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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
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Foreword

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1 Scope

The present document contains the definition of the LTE Positioning Protocol (LPP).

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
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- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 36.305: "Stage 2 functional specification of User Equipment (UE) positioning in E-UTRAN".

[3] 3GPP TS 23.271: "Functional stage 2 description of Location Services (LCS)".

[4] IS-GPS-200, Revision D, Navstar GPS Space Segment/Navigation User Interfaces, March 7th, 2006.

[5] IS-GPS-705, Navstar GPS Space Segment/User Segment L5 Interfaces, September 22, 2005.

[6] IS-GPS-800, Navstar GPS Space Segment/User Segment L1C Interfaces, September 4, 2008.

[7] IS-QZSS, Quasi Zenith Satellite System Navigation Service Interface Specifications for QZSS, Ver.1.1, July 31, 2009.

[8] Galileo OS Signal in Space ICD (OS SIS ICD), Draft 0, Galileo Joint Undertaking, May 23rd, 2006.

[9] Global Navigation Satellite System GLONASS Interface Control Document, Version 5.1, 2008.

[10] Specification for the Wide Area Augmentation System (WAAS), US Department of Transportation, Federal Aviation Administration, DTFA01-96-C-00025, 2001.

[11] RTCM-SC104, RTCM Recommended Standards for Differential GNSS Service (v.2.3), August 20, 2001.

[12] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); "Radio Resource Control (RRC); Protocol specification".

[13] 3GPP TS 25.331: " Radio Resource Control (RRC); Protocol Specification".

[14] 3GPP TS 44.031: "Location Services (LCS); Mobile Station (MS) - Serving Mobile Location Centre (SMLC) Radio Resource LCS Protocol (RRLP)".

[15] 3GPP TS 23.032: 'Universal Geographical Area Description (GAD)'.

[16] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[17] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer – Measurements".

[18] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".

[19] 3GPP TS 23.003: "Numbering, addressing and identification".

3 Definitions and Abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in [1], [2] and [3] apply. Other definitions are provided below.

Location Server: a physical or logical entity (e.g. E-SMLC or SUPL SLP) that manages positioning for a target device by obtaining measurements and other location information from one or more positioning units and providing assistance data to positioning units to help determine this. An Location Server may also compute or verify the final location estimate.

Reference Source: a physical entity or part of a physical entity that provides signals (e.g. RF, acoustic, infra-red) that can be measured (e.g. by a Target Device) in order to obtain the location of a Target Device.

Target Device: the device that is being positioned (e.g. UE or SUPL SET).

Observed Time Difference Of Arrival (OTDOA): The time interval that is observed by a target device between the reception of downlink signals from two different cells. If a signal from cell *1* is received at the moment t_1, and a signal from cell *2* is received at the moment t_2, the OTDOA is $t_2 - t_1$.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply.

ADR	Accumulated Delta-Range
A-GNSS	Assisted-GNSS
ARFCN	Absolute Radio Frequency Channel Number
BTS	Base Transceiver Station (GERAN)
CID	Cell-ID (positioning method)
CNAV	Civil Navigation
ECEF	Earth-Centered, Earth-Fixed
ECGI	Evolved Cell Global Identifier
ECI	Earth-Centered-Inertial
E-CID	Enhanced Cell-ID (positioning method)
EGNOS	European Geostationary Navigation Overlay Service
E-SMLC	Enhanced Serving Mobile Location Centre
E-UTRAN	Enhanced Universal Terrestrial Radio Access Network
EOP	Earth Orientation Parameters
EPDU	External Protocol Data Unit
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FTA	Fine Time Assistance
GAGAN	GPS Aided Geo Augmented Navigation
GLONASS	GLObal'naya NAvigatsionnaya Sputnikovaya Sistema (Engl.: Global Navigation Satellite System)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ICD	Interface Control Document
IOD	Issue of Data
IS	Interface Specification
LPP	LTE Positioning Protocol
LPPa	LTE Positioning Protocol Annex
LSB	Least Significant Bit
MO-LR	Mobile Originated Location Request

MSAS	Multi-functional Satellite Augmentation System
MSB	Most Significant Bit
msd	mean solar day
MT-LR	Mobile Terminated Location Request
NAV	Navigation
NICT	National Institute of Information and Communications Technology
NI-LR	Network Induced Location Request
OTDOA	Observed Time Difference Of Arrival
PRC	Pseudo-Range Correction
PRS	Positioning Reference Signals
PDU	Protocol Data Unit
PZ-90	Parametry Zemli 1990 Goda – Parameters of the Earth Year 1990
QZS	Quasi Zenith Satellite
QZSS	Quasi-Zenith Satellite System
QZST	Quasi-Zenith System Time
RF	Radio Frequency
RRC	Range-Rate Correction Radio Resource Control
RSRP	Reference Signal Received Power
RSRQ	Reference Signal Received Quality
RSTD	Reference Signal Time Difference
RU	Russia
SBAS	Space Based Augmentation System
SET	SUPL Enabled Terminal
SFN	System Frame Number
SLP	SUPL Location Platform
SUPL	Secure User Plane Location
SV	Space Vehicle
TLM	Telemetry
TOD	Time Of Day
TOW	Time Of Week
UDRE	User Differential Range Error
ULP	User Plane Location Protocol
USNO	US Naval Observatory
UT1	Universal Time No.1
UTC	Coordinated Universal Time
WAAS	Wide Area Augmentation System
WGS-84	World Geodetic System 1984

4 Functionality of Protocol

4.1 General

4.1.1 LPP Configuration

LPP is used point-to-point between a location server (E-SMLC or SLP) and a target device (UE or SET) in order to position the target device using position-related measurements obtained by one or more reference sources. Figure 4.1.1-1 shows the configuration as applied to the control- and user-plane location solutions for E-UTRAN (as defined in [2] and [3]).

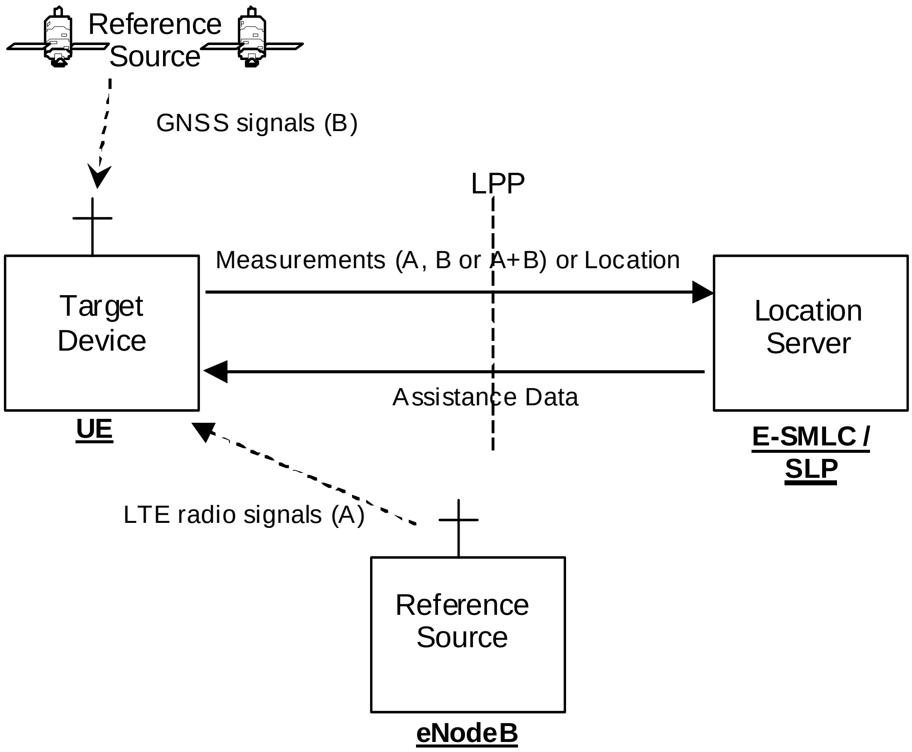

Figure 4.1.1-1: LPP Configuration for Control- and User-Plane Positioning in E-UTRAN

4.1.2 LPP Sessions and Transactions

An LPP session is used between a Location Server and the target device in order to obtain location related measurements or a location estimate or to transfer assistance data. A single LPP session is used to support a single location request (e.g. for a single MT-LR, MO-LR or NI-LR). Multiple LPP sessions can be used between the same endpoints to support multiple different location requests (as required by [3]). Each LPP session comprises one or more LPP transactions which each perform a single activity, and which in turn comprise one or more procedures. The instigator of an LPP session will always instigate the first LPP transaction, but subsequent transactions may be instigated by either end. LPP transactions within a session may occur serially or in parallel. LPP transactions are indicated at the LPP protocol level with a transaction ID in order to associate messages with one another (e.g., request and response). Each transaction comprises a single operation (capability exchange, assistance data transfer, or location information transfer).

Messages within a transaction are linked by a common transaction identifier.

4.1.3 LPP Position Methods

Internal LPP positioning methods and associated signalling content are defined in this specification.

This version of the specification defines OTDOA, A-GNSS, and E-CID positioning methods.

4.1.4 LPP Messages

Each LPP transaction involves the exchange of one or more LPP messages between the location server and the target device. The general format of an LPP message consists of a set of common fields followed by a body. The body (which may be empty) contains information specific to a particular message type. The LPP message body includes common information applicable to all position methods and information specific to particular positioning methods.

The common fields are as follows:

Field	Role
Transaction ID	Identify messages belonging to the same transaction
Transaction End Flag	Indicate when a transaction (e.g. one with periodic responses) has ended
Ack	Enable an optional transport level acknowledgement of a received message (FFS)

It is FFS if additional fields (e.g. session ID) are required for explicit modelling of an LPP session.

The following message types are defined:

- Request Capabilities;
- Provide Capabilities;
- Request Assistance Data;
- Provide Assistance Data;
- Request Location Information;
- Provide Location Information;
- Abort;
- Error.

4.2 Common LPP Session Procedure

The purpose of this procedure is to support an LPP session comprising a sequence of LPP transactions. The procedure is described in Figure 4.2-1.

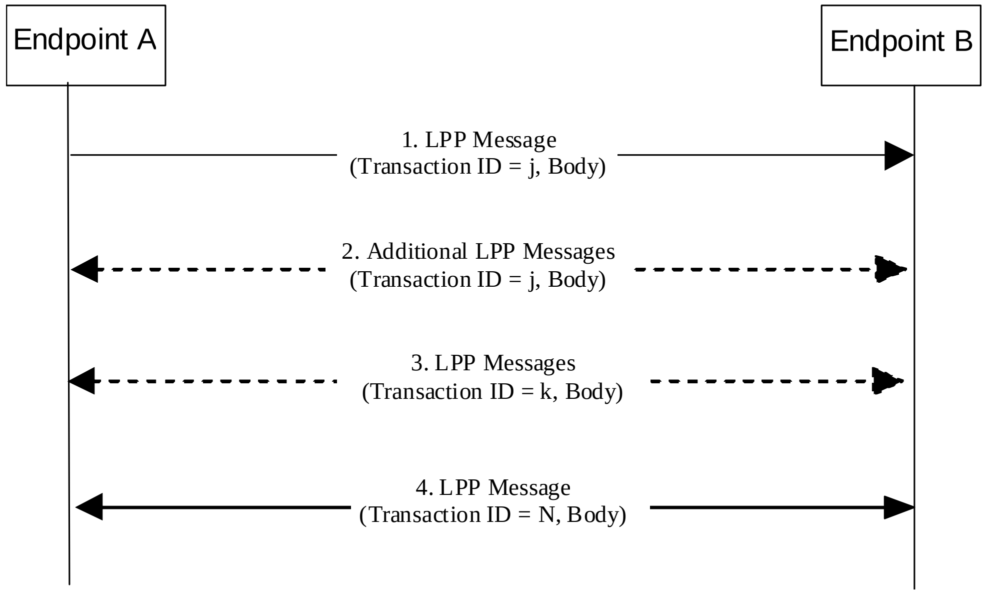

Figure 4.2-1 LPP Session Procedure

1. Endpoint A, which may be either the target or the server, initiates an LPP session by sending an LPP message for an initial LPP transaction j to the other endpoint B (which has an opposite role to A).
2. Endpoints A and B may exchange further messages to continue the transaction started in step 1.
3. Either endpoint may instigate further transactions by sending additional LPP messages.
4. A session is terminated by a final transaction N in which LPP messages will be exchanged between the two endpoints.

