequest,
    crowdsourcingQuery                      OMA-LPPe-ver2-0-CrowdsourcingQuery,
    ...
}

OMA-LPPe-ver2-0-CrowdsourcingRequest ::= SEQUENCE {
    sessionID-Request                       OMA-LPPe-ver2-0-CrowdsourcingSessionID,
    dataServer                              OMA-LPPe-ver2-0-ServerAddress       OPTIONAL,   --Cond
NotControlServer
    crowdsourcingControlParameters          OMA-LPPe-ver2-0-CrowdsourcingControlParameters,
    advancedCrowdsourcingParameters         OMA-LPPe-ver2-0-AdvancedCrowdsourcingParameters OPTIONAL,
    --Cond AdvancedCrowdsourcing
    proprietaryCrowdsourcingParameters      OMA-LPPe-LocationInformationContainer           OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-CrowdsourcingQuery ::= SEQUENCE {
    sessionID-Query                         OMA-LPPe-ver2-0-CrowdsourcingSessionID  OPTIONAL,
    ...
}


-- ASN1STOP
```

Conditional presence	Explanation
NotControlServer	This parameter is conditional and SHALL be included only when the data server for crowdsourcing is not the same as the control server.
AdvancedCrowdsourcing	This parameter is conditional and SHALL be included when and only when advanced crowdsourcing is requested.

***OMA-LPPe-ver2-0-Crowdsourcing-RequestLocationInformation* field descriptions**
crowdsourcingRequest This parameter is included by a control server to indicate a request for crowdsourcing at a target.
crowdsourcingQuery This parameter is included by a control server or data server to indicate a query for crowdsourcing at a target.
sessionID-Request This parameter provides the crowdsourcing session ID assigned by a control server.
dataServer This parameter provides the address of the data server for a crowdsourcing session. This parameter is optional and is only included when the control and data servers are different.
crowdsourcingControlParameters This parameter provides the control parameters requested by a control server for a new crowdsourcing session.
advancedCrowdsourcingParameters This parameter provides measurement related parameters applicable to advanced crowdsourcing requested by a control server. This parameter is optional and SHALL be provided only for advanced crowdsourcing.

OMA-LPPe-ver2-0-Crowdsourcing-RequestLocationInformation **field descriptions**
proprietaryCrowdsourcingParameters This parameter provides proprietary crowdsourcing parameters and is optional. A target device may ignore this parameter if not recognized.
serviceID-Query This parameter provides the session ID for a crowdsourcing session whose status is queried by a control server or data server. This parameter is optional and SHALL NOT be included if the control server or data server is not aware of an active crowdsourcing session with the target.

6.5.14.3 Crowdsourcing Location Information Elements

– *OMA-LPPe-ver2-0-CrowdsourcingControlParameters*

The IE *OMA-LPPe-ver2-0-CrowdsourcingControlParameters* is used by a server to define required measurement and reporting characteristics for crowdsourcing and by a target to define accepted measurement and reporting characteristics for crowdsourcing.

```
-- ASN1START

OMA-LPPe-ver2-0-CrowdsourcingControlParameters ::= SEQUENCE {
    activationTriggers              OMA-LPPe-ver2-0-crowdsourcingActivationTriggers     OPTIONAL,
    measurementTriggers             OMA-LPPe-ver2-0-crowdsourcingMeasurementTriggers    OPTIONAL,
    reportingTriggers               OMA-LPPe-ver2-0-crowdsourcingReportingTriggers      OPTIONAL,
    durationParameters              OMA-LPPe-ver2-0-crowdsourcingDurationParameters     OPTIONAL,
    locationPrecision               INTEGER (1..1024)   OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-crowdsourcingActivationTriggers ::= SEQUENCE {
    geographicArea              SEQUENCE {
                                activationArea          SEQUENCE (SIZE (1..16)) OF Polygon  OPTIONAL,
                                deactivationArea        SEQUENCE (SIZE (1..16)) OF Polygon  OPTIONAL,
                                ...
                                }                               OPTIONAL,
    country-network             BIT STRING {
                                inCoverageOfHomeNetwork             (0),
                                inHomeCountryOutsideHomeNetwork     (1),
                                notInHomeCountry                    (2) } (SIZE (1..8)) OPTIONAL,
    minimumdetectedTransmitters INTEGER (1..20)                 OPTIONAL,
    targetMotionState           BIT STRING {
                                unknown     (0),
                                stationary  (1),
                                walking     (2),
                                running     (3),
                                cycling     (4),
                                car         (5),
                                train       (6),
                                boat        (7),
                                otherState  (8)}     (SIZE (1..16))     OPTIONAL,
    environment                 BIT STRING {
                                unknown     (0),
                                indoors     (1),
                                outdoors    (2)} (SIZE (1..8))      OPTIONAL,
    logicalTriggerCombination   ENUMERATED {or, and, ...}           OPTIONAL,
    activationDelay             INTEGER (1..256)            OPTIONAL,
    deactivationDelay           INTEGER (1..256)            OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-crowdsourcingMeasurementTriggers ::= SEQUENCE {
    measurementPeriodicity                      INTEGER (1..512),
    measurementMovement                         INTEGER (1..256)            OPTIONAL,
    measurementFloorChange                      NULL                        OPTIONAL,
    measurementChangeOfServingCellOrAP          NULL                        OPTIONAL,
    logicalMeasurementCombination               ENUMERATED {or, and, ...}   OPTIONAL,
    ...
```

```
}

OMA-LPPe-ver2-0-crowdsourcingReportingTriggers ::= CHOICE {
    realTime                OMA-LPPe-ver2-0-crowdsourcingRealTimeParameters,
    quasiRealTime           OMA-LPPe-ver2-0-crowdsourcingQuasiRealTimeParameters,
    batch                   OMA-LPPe-ver2-0-crowdsourcingBatchParameters,
    ...
}

OMA-LPPe-ver2-0-crowdsourcingRealTimeParameters ::= SEQUENCE {
    ...
}

OMA-LPPe-ver2-0-crowdsourcingQuasiRealTimeParameters ::= SEQUENCE {
    ...
}

OMA-LPPe-ver2-0-crowdsourcingBatchParameters ::= SEQUENCE {
    batchReportPeriodicity                  INTEGER (1..672),
    batchReportMovement                     INTEGER (1..256)            OPTIONAL,
    batchReportOnChangeOfServingNetwork     NULL                        OPTIONAL,
    batchAccessNetworkRestriction   BIT STRING {
                                    homeCellularNetwork                 (0),
                                    otherCellularNetworkInHomeCountry   (1),
                                    cellularNetworkInForeignCountry     (2),
                                    wlanNetwork                         (3),
                                    srnNetwork                          (4),
                                    userSpecified                       (5)} (SIZE (1..16))
    OPTIONAL,
    batchStorageOverflow    SEQUENCE {
        send        ENUMERATED {send, doNotSend, ...},
        discard     ENUMERATED {discardNewMeasurements, discardOldestMeasurements, ...}
        },
    ...
}

OMA-LPPe-ver2-0-crowdsourcingDurationParameters ::= SEQUENCE {
    crowdsourcingStartTime      INTEGER (1..672)            OPTIONAL,
    crowdsourcingDuration       INTEGER (1..2880)           OPTIONAL,
    ...
}

-- ASN1STOP
```

***OMA-LPPe-ver2-0-CrowdsourcingControlParameters* field descriptions**
activationTriggers
This parameter indicates the trigger conditions for activating and deactivating crowdsourcing. If crowdsourcing has been activated, a target obtains measurements according to the measurementTriggers parameter and reports them according to the reportingTriggers parameter. While crowdsourcing is deactivated, a target ceases measurements but continues to report any previous measurements not yet sent according to the reportingTriggers parameter. Crowdsourcing is activated by the dectection of required activation trigger conditions and is deacticated either when required activation trigger conditions are no longer detected or when any deactivation trigger condition is detected regardless of activation trigger conditions. This parameter is optional and if not included indicates (as a default) that crowdsourcing is always activated.
measurementTriggers
This parameter indicates the trigger conditions for obtaining a new set of measurements. This parameter is optional and if not included indicates (as a default) that measurements should be obtained at periodic intervals of 15 minutes.
reportingTriggers
This parameter indicates the trigger conditions for reporting each new set of measurements to the data server. This parameter is optional and if not included indicates (as a default) that quasi-real time reporting SHALL be used where a target is allowed to decide when to send reports to the server (either in real time or in batches).

OMA-LPPe-ver2-0-CrowdsourcingControlParameters **field descriptions**
durationParameters
This parameter indicates the duration of crowdsourcing. This parameter is optional and if not included indicates (as a default) an unlimited duration starting immediately. Note that an unlimited duration may later be terminated by the server or target.
locationPrecision
This parameter provides the maximum distance in meters that a target may move while performing consecutive crowdsourcing measurements that will be included in the same measurement subset. For advanced crowdsourcing, each measurement subset is defined by the advanced-measurement-subsets parameter in the OMA-LPPe-ver2-0-Crowdsourcing-AdvancedMeasurements data type. For basic crowdsourcing, each measurement subset is contained in a separate LPP Provide Location Information message. When performing measurements, a target should monitor its location (e.g. using sensors) and divide measurements into subsets that satisfy this requirement. The parameter may be used by a server to control the location precision for crowdsourcing measurements within each subset. This parametrer is optional and when omitted indicates that a target may determine any location precision itself – although it is recommended that a target attempt to employ a high precision if possible.
geographicArea
This parameter provides a set of geographic areas within which crowdsourcing should be activated or deactivated. This parameter is optional and if omitted indicates that there are no geographic area conditions.
activationArea
This parameter provides one or more geographic areas within which crowdsourcing should be activated by a target.
deactivationArea
This parameter provides one or more geographic areas within which crowdsourcing SHALL be deactivated by a target.
country-network
This parameter indicates whether a target needs to be within certain network coverage or within a particular country in order for crowdsourcing to be activated. The parameter is encoded as a bit string with each network or country condition represented by a different bit. A bit is set to one to indicate that crowdsourcing should be activated when the corresponding network or country condition is detected. A bit is set to zero to indicate that crowdsourcing SHALL be deactivated for the corresponding network or country condition. A bit that is not included indicates that the associated network or country condition can be ignored. This parameter is optional and if not included indicates that network and country conditions do not affect crowdsourcing.
detectedTransmitters
This parameter provides a count of the minimum number of transmitters visible to a target at the same time that are needed to activate crowdsourcing. The parameter is not used to explictly deactivate crowdsourcing when the minimum number of transmitters is not detected. The transmitters SHALL only include transmitters for which crowdsourcing measurements have been requested. For example, if a target receives signals from 5 WiFi APs, 3 LTE eNode Bs and 4 UTRA node Bs and crowdsourcing was requrested for WiFi and LTE but not for UTRA, the number of detected transmitters would be 8. This parameter is optional and if omitted indicates that the number of detected transmitters is not a condition for crowdsourcing.
targetMotionState
This parameter provides a set of target motion states that may activate crowdsourcing. The parameter is encoded as a bit string with each motion state represented by a different bit. A bit is set to one to indicate that crowdsourcing should be activated when the corresponding motion state is detected. A bit is set to zero to indicate that crowdsourcing SHALL be deactivated for the corresponding motion state. A bit that is not included indicates that the associated motion state can be ignored. The parameter may be used to help ensure high target location accuracy during crowdsourcing by restricting target motion states to those with low velocity. This parameter is optional and if not included indicates that the target motion state does not affect crowdsourcing.
environment
This parameter indicates a set of environments that may activate crowdsourcing. The parameter is encoded as a bit string with each environment represented by a different bit. A bit is set to one to indicate that crowdsourcing should be activated when the corresponding environment is detected. A bit is set to zero to indicate that crowdsourcing SHALL be deactivated when the corresponding environment is detected. A bit that is not included indicates that the associated environment can be ignored. This parameter is optional and if not included indicates that the environment does not affect crowdsourcing.

OMA-LPPe-ver2-0-CrowdsourcingControlParameters field descriptions
logicalTriggerCombination   This parameter indicates how the other activation triggers are to be combined. If set to the value "or", triggers are combined via logical OR such that crowdsourcing is activated if and only if at least one condition for activation is detected and provided no condition for deactivation is detected. If set to the value "and", triggers are combined via logical AND such that crowdsourcing is activated if and only if any parameters that are included for activation (from among geographicArea, country-network, detectedTransmitters, targetMotionState and environment) all indicate activation and provided no condition for deactivation is detected. This parameter is optional and if not included has the default value "and". Note that deactivation triggers take precedence over activation triggers such that crowdsourcing is deactivated if any one deactivation trigger is detected. Furthermore, crowdsourcing SHALL be deactivated when activation triggers (as combined using OR or AND) are no longer detected.
activationDelay   This parameter provides the minimum duration in units of 5 seconds for which trigger conditions that activate crowdsourcing MUST continuously persist before crowdsourcing is activated by a target. This parameter can help avoid unnecessary transient crowdsourcing when a target is at a location where crowdsourcing is generally not needed. This parameter is optional and has the default value zero when not included.
deactivationDelay   This parameter provides the minimum duration in units of 5 seconds for which trigger conditions that deactivate crowdsourcing MUST continuously persist before crowdsourcing is deactivated by a target. This parameter can help avoid unnecessary transient deactivation of crowdsourcing when a target is at a location where crowdsourcing is generally needed. This parameter is optional and has the default value zero when not included.
measurementPeriodicity   This parameter provides the periodicity in units of 10 seconds for obtaining new sets of crowdsourcing measurements when crowdsourcing is activated. A periodicity condition is detected once the period since the last set of crowdsourcing measurements attains or exceeds the measurementPeriodicity value.
measurementMovement   This parameter provides the minimum distance in units of 5 meters that a target MUST move before a new set of measurements may be obtained. Movement should equate to the distance (or an estimate of the distance) between a previous and new target location. This parameter is optional and when omitted indicates target movement is not a factor in determining measurements.
measurementFloorChange   This parameter when present indicates that a target should make a new set of measurements when the target can determine that it is indoors and has changed floor level. To guard against transient floor levels (e.g. for a target inside an elevator), a target should wait until its floor level appears stable before making new measurements. This parameter is optional and when omitted indicates that change of floor level is not a direct factor in determining measurements. As an option, a target may wait for some short random period (e.g. 0 to 30 seconds) before obtaining measuremenmts due to this trigger in order to avoid measurements being made at the same locations by all targets (e.g. at the entrance to an elevator or escalator).
measurementChangeOfServingCellOrAP   This parameter when present indicates that a new set of measurements should be obtained whenever a target changes its current serving cell or serving access point or changes to or from cellular access (e.g. from or to a WLAN AP or SRN AP). This parameter is optional and if not present indicates that change of serving cell or AP is not a factor in determining measurements.
logicalMeasurementCombination   This parameter indicates how other measurement triggers are to be combined. If set to the value "or", triggers are combined via logical OR such that a new set of crowdsourcing measurements is obtained if and only if at least one condition for obtaining measurements is detected. If set to the value "and", triggers are combined via logical AND such that a new set of crowdsourcing measurements is obtained if and only if all conditions that are included for measurements are detected at the same time. For the "and" value, conditions MUST be concurrently detected (e.g. a condition that was previously detected but no longer applies counts as not being detected). This parameter is optional and if not included has the default value "or".

OMA-LPPe-ver2-0-CrowdsourcingControlParameters field descriptions
realTime   The presence of this parameter indicates that reporting of crowdsourcing measurements to a data server SHALL occur in real time. In this case, a target SHALL attempt to send each new set of crowdsourcing measurements to the data server as soon the complete set has been obtained. If this is not possible (e.g. a connection to the server cannot be established or is inhibited by a user preference to use only certain access networks to reduce billing) then the measurements SHALL be discarded. A target may vertify some of the conditions for being able to access the data server (e.g. the availability of a suitable access network) before making crowdsourcing measurements to avoid wasting resources in unnecessary measurement.
quasiRealTime   The presence of this parameter indicates that reporting of crowdsourcing measurements to a data server SHALL occur in quasi-real time. In this case, a target SHALL attempt to send each new set of crowdsourcing measurements to the data server as soon as the complete set has been obtained. If this is not possible (e.g. a connection to the server cannot be established or is inhibited by a user preference to use only certain access network to reduce billing) then the measurements SHALL be stored and sent at a later time (e.g. along with other deferred measurement sets) when a connection to the data server is again possible. If storage for measurements is completely filled before the measurements can be reported, the oldest measurements SHALL be discarded in order to store new measurements.
batch   The presence of this parameter indicates that reporting of crowdsourcing measurements to a data server SHALL occur only at certain times indicated by a set of reporting triggers. In this case, a target SHALL store each set of crowdsourcing measurements and send all stored sets only when allowed by the reporting triggers. The reporting triggers are combined by a logical “OR” operation except for the accessNetwork restriction. Once a batch report is sent, the initial conditions for each reporting trigger are reset – e.g. any periodicity or determination of target movement begins again.
batchReportPeriodicity   This parameter indicates the periodicity of batch reporting in units of 15 minutes and in the range of 15 minutes to 7 days. Batch reports SHALL be sent with at least this periodicity except when precluded by the accessNetwork condition.
batchReportMovement   This parameter provides the maximum distance in units of 1 kilometer that a target may move before a new batch report should be sent. Movement should equate to the distance (or an estimate of the distance) between a previous and new target location. This parameter is optional and when omitted indicates target movement is not a factor in determining reporting.
batchReportOnChangeOfServingNetwork   The inclusion of this parameter indicates that a batch report should be sent each time that a target changes from one cellular serving network to another. Changes to and from WLAN or SRN networks are not counted but a change from one cellular network to another with some WLAN or SRN access in between is counted.
batchAccessNetworkRestriction   This parameter provides restrictions on batch reporting associated with the access network via which batch reports would be sent. This parameter is encoded as a bit string with each type of access network represented by a different bit. A bit is set to one to indicate that batch reporting is not allowed via the corresponding access network. A bit is set to zero or is omitted to indicate that batch reporting is allowed via the corresponding access network. The userSpecified bit indicates whether the user may or may not define certain allowed and/or disallowed networks that, in the case of a conflict, would override any server preferences. This parameter is optional and if not included indicates that any access network may be used for reporting.
batchStorageOverflow   This parameter indicates whether a target should send or not send a batch report when storage for crowdsourcing measurements would otherwise overflow. The parameter also indicates whether the target SHALL discard new measurements or the oldest measureements when storage overflow does occur due to a requirement not to send or an inability to send. This parameter is optional and if omitted indicates that a target may employ an implementation specific preference.
crowdsourcingStartTime   This parameter indicates when crowdsourcing SHALL begin relative to the time of receipt of a crowdsourcing request in units of 15 minutes. This parameter is optional and if omitted indicates a start time at the current time.

OMA-LPPe-ver2-0-CrowdsourcingControlParameters **field descriptions**
crowdsourcingDuration This parameter provides the duration of crowdsourcing in units of 15 minutes. This parameter is optional and if not included indicates an unlimited duration.

– *OMA-LPPe-ver2-0-BasicCrowdsourcingParameters*

The IE *OMA-LPPe-ver2-0-BasicCrowdsourcingParameters* is used by a target to define accepted measurement types for basic crowdsourcing. The granularity of acceptance is on an LPP and LPPe position method basis with individual measurements for each accepted position method not being indicated. LPP and LPPe position methods are represented using a bit string with one bit corresponding to each position method. A bit is set to one to indicate that measurements for the corresponding position method will be provided and is set to zero or omitted when they will not.

```
-- ASN1START

OMA-LPPe-ver2-0-BasicCrowdsourcingParameters ::= SEQUENCE {
    measuremnent-types       BIT STRING {
                             lpp-otdoa    (0),
                             lpp-ecid     (1),
                             otdoa        (2),
                             eotd         (3),
                             otdoa-utra   (4),
                             lte-ecid     (5),
                             gsm-ecid     (6),
                             utra-ecid    (7),
                             wlan-ap      (8),
                             wimax        (9),
                             sensor       (10),
                             srn          (11),
                             pdr          (12),
                             irb          (13)} (SIZE (1..32)),
    ...
}

-- ASN1STOP
```

– *OMA-LPPe-ver2-0-AdvancedCrowdsourcingParameters*

The IE *OMA-LPPe-ver2-0-AdvancedCrowdsourcingParameters* is used by a server to define required measurement types for advanced crowdsourcing and by a target to define accepted measurement types for advanced crowdsourcing. Measurement types are indicated using bit strings with one bit assigned to each measurement type where a one value indicates a measurement is requested by a server or agreed by a target and a zero value or omission of a bit indicates a measurement is not requested by a server or not agreed by a target.

```
-- ASN1START

OMA-LPPe-ver2-0-AdvancedCrowdsourcingParameters ::= SEQUENCE {
    wlan-ap-measurements        OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-Parameters        OPTIONAL,
    lte-measurements            OMA-LPPe-ver2-0-Crowdsourcing-LTE-Parameters            OPTIONAL,
    utra-measurements           OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Parameters           OPTIONAL,
    gsm-measurements            OMA-LPPe-ver2-0-Crowdsourcing-GSM-Parameters            OPTIONAL,
    srn-measurements            OMA-LPPe-ver2-0-Crowdsourcing-SRN-Parameters            OPTIONAL,
    sensor-measurements         OMA-LPPe-ver2-0-Crowdsourcing-Sensor-Parameters         OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-Parameters ::= SEQUENCE {
    frequency           INTEGER (1..256)    OPTIONAL,
    measurements        BIT STRING {
```

```
                        apSSID              (0),
                        operatingClass      (1),
                        apDeviceType        (2),
                        apReportedLocation  (3),
                        apEstimatedLocation (4),
                        apChannel           (5),
                        apAntennaGain       (6),
                        ueAntennaGain       (7),
                        apTransmitPower     (8),
                        apSignaltoNoise     (9),
                        apSignalStrength    (10),
                        apRoundTripDelay    (11),
                        ueTransmitPower     (12),
                        ueSignaltoNoise     (13),
                        ueSignalStrength    (14)} (SIZE (1..32)),
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-LTE-Parameters ::= SEQUENCE {
    frequency           INTEGER (1..256)    OPTIONAL,
    measurements        BIT STRING {
                        eNBestimatedLocation    (0),
                        rsrp                    (1),
                        rsrq                    (2),
                        ueRxTx                  (3),
                        non-serving-cell        (4),
                        non-serving-plmn        (5)} (SIZE (1..16)),
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Parameters ::= SEQUENCE {
    frequency           INTEGER (1..256)    OPTIONAL,
    measurements        BIT STRING {
                        nBestimatedLocation     (0),
                        utra-carrier-RSSI       (1),
                        fdd-cpich-Ec-N0         (2),
                        fdd-cpich-RSCP          (3),
                        fdd-pathloss            (4),
                        tdd-primary-ccpch-RSCP  (5),
                        tdd-pathloss            (6),
                        tdd-timing-advance      (7),
                        non-serving-cell        (8),
                        non-serving-plmn        (9) } (SIZE (1..16)),
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-GSM-Parameters ::= SEQUENCE {
    frequency           INTEGER (1..256)    OPTIONAL,
    measurements        BIT STRING {
                        bts-estimatedLocation   (0),
                        rxLevel                 (1),
                        timingAvance            (2),
                        non-serving-cell        (3),
                        non-serving-plmn        (4)} (SIZE (1..8)),
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-SRN-Parameters ::= SEQUENCE {
    frequency           INTEGER (1..256)    OPTIONAL,
    srn-Categories      SEQUENCE (SIZE (1..16)) OF  OMA-LPPe-SRN-Category,
    measurements        BIT STRING {
                        apReportedLocation      (0),
                        apEstimatedLocation     (1),
                        rssi                    (2),
                        rtd                     (3)} (SIZE (1..16)),
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-Sensor-Parameters ::= SEQUENCE {
    frequency           INTEGER (1..256)    OPTIONAL,
    measurements        BIT STRING {
```

```
                        motionState             (0),
                        atmosphericPressure     (1),
                        temperature             (2),
                        humidity                (3),
                        soundLevel              (4),
                        illuminance             (5)} (SIZE (1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-AdvancedCrowdsourcingParameters field descriptions
frequency The frequency parameter for each measurement type defines for which measurement sets the measurement type is requested by a server or accepted by a target. A value of N for the frequency field indicates that measurements SHALL only be obtained by a target for measurement sets N, 2N, 3N, 4N etc. where measurement set 1 is the first measurement set triggered for a particular crowdsourcing session, 2 is the second, 3 is the third etc. A frequency of more than one allows measurements to be reduced for a particular measurement type by skipping measurement sets. Use of a frequency N1 for one type of measurement and a frequency of N2 for another type of measurement where N1 and N2 are coprime also minimizes the number of measurement sets for which both measurement types are obtained. The frequency parameter may be used to reduce resource usage for sending and receiving crowdsourcing measurements. The parameter is optional and has the default value of one when not included. Note that when all measurements for a particular measurement set are skipped, no information regarding the measurement set should be provided to the server.
wlan-ap-measurements This parameter defines the requested or accepted WLAN AP related measurements. Requested or accepted measurements are defined using a bit string with one bit corresponding to each type of measurement. A bit setting of one indicates that a measurement is requested by a server or accepted by a target and a bit setting of zero or omission of a bit indicates a measurement is not requested or not accepted.
lte-measurements This parameter defines the requested or accepted LTE related measurements. Requested or accepted measurements are defined using a bit string with one bit corresponding to each type of measurement. A bit setting of one indicates that a measurement is requested by a server or accepted by a target and a bit setting of zero or omission of a bit indicates a measurement is not requested or not accepted.
utra-measurements This parameter defines the requested or accepted UTRA related measurements. Requested or accepted measurements are defined using a bit string with one bit corresponding to each type of measurement. A bit setting of one indicates that a measurement is requested by a server or accepted by a target and a bit setting of zero or omission of a bit indicates a measurement is not requested or not accepted.
gsm-measurements This parameter defines the requested or accepted GSM related measurements. Requested or accepted measurements are defined using a bit string with one bit corresponding to each type of measurement. A bit setting of one indicates that a measurement is requested by a server or accepted by a target and a bit setting of zero or omission of a bit indicates a measurement is not requested or not accepted.
srn-measurements This parameter defines the requested or accepted SRN related measurements. Requested or accepted measurements are defined using a bit string with one bit corresponding to each type of measurement. A bit setting of one indicates that a measurement is requested by a server or accepted by a target and a bit setting of zero or omission of a bit indicates a measurement is not requested or not accepted.
srn-Categories Thie parameter defines the SRN technologies and/or SRN vendors for which SRN measurements are requested by a server or accepted by a target.

OMA-LPPe-ver2-0-AdvancedCrowdsourcingParameters field descriptions
sensor-measurements This parameter defines the requested or accepted sensor related measurements. Requested or accepted measurements are defined using a bit string with one bit corresponding to each type of measurement. A bit setting of one indicates that a measurement is requested by a server or accepted by a target and a bit setting of zero or omission of a bit indicates a measurement is not requested or not accepted. Sensor measurements may be used to help determine environmental conditions associated with other crowdsourcing measurements such as being indoors, outdoors, in a subway, tall building etc.

– *OMA-LPPe-ver2-0-CrowdsourcingMeasurements*

The IE *OMA-LPPe-ver2-0-CrowdsourcingMeasurements* is used by a target to report crowdsourcing measurements to a server. The IE applies to both basic crowdsourcing and advanced crowdsourcing.

```
-- ASN1START

OMA-LPPe-ver2-0-CrowdsourcingMeasurements ::= SEQUENCE {
    crowdsourcingCommonData     OMA-LPPe-ver2-0-Crowdsourcing-CommonData    OPTIONAL,              --Cond
FirstMessage
    sequence-number         INTEGER (0..255)            OPTIONAL,   -- Cond MoreThanOneMessage
    measurements    CHOICE {
                        basicMeasurements       OMA-LPPe-ver2-0-Crowdsourcing-BasicMeasurements,
                        advancedMeasurements    OMA-LPPe-ver2-0-Crowdsourcing-AdvancedMeasurements,
                        ...
                    }   OPTIONAL,
    error           OMA-LPPe-ver2-0-Crowdsourcing-TargetCause               OPTIONAL,
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-BasicMeasurements ::= SEQUENCE {
    basicMeasurementSubset      OMA-LPPe-ver2-0-Crowdsourcing-MeasurementSubset,
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-AdvancedMeasurements ::= SEQUENCE {
    advanced-measurement-subsets    SEQUENCE   (SIZE   (1..ver2-0-maxMeasurements))   OF   OMA-LPPe-ver2-0-
Crowdsourcing-MeasurementSubset,
    wlan-ap-measurements        OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-Measurements  OPTIONAL,
    lte-measurements            OMA-LPPe-ver2-0-Crowdsourcing-LTE-Measurements      OPTIONAL,
    utra-measurements           OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Measurements     OPTIONAL,
    gsm-measurements            OMA-LPPe-ver2-0-Crowdsourcing-GSM-Measurements      OPTIONAL,
    srn-measurements            OMA-LPPe-ver2-0-Crowdsourcing-SRN-Measurements      OPTIONAL,
    sensor-measurements         OMA-LPPe-ver2-0-Crowdsourcing-Sensor-Measurements   OPTIONAL,
    ...
}

-- Temporary Editorial Note: the LTE, UTRA and GSM crowdsourcing support will be added in a later CR

ver2-0-maxMeasurements  INTEGER ::= 512


-- ASN1STOP
```

Conditional presence	Explanation
FirstMessage	This parameter is conditional and may only be included in the first or only LPP Provide Location Information sent as part of a single LPP transaction to provide crowdsourcing measurements to a data server.
MoreThanOneMessage	This parameter is conditional and SHALL be included when more then one LPP Provide Location Information message is sent as part of a single LPP transaction to provide crowdsourcing measurements to a data server.

OMA-LPPe-ver2-0-CrowdsourcingMeasurements
crowdsourcingCommonData
This parameter is used to provide data that is common to all basic or advanced crowdsourcing measurements reported by the target.
sequence-number
This parameter provides a sequence number for each LPP Provide Location Information message sent as part of the same LPP transaction to report crowdsourcing measurements. The sequence number starts at 0 and is incremented by 1 modulo 256 in each succeeding message. A server may use the sequence-number to detect message loss and in some cases message duplication.
measurements
This parameter indicates whether basic or advanced crowdsourcing measurements are provided and provides common data for each case and, in the case of advanced crowdsourcing, the measurements themselves. This parameter is optional and may be excluded when no measurements were obtained – e.g. in order to report an error condition to the server.
basicMeasurements
This parameter provides common data for a basic crowdsourcing measurement subset. The basic measurements themselves for the subset are provided in separate LPP and LPPe position method containers within the same LPP message in the same way as measurements for target positioning. Each LPP Provide Location Information message is restricted to providing one subset of measurements which will be part of or all of one measurement set (instigated by one instance of measurement triggers).
advancedMeasurements
This parameter provides one or more subsets of advanced measurements.
error
This parameter may be included to report error information concerning a target inability to obtain or report certain measurements. This parameter may be included with or without measurements, although it is suggested to only sparingly send an error without any measurements to reduce load on the server. The inclusion of this parameter does not indicate the termination of a crowdsourcing session.
basicMeasurementSubset
This parameter provides common data for one basic measurement subset.
advanced-measurement-subsets
This parameter references up to 512 successive measurement subsets for advanced crowdsourcing. The measurement subsets may belong either to the same measurement set (comprising measurements obtained due to one measurement trigger event) or to more than one measurement set. The measurement subsets SHALL be included and referenced in the order they were obtained and are indexed from 1 for the first subset to N ($N \leq 512$) for the last subset where the index for any measurement subset corresponds to its position in the SEQUENCE OF data type.
wlan-ap-measurements
This parameter contains advanced crowdsourcing measurements for WLAN APs. The measurements are contained in measurement subsets that are referred to using the measurement subset indices defined for the advanced-measurement-subsets parameter,

OMA-LPPe-ver2-0-CrowdsourcingMeasurements
lte-measurements This parameter contains advanced crowdsourcing measurements for LTE. The measurements are contained in measurement subsets that are referred to using the measurement subset indices defined for the advanced-measurement-subsets parameter.
utra-measurements This parameter contains advanced crowdsourcing measurements for UTRA. The measurements are contained in measurement subsets that are referred to using the measurement subset indices defined for the advanced-measurement-subsets parameter.
gsm-measurements This parameter contains advanced crowdsourcing measurements for GSMN. The measurements are contained in measurement subsets that are referred to using the measurement subset indices defined for the advanced-measurement-subsets parameter.
srn-measurements This parameter contains advanced crowdsourcing measurements for SRN. The measurements are contained in measurement subsets that are referred to using the measurement subset indices defined for the advanced-measurement-subsets parameter.
sensor-measurements This parameter contains advanced crowdsourcing measurements for sensors. The measurements are contained in measurement subsets that are referred to using the measurement subset indices defined for the advanced-measurement-subsets parameter.

– *OMA-LPPe-ver2-0-Crowdsourcing-MeasurementSubset*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-MeasurementSubset* is used by a target to provide common data for a measurement subset for either basic crowdsourcing or advanced crowdsourcing. Each measurement subset should contain measurements obtained for the same (or almost the same) target location. Measurements in a measurement set (triggered by one instance of measurement triggers in crowdsourcing control parameters) may all be included in one measurement subset if all the measurements were obtained at the same (or nearly the same) target location but should be included in multiple measurement subsets if the target location changed while the measurements were being made. A server may control the precision of location for each measurement subset using the locationPrecision parameter in the OMA-LPPe-ver2-0-CrowdsourcingControlParameters data type.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-MeasurementSubset ::= SEQUENCE {
    measurementLocation     OMA-LPPe-ver2-0-Crowdsourcing-Location      OPTIONAL,
    measurementTime         OMA-LPPe-ver2-0-Crowdsourcing-Time          OPTIONAL,
    endOfMeasurementSet     NULL                                        OPTIONAL,
    anchorPoint             NULL                                        OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Crowdsourcing-MeasurementSubset
measurementLocation This parameter provides an absolute and/or a relative target location at which the measurements reported for this measurement subset were obtained. This parameter is optional and SHALL be included if available. If the parameter is not included, the target location is considered to be unknown.

OMA-LPPe-ver2-0-Crowdsourcing-MeasurementSubset
measurementTime This parameter provides an absolute or a relative time at which the measurements reported for this measurement subset were obtained. This parameter is optional and SHALL be included if available. If the parameter is not included, the time is considered to be unknown.
endOfMeasurementSet This parameter is included to indicate the end of a measurement set and enables different measurement sets to be distinguished and the measurement subsets belonging to each measurement set to be identified. By convention, a new measurement set is assumed to begin in the first measurement subset reported by a target as part of one LPP transaction and a measurement set is assumed to end in the last measurement subset reported by a target as part of one LPP transaction.
anchorPoint This presence of this optional parameter indicates that the target location for this measurement subset may be used as an anchor point to define a relative target location for one or more subsequent measurement subsets. Even if the absolute target location for an anchor point is unknown, target locations relative to the anchor point may still be usefully provided to enable a server to infer some information about the transmitters being reported such as their locations relative to one another. It is recommended that whenever absolute location is available for some measurement subsets, that anchor points only be defined for the measurement subsets for which absolute location is explicitly provided. This can increase the accuracy of absolute location derivation for the measurement subsets whose locations are defined relative to an anchor point by avoiding the need to chain a sequence of two or more relative locations back to a measurement subset for which an absolute location is provided. Note that each time that a relative location is combined with a previous location, to obtain the cumulative location estimate, the errors expressed by any location uncertainty and confidence need to be combined, resulting in a greater uncertainty and greater corresponding error. Minimizing the number of relative and absolute locations that need to be combined can thereby reduce error.

– *OMA-LPPe-ver2-0-Crowdsourcing-Location*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-Location* is used by a target to report the absolute and/or relative target location corresponding to one subset of measurements for either advanced or basic crowdsourcing.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-Location ::= SEQUENCE {
    absoluteLocation    SEQUENCE {
                        geodeticLocation    CHOICE {
                            location2D          EllipsoidPointWithUncertaintyEllipse,
                            location3D          EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
                            highaccuracy3D      OMA-LPPe-HighAccuracy3Dposition,
                            ...
                            },
                        relativeAltitude        OMA-LPPe-RelativeAltitude       OPTIONAL,
                        absoluteLocationSource  OMA-LPPe-LocationSource         OPTIONAL,
                        ...
                        }           OPTIONAL,
    relativeLocation    SEQUENCE {
                        location                OMA-LPPe-RelativeLocation,
                        relativeLocationSource  OMA-LPPe-LocationSource         OPTIONAL,
                        ...
                        }           OPTIONAL,       --Cond NotFirstSubset
    locationPrecision   INTEGER (1..1024)       OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
NotFirstSubset	This parameter is conditional and may be included for any measurement subset except the first subset reported by a target in any LPP transaction.

OMA-LPPe-ver2-0-Crowdsourcing-Location
absoluteLocation   This parameter provides the absolute location of the target corresponding to one measurement subset. This parameter is optional and SHALL be provided for the first measurement subset reported by a target in any LPP transaction for which an absolute location is available. Thereafter, a target should report subsequent absolute locations if this will provide better absolute location accuracy than that inferred using the relativeLocation parameter. When absolute location accuracy for the absoluteLocation parameter would be roughly comparable to the absolute location accuracy inferred from one or more instances of the relativeLocation parameter, a target should report only the relativeLocation parameter to reduce signaling. The uncertainty and confidence for an absolute location SHALL be as precise as possible and refer to the target location at some point during the measurement subset.
geodeticLocation   This parameter provides an absolute geodetic location for the target for one measurement subset. The geodetic location can be provided as a 2-D, 3-D or high accuracy 3-D absolute location with uncertainty and confidence.
relativeAltitude   This parameter provides the target altitude relative to ground level. This parameter and a 3-D geodeticLocation, if both are present, refer to the same altitude. This parameter is optional and SHALL be included when available.
absoluteLocationSource   This parameter indicates the source or sources of an absolute location. This parameter is optional and SHALL be included when available.
relativeLocation   This parameter provides the target location relative to a previous target location (whether known or unknown) for a previous measurement subset that is either the most recent measurement subset marked as an anchor point or the immediately preceding measurement subset if no anchor points were defined. The previous target location SHALL coincide with any absolute and/or relative location that was provided for the previous measurement subset that is referenced in order that the relative location can be accurately combined with the previous relative or absolute location (e.g. to infer an accurate absolute location for the current measurement subset). The accuracy of the relativeLocation SHALL be the accuracy of the relative location estimate itself, i.e. not including any uncertainty attributable to the point to which the relativeLocation is relative. This means that the accuracy and confidence for the relativeLocation MUST be combined with those for the referenced location when obtaining either an absolute location or a location relative to an earlier measurement subset for the current measurement subset. It should be noted that the relativeLocation parameter may have a higher or lower location accuracy than the absoluteLocation parameter. As an example of higher location accuracy, the absolute location of a target may be known with an expected error of 100 meters (e.g. based on A-GNSS) while the relative location of the target with respect to its location 5 minutes earlier may have an expected error of only 2 meters (e.g. if sensors detected the user was nearly stationary). As an example of lower location accuracy, a very precise absolute location may be obtained after a target has moved by a distance with a high level of uncertainty. It should be noted that relativeLocation for some measurement subset A given relative to the location for a previous measurement subset B may be used to infer the absolute location for either measurement subset A or measurement subset B depending on whether absolute location is provided or can be inferred (e.g. using additional relativeLocation values) for measurement subset B or measurement subset A, respectively. This enables later as well as earlier absolute locations to be used to infer absolute location for measurement subsets for which an absolute location is not provided.   A target SHALL provide relativeLocation when available either when the absoluteLocation parameter is not provided or when absoluteLocation is provided and a relative location may be needed to infer the location of one or more previous measurement subsets. When both a relative and an absolute location type are reported for the same measurement subset, they SHALL both refer to the same target location and be obtained at the same time.
relativeLocationSource   This parameter indicates the source or sources of a relative location. This parameter is optional and SHALL be included when available

OMA-LPPe-ver2-0-Crowdsourcing-Location
locationPrecision This parameter provides the maximum straight line distance that the target may have moved while obtaining measurements for the reported measurement subset. The parameter may be approximated by the distance between the target locations for the first and last measurements reported. The parameter may also be measured using sensors. The distance D moved by the target is encoded as an integer N in the range 1 to 1024 where: $D \leq N$ meters for $N < 1024$ and $D > 1023$ meters for $N = 1024$

– *OMA-LPPe-ver2-0-Crowdsourcing-Time*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-Location* is used by a target to report the absolute and/or relative target location corresponding to one subset of measurements for either advanced or basic crowdsourcing.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-Time ::= SEQUENCE {
    time            CHOICE {
                    absoluteTime        UTCTime,
                    relativeTime        INTEGER (0..86400)
                    },
    duration        INTEGER (1..1024)   OPTIONAL,
    locationTime    INTEGER (0..1023)   OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Crowdsourcing-Time
absoluteTime This parameter provides the absolute UTC time corresponding to one measurement subset in seconds if available and otherwise in minutes. This parameter SHALL be provided for the first measurement subset reported by a target in one LPP transaction for which absolute time is available. Thereafter, a target may report time using the relativeTime parameter. The absolute time should preferably refer to the midpoint of a measurement subset.
relativeTime This parameter provides the time in seconds for a measurement subset relative to the time for the last measurement subset.
duration This parameter provides the duration of a measurement subset in seconds rounded up to the nearest second except for a value of 1024 which indicates a duration of more than 1023 seconds. Duration is measured from the time of the first measurement in a measurement subset to the time the last measurement in the measurement subset is obtained. This parameter is optional and SHALL be provided if available.
locationTime This parameter provides the time in seconds at which an absolute location and/or a relative location was/were obtained for the measurement subset relative to the start of (i.e. first measurement for) the measurement subset. This parameter is optional and SHALL be provided if available.

– *OMA-LPPe-ver2-0-Crowdsourcing-CommonData*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-CommonData* is used by a target to provide common data for crowdsourcing.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-CommonData ::= SEQUENCE {
    deviceType          OMA-LPPe-ver2-0-DeviceType                              OPTIONAL,
    reportNumber        INTEGER (1..16777216)                                   OPTIONAL,
    lastReportingTime   UTCTime                                                 OPTIONAL,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Crowdsourcing-CommonData
deviceType This optional parameter identifies the oem vendor and optionally the oem model and version for the target device. The parameter may also identify the vendor, model and version for each wireless baseband chip in the target device. This parameter should be included when available.
reportNumber This optional parameter provides the report number which SHALL start at one for the first crowdsourcing report and increase by one for each successive report. Should the maximum value be reached, all successive reports SHALL indicate the maximum number. This parameter is optional and may be omitted for anonymous crowdsourcing to help protect user privacy.
lastReportingTime This optional parameter provides the time of the last crowdsourcing measurement report to the data server. This may be used by a server to compile statistics on the frequency of reporting by a particular target or by all targets. This parameter is optional and may be omitted for anonymous crowdsourcing to help protect user privacy.

– *OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-Measurements*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-Measurements* is used by a target to report advanced crowdsourcing measurements for WLAN APs. The measurements for each AP are compressed by including measurements only for measurement subsets where measurements for the particular AP were obtained. The measurement subsets for which such measurements were obtained are referred to using the measurement subset index defined for the parameter advanced-measurement-subsets for the *OMA-LPPe-ver2-0-CrowdsourcingMeasurements* data type.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-Measurements ::= SEQUENCE (SIZE (1..ver2-0-maxAPs)) OF OMA-LPPe-
ver2-0-Crowdsourcing-WLAN-Single-AP-Measurements

ver2-0-maxAPs       INTEGER ::= 1024

OMA-LPPe-ver2-0-Crowdsourcing-WLAN-Single-AP-Measurements ::= SEQUENCE {
    apMACAddress            OMA-LPPe-WLAN-AP-ID,
    startIndex              INTEGER (1..ver2-0-maxMeasurements)             OPTIONAL,
    apMeasurements          SEQUENCE (SIZE (1..ver2-0-maxMeasurements)) OF CHOICE {
                                notPresent          NULL,
                                arePresent          SEQUENCE {
                                    static-ap-measurements  OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-
StaticMeasurements      OPTIONAL,       --Cond OnlyIfDifferentPerAP
                                    dynamic-ap-measurements OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-
DynamicMeasurements     OPTIONAL
                                }
                            },
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-StaticMeasurements ::= SEQUENCE {
    apSSID                  OCTET STRING (SIZE (1..32))     OPTIONAL,       --Cond OnlyIfDifferentPerAP
    operatingClass          INTEGER (0..255)                OPTIONAL,       --Cond OnlyIfDifferentPerAP
```

```
    apDeviceType            OMA-LPPe-WLAN-AP-Type           OPTIONAL,       --Cond OnlyIfDifferentPerAP
    apReportedLocation      OMA-LPPe-WLAN-ReportedLocation  OPTIONAL,       --Cond OnlyIfDifferentPerAP
    apEstimatedLocation     OMA-LPPe-RelativeLocation       OPTIONAL,       --Cond OnlyifDifferentPerAP
    apChannel               INTEGER (0..256)                OPTIONAL,       --Cond OnlyIfDifferentPerAP
    apAntennaGain           INTEGER (-127..128)             OPTIONAL,       --Cond OnlyIfDifferentPerAP
    ueAntennaGain           INTEGER (-127..128)             OPTIONAL,       --Cond OnlyIfDifferentPerAP
    apTransmitPower         INTEGER (-127..128)             OPTIONAL,       --Cond OnlyIfDifferentPerAP
    ...
}


OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-DynamicMeasurements ::= SEQUENCE {
    apSignaltoNoise         INTEGER (0..255)                OPTIONAL,
    apSignalStrength        INTEGER (0..255)                OPTIONAL,
    apRoundTripDelay        OMA-LPPe-WLAN-RTD               OPTIONAL,
    ueTransmitPower         INTEGER (-127..128)             OPTIONAL,
    ueSignaltoNoise         INTEGER  (0..255)               OPTIONAL,
    ueSignalStrength        INTEGER  (0..255)               OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
OnlyIfDiferentPerAP	This parameter is conditional and SHALL be included for the first measurement subset in which measurements for each WLAN AP are included and for any subsequent measurement subset for the same WLAN AP for which the parameter content has changed. The parameter SHALL NOT be included for any subsequent measurement subset for the same WLAN AP for which the parameter content is unchanged.

OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-Measurements
apMACAddress This parameter provides the MAC address for a WLAN AP for which crowdsourcing measurements are provided.
startIndex This parameter provides the index in the range 1-512 of the first measurement subset for which measurements for the AP are provided. If omitted, this parameter has the default value of 1.
apMeasurements This parameter provides measurements for the WLAN AP for a sequence of consecutive measurement subsets starting with the measurement subset with index given by startIndex. The number of measurement subsets for which measurements are provided plus (startIndex – 1) SHALL NOT exceed 512. The AP measurements for each measurement subset are provided as a CHOICE, where the parameter notPresent indicates that no measurements for the AP are present for this subset and the parameter arePresent indicates that measurements are present.
static-ap-measurements This parameter provides static measurements for the WLAN AP for one measurement subset. Static measurements refer to measurements that seldom or never change. This parameter SHALL be included if requested and available for the first measurement subset and for any subsequent measurement subset in which one or more of the contained measurements have changed.
dynamic-ap-measurements This parameter provides dynamic measurements for the WLAN AP for one measurement subset. Dynamic measurements refer to measurements that normally change. This parameter SHALL be included if requested and available for each measurement subset.
apSSID This parameter provides the SSID of the wireless network served by the AP.
operatingClass This parameter defines the Operating Class as defined in [IEEE 802.11].

OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-Measurements	
apDeviceType	
This parameter provides the AP device type – 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac or 802.11ad. The AP device type refers to the device type being used for signalling as opposed to the capability of the AP (for instance an 802.11n capable AP in e.g., 802.11a signalling mode).	
APReportedLocation	
This parameter provides the reported location of the AP in the form of the Location Configuration Information (LCI) defined in [IEEE 802.11][RFC 3825] and includes the following subfields:	
latitudeResolution:	6-bits indicating the number of valid bits in the fixed-point value of *latitude*. (This value is the number of high-order Latitude bits that should be considered valid. Any bits entered to the right of this limit should not be considered valid. Values above decimal 34 are undefined and reserved.)
latitude:	A 34-bits fixed point value consisting of 9-bits of integer and 25-bits of fraction indicating the Latitude (+/- 90 degrees) of the AP.
longitudeResolution:	6-bits indicating the number of valid bits in the fixed-point value of *longitude*. (This value is the number of high-order Longitude bits that should be considered valid. Any bits entered to the right of this limit should not be considered valid. Values above decimal 34 are undefined and reserved.)
longitude:	A 34-bits fixed point value consisting of 9-bits of integer and 25-bits of fraction indicating the Longitude (+/- 180 degrees) of the AP.
altitudeType:	Defines the altitude type. Codes defined are: 1: Meters of altitude. 2: Building floors of altitude.
altitude value	0.0 represents the floor level associated with ground level.
altitudeResolution:	6-bits indicating the number of valid bits in the *altitude*. (This value is the number of high-order Altitude bits that should be considered valid. Any bits entered to the right of this limit should not be considered valid. Values above decimal 30 are undefined and reserved.)
altitude:	A 30-bit fixed point value consisting of 22-bits of integer and 8-bits of fraction indicating the Altitude of the AP in units defined by *altitudeType*.
datum:	Defines the map datum used for the coordinates. Codes defined are: 1: World Geodetic System 1984 (WGS-84) 2: North American Datum 1983 (NAD-83) with North American Vertical Datum 1988 (NAVD-88) 3: North American Datum 1983 (NAD-83) with Mean Lower Low Water (MLLW) vertical datum.
apEstimatedLocation	
This parameter provides the estimated location of the AP as estimated by the target based on measurements of the AP. The location is expressed as a location relative to the target location for either (a) the most recent measurement subset (including the current subset) that is marked as an anchor point or (b) the current measurement subset if no anchor points were defined. The accuracy of the estimated location refers only to the accuracy of the relative location estimate itself, i.e. not including any uncertainty attributable to the reference location for the point to which the estimated location is relative. This means that the accuracy and confidence for the estimated location MUST be combined with those for the reference location when obtaining either an absolute location for the AP or a relative location for the AP relative to an earlier measurement subset. The parameter SHALL be included if requested and available.	
apChannel	
This parameter provides the AP channel number identification of the reported WLAN AP.	
apAntennaGain	
This parameter provides the antenna gain of the AP in dBi.	
ueAntennaGain	
This parameter provides the antenna gain of the target in dBi for transmission to the WLAN AP.	

OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-Measurements
apTransmitPower This parameter provides the power the AP transmits on a beacon, probe response or measurement pilot frame in dBm.
apSignaltoNoise This parameter provides the AP signal to noise ratio (S/N) of a beacon, probe response or measurement pilot frame in dB as measured at the target. The encoded value in the range 0-255 provides the S/N in the range -10 to 117.5 dB as follows: S/N = (encoded value / 2) – 10 The parameter SHALL be included if requested and available.
apSignalStrength This parameter provides the AP signal strength (RSSI) of a beacon frame, probe response frame or measurement pilot frame measured at the target in dBm on the channel indicated by the *apChannel* parameter. The encoded value in the range 0-255 provides the RSSI in the range -112.5 to 15 dBm as follows: RSSI = (encoded value / 2) – 112.5 The parameter SHALL be included if requested and available.
apRoundTripDelay This parameter provides the measured round trip delay between the target and WLAN AP and optionally the accuracy expressed as the standard deviation of the delay. Units for each of these are 1000ns, 100ns, 10ns, 1ns or 0.1ns. The parameter SHALL be included if requested and available.
ueTransmitPower This parameter provides the transmit power used by the target to access the WLAN AP in dBm. The parameter SHALL be included if requested and available.
ueSignaltoNoise This parameter provides the target's signal to noise ratio (S/N) measured at the AP in dB. The encoded value in the range 0-255 provides the S/N in the range -10 to 117.5 dB as follows: S/N = (encoded value / 2) – 10 The parameter SHALL be included if requested and available.
ueSignalStrength This field provides the target's signal strength (RSSI) measured at the AP on the channel indicated by the *apChannel* field in dBm. The encoded value in the range 0-255 provides the RSSI in the range -112.5 to 15 dBm as follows: RSSI = (encoded value / 2) – 112.5 The parameter SHALL be included if requested and available.

– *OMA-LPPe-ver2-0-Crowdsourcing-LTE-Measurements*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-LTE-Measurements* is used by a target to report advanced crowdsourcing measurements for LTE cells. The measurements for each cell are compressed by including measurements only for measurement subsets where measurements for the particular cell were obtained. The measurement subsets for which such measurements were obtained are referred to using the measurement subset index defined for the parameter advanced-measurement-subsets for the *OMA-LPPe-ver2-0-CrowdsourcingMeasurements* data type.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-LTE-Measurements ::= SEQUENCE (SIZE (1..ver2-0-maxLTECells)) OF OMA-LPPe-
ver2-0-Crowdsourcing-LTE-Single-Cell-Measurements

ver2-0-maxLTECells      INTEGER ::= 1024

OMA-LPPe-ver2-0-Crowdsourcing-LTE-Single-Cell-Measurements ::= SEQUENCE {
    plmn-Information            SEQUENCE {
        plmn-Identity               SEQUENCE {
                                    mcc     SEQUENCE (SIZE (3))     OF INTEGER (0..9),
```

```
                                    mnc     SEQUENCE (SIZE (2..3))  OF INTEGER (0..9),
                                    ...
                                    },
        multiple-PLMNs              BOOLEAN
                                }               OPTIONAL,   --Cond OnlyIfDifferentPerReport
    physCellId                  INTEGER (0..503),
    cellId                  BIT STRING (SIZE (28)),
    startIndex              INTEGER (1..ver2-0-maxMeasurements)             OPTIONAL,
    lteMeasurements             SEQUENCE (SIZE (1..ver2-0-maxMeasurements)) OF CHOICE {
                                notPresent          NULL,
                                arePresent          SEQUENCE {
                                    static-LTE-measurements OMA-LPPe-ver2-0-Crowdsourcing-LTE-
StaticMeasurements      OPTIONAL,       --Cond OnlyIfDifferentPerCell
                                    dynamic-LTE-measurements    OMA-LPPe-ver2-0-Crowdsourcing-LTE-
DynamicMeasurements     OPTIONAL
                                }
                            },
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-LTE-StaticMeasurements ::= SEQUENCE {
    arfcnEUTRA              SEQUENCE {
                            arfcn           ARFCN-ValueEUTRA,
                            arfcn-extension ARFCN-ValueEUTRA-v9a0 OPTIONAL  --Cond EARFCN-max
                            }                       OPTIONAL,       --Cond OnlyIfDifferentPerCell
    eNBestimatedLocation    OMA-LPPe-RelativeLocation   OPTIONAL,       --Cond OnlyIfDifferentPerCell
    ...
}


OMA-LPPe-ver2-0-Crowdsourcing-LTE-DynamicMeasurements ::= SEQUENCE {
    primaryCell             BOOLEAN,
    rsrp-Result             INTEGER (0..97)                 OPTIONAL,
    rsrq-Result             INTEGER (0..34)                 OPTIONAL,
    ue-RxTxTimeDiff         INTEGER (0..4095)               OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
OnlyIfDifferentPerReport	This parameter is conditional and SHALL be included only for the first reported cell in OMA-LPPe-ver2-0-Crowdsourcing-LTE-Measurements and for any subsequent reported cell where the parameter is different to that for the previous reported cell.
EARFCN-max	The field is mandatory present if the corresponding *arfcn* (i.e. without suffix) is set to *maxEARFCN* (65535). Otherwise the field is not present.
OnlyIfDiferentPerCell	This parameter is conditional and SHALL be included for the first measurement subset in which measurements for each LTE cell are included and for any subsequent measurement subset for the same cell for which the parameter content has changed. The parameter SHALL NOT be included for any subsequent measurement subset for the same cell for which the parameter content is unchanged.

OMA-LPPe-ver2-0-Crowdsourcing-LTE-Measurements
plmn-Information This parameter provides the PLMN identity for an LTE cell and indicates whether the cell supports more than PLMN. For a cell that supports more than one PLMN, the PLMN identity is for the primary PLMN.
physCellId This field specifies the physical cell identity of the reported cell.
cellId This field specifies the cell ID of the reported LTE cell.

OMA-LPPe-ver2-0-Crowdsourcing-LTE-Measurements
startIndex This parameter provides the index in the range 1-512 of the first measurement subset for which measurements for the LTE cell are provided. If omitted, this parameter has the default value of 1.
lteMeasurements This parameter provides measurements for the LTE cell for a sequence of consecutive measurement subsets starting with the measurement subset with index given by startIndex. The number of measurement subsets for which measurements are provided plus (startIndex – 1) SHALL NOT exceed 512. The LTE cell measurements for each measurement subset are provided as a CHOICE, where the parameter notPresent indicates that no measurements for the LTE cell are present for this subset and the parameter arePresent indicates that measurements are present.
static-lte-measurements This parameter provides static measurements for the LTE cell for one measurement subset. Static measurements refer to measurements that seldom or never change. This parameter SHALL be included for the first measurement subset and for any subsequent measurement subset in which one or more of the contained measurements have changed.
dynamic-lte-measurements This parameter provides dynamic measurements for the LTE cell for one measurement subset. Dynamic measurements refer to measurements that normally change. This parameter SHALL be included if requested and available for each measurement subset.
arfcnEUTRA This field specifies the ARFCN of the measured E-UTRA carrier frequency, as used in [LPP].
eNBestimatedLocation This parameter provides the estimated location of the eNB antenna for the reported cell as estimated by the target based on measurements of the cell. The location is expressed as a location relative to the target location for either (a) the most recent measurement subset (including the current subset) that is marked as an anchor point or (b) the current measurement subset if no anchor points were defined. The accuracy of the estimated location refers only to the accuracy of the relative location estimate itself, i.e. not including any uncertainty attributable to the reference location for the point to which the estimated location is relative. This means that the accuracy and confidence for the estimated location MUST be combined with those for the reference location when obtaining either an absolute location for the eNB or a relative location for the eNB relative to an earlier measurement subset. The parameter SHALL be included if requested and available.
primaryCell This parameter indicates if the reported cell is the primary serving cell for the target when the measurements are made.
rsrp-Result This field specifies the reference signal received power (RSRP) measurement, as defined in [36.331] and [36.214]. The parameter SHALL be included if requested and available.
rsrq-Result This field specifies the reference signal received quality (RSRQ) measurement, as defined in [36.331] amd [36.214]. The parameter SHALL be included if requested and available.
ue-RxTxTimeDiff This field specifies the target Rx–Tx time difference measurement, as defined in [36.214]. It is provided only for measurements on the target's primary cell. Measurement report mapping is according to [36.133]. The parameter SHALL be included if requested and available.

– *OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Measurements*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Measurements* is used by a target to report advanced crowdsourcing measurements for UTRA cells. The measurements for each cell are compressed by including measurements only for measurement subsets where measurements for the particular cell were obtained. The measurement subsets for which such measurements were obtained are referred to using the measurement subset index defined for the parameter advanced-measurement-subsets for the *OMA-LPPe-ver2-0-CrowdsourcingMeasurements* data type.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Measurements  ::=  SEQUENCE  (SIZE  (1..ver2-0-maxUTRACells))  OF  OMA-
LPPe-ver2-0-Crowdsourcing-UTRA-Single-Cell-Measurements

ver2-0-maxUTRACells     INTEGER ::= 512

OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Single-Cell-Measurements ::= SEQUENCE {
    plmn-Information            SEQUENCE {
        plmn-Identity               SEQUENCE {
                                    mcc     SEQUENCE (SIZE (3))     OF INTEGER (0..9),
                                    mnc     SEQUENCE (SIZE (2..3))  OF INTEGER (0..9),
                                    ...
                                    },
        multiple-PLMNs              BOOLEAN
                                }               OPTIONAL,   --Cond OnlyIfDifferentPerReport
    cellId                  BIT STRING (SIZE (32)),
    startIndex              INTEGER (1..ver2-0-maxMeasurements)             OPTIONAL,
    utraMeasurements            SEQUENCE (SIZE (1..ver2-0-maxMeasurements)) OF CHOICE {
                                notPresent          NULL,
                                arePresent          SEQUENCE {
                                    static-UTRA-measurements    OMA-LPPe-ver2-0-Crowdsourcing-UTRA-
StaticMeasurements      OPTIONAL,       --Cond OnlyIfDifferentPerCell
                                    dynamic-UTRA-measurements   OMA-LPPe-ver2-0-Crowdsourcing-UTRA-
DynamicMeasurements     OPTIONAL
                                }
                            },
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-UTRA-StaticMeasurements ::= SEQUENCE {
    uarfcn                  CHOICE {
                            fdd-DL      ARFCN-ValueUTRA,
                            tdd         ARFCN-ValueUTRA
                            }                       OPTIONAL,       --Cond OnlyifDifferentPerCell
    physicalID              CHOICE {
                            fdd         OMA-LPPe-OTDOA-UTRA-PrimaryScramblingCode,
                            tdd         OMA-LPPe-OTDOA-UTRA-CellParametersID
                            }                       OPTIONAL,       --Cond OnlyifDifferentPerCell
    nBestimatedLocation     OMA-LPPe-RelativeLocation   OPTIONAL,       --Cond OnlyifDifferentPerCell
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-UTRA-DynamicMeasurements ::= SEQUENCE {
    utra-CarrierRSSI        OMA-LPPe-ECID-UTRA-CarrierRSSI  OPTIONAL,   --Cond FirstOnly
    servingCell             BOOLEAN,
    modeSpecificInfo        CHOICE {
        fdd     SEQUENCE {
                        cpich-Ec-N0         OMA-LPPe-ECID-UTRA-CPICH-Ec-N0          OPTIONAL,
                        cpich-RSCP          OMA-LPPe-ECID-UTRA-CPICH-RSCP           OPTIONAL,
                        fdd-pathloss        OMA-LPPe-ECID-UTRA-Pathloss             OPTIONAL,
                        ...
                },
        tdd     SEQUENCE {
                        primaryCCPCH-RSCP   OMA-LPPe-ECID-UTRA-PrimaryCCPCH-RSCP    OPTIONAL,
                        tdd-pathloss        OMA-LPPe-ECID-UTRA-Pathloss             OPTIONAL,
                        utratimingAdvance   OMA-LPPe-ECID-UTRA-UTRATimingAdvance    OPTIONAL,
                        ...
                }
    },
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
OnlyIfDifferentPerReport	This parameter is conditional and SHALL be included only for the first reported cell in OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Measurements and for any subsequent reported cell where the parameter is different to that for the previous reported cell.
FirstOnly	The parameter is conditional and SHALL be included if available only for the first reported cell in each measurement subset measured by the target using a particular UARFCN.
OnlyIfDiferentPerCell	This parameter is conditional and SHALL be included for the first measurement subset for any UTRA cell in which measurements for the cell are included and for any subsequent measurement subset for the same cell for which the parameter content has changed. The parameter SHALL NOT be included for any subsequent measurement subset for the cell for which the parameter content is unchanged.

OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Measurements
plmn-Information This parameter provides the PLMN identity for an UTRA cell and indicates whether the cell supports more than PLMN. For a cell that supports more than one PLMN, the PLMN identity is for the primary PLMN.
cellId This field specifies cell ID of the reported UTRA cell.
startIndex This parameter provides the index in the range 1-512 of the first measurement subset for which measurements for the LTE cell are provided. If omitted, this parameter has the default value of 1.
utraMeasurements This parameter provides measurements for the UTRA cell for a sequence of consecutive measurement subsets starting with the measurement subset with index given by startIndex. The number of measurement subsets for which measurements are provided plus (startIndex – 1) SHALL NOT exceed 512. The UTRA cell measurements for each measurement subset are provided as a CHOICE, where the parameter notPresent indicates that no measurements for the UTRA cell are present for this subset and the parameter arePresent indicates that measurements are present.
static-utra-measurements This parameter provides static measurements for the UTRA cell for one measurement subset. Static measurements refer to measurements that seldom or never change. This parameter SHALL be included for the first measurement subset and for any subsequent measurement subset in which one or more of the contained measurements have changed.
dynamic-utra-measurements This parameter provides dynamic measurements for the UTRA cell for one measurement subset. Dynamic measurements refer to measurements that normally change. This parameter SHALL be included if requested and available for each measurement subset.
uarfcn This field specifies the UARFCN for which measurements were made – either the downlink UARFCN for FDD as specified in [25.101] or the UARFCN for TDD as specified in [25.102].
physicalID For FDD, this field provides the scrambling code (0-511) for the primary CPICH. For TDD, this field provides the cell parameter ID (0-127).
nBestimatedLocation This parameter provides the estimated location of the Node B antenna for the reported cell as estimated by the target based on measurements of the cell. The location is expressed as a location relative to the target location for either (a) the most recent measurement subset (including the current subset) that is marked as an anchor point or (b) the current measurement subset if no anchor points were defined. The accuracy of the estimated location refers only to the accuracy of the relative location estimate itself, i.e. not including any uncertainty attributable to the reference location for the point to which the estimated location is relative. This means that the accuracy and confidence for the estimated location MUST be combined with those for the reference location when obtaining either an absolute location for the Node B or a relative location for the Node B relative to an earlier measurement subset. The parameter SHALL be included if requested and available.

OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Measurements
utra-CarrierRSSI This parameter provides the UTRA Carrier RSSI level for the UARFCN measured for the cell in the range 0-76 as defined and encoded in [25.133] for FDD and [25.123] for TDD. Values over 76 are spare (not used). This parameter SHALL be included if requested and available for the first reported cell for the UARFCN being measured.
servingCell This parameter indicates if the reported cell is a serving cell for the target when the measurements are made.
cpich-Ec-N0 This parameter is applicable only to FDD and provides an encoded value for CPICH_Ec/Io. This is the ratio of the received energy per PN chip for the CPICH to the total received power spectral density at the UE antenna connector. For a target that is able to simultaneously receive signals from more than 1 carrier, CPICH_Ec/Io is defined for each carrier individually. The encoding is as defined in [25.133]. The value range for this field is 0-63, but values over 49 are not used. This parameter SHALL be provided if requested and available.
cpich-RSCP This parameter provides an encoded value for the CPICH RSCP. The encoding is based on [25.331] and [25.133] as follows: cpich-RSCP = 123 CPICH RSCP < -120 dBm cpich-RSCP = 124 -120 ≤ CPICH RSCP < -119 dBm cpich-RSCP = 125 -119 ≤ CPICH RSCP < -118 dBm cpich-RSCP = 126 -118 ≤ CPICH RSCP < -117 dBm cpich-RSCP = 127 -117 ≤ CPICH RSCP < -116 dBm cpich-RSCP = 0 -116 ≤ CPICH RSCP < -115 dBm cpich-RSCP = 1 -115 ≤ CPICH RSCP < -114 dBm … … … cpich-RSCP = 89 -27 ≤ CPICH RSCP < -26 dBm cpich-RSCP = 90 -26 ≤ CPICH RSCP < -25 dBm cpich-RSCP = 91 -25 ≤ CPICH RSCP dB The value range of this parameter is 0-127 with values in the range 92-122 not used. This parameter SHALL be provided if requested and available.
fdd-pathloss The parameter provides the path loss for FDD in the range 46-158 dB. Values above 158 are spare. This parameter SHALL be provided if requested and available.

OMA-LPPe-ver2-0-Crowdsourcing-UTRA-Measurements
primaryCCPCH-RSCP This paremeter provides the encoded value for the primary CCPCH RSCP for TDD. Encoding is based on [25.331] and [25.123] as follows: cpich-RSCP = 123 CPICH RSCP < -120 dBm cpich-RSCP = 124 -120 ≤ CPICH RSCP < -119 dBm cpich-RSCP = 125 -119 ≤ CPICH RSCP < -118 dBm cpich-RSCP = 126 -118 ≤ CPICH RSCP < -117 dBm cpich-RSCP = 127 -117 ≤ CPICH RSCP < -116 dBm cpich-RSCP = 0 -116 ≤ CPICH RSCP < -115 dBm cpich-RSCP = 1 -115 ≤ CPICH RSCP < -114 dBm … … … cpich-RSCP = 89 -27 ≤ CPICH RSCP < -26 dBm cpich-RSCP = 90 -26 ≤ CPICH RSCP < -25 dBm cpich-RSCP = 91 -25 ≤ CPICH RSCP dB The value range of this parameter is 0-127 with values in the range 92-122 not used. This parameter SHALL be provided if requested and available.
tdd-pathloss This parameter provides the path loss for TDD in the range 46-158 dB. Values above 158 are spare. This parameter SHALL be provided if requested and available.
utraTimingAdvance This parameter provides the timing advance for TDD. This is measured as defined in [25.225] for 1.28Mcps TDD (though applies also to 3.84 and 7.68 Mcps). Encoding uses the following fields: tA: timing advance in the range 0-8191 tAResolution: units for tA res1-0chip: 1.0 chips res0-5chip: 0.5 chips res0-125chip: 0.125 chips (default value if absent) chipRate : chip rate tdd128: 1.28 Mcps (default if absent) tdd384: 3.84 Mcps tdd768: 7.68 Mcps This parameter SHALL be provided for a serving cell if requested and available.