Within each transaction, all constituent messages shall contain the same transaction identifier. The last message sent in each transaction shall have the field 'Transaction end indicator' set to TRUE. Transactions that occur in parallel shall use different transaction IDs; transaction IDs for completed transactions may be reused at any time after the final message of the previous transaction with the same ID is known to have been received..

4.3 LPP Transport

4.3.1 Transport Layer Requirements

LPP requires reliable, in sequence delivery of LPP messages from the underlying transport layers. If the transport layer is reliable and provides in-sequence delivery (e.g., SUPL), no additional support for reliable transfer of messages is needed at the LPP level. However, LPP provides its own support for reliable in sequence delivery of LPP messages in the case of an underlying transport layer that is not fully reliable. This section describes the transport capabilities that are available within LPP.

4.3.2 LPP Duplicate Detection

A sender may include a sequence number in some or all LPP messages sent for a particular location session. The sequence number shall be distinct for different LPP messages in the same location session – e.g. may start at zero in the first LPP message and increase monotonically in each succeeding LPP message.

A receiver records the most recent received sequence number for each location session. If a message is received carrying the same sequence number as that last received for the associated location session, it shall be discarded. Otherwise (i.e. if the sequence number is different or if no sequence number was previously received or if no sequence number is included), the message shall be processed.

Sending and receiving sequence numbers shall be deleted in a server when the associated location session is terminated and shall be deleted in a target device when there has been no activity for a particular location session for 10 minutes.

NOTE: For LPP control plane use, a target device can be aware of a location session from information provided at the NAS level for downlink transport of an LPP message.

4.3.3 LPP Acknowledgment

4.3.3.1 General

Each LPP message may carry an acknowledgment request indicator and/or an acknowledgement indicator. Upon reception of an LPP message which includes a request for acknowledgment, a receiver returns an acknowledgement response that includes the same sequence number if the message being acknowledged contains a sequence number. An acknowledgment is returned for each received LPP message including any duplicate. Once a sender receives an acknowledgment for an LPP message and provided any included sequence number is matching, it is permitted to send the next LPP message. No message reordering is needed at the receiver since this stop and wait method of sending ensures that messages normally arrive in the correct order.

4.3.3.2 Procedure related to Acknowledgment

Figure 4.3.3.2-1 shows the procedure related to acknowledgment.

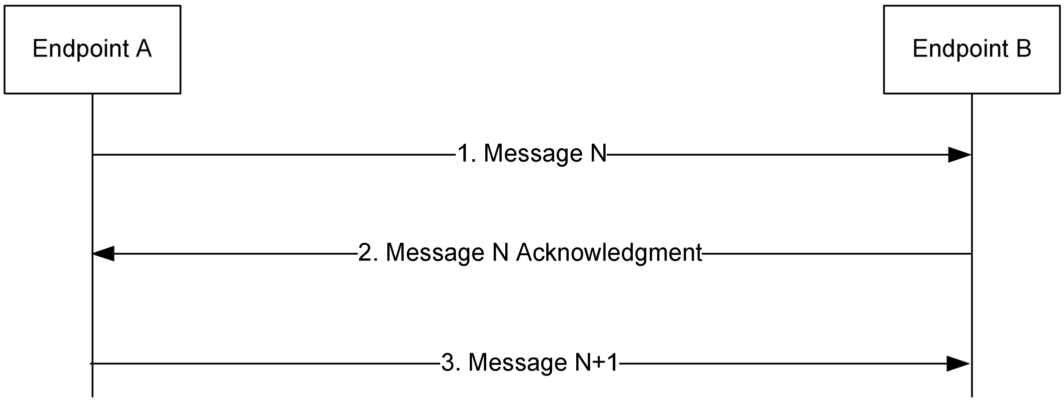

Figure 4.3.3.2-1: LPP Acknowledgment procedure

1. Endpoint A sends an LPP message N to Endpoint B and includes a request for acknowledgment.
2. If LPP message N is received (regardless of whether the message body can be correctly decoded), Endpoint B returns an acknowledgment for message N. The acknowledgment contains the same sequence number as that in message N if included.
3. When the acknowledgment for LPP message N is received and provided any included sequence number matches that in message N, Endpoint A sends the next LPP message N+1 to Endpoint B when this message is available.

Editor's Note: For step 3, it is assumed that LPP retransmission is used to ensure that either an acknowledgment is eventually received or all LPP activity for the location session is aborted. If LPP retransmission is not used, an additional mechanism is needed to detect and recover from message and acknowledgment loss (i.e. to avoid LPP transmission becoming blocked).

4.3.4 LPP Retransmission

4.3.4.1 General

This capability builds on the acknowledgment and duplicate detection capabilities. When an LPP message which requires acknowledgement is sent and not acknowledged, it is resent by the sender following a timeout period up to three times. If still unacknowledged after that, the sender aborts all LPP activity for the associated session. The timeout period is determined by the sender implementation but shall not be less than a minimum value of [FFS].

4.3.4.2 Procedure related to Retransmission

Figure 4.3.4.2-1 shows the procedure related to retransmission when combined with acknowledgment and duplicate detection.

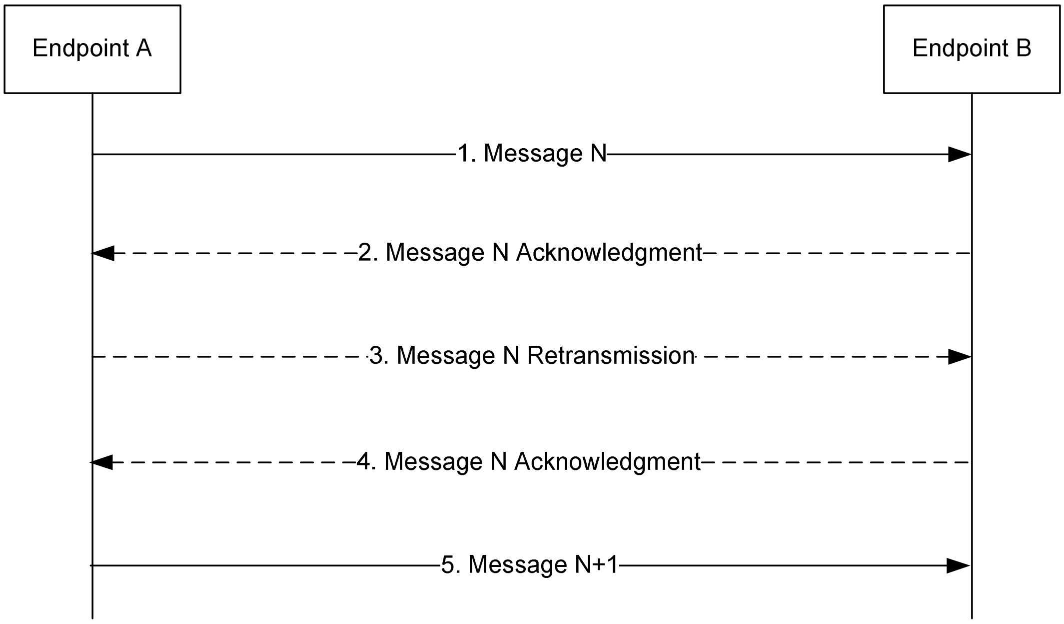

Figure 4.3.4.2-1: LPP Retransmission procedure

1. Endpoint A sends an LPP message N to Endpoint B for a particular location session and includes a request for acknowledgment.
2. If LPP message N is received (regardless of whether the message body can be correctly decoded), Endpoint B returns an acknowledgment for message N. If the acknowledgment is received by Endpoint A (such that the acknowledged message can be identified and any included sequence numbers are matching), Endpoint A skips steps 3 and 4.
3. If the acknowledgment in step 2 is not received after a timeout period, Endpoint A retransmits LPP message N and includes the same sequence number as in step 1 if a sequence number was included in step 1.
4. If LPP message N in step 3 is received (regardless of whether the message body can be correctly decoded and whether or not the message is considered a duplicate), Endpoint B returns an acknowledgment. Steps 3 and 4 may be repeated one or more times if the acknowledgment in step 3 is not received after a timeout period by Endpoint A. If the acknowledgment in step 4 is still not received after sending three retransmissions, Endpoint A aborts all procedures and activity associated with LPP support for the particular location session.
5. Once an acknowledgment in step 2 or step 4 is received, Endpoint A sends the next LPP message N+1 for the location session to Endpoint B when this message is available.

5 LPP Procedures

5.1 Procedures related to capability transfer

The purpose of the procedures that are grouped together in this section is to enable the transfer of capabilities from the target device to the server. Capabilities in this context refer to positioning and protocol capabilities related to LPP and the position methods supported by LPP.

These procedures instantiate the Capability Transfer transaction from 3GPP TS 36.305 [2].

5.1.1 Capability Transfer procedure

The Capability Transfer procedure is shown in Figure 5.1.1-1.

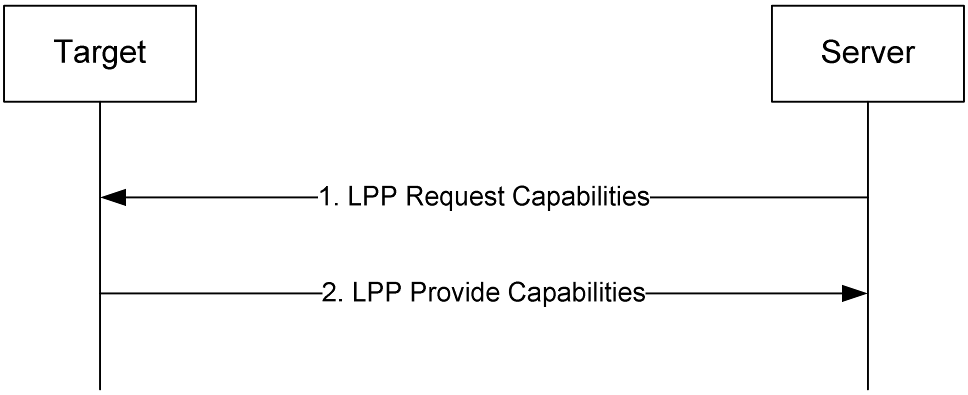

Figure 5.1.1-1: LPP Capability Transfer procedure

1. The server sends an LPP Request Capabilities message to the target. The server may indicate the types of capability needed.
2. The target responds with an LPP Provide Capabilities message to the server. The capabilities shall correspond to any types specified in step 1. This message carries an end transaction indication.

5.1.2 Capability Indication procedure

The Capability Indication procedure is shown in Figure 5.1.2-1.

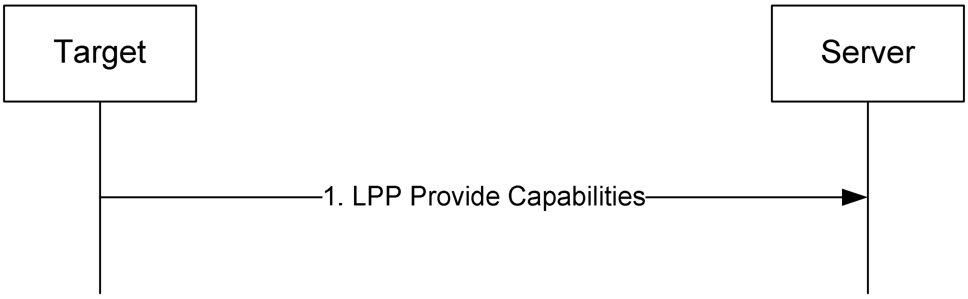

Figure 5.1.2-1: LPP Capability Indication procedure

1. The target sends an LPP Provide Capabilities message to the server. This message carries an end transaction indication.

5.1.3 Reception of LPP Request Capabilities

Upon receiving an LPP Request Capabilities message, the target device shall generate an LPP Provide Capabilities message as a response.