– OMA-LPPe-ver2-0-Crowdsourcing-GSM-Measurements

The IE *OMA-LPPe-ver2-0-Crowdsourcing-GSM-Measurements* is used by a target to report advanced crowdsourcing measurements for GSM cells. The measurements for each cell are compressed by including measurements only for measurement subsets where measurements for the particular cell were obtained. The measurement subsets for which such measurements were obtained are referred to using the measurement subset index defined for the parameter advanced-measurement-subsets for the *OMA-LPPe-ver2-0-CrowdsourcingMeasurements* data type.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-GSM-Measurements ::= SEQUENCE (SIZE (1..ver2-0-maxGSMCells)) OF OMA-LPPe-
ver2-0-Crowdsourcing-GSM-Single-Cell-Measurements

ver2-0-maxGSMCells      INTEGER ::= 256
```

```
OMA-LPPe-ver2-0-Crowdsourcing-GSM-Single-Cell-Measurements ::= SEQUENCE {
    plmn-Identity           SEQUENCE {
                                mcc     SEQUENCE (SIZE (3))     OF INTEGER (0..9),
                                mnc     SEQUENCE (SIZE (2..3))  OF INTEGER (0..9),
                                ...
                                }                   OPTIONAL,   --Cond OnlyIfDifferentPerReport
    locationAreaCode        BIT STRING (SIZE (16))  OPTIONAL,   --Cond OnlyIfDifferentPerReport
    cellId                  BIT STRING (SIZE (16)),
    bsic-bcch               OMA-LPPe-CellNonUniqueIDGERAN,
    startIndex              INTEGER (1..ver2-0-maxMeasurements)             OPTIONAL,
    gsmMeasurements             SEQUENCE (SIZE (1..ver2-0-maxMeasurements)) OF CHOICE {
                                notPresent          NULL,
                                arePresent          SEQUENCE {
                                    static-GSM-measurements OMA-LPPe-ver2-0-Crowdsourcing-GSM-
StaticMeasurements      OPTIONAL,       --Cond OnlyIfDifferentPerCell
                                    dynamic-GSM-measurements    OMA-LPPe-ver2-0-Crowdsourcing-GSM-
DynamicMeasurements     OPTIONAL
                                }
                            },
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-GSM-StaticMeasurements ::= SEQUENCE {
    btsEstimatedLocation    OMA-LPPe-RelativeLocation   OPTIONAL,       --Cond OnlyifDifferentPerCell
    ...
}


OMA-LPPe-ver2-0-Crowdsourcing-GSM-DynamicMeasurements ::= SEQUENCE {
    servingCell             BOOLEAN,
    rxLevel                 INTEGER (0..63)                 OPTIONAL,
    tA                      INTEGER (0..255)                OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
OnlyIfDifferentPerReport	This parameter is conditional and SHALL be included only for the first reported cell in OMA-LPPe-ver2-0-Crowdsourcing-GSM-Measurements and for any subsequent reported cell where the parameter is different to that for the previous reported cell.
OnlyIfDiferentPerCell	This parameter is conditional and SHALL be included for the first measurement subset for any GSM cell in which measurements for the cell are included and for any subsequent measurement subset for the same cell for which the parameter content has changed. The parameter SHALL NOT be included for any subsequent measurement subset for the cell for which the parameter content is unchanged.

OMA-LPPe-ver2-0-Crowdsourcing-GSM-Measurements
plmn-Identity This parameter provides the PLMN identity for the reported GSM cell.
locationAreaCode This parameter provides the location area code for the reported GSM cell.
cellId This parameter provides the cell ID for the reported GSM cell.
bsic-bcch This parameter provides the BSIC and BCCH ARFCN for the reported GSM cell.

OMA-LPPe-ver2-0-Crowdsourcing-GSM-Measurements
startIndex This parameter provides the index in the range 1-512 of the first measurement subset for which measurements for the GSM cell are provided. If omitted, this parameter has the default value of 1.
gsmMeasurements This parameter provides measurements for the GSM cell for a sequence of consecutive measurement subsets starting with the measurement subset with index given by startIndex. The number of measurement subsets for which measurements are provided plus (startIndex – 1) SHALL NOT exceed 512. The GSM cell measurements for each measurement subset are provided as a CHOICE, where the parameter notPresent indicates that no measurements for the GSM cell are present for this subset and the parameter arePresent indicates that measurements are present.
static-gsm-measurements This parameter provides static measurements for the GSM cell for one measurement subset. Static measurements refer to measurements that seldom or never change. This parameter SHALL be included for the first measurement subset and for any subsequent measurement subset in which one or more of the contained measurements have changed.
dynamic-gsm-measurements This parameter provides dynamic measurements for the GSM cell for one measurement subset. Dynamic measurements refer to measurements that normally change. This parameter SHALL be included if requested and available for each measurement subset.
btsEstimatedLocation This parameter provides the estimated location of the BTS antenna for the reported cell as estimated by the target based on measurements of the cell. The location is expressed as a location relative to the target location for either (a) the most recent measurement subset (including the current subset) that is marked as an anchor point or (b) the current measurement subset if no anchor points were defined. The accuracy of the estimated location refers only to the accuracy of the relative location estimate itself, i.e. not including any uncertainty attributable to the reference location for the point to which the estimated location is relative. This means that the accuracy and confidence for the estimated location MUST be combined with those for the reference location when obtaining either an absolute location for the BTS or a relative location for the BTS relative to an earlier measurement subset. The parameter SHALL be included if requested and available.
servingCell This parameter indicates if the reported cell is the serving cell for the target when the measurements are made.
rxLevel This field specifies the received signal level for a measured cell. Rx-level is encoded according to [45.008] as: 0: < -110 dBm. 1: -110 dBm to -109 dBm. 2: -109 dBm to -108 dBm. … 62: -49 dBm to -48 dBm. 63: >= -48 dBm. This field SHALL be included if requested and available.
tA This field specifies the timing advance of a serving cell in units of 48/13µs (length of a GSM bit). This provides an approximation for the round trip propagation time between the target and the base station of the measured cell. This field SHALL be included if requested and available.

– *OMA-LPPe-ver2-0-Crowdsourcing-SRN-Measurements*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-SRN-Measurements* is used by a target to report advanced crowdsourcing measurements for SRN access points. The measurements for each SRN AP are compressed by including measurements only for measurement subsets where measurements for the particular AP were obtained. The measurement subsets for which such measurements were obtained are referred to using the measurement subset index defined for the parameter advanced-measurement-subsets for the *OMA-LPPe-ver2-0-CrowdsourcingMeasurements* data type.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-SRN-Measurements ::= SEQUENCE (SIZE (1..ver2-0-maxSRNAPs)) OF OMA-LPPe-ver2-0-Crowdsourcing-SRN-AP-Measurements

ver2-0-maxSRNAPs        INTEGER ::= 1024

OMA-LPPe-ver2-0-Crowdsourcing-SRN-AP-Measurements ::= SEQUENCE {
    srnID                   OMA-LPPe-SRN-SRNid,
    srnCategory             OMA-LPPe-SRN-Category   OPTIONAL, --Cond OnlyIfDifferentPerReport
    startIndex              INTEGER (1..ver2-0-maxMeasurements)             OPTIONAL,
    srnMeasurements             SEQUENCE (SIZE (1..ver2-0-maxMeasurements)) OF CHOICE {
                                notPresent          NULL,
                                arePresent          SEQUENCE {
                                    static-SRN-measurements OMA-LPPe-ver2-0-Crowdsourcing-SRN-StaticMeasurements      OPTIONAL,       --Cond OnlyIfDifferentPerAP
                                    dynamic-SRN-measurements    OMA-LPPe-ver2-0-Crowdsourcing-SRN-DynamicMeasurements     OPTIONAL
                                }
                            },
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-SRN-StaticMeasurements ::= SEQUENCE {
    apReportedLocation      OMA-LPPe-ver2-0-SRN-ReportedLocation OPTIONAL,  --Cond OnlyIfDifferentPerAP
    aPestimatedLocation     OMA-LPPe-RelativeLocation           OPTIONAL,       --Cond OnlyIfDifferentPerAP
    ...
}

OMA-LPPe-ver2-0-SRN-ReportedLocation ::= CHOICE {
    coarse-3D               EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
    fine-3D                 OMA-LPPe-HighAccuracy3Dposition,
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-SRN-DynamicMeasurements ::= SEQUENCE {
    rssi                INTEGER(-128..127)      OPTIONAL,
    rtd                 OMA-LPPe-WLAN-RTD       OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
OnlyIfDifferentPerReport	This parameter is conditional and SHALL be included only for the first reported SRN AP in OMA-LPPe-ver2-0-Crowdsourcing-SRN-Measurements and for any subsequent reported SRN AP where the parameter is different to that for the previous reported SRN AP.
OnlyIfDiferentPerAP	This parameter is conditional and SHALL be included for the first measurement subset in which measurements for any SRN AP are included and for any subsequent measurement subset for the same AP for which the parameter content has changed. The parameter SHALL NOT be included for any subsequent measurement subset for the same AP for which the parameter content is unchanged.

OMA-LPPe-ver2-0-Crowdsourcing-SRN-Measurements
srnID This field identifies the SRN AP.
srnCategory This field identifies the SRN technology and may indicate an SRN vendor.

OMA-LPPe-ver2-0-Crowdsourcing-SRN-Measurements
startIndex This parameter provides the index in the range 1-512 of the first measurement subset for which measurements for the SRN AP are provided. If omitted, this parameter has the default value of 1.
srnMeasurements This parameter provides measurements for the SRN AP for a sequence of consecutive measurement subsets starting with the measurement subset with index given by startIndex. The number of measurement subsets for which measurements are provided plus (startIndex – 1) SHALL NOT exceed 512. The SRN AP measurements for each measurement subset are provided as a CHOICE, where the parameter notPresent indicates that no measurements for the SRN AP are present for this subset and the parameter arePresent indicates that measurements are present.
static-srn-measurements This parameter provides static measurements for the SRN AP for one measurement subset. Static measurements refer to measurements that seldom or never change. This parameter SHALL be included for the first measurement subset and for any subsequent measurement subset in which one or more of the contained measurements have changed.
dynamic-srn-measurements This parameter provides dynamic measurements for the SRN AP for one measurement subset. Dynamic measurements refer to measurements that normally change. This parameter SHALL be included if requested and available for each measurement subset.
apReportedLocation This parameter provides the location of the AP as reported by the AP. The target should report the location using a precision at least equal to that reported by the AP. This parameter SHALL be included if requested and available.
aPestimatedLocation This parameter provides the estimated location of the SRN AP as estimated by the target based on measurements of the SRN AP. The location is expressed as a location relative to the target location for either (a) the most recent measurement subset (including the current subset) that is marked as an anchor point or (b) the current measurement subset if no anchor points were defined. The accuracy of the estimated location refers only to the accuracy of the relative location estimate itself, i.e. not including any uncertainty attributable to the reference location for the point to which the estimated location is relative. This means that the accuracy and confidence for the estimated location MUST be combined with those for the reference location when obtaining either an absolute location for the SRN AP or a relative location for the SRN AP relative to an earlier measurement subset. The parameter SHALL be included if requested and available.
rssi This field provides the Received Signal Strength Indicator. The interpretation and the scale are SRN-type specific.
rtd This field provides the measured round trip delay between the target and the SRN AP, and optionally the accuracy expressed as the standard deviation of the delay.

– *OMA-LPPe-ver2-0-Crowdsourcing-Sensor-Measurements*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-Sensor-Measurements* is used by a target to report advanced crowdsourcing measurements derived from sensors. The measurements are compressed by including measurements only for measurement subsets where measurements were obtained. The measurement subsets for which such measurements were obtained are referred to using the measurement subset index defined for the parameter advanced-measurement-subsets for the *OMA-LPPe-ver2-0-CrowdsourcingMeasurements* data type.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-Sensor-Measurements ::= SEQUENCE {
    startIndex              INTEGER (1..ver2-0-maxMeasurements)             OPTIONAL,
    sensorMeasurements          SEQUENCE (SIZE (1..ver2-0-maxMeasurements)) OF CHOICE {
                                notPresent          NULL,
                                arePresent          SEQUENCE {
```

```
                              static-Sensor-measurements  OMA-LPPe-ver2-0-Crowdsourcing-Sensor-
StaticMeasurements      OPTIONAL,       --Cond OnlyIfDifferent
                              dynamic-Sensor-measurements OMA-LPPe-ver2-0-Crowdsourcing-Sensor-
DynamicMeasurements     OPTIONAL
                                  }
                          },
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-Sensor-StaticMeasurements ::= SEQUENCE {
    ...
}


OMA-LPPe-ver2-0-Crowdsourcing-Sensor-DynamicMeasurements ::= SEQUENCE {
    motionState             OMA-LPPe-Sensor-MotionStateList         OPTIONAL,
    atmosphericPressure     INTEGER (30000..115000)                 OPTIONAL,
    temperature             INTEGER (-100..100)                     OPTIONAL,
    humidity                INTEGER (0..100)                        OPTIONAL,
    soundLevel              INTEGER (0..200)                        OPTIONAL,
    illuminance             INTEGER (-100..100)                     OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
OnlyIfDiferent	This parameter is conditional and SHALL be included for the first measurement subset in which static sensor measurements are available and for any subsequent measurement subset for which the parameter content has changed. The parameter SHALL NOT be included for any subsequent measurement subset for which the parameter content is unchanged.

OMA-LPPe-ver2-0-Crowdsourcing-Sensor-Measurements
startIndex   This parameter provides the index in the range 1-512 of the first measurement subset for which sensor cmeasurements are provided. If omitted, this parameter has the default value of 1.
sensorMeasurements   This parameter provides sensor measurements for a sequence of consecutive measurement subsets starting with the measurement subset with index given by startIndex. The number of measurement subsets for which measurements are provided plus (startIndex – 1) SHALL NOT exceed 512. The sensor measurements for each measurement subset are provided as a CHOICE, where the parameter notPresent indicates that no sensor measurements are present for this subset and the parameter arePresent indicates that measurements are present.
static-sensor-measurements   This parameter provides static sensor measurements for one measurement subset. Static measurements refer to measurements that seldom or never change. In LPPe version 2.0, this parameter is a placeholder and SHALL NOT be included by a target.
dynamic-sensor-measurements   This parameter provides dynamic sensor measurements for one measurement subset. Dynamic measurements refer to measurements that normally change. This parameter SHALL be included if requested and available. The parameter need only be provided for one measurement subset for each measurement set.
motionState   This parameter provides the motion state of the target during the measurement subset. This parameter SHALL be included if requested and available.
atmosphericPressure   This parameter provides the atmospheric pressure in units of Pa. This parameter SHALL be included if requested and available.

OMA-LPPe-ver2-0-Crowdsourcing-Sensor-Measurements
temperature This parameter provides the temperature at the target in degrees Celsius. This parameter SHALL be included if requested and available.
humidity This parameter provides the humidity as a percentage. This parameter SHALL be included if requested and available.
soundLevel This parameter provides the average sound level during all or part of a measurement set in units of dB relative to a standard sound pressure of 20 µPa. This parameter SHALL be included if requested and available.
illuminance This parameter provides the average illuminance at the target during all or part of a measurement set. The parameter is expressed as 10 Log_{10} (I) rounded to the nearest integer where I is the average illuminance measured in lux. This parameter SHALL be included if requested and available.

6.5.14.4 Crowdsourcing Capability Information

– *OMA-LPPe-ver2-0-Crowdsourcing-ProvideCapabilities*

The IE *OMA-LPPe-Crowdsourcing-ProvideCapabilities* is used by a target to provide its capabilities for crowdsourcing to a server. The IE is not included when a target does not support crowdsourcing.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-ProvideCapabilities ::= SEQUENCE {
    basicCrowdsourcingCapabilities      SEQUENCE {
        basicControlParameterCapabilities   OMA-LPPe-ver2-0-Crowdsourcing-ControlParamaterCapabilities,
        basicMeasurementCapabilities        OMA-LPPe-ver2-0-Crowdsourcing-BasicMeasurementCapabilities,
        ...
    }           OPTIONAL,
    advancedCrowdsourcingCapabilities       SEQUENCE {
        advancedControlParameterCapabilities    OMA-LPPe-ver2-0-Crowdsourcing-
ControlParamaterCapabilities,
        advancedMeasurementCapabilities     OMA-LPPe-ver2-0-Crowdsourcing-
AdvancedMeasurementCapabilities,

        ...
    }           OPTIONAL,
    crowdsourcing-session   OMA-LPPe-ver2-0-CrowdsourcingSessionID      OPTIONAL,   --Cond ActiveSession
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-ControlParamaterCapabilities ::= SEQUENCE {
    controlParameters   BIT STRING {
                        locationPrecision                       (0),
                        geographicArea                          (1),
                        country-network                         (2),
                        detectedTransmitters                    (3),
                        targetMotionState                       (4),
                        environment                             (5),
                        logicalTriggerCombination               (6),
                        activationDelay                         (7),
                        deactivationDelay                       (8),
                        measurementPeriodicity                  (9),
                        measurementMovement                     (10),
                        measurementFloorChange                  (11),
                        measurementChangeOfServingCellOrAP      (12),
                        logicalMeasurementCombination           (13),
                        realTimeReporting                       (14),
                        quasiRealTimeReporting                  (15),
                        batchReporting                          (16),
                        batchReportPeriodicity                  (17),
                        batchReportMovement                     (18),
                        batchReportOnChangeOfServingNetwork     (19),
```

```
                        batchAccessNetworkRestriction           (20),
                        batchStorageOverflow                    (21),
                        crowdsourcingStartTime                  (22),
                        crowdsourcingDuration                   (23)}   (SIZE (1..32)),
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-BasicMeasurementCapabilities ::= SEQUENCE {
    basicPosMethods     BIT STRING {
                        lpp-otdoa   (0),
                        lpp-ecid    (1),
                        otdoa       (2),
                        eotd        (3),
                        otdoa-utra  (4),
                        lte-ecid    (5),
                        gsm-ecid    (6),
                        utra-ecid   (7),
                        wlan-ap     (8),
                        wimax       (9),
                        sensor      (10),
                        srn         (11),
                        pdr         (12),
                        irb         (13)}   (SIZE(1..32)),
    basicSupportedMeasurements  ENUMERATED  {sameAsPositioning,subsetOfPositioning,
supersetOfPositioning, other, ... },
    ...
}

OMA-LPPe-ver2-0-Crowdsourcing-AdvancedMeasurementCapabilities ::= SEQUENCE {
    wlan-ap-advancedMeasurements    OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-MeasurementCapabilities
    OPTIONAL,
    lte-advancedMeasurements    OMA-LPPe-ver2-0-Crowdsourcing-LTE-MeasurementCapabilities   OPTIONAL,
    utra-advancedMeasurements   OMA-LPPe-ver2-0-Crowdsourcing-UTRA-MeasurementCapabilities  OPTIONAL,
    gsm-advancedMeasurements    OMA-LPPe-ver2-0-Crowdsourcing-GSM-MeasurementCapabilities   OPTIONAL,
    srn-advancedMeasurements    OMA-LPPe-ver2-0-Crowdsourcing-SRN-MeasurementCapabilities   OPTIONAL,
    sensor-advancedMeasurements OMA-LPPe-ver2-0-Crowdsourcing-Sensor-MeasurementCapabilities
    OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
ActiveSession	This parameter is conditional and SHALL be included if and only if there is an ongoing crowdsourcing session with the target for which the server is the control server or data server (or both).

OMA-LPPe-ver2-0-Crowdsourcing-ProvideCapabilities **field descriptions**
basicCrowdsourcingCapabilities This parameter specifies target capabilities for basic crowdsourcing. This parameter is optional and if not included indicates that a target does not support basic crowdsourcing.
basicControlParameterCapabilities This parameter specifies the control parameters supported by a target for basic crowdsourcing.
basicMeasurementCapabilities This parameter specifies the measurements supported by a target for basic crowdsourcing.
advancedCrowdsourcingCapabilities This parameter specifies target capabilities for advanced crowdsourcing. This parameter is optional and if not included indicates that a target does not support advanced crowdsourcing.
advancedControlParameterCapabilities This parameter specifies the control parameters supported by a target for advanced crowdsourcing.

OMA-LPPe-ver2-0-Crowdsourcing-ProvideCapabilities field descriptions
advancedMeasurementCapabilities This parameter specifies the measurements supported by a target for advanced crowdsourcing.
crowdsourcing-session This parameter provides the crowdsourcing session ID for any ongoing crowdsourcing session between the target and the server. This parameter is optional and if not included indicates that there is no ongoing crowdsourcing session between the target and the server. A server may use the query procedure to discover the control parameters and measurements in use for any reported crowdsourcing session – e.g. if the server does not record these.
controlParameters This parameter indicates the control parameters supported by the target for either basic or advanced crowdsourcing. The parameter is encoded as a bit string with each control parameter represented by a different bit. A bit is set to one to indicate that the corresponding control parameter is supported by the target. A bit is set to zero or omitted to indicate that the corresponding control parameter is not supported by the target. A target SHALL minimally support the default requirements for absence of control parameters for activation triggers, measurement triggers, reporting triggers and/or duration parameters in a crowdsourcing request from a control server. Ths enables a control server to set up default crowdsourcing in a target even when the target supports few or no control parameters.
basicPosmethods This parameter indicates the positioning methods for which a target supports basic crowdsourcing measurements. The parameter is encoded as a bit string with each positioning method represented by a different bit. A bit is set to one to indicate that crowdsourcing measurements for the corresponding positioning method are supported by the target. A bit is set to zero or omitted to indicate that crowdsourcing measurements for the corresponding positioning method are not supported by the target.
basicSupportedMeasurements This parameter indicates whether a target supports the same measurements for crowdsourcing for each positioning method for which basic crowdsourcing is supported as the target supports for positioning. The choices are an indication of the same measurements for all position methods, a subset of measurements for some or all position methods (where measurements may be the same for some position methods and a subset for others), a superset of measurements (where measurements may be the same for some position methods and a superset for others) or some other relationship (e.g. a mixture of subsets and supersets).
wlan-ap-advancedMeasurements This parameter indicates the WLAN AP advanced crowdsourcing measurements supported by a target. This parameter is optional and if not included indicates that a target does not support advanced crowdsourcing for WLAN APs.
lte-advancedMeasurements This parameter indicates the LTE advanced crowdsourcing measurements supported by a target. This parameter is optional and if not included indicates that a target does not support advanced crowdsourcing for LTE.
utra-advancedMeasurements This parameter indicates the UTRA advanced crowdsourcing measurements supported by a target. This parameter is optional and if not included indicates that a target does not support advanced crowdsourcing for UTRA.
gsm-advancedMeasurements This parameter indicates the GSM advanced crowdsourcing measurements supported by a target. This parameter is optional and if not included indicates that a target does not support advanced crowdsourcing for GSM.
srn-advancedMeasurements This parameter indicates the SRN advanced crowdsourcing measurements supported by a target. This parameter is optional and if not included indicates that a target does not support advanced crowdsourcing for SRN.
sensor-advancedMeasurements This parameter indicates the sensor advanced crowdsourcing measurements supported by a target. This parameter is optional and if not included indicates that a target does not support advanced crowdsourcing for sensors.

6.5.14.5 Crowdsourcing Capability Information Request

– *OMA-LPPe-ver2-0-Crowdsourcing-RequestCapabilities*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-RequestCapabilities* is used to request crowdsourcing capabilities information from the target.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.14.6 Crowdsourcing Capability Information Elements

– *OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-MeasurementCapabilities*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-MeasurementCapabilites* is used by a target to provide its capabilities for advanced crowdsourcing of WLAN AP measurements to a server.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-MeasurementCapabilities ::= SEQUENCE {
    measurements        BIT STRING {
                        apSSID              (0),
                        operatingClass      (1),
                        apDeviceType        (2),
                        apReportedLocation  (3),
                        apEstimatedLocation (4),
                        apChannel           (5),
                        apAntennaGain       (6),
                        ueAntennaGain       (7),
                        apTransmitPower     (8),
                        apSignaltoNoise     (9),
                        apSignalStrength    (10),
                        apRoundTripDelay    (11),
                        ueTransmitPower     (12),
                        ueSignaltoNoise     (13),
                        ueSignalStrength    (14)} (SIZE (1..32)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Crowdsourcing-WLAN-AP-MeasurementCapabilities field descriptions
measurements This parameter specifies the WLAN AP measurements supported by a target for advanced crowdsourcing. The parameter is encoded as a bit string with each WLAN AP measurement represented by a different bit. A bit is set to one to indicate that the corresponding WLAN AP measurement is supported by the target. A bit is set to zero or omitted to indicate that the corresponding WLAN AP measurement is not supported by the target.

– *OMA-LPPe-ver2-0-Crowdsourcing-LTE-MeasurementCapabilities*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-LTE-MeasurementCapabilites* is used by a target to provide its capabilities for advanced crowdsourcing of LTE measurements to a server.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-LTE-MeasurementCapabilities ::= SEQUENCE {
    measurements        BIT STRING {
                        eNBEstimatedLocation    (0),
                        rsrp                    (1),
                        rsrq                    (2),
                        ueRxTx                  (3),
                        non-serving-cell        (4),
                        non-serving-plmn        (5)} (SIZE (1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Crowdsourcing-LTE-MeasurementCapabilities **field descriptions**
Measurements
This parameter specifies the LTE measurements supported by a target for advanced crowdsourcing. The parameter is encoded as a bit string with each LTE measurement capability represented by a different bit. A bit is set to one to indicate that the corresponding LTE measurement capability is supported by the target. A bit is set to zero or omitted to indicate that the corresponding LTE measurement capability is not supported by the target.

– *OMA-LPPe-ver2-0-Crowdsourcing-UTRA-MeasurementCapabilities*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-UTRA-MeasurementCapabilites* is used by a target to provide its capabilities for advanced crowdsourcing of UTRA measurements to a server.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-UTRA-MeasurementCapabilities ::= SEQUENCE {
    measurements        BIT STRING {
                        nBestimatedLocation     (0),
                        utra-carrier-RSSI       (1),
                        fdd-cpich-Ec-No         (2),
                        fdd-cpich-RSCP          (3),
                        fdd-pathloss            (4),
                        tdd-primary-ccpch-RSCP  (5),
                        tdd-pathloss            (6),
                        tdd-timing-advance      (7),
                        non-serving-cell        (8),
                        non-serving-plmn        (9)} (SIZE (1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Crowdsourcing-UTRA-MeasurementCapabilities **field descriptions**
measurements
This parameter specifies the UTRA measurements supported by a target for advanced crowdsourcing. The parameter is encoded as a bit string with each UTRA measurement capability represented by a different bit. A bit is set to one to indicate that the corresponding UTRA measurement capability is supported by the target. A bit is set to zero or omitted to indicate that the corresponding UTRA measurement capability is not supported by the target.

– *OMA-LPPe-ver2-0-Crowdsourcing-GSM-MeasurementCapabilities*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-GSM-MeasurementCapabilites* is used by a target to provide its capabilities for advanced crowdsourcing of GSM measurements to a server.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-GSM-MeasurementCapabilities ::= SEQUENCE {
    measurements        BIT STRING {
                        bts-estimatedLocation   (0),
                        rxLevel                 (1),
                        timingAdvance           (2),
                        non-serving-cell        (3),
                        non-serving-plmn        (4)} (SIZE (1..8)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Crowdsourcing-GSM-MeasurementCapabilities field descriptions
Measurements This parameter specifies the GSM measurements supported by a target for advanced crowdsourcing. The parameter is encoded as a bit string with each GSM measurement capability represented by a different bit. A bit is set to one to indicate that the corresponding GSM measurement capability is supported by the target. A bit is set to zero or omitted to indicate that the corresponding GSM measurement capability is not supported by the target.

– *OMA-LPPe-ver2-0-Crowdsourcing-SRN-MeasurementCapabilities*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-SRN-MeasurementCapabilites* is used by a target to provide its capabilities for advanced crowdsourcing of SRN measurements to a server.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-SRN-MeasurementCapabilities ::= SEQUENCE {
    measurements        BIT STRING {
                        apReportedLocation      (0),
                        apEstimatedLocation     (1),
                        rssi                    (2),
                        rtd                     (3)} (SIZE (1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Crowdsourcing-SRN-MeasurementCapabilities field descriptions
Measurements This parameter specifies the SRN measurements supported by a target for advanced crowdsourcing. The parameter is encoded as a bit string with each SRN measurement capability represented by a different bit. A bit is set to one to indicate that the corresponding SRN measurement capability is supported by the target. A bit is set to zero or omitted to indicate that the corresponding SRN measurement capability is not supported by the target.

– *OMA-LPPe-ver2-0-Crowdsourcing-Sensor-MeasurementCapabilities*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-Sensor-MeasurementCapabilites* is used by a target to provide its capabilities for advanced crowdsourcing of sensor measurements to a server.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-Sensor-MeasurementCapabilities ::= SEQUENCE {
```

```
    measurements        BIT STRING {
                        motionState             (0),
                        atmosphericPressure     (1),
                        temperature             (2),
                        humidity                (3),
                        soundLevel              (4),
                        illuminance             (5)} (SIZE (1..16)),
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Crowdsourcing-Sensor-MeasurementCapabilities field descriptions
Measurements This parameter specifies the sensor measurements supported by a target for advanced crowdsourcing. The parameter is encoded as a bit string with each sensor measurement capability represented by a different bit. A bit is set to one to indicate that the corresponding sensor measurement capability is supported by the target. A bit is set to zero or omitted to indicate that the corresponding sensor measurement capability is not supported by the target.

6.5.14.7 Crowdsourcing Abort

– *OMA-LPPe-ver2-0-Crowdsourcing-Abort*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-Abort* is used by a control server or data server to abort a crowdsourcing session with a target device and to provide a reason for the abort.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-Abort ::= SEQUENCE {
    sessionID       OMA-LPPe-ver2-0-CrowdsourcingSessionID      OPTIONAL,
    cause           OMA-LPPe-ver2-0-Crowdsourcing-ServerCause,
    ...
}

-- ASN1STOP
```

OMA-LPPe-ver2-0-Crowdsourcing-Abort field descriptions
session-ID This parameter specifies the session ID for the crowdsourcing session to be aborted. This parameter is optional and if omitted indicates that the target SHALL abort any crowdsourcing session that is currently ongoing with the server in the role of either a control server or data server.
cause This parameter provides the reason for the abort.

6.5.14.8 Crowdsourcing Cause Elements

– *OMA-LPPe-ver2-0-Crowdsourcing-TargetCause*

The IE *OMA-LPPe-ver2-0-Crowdsourcing-TargetCause* is used by the target device to provide cause information to the server related to termination of crowdsourcing or inability to provide certain measurements.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-TargetCause ::= SEQUENCE {
    cause           ENUMERATED  {   undefined,
                                    normalTermination,
                                    crowdsourcingStoppedByUser,
                                    insufficientTargetResources,
```

```
                                    networkPrivacyRestriction,
                                    someRequestedMeasurementsNotObtainable,
                                    temporaryInabilityToConnectToDataServer,
                                    crowdsourcingNotAllowedByHomeOperator,
                                    crowdsourcingNotAllowedByUser,
                                    dataServerNotAuthorized,
                                    sessionAlreadyEstablishedToTheDataServer,
                                    crowdsourcingNotSupportedForTemporaryReasons,
                                    crowdsourcingNotSupportedForPermanentReasons,
                                    controlParametersNotAcceptible,
                                    controlParametersNotSupported,
                                    measurementsNotAcceptible,
                                    measurementsNotSupported,
                                    networkBandwidthRestrictedOrInsufficient,
                                    networkBandwidthTooCostly,
                                    targetControlInformationCorrupted,
                                    ...
                                    },
    ...
}

-- ASN1STOP
```

– OMA-LPPe-ver2-0-Crowdsourcing-ServerCause

The IE *OMA-LPPe-ver2-0-Crowdsourcing-ServerCause* is used by a server to provide cause information to a target related to termination of crowdsourcing.

```
-- ASN1START

OMA-LPPe-ver2-0-Crowdsourcing-ServerCause ::= SEQUENCE {
    cause           ENUMERATED  {   undefined,
                                    terminatedByOperator,
                                    serverCongestion,
                                    serverShutDown,
                                    errorsInCrowdsourcingReports,
                                    sessionNoLongerNeeded,
                                    sessionNeedsToBeChanged,
                                    ...
                                    },
    ...
}

-- ASN1STOP
```

6.6 (End of ASN.1 definition)

6.6.1 End of LPPE-PDU-Definitions

```
-- ASN1START

END

      -- ASN1STOP
```

Appendix A. Change History (Informative)

A.1 Approved Version History

Reference	Date	Description
n/a	n/a	No prior version

A.2 Draft/Candidate Version 2.0 History

Document Identifier	Date	Sections	Description
Draft Versions OMA-TS-LPPe-V2_0	23 Jan 2013	All	First baseline
	26 Sep 2013	2.1, 6.3, 6.4.1, 6.4.2, 6.5.8.2, 6.5.8.3, 6.5.8.5, 6.5.8.6, 6.5.8.7, 6.5.8.9, 6.5.10.6, 6.5.12, Appendix C.10, C11	Incorporated CRs: OMA-LOC-2013-0122R01-CR_LPPe_2.0_WLAN_AP_Location_Information_Corrections, OMA-LOC-2013-0123R02-CR_LPPe2 0_TS_step_length_estimation_model_AD_for_UE_base_PDR, OMA-LOC-2013-0124R02-CR_LPPe2.0_TS_UE_motion_sub_state_request_provision, OMA-LOC-2013-0148-CR_LPPe_2.0_Provide_Location_Information_Correction, OMA-LOC-2013-0074R07-CR_LPPe_2.0_TS_Radio_Characteristic_Information
	25 Nov 2013	2.1, 2.2, 6.3.5, 6.3.6, 6.4.1, 6.5.8, 6.5.12, 6.5.13, Appendix G	Incorporated CRs: OMA-LOC-2013-0113R01-CR_LPPe_2.0_WLAN_AP_Heat_Maps_and_Group_Data OMA-LOC-2013-0176-CR_LPPe_2.0_Image_Recognition_Based_Positioning OMA-LOC-2013-0180R03-CR_LPPe2.0_TS_UE_assisted_motion_sub_state_positioning OMA-LOC-2013-0181-CR_LPPe2.0_TS_PDR_bugfix
	16 Jan 2014	6.4.1, 6.5.8.3, 6.5.8.7, Appendix G.4, Appendix G.5	Incorporated CRs: OMA-LOC-2014-0003-CR_LPPe_2.0_TS_Heatmaps_Extension
	27 Feb 2014	5.2.6, 6.2.1, 6.3, 6.5.14, Appendix H	Incorporated CRs: OMA-LOC-2013-0171R02-CR_LPPe_2 0_Crowdsourcing
	25 Mar 2014	6.2.2.1, 6.5.8.1, 6.5.8.2	Incorporated CRs: OMA-LOC-2014-0054-CR_LPPe_2.0_ASN.1_Corrections
	23 Apr 2014	5.2.1.1, 6.4.1, 6.4.2, 6.5.2.3, 6.5.5.2	Incorporated CRs: OMA-LOC-2014-0070-CR_LPPe_V2.0_ASN.1_corrections, OMA-LOC-2014-0072-CR_LPPe_2.0_Corrections
	09 Jun 2014	6.4.1, 6.4.2, 6.5.8.3, 6.5.14.3, Appendix G.6	Incorporated CRs: OMA-LOC-2014-0096-CR_LPPe_2.0_Heat_Maps_Source_and_Calibration OMA-LOC-2014-0098-CR_LPPe_2.0_ASN.1_Corrections
	28 Aug 2014	2.1, 5.2.6, 6.2.1, 6.4.1, 6.5.8, 6.5.10, 6.5.11, 6.5.14, Appendix G	Incorporated CRs: OMA-LOC-2014-0149R01-CR_LPPe_2.0_Pressure_Measurements OMA-LOC-2014-0150R01-CR_LPPe_2.0_Crowdsourcing OMA-LOC-2014-0069R05-CR_LPPe_V2_0_Addition_of_srns_to_rf_coverage_maps

Document Identifier	Date	Sections	Description
	06 Nov 2014	Throughout the document	As per comments received during consistency review and agreed proposed solutions documented in OMA-CONRR-LPPe-V2_0-20141105-D Incorporated CRs: OMA-LOC-2014-0162-CR_LPPe_2.0_TS_ASN.1_Corrections OMA-LOC-2014-0163-CR_LPPe_2.0_TS_Static_Conformance_Requirements_Updates OMA-LOC-2014-0182-CR_LPPe_2.0_Correction_of_RF_Heat_Map_Reorientation OMA-LOC-2014-0185R02-CR_Resolution_of_review_comment_B041_of_LPPe_2.0_CONR_report OMA-LOC-2014-0186-CR_LPPe_2.0_Barometric_and__Atmospheric_Pressure OMA-LOC-2014-0187R01-CR_Resolution_of_NEC_s_technical_comments_for_LPPe_2.0_TS_spec
Candidate Version OMA-TS-LPPe-V2_0	02 Dec 2014	n/a	Status changed to Candidate by TP TP Ref # OMA-TP-2014-0269-INP_LPPe_V2_0_ERP_and_ETR_for_Candidate_Approval
Draft Versions OMA-TS-LPPe-V2_0	13 Nov 2015	6.4.2, 6.5.8.5, 6.5.12.2, 6.5.13.4, 6.5.14.1, 6.5.14.3	OMA-LOC-2015-0045-CR_LPPe_2.0_ASN.1_Corrections, OMA-LOC-2015-0047-CR_LPPe_2.0_Clarification
Draft Versions OMA-TS-LPPe-V2_0	25 Jul 2016	6.4.1, 6.5.1.8, 6.5.8.5, 6.5.8.6, 6.5.8.7, 6.5.8.9	OMA-LOC-2016-0032-CR_LPPe_2.0_Indoor_Positioning_Correction_Part_I OMA-LOC-2016-0033-CR_LPPe_2.0_Indoor_Positioning_Correction_Part_II_Option_1
Draft Versions OMA-TS-LPPe-V2_0	8 Feb 2017	2.1, 6.5.10, 6.5.12.7, Appendix G	OMA-LOC-2017-0001-CR_LPPe_2.0_TS_Supporting_Geomagnetic_Field_Heat_map OMA-LOC-2017-0009-CR_LPPe_2_0_TS_UE_orientation_corrections OMA-LOC-2017-0012-CR_LPPe_2_0_EGM96_reference
Draft Versions OMA-TS-LPPe-V2_0	19 Apr 2017	6.5	OMA-LOC-2017-0016R01-CR_LPPe_2.0_Editorial_Corrections
Draft Versions OMA-TS-LPPe-V2_0	30 Jun 2020	2.1, 3.3, 6.4.1 6.4.2	OMA-LOC-2020-0015R01-CR_LPPe2.0_Civic_Location
Candidate Version OMA-TS-LPPe-V2_0	04 Aug 2020	n/a	OMA-LOC-2020-0020-INP_LPP_Extensions_2.0_for_Candidate_Approva

Appendix B. Static Conformance Requirements (Normative)

The notation used in this appendix is specified in [SCRRULES].

B.1 SCR for LPPe Client

B.1.1 LPPe messages

Item	Function	Reference	Requirement
LPPe-MSG-C-001-M	Support message extension header	TS 6.2.2	
LPPe-MSG-C-002-M	Support version adaptation based on version and compatibility level	TS 4.4	
LPPe-MSG-C-003-M	Support of the extension to LPP Request Capabilities message	TS 6.2.2	
LPPe-MSG-C-004-M	Support of the extension to LPP Provide Capabilities message	TS 6.2.2	
LPPe-MSG-C-005-M	Support of the extension to LPP Request Assistance Data message	TS 6.2.2	
LPPe-MSG-C-006-M	Support of the extension to LPP Provide Assistance Data message	TS 6.2.2	
LPPe-MSG-C-007-M	Support of the extension to LPP Request Location Information message	TS 6.2.2	
LPPe-MSG-C-008-M	Support of the extension to LPP Provide Location Information message	TS 6.2.2	
LPPe-MSG-C-009-M	Support of the extension to LPP Error message	TS 6.2.2	
LPPe-MSG-C-010-M	Support of the extension to LPP Abort message	TS 6.2.2	
LPPe-MSG-C-011-M	Support reversed mode for Capability Exchange	TS 5.3	
LPPe-MSG-C-012-M	Support reversed mode for Location Information Exchange	TS 5.3	
LPPe-MSG-C-013-O	Support Broadcast Message Extensions	TS 6.2.2.2	

B.1.2 LPPe procedures

Item	Function	Reference	Requirement
LPPe-PRO-C-001-O	Support of periodic assistance data	TS 5.2.1 TS 5.2.1.1	
LPPe-PRO-C-002-O	Support target update of periodic assistance data delivery parameters	TS 5.2.1.2	LPPe-PRO-C-001-O

Item	Function	Reference	Requirement
LPPe-PRO-C-003-O	Support server update of periodic assistance data delivery parameters	TS 5.2.1.3	LPPe-PRO-C-001-O
LPPe-PRO-C-004-O	Support of periodic location information	TS 5.2.2 TS 5.2.2.1	
LPPe-PRO-C-005-O	Support target update of periodic location information reporting parameters	TS 5.2.2.3	LPPe-PRO-C-004-O
LPPe-PRO-C-006-O	Support server update of periodic location information reporting parameters	TS 5.2.2.2	LPPe-PRO-C-004-O
LPPe-PRO-C-007-O	Support assistance data segmentation procedures	TS 5.2.3	
LPPe-PRO-C-008-O	Support location information segmentation procedures	TS 5.2.4	
LPPe-PRO-C-009-O	Support broadcast of assistance data	TS 5.2.5	
LPPe-PRO-C-010-O	Support basic crowdsourcing	TS 5.2.6	
LPPe-PRO-C-011-O	Support advanced crowdsourcing	TS 5.2.6	

B.1.3 LPPe Assistance Data

Item	Function	Reference	Requirement
LPPe-AD-C-001-O	Support of validity area	TS 6.4.1	
LPPe-AD-C-002-O	Support of validity period	TS 6.4.1	
LPPe-AD-C-003-O	Support of generic assistance container	TS 6.4.1	
LPPe-AD-C-004-O	Support of geographical coverage areas	TS 6.4.1	
LPPe-AD-C-005-O	Support of common AGNSS assistance data	TS 6.5.1.1 TS 6.5.1.3	
LPPe-AD-C-006-O	Support of generic AGNSS assistance data	TS 6.5.1.1 TS 6.5.1.3	
LPPe-AD-C-007-O	Support of local Klobuchar ionosphere model	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-C-001-O LPPe-AD-C-002-O
LPPe-AD-C-008-O	Support of ionosphere storm indication	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-C-001-O LPPe-AD-C-002-O
LPPe-AD-C-009-O	Support of wide area ionosphere surface	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-C-001-O LPPe-AD-C-002-O LPPe-PRO-C-001-O
LPPe-AD-C-010-O	Support troposphere delay	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-C-001-O LPPe-AD-C-002-O LPPe-AD-C-012-O

Item	Function	Reference	Requirement
LPPe-AD-C-011-O	Support of troposphere surface parameters	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-C-001-O LPPe-AD-C-002-O LPPe-AD-C-012-O
LPPe-AD-C-012-O	Support of mapping function	TS 6.5.1.2 TS 6.5.1.4	
LPPe-AD-C-013-O	Support of altitude assistance	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-C-001-O LPPe-AD-C-002-O
LPPe-AD-C-014-O	Support of SV mechanics assistance	TS 6.5.1.2 TS 6.5.1.4	
LPPe-AD-C-015-O	Support of SV differential code biases	TS 6.5.1.2 TS 6.5.1.4	
LPPe-AD-C-016-O	Support of navigation model degradation models	TS 6.5.1.2 TS 6.5.1.4	
LPPe-AD-C-017-O	Support CCP assistance	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-C-001-O LPPe-PRO-C-001-O LPPe-PRO-C-002-O LPPe-PRO-C-003-O LPPe-AD-C-019-O
LPPe-AD-C-018-O	Support change of CCP reference station	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-C-017-O
LPPe-AD-C-019-O	Support of antenna information	TS 6.5.1.13	
LPPe-AD-C-020-O	Support of coordinate-based navigation model	TS 6.5.1.2 TS 6.5.1.4	
LPPe-AD-C-021-O	Support assistance for UE-based LTE OTDOA	TS 6.5.2.1 TS 6.5.2.2 TS 6.5.2.3	
LPPe-AD-C-022-O	Support assistance for UE-based EOTD	TS 6.5.3.1 TS 6.5.3.2 TS 6.5.3.3	
LPPe-AD-C-023-O	Support assistance for UE-assisted EOTD	TS 6.5.2.1 TS 6.5.2.2 TS 6.5.2.3	
LPPe-AD-C-024-O	Support assistance for UE-based OTDOA-UTRA	TS 6.5.4.1 TS 6.5.4.2 TS 6.5.4.3	
LPPe-AD-C-025-O	Support assistance for UE-assisted OTDOA-UTRA	TS 6.5.4.1 TS 6.5.4.2 TS 6.5.4.3	
LPPe-AD-C-026-O	Support assistance for UE-based LTE ECID for eNodeBs	TS 6.5.5.1 TS 6.5.5.2 TS 6.5.5.3	

Item	Function	Reference	Requirement
LPPe-AD-C-027-O	Support assistance for UE-based LTE ECID for Home eNodeBs	TS 6.5.5.1 TS 6.5.5.2 TS 6.5.5.3	LPPe-AD-C-004-O
LPPe-AD-C-028-O	Support assistance for UE-based GSM ECID	TS 6.5.6.1 TS 6.5.6.2 TS 6.5.6.3	
LPPe-AD-C-029-O	Support assistance for UE-based UTRA ECID for Node Bs	TS 6.5.7.1 TS 6.5.7.2 TS 6.5.7.3	LPPe-AD-C-004-O
LPPe-AD-C-030-O	Support assistance for UE-based UTRA ECID for Home Node Bs	TS 6.5.7.1 TS 6.5.7.2 TS 6.5.7.3	LPPe-AD-C-004-O
LPPe-AD-C-031-O	Support assistance for UE-based WLAN ECID	TS 6.5.8.1 TS 6.5.8.2 TS 6.5.8.3	LPPe-AD-C-004-O
LPPe-AD-C-032-O	Support assistance for UE-based BT (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-C-033-O	Support assistance data validity checking of assistance data for UE-based BT (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-C-034-O	Support assistance for UE-based BTLE (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-C-035-O	Support assistance data validity checking of assistance data for UE-based BTLE (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-C-036-O	Support assistance for UE-based NFC (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-C-037-O	Support assistance data validity checking of assistance data for UE-based NFC (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-C-038-O	Support assistance data for UE-based atmospheric pressure based altitude determination	TS 6.5.10.1 TS 6.5.10.2 TS 0 TS 0	

Item	Function	Reference	Requirement
LPPe-AD-C-039-O	Support assistance data for UE-assisted atmospheric pressure based altitude determination	TS 6.5.10.1 TS 6.5.10.2 TS 0 TS 0	
LPPe-AD-C-040-O	Support of Assistance Data Broadcast	TS 6.4.1	LPPe-MSG-C-013-O
LPPe-AD-C-041-O	Support assistance data for UE-based PDR	TS 6.5.12.1 TS 6.5.12.2 TS 6.5.12.3 TS 6.5.12.4	
LPPe-AD-C-042-O	Support assistance data for UE-assisted PDR	TS 6.5.12.1 TS 6.5.12.2 TS 6.5.12.3 TS 6.5.12.4	
LPPe-AD-C-043-O	Support for UE-assisted IRB	TS 6.5.13.1 TS 6.5.12.2	
LPPe-AD-C-044-O	Support for WLAN RF Heat Maps	TS 6.4.1 TS 6.5.8.2 TS 6.5.8.3	
LPPe-AD-C-045-O	Support for SRN RF Heat Maps	TS 6.4.1 TS 6.5.11.2 TS 6.5.11.3	
LPPe-AD-C-046-O	Support assistance data for UE-assisted IRB	TS 6.5.13.1 TS 6.5.13.2	
LPPe-AD-C-047-O	Support assistance data for UE-assisted PDR	TS 6.5.12.1 TS 6.5.12.2 TS 6.5.12.3 TS 6.5.12.4	
LPPe-AD-C-048-O	Support assistance data for UE-based PDR	TS 6.5.12.1 TS 6.5.12.2 TS 6.5.12.3 TS 6.5.12.4	
LPPe-AD-C-049-O	Support assistance data for RF Propagation for WLAN	TS 6.5.8.1 TS 6.5.8.2	
LPPe-AD-C-050-O	Support assistance data for RF Propagation for SRN	TS 6.5.11.1 TS 6.5.11.2	

B.1.4 LPPe Location Information

Item	Function	Reference	Requirement
LPPe-LOC-C-001-O	Support high accuracy position representation	TS 6.4.1	
LPPe-LOC-C-002-O	Support high accuracy velocity representation	TS 6.4.1	
LPPe-LOC-C-003-O	Support IP address reporting	TS 6.4.2	

Item	Function	Reference	Requirement
LPPe-LOC-C-004-O	Support location information container	TS 6.4.2	
LPPe-LOC-C-005-O	Support relative location change	TS 6.4.2	
LPPe-LOC-C-006-O	Support ionosphere observations	TS 6.5.1.6 TS 6.5.1.8	
LPPe-LOC-C-007-O	Support surface observations	TS 6.5.1.6 TS 6.5.1.8	
LPPe-LOC-C-008-O	Support HA GNSS measurements	TS 6.5.1.5 TS 6.5.1.8	LPPe-PRO-C-004-O LPPe-PRO-C-005-O LPPe-PRO-C-006-O LPPe-AD-C-018-O
LPPe-LOC-C-009-O	Support UE-based high accuracy GNSS positioning	TS 6.5.1.8	LPPe-LOC-C-001-O LPPe-LOC-C-002-O LPPe-AD-C-017-O
LPPe-LOC-C-010-O	Support UE-based LTE OTDOA	TS 6.5.2.4 TS 6.5.2.5 TS 6.5.2.6	LPPe-AD-C-021-O
LPPe-LOC-C-011-O	Support UE-based EOTD	TS 6.5.3.4 TS 6.5.3.5 TS 6.5.3.6	LPPe-AD-C-022-O
LPPe-LOC-C-012-O	Support UE-assisted EOTD	TS 6.5.3.4 TS 6.5.3.5 TS 6.5.3.6	LPPe-AD-C-023-O
LPPe-LOC-C-013-O	Support UE-based OTDOA-UTRA	TS 6.5.4.4 TS 6.5.4.5 TS 6.5.4.6	LPPe-AD-C-024-O
LPPe-LOC-C-014-O	Support UE-assisted OTDOA-UTRA	TS 6.5.4.4 TS 6.5.4.5 TS 6.5.4.6	LPPe-AD-C-025-O
LPPe-LOC-C-015-O	Support UE-based LTE ECID	TS 6.5.5.4 TS 6.5.5.5 TS 6.5.5.6	LPPe-AD-C-026-O LPPe-AD-C-027-O
LPPe-LOC-C-016-O	Support historic reporting of LTE ECID measurements	TS 6.5.5.4 TS 6.5.5.5 TS 6.5.5.6	
LPPe-LOC-C-017-O	Support UE-based GSM ECID	TS 6.5.6.4 TS 6.5.6.5	LPPe-AD-C-028-O
LPPe-LOC-C-018-O	Support UE-assisted GSM ECID	TS 6.5.6.4 TS 6.5.6.5	
LPPe-LOC-C-019-O	Support historic reporting of GSM ECID measurements	TS 6.5.6.4 TS 6.5.6.5	
LPPe-LOC-C-020-O	Support UE-based UTRA ECID	TS 6.5.7.4 TS 6.5.7.5 TS 6.5.7.6	LPPe-AD-C-029-O LPPe-AD-C-030-O

Item	Function	Reference	Requirement
LPPe-LOC-C-021-O	Support UE-assisted UTRA ECID	TS 6.5.7.4 TS 6.5.7.5 TS 6.5.7.6	
LPPe-LOC-C-022-O	Support historic reporting of UTRA ECID measurements	TS 6.5.7.4 TS 6.5.7.5 TS 6.5.7.6	
LPPe-LOC-C-023-O	Support UE-based WLAN ECID	TS 6.5.8.4 TS 6.5.8.5 TS 6.5.8.6	LPPe-AD-C-031-O
LPPe-LOC-C-024-O	Support UE-assisted WLAN ECID	TS 6.5.8.4 TS 6.5.8.5 TS 6.5.8.6	
LPPe-LOC-C-025-O	Support historic reporting of WLAN ECID measurements	TS 6.5.8.4 TS 6.5.8.5 TS 6.5.8.6	
LPPe-LOC-C-026-O	Support UE-assisted WiMax ECID	TS 6.5.7.1 TS 6.5.7.2 TS 6.5.7.3	
LPPe-LOC-C-027-O	Support historic reporting of WiMax ECID measurements	TS 6.5.7.4 TS 6.5.7.5 TS 6.5.7.6	
LPPe-LOC-C-028-O	Support motion state	TS 6.5.10.5 TS 6.5.10.6 TS 6.5.10.7	
LPPe-LOC-C-029-O	Support UE-based BT (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	LPPe-AD-C-032-O LPPe-AD-C-033-O
LPPe-LOC-C-030-O	Support UE-assisted BT (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	
LPPe-LOC-C-031-O	Support UE-based BTLE (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	LPPe-AD-C-034-O LPPe-AD-C-035-O
LPPe-LOC-C-032-O	Support UE-assisted BTLE (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	
LPPe-LOC-C-033-O	Support UE-based NFC (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	LPPe-AD-C-036-O LPPe-AD-C-037-O

Item	Function	Reference	Requirement
LPPe-LOC-C-034-O	Support UE-assisted NFC (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	
LPPe-LOC-C-035-O	Support UE-assisted Mobile Code –based positioning	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	
LPPe-LOC-C-036-O	Support historic measurement reporting for BT (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	
LPPe-LOC-C-037-O	Support historic measurement reporting for BTLE (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	
LPPe-LOC-C-038-O	Support historic measurement reporting for NFC (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	
LPPe-LOC-C-039-O	Support historic measurement reporting for Mobile Codes	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	
LPPe-LOC-C-040-O	Support UE-assisted atmospheric pressure altitude determination	TS 6.5.10.5 TS 6.5.10.6 TS 6.5.10.7 TS 6.5.10.8	
LPPe-LOC-C-041-O	Support UE-based atmospheric pressure altitude determination	TS 6.5.10.5 TS 6.5.10.6 TS 6.5.10.7 TS 6.5.10.8	
LPPe-LOC-C-042-O	Support Atmospheric Pressure measurements	TS 6.5.10.6 TS 6.5.10.7	LPPe-LOC-C-040-O
LPPe-LOC-C-043-O	Support Sensor Motion State measurements	TS 6.5.10.6 TS 6.5.10.7	
LPPe-LOC-C-044-O	Support UE-assisted PDR	TS 6.5.12.5 TS 6.5.12.6 TS 6.5.12.7	
LPPe-LOC-C-045-O	Support PDR measurements	TS 6.5.12.5 TS 6.5.12.6	LPPe-LOC-C-044-O
LPPe-LOC-C-046-O	Support UE-based PDR	TS 6.5.12.5 TS 6.5.12.6 TS 6.5.12.7	
LPPe-LOC-C-047-O	Support UE-assisted IRB	TS 6.5.13.3 TS 6.5.13.4 TS 6.5.13.5	

Item	Function	Reference	Requirement
LPPe-LOC-C-048-O	Support IRB measurements	TS 6.5.13.3 TS 6.5.13.4	LPPe-LOC-C-047-O
LPPe-LOC-C-049-O	Support Crowdsourcing Basic Measurements	TS 6.5.14	LPPe-PRO-C-010-O
LPPe-LOC-C-050-O	Support Crowdsourcing Advanced Measurements	TS 6.5.14	LPPe-PRO-C-011-O
LPPe-LOC-C-051-O	Support Crowdsourcing of WLAN AP Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-C-049-O OR LPPe-LOC-C-050-O
LPPe-LOC-C-052-O	Support Crowdsourcing of LTE Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-C-049-O OR LPPe-LOC-C-050-O
LPPe-LOC-C-053-O	Support Crowdsourcing of UTRA Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-C-049-O OR LPPe-LOC-C-050-O
LPPe-LOC-C-054-O	Support Crowdsourcing of GSM Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-C-049-O OR LPPe-LOC-C-050-O
LPPe-LOC-C-055-O	Support Crowdsourcing of SRN Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-C-049-O OR LPPe-LOC-C-050-O
LPPe-LOC-C-056-O	Support Crowdsourcing of Sensor Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-C-049-O OR LPPe-LOC-C-050-O

B.2 SCR for LPPe Server

B.2.1 LPPe messages

Item	Function	Reference	Requirement
LPPe-MSG-S-001-M	Support message extension header	TS 6.2.2	
LPPe-MSG-S-002-M	Support version adaptation based on version and compatibility level	TS 4.4	
LPPe-MSG-S-003-M	Support of the extension to LPP Request Capabilities message	TS 6.2.2	
LPPe-MSG-S-004-M	Support of the extension to LPP Provide Capabilities message	TS 6.2.2	
LPPe-MSG-S-005-M	Support of the extension to LPP Request Assistance Data message	TS 6.2.2	
LPPe-MSG-S-006-M	Support of the extension to LPP Provide Assistance Data message	TS 6.2.2	
LPPe-MSG-S-007-M	Support of the extension to Request Location Information message	TS 6.2.2	
LPPe-MSG-S-008-M	Support of the extension to Provide Location Information message	TS 6.2.2	
LPPe-MSG-S-009-M	Support of the extension to LPP Error message	TS 6.2.2	

Item	Function	Reference	Requirement
LPPe-MSG-S-010-M	Support of the extension to LPP Abort message	TS 6.2.2	
LPPe-MSG-S-011-M	Support reversed mode for Capability Exchange	TS 5.3	
LPPe-MSG-S-012-M	Support reversed mode for Location Information Exchange	TS 5.3	
LPPe-MSG-S-013-O	Support Broadcast Message Extensions	TS 6.2.2.2	

B.2.2 LPPe procedures

Item	Function	Reference	Requirement
LPPe-PRO-S-001-O	Support of periodic assistance	TS 5.2.1 TS 5.2.1.1	
LPPe-PRO-S-002-O	Support target update of periodic assistance parameters	TS 5.2.1.2	LPPe-PRO-S-001-O
LPPe-PRO-S-003-O	Support server update of periodic assistance parameters	TS 5.2.1.3	LPPe-PRO-S-001-O
LPPe-PRO-S-004-O	Support of periodic measurements	TS 5.2.2 TS 5.2.2.1	
LPPe-PRO-S-005-O	Support target update of periodic measurement parameters	TS 5.2.2.3	LPPe-PRO-S-004-O
LPPe-PRO-S-006-O	Support server update of periodic measurement parameters	TS 5.2.2.2	LPPe-PRO-S-004-O
LPP-PRO-S-007-O	Support assistance data segmentation procedures	TS 5.2.3	
LPPe-PRO-S-008-O	Support location information segmentation procedures	TS 5.2.4	
LPPe-PRO-S-009-O	Support broadcast of assistance data	TS 5.2.5	
LPPe-PRO-S-010-O	Support basic crowdsourcing	TS 5.2.6	
LPPe-PRO-S-011-O	Support advanced crowdsourcing	TS 5.2.6	

B.2.3 LPPe assistance data

Item	Function	Reference	Requirement
LPPe-AD-S-001-O	Support of validity area	TS 6.4.1	
LPPe-AD-S-002-O	Support of validity period	TS 6.4.1	
LPPe-AD-S-003-O	Support of generic assistance container	TS 6.4.1	
LPPe-AD-S-004-O	Support of geographical coverage areas	TS 6.4.1	
LPPe-AD-S-005-O	Support of common AGNSS assistance data	TS 6.5.1.1 TS 6.5.1.3	
LPPe-AD-S-006-O	Support of generic AGNSS assistance data	TS 6.5.1.1 TS 6.5.1.3	
LPPe-AD-S-007-O	Support of local Klobuchar ionosphere model	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-S-001-O LPPe-AD-S-002-O
LPPe-AD-S-008-O	Support of ionosphere storm indication	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-S-001-O LPPe-AD-S-002-O
LPPe-AD-S-009-O	Support of wide area ionosphere surface	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-S-001-O LPPe-AD-S-002-O

Item	Function	Reference	Requirement
			LPPe-PRO-S-001-O LPPe-PRO-S-002-O LPPe-PRO-S-003-O
LPPe-AD-S-010-O	Support troposphere delay	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-S-001-O LPPe-AD-S-002-O LPPe-AD-S-012-O
LPPe-AD-S-011-O	Support of troposphere surface parameters	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-S-001-O LPPe-AD-S-002-O LPPe-AD-S-012-O
LPPe-AD-S-012-O	Support of mapping function	TS 6.5.1.2 TS 6.5.1.4	
LPPe-AD-S-013-O	Support of altitude assistance	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-S-001-O LPPe-AD-S-002-O
LPPe-AD-S-014-O	Support of SV mechanics assistance	TS 6.5.1.2 TS 6.5.1.4	
LPPe-AD-S-015-O	Support of SV differential code biases	TS 6.5.1.2 TS 6.5.1.4	
LPPe-AD-S-016-O	Support of navigation model degradation models	TS 6.5.1.2 TS 6.5.1.4	
LPPe-AD-S-017-O	Support CCP assistance	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-S-001-O LPPe-PRO-S-001-O LPPe-PRO-S-002-O LPPe-PRO-S-003-O LPPe-AD-S-019-O
LPPe-AD-S-018-O	Support change of CCP reference station	TS 6.5.1.2 TS 6.5.1.4	LPPe-AD-S-017-O
LPPe-AD-S-019-O	Support of antenna information	TS 6.5.1.13	
LPPe-AD-S-020-O	Support of coordinate-based navigation model	TS 6.5.1.2 TS 6.5.1.4	
LPPe-AD-S-021-O	Support assistance for UE-based LTE OTDOA	TS 6.5.2.1 TS 6.5.2.2 TS 6.5.2.3	
LPPe-AD-S-022-O	Support assistance for UE-based EOTD	TS 6.5.3.1 TS 6.5.3.2 TS 6.5.3.3	
LPPe-AD-S-023-O	Support assistance for UE-assisted EOTD	TS 6.5.2.1 TS 6.5.2.2 TS 6.5.2.3	
LPPe-AD-S-024-O	Support assistance for UE-based OTDOA-UTRA	TS 6.5.4.1 TS 6.5.4.2 TS 6.5.4.3	
LPPe-AD-S-025-O	Support assistance for UE-assisted OTDOA-UTRA	TS 6.5.4.1 TS 6.5.4.2 TS 6.5.4.3	
LPPe-AD-S-026-O	Support assistance for	TS 6.5.5.1	

Item	Function	Reference	Requirement
	UE-based LTE ECID for eNodeBs	TS 6.5.5.2 TS 6.5.5.3	
LPPe-AD-S-027-O	Support assistance for UE-based LTE ECID for Home eNodeBs	TS 6.5.5.1 TS 6.5.5.2 TS 6.5.5.3	LPPe-AD-S-004-O
LPPe-AD-S-028-O	Support assistance for UE-based GSM ECID	TS 6.5.6.1 TS 6.5.6.2 TS 6.5.6.3	
LPPe-AD-S-029-O	Support assistance for UE-based UTRA ECID for Node Bs	TS 6.5.7.1 TS 6.5.7.2 TS 6.5.7.3	LPPe-AD-S-004-O
LPPe-AD-S-030-O	Support assistance for UE-based UTRA ECID for Home Node Bs	TS 6.5.7.1 TS 6.5.7.2 TS 6.5.7.3	LPPe-AD-S-004-O
LPPe-AD-S-031-O	Support assistance for UE-based WLAN ECID	TS 6.5.8.1 TS 6.5.8.2 TS 6.5.8.3	LPPe-AD-S-004-O
LPPe-AD-S-032-O	Support assistance for UE-based BT (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-S-033-O	Support assistance data validity checking of assistance data for UE-based BT (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-S-034-O	Support assistance for UE-based BTLE (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-S-035-O	Support assistance data validity checking of assistance data for UE-based BTLE (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-S-036-O	Support assistance for UE-based NFC (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-S-037-O	Support assistance data validity checking of assistance data for UE-based NFC (E)CID	TS 6.5.11.1 TS 6.5.11.2 TS 6.5.11.3 TS 6.5.11.4	
LPPe-AD-S-038-O	Support assistance data for UE-based atmospheric pressure based altitude determination	TS 6.5.10.1 TS 6.5.10.2 TS 0 TS 0	
LPPe-AD-S-039-O	Support assistance data for UE-assisted	TS 6.5.10.1 TS 6.5.10.2	

Item	Function	Reference	Requirement
	atmospheric pressure based altitude determination	TS 0 TS 0	
LPPe-AD-S-040-O	Support of Assistance Data Broadcast	TS 6.4.1	LPPe-MSG-S-013-O
LPPe-AD-S-041-O	Support assistance data for UE-based PDR	TS 6.5.12.1 TS 6.5.12.2 TS 6.5.12.3 TS 6.5.12.4	
LPPe-AD-S-042-O	Support assistance data for UE-assisted PDR	TS 6.5.12.1 TS 6.5.12.2 TS 6.5.12.3 TS 6.5.12.4	
LPPe-AD-S-043-O	Support for UE-assisted IRB	TS 6.5.13.1 TS 6.5.12.2	
LPPe-AD-S-044-O	Support for WLAN RF Heat Maps	TS 6.4.1 TS 6.5.8.2 TS 6.5.8.3	
LPPe-AD-S-045-O	Support for SRN RF Heat Maps	TS 6.4.1 TS 6.5.11.2 TS 6.5.11.3	
LPPe-AD-S-046-O	Support assistance data for UE-assisted IRB	TS 6.5.13.1 TS 6.5.13.2	
LPPe-AD-S-047-O	Support assistance data for UE-assisted PDR	TS 6.5.12.1 TS 6.5.12.2 TS 6.5.12.3 TS 6.5.12.4	
LPPe-AD-S-048-O	Support assistance data for UE-based PDR	TS 6.5.12.1 TS 6.5.12.2 TS 6.5.12.3 TS 6.5.12.4	
LPPe-AD-S-049-O	Support assistance data for RF Propagation for WLAN	TS 6.5.8.1 TS 6.5.8.2	
LPPe-AD-S-050-O	Support assistance data for RF Propagation for SRN	TS 6.5.11.1 TS 6.5.11.2	

B.2.4 LPPe location information

Item	Function	Reference	Requirement
LPPe-LOC-S-001-O	Support high accuracy position representation	TS 6.4.1	
LPPe-LOC-S-002-O	Support high accuracy velocity representation	TS 6.4.1	
LPPe-LOC-S-003-O	Support IP address reporting	TS 6.4.2	
LPPe-LOC-S-004-O	Support location information container	TS 6.4.2	

Item	Function	Reference	Requirement
LPPe-LOC-S-005-O	Support relative location change	TS 6.4.2	
LPPe-LOC-S-006-O	Support ionosphere observations	TS 6.5.1.6 TS 6.5.1.8	
LPPe-LOC-S-007-O	Support surface observations	TS 6.5.1.6 TS 6.5.1.8	
LPPe-LOC-S-008-O	Support HA GNSS measurements	TS 6.5.1.5 TS 6.5.1.8	LPPe-PRO-S-004-O LPPe-PRO-S-005-O LPPe-PRO-S-006-O LPPe-AD-S-018-O
LPPe-LOC-S-009-O	Support UE-based high accuracy GNSS positioning	TS 6.5.1.8	LPPe-LOC-S-001-O LPPe-LOC-S-002-O LPPe-AD-S-017-O
LPPe-LOC-S-010-O	Support UE-based LTE OTDOA	TS 6.5.2.4 TS 6.5.2.5 TS 6.5.2.6	LPPe-AD-S-021-O
LPPe-LOC-S-011-O	Support UE-based EOTD	TS 6.5.3.4 TS 6.5.3.5 TS 6.5.3.6	LPPe-AD-S-022-O
LPPe-LOC-S-012-O	Support UE-assisted EOTD	TS 6.5.3.4 TS 6.5.3.5 TS 6.5.3.6	LPPe-AD-S-023-O
LPPe-LOC-S-013-O	Support UE-based OTDOA-UTRA	TS 6.5.4.4 TS 6.5.4.5 TS 6.5.4.6	LPPe-AD-S-024-O
LPPe-LOC-S-014-O	Support UE-assisted OTDOA-UTRA	TS 6.5.4.4 TS 6.5.4.5 TS 6.5.4.6	LPPe-AD-S-025-O
LPPe-LOC-S-015-O	Support UE-based LTE ECID	TS 6.5.5.4 TS 6.5.5.5 TS 6.5.5.6	LPPe-AD-S-026-O LPPe-AD-S-027-O
LPPe-LOC-S-016-O	Support historic reporting of LTE ECID measurements	TS 6.5.5.4 TS 6.5.5.5 TS 6.5.5.6	
LPPe-LOC-S-017-O	Support UE-based GSM ECID	TS 6.5.6.4 TS 6.5.6.5	LPPe-AD-S-028-O
LPPe-LOC-S-018-O	Support UE-assisted GSM ECID	TS 6.5.6.4 TS 6.5.6.5	
LPPe-LOC-S-019-O	Support historic reporting of GSM ECID measurements	TS 6.5.6.4 TS 6.5.6.5	
LPPe-LOC-S-020-O	Support UE-based UTRA ECID	TS 6.5.7.4 TS 6.5.7.5 TS 6.5.7.6	LPPe-AD-S-029-O LPPe-AD-S-030-O
LPPe-LOC-S-021-O	Support UE-assisted UTRA ECID	TS 6.5.7.4 TS 6.5.7.5 TS 6.5.7.6	

Item	Function	Reference	Requirement
LPPe-LOC-S-022-O	Support historic reporting of UTRA ECID measurements	TS 6.5.7.4 TS 6.5.7.5 TS 6.5.7.6	
LPPe-LOC-S-023-O	Support UE-based WLAN ECID	TS 6.5.8.4 TS 6.5.8.5 TS 6.5.8.6	LPPe-AD-S-031-O
LPPe-LOC-S-024-O	Support UE-assisted WLAN ECID	TS 6.5.8.4 TS 6.5.8.5 TS 6.5.8.6	
LPPe-LOC-S-025-O	Support historic reporting of WLAN ECID measurements	TS 6.5.8.4 TS 6.5.8.5 TS 6.5.8.6	
LPPe-LOC-S-026-O	Support UE-assisted WiMax ECID	TS 6.5.7.1 TS 6.5.7.2 TS 6.5.7.3	
LPPe-LOC-S-027-O	Support historic reporting of WiMax ECID measurements	TS 6.5.7.4 TS 6.5.7.5 TS 6.5.7.6	
LPPe-LOC-S-028-O	Support motion state	TS 6.5.10.5 TS 6.5.10.6 TS 6.5.10.7	
LPPe-LOC-S-029-O	Support UE-based BT (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.11.8	LPPe-AD-S-032-O LPPe-AD-S-033-O
LPPe-LOC-S-030-O	Support UE-assisted BT (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.	
LPPe-LOC-S-031-O	Support UE-based BTLE (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.	LPPe-AD-S-034-O LPPe-AD-S-035-O
LPPe-LOC-S-032-O	Support UE-assisted BTLE (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.	
LPPe-LOC-S-033-O	Support UE-based NFC (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.	LPPe-AD-S-036-O LPPe-AD-S-037-O
LPPe-LOC-S-034-O	Support UE-assisted NFC (E)CID	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.	