The target device shall:

1> for each positioning method for which a request for capabilities is included in the message:

2> if the target device supports this positioning method:

3> nclude the capabilities of the device for that supported positioning method in the response message;

1> set the IE *LPP-TransactionID* in the response message to the same value as the IE *LPP-TransactionID* in the received message;

1> deliver the response message to lower layers for transmission.

5.1.4 Transmission of LPP Provide Capabilities

When triggered to transmit an LPP *Provide Capabilities* message, the target device shall:

1> for each positioning method whose capabilities are to be indicated:

2> set the corresponding IE to include the device"s capabilities;

1> deliver the response to lower layers for transmission.

5.2 Procedures related to Assistance Data Transfer

The purpose of the procedures in this section is to enable the target to request assistance data from the server to assist in positioning, and to enable the server to transfer assistance data to the target in the absence of a request.

These procedures instantiate the Assistance Data Transfer transaction from 3GPP TS 36.305 [2].

5.2.1 Assistance Data Transfer procedure

The Assistance Data Transfer procedure is shown in Figure 5.2.1-1.

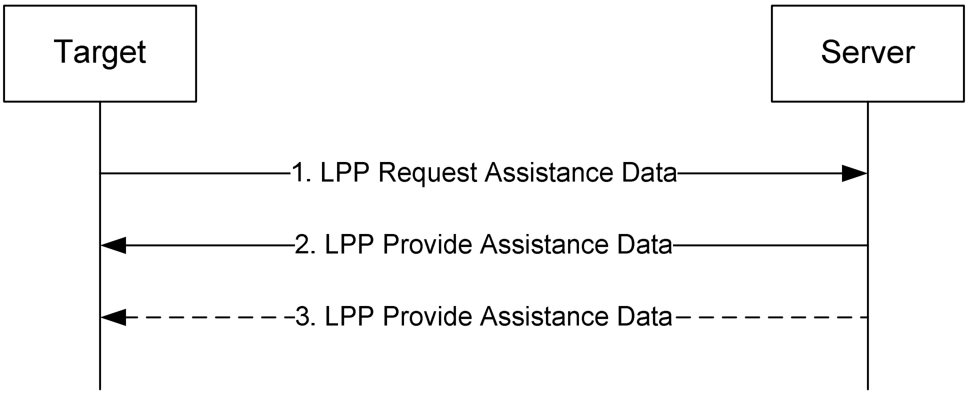

Figure 5.2.1-1: LPP Assistance data transfer procedure

1. The target sends an LPP Request Assistance message to the server.
2. The server responds with an LPP Provide Assistance Data message to the target containing assistance data. The transferred assistance data should match or be a subset of the assistance data requested in step 1.
3. The server may transmit one or more additional LPP Provide Assistance Data messages to the target containing further assistance data. The transferred assistance data should match or be a subset of the assistance data requested in step 1. The last message carries an end transaction indication.

5.2.2 Assistance Data Delivery procedure

The Assistance Data Transfer procedure is shown in Figure 5.2.2-1.

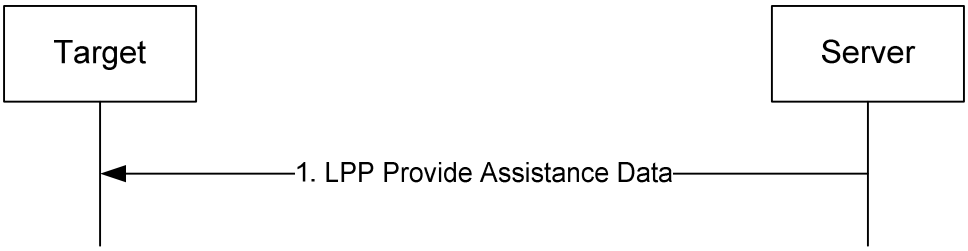

Figure 5.2.2-1: LPP Assistance data transfer procedure

1. The server sends an LPP Provide Assistance Data message to the target containing assistance data. This message may contain an end transaction indication.

5.2.3 Transmission of LPP Request Assistance Data

When triggered to transmit an LPP Request Assistance Data message, the target device shall:

1> set the IEs for the positioning-method-specific request for assistance data to request the data indicated by upper layers.

5.2.4 Reception of LPP Provide Assistance Data

Upon receiving an LPP Provide Assistance Data message, the target device shall:

1> for each positioning method contained in the Body:

2> deliver the related assistance data to upper layers.

5.3 Procedures related to Location Information Transfer

The purpose of the procedures in this section is to enable the server to request location measurement data and/or a location estimate from the target, and to enable the target to transfer location measurement data and/or a location estimate to a server in the absence of a request.

These procedures instantiate the Location Information Transfer transaction in 3GPP TS 36.305 [2].

NOTE: The service layer (e.g. NAS or OMA SUPL ULP) would be used to transfer information associated with a location request from a target to a server (MO-LR).

5.3.1 Location Information Transfer procedure

The Location Information Transfer procedure is shown in Figure 5.3.1-1.

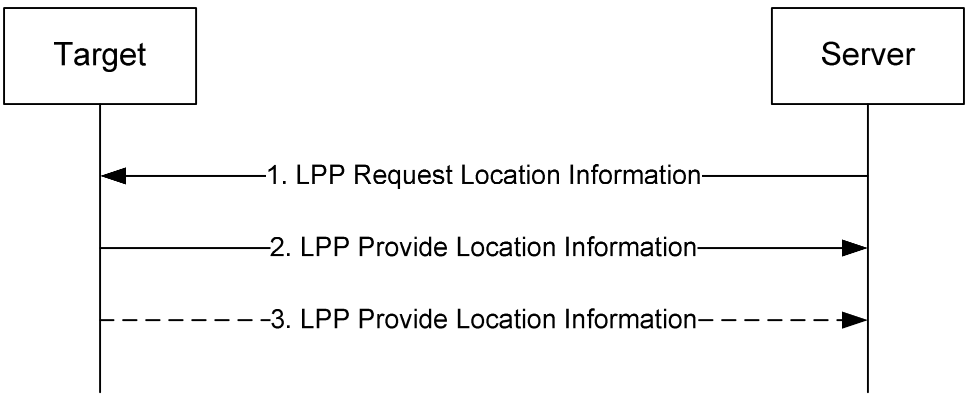

Figure 5.3.1-1: LPP Location Information transfer procedure

1. The server sends an LPP Request Location Information message to the target to request location information, indicating the type of location information needed and potentially the associated QoS.

2. The target sends an LPP Provide Location Information message to the server to transfer location information. The location information transferred should match or be a subset of the location information requested in step 1 unless the server explicitly allows additional location information. This message may carry an end transaction indication.

3. If requested in step 1, the target sends additional LPP Provide Location Information messages to the server to transfer location information. The location information transferred should match or be a subset of the location

information requested in step 1 unless the server explicitly allows additional location information. The last message carries an end transaction indication.

5.3.2 Location Information Delivery procedure

The Location Information Transfer procedure is shown in Figure 5.3.2-1.

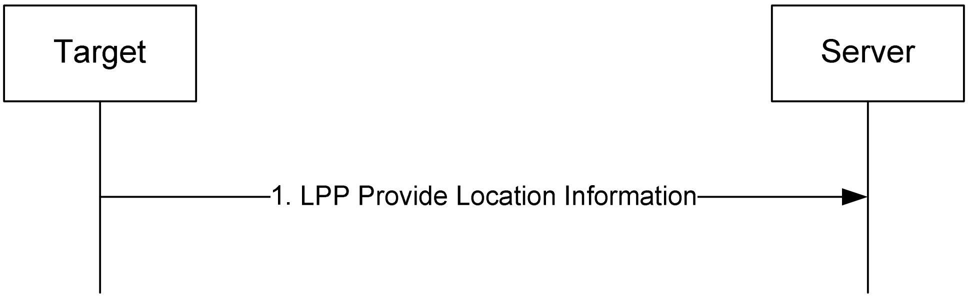

Figure 5.3.2-1: LPP Location Information Delivery procedure

1. The target sends an LPP Provide Location Information message to the server to transfer location information. This message may carry an end transaction indication.

5.3.3 Reception of Request Location Information

Upon receiving an LPP Request Location Information message, the target device shall:

1> if the requested information is compatible with the target device capabilities and configuration:

2> include the requested information in an LPP Provide Location Information message;

2> set the IE LPP-TransactionID in the response to the same value as the IE LPP-TransactionID in the received message;

2> deliver the LPP *Provide Location Information* message to lower layers for transmission.

1> otherwise:

2> if one or more positioning methods are included that the target device does not support:

3> Continue to process the message as if it contained only information for the supported position methods.

3> Handle the signaling content of the not supported positioning methods by LPP error detection as in 5.4.3.

5.3.4 Transmission of Provide Location Information

When triggered to transmit an LPP *Provide Location Information* message, the target device shall:

1> for each position method contained in the message:

2> deliver the position method information to upper layers.

5.4 Error Handling Procedures

5.4.1 General

This sub-clause describes how a receiving entity behaves in cases when it receives erroneous or unexpected data or detects that certain data are missing.

5.4.2 Procedures related to Error Indication

Figure 5.4.2-1 shows the procedure related to Error indication.

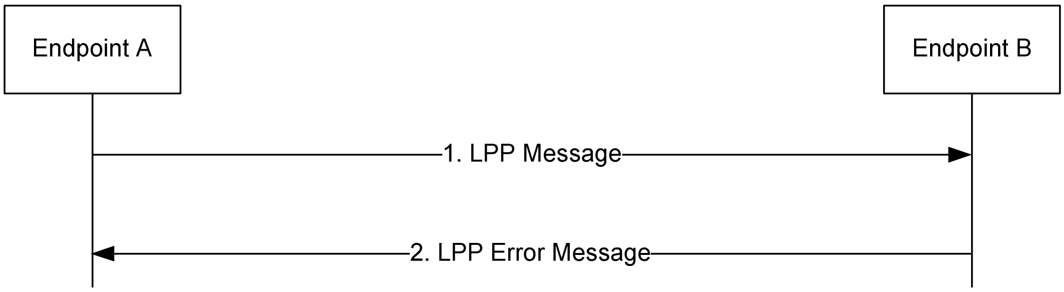

Figure 5.4.2-1: LPP Error Indication procedure

1. Endpoint A sends an LPP message to Endpoint B.
2. Endpoint B determines that the LPP message in step 1 contains an error and is not an LPP Error or Abort message. Endpoint B returns an LPP Error message to Endpoint A indicating the error or errors and discards the message in step 1.

5.4.3 LPP Error Detection

Upon receiving any LPP message, the receiving device shall attempt to decode the message and verify the presence of any errors prior to using the following procedure:

1> if decoding errors are encountered:

2> if decoding cannot determine the *LPP-TransactionID*:

3> discard the message and stop error detection.

2> if decoding can determine that the message is not an LPP *Error* or *Abort* message:

3> return an LPP *Error* message to the sender and include the received *LPP-TransactionID* and type of error;

3> discard the message and stop error detection;

1> if the message is a duplicate of previously received message

2> discard the message and stop error detection.

Editor"s Note: the method used to determine a duplicate is FFS.

1> if the *LPP-TransactionID* matches the *LPP-TransactionID* for a procedure that is still ongoing for the same session and the message type is invalid for the current state of the procedure:

2> abort the ongoing procedure;

2> return an Error message to the sender and include the received transaction ID and type of error;

2> discard the message and stop error detection.

1> if the message type is an LPP *RequestCapabilities*, *RequestAssistanceData*, *or RequestLocationInformation* and some or all of the requested information is not supported:

2> return any information that can be provided in a normal response, plus an indication that other information is not supported.

5.4.4 Reception of an LPP Error Message

Upon receiving an LPP Error message, a device shall:

1> abort any ongoing procedure associated with the *LPP-TransactionID* indicated in the message.

The device may:

1> restart the aborted procedure taking into consideration the returned error information.

5.5 Abort Procedure

5.5.1 General

The purpose of the abort procedure is to abort an ongoing procedure due to some unexpected event – e.g. cancelation of a location request by an LCS client.

5.5.2 Procedures related to Abort

Figure 5.5.2-1 shows the Abort procedure.