Item	Function	Reference	Requirement
LPPe-LOC-S-035-O	Support UE-assisted Mobile Code –based positioning	TS 6.5.11.5 TS 6.5.11.6 TS 6.5.11.7 TS 6.5.	
LPPe-LOC-S-036-O	Support UE-assisted atmospheric pressure altitude determination	TS 6.5.10.5 TS 6.5.10.6 TS 6.5.10.7 TS 6.5.10.8	
LPPe-LOC-S-037-O	Support UE-based atmospheric pressure altitude determination	TS 6.5.10.5 TS 6.5.10.6 TS 6.5.10.7 TS 6.5.10.8	
LPPe-LOC-S-038-O	Support Atmospheric Pressure measurements	TS 6.5.10.6 TS 6.5.10.7	LPPe-LOC-S-036-O
LPPe-LOC-S-039-O	Support Sensor Motion State measurements	TS 6.5.10.6 TS 6.5.10.7	
LPPe-LOC-S-040-O	Support UE-assisted PDR	TS 6.5.12.5 TS 6.5.12.6 TS 6.5.12.7	
LPPe-LOC-S-041-O	Support PDR measurements	TS 6.5.12.5 TS 6.5.12.6	LPPe-LOC-S-040-O
LPPe-LOC-S-042-O	Support UE-based PDR	TS 6.5.12.5 TS 6.5.12.6 TS 6.5.12.7	
LPPe-LOC-S-043-O	Support UE-assisted IRB	TS 6.5.13.3 TS 6.5.13.4 TS 6.5.13.5	
LPPe-LOC-S-044-O	Support IRB measurements	TS 6.5.13.3 TS 6.5.13.4	LPPe-LOC-S-043-O
LPPe-LOC-S-045-O	Support Crowdsourcing Basic Measurements	TS 6.5.14	LPPe-PRO-S-010-O
LPPe-LOC-S-046-O	Support Crowdsourcing Advanced Measurements	TS 6.5.14	LPPe-PRO-S-011-O
LPPe-LOC-S-047-O	Support Crowdsourcing of WLAN AP Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-S-045-O OR LPPe-LOC-S-046-O
LPPe-LOC-S-048-O	Support Crowdsourcing of LTE Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-S-045-O OR LPPe-LOC-S-046-O
LPPe-LOC-S-049-O	Support Crowdsourcing of UTRA Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-S-045-O OR LPPe-LOC-S-046-O
LPPe-LOC-S-050-O	Support Crowdsourcing of GSM Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-S-045-O OR LPPe-LOC-S-046-O
LPPe-LOC-S-051-O	Support Crowdsourcing of SRN Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-S-045-O OR LPPe-LOC-S-046-O
LPPe-LOC-S-052-O	Support Crowdsourcing of Sensor Measurements	TS 6.5.14.2 TS 6.5.14.3	LPPe-LOC-S-045-O OR LPPe-LOC-S-046-O

Appendix C. Use of Information Elements (Informative)

C.1 Use of Validity Area Parameters

RLE (Run-Length Encoding) is an efficient method to encode areas. The building element of the area definition is a region of the grid. The size of the region, i.e. the number of degrees on each side of the region, is defined by 10/*RegionSizeInv*, where *RegionSizeInv* is given in the ValidityArea IE. Regions are rectangular in spherical coordinates, i.e. as many degrees in the north-south direction as in the east-west direction. A single region is described as a red box Figure 17.

The area to be described is fixed in the global coordinate system by expressing the coordinates of the north-west corner of the area. Let RS be the size of the grid region in degrees. Then

regionSizeInv = 10 / RS

And

North-West corner latitude in degrees = RS * *codedLatOfNWCorner* – 90 degrees

North-West corner longitude in degrees = RS * *codedLonOfNWCorner* – 180 degrees

And vice versa

codedLatOfNWCorner = floor ((North-West corner latitude in degrees + 90 degrees) / RS)

codedLonOfNWCorner = floor ((North-West corner longitude in degrees + 180 degrees) / RS)

The latitude in degrees is expressed in range [-90, 90] degrees and longitude in range [-180, 180) degrees.

Further, the width of the area is expressed in terms of how many regions fit into the area, i.e.

areaWidth = Area Width in degrees / RS.

NOTE: This assumes that the area width has been chosen appropriately so that it is divisible by RS.

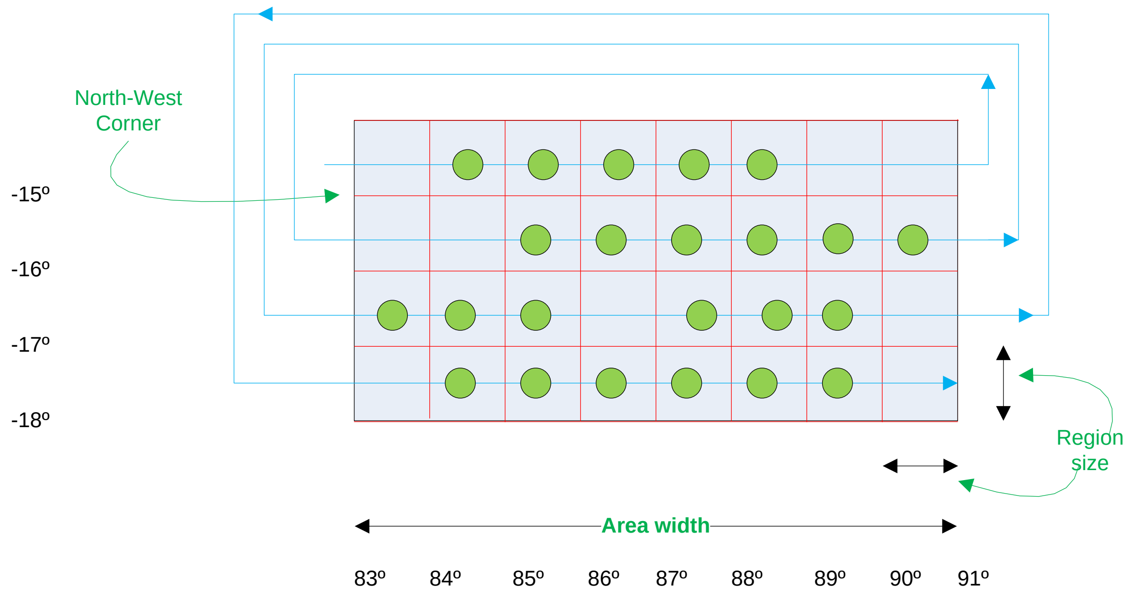


Figure 17: Run length encoding

In the example of Figure 17 RS = 1 degree, i.e. *regionSizeInv* = 10 / 1 = 10.

And the *areaWidth* = 8 degrees / RS = 8.

codedLatOfNWCorner = floor ((-15°+90°)/1°)=75. *codedLonOfNWCorner* = floor ((83°+180°)/1°) = 263.

The final aspect of the RLE encoding is to describe, in which regions the provided data is valid. In the case illustrated in Figure 17 the provided data is valid in regions marked with green dots. The blue line shows the order, in which the area is run through, i.e. always from left to right and starting from the upper left corner.

The *rleList* SHALL begin with the number of regions for which the data is not valid. Therefore, the first element in the *rleList* is "1". Note that if the data was valid in the first region (the region in the left upper corner), the first element would be "0".

Next, there are five regions for which the data is valid. Hence, the second element is "5". Next, there are four regions for which the data is not valid. Thus the next element is "4". Note that the knowing the width of the area in regions allows changing the line at the correct place. After this there are nine regions for which data is valid and the next element is "9".

The full *rleList*, therefore, is: 1 ; 5 ; 4 ; 9 ; 1 ; 3 ; 2 ; 6 ; 1.

In case there are more than 255 regions for which data is valid/non-valid, one can present this by "255 ; 0 ; x" denoting that there are 255+x regions for which data is valid/non-valid.

Finally, Figure 18 shows another example for which the *rleList* reads 0 ; 6 ; 4 ; 6 ; 1 ; 2 ; 1 ; 3 ; 2 ; 6 ; 1.

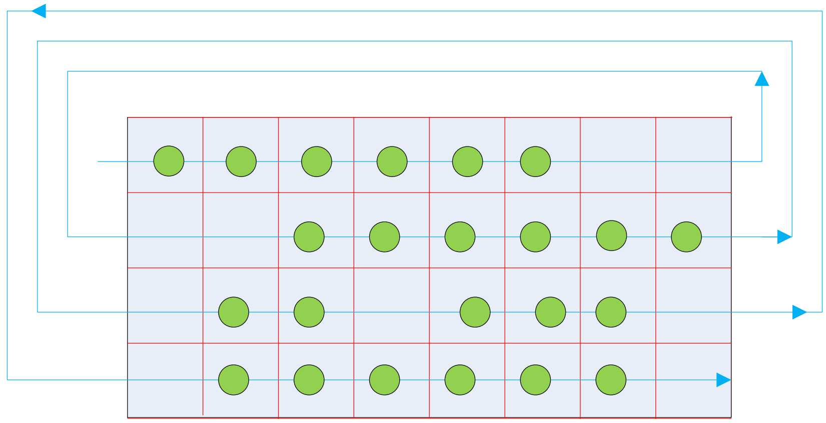


Figure 18: Run length encoding –example 2

C.2 Use of Ionospheric storm indications

The ionospheric storm indications are used for alerting the user on possible performance degradation due to high ionospheric activity. The storms tend to have high dynamics, and thus, the prediction may need to be divided in short validity periods, e.g. one hour periods. The prediction periods for the same area are listed in the IE StormList. The elements of StormList, OMA-*LPPe-AGNSS-StormElement*, comprise of the validity period and the *rleListIono* that indicates the ionospheric activity during the validity period, in each region in the area.

The area coding is carried out using a RLE list as above with the validity area. In this case, however, each region is assigned with an ionospheric index instead of Boolean valid/non-valid values. For example, if the first *rleIonoElement* in the *rleListIono* has the *ionoIndex* value G2 and *regionCount* value 11, it means that in the 11 first regions in the area, starting from the North-West corner as explained above, the ionospheric activity level is G2, which means negligible effect on satellite navigation.

The NOAA ionospheric storm grading is as follows: G5 is an "extreme" storm, G4 "severe" and G3 "strong". There are also G1 (minor) and G2 (moderate). Storms G3-G5 affect satellite navigation. G1 and G2 have negligible effect on satellite navigation. The values "unknown" and "none" describe the cases when there is no ionospheric data available or there is no activity, respectively. The NOAA storm definitions are available at http://www.swpc.noaa.gov/NOAAscales/ and from American Geophysical Union's Eos (weekly newspaper of geophysics) Vol. 81, No. 29, July 18, 2000, Pages 322-328.

As an example, consider the case in Figure 19. In this scenario, the field *rleListIono* in the IE *OMA-LPPe-AGNSS-StormElement* would read {1,G3} ; {4,G4} ; {2,unknown} ; {1,G4} ; {2,G5} ; {1,G4} ; {2,G3} ; {1,G4} ; {1,G5} ; {6,G4} ; {2,G3} ; {1,none}.

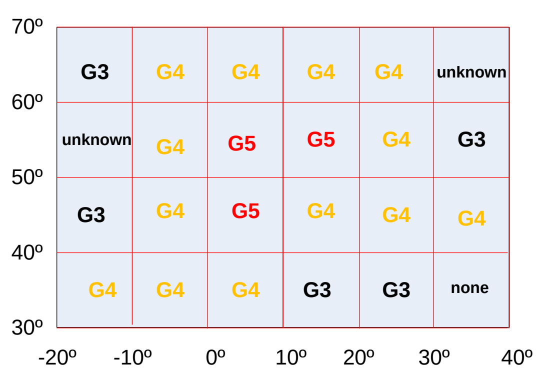


Figure 19: Ionosphere storm region

C.3 Use of periodic wide area ionosphere corrections

The ionosphere slant delay D^i in the units of TECU (10^{16} e^-/m^2) for the SV *i* at the target location can be given by

$$D^i = a_0 + e_1 \cdot \Delta e + n_1 \cdot \Delta n + e_2 \cdot (\Delta e)^2 + n_2 \cdot (\Delta n)^2 + en \cdot \Delta e \cdot \Delta n ,$$

where a_0, e_1, n_1, e_2, n_2 and en are the model coefficients. Further, Δe and Δn are the distances from the model reference position to the target position in the east and north directions expressed in kilometres, respectively. The distances are calculated along the surface of the geoid.

C.4 Troposphere Delay Model

The tropospheric delay is divided into two components, hydrostatic (dry) and non-hydrostatic (wet). Atmospheric gases that are in hydrostatic equilibrium cause the hydrostatic delay. This is usually the case for the dry gases and part of the water vapour. The wet delay, caused by water vapour that is not in hydrostatic equilibrium, varies widely, both spatially and temporally. Although the wet component is much smaller than the hydrostatic component, the uncertainties in the wet tropospheric delay modelling limit the achievable performance of the high precision GNSS applications given that carrier phase measurements themselves have an accuracy of a few millimeters.

Each of these components can be expressed as the product of the delay experienced by the radio signals in the zenith direction, the zenith delay, and a mapping function, which models the elevation angle dependence of the tropospheric delay:

$$\Delta(\varepsilon, h_{user}) = \Delta_{\mathrm{z,h}}(\mathrm{h}_{\mathrm{user}}) \cdot \mathrm{m}_{\mathrm{h}}(\varepsilon) + \Delta_{\mathrm{z,w}}(\mathrm{h}_{\mathrm{user}}) \cdot \mathrm{m}_{\mathrm{w}}(\varepsilon)$$

where $\Delta(\varepsilon, h_{user})$ is the tropospheric delay at a given SV elevation angle ε and user altitude h_{user}, $\Delta_{z,h}(h_{user})$ and $\Delta_{z,w}(h_{user})$ are, respectively, the hydrostatic and wet zenith delays at the user altitude, and $m_h(\varepsilon)$ and $m_w(\varepsilon)$ are the hydrostatic and wet mapping functions, respectively.

C.4.1 Mapping Zenith Delays to Target Altitude

The hydrostatic and wet zenith delays can be determined based on numerical weather predictions or some other meteorological data. Parameters for the troposphere zenith delay model are then determined by e.g. least-squares-fit of the computed zenith delay profiles. The model parameters are referred to the reference altitude h_{ref}. The zenith delays can be scaled to the user altitude as follows:

$$\Delta_{\mathrm{h,z}}(\mathrm{h}_{\mathrm{user}}) = \mathrm{zh}_0(\mathrm{h}_{\mathrm{ref}}) \cdot \exp(-\mathrm{e}_{\mathrm{h}} \cdot (\mathrm{h}_{\mathrm{user}} - \mathrm{h}_{\mathrm{ref}}))$$

$$\Delta_{\mathrm{w,z}}(\mathrm{h}_{\mathrm{user}}) = zw_0(\mathrm{h}_{\mathrm{ref}}) \cdot \exp(-\mathrm{e}_{\mathrm{w}} \cdot (\mathrm{h}_{\mathrm{user}} - \mathrm{h}_{\mathrm{ref}}))$$

where $\Delta_{\mathrm{h,z}}(\mathrm{h}_{\mathrm{user}})$ is hydrostatic and $\Delta_{\mathrm{w,z}}(\mathrm{h}_{\mathrm{user}})$ wet zenith delays in meters at the user altitude h_{user}. The user altitude h_{user} is calculated with respect to the nominal sea level [EGM96]. The terms $\mathrm{zh}_0(\mathrm{h}_{\mathrm{ref}})$ and $zw_0(\mathrm{h}_{\mathrm{ref}})$ are the hydrostatic and wet zenith delays at the reference altitude given in the IE *OMA-LPPe-AGNSS-LocalTroposphereDelayTimeElement.* Finally, the terms e_h and e_w are the exponential fit parameters for the hydrostatic and wet zenith delays.

C.4.1.1 Gradient Parameters

The total tropospheric slant delay can be considered as a combination of the azimuthally symmetric and asymmetric parts.

Consequently, the notation for the neutral delay becomes

$$\Delta(\varepsilon,\phi,h_{user}) = \Delta_{z,h}(h_{user})m_h(\varepsilon) + \Delta_{z,w}(h_{user})m_w(\varepsilon) + m_a(\varepsilon)\cot\varepsilon\left[G_N\cos\phi + G_E\sin\phi\right]$$

where the tropospheric delay is first modelled into zenith direction and then projected into the direction of the satellite using a mapping function that is not only a function of the elevation angle, but also of azimuth angle ϕ, the angle counted clockwise from the true north. The m_a, which is a specific mapping function for the gradient terms can be chosen equal to m_h. The asymmetric components are determined by a horizontal gradient model, where G_N and G_E are the path delay gradient parameters in the North and East direction, respectively, from the IE *OMA-LPPe-AGNSS-LocalTroposphereDelayTimeElement*. These terms describe the total horizontal gradients, including both hydrostatic and wet components.

Horizontal gradients in the refractivity field result from pressure, temperature, and humidity gradients. Path delay exhibits thus both hydrostatic and wet gradients, though of different spatial scales and temporal correlation. Gradient parameters can be modelled either deterministically or stochastically as random walks in the estimation algorithm. Typically gradients are smaller than 1mm in zenith direction, which translates to a delay of a few centimeters at 10 degrees elevation. The importance of accounting for the azimuthal asymmetry increases, when the satellite elevation angle mask, i.e. the minimum elevation angle from which the measurements are accepted, decreases. This is because then the distance travelled in the troposphere increases.

C.4.2 Mapping Function

The tropospheric delay in the direction of zenith is scaled to lower elevation angles by using a mapping function defined by:

$$m(\varepsilon) = \frac{\Delta(\varepsilon)}{\Delta_z},$$

where ε is the elevation angle of the observed satellite from the horizon, $m(\varepsilon)$ is the mapping function, Δ_z is the zenith delay and $\Delta(\varepsilon)$ the slant delay. Δ_z is either computed from the surface parameters in the IE *OMA-LPPe-AGNSS-LocalSurfaceParameterList* or given as a parameter in the IE *OMA-LPPe-AGNSS-LocalTroposphereDelay*.

The approach taken here assumes a horizontally stratified atmosphere with separated mapping functions for the hydrostatic and the wet part. The total slant delay thus becomes:

$$\Delta(\varepsilon,h_{user}) = \Delta_{z,h}(h_{user})\cdot m_h(\varepsilon) + \Delta_{z,w}(h_{user})\cdot m_w(\varepsilon)$$

where the mapping functions are presented in the continued fraction expansion form proposed by Herring (Herring, T.A. 1992. Modeling Atmospheric Delays in the Analysis of Space Geodetic Data. In proceedings of the Symposium: Refraction of the Transatmospheric Signals in Geodesy, Hague, The Netherlands):

$$m(\varepsilon) = \frac{1 + \dfrac{a}{1 + \dfrac{b}{1+c}}}{\sin(\varepsilon) + \dfrac{a}{\sin(\varepsilon) + \dfrac{b}{\sin(\varepsilon)+c}}}$$

Three coefficients a, b, and c are enough to map zenith delays down to elevations of 3 degrees. The values for the hydrostatic and wet mapping functions can be derived from numerical weather prediction (NWP) models. The mapping function is independent of the target altitude.

The mapping function m_h is obtained using the mapping function parameters *ah*, *bh* and *ch* from the IE *OMA-LPPe-AGNSS-MappingFunctionParameters*. Likewise, m_w is obtained using the mapping function parameters *aw*, *bw* and *cw* from the IE *OMA-LPPe-AGNSS-MappingFunctionParameters*.

C.5 Satellite body-fixed coordinate frame

The satellite body fixed coordinate frame is defined as follows:

$$\underline{e_z} = -\frac{\underline{r_{sat}}}{\left\|\underline{r_{sat}}\right\|},\ \underline{e_y} = \frac{\underline{e_z} \times \underline{e_{sun}}}{\left\|\underline{e_z} \times \underline{e_{sun}}\right\|},\ \underline{e_x} = \frac{\underline{e_y} \times \underline{e_z}}{\left\|\underline{e_y} \times \underline{e_z}\right\|},$$

where $\underline{e_{sun}} = \frac{\underline{r_{sun}} - \underline{r_{sat}}}{\left\|\underline{r_{sun}} - \underline{r_{sat}}\right\|}$ is the unit vector from the satellite to the sun. The vectors $\underline{r_{sun}}$ and $\underline{r_{sat}}$ are the sun and satellite positions in Earth-centered reference frame.

Figure 20 shows the resulting Satellite-fixed coordinate system. The unit vector $\underline{e_z}$ points from the satellite center of mass to the center of the Earth. The unit vector $\underline{e_y}$ is perpendicular to both $\underline{e_z}$ and $\underline{e_{sun}}$. The $\underline{e_y}$ thus (righ-hand convention) points away from the plane. Finally, $\underline{e_x}$ is perpendicular to both $\underline{e_y}$ and $\underline{e_z}$ and thus lies in the plane.

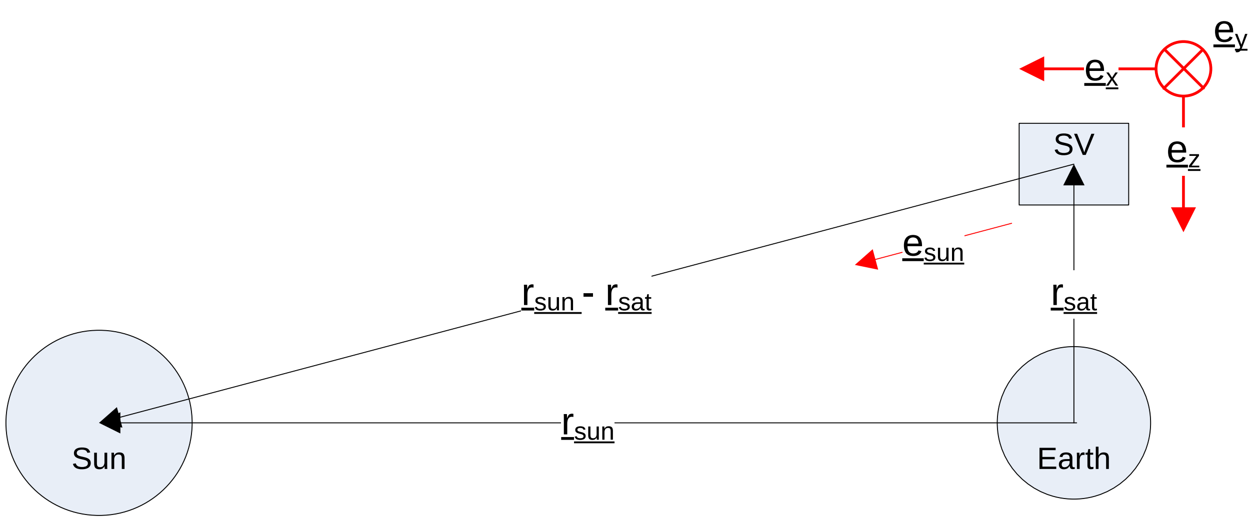


Figure 20: Satellite-fixed coordinate system

C.6 Navigation Degradation Models

C.6.1 Clock model Degradation Model

The clock model degradation at time t is modelled with the first-order polynomial

$$RMS_{CLOCK}(t) = cRMS_0 + cRMS_1(t - t_{oe}),$$

where t_{oe} is the time of ephemeris given in the Navigation Model parameters.

C.6.2 Orbit Model Degradation Model

The orbit model degradation at time t is modelled with the first-order polynomial

$$RMS_{ORBIT}(t) = oRMS_0 + oRMS_1(t - t_{oe}),$$

where t_{oe} is the time of ephemeris given in the Navigation Model parameters.

C.7 Solar radiation pressure

The acceleration a_{solar} due to the solar radiation experienced by the SV can be computed from

$$a_{solar} \sim P_{solar} \cdot (eA)_{eff} \cdot \frac{1}{m},$$

where P_{solar} is the solar radiation intensity at the Earth orbit, and $(eA)_{eff}$ the effective combined reflectivity and area. Lastly, m is the SV mass.

C.8 CRC16-IBM

The CRC16-IBM is calculated from an array of bytes using the polynomial $x^{16}+x^{15}+x^2+1$. The following code (in C) shows the reference implementation for calculating the CRC16-IBM.

```
#define WIDTH 16 /* Width of polynomial */
#define POLY 0x8005 /* Polynomial Bit #16 is set and hidden */
#define BYTE_BITS 8 /* Number of bits in byte */
#define TABLE_SIZE (1 << BYTE_BITS) /* Size of table */
#define MSB_MASK (1 << (WIDTH - 1)) /* Mask for high order bit in a word */

/* Table generated by 'crc16init()'  */
typedef uint16 Crc16;
static Crc16 table[TABLE_SIZE];

/* Initializes the table. Should be called once before the first call to 'crc16()' */
void crc16init(void)
        {
        Crc16 i;
        int j;
```

```
for(i = 0; i < TABLE_SIZE; ++i)
    {
    Crc16 val = i << (WIDTH - BYTE_BITS);
    for (j = 0; j < BYTE_BITS; ++j)
            val = (val << 1) ^ ((val & MSB_MASK) ? POLY : 0);
    table[i] = val;
    }
    }

/* Calculates CRC16 of 'cnt' bytes from 'src' and returns result */
/*  Initial value of CRC16 is supplied by caller in 'crc' */
 Crc16 crc16(Crc16 crc, void const* src, int cnt)
    {
    unsigned char const* s = (unsigned char const*)src;
    while(cnt--)
      crc = (crc << BYTE_BITS)^ table[(crc >> (WIDTH - BYTE_BITS)) ^ *s++];

    return crc;
    }
```

C.9 Antenna information

LPPe allows for defining the antenna orientation with respect to the Earth-Fixed system with Euler Angles (α , β and γ).

C.9.1 Antenna reference frame

Figure 21 shows the reference coordinate system associated with the antenna. The coordinate system is defined so that the Z-axis co-incidences with the Antenna Plane normal vector and the Y-axis co-incidences with the Antenna Reference Direction. The X-axis is chosen so that the resulting X-Y-Z system is right-handed.

The plane and reference direction definitions are antenna vendor-specific.

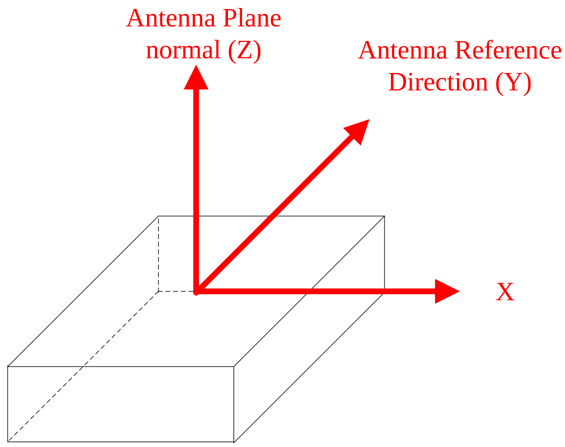


Figure 21: Antenna reference frame

C.9.2 Euler angles

Figure 22 shows the Euler Angles α, β and γ and their positive counter clock-wise directions (right-hand convention) with respect to the Earth-fixed East-North-Up right-handed coordinate system (blue axes).

The β denotes the counter-clockwise angle between the vertical direction and the antenna plane normal vector (Z). The β ranges from 0º (Vertical and Z parallel) to 180º (Vertical and Z anti-parallel).

The α denotes the counter-clockwise angle between East and Line of Nodes. The α ranges from 0º (East and Line of Nodes parallel) to 359º.

The γ denotes the counter-clockwise angle between X and Line of Nodes. The γ ranges from 0º (X and Line of Nodes parallel) to 359º.

Line of Nodes is shown in Figure 22 as being the line of intersection for the horizontal and antenna planes. Line of Nodes is perpendicular to both Vertical and Z axes.

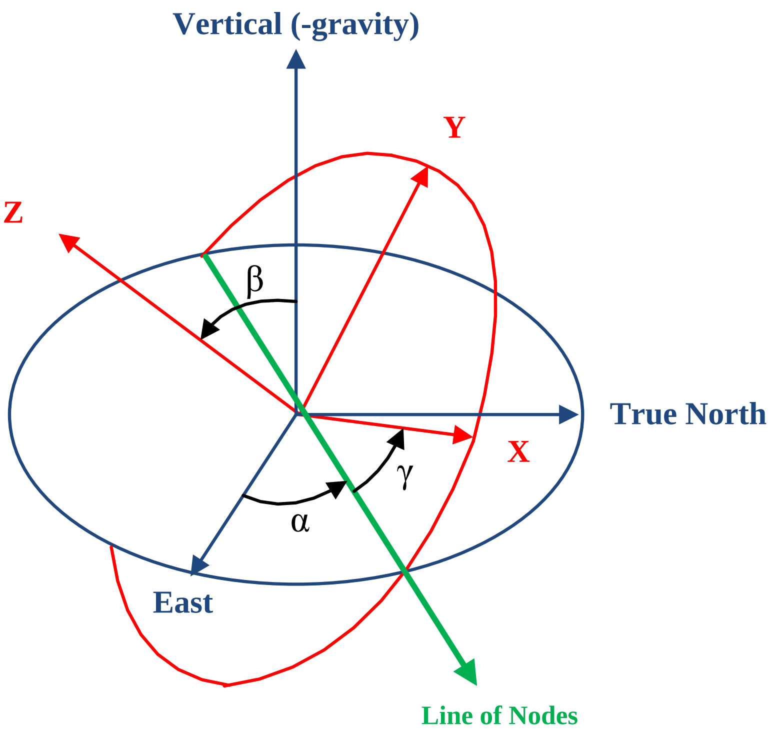


Figure 22: Euler Angles

Going from global coordinate system (East, True North, Vertical) to XYZ system in Figure 22 (extrinsic rotations):

- Rotate XYZ system about Vertical by γ . The X axis now makes angle γ with the East axis
- Rotate XYZ system about the East axis by β . The Z-axis now makes angle β with the Vertical
- Rotate XYZ system about the Vertical by α .

Alternatively, going from global coordinate system (East, True North, Vertical) to XYZ system in Figure 22 (intrinsic rotations):

- Rotate XYZ system about the Z-axis b α . The X-axis now lies on the Line of Nodes.
- Rotate XYZ system about the now-rotated X-axis b β . The Z-axis is now in its final direction. The X-axis is still on the Line of Node.
- Rotate the XYZ system about the new Z-axis by γ .

Note that in the gimbal lock situation (Z parallel or anti-parallel to β) the values of α and γ are not meaningful (non-unique) by themselves, but one considers the value of $\alpha + \gamma$ (when Z parallel to β) or $\alpha - \gamma$ (when Z anti-parallel to β), which are uniquely defined, respectively.

C.10 Use of step length estimation models

One exemplary step frequency-user's height model in the units of meter for the i-th motion state at the target can be given by

$$SL^i(k) = h \cdot (\alpha_i \cdot SF(k) + \cdot \beta_i) + \gamma_i$$

where h is the user's height, $SF(k)$ is the step frequency at time k and $\{\alpha_i, \beta_i, \gamma_i\}$ is a set of model parameters according to the i-th motion state. This step length estimation model can be used not only to provide immediate step length at the arbitrary target but also to give a first approximation for any calibration filter that would offer tuning functionality of these model parameters.

The linear sensor combination model is modelled with the linear combination of one or more walking characteristics such as step frequency, peak difference of accelerometer, variance of accelerometer, peak of gyroscope, variance of gyroscope etc. One exemplary step length estimation model using three walking characteristics inputs from both 3-axis accelerometer and 3-axis gyroscope can be expressed as follows.

$$SL^i(k) = SL_0 + \frac{1}{\sum_{i=1}^{3} WF_i = 1}\{\alpha^i \cdot (SF(k) - SF_n{}^i) \cdot WF_1 + \beta^i \cdot (PA(k) - PA_n{}^i) \cdot WF_2 + \gamma^i \cdot (PG(k) - PG_n{}^i) \cdot WF_3\},$$

where $SL^i(k)$ is the step length at time k for the i-th motion state, SL_0 is the initial step length and $SF_n{}^i, PA_n{}^i, PG_n{}^i$ are, respectively, the nominal value of step frequency, peak difference of 3-axis acceleration norm and peak difference of 3-axis gyroscope for the i-th motion state. $SF(k), PA(k), PG(k)$ are, respectively, the measurement of step frequency, peak difference of 3-axis acceleration norm, peak difference of 3-axis gyroscope at time k. $\alpha^i, \beta^i, \gamma^i$ are, respectively, the coefficients of step frequency, peak difference of 3-axis acceleration norm and peak difference of 3-axis gyroscope for the i-th motion state. WF_i is the i-th weight factor of all available walking characteristics and $\sum_{i=1}^{3} WF_i = 1$. Note that the combination of available walking characteristics is dependent on the available sensors at the target.

C.11 Propagation model descriptions

C.11.1 Circular Contour with Applicability area

The relationship between a circular contour propagation model and area of applicability is exemplified in Figure 23.