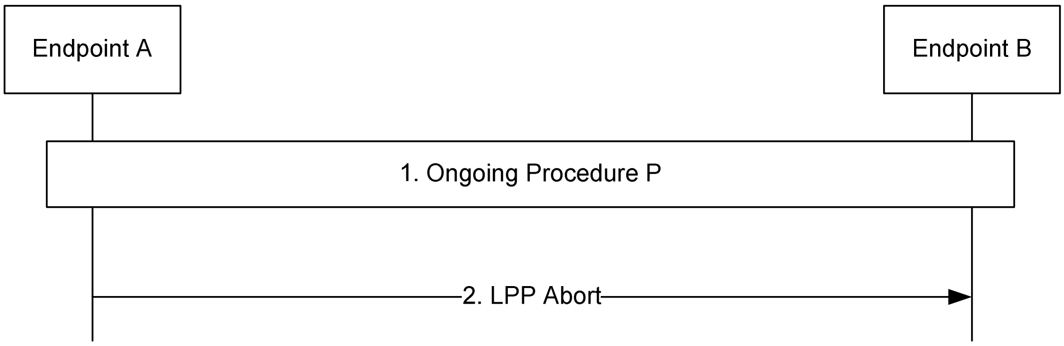

Figure 5.5.2-1: LPP Abort procedure

1. A procedure P is ongoing between endpoints A and B
2. Endpoint A determines that the procedure must be aborted and sends an LPP Abort message to Endpoint B carrying the transaction ID for procedure P. Endpoint B aborts procedure P.

5.5.3 Reception of an LPP Abort Message

Upon receiving an LPP Abort message, a device shall:

1> abort any ongoing procedure associated with the transaction ID indicated in the message.

6 Information Element Abstract Syntax Definition

6.1 General

The contents of each LPP message is specified in sub-clause 6.2 using ASN.1 to specify the message syntax and using tables when needed to provide further detailed information about the information elements specified in the message syntax. The syntax of the information elements that are defined as stand-alone abstract types is further specified in a similar manner in sub-clause 6.3.

The ASN.1 in this section uses the same format and coding conventions as described in Annex A of [12].

6.2 LPP PDU Structure

– LPP-PDU-Definitions

This ASN.1 segment is the start of the LPP PDU definitions.

```
-- ASN1START

LPP-PDU-Definitions DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- ASN1STOP
```

– LPP-Message

The *LPP-Message* provides the complete set of information for an invocation or response pertaining to a single LPP transaction.

```
-- ASN1START

LPP-Message ::= SEQUENCE {
    transactionID           LPP-TransactionID   OPTIONAL,   -- Need ON
    endTransaction          BOOLEAN,
    sequenceNumber          SequenceNumber      OPTIONAL,   -- Need ON
    acknowledgment          Acknowledgment      OPTIONAL,   -- Need ON
    lpp-MessageBody         LPP-MessageBody     OPTIONAL    -- Need ON

}

SequenceNumber ::= INTEGER (0..255)

Acknowledgment ::= SEQUENCE {
    ackRequested    BOOLEAN,
    ackIndicator    SequenceNumber      OPTIONAL
}

-- ASN1STOP
```

***LPP-Message* field descriptions**
sequenceNumber This field is included when LPP operates over the control plane and omitted otherwise.
acknowledgment This field is included when LPP operates over the control plane and is omitted otherwise
ackIndicator This field indicates the sequence number of the message being acknowledged.
lpp-MessageBody This field is omitted in an LPP transport level ack
transactionID This field is omitted if it is not available to the transmitting entity (e.g., in an *LPP-Error* message triggered by a message that could not be parsed).

– LPP-MessageBody

The *LPP-MessageBody* identifies the type of a message and contains all LPP information specifically associated with that type.

```
-- ASN1START

LPP-MessageBody ::= CHOICE {
    c1                      CHOICE {
        requestCapabilities         RequestCapabilities,
        provideCapabilities         ProvideCapabilities,
        requestAssistanceData       RequestAssistanceData,
        provideAssistanceData       ProvideAssistanceData,
        requestLocationInformation  RequestLocationInformation,
        provideLocationInformation  ProvideLocationInformation,
        abort                       Abort,
        error                       Error,
        spare7 NULL, spare6 NULL, spare5 NULL, spare4 NULL,
        spare3 NULL, spare2 NULL, spare1 NULL, spare0 NULL
    },
    messageClassExtension   SEQUENCE {}
}

-- ASN1STOP
```

– LPP-TransactionID

The *LPP-TransactionID* identifies a particular LPP transaction, the initiator of the transaction and optionally an associated LCS session.

```
-- ASN1START

LPP-TransactionID ::= SEQUENCE {
    initiator               Initiator,
    transactionNumber       TransactionNumber,
    ...
    -- Session ID is FFS
}

Initiator ::= ENUMERATED {
    locationServer,
    targetDevice,
    ...
}

TransactionNumber ::= INTEGER (0..255)

-- ASN1STOP
```

6.3 Message Body IEs

– RequestCapabilities

The *RequestCapabilities* message requests capability information for LPP and individual positioning methods.

```
-- ASN1START

RequestCapabilities ::= SEQUENCE {
    criticalExtensions      CHOICE {
        c1                      CHOICE {
            requestCapabilities-r9      RequestCapabilities-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture    SEQUENCE {}
    }
}

RequestCapabilities-r9-IEs ::= SEQUENCE {
    commonIEsRequestCapabilities            CommonIEsRequestCapabilities        OPTIONAL,   -- Need
ON
```

```
    a-gnss-RequestCapabilities              A-GNSS-RequestCapabilities          OPTIONAL,
    otdoa-RequestCapabilities               OTDOA-RequestCapabilities           OPTIONAL,
    ecid-RequestCapabilities                ECID-RequestCapabilities            OPTIONAL,
    epdu-RequestCapabilities                EPDU-Sequence                       OPTIONAL,   -- Need 
ON
    ...
}

-- ASN1STOP
```

RequestCapabilities field descriptions
commonIEsRequestCapabilities This IE is provided for future extensibility and should not be included in this version of the protocol.

– ProvideCapabilities

The *ProvideCapabilities* message indicates the LPP capabilities of the sender.

```
-- ASN1START

ProvideCapabilities ::= SEQUENCE {
    criticalExtensions      CHOICE {
        c1                      CHOICE {
            provideCapabilities-r9      ProvideCapabilities-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture    SEQUENCE {}
    }
}

ProvideCapabilities-r9-IEs ::= SEQUENCE {
    commonIEsProvideCapabilities            CommonIEsProvideCapabilities        OPTIONAL,   -- Need 
ON
    a-gnss-ProvideCapabilities              A-GNSS-ProvideCapabilities          OPTIONAL,   -- Need 
ON
    otdoa-ProvideCapabilities               OTDOA-ProvideCapabilities           OPTIONAL,   -- Need 
ON
    ecid-ProvideCapabilities                ECID-ProvideCapabilities            OPTIONAL,   -- Need 
ON
    epdu-ProvideCapabilities                EPDU-Sequence                       OPTIONAL,   -- Need 
ON
    ...
}

-- ASN1STOP
```

ProvideCapabilities field descriptions
commonIEsProvideCapabilities This IE is provided for future extensibility and should not be included in this version of the protocol.

– RequestAssistanceData

The *RequestAssistanceData* message requests assistance data.

```
-- ASN1START

RequestAssistanceData ::= SEQUENCE {
    criticalExtensions      CHOICE {
        c1                      CHOICE {
            requestAssistanceData-r9    RequestAssistanceData-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture    SEQUENCE {}
    }
}

RequestAssistanceData-r9-IEs ::= SEQUENCE {
    commonIEsRequestAssistanceData          CommonIEsRequestAssistanceData          OPTIONAL,   -- 
Need ON
```

```
    a-gnss-RequestAssistanceData            A-GNSS-RequestAssistanceData            OPTIONAL,   --
Need ON
    otdoa-RequestAssistanceData             OTDOA-RequestAssistanceData             OPTIONAL,   --
Need ON
    epdu-RequestAssistanceData              EPDU-Sequence                           OPTIONAL,   --
Need ON
    ...
}

-- ASN1STOP
```

– ProvideAssistanceData

The *ProvideAssistanceData* message provides assistance data.

```
-- ASN1START

ProvideAssistanceData ::= SEQUENCE {
    criticalExtensions      CHOICE {
        c1                      CHOICE {
            provideAssistanceData-r9    ProvideAssistanceData-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture    SEQUENCE {}
    }
}

ProvideAssistanceData-r9-IEs ::= SEQUENCE {
    commonIEsProvideAssistanceData          CommonIEsProvideAssistanceData          OPTIONAL,   --
Need ON
    a-gnss-ProvideAssistanceData            A-GNSS-ProvideAssistanceData            OPTIONAL,   --
Need ON
    otdoa-ProvideAssistanceData             OTDOA-ProvideAssistanceData             OPTIONAL,   --
Need ON
    epdu-Provide-Assistance-Data            EPDU-Sequence                           OPTIONAL,   --
Need ON
    ...
}

-- ASN1STOP
```

***ProvideAssistanceData* field descriptions**
commonIEsProvideAssistanceData This IE is provided for future extensibility and should not be included in this version of the protocol.

– RequestLocationInformation

The *RequestLocationInformation* message carries a request for measurements or a position estimate.

```
-- ASN1START

RequestLocationInformation ::= SEQUENCE {
    criticalExtensions      CHOICE {
        c1                      CHOICE {
            requestLocationInformation-r9   RequestLocationInformation-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture    SEQUENCE {}
    }
}

RequestLocationInformation-r9-IEs ::= SEQUENCE {
    commonIEsRequestLocationInformation         CommonIEsRequestLocationInformation     OPTIONAL, --
Need ON
    a-gnss-RequestLocationInformation           A-GNSS-RequestLocationInformation       OPTIONAL, --
Need ON
    otdoa-RequestLocationInformation            OTDOA-RequestLocationInformation        OPTIONAL, --
Need ON
    ecid-RequestLocationInformation             ECID-RequestLocationInformation         OPTIONAL, --
Need ON
```

```
    epdu-RequestLocationInformation             EPDU-Sequence                          OPTIONAL, --
Need ON
    ...
}

-- ASN1STOP
```

– ProvideLocationInformation

The *ProvideLocationInformation* message carries measurements or position estimates.

```
-- ASN1START

ProvideLocationInformation ::= SEQUENCE {
    criticalExtensions      CHOICE {
        c1                      CHOICE {
            provideLocationInformation-r9   ProvideLocationInformation-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture    SEQUENCE {}
    }
}

ProvideLocationInformation-r9-IEs ::= SEQUENCE {
    commonIEsProvideLocationInformation         CommonIEsProvideLocationInformation     OPTIONAL, --
Need ON
    a-gnss-ProvideLocationInformation           A-GNSS-ProvideLocationInformation       OPTIONAL, --
Need ON
    otdoa-ProvideLocationInformation            OTDOA-ProvideLocationInformation        OPTIONAL, --
Need ON
    ecid-ProvideLocationInformation             ECID-ProvideLocationInformation         OPTIONAL, --
Need ON
    epdu-ProvideLocationInformation             EPDU-Sequence                           OPTIONAL, --
Need ON
    ...
}

-- ASN1STOP
```

– Abort

The *Abort* message carries a request to abort an ongoing LPP procedure.

```
-- ASN1START

Abort ::= SEQUENCE {
    criticalExtensions      CHOICE {
        c1                      CHOICE {
            abort-r9        Abort-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture    SEQUENCE {}
    }
}

Abort-r9-IEs ::= SEQUENCE {
    commonIEsAbort      CommonIEsAbort          OPTIONAL,   -- Need ON
    ...
}

-- ASN1STOP
```

– Error

The *Error* message carries information concerning a LPP message that was received with errors.

```
-- ASN1START

Error ::= CHOICE {
    error-r9                    Error-r9-IEs,
```

```
    criticalExtensionsFuture    SEQUENCE {}
}

Error-r9-IEs ::= SEQUENCE {
    commonIEsError      CommonIEsError          OPTIONAL,   -- Need ON
    ...
}

-- ASN1STOP
```

Editor"s Note: to ensure compatibility of an Error message between different versions of LPP, it is not expected that critical extensions will be used in future versions; hence only one method of supporting critical extensions is provided

6.4 Common IEs

Common IEs comprise IEs that are applicable to more than one LPP positioning method.