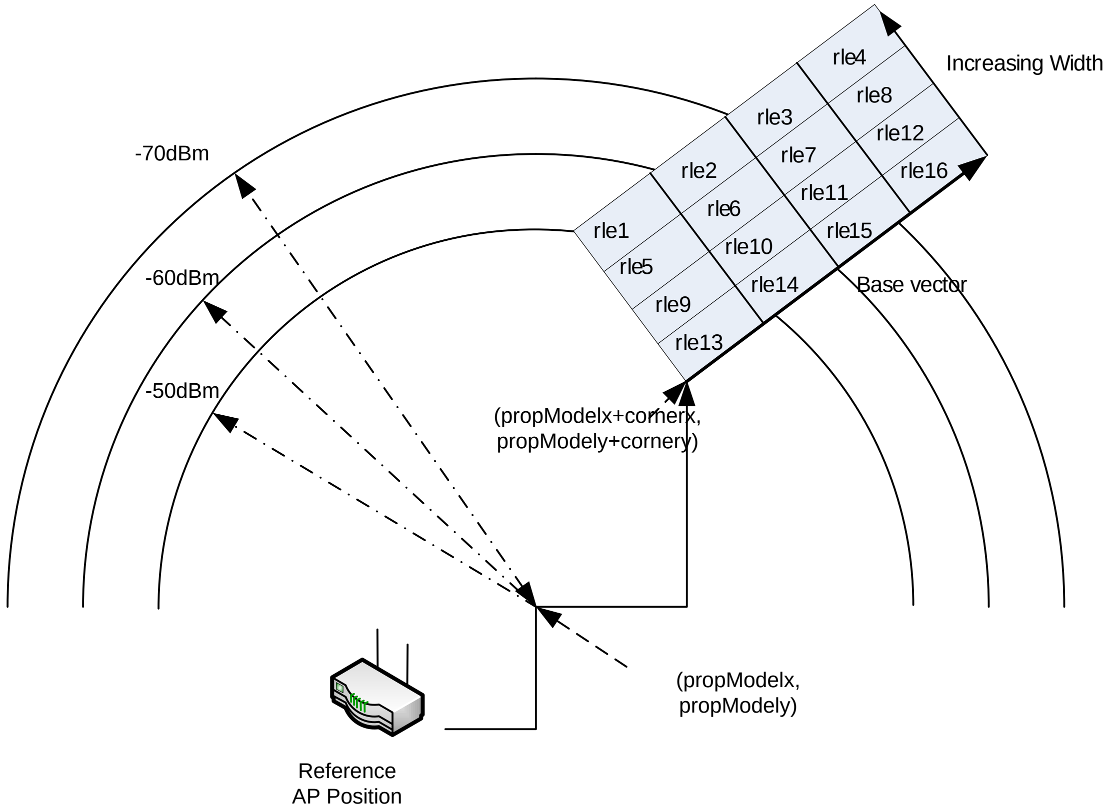


Figure 23 Usage of Propagation and applicability area parameters

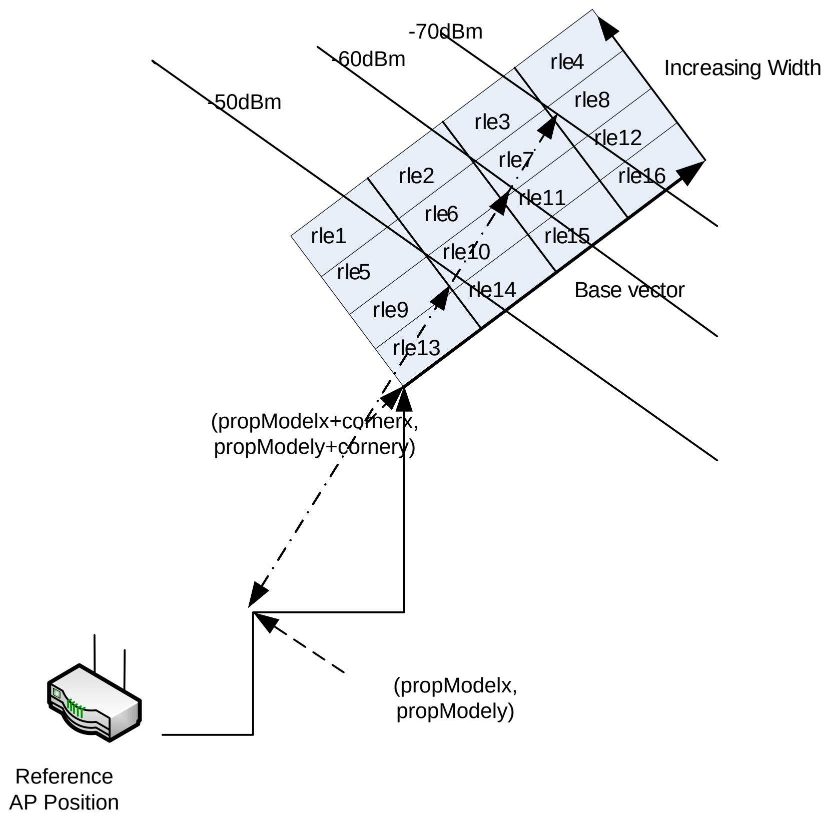


Figure 24 Usage of Propagation and applicability area parameters (corner x,y values defining direction only)

Appendix D. Example flows (informative)

D.1 Exemplary periodic data flows

D.1.1 CCP Assistance Data Transfer procedure – nominal case

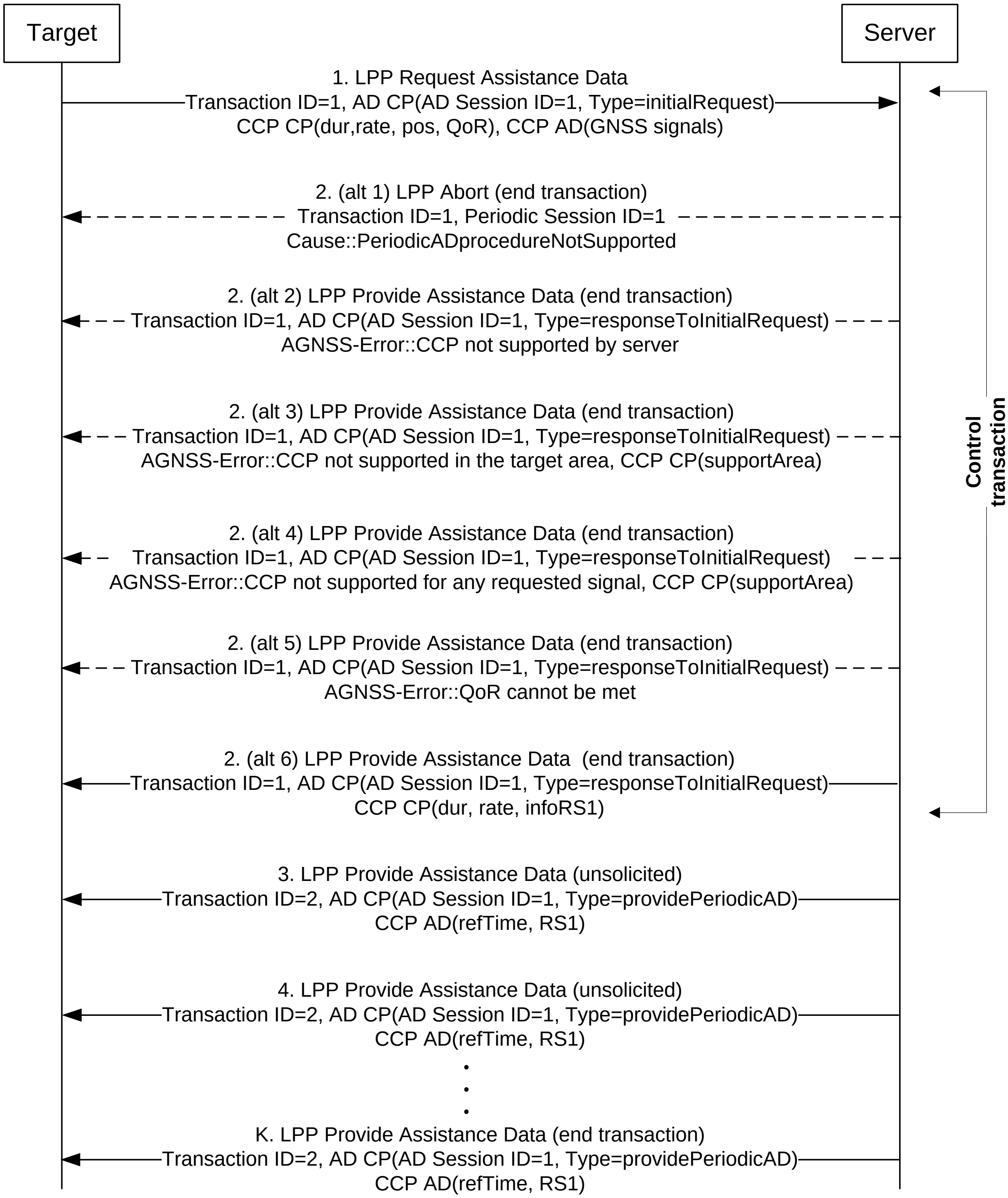


Figure 25: Assistance data transfer – nominal case

1. The target requests for the periodic AD and within that CCP assistance. The request contains the Periodic AD session ID in the AD control parameters (AD CP) and the requested duration, rate, QoR (quality-of-reference-station) and the target position in the CCP-specific control parameters (CCP CP). Furthermore, the generic part of the AGNSS AD request carries the information for which GNSS signals the CCP AD is being requested.

   The Periodic AD session ID (1 in this flow) in the AD CP allows for modifying the periodic AD session parameters (stopping, changing duration and rate of delivery) as well as changing reference stations within the CCP assistance session. The Periodic AD session ID binds the messaging associated with the single Periodic AD session together by making the Periodic AD session-related message exchange independent of the LPP transaction handling.

2. (alternative 1) In case the server does not support periodic AD, the server shall abort the ongoing procedure.

3. (alternative 2) In case the server does not support CCP assistance, the server shall send back LPP Provide Assistance Data with AGNSS error code "CCP not supported by server". The transaction gets terminated.

4. (alternative 3) In case the server does not support CCP assistance for the target area, the server shall send back LPP Provide Assistance Data with AGNSS error code "CCP not supported in the target area" as well as the CCP support area assistance. The transaction gets terminated.

5. (alternative 4) In case the server cannot provide the target with a CCP assistance for any requested GNSS signal, the server shall send back LPP Provide Assistance Data with AGNSS error code "CCP not supported for any requested signal". The transaction gets terminated.

6. (alternative 5) In case the server cannot provide the target with a CCP assistance at the requested QoR, the server shall send back LPP Provide Assistance Data with AGNSS error code "QoR cannot be met". The transaction gets terminated.

7. (alternative 6) The server sends LPP Provide AD message with the AD CP as well as the CCP-specific control parameters (CCP CP) in the common part of the AGNSS AD. The AD CP carries the periodic AD session ID. In the CCP CP the server provides back at least the duration, rate and information on the reference station RS1 for which CCP AD will be provided. The duration and rate may or may not be the same as requested. In case multi-reference support is indicated (in the capabilities), the server may provide CCP AD also for multiple reference stations.

8. Server starts to provide periodic CCP AD to the target for RS1. The common CCP AD carries the reference time and the generic CCP AD the assistance for the GNSS signals and for the reference stations in use.

   The actual CCP AD is provided to the target in a new transaction (ID=2). The AD session ID stays at ID=1.

9. The server continues to provide the target with periodic CCP AD.

K. Periodic session terminates, when the duration of the session expires.

D.1.2 CCP Assistance Data Transfer procedure – session abort by target/server

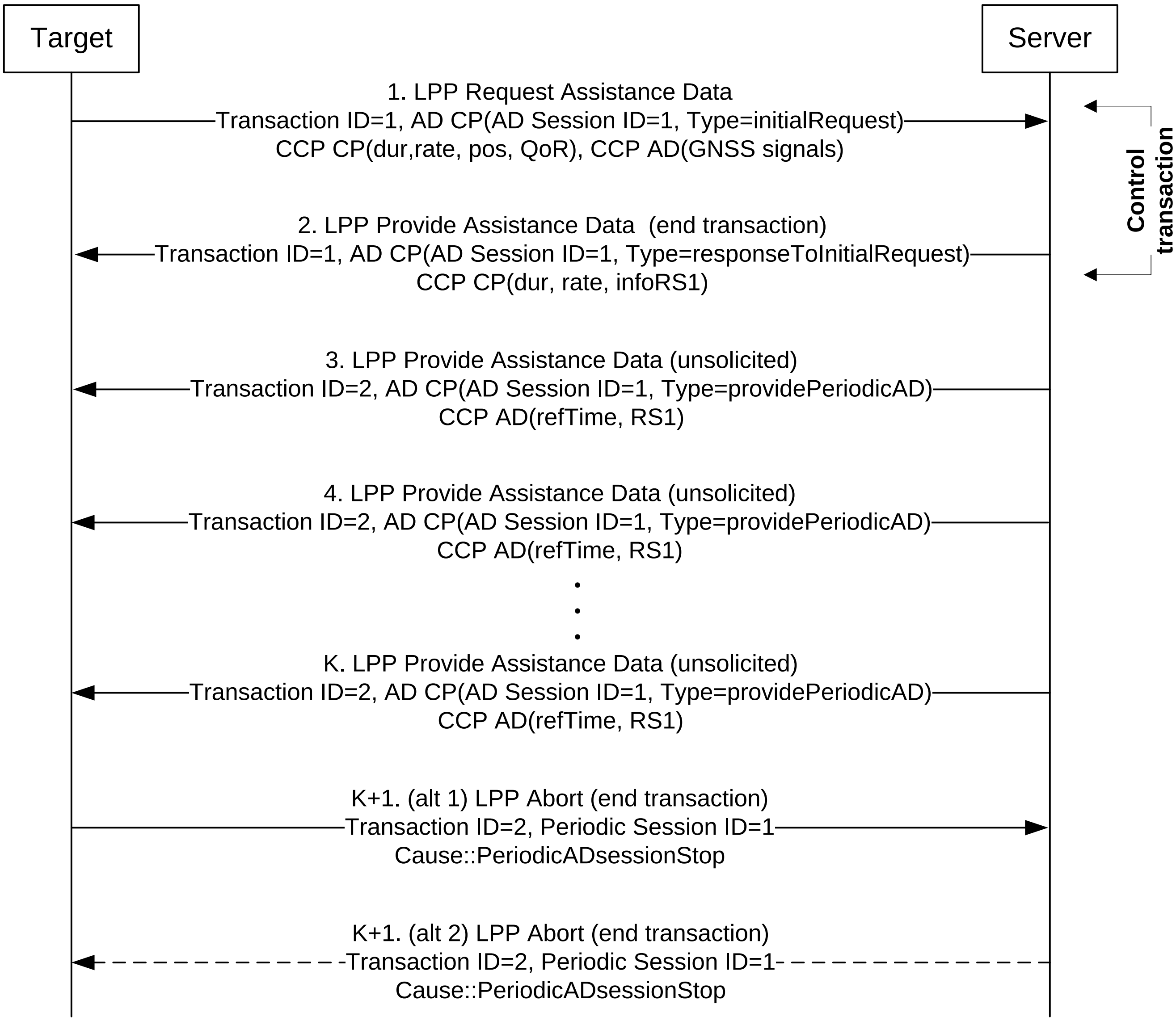


Figure 26: CCP assistance data transfer – session stop

1 - 4. As in the previous flow.

K. The server continues to provide the target with periodic CCP AD.

K+1. (alt 1) The target aborts the session prematurely.

K+1. (alt 2) The server aborts the session prematurely.

D.1.3 CCP Assistance Data Transfer procedure - session modification (target)

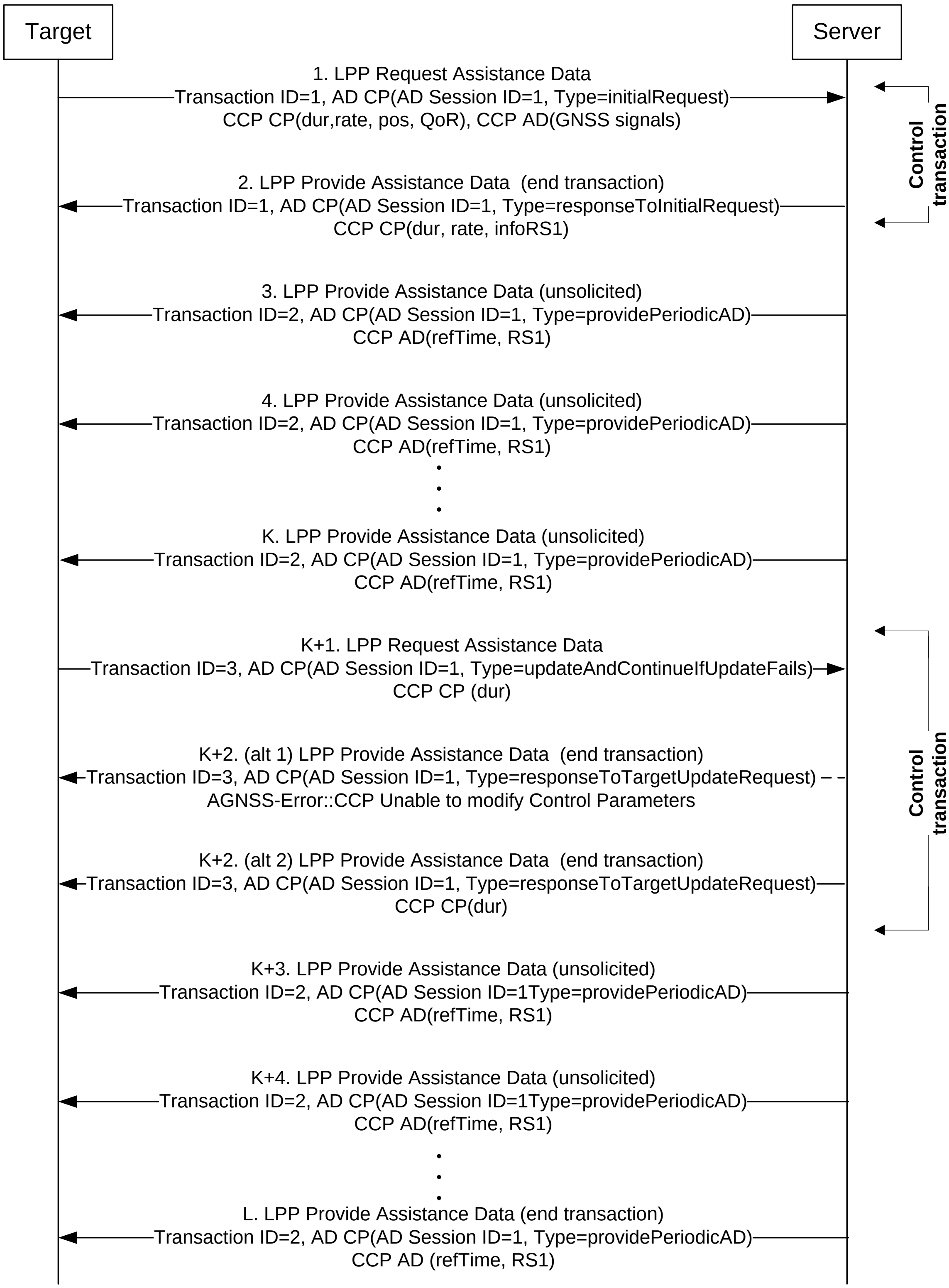


Figure 27: CCP assistance data transfer – session parameter modification (target)

1 - K. As in the previous flow.

K+1. The target requests the modification of the CCP CP (duration in this example). The request launches a new LPP transaction (ID=3), but the period AD session ID does not change (ID=1).

K+2. (alt 1) In case the server is unable to modify the CCP CP, the server shall return the error code “Unable to modify control parameters”.

Note that in case the target had indicated “updateAndAbortIfUpdateFails” the provision of AD would have been aborted by server without any further Provide AD (or Abort/Error) messages.

K+2. (alt 2) The server sends LPP Provide AD message with the modified CCP Control Parameter (duration). The modified duration may or may not be the same as requested by the target.

K+3. The server continues to provide the target with periodic CCP AD in the transaction with ID=2 and periodic session ID=1.

K+4. The server continues to provide the target with periodic CCP AD in the transaction with ID=2 and periodic session ID=1.

L. The session terminates, when the duration expires.

D.1.4 CCP Assistance Data Transfer procedure - session modification (server)

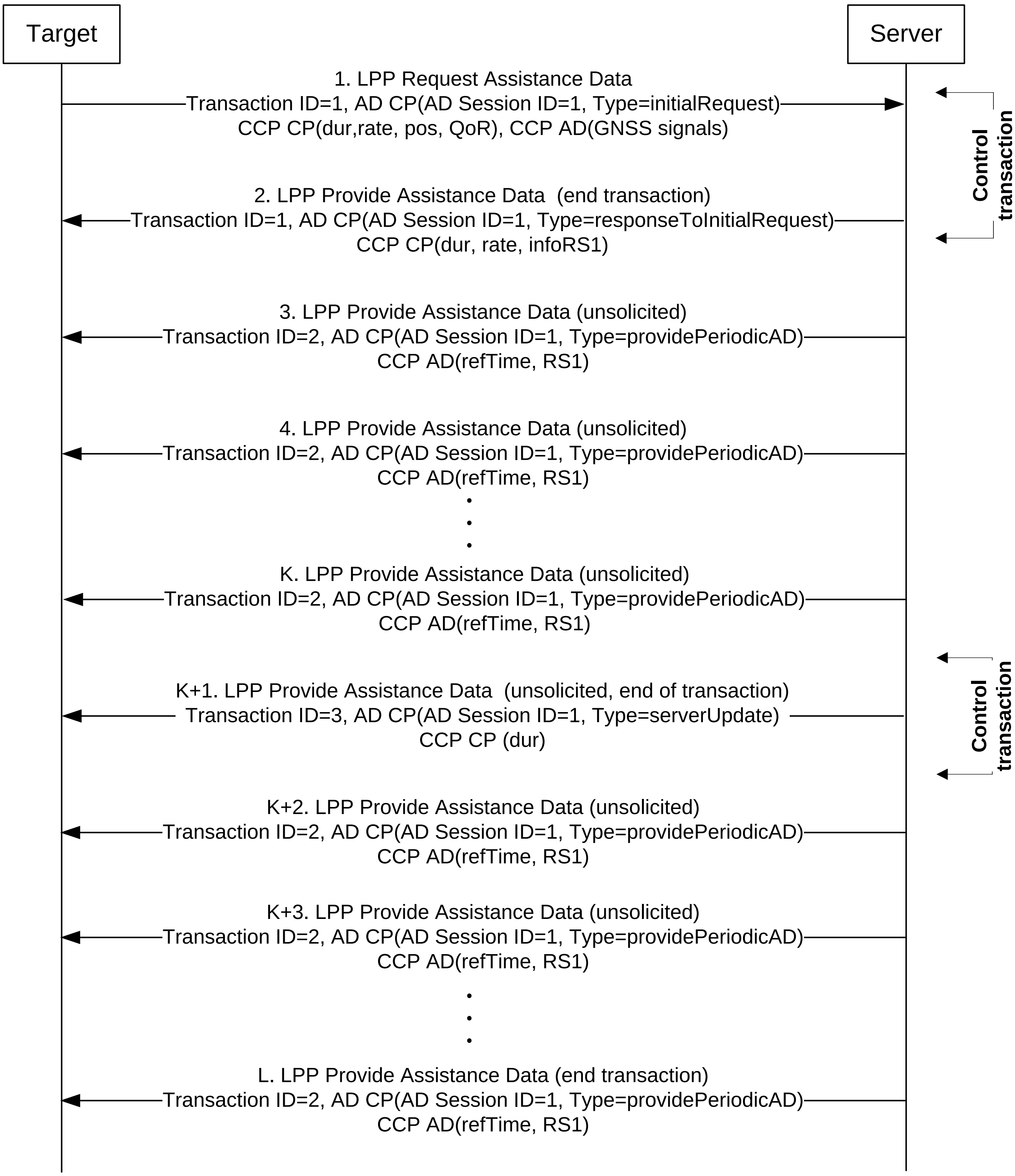


Figure 28: CCP assistance data transfer – session parameter modification (server)

1 - K. As in the previous flow.

K+1. The server sends LPP Provide AD message with the new CCP Control Parameters (duration in this example). The new duration overrides the previous duration.

The new duration is provided in a new LPP transaction (ID=3), but the periodic AD session ID does not change (ID=1).

K+2. The server continues to provide the target with periodic CCP AD in the transaction with ID=2 and periodic AD session ID=1.

K+3. The server continues to provide the target with periodic CCP AD in the transaction with ID=2 and periodic AD session ID=1.

L. The session terminates, when the duration expires.

D.1.5 CCP Assistance Data Transfer procedure - change of reference station

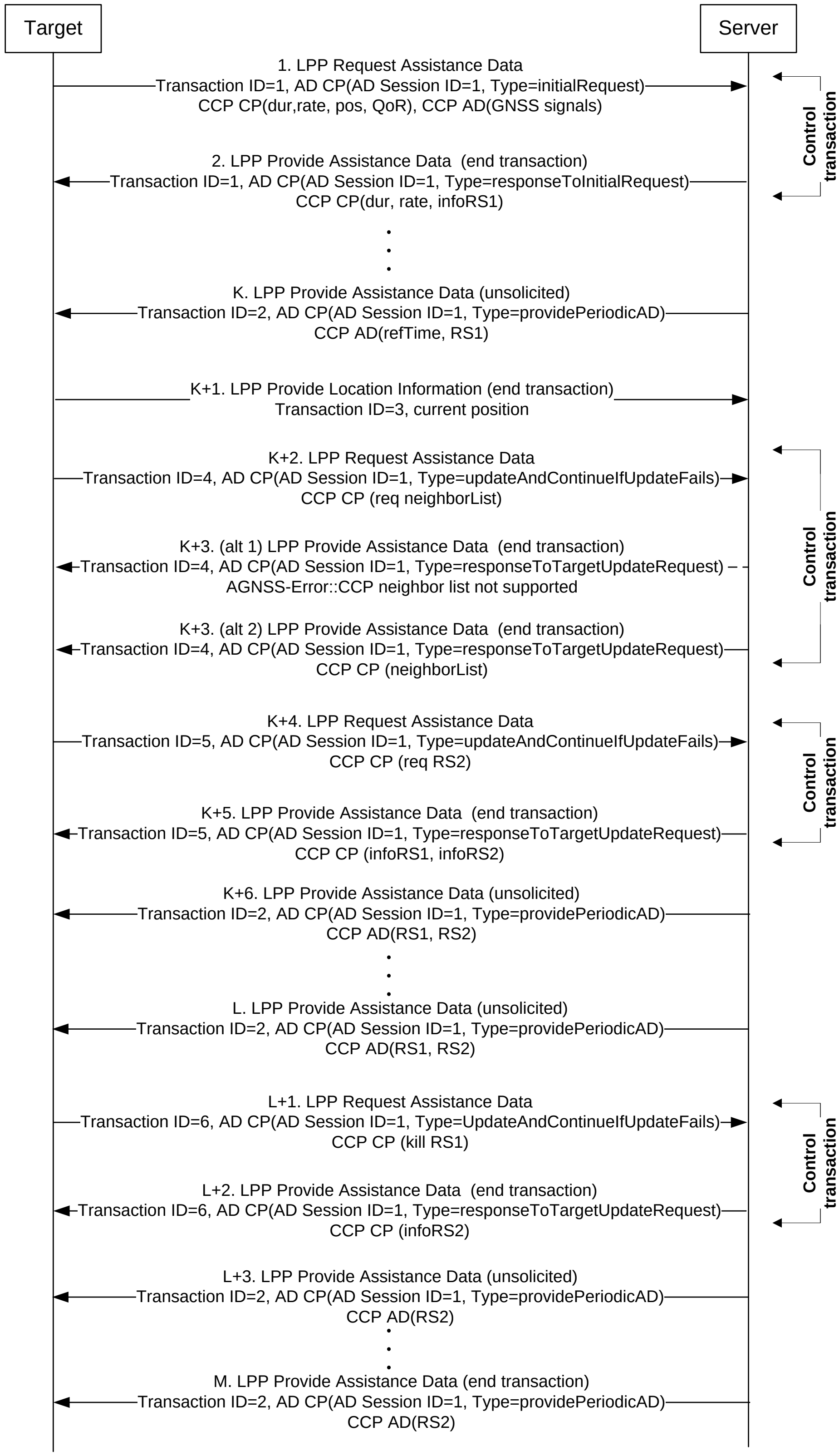


Figure 29: CCP assistance data transfer – change of reference station

1 - K. As in the previous flow

K+1. The target provides its current location to the server in the new transaction with ID=3

K+2. The target request for the neighbor list in the new transaction with ID=4

K+3. (alternative 1) The server indicates that the neighbor list is not supported. The session continues, but the target does not obtain the neighbor list. Note that in the further steps shown it is assumed that the target did receive the neighbor list, i.e. the rest of the call flow assumes alternative 2 in the step K+3.

Note that in case the target had indicated "updateAndAbortIfUpdateFails" the provision of AD would have been aborted by server without any further Provide AD (or Abort/Error) messages.

K+3. (alternative 2) The server provides the neighbor list

K+4. The target request for CCP AD for the RS2 in the new transaction with ID=5

K+5. The server provides the reference station information for the RS1 and RS2. This indicates that the server starts provide AD for the both reference stations.

Note that the call flow assumes that the AD update request is a successful one. See D.1.6 for a failure case.

K+6. The server provides CCP AD for RS1 and RS2

(target performs operations required to change the reference station)

L. The server provides CCP AD for RS1 and RS2

L+1. The target request for killing the CCP AD delivery for the RS1 in the new transaction with ID=6

L+2. The server confirms the change by providing the RS information only for the RS2 in the CCP CP

L+3. The server provides CCP AD for RS2 in the transaction with ID=2. The periodic AD session ID has stayed the same throughout the session.

M. The periodic AD assistance session terminates, when the duration expires.

D.1.6 CCP Assistance Data Transfer procedure - change of reference station (fail)

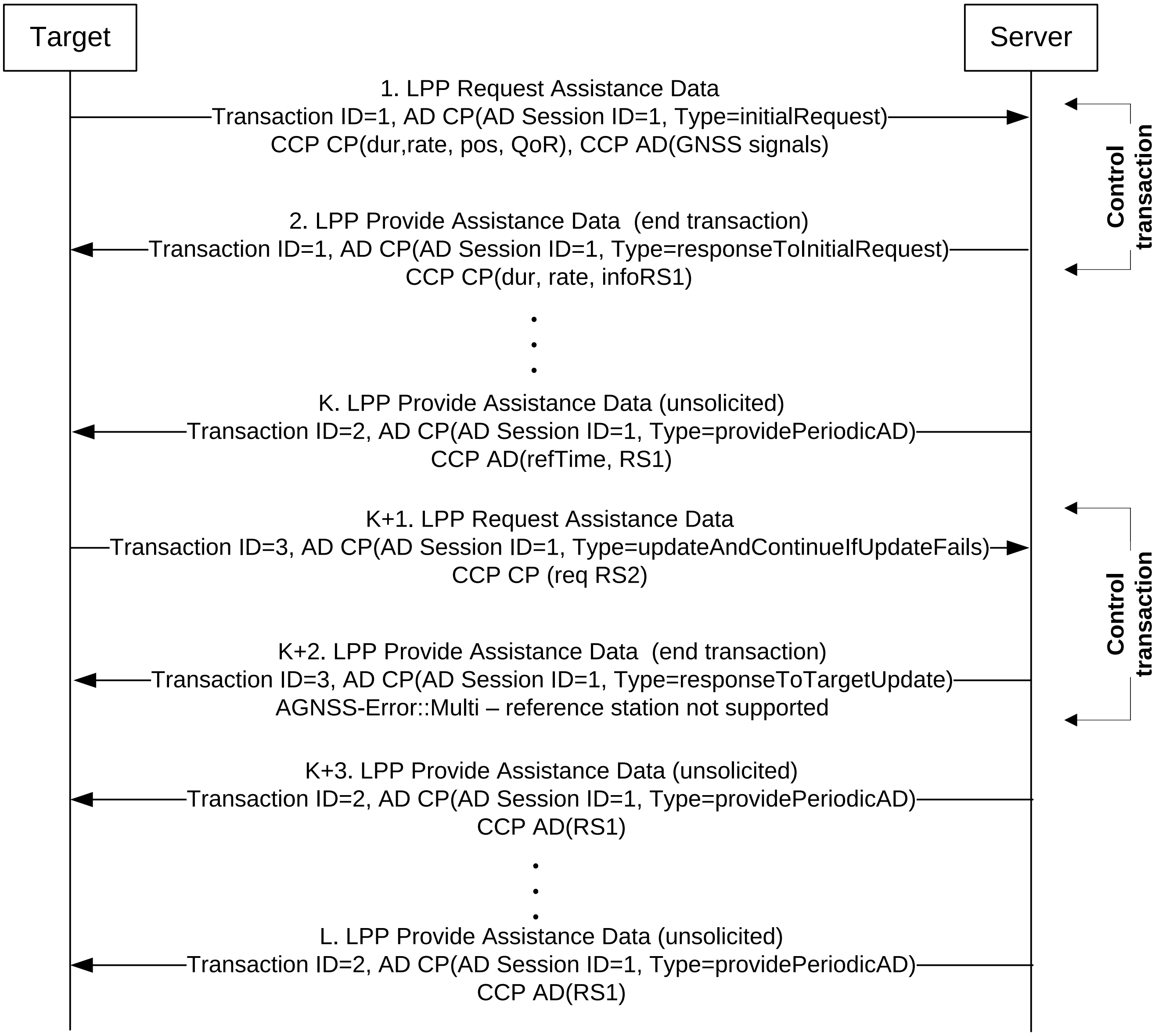


Figure 30: CCP assistance data transfer – failure in the change of reference station

1 - K. As in the previous flow

K+1. The target request for CCP AD for RS2 in the new transaction with ID=3

Note that the target might have requested for the neighbor list as in the previous case prior to this step.

In case the neighbor list is empty, the target may still request for another reference station based on position, i.e. the empty neighbor list does not indicate that the server is not capable of providing CPP AD for multiple reference stations.

K+2. The server responds with the AGNSS-Error "multi-reference station not supported" in LPP Provide AD indicating that the server cannot provide CCP AD for multiple reference stations at the same time.

Note that in case the target requested for the neighbor list and it was returned non-empty, the server may still be unable to provide CPP AD for multiple reference stations (see next step). In this case the target might decide to continue with the current reference station. Alternatively the target may abort the current session and start another CCP AD session based on the knowledge (from the neighbor list) that there are potential reference stations nearby.

Note that in case the target had indicated "updateAndAbortIfUpdateFails" the provision of AD would have been aborted by server without any further Provide AD (or Abort/Error) messages.

K+3. The server continues to provide CCP AD for RS1 in the transaction with ID=1 and periodic AD session ID=1

L. The periodic AD assistance session terminates, when the duration expires.

D.1.7 CCP Assistance Data Transfer procedure – unsolicited

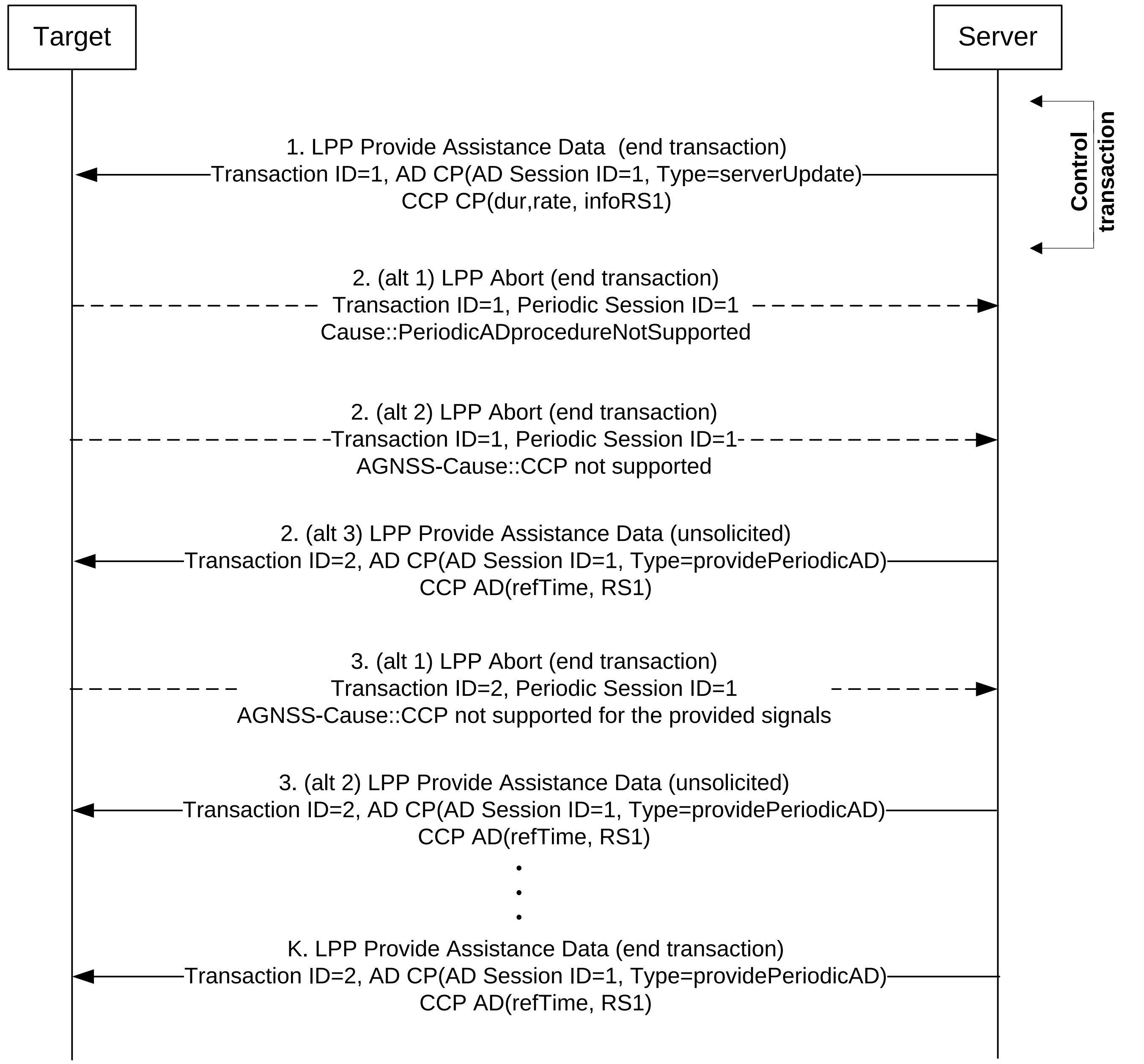


Figure 31: CCP assistance data transfer – unsolicited

1. The server sends LPP Provide AD message with the Periodic AD control parameters (AD CP) as well as the CCP-specific control parameters (CCP CP).