6.4.1 Common Lower-Level IEs

– ARFCN-ValueEUTRA

The IE *ARFCN-ValueEUTRA* is used to indicate the ARFCN of the E-UTRA carrier frequency, as defined in [12].

```
-- ASN1START

ARFCN-ValueEUTRA ::= INTEGER (0.. 65535)

-- ASN1STOP
```

– CellGlobalIdEUTRA-AndUTRA

The IE *CellGlobalIdEUTR-AndUTRA* specifies the global Cell Identifier for E-UTRA or UTRA, the globally unique identity of a cell in E-UTRA or UTRA.

```
-- ASN1START

CellGlobalIdEUTRA-AndUTRA ::= SEQUENCE {
    plmn-Identity       SEQUENCE {
                            mcc     SEQUENCE (SIZE (3))     OF INTEGER (0..9),
                            mnc     SEQUENCE (SIZE (2..3))  OF INTEGER (0..9)
                        },
    cellIdentity        CHOICE {
        eutra   BIT STRING (SIZE (28)),
        utra    BIT STRING (SIZE (32))
    },
    ...
}

-- ASN1STOP
```

***CellGlobalIdEUTRA-AndUTRA* field descriptions**
plmn-Identity This field identifies the PLMN of the cell as defined in [12].
cellIdentity This field defines the identity of the cell within the context of the PLMN as defined in [12] and [13]. 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.

– CellGlobalIdGERAN

The IE *CellGlobalIdGERAN* specifies the global Cell Identifier for GERAN, the globally unique identity of a cell in GERAN.

```
-- ASN1START

CellGlobalIdGERAN ::= SEQUENCE {
    plmn-Identity       SEQUENCE {
                            mcc     SEQUENCE (SIZE (3))     OF INTEGER (0..9),
                            mnc     SEQUENCE (SIZE (2..3))  OF INTEGER (0..9)
                            },
    locationAreaCode        BIT STRING (SIZE (16)),
    cellIdentity            BIT STRING (SIZE (16)),
    ...
}

-- ASN1STOP
```

***CellGlobalIdGERAN* field descriptions**
plmn-Identity This field identifies the PLMN of the cell.
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.

– Ellipsoid-Point

The IE *Ellipsoid-Point* is used to describe a geographic shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

Ellipsoid-Point ::= SEQUENCE {
    latitudeSign                ENUMERATED {north, south},
    degreesLatitude             INTEGER (0..8388607),           -- 23 bit field
    degreesLongitude            INTEGER (-8388608..8388607)     -- 24 bit field
}

-- ASN1STOP
```

– Ellipsoid-PointWithUncertaintyCircle

The IE *Ellipsoid-PointWithUncertaintyCircle* is used to describe a geographic shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

Ellipsoid-PointWithUncertaintyCircle ::= SEQUENCE {
    latitudeSign                ENUMERATED {north, south},
    degreesLatitude             INTEGER (0..8388607),           -- 23 bit field
    degreesLongitude            INTEGER (-8388608..8388607),    -- 24 bit field
    uncertainty                 INTEGER (0..127)
}

-- ASN1STOP
```

– EllipsoidPointWithUncertaintyEllipse

The IE *EllipsoidPointWithUncertaintyEllipse* is used to describe a geographic shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

EllipsoidPointWithUncertaintyEllipse ::= SEQUENCE {
    latitudeSign                ENUMERATED {north, south},
    degreesLatitude             INTEGER (0..8388607),           -- 23 bit field
    degreesLongitude            INTEGER (-8388608..8388607),    -- 24 bit field
    uncertaintySemiMajor        INTEGER (0..127),
    uncertaintySemiMinor        INTEGER (0..127),
    orientationMajorAxis        INTEGER (0..179),
    confidence                  INTEGER (0..100)
```

```
}

-- ASN1STOP
```

– EllipsoidPointWithAltitude

The IE *EllipsoidPointWithAltitude* is used to describe a geographic shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

EllipsoidPointWithAltitude ::= SEQUENCE {
    latitudeSign                ENUMERATED {north, south},
    degreesLatitude             INTEGER (0..8388607),           -- 23 bit field
    degreesLongitude            INTEGER (-8388608..8388607),    -- 24 bit field
    altitudeDirection           ENUMERATED {height, depth},
    altitude                    INTEGER (0..32767)              -- 15 bit field
}

-- ASN1STOP
```

– EllipsoidPointWithAltitudeAndUncertaintyEllipsoid

The IE *EllipsoidPointWithAltitudeAndUncertaintyEllipsoid* is used to describe a geographic shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

EllipsoidPointWithAltitudeAndUncertaintyEllipsoid ::= SEQUENCE {
    latitudeSign                ENUMERATED {north, south},
    degreesLatitude             INTEGER (0..8388607),           -- 23 bit field
    degreesLongitude            INTEGER (-8388608..8388607),    -- 24 bit field
    altitudeDirection           ENUMERATED {height, depth},
    altitude                    INTEGER (0..32767),             -- 15 bit field
    uncertaintySemiMajor        INTEGER (0..127),
    uncertaintySemiMinor        INTEGER (0..127),
    orientationMajorAxis        INTEGER (0..179),
    uncertaintyAltitude         INTEGER (0..127),
    confidence                  INTEGER (0..100)
}

-- ASN1STOP
```

– EllipsoidArc

The IE *EllipsoidArc* is used to describe a geographic shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

EllipsoidArc ::= SEQUENCE {
    latitudeSign                ENUMERATED {north, south},
    degreesLatitude             INTEGER (0..8388607),           -- 23 bit field
    degreesLongitude            INTEGER (-8388608..8388607),    -- 24 bit field
    innerRadius                 INTEGER (0..65535),             -- 16 bit field,
    uncertaintyRadius           INTEGER (0..127),
    offsetAngle                 INTEGER (0..179),
    includedAngle               INTEGER (0..179),
    confidence                  INTEGER (0..100)
}

-- ASN1STOP
```

– EPDU-Sequence

The *EPDU-Sequence* contains IEs that are defined externally to LPP by other organizations.

```
-- ASN1START
```

```
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

-- ASN1STOP
```

***EPDU-Sequence* field descriptions**
EPDU-ID This field provides a unique integer ID for the externally defined positioning method. Its value is assigned to the external entity that defines the EPDU and defined by that entity.
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.

– HorizontalVelocity

The IE *HorizontalVelocity* is used to describe a velocity shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

HorizontalVelocity ::= SEQUENCE {
    bearing                     INTEGER(0..359),
    horizontalSpeed             INTEGER(0..2047)
}

-- ASN1STOP
```

– HorizontalWithVerticalVelocity

The IE *HorizontalWithVerticalVelocity* is used to describe a velocity shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

HorizontalWithVerticalVelocity ::= SEQUENCE {
    bearing                     INTEGER(0..359),
    horizontalSpeed             INTEGER(0..2047),
    verticalDirection           ENUMERATED{upward, downward},
    verticalSpeed               INTEGER(0..255)
}

-- ASN1STOP
```

– HorizontalVelocityWithUncertainty

The IE *HorizontalVelocityWithUncertainty* is used to describe a velocity shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START
```

```
HorizontalVelocityWithUncertainty ::= SEQUENCE {
    bearing                     INTEGER(0..359),
    horizontalSpeed             INTEGER(0..2047),
    uncertaintySpeed            INTEGER(0..255)
}

-- ASN1STOP
```

– HorizontalWithVerticalVelocityAndUncertainty

The IE *HorizontalWithVerticalVelocityAndUncertainty* is used to describe a velocity shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

HorizontalWithVerticalVelocityAndUncertainty ::= SEQUENCE {
    bearing                     INTEGER(0..359),
    horizontalSpeed             INTEGER(0..2047),
    verticalDirection           ENUMERATED{upward, downward},
    verticalSpeed               INTEGER(0..255),
    horizontalUncertaintySpeed  INTEGER(0..255),
    verticalUncertaintySpeed    INTEGER(0..255)
}

-- ASN1STOP
```

– LocationCoordinateTypes

The IE *LocationCoordinateTypes* defines a list of possible geographic shapes as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

LocationCoordinateTypes ::= SEQUENCE {
    ellipsoidPoint                                          BOOLEAN,
    ellipsoidPointWithUncertaintyCircle                     BOOLEAN,
    ellipsoidPointWithUncertaintyEllipse                    BOOLEAN,
    polygon                                                 BOOLEAN,
    ellipsoidPointWithAltitude                              BOOLEAN,
    ellipsoidPointWithAltitudeAndUncertaintyEllipsoid       BOOLEAN,
    ellipsoidArc                                            BOOLEAN,
    ...
}

-- ASN1STOP
```

– Polygon

The IE *Polygon* is used to describe a geographic shape as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

Polygon ::= SEQUENCE (SIZE (3..15)) OF PolygonPoints

PolygonPoints ::= SEQUENCE {
    latitudeSign                ENUMERATED {north, south},
    degreesLatitude             INTEGER (0..8388607),           -- 23 bit field
    degreesLongitude            INTEGER (-8388608..8388607)     -- 24 bit field
}

-- ASN1STOP
```

– PositioningModes

The IE *PositioningModes* is used to indicate several positioning modes using a bit map.

```
-- ASN1START
```

```
PositioningModes ::= SEQUENCE {
    posModes        BIT STRING {    standalone  (0),
                                    ue-based    (1),
                                    ue-assisted (2)  } (SIZE (1..8)),
    ...
}

-- ASN1STOP
```

***PositioningModes* field descriptions**
posModes This field specifies the positioning mode(s). This is represented by a bit string, with a one-value at the bit position means the particular positioning mode is addressed; a zero-value means not addressed.

– VelocityTypes

The IE *VelocityTypes* defines a list of possible velocity shapes as defined in 3GPP TS 23.032 [15].

```
-- ASN1START

VelocityTypes ::= SEQUENCE {
    horizontalVelocity                                      BOOLEAN,
    horizontalWithVerticalVelocity                          BOOLEAN,
    horizontalVelocityWithUncertainty                       BOOLEAN,
    horizontalWithVerticalVelocityAndUncertainty            BOOLEAN,
    ...
}

-- ASN1STOP
```

6.4.2 Common Positioning

– CommonIEsRequestCapabilities

The *CommonIEsRequestCapabilities* carries common IEs for a Request Capabilities PDU Type.

```
-- ASN1START

CommonIEsRequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– CommonIEsProvideCapabilities

The *CommonIEsProvideCapabilities* carries common IEs for a Provide Capabilities PDU Type.

```
-- ASN1START

CommonIEsProvideCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– CommonIEsRequestAssistanceData

The *CommonIEsRequestAssistanceData* carries common IEs for a Request Assistance Data PDU Type.

```
-- ASN1START

CommonIEsRequestAssistanceData ::= SEQUENCE {
```

```
    servingCellID
ECGI        OPTIONAL,   -- Cond EUTRA
    ...
}

ECGI ::= SEQUENCE {
    mcc             SEQUENCE (SIZE (3))     OF INTEGER (0..9),
    mnc             SEQUENCE (SIZE (2..3))  OF INTEGER (0..9),
    cellidentity    BIT STRING (SIZE (28))
}

-- ASN1STOP
```

Conditional presence	Explanation
EUTRA	The field is mandatory present for E-UTRA access. The field shall be omitted for non-EUTRA user plane support..

***CommonIEsRequestAssistanceData* field descriptions**
servingCellID This parameter identifies the current serving cell for the target device.

– CommonIEsProvideAssistanceData

The *CommonIEsProvideAssistanceData* carries common IEs for a ProvideAssistance Data PDU Type.

```
-- ASN1START

CommonIEsProvideAssistanceData ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

– CommonIEsRequestLocationInformation

The *CommonIEsRequestLocationInformation* carries common IEs for a Request Location Information PDU Type.

```
-- ASN1START

CommonIEsRequestLocationInformation ::= SEQUENCE {
    locationInformationType     LocationInformationType,
    triggeredReporting          TriggeredReportingCriteria  OPTIONAL,   -- Cond ECID
    periodicalReporting         PeriodicalReportingCriteria OPTIONAL,
    additionalInformation       AdditionalInformation       OPTIONAL,
    qos                         QoS                         OPTIONAL,
    environment                 Environment                 OPTIONAL,
    locationCoordinateTypes     LocationCoordinateTypes     OPTIONAL,
    velocityTypes               VelocityTypes               OPTIONAL,
    ...
}

LocationInformationType ::= ENUMERATED {
    locationEstimateRequired,
    locationMeasurementsRequired,
    locationEstimatePreferred,
    locationMeasurementsPreferred,
    ...
}

PeriodicalReportingCriteria ::=     SEQUENCE {
    reportingAmount
ENUMERATED {
                                            ra1, ra2, ra4, ra8, ra16, ra32,
                                            ra64, ra-Infinity
                } DEFAULT ra-Infinity,
    reportingInterval
ENUMERATED {
                                            noPeriodicalReporting, ri0-25,
                                            ri0-5, ri1, ri2, ri4, ri8, ri16, ri32, ri64
```

```
                                        }

}


TriggeredReportingCriteria ::=      SEQUENCE {
    cellChange                          BOOLEAN,
    reportingDuration                   ReportingDuration,
    ...
}

ReportingDuration ::=               INTEGER (0..255)

AdditionalInformation ::= ENUMERATED {
    onlyReturnInformationRequested,
    mayReturnAditionalInformation,
    ...
}

QoS ::= SEQUENCE {
    horizontalAccuracy          HorizontalAccuracy      OPTIONAL,
    verticalCoordinateRequest   BOOLEAN,
    verticalAccuracy            VerticalAccuracy        OPTIONAL,
    responseTime                ResponseTime            OPTIONAL,
    velocityRequest             BOOLEAN,
    ...
}

HorizontalAccuracy ::= SEQUENCE {
    accuracy        INTEGER(0..127),
    confidence      INTEGER(0..100),
    ...
}

VerticalAccuracy ::= SEQUENCE {
    accuracy        INTEGER(0..127),
    confidence      INTEGER(0..100),
    ...
}


Confidence ::= INTEGER (1..100)

ResponseTime ::= SEQUENCE {
    time            INTEGER (1..128),
    ...
}

Environment ::= ENUMERATED {
    badArea,
    notBadArea,
    mixedArea,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
ECID	The field is optionally present, need ON, if ECID is requested. Otherwise it is not present.

***CommonIEsRequestLocationInformation* field descriptions**
locationInformationType
This IE indicates whether the server requires a location estimate or measurements. For "*locationEstimateRequired*", the UE shall return a location estimate if possible, or indicate 'location estimate not allowed' if not possible. For "*locationMeasurementsRequired*", the UE shall return measurements if possible, or indicate 'measurements not allowed' if not possible. For "*locationEstimatePreferred*", the UE shall return a location estimate if possible, but may also or instead return measurements for any requested position methods for which a location estimate is not possible. For "*locationMeasurementsPreferred*", the UE shall return location measurements if possible, but may also or instead return a location estimate for any requested position methods for which return of location measurements is not possible.

CommonIEsRequestLocationInformation **field descriptions**
periodicalReporting This IE indicates that periodic reporting is requested and comprises the following subfields: • ***reportingAmount*** indicates the number of periodic location information reports requested. Enumerated values correspond to 2, 4, 8, 16, 32, 64, 128, or infinite/indefinite number of reports. If the *reportingAmount* is "*infinite/indefinite"*, the target device should continue periodic reporting until an LPP *Abort* message is received. • ***reportingInterval*** indicates the interval between location information reports and the response time requirement for the first location information report. This is given as an integer number of seconds between 1 and 64. Measurement reports containing no measurements or no location estimate are required when a *reportingInterval* expires before a target device is able to obtain new measurements or obtain a new location estimate.
additionalInformation This IE indicates whether a target device is allowed to return additional information to that requested. If a location estimate is returned, any additional information is restricted to that associated with a location estimate (e.g. might include velocity if velocity was not requested but cannot include measurements). If measurements are returned, any additional information is restricted to additional measurements (e.g. might include E-CID measurements if A-GNSS measurements were requested but not E-CID measurements).
qos This IE indicates the quality of service and comprises a number of sub-fields. In the case of measurements, some of the sub-fields apply to the location estimate that could be obtained by the server from the measurements provided by the target device assuming that the measurements are the only sources of error. Fields are as follows: • ***horizontalAccuracy*** indicates the maximum horizontal error in the location estimate at an indicated confidence level. The "*accuracy*" code and "*confidence*" is as defined in 3GPP TS 23.032 [15]. • ***verticalCoordinateRequest*** indicates whether a vertical coordinate is required (true) or not (false) • ***verticalAccuracy*** indicates the maximum vertical error in the location estimate at an indicated confidence level and is only applicable when a vertical coordinate is requested. The "*accuracy*" code and "*confidence*" is as defined in 3GPP TS 23.032 [15]. • ***responseTime*** indicates the maximum response time as measured between receipt of the *RequestLocationInformation* and transmission of a *ProvideLocationInformation*. This is given as an integer number of seconds between 1 and 128. If the *periodicalReporting* IE is included in *CommonIEsRequestLocationInformation*, this field should not be included by the location server and shall be ignored by the target device (if included). • **velocity** indicates whether velocity is requested (true) or not (false). All QoS requirements shall be obtained by the target device to the degree possible but it is permitted to return a response that does not fulfill all QoS requirements if some were not attainable. The single exception is response-time which shall always be fulfilled – even if that means not fulfilling other QoS requirements.
environment This field provides the target device with information about expected multipath and non line of sight (NLOS) in the current area. The following values are defined: • badArea: possibly heavy multipath and NLOS conditions (e.g. bad urban or urban). • notBadArea: no or light multipath and usually LOS conditions (e.g. suburban or rural). • mixedArea: environment that is mixed or not defined.
locationCoordinateTypes This field provides a list of the types of location estimate that the target device may return when a location estimate is obtained by the target.
velocityTypes This fields provides a list of the types of velocity estimate that the target device may return when a velocity estimate is obtained by the target.
cellChange If this field is present and set to TRUE, the target device provides requested location information each time the serving cell has changed.
reportingDuration Maximum duration of triggered reporting in seconds. A value of zero is interpreted to mean an unlimited (i.e. "infinite") duration.

– CommonIEsProvideLocationInformation

The *CommonIEsProvideLocationInformation* carries common IEs for a Provide Location Information PDU Type.

```
-- ASN1START

CommonIEsProvideLocationInformation ::= SEQUENCE {
    locationEstimate            LocationCoordinates     OPTIONAL,
    velocityEstimate            Velocity                OPTIONAL,
    locationError               LocationError           OPTIONAL,
    ...
```

```
}

LocationCoordinates ::= CHOICE {
    ellipsoidPoint                              Ellipsoid-Point,
    ellipsoidPointWithUncertaintyCircle         Ellipsoid-PointWithUncertaintyCircle,
    ellipsoidPointWithUncertaintyEllipse        EllipsoidPointWithUncertaintyEllipse,
    polygon                                     Polygon,
    ellipsoidPointWithAltitude                  EllipsoidPointWithAltitude,
    ellipsoidPointWithAltitudeAndUncertaintyEllipsoid
                                                EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
    ellipsoidArc                                EllipsoidArc,
    ...
}

Velocity ::= CHOICE {
    horizontalVelocity                          HorizontalVelocity,
    horizontalWithVerticalVelocity              HorizontalWithVerticalVelocity,
    horizontalVelocityWithUncertainty           HorizontalVelocityWithUncertainty,
    horizontalWithVerticalVelocityAndUncertainty
                                                HorizontalWithVerticalVelocityAndUncertainty,
    ...
}

LocationError ::= SEQUENCE {
    locationfailurecause            LocationFailureCause,
    ...
}

LocationFailureCause ::= ENUMERATED {
    undefined,
    requestedMethodNotSupported,
    positionMethodFailure,
    periodicLocationMeasurementsNotAvailable,
    ...
}

degreesMaximum          INTEGER ::= 8388607
degreesMaximumNegative  INTEGER ::= -8388608

-- ASN1STOP
```

***CommonIEsProvideLocationInformation* field descriptions**
locationEstimate This field provides a location estimate using one of the geographic shapes defined in 3GPP TS 23.032 [15]. Coding of the values the various fields internal to each geographic shape follow the rules in [15]. The conditions for including this field are defined for the *locationInformationType* field in a Request Location Information message.
velocityEstimate This field provides a velocity estimate using one of the velocity shapes defined in 3GPP TS 23.032 [15]. Coding of the values the various fields internal to each velocity shape follow the rules in [15].
locationError This field shall be included if and only if a location estimate and measurements are not included in the LPP PDU. The field includes information concerning the reason for the lack of location information. The *LocationFailureCause* "*periodicLocationMeasurementsNotAvailable*" shall be used by the target device if periodic location reporting was requested, but no measurements or location estimate are available when *the reportingInterval* expired.

– CommonIEsAbort

The *CommonIEsAbort* carries common IEs for an Abort PDU Type.

```
-- ASN1START

CommonIEsAbort ::= SEQUENCE {
    abortCause          ENUMERATED {
        undefined,
        stopPeriodicReporting,
        targetDeviceAbort,
        networkAbort,
        ...
    }
}

-- ASN1STOP
```

***CommonIEsAbort* field descriptions**
abortCause This IE defines the request to abort an ongoing procedure.

– CommonIEsError

The *CommonIEsError* carries common IEs for an Error PDU Type.

```
-- ASN1START

CommonIEsError ::= SEQUENCE {
    errorCause      ENUMERATED {
        undefined,
        lppMessageHeaderError,
        lppMessageBodyError,
        epduError,
        incorrectDataValue,
    ...
    }
}

-- ASN1STOP
```

***CommonIEsError* field descriptions**
errorCause This IE defines the cause for an error. "*lppMessageHeaderError*", "*lppMessageBodyError*" and "*epduError*" shall be used when a receiver detects a coding error in the LPP header, LPP message body or in an EPDU, respectively.

6.5 Positioning Method IEs

6.5.1 OTDOA Positioning

6.5.1.1 OTDOA Assistance Data

– OTDOA-ProvideAssistanceData

The IE *OTDOA-ProvideAssistanceData* is used by the location server to provide assistance data to enable UE-assisted downlink OTDOA. It may also be used to provide OTDOA positioning specific error reason.

```
-- ASN1START

OTDOA-ProvideAssistanceData ::= SEQUENCE {
    otdoa-ReferenceCellInfo         OTDOA-ReferenceCellInfo             OPTIONAL,
    otdoa-NeighbourCellInfo         OTDOA-NeighbourCellInfoList         OPTIONAL,
    otdoa-Error                     OTDOA-Error                         OPTIONAL,
    ...
}

-- ASN1STOP
```

6.5.1.2 OTDOA Assistance Data Elements

– OTDOA-ReferenceCellInfo

The IE *OTDOAReferenceCellInfo* is used by the location server to provide reference cell information for OTDOA assistance data. The slot number offsets and expected RSTDs in *OTDOANeighbourCellInfoList* are provided relative to the cell defined by this IE.

```
-- ASN1START
```

```
OTDOA-ReferenceCellInfo ::= SEQUENCE {
    physCellId                 INTEGER (0..503),
    cellGlobalId               ECGI                        OPTIONAL,
    earfcnRef                  ARFCN-ValueEUTRA            OPTIONAL,        -- Cond NotSameAsServ0
    antennaPortConfig          ENUMERATED {ports1-or-2, ports4, ... }
                                                           OPTIONAL,        -- Cond NotSameAsServ1
    cpLength                   ENUMERATED { normal, extended, ... },
    prsInfo                    PRS-Info                    OPTIONAL,        -- Cond PRS
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
NotSameAsServ0	The field is mandatory present if the ARFCN of the OTDOA reference cell for assistance data is not the same as the ARFCN of the target devices''s current serving cell.
NotSameAsServ1	The field is mandatory present if the antenna port configuration of the OTDOA reference cell for assistance data is not the same as the antenna port configuration of the target devices''s current serving cell.
PRS	The field is mandatory present if positioning reference signals are available in the reference cell [16]; otherwise it is not present.

***OTDOA-ReferenceCellInfo* field descriptions**
physCellId This field specifies the physical cell identity of the reference cell, as defined in [12].
cellGlobalId This field specifies the ECGI, the globally unique identity of a cell in E-UTRA, of the reference cell, as defined in [12]. The server includes this field if it considers that it is needed to resolve ambiguity in the cell indicated by *physCellId*.
earfcnRef This field specifies the ARFCN of the reference cell for the OTDOA assistance data.
antennaPortConfig This field specifies whether 1 (or 2) antenna port(s) or 4 antenna ports for cell specific reference signals are used in the reference cell for OTDOA assistance data.
cpLength This field specifies the cyclic prefix length of the reference cell PRS.
prs-Info This field specifies the PRS configuration of the reference cell for OTDOA assistance data.

– PRS-Info