2. (alternative 1) The target aborts the session, because the target does not support periodic AD procedure.

3. (alternative 2) The target aborts the session, because the target does not support CCP AD.

4. (alternative 3) Server starts to provide periodic CCP AD to the target for RS1.

5. (alternative 1) The target aborts the session, because the target does not support CCP AD for the provided GNSSs/signals

6. (alternative 2) Server provides periodic CCP AD to the target for RS1

K. Periodic session terminates, when the duration of the session expires.

D.2 Periodic High Accuracy GNSS examples

D.2.1 Nominal case

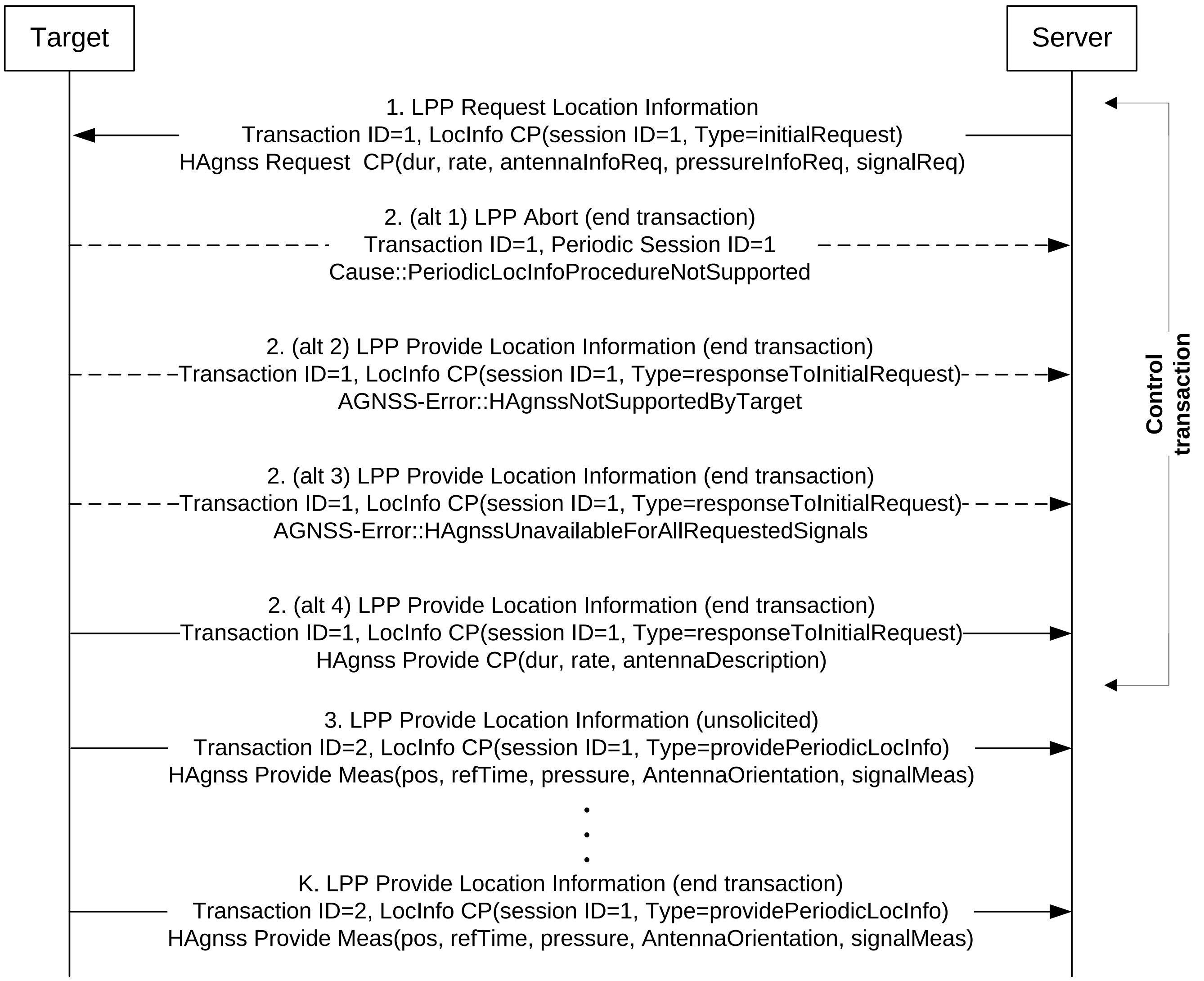


Figure 32: Periodic HA GNSS – nominal case

1. The server requests the periodic HA GNSS measurements from the target. The common part of the Location Information request carries the periodic session ID, which stays the same throughout the HA GNSS session.

   The HA GNSS CP (Control Parameter) request carries the requested duration of the session, rate of the measurement deliveries, information if pressure information is to be provided and GNSS signals requested. Moreover, the request also defines if the antenna information is to be provided.

2. (alternative 1) In case the target does not support periodic Location Information delivery, the target shall abort the session by the cause “Periodic Location Information Procedure Not Supported”.

3. (alternative 2) In case the target does not support HA GNSS, the target shall reply with the AGNSS Error “HA

GNSS Not Supported By Target”. The session gets terminated without further message exchange.

4. (alternative 3) In case the target does not support HA GNSS for any requested GNSS signal, the target shall reply with AGNSS Error “HA GNSS not unavailable for all requested signals”. The session gets terminated without further message exchange.

5. (alternative 4) In case the target can support the request the HA GNSS CP provide IE carries the confirmation for the duration of the session and the rate of the message deliveries. The duration and rate may or may not be the same as requested. In case antenna description was requested and supported, it shall be provided in the provide CP.

6. The target starts to provide Periodic Location Information messages from the server to the target in a new (unsolicited) transaction with ID=2. The provide message carry at least the signal measurements. The pressure information is carried, if requested and supported. The position and reference time information is carried unless forbidden by the LPP proper AGNSS measurement control. The antenna orientation information is provided, if requested and supported.

K. The session terminates, when the duration expires.

D.2.2 Server-side session modification

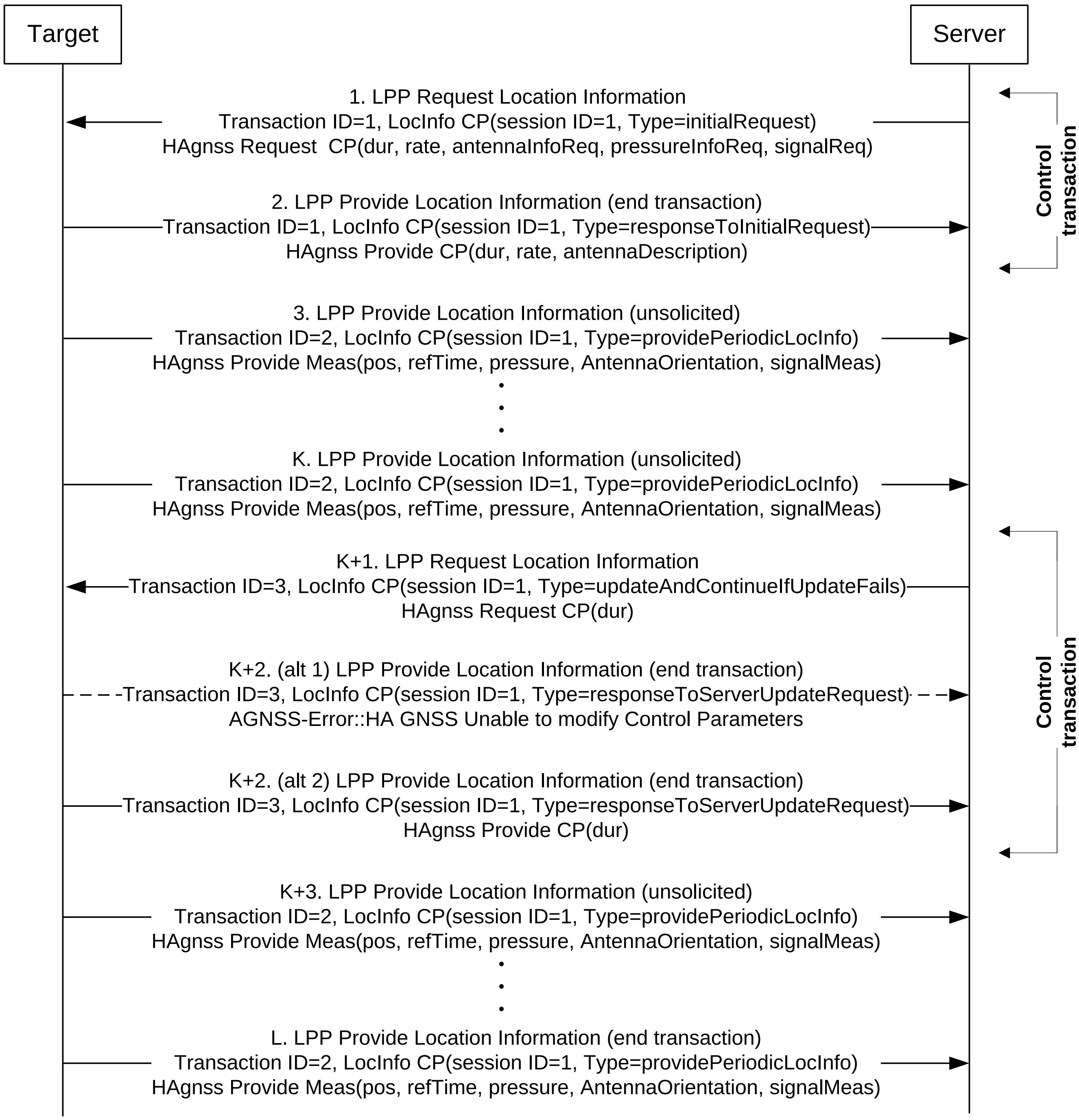


Figure 33: Periodic HA GNSS – nominal case

1 - 3. As in the previous flow.

K. The target continues to provide periodic HA GNSS measurements to the server according to the control parameters.

K+1. The server requests for a new duration for the periodic HA GNSS in HA GNSS CP Request. The request launches a new transaction with ID=3.

K+2. (alternative 1) In case the target cannot update the HA GNSS CP, the target shall reply with the error code

"Unable to Modify Control Parameters". The session continues without abruption, because the server indicated in the request "Continue If Update Fails". In case, however, the server indicated "Abort If Update Fails" then the target would have aborted the session without further messages to the server.

K+2. (alternative 2) The target confirms the new duration in the HA GNSS CP Provide. The duration may or may not be the same as requested by the server.

K+3. The target continues to provide HA GNSS measurements to the server in the transaction with ID=2 according to the updated control parameters.

L. The session terminates, when the duration expires.

D.2.3 Target/server-side abort

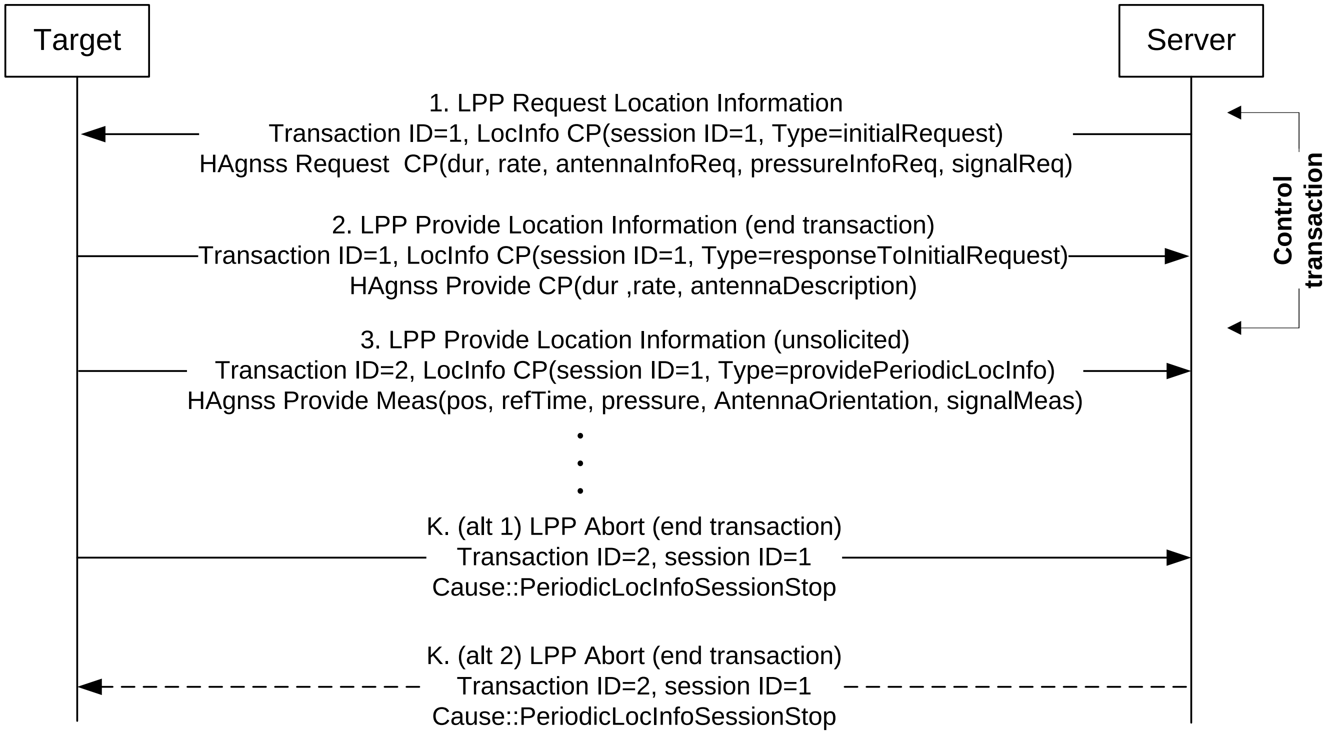


Figure 34: Periodic HA GNSS – abort

1 - 3. As in the previous flow.

K. (alternative 1) The target aborts the session with the cause Periodic Location Information Session Stop

K. (alternative 2) The server aborts the session with the cause Periodic Location Information Session Stop

D.3 Periodic wide area ionosphere corrections procedure

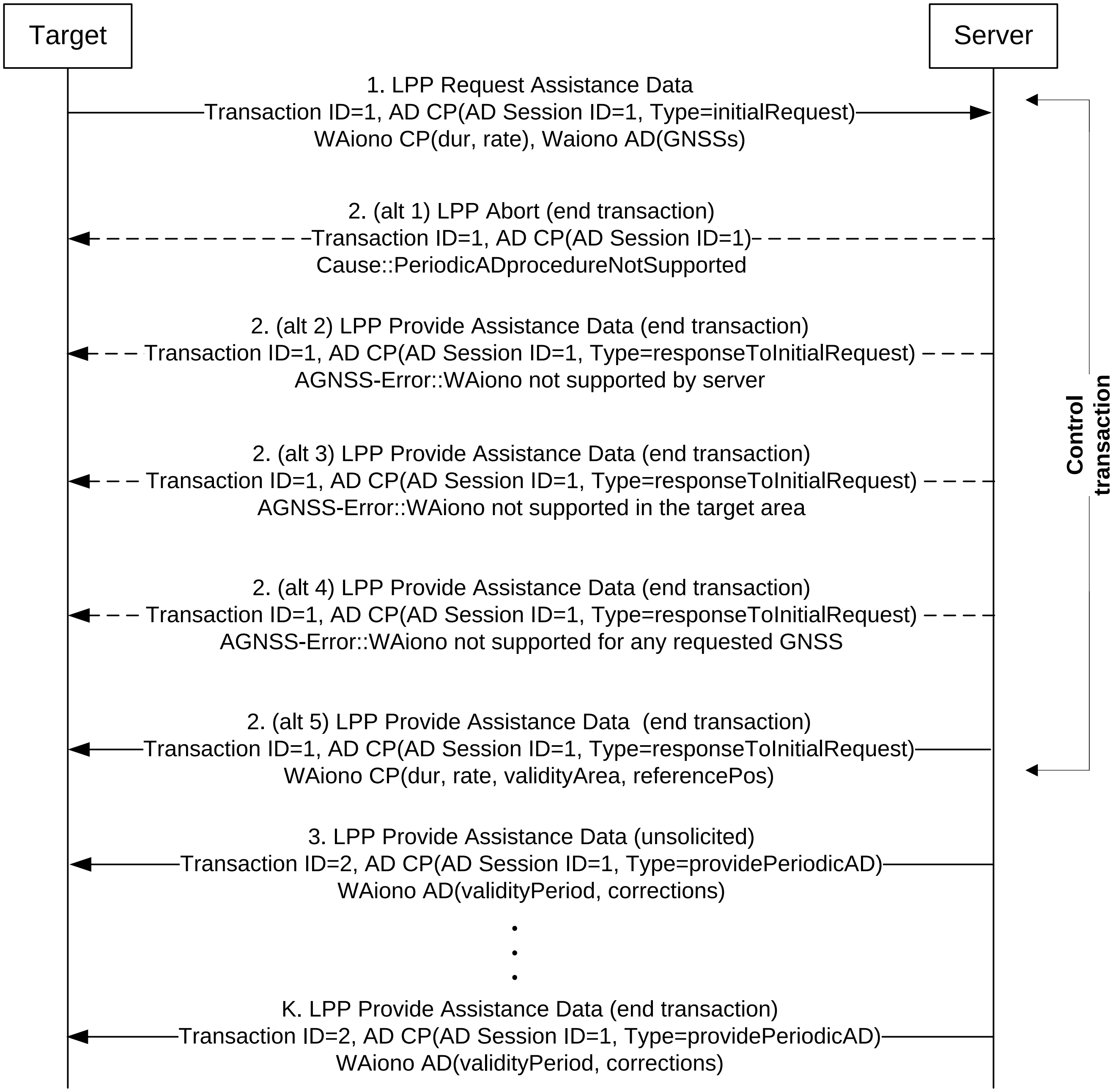


Figure 35: Periodic procedure in the context of wide area ionosphere surface corrections

1. The target requests for the periodic AD for WA Ionosphere Surface AD. The request contains the requested WA Iono Control Parameters (duration, rate) and the list of GNSSs for which the corrections are being requested for.

2. (alternative 1) In case the server does not support periodic AD, the server shall abort the ongoing procedure.

3. (alternative 2) In case the server does not support WA Ionosphere Surface assistance, the server shall send back LPPe Provide Assistance Data with AGNSS error code "WA iono not supported by server". The transaction gets terminated.

4. (alternative 3) In case the server does not support WA Ionosphere Surface assistance for the target area, the server shall send back LPPe Provide Assistance Data with AGNSS error code “WA iono not supported in the target area”. The transaction gets terminated.

5. (alternative 4) In case the server cannot provide the target with WA Ionosphere Surface assistance for any requested GNSS, the server shall send back LPP Provide Assistance Data with AGNSS error code “WA iono not supported for any requested GNSS”. The transaction gets terminated.

6. (alternative 5) The server sends LPP Provide AD message with the WA Iono Control. The first message carries the duration, rate, validity area and the model reference position. Note that the duration and/or rate may or may not be the same as requested by the target.

   All the control parameters may be updated in a later phase either unsolicited by server or based on the target request using the periodic AD update procedure.

7. Server starts to provide periodic WA Ionosphere Surface AD to the target. The actual WA Ionosphere Surface AD is provided to the target in a new transaction (ID=2). The AD session ID stays at ID=1.

K. Periodic session terminates, when the duration of the session expires.

Appendix E. Broadcast Restrictions and Labelling (Normative) – version 1.1

This appendix defines restrictions applicable to the content of broadcast assistance data and limitations on the areas within which certain types of assistance data may be broadcast. This appendix also provides a means of labelling different types of assistance data. The labels may be used both within LPPe and by a broadcast system to advertise support for particular types of assistance data and/or to provide broadcast scheduling information. The precise use of the labels by particular broadcast systems is outside the scope of this specification.

E.1 LPP Restrictions and Labels

Table 7 shows the different types of assistance data for LPP that may be broadcast where each assistance data type is referred to using its ASN.1 parameter name. For each assistance data type, an area limitation is shown if the assistance data is only valid within a restricted area. A server may broadcast assistance data outside the area limitation if it is preferred to provide target devices with assistance data for a wider geographic area although there is no guarantee that the data will always be usable in that case. Other restrictions for assistance data are also shown where these exist – e.g. any restrictions on content. It is assumed that assistance data that is time sensitive (e.g. GNSS time, GNSS real time integrity, GNSS acquisition assistance) will be updated as needed by the server and that stale data will be removed. For assistance data that includes an explicit validity area, broadcast outside the validity area is allowed and a target is assumed to verify presence within the validity area before using the data.

The table also shows labels that may be used within LPPe and by a broadcast system to refer to particular types of assistance data – e.g. when indicating broadcast support for different types of assistance data within LPPe or when indicating which assistance data types are being broadcast by a broadcast system. A label is specified as a sequence of n (n = 1 to 4) numerical elements separated by periods – e.g. 2, 2.1, 2.1.3, 2.1.3.5 – where n is the nesting level of the labelled data item.

In the table, the nesting level of any assistance data type is indicated using a “>” symbol where the number of concatened “>” symbols m shown for any data item and its associated label indicates that its nesting level is m+1 where m is in the range 0 to 3. The order of data items in the table follows the ASN.1 definition which means that the parent data item for any nested data item at level n is the closest preceding data item in the table at level n-1. Labels are shown in column 1 and show only the final elements, since preceding elements can be inferred from the final elements for the parent data items. As an example, the assistance data type otdoa-ProvideAssistanceData has a nesting level of 1 and label of 2; the data type otdoa-NeighbourCellInfo (which is nested within and one level deeper than otdoa-ProvideAssistanceData) has a nesting level of 2 and a label of 2.2; and the assistance data type gnss-DataBitAssistance has a nesting level of 4 and a label of 3.2.N.5 where N (N = 1 to 9) indicates the particular GNSS or SBAS system to which it applies.

Label	ASN.1 Assistance Data Type	Area Limitation	Other Restrictions
1	commonIEsProvideAssistanceData	None	None (Note 1)
2	otdoa-ProvideAssistanceData		
> 1	> otdoa-ReferenceCellInfo	Limited to the area served by the provided neighbor cells and reference cell	

> 2	> otdoa-NeighbourCellInfo	Limited to the area served by the provided neighbor cells and reference cell	expectedRSTD SHALL refer to a target at the midpoint between the reference cell and neighbor cell eNodeB antenna locations. expectedRSTD-Uncertainty SHALL allow for a target at any location where the neighbor and reference cells can both be measured.
3	a-gnss-ProvideAssistanceData		
> 1	> gnss-CommonAssistData		
>> 1	>> gnss-ReferenceTime	Limited to the area served by the provided cells (up to 16) if GNSS-cell time is included. No restriction otherwise.	GNSS-cell time association, if provided for any cell, applies to the antenna location for the cell
>> 2	>> gnss-ReferenceLocation	None	The location uncertainty ellipsoid should encompass the area within which this assistance data is broadcast
>> 3	>> gnss-IonosphericModel	None	None
>> 4	>> gnss-EarthOrientationParameters	None	None
> 2	> gnss-GenericAssistData		
>> N	>> gnss-ID / sbas-ID		The label N indicates the GNSS or SBAS system as follow: N=1: GPS N=2: QZSS N=3: Galileo N=4: Glonass N=5: WAAS N=6: EGNOS N=7: MSAS N=8: GAGAN
>>> 1	>>> gnss-TimeModels	None	None
>>> 2	>>> gnss-DifferentialCorrections	None	None
>>> 3	>>> gnss-NavigationModel	None	None
>>> 4	>>> gnss-RealTimeIntegrity	None	None
>>> 5	>>> gnss-DataBitAssistance	None	None

>>> 6	>>> gnss-AcquisitionAssistance	It is recommended to limit this data type to an area of 100 miles across or less	The server should ensure that the data is valid for all locations at which it may be received (e.g. by providing suitable values for Doppler uncertainty and Code Phase search window).
>>> 7	>>> gnss-Almanac	None	None
>>> 8	>>> gnss-UTC-Model	None	None
>>> 9	>>> gnss-AuxiliaryInformation	None	None

Table 7: LPP Assistance Data Restrictions and Labels

Note 1: this AD parameter is empty in LPP Rel-9 through Rel-11 but is included as a placeholder for possible use in a later release of LPP.

E.2 LPPe Restrictions and Labels

Table 8 shows the different types of assistance data for LPPe 1.1 that may be broadcast, with associated area limitations and other restrictions, where each data type is referred to using using its ASN.1 parameter name. The conventions used to define nesting levels and labels are as described for LPP in section E.1.

Label	**ASN.1 Assistance Data Type**	**Area Limitation**	**Other Restrictions**
1	commonIEsProvideAssistanceData	None	None
> 1	> assistanceContainerList	Any area limitation is specific to the type of proprietary assistance data	checkOrUpdateOrError SHALL NOT be included dataResult SHALL contain OMA-LPPe-AssistanceContainerData
> 2	> providePeriodicADwithUpdate	Any area limitation is specific to the type of assistance data	A server SHALL follow the procedure defined in section 5.2.1.4 when including this parameter.
> 3	> segmentedADTransfer		Not used in this version of LPPe. A target SHALL ignore this parameter if included by a server.
> 4	> default-reference-point	None	None
> 5	> localCellInformation	Limited to the area served by the provided cells.	GNSS-cell time association, if provided for any cell, applies to the antenna location for the cell
2	agnss-ProvideAssistanceData		
> 1	> commonAssistData		
>> 1	>> ionosphericModel	None	None
>> 2	>> troposphereModel	None	None

>> 3	>> altitudeAssistance	None	None
>> 4	>> solarRadiation	None	None
>> 5	>> ccpAssistCommonProvide	Limited to a geographic area supported by the provided reference stations.	ccpProvideControlParameters SHALL be included in ccpAssistCommonProvide only in the messages corresponding to steps 1 and 4 of the procedure in section 5.2.1.4.
> 2	> genericAssistData		
>> N	>> gnss-ID		The label N indicates the GNSS or SBAS system as follow: N=1: GPS N=2: QZSS N=3: Galileo N=4: Glonass
>>> 1	>>> wideAreaIonoSurfacePerSVlist	None	None
>>> 2	>>> mechanicsForAllSVs	None	None
>>> 3	>>> dcbsForAllSVs	None	None
>>> 4	>>> navModelDegradationModel	None	None
>>> 5	>>> ccpAssistProvide	Limited to a geographic area supported by the provided reference stations.	This paramater SHALL be included only in messages corresponding to steps 2 and 3 in the procedure in section 5.2.1.4.
>>> 6	>>> navModelList	None	None
3	otdoa-ProvideAssistanceData		
> 1	> otdoa-ReferenceCellInfo	Limited to the area served by the neighbor cells and reference cell	None
> 2	> otdoa-NeighbourCellInfo	Limited to the area served by the neighbor cells and reference cell	expectedRSTD SHALL refer to a target at the midpoint between the reference cell and neighbor cell eNodeB antenna locations. expectedRSTD-Uncertainty SHALL allow for a target at any location where the neighbor and reference cells can both be measured.
4	eotd-ProvideAssistanceData		

> 1	> referenceBTS	Limited to the area served by the provided neighbor cells and reference cell	None
> 2	> msrAssistDataList	Limited to the area served by the provided neighbor cells and reference cell	expectedOTD SHALL refer to a target at the midpoint between the reference BTS and neighbor BTS antenna locations. expOTDUncertainty SHALL allow for a target at any location where the neighbor and reference BTSs can both be measured.
> 3	> systemInfoAssistDataList	Limited to the area served by the provided neighbor cells and reference cell	expectedOTD SHALL refer to a target at the midpoint between the reference BTS and neighbor BTS antenna locations. expOTDUncertainty SHALL allow for a target at any location where the neighbor and reference BTSs can both be measured.
5	otdoa-utra-ProvideAssistanceData		
> 1	> referenceCellInfo	Limited to the area served by the provided neighbor cells and reference cell	roundTripTime and roundTripTimeExtension SHALL NOT be included and SHALL be ignored by a target if included.
> 2	> neigborCellList	Limited to the area served by the provided neighbor cells and reference cell	searchWindowSize SHALL allow for a target at any location where the reference and neighbor cells can both be measured. roundTripTime and roundTripTimeExtension SHALL NOT be included and SHALL be ignored by a target if included.
6	ecid-lte-ProvideAssistanceData		
> 1	> ecid-LTE-NetworkData	Limited to the area served by the provided eNBs and HeNBs	None
7	ecid-gsm-ProvideAssistanceData		
> 1	> ecid-gsm-NetworkData	Limited to the area served by the provided BTSs	
8	ecid-utra-ProvideAssistanceData		
> 1	> ecid-UTRA-NetworkData	Limited to the area served by the provided Node Bs and HNBs	None

9	wlan-ap-ProvideAssistanceData		
> 1	> wlan-DataSet	Limited to the area served by the provided WLAN APs	None
10	sensor-ProvideAssistanceData	None	None (Note 2)
11	srn-ProvideAssistanceData		
> 1	> srnGroup	Limited to the area served by the provided SRNs	Shall provide srnGroupList and SHALL NOT provide srnGroupUpdateResponse
> 2	> antennaPattern	Limited to the area served by the referenced SRNs	None

Table 8: LPPe Assistance Data Restrictions and Labels

Note 2: this assistance data parameter is empty in LPPe 1.1 but is included as a placeholder for possible use in a later version of LPPe.

Appendix F. Broadcast Ciphering (Informative) – version 1.1

This appendix provides an informative level description of the algorithm use to cipher and decipher LPPe 1.1 broadcast assistance data messages. For a normative definition, refer to to [AES] and [NIST-800-38A].

The algorithm uses AES ciphering with counter mode. AES is a block mode cipher algorithm that ciphers blocks of 128 bits at a time. However, Counter mode enables usage for a bit string that is not an exact multiple of 128 bits. Further, Counter mode enables a target (or a server) to perform most of the deciphering (or ciphering) processing independently of receipt of the data to be deciphered (or ciphered) which may enable more efficient processing. Provided counters are chosen in a non-repeating manner by the server (which is a requirement for Counter mode), every block of data will be ciphered in a unique manner.

The algorithm makes user of a sequence of counters <C1, C2, C3, …> each containing 128 bits, where C1 is specified by the server and each subsequent counter (C2, C3 etc.) is obtained from the previous counter by adding one modulo 2**128. Each counter Ci is ciphered using the AES algorithm with a common 128 bit key to produce an output block Oi of 128 bits. To perform ciphering of a broadcast message, the LPP/LPPe message is divided into blocks B1, B2, … Bn of 128 bits each, except for the last block Bn which may contain fewer than 128 bits. The ciphered message is obtained as a sequence of n blocks containing 128 bits each (except possibly for the last block) given by (O1 XOR B1), (O2 XOR B2), … (On XOR Bn), where XOR denotes bitwise exclusive OR. In the case of the last block, if Bn contains m bits (m<128), then the m most significant bits of On would be used for the exclusive OR. Deciphering is performed in the same way except that the blocks B1, B2, … Bn are now obtained from the ciphered message and the result of the exclusive OR operations yields the original unciphered message. Figure 36 provides an illustration of Counter mode for the generic case of an arbitrary block cipher algorithm $CIPH_{K.}$

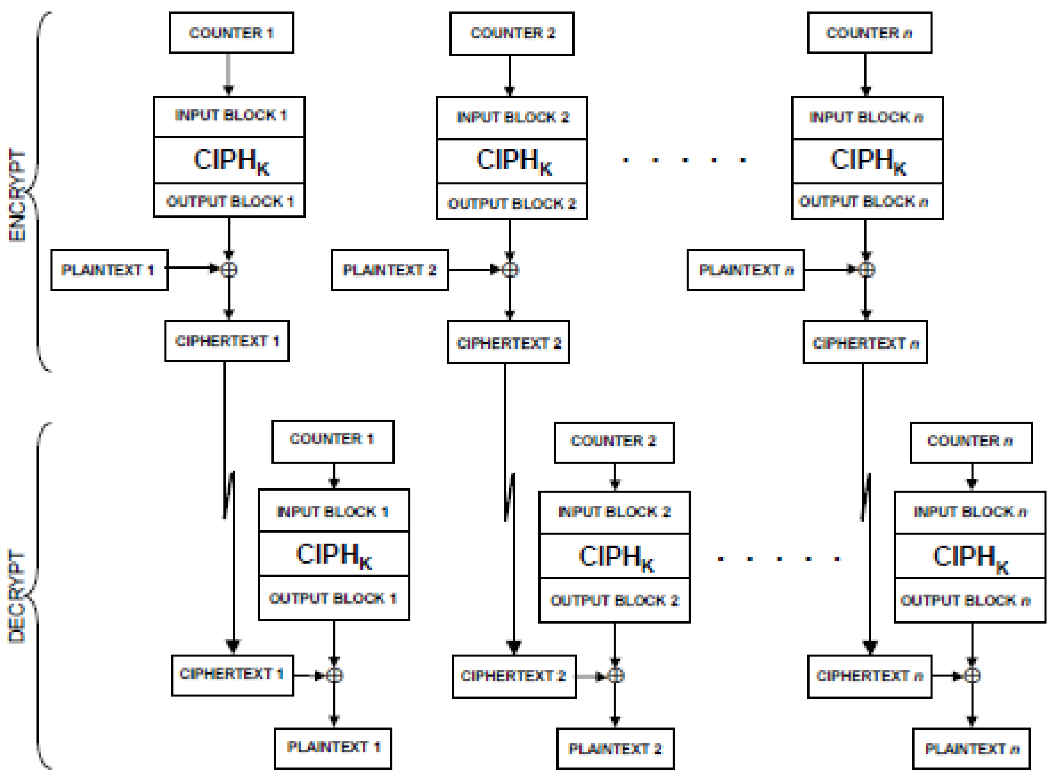


Figure 36: Illustration of Block Ciphering with Counter Mode

Appendix G. Encoding of RF Heat Maps (Normative) – version 2.0

This appendix applies only to LPPe 2.0 and defines how RF heat maps are encoded for a transmitter (e.g. an WLAN AP or SRN AP) using an octet string and with optional compression.

G.1 Reference Grid and Heat Map Area

RF heat maps are defined relative to a reference grid which comprises a two dimensional horizontal X,Y coordinate system with a given origin, orientation and grid point spacing as shown in Figure 37.