```
-- ASN1START

PRS-Info ::= SEQUENCE {
    prs-Bandwidth              ENUMERATED { n6, n15, n25, n50, n75, n100, ... },
    prs-ConfigurationIndex  INTEGER (0..4095),
    numDL-Frames            ENUMERATED {sf-1, sf-2, sf-4, sf-6, ...},
    ...
}

-- ASN1STOP
```

***PRS-Info* field descriptions**
prs-Bandwidth This field specifies the bandwidth that is used to configure the positioning reference signals on. Enumerated values are specified in number of resource blocks (n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on) and define 1.4, 3, 5, 10, 15 and 20 MHz bandwidth.
prs-ConfigurationIndex This field specfies the positioning reference signals configuration index I_{PRS} as defined in [16].
numDL-Frames This field specifies the number of consecutive downlink subframes N_{PRS} with positioning reference signals, as defined in [16]. Enumerated values define 1, 2, 4, or 6 consecutive subframes.

– OTDOA-NeighbourCellInfoList

The IE *OTDOA-NeighbourCellInfoList* is used by the location server to provide neighbour cell information for OTDOA assistance data. The *OTDOA-NeighbourCellInfoList* is sorted according to best measurement geometry at the a-priori location estimate of the target device. I.e., the target device is expected to provide measurements in increasing neighbor cell list order (to the extent that this information is available to the target device).

```
-- ASN1START

OTDOA-NeighbourCellInfoList ::= SEQUENCE (SIZE (1..maxFreqLayers)) OF OTDOA-NeighbourFreqInfo
OTDOA-NeighbourFreqInfo ::= SEQUENCE (SIZE (1..24)) OF OTDOA-NeighbourCellInfoElement

OTDOA-NeighbourCellInfoElement ::= SEQUENCE {
    physCellId                          INTEGER (0..503),
    cellGlobalId                        ECGI                OPTIONAL,
    earfcn                              ARFCN-ValueEUTRA    OPTIONAL,       -- Cond NotSameAsRef0
    cpLength                            ENUMERATED {normal, extended, ...}
                                                            OPTIONAL,       -- Cond NotSameAsRef1
    prsInfo                             PRS-Info            OPTIONAL,       -- Cond NotSameAsRef2
    antennaPortConfig                   ENUMERATED {ports-1-or-2, ports-4, ...}
                                                            OPTIONAL,       -- Cond NotsameAsRef3
    slotNumberOffset                    INTEGER(0..31)      OPTIONAL,       -- Cond NotSameAsRef4
    prs-SubframeOffset                  INTEGER (0..1279)   OPTIONAL,       -- Cond InterFreq
    expectedRSTD                        INTEGER (0..16383),
    expectedRSTD-Uncertainty            INTEGER (0..1023),
    ...
}

maxFreqLayers   INTEGER ::= 3

-- ASN1STOP
```

Conditional presence	Explanation
NotsameAsRef0	The field is mandatory present if the ARFCN is not the same as for the reference cell; otherwise it is not present.
NotsameAsRef1	The field is mandatory present if the cyclic prefix length is not the same as for the reference cell; otherwise it is not present.
NotsameAsRef2	The field is mandatory present if the PRS configuration is not the same as for the reference cell; otherwise it is not present.
NotsameAsRef3	The field is mandatory present if the antenna port configuration is not the same as for the reference cell; otherwise it is not present.
NotsameAsRef4	The field is mandatory present if the slot timing is not the same as for the reference cell; otherwise it is not present.
InterFreq	The field is optionally present, need OP, if the ARFCN is not the same as for the reference cell; otherwise it is not present.

***OTDOA-NeighbourCellInfoList* field descriptions**
physCellId This field specifies the physical cell identity of the neighbour cell, as defined in [12].
cellGlobalId This field specifies the ECGI, the globally unique identity of a cell in E-UTRA, of the neighbour cell, as defined in [12]. The server provides this field if it considers that it is needed to resolve any ambiguity in the cell identified by *physCellId*.
earfcn This field specifies the ARFCN of the neighbor cell.
cpLength This field specifies the cyclic prefix length of the neigbour cell PRS.
prsInfo This field specifies the PRS configuration of the neighbour cell.
antennaPortConfig This field specifies whether 1 (or 2) antenna port(s) or 4 antenna ports for cell specific reference signals are used.
slotNumberOffset This field specifies the slot number offset between this neighbour cell and the reference cell. If this field is absent, the slot timing is the same as for the reference cell.

***OTDOA-NeighbourCellInfoList* field descriptions**
prs-SubframeOffset This field specifies the offset between the first PRS subframe in the reference cell on the reference carrier frequency layer and the first PRS subframe in the closest subsequent PRS burst of the other cell on the other carrier frequency layer. The value is given in sub-frames. If the ARFCN is not the same as for the reference cell and the field is not present, the receiver shall consider the PRS subframe offset for this cell to be 0.
expectedRSTD This field indicates the RSTD value that the target device is expected to measure between this cell and the reference cell in *OTDOAReferenceCellInfo*. The resolution is $3 \times T_s$, with T_s=1/(15000*2048) seconds.
expectedRSTD-Uncertainty This field indicates the uncertainty in *expectedRSTD* value. The uncertainty is related to the location server"s a-priori estimation of the target device location. The *expectedRSTDUncertainty* defines the following search window for the target device: [*expectedRSTD* − *expectedRSTD-Uncertainty*] < measured RSTD < [*expectedRSTD* + *expectedRSTD-Uncertainty*] The scale factor of the *expectedRSTD-Uncertainty* field is $3 \times T_s$, with T_s=1/(15000*2048) seconds.

6.5.1.3 OTDOA Assistance Data Request

– OTDOA-RequestAssistanceData

The IE *OTDOA-RequestAssistanceData* is used by the target device to request assistance data from a location server.

```
-- ASN1START

OTDOA-RequestAssistanceData ::= SEQUENCE {
    physCellId      INTEGER (0..503),
    ...
}

-- ASN1STOP
```

***OTDOA-RequestAssistanceData* field descriptions**
physCellId This field specifies the physical cell identity of the current serving cell of the target device.

6.5.1.4 OTDOA Location Information

– OTDOA-ProvideLocationInformation

The IE *OTDOA-ProvideLocationInformation* is used by the target device to provide OTDOA location measurements to the location server. It may also be used to provide OTDOA positioning specific error reason.

```
-- ASN1START

OTDOA-ProvideLocationInformation ::= SEQUENCE {
    otdoaSignalMeasurementInformation   OTDOA-SignalMeasurementInformation  OPTIONAL,
    otdoa-Error                         OTDOA-Error                         OPTIONAL,
    ...
}

-- ASN1STOP
```

6.5.1.5 OTDOA Location Information Elements

– OTDOA-SignalMeasurementInformation

The IE *OTDOA-SignalMeasurementInformation* is used by the target device to provide RSTD measurements to the location server.

```
-- ASN1START
```

```
OTDOA-SignalMeasurementInformation ::= SEQUENCE {
    systemFrameNumber       BIT STRING (SIZE (10)),
    physCellIdRef           INTEGER (0..503),
    cellGlobalIdRef         ECGI                    OPTIONAL,
    earfcnRef               ARFCN-ValueEUTRA        OPTIONAL,
    referenceQuality        OTDOA-MeasQuality       OPTIONAL,
    neighbourMeasurementList    NeighbourMeasurementList,
    ...
}

NeighbourMeasurementList ::= SEQUENCE (SIZE(1..24)) OF NeighbourMeasurementElement

NeighbourMeasurementElement ::= SEQUENCE {
    physCellIdNeighbor      INTEGER (0..503),
    cellGlobalIdNeighbour   ECGI                    OPTIONAL,
    earfcnNeighbour         ARFCN-ValueEUTRA                            OPTIONAL,
    rstd                    INTEGER (0..12711),
    rstd-Quality            OTDOA-MeasQuality,
    ...
}

-- ASN1STOP
```

***OTDOA-SignalMeasurementInformation* field descriptions**
systemFrameNumber This field specifies the SFN during which the last measurement was performed.
physCellIdRef This field specifies the physical cell identity of the reference cell relative to which the RSTDs are provided.
cellGlobalIdRef This field specifies the ECGI, the globally unique identity of a cell in E-UTRA, of the reference cell relative to which the RSTDs are provided. The target shall provide this IE if it knows the ECGI of the reference cell.
earfcnRef This field specifies the E-UTRA carrier frequency of the reference cell used for the RSTD measurements. The target device shall include this field if the ARFCN used for RSTD measurements is not the same as the ARFCN of the reference cell provided in the OTDOA assistance data.
referenceQuality This field specifies the target device''s best estimate of the quality of the TOA measurement from the reference cell, $T_{SubframeRxRef}$, where $T_{SubframeRxRef}$ is the time of arrival of the signal from the reference cell used to calculate the RSTD values.
neighbourMeasurementList This list contains the measured RSTD values together with quality for the measurement.
physCellIdNeighbor This field specifies the physical cell identity of the neighbour cell for which the RSTDs are provided.
cellGlobalIdNeighbour This field specifies the ECGI, the globally unique identity of a cell in E-UTRA, of the neighbour cell for which the RSTDs are provided. The target device shall provide this IE if it was able to determine the ECGI of the neighbour cell at the time of measurement.
earfcnNeighbour This field specifies the E-UTRA carrier frequency of the neighbour cell used for the RSTD measurements. The target device shall include this field if the ARFCN of this neighbor cell is not the same as the *earfcnRef* for the reference cell.
rstd This field specifies the relative timing difference between this neighbour cell and the reference cell, as defined in [17]. If $T_{SubframeRxNeighbor,i}$ is the time when the target device receives the start of one subframe from this neighbor cell, and $T_{SubframeRxRef}$ is the time when the target device receives the start of one subframe from the reference cell, the *rstd* is $T_{SubframeRxNeighbor,i} - T_{SubframeRxRef}$.
rstd-Quality This field specifies the target device''s best estimate of the quality of the measured *rstd*.

– OTDOA-MeasQuality

```
-- ASN1START

OTDOA-MeasQuality ::= SEQUENCE {
    error-Resolution        BIT STRING (SIZE (2)),
    error-Value             BIT STRING (SIZE (5)),
    error-NumSamples        BIT STRING (SIZE (3))               OPTIONAL,
    ...
}
```

```
-- ASN1STOP
```

***OTDOA-MeasQuality* field descriptions**
error-Resolution This field specifies the resolution R used in *error-Value* field. The encoding on two bits is as follows: '00' 5 meters '01' 10 meters '10' 20 meters '11' 30 meters.
error-Value This field specifies the target device''s best estimate of the uncertainty of the OTDOA measurement. The encoding on five bits is as follows: '00000' 0 to (R*1-1) meters '00001' R*1 to (R*2-1) meters '00010' R*2 to (R*3-1) meters … '11111' R*31 meters or more; where R is the resolution defined by *error-Resolution* field. E.g. , R=20 m corresponds to 0-19 m, 20-39 m,…,620+ m.
error-NumSamples If the *std-Value* field provides the sample uncertainty of the OTDOA measurement, this field specifies how many measurements have been used by the target device to determine this (i.e., sample size). Following 3 bit encoding is used: "000" Not the baseline metric '001' 5-9 '010' 10-14 '011' 15-24 '100' 25-34 '101' 35-44 '110' 45-54 '111' 55 or more. In case of the value "000", the *error-Value* field contains the target device''s best estimate of the uncertainty of the OTDOA measurement not based on the baseline metric. E.g., other measurements such as signal-to-noise-ratio or signal strength can be utilized to estimate the *error-Value.* If this field is absent, the value of this field is "000".

6.5.1.6 OTDOA Location Information Request

– OTDOA-RequestLocationInformation

The IE *OTDOA-RequestLocationInformation* is used by the location server to request OTDOA location measurements from a target device. Details of the required measurements (e.g. details of reference cell and neighbour cells) are conveyed in the *OTDOA-ProvideAssistanceData* IE in a separate Provide Assistance Data message.