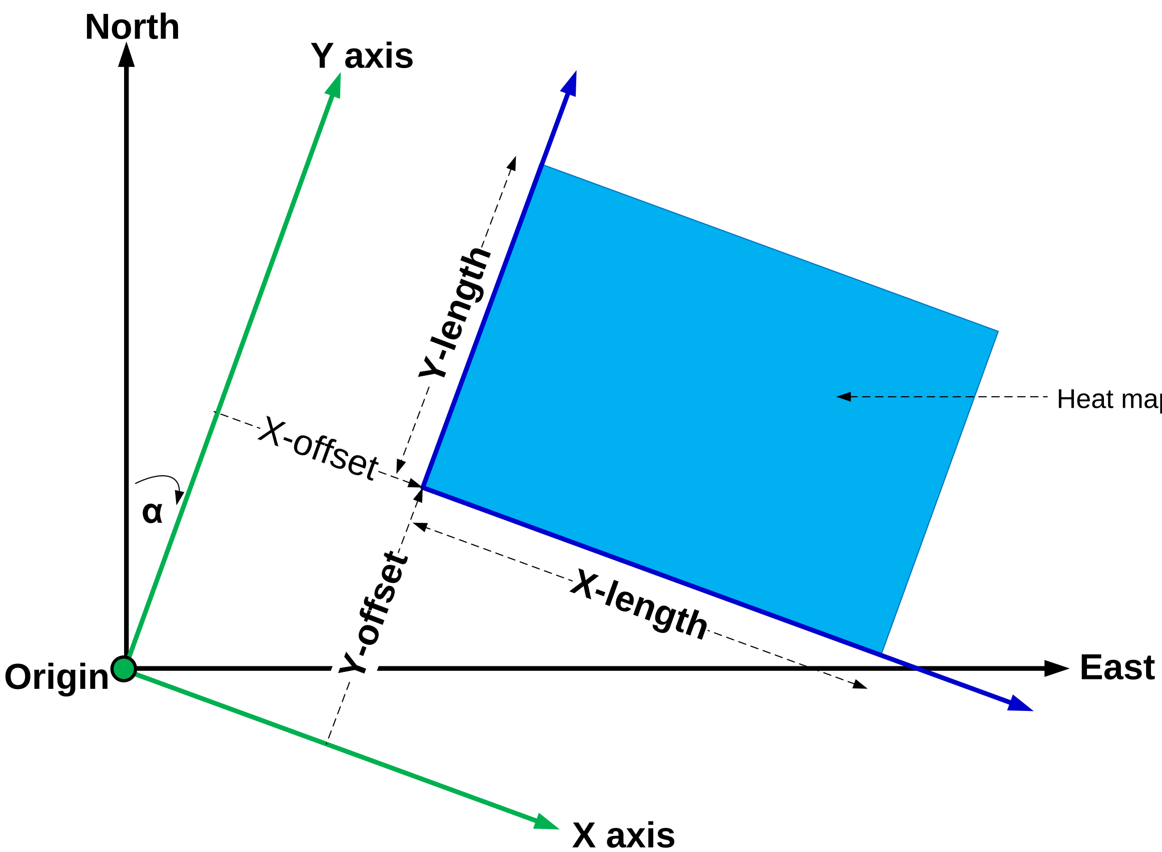


Figure 37: Reference Grid with an RF Heat Map Area

The origin of the X,Y coordinate system is defined relative to an LPPe reference point. The orientation α gives the clockwise angle between North and the Y axis in units of degrees. X and Y coordinates are restricted to integers based on a common unit of X and Y length known as the grid spacing. The area for any heat map is always a rectangle with sides parallel to the X and Y axes. The location of the heat map is defined by the X and Y offsets of the corner of the rectangle with minimum X and Y coordinates and its size is defined by the length of each side in units of the common grid spacing. Figure 38 shows more details of a heat map area including the grid points that it contains.

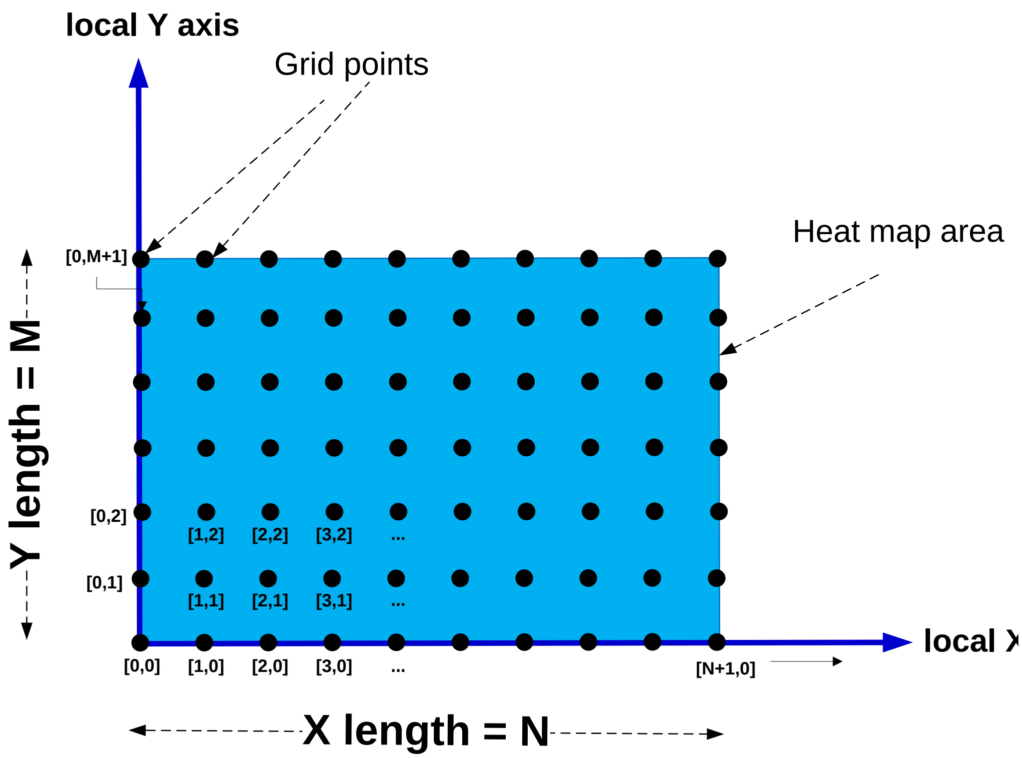


Figure 38: RF Heat Map Area including grid points

In Figure 38, the X and Y lengths are N and M, respectively, meaning that the heap map area contains (N+1)*(M+1) grid points. Grid points align with integer X and Y coordinates in the reference grid and may be given local X,Y coordinates as shown in Figure 38 relative to the corner of the rectangle with minimum X,Y coordinates in the reference grid. Heat map data (e.g. mean RSSI, mean RTT) are specified for each separate grid point.

G.2 Encoding of heat map values without Compression

Heat map values are each encoded using a single octet encoding an integer value between 0 and 255. The relationship of each encoded value to some RF related statistic (e.g. mean RSSI or mean RTT) is defined as part of the ASN.1 previously. Encoded values are provided as an octet string for successive grid points using the scanning order shown in Figure 39.

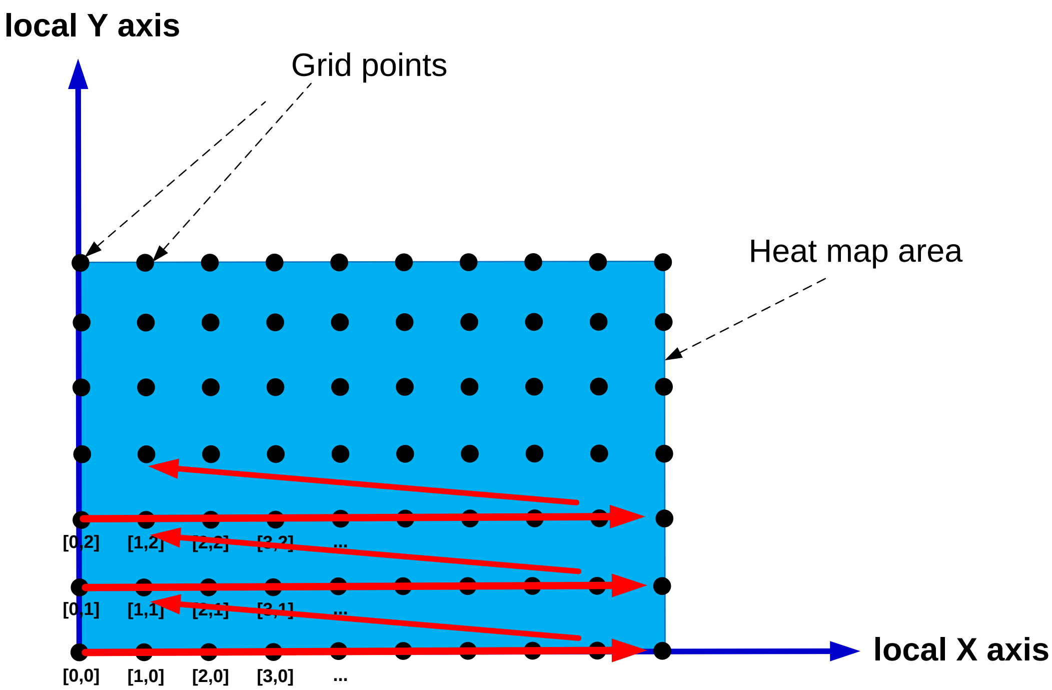


Figure 39: Scanning order of grid points within a Heat Map Area

Scanning begins at the grid point with minimum X and Y coordinates in the reference grid and proceeds to subsequent grid points along the local X axis. When the last grid point within the heat map area along the local X axis is reached, scanning resumes again from low X to high X for grid points with Y coordinate one greater than the previous set. This continues until grid points with maximum Y coordinate have been scanned from low X to high X. Scanning at each grid point involves encoding the RF statistic of interest as a single octet and adding the encoded value to the octet string. As an example, Figure 40 shows a heat map area of size 4 by 4 units, where the letter within each square represents the encoded value of one particular signal statistic (e.g. mean RSSI or mean RTT) at a grid point centered within the square. The octet string that would be produced following scanning of this particular grid area would be the alphabetic sequence A, B, C, D, … X, Y.

U	V	W	X	Y
P	Q	R	S	T
K	L	M	N	O
F	G	H	I	J
A	B	C	D	E

Figure 40: Example Heat map Encoding

G.3 Encoding of a Heat Map with Compression

A heat map is first encoded as an octet string as defined in G.2. In the case of JPEG compression, a standard JPEG compression library is used to compress the octet string using the known X and Y lengths of the heat map area, The resulting compressed octet string is then used. Decompression at a receiver also uses standard JPEG routines. There may be some loss (small errors) resulting from this so the compressing side is advised to limit the amount of compression.

G.4 Non-Rectangular Heat Maps

Non-rectangular heat maps may be used to more efficiently overlay areas that have arbitrary shapes and/or are not oriented with fixed X and Y directions for a rectangular grid. Two types of non-rectangular heat maps are supported in LPPe 2.0. One type enables reorientation of a rectangular area and the other type supports arbitrary shapes within a rectangular area. Both types enable use of a common reference grid with a common grid point spacing thereby avoiding multiple non-overlapping reference grids. Both types can be used separately or in combination and may be combined with compression of a heat map using JPEG.

G.4.1 Reorientation of a Heat Map

To support arbitrary reorientation of a heat map, an initial heat map area composed of a rectangular array of equally spaced grids points is first defined as before and as shown in Figure 38. Then a straight line through the local origin at a clockwise angle θ to the local Y axis is defined with -90° ≤ θ ≤ 90°. Note that the straight line includes both a portion above the X axis and a portion below the X axis. Grid point rows (parallel to the local X axis) in the initial heat map area are then shifted in the positive X direction when θ is positive and in the negative X direction when θ is negative by an integer number of inter-grid points units of distance so that each row starts at a grid point that is either exactly on the line or just to the positive X side (i.e. right) of it. As an alternative, grid point columns (parallel to the local Y axis) may be shifted in the positive Y direction when θ is positive and in the negative Y direction when θ is negative by an integer number of inter-grid points units of distance so that each column starts at a grid point that is either exactly on the line or just to the positive Y side of it (i.e. above it). Both X and Y shifting alternatives are allowed (though only one can be used at any time) and are illustrated in Figure 41 and Figure 42. The new heat map area in each case is roughly a parallelogram and, while based on the original grid point array, has an orientation θ to the Y axis that may allow a better fit with areas with a similar orientation (e.g. such as a room or corridor in a building with the same orientation θ).

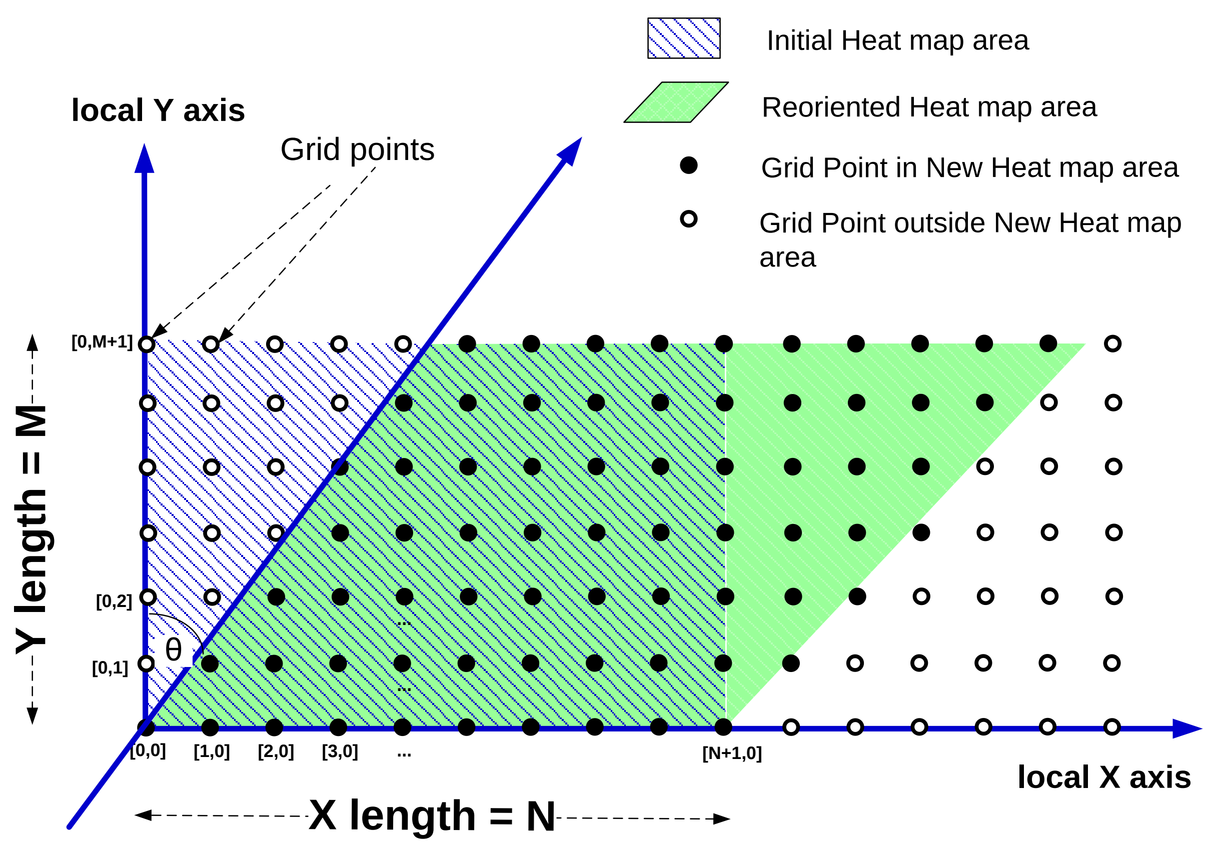


Figure 41: Reorientation of a Heat Map Area with Rows shifted in the Positive X Direction

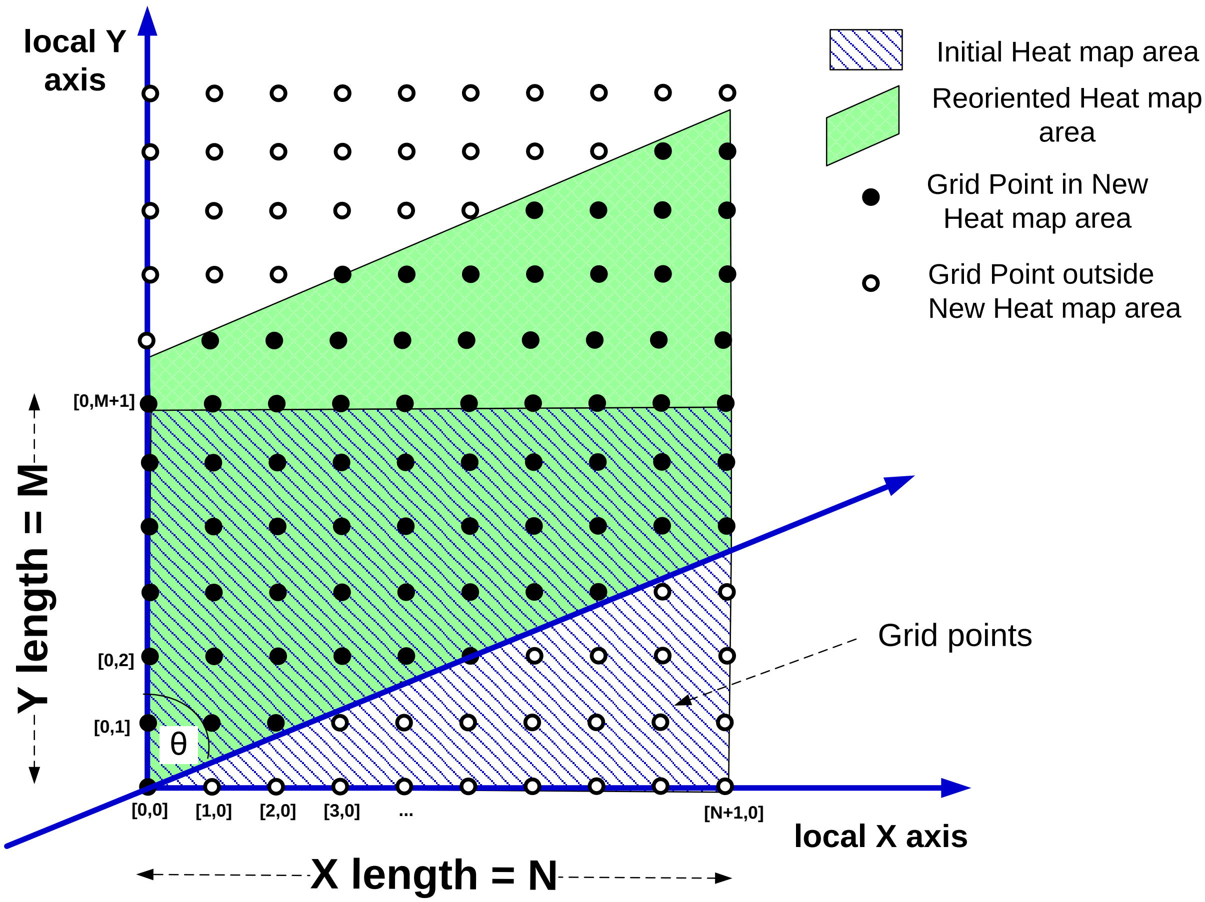


Figure 42: Reorientation of a Heat Map Area with Columns shifted in the Positive Y Direction

Heat map values (e.g. for RSSI) are assigned to each grid point in the new (reoriented) heat map area using a single octet to encode values between 0 and 255 as before. Heat map values (i.e. octets) may then be assembled into an uncompressed octet string by first shifting rows or columns of grid points in the new heat map area back into the initial rectangular heat map area (i.e. using a reverse transformation to that shown in Figure 41 and Figure 42). This transformed heat map is then scanned in the order described in section G.2 and illustrated in Figure 39 to provide an octet string of heat map values which may then be transferred to a target using LPPe. When JPEG compression is used as described in section G.3, the reoriented heat map area is again transformed into the initial rectangular heat map area which is then compressed using JPEG. To achieve high compression when JPEG is used without significant error, it is recommended that for values of θ from -45° to 45°, the variant in which rows of grid points are shifted in the positive or negative X direction is used and that for values of θ from -90° to -45° and from 45° to 90°, the variant in which columns of grid are shifted in the positive or negative Y direction is used. This will keep neighbouring grid points close together after the shifting operation and thereby retain a high correlation of heat map values in the rectangular array to be compressed.

G.4.2 Arbitrary Shaped Heat Maps using Run Length Encoding

To support heat maps with arbitrary shape, alternating run lengths of consecutive excluded and included grid points are used. A rectangular heat map area is first defined as described in section G.1 and illustrated in Figure 38. The grid points in the rectangular heat map area are then scanned in the order described in section G.2 and illustrated in Figure 39. Based on this scan order, an alternating set of integer values V1, V2, V3, V4, V5 etc., is defined where odd numbered values (V1, V3, V5 etc.) define a consecutive number of excluded grid points from the scan order and even numbered values (V2, V4 etc.) define a consecutive number of included grid points from the scan order. A new heat map area is thereby created that contains just the included grid points. The values V1, V2, V3 etc. are each encoded as a single octet with a value in the range 0-255. To encode values greater than 255, values of 255 (or less than 255) can be alternated with values of 0 (e.g. to encode a value of 522, the sequence could be 255, 0, 255, 0, 12).

Application of run length encoding to an irregular area is illustrated in Figure 43. Here the initial rectangular heat map area contains 99 grid points which is reduced to the 42 grid points (shown in red) that are contained in the yellow shaded area. To define the 42 grid points, the alternating sequence of run length values would be: 24, 9, 2, 9, 2, 9, 4, 4, 7, 5, 6, 4, 8, 2, 4. This sequence of values would be provided to a target using LPPe in addition to the parameters defining the initial rectangular heat map area and the heat map values themselves.

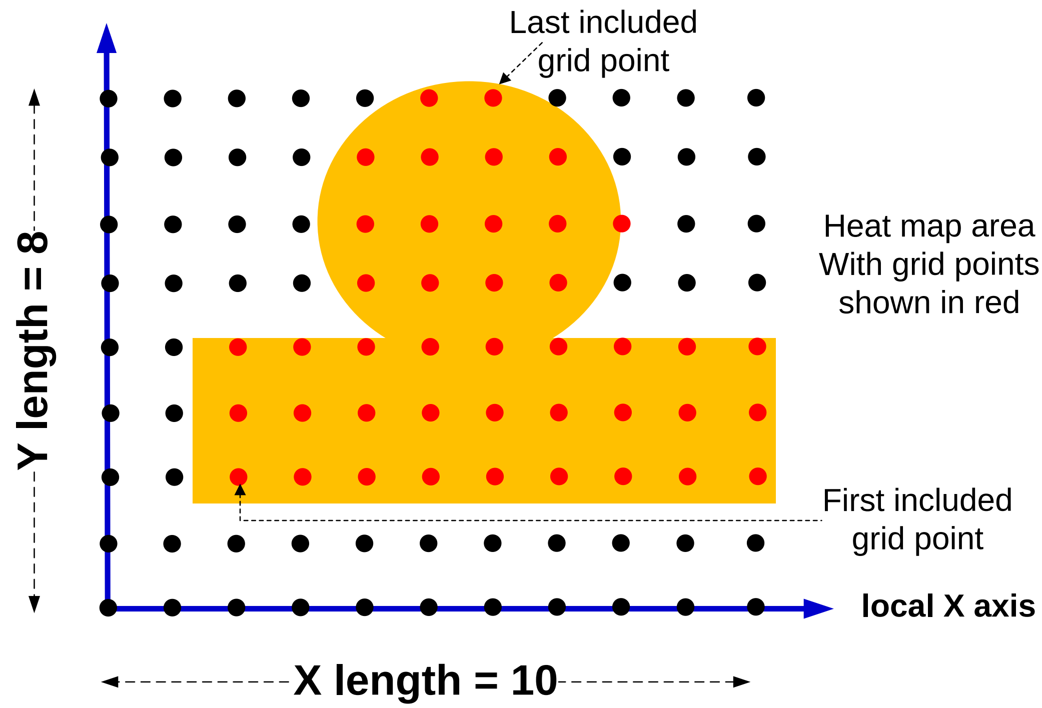


Figure 43: Application of Run Length Encoding to an Arbitrary Area

When Run Length Encoding is used without compression or reorientation, heat map values (e.g. RSSI, RTT) are provided only for included grid points in the scan order of grid points for the initial rectangular heat map area. For example, in Figure 43, heat map values would be provided for the 42 included grid points starting with the grid point at the bottom left of the shaded area and ending with the grid point at the top right of the shaded area.

When run length encoding is used with reorientation but without compression, the reoriented (parallelogram shaped) area is first transformed back into the original rectangular heat map area as described in section G.4.1 and then run length encoding is applied to this area to define which grid points are to be included and excluded.

When run length encoding is used with compression and with or without reorientation, heat map values are provided for both included and excluded grid points to allow two dimensional JPEG compression of a complete rectangular array of heat map values. However, dummy values are assigned to all excluded grid points (e.g. constant values that will compress well). These dummy values are then removed at a receiver.

G.5 Encoding of Update-required Points of a Heat Map

The update-required points refer to a set of grid points where the heat map (or other assistance data) needs to be updated, for example, at or nearby to stairs in the given heat map coverage area or at a corridor at the edge of the given heat map where a target may be about to enter an area for which the target does not have assistance data. When a target locates itself at or nearby to such a grid point, the target is triggered to request new assistance data (e.g. a new RF heat map). To define which grid points should trigger a target request for new assistance data, a rectangular heat map area is used. This rectangular area is either (i) the heat map area defined in section G.1 and shown in Figure 38 when reorientation is not used or (ii) is the initial rectangular area into which a reoriented heat map area is transformed prior to scanning and encoding as described in section G.4.1 and as shown by the rectangular blue striped areas in Figure 41 and Figure 42 when reorientation is used. Use of run length encoding to create arbitrary non-rectangular shapes as described in Appendix G.4.2 may or may not be used but does not impact the definition and use of update-required grid points. Grid points in the rectangular heat map area are scanned in the order shown in Figure 39 and Figure 44 and the update-required grid points are defined using Run Length Encoding (RLE) whereby a sequence of integer values V1, V2, V3, V4,. V5 etc. each between 0 and 255 is defined where odd numbered values (V1, V3, V5) etc., define a consecutive sequence of grid points in the scan order that are not update-required points and even numbered values (V2, V4 etc.) define a consecutive sequence of grid points in the scan order that are update-required grid points. As an example, consider the case in Figure 44. Here, the shaded boxes indicate the update-required grid points of the heat map area and, based on the RLE encoding, the sequence of values to define these would be 0:1:1:2:1:1:3:2:3:1:3:1:2:1:3.

Grid points are also identified by indices with the index of each grid point given by its position in the scanning order – e.g. as illustrated by the indices shown for the rectangular heat map area in Figure 44.

When the target needs to send a request for updating assistance data due to being located at or nearby to an update-required grid point, the target sends the ID of the heat map area and the index of the update required grid point to the server. For instance, if the target is located at or nearby to the grid point that is labelled 15 in Figure 44, the target sends an assistance data request for updating assistance data with 15 as the index of the grid point.

21	22	23	24	25
16	17	18	19	20
11	12	13	14	15
6	7	8	9	10
1	2	3	4	5

Figure 44: Example Heat Map Update Required Point Encoding

G.6 RSSI Calibration Model

The RSSI calibration function which transforms RSSI values measured by a target device into corresponding RSSI values for a reference device associated with a heat map for RSSI is expressed by the following linear function.

$$RSSI_{ref} = c_{1,i} \cdot RSSI_{target,i} - c_{2,i}$$

Here $c_{1,i}$ and $c_{2,i}$ are the slope and constant, respectively, of a linear function which transforms an RSSI value measured by a target device i into a RSSI value that would be measured by a reference device. A reference device can be any vendor or operator chosen device which includes a WLAN basedband chipset, e.g. notebook, table PC, smartphone, etc. A ($c_{1,i}$, $c_{2,i}$) pairs are uniquely defined according to the relationship between the reference device and/or a baseband chipset in the reference device and the target device and/or a baseband chipset in the target device using information about the respective OEM and/or chipset vendors. The following table shows exemplary mappings from a reference device to a series of target devices in the case of WLAN baseband chipsets.

index	Device Vendor	Device model	WLAN baseband chipset Vendor	WLAN baseband chipset Model	c_1	c_2
0 (Ref device)	Lenovo	ThinkPad X200	Intel	5300	1	0
1	Motorola	RAZR	Texas Instrument	WiLink7.0	0.81	-20.69
2	Samsung	GalaxyS1	Broadcom	BCM4329	0.72	-8.23
...	...	...	...	...	...	...

100	Sony	Xperia Z	Qualcomm Atheros	WCN3660	1.27	-10.13
...	...	...	...	...	...	...
200	HTC	One	Broadcom	BCM4335	1.14	-7.12
...	...	...	...	...	...	...

Assume a target device and a sourcing device with index numbers i and j, respectively, where the sourcing device is used to generate an RSSI heat map and is not the same as the reference device for which calibration parameters are known (e.g. as in the above table). The following calculation shows how to derive the RSSI calibration model parameter pairs (c_{1_calib}, c_{2_calib}) which transform an RSSI value measured by the target device into an RSSI value measured by the sourcing device according to the RSSI heat map.

$$RSSI_{sourcing} = c_{1\_calib} \cdot RSSI_{target} - c_{2\_calib}$$

To obtain the calibration parameters above which relate RSSI values for the target and sourcing devices, the calibration for the reference device can be used (e.g. from the above table) as follows.

$$RSSI_{ref} = c_{1,i} \cdot RSSI_{target,i} - c_{2,i} = c_{1,i} \cdot RSSI_{target} - c_{2,i}$$

$$= c_{1,j} \cdot RSSI_{target,j} - c_{2,j} = c_{1,j} \cdot RSSI_{sourcing} - c_{2,j}$$

By rearranging the above expression, the RSSI calibration model parameters are expressed as follows.

$$RSSI_{sourcing} = \frac{c_{1,i}}{c_{1,j}} \cdot RSSI_{target} - \left(\frac{c_{2,i} - c_{2,j}}{c_{1,j}} \right)$$

$$\therefore \quad c_{1\_calib} = \frac{c_{1,i}}{c_{1,j}}, \quad c_{2\_calib} = \frac{c_{2,i} - c_{2,j}}{c_{1,j}}$$

G.7 Geomagnetic Field Information for a Heat map

G.7.1 Declination and Inclination Angle

The declination angle (D) is defined by the angle on the horizontal plane between magnetic north and true north. It can be given by

$$D = Az - \psi$$

Where Az is the Azimuth angle of a target or survey device. ψ is the yaw angle of a target or survey device.

The inclination angle (I) is defined by the angle between the horizontal plane and the total geomagnetic field vector, measured positive into Earth. It can be given by

$$I = \frac{\pi}{2} - \arccos\left(\frac{M_{xyz} \cdot A_{xyz}}{|M_{xyz}||A_{xyz}|}\right)$$

Where A_{xyz} is the acceleration or gravity vector with respect to the body-fixed frame of a target or survey device, M_{xyz} is the geomagnetic field vector with respect to the body-fixed frame of a target or survey device. $A \cdot B$ is the inner product of vector A and vector B. $|A|$ is the Euclidean norm of vector A.

G.7.2 Geomagnetic Field w.r.t true north navigation frame

To express the geomagnetic field vector of a target or survey device with respect to true north navigation frame, the declination angle as well as the inclination angle of a target or survey device are used as follows.

$$M_N = |M_{xyz}|\cos(I)\cos(D)$$

$$M_E = |M_{xyz}|\cos(I)\sin(D)$$

$$M_D = -|M_{xyz}|\sin(I)$$

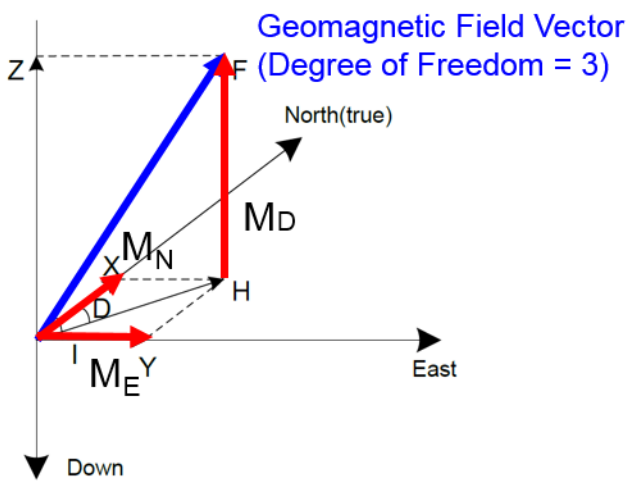


Figure 45: Geomagnetic Field w.r.t true north navigation frame

Appendix H. Crowdsourcing with SUPL 2.x (Informative) – version 2.0

This appendix provides a brief informative level description of how crowdsourcing may be supported using SUPL 2.x (e.g. SUPL 2.0 or SUPL 2.1).

In order to request crowdsourcing from a target (e.g. perform steps 1 and 2 in Figure 14), a control server may initiate a new SUPL session to the target or make use of an existing session with the target and may first request the crowdsourcing capabilities of the target if not already known. The server may then send an LPP Request Location Information message within a SUPL POS message to the target to request crowdsourcing. The target may return a confirmation of crowdsourcing in an LPP Provide Location Information message in a SUPL POS message. The SUPL session may then be terminated by the server by sending of a SUPL END or may be continued to perform positioning and/or provide the target with assistance data.

In order to query crowdsourcing (e.g. perform steps 7 and 8 in Figure 14), a control server or data server may initiate a new SUPL session or make use of an existing session and may first request the crowdsourcing capabilities of the target (if not already known) which may indicate to the server whether there is already an ongoing crowdsourcing session between the server and the target. The server may then send an LPP Request Location Information message within a SUPL POS message to the target to query the status of crowdsourcing between the server and the target. The target may return any status response in an LPP Provide Location Information message in a SUPL POS message. The server may terminate the session if needed by sending an LPP Abort message to the target in a SUPL POS message. The SUPL session may then be terminated by the server by sending of a SUPL END or may be continued to perform positioning and/or provide the target with assistance data.

In order to report crowdsourcing measurements to a data server (e.g. perform steps 3 and 4 in Figure 14), a target may initiate a new SET initiated SUPL session to the data server or may make use of an existing session. If a new session is initiated, a target may indicate to the server that the purpose of the session is to transfer crowdsourcing measurements (see Editor's Note). A target may send each LPP Provide Location Information message containing crowdsourcing measurements that are to be reported at the same time (and that thus form part of the same LPP transaction) in one or more SUPL POS messages to the data server. After the last LPP Provide Location Information message has been sent (which will terminate the LPP transaction), the data server may end the SUPL session by sending a SUPL END to the target, may query the status of the session by sending an LPP Request Location Information message to the target in a SUPL POS message and/or may terminate the session by sending an LPP Abort message to the target in a SUPL POS message.

Editor's Note: A new parameter, field or parameter value could be added to a SUPL START message to indicate crowdsourcing (e.g. a new field in the QoP parameter) or the first LPP Provide Location Information message containing crowdsourcing measurements could be included within a SUPL POS message in the SUPL POS INIT message. This may need to be evaluated within the context of SUPL rather than LPPe.