```
-- ASN1START

OTDOA-RequestLocationInformation ::= SEQUENCE {
    assistanceAvailability      BOOLEAN,
    ...
}

-- ASN1STOP
```

***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.

6.5.1.7 OTDOA Capability Information

– OTDOA-ProvideCapabilities

The IE *OTDOA-ProvideCapabilities* is used by the target device to indicate its capability to support OTDOA and to provide its OTDOA location capabilities to the location server.

```
-- ASN1START

OTDOA-ProvideCapabilities ::= SEQUENCE {
    otdoa-Mode      BIT STRING {    ue-assisted (0) } (SIZE (1..8)),
    ...
}

-- ASN1STOP
```

***OTDOA-ProvideCapabilities* field descriptions**
otdoa-Mode This field specifies the OTDOA mode(s) supported by the target device. This is represented by a bit string, with a one-value at the bit position means the particular OTDOA mode is supported; a zero-value means not supported.

6.5.1.8 OTDOA Capability Information Request

– OTDOA-RequestCapabilities

The IE *OTDOA-Request-Capabilities* is used by the location server to request the capability of the target device to support OTDOA and to request OTDOA location capabilities from a target device.

```
-- ASN1START

OTDOA-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.1.9 OTDOA Error Elements

– OTDOA-Error

The IE *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

OTDOA-Error ::= CHOICE {
    locationServerErrorCauses       OTDOA-LocationServerErrorCauses,
    targetDeviceErrorCauses         OTDOA-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– OTDOA-LocationServerErrorCauses

The IE *OTDOA-LocationServerErrorCauses* is used by the location server to provide OTDOA error reasons to the target device.

```
-- ASN1START

OTDOA-LocationServerErrorCauses ::= SEQUENCE {
    cause       ENUMERATED  {   undefined,
                                assistanceDataNotSupportedByServer,
```

```
                                assistanceDataSupportedButCurrentlyNotAvailableByServer,
                                ...
                            },
    ...
}

-- ASN1STOP
```

– OTDOA-TargetDeviceErrorCauses

The IE *OTDOA-TargetDeviceErrorCauses* is used by the target device to provide OTDOA error reasons to the location server.

```
-- ASN1START

OTDOA-TargetDeviceErrorCauses ::= SEQUENCE {
    cause       ENUMERATED {    undefined,
                                assistance-data-missing,
                                unableToMeasureReferenceCell,
                                unableToMeasureAnyNeighbourCell,
                                attemptedButUnableToMeasureSomeNeighbourCells,
                                ...
                            },
    ...
}

-- ASN1STOP
```

6.5.2 A-GNSS Positioning

6.5.2.1 GNSS Assistance Data

– A-GNSS-ProvideAssistanceData

The IE *A-GNSS-ProvideAssistanceData* is used by the location server to provide assistance data to enable UE-based and UE-assisted A-GNSS. It may also be used to provide GNSS positioning specific error reasons.

```
-- ASN1START

A-GNSS-ProvideAssistanceData ::= SEQUENCE {
    gnss-CommonAssistData           GNSS-CommonAssistData               OPTIONAL,
    gnss-GenericAssistData          GNSS-GenericAssistData              OPTIONAL,
    gnss-Error                      A-GNSS-Error                        OPTIONAL,
    ...
}

-- ASN1STOP
```

– GNSS-CommonAssistData

The IE *GNSS-CommonAssistData* is used by the location server to provide assistance data which can be used for any GNSS (e.g., GPS, Galileo, GLONASS, etc.).

```
-- ASN1START

GNSS-CommonAssistData ::= SEQUENCE {
    gnss-ReferenceTime              GNSS-ReferenceTime                  OPTIONAL,
    gnss-ReferenceLocation          GNSS-ReferenceLocation              OPTIONAL,
    gnss-IonosphericModel           GNSS-IonosphericModel               OPTIONAL,
    gnss-EarthOrientationParameters GNSS-EarthOrientationParameters     OPTIONAL,
    ...
}

-- ASN1STOP
```

– GNSS-GenericAssistData

The IE *GNSS-GenericAssistData* is used by the location server to provide assistance data for a specific GNSS (e.g., GPS, Galileo, GLONASS, etc.). The specific GNSS for which the provided assistance data are applicable is indicated by the IE *GNSS-ID* and (if applicable) by the IE *SBAS-ID*. Assistance for up to 16 GNSSs can be provided.

```
-- ASN1START

GNSS-GenericAssistData ::= SEQUENCE (SIZE (1..16)) OF GNSS-GenericAssistDataElement

GNSS-GenericAssistDataElement ::= SEQUENCE {
    gnss-ID                         GNSS-ID,
    sbas-ID                         SBAS-ID                         OPTIONAL, -- Cond GNSS-ID-SBAS
    gnss-TimeModels                 GNSS-TimeModelList              OPTIONAL,
    gnss-DifferentialCorrections    GNSS-DifferentialCorrections    OPTIONAL,
    gnss-NavigationModel            GNSS-NavigationModel            OPTIONAL,
    gnss-RealTimeIntegrity          GNSS-RealTimeIntegrity          OPTIONAL,
    gnss-DataBitAssistance          GNSS-DataBitAssistance          OPTIONAL,
    gnss-AcquisitionAssistance      GNSS-AcquisitionAssistance      OPTIONAL,
    gnss-Almanac                    GNSS-Almanac                    OPTIONAL,
    gnss-UTC-Model                  GNSS-UTC-Model                  OPTIONAL,
    gnss-AuxiliaryInformation       GNSS-AuxiliaryInformation       OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
GNSS-ID-SBAS	The field is mandatory present if the *GNSS-ID* = *sbas*; otherwise it is not present.

6.5.2.2 GNSS Assistance Data Elements

– GNSS-ReferenceTime

The IE *GNSS-ReferenceTime* is used by the location server to provide the GNSS specific system time with uncertainty and the relationship between GNSS system time and network air-interface timing of the eNodeB/NodeB/BTS transmission in the reference cell.

If the IE *networkTime* is present, the IEs *gnss-SystemTime* and *networkTime* provide a valid relationship between GNSS system time and air-interface network time, as seen at the approximate location of the target device, i.e. the propagation delay from the the eNodeB/NodeB/BTS to the target device shall be compensated for by the location server. Depending on implementation, the relation between GNSS system time and air-interface network time may have varying accuracy. The uncertainty of this timing relation is provided in the IE *referenceTimeUnc*. If the propagation delay from the eNodeB/NodeB/BTS to the target device is not accurately known, the location server shall use the best available approximation of the propagation delay and take the corresponding delay uncertainty into account in the calculation of the IE *referenceTimeUnc*.

If the IE *networkTime* is not present, the IE *gnssSystemTime* is an estimate of current GNSS system time at time of reception of the IE *GNSS-ReferenceTime* by the target device. The location server should achieve an accuracy of +/- 3 seconds for this estimate including allowing for the transmission delay between the location server and the target device. Note that the target device should further compensate *gnss-SystemTime* for the time between the reception of *GNSS-ReferenceTime* and the time when the *gnss-SystemTime* is used.

The location server shall provide a value for the *gnss-TimeID* only for GNSSs supported by the target device.

The IE *GNSS-ReferenceTimeForOneCell* can be provided multiple times (up to 16) to provide fine time assistance for several (neighbour) cells.

```
-- ASN1START

GNSS-ReferenceTime ::= SEQUENCE  {
    gnss-SystemTime             GNSS-SystemTime,
    referenceTimeUnc            INTEGER (0..127)                    OPTIONAL,   -- Cond noFTA
    gnss-ReferenceTimeForCells  SEQUENCE (SIZE (1..16)) OF
                                    GNSS-ReferenceTimeForOneCell    OPTIONAL,
    ...
}
```

```
GNSS-ReferenceTimeForOneCell  ::= SEQUENCE {
    networkTime                   NetworkTime,
    referenceTimeUnc              INTEGER (0..127),
    bsAlign                       ENUMERATED {true}   OPTIONAL,
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
noFTA	The field may be present if *gnss-ReferenceTimeForCells* is absent; otherwise it is not present.

***GNSS-ReferenceTime* field descriptions**
gnss-SystemTime This field provides the specific GNSS system time.
networkTime This field specifies the cellular network time at the epoch corresponding to *gnss-SystemTime.*
referenceTimeUnc This field provides the accuracy of the relation between *gnssSystemTime* and *networkTime* time if IE *networkTime* is provided. When IE *networkTime* is not provided, this field can be included to provide the accuracy of the provided *gnssSystemTime*. If GNSS TOD is the given GNSS time, then the true GNSS time, corresponding to the provided network time as observed at the target device location, lies in the interval [GNSS TOD - *referenceTimeUnc*, GNSS TOD + *referenceTimeUnc*]. The uncertainty *r*, expressed in microseconds, is mapped to a number *K*, with the following formula: $r = C*(((1+x)^K)-1)$ with C = 0.5 and x = 0.14. To encode any higher value of uncertainty than that corresponding in the above formula to K=127, the same value, K=127, shall also be used. The uncertainty is then coded on 7 bits, as the binary encoding of K. Example values for the *referenceTimeUnc* Format: see table K to uncertainty relation below
bsAlign This flag, if present, indicates that the transmission timings of all cells sharing, depending on the RAT, the same carrier frequency and Tracking Area/Location Area/Routing Area as the cell indicated, are frame aligned. This information allows the UE to derive the GNSS - cellular time relation for any of these cells based on the timing relation information provided in GNSS-ReferenceTime. The flag should be set consistently in all these cells. This flag does not guarantee SFN alignment.

K to uncertainty relation

Value of K	Value of uncertainty
0	0 nanoseconds
1	70 nanoseconds
2	149.8 nanoseconds
-	-
50	349.62 microseconds
-	-
127	≥ 8.43 seconds

– GNSS-SystemTime

```
-- ASN1START

GNSS-SystemTime ::= SEQUENCE {
    gnss-TimeID                     GNSS-ID,
    gnss-DayNumber                  INTEGER (0..32767),
    gnss-TimeOfDay                  INTEGER (0..86399),
    gnss-TimeOfDayFrac-msec         INTEGER (0..999)        OPTIONAL,
    notificationOfLeapSecond        BIT STRING (SIZE(2))    OPTIONAL,   -- Cond gnss-TimeID-glonass
    gps-TOW-Assist                  GPS-TOW-Assist          OPTIONAL,   -- Cond gnss-TimeID-gps
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
gnss-TimeID-glonass	The field may be present if *gnss-TimeID*=`glonass"; otherwise it is not present.
gnss-TimeID-gps	The field may be present if *gnss-TimeID*=`gps"; otherwise it is not present.

***GNSS-SystemTime* field descriptions**
gnss-TimeID This field specifies the GNSS for which the *GNSS-SystemTime* is provided.
gnss-DayNumber This field specifies the sequential number of days from the origin of the GNSS System Time as follows: GPS, QZSS, SBAS – Days from January 6th 1980 00:00:00 UTC(USNO); Galileo – TBD; GLONASS – Days from January 1st 1996.
gnss-TimeOfDay This field specifies the integer number of seconds from the GNSS day change.
gnss-TimeOfDayFrac-msec This field specifies the fractional part of the *gnssTimeOfDay* field in 1-milli-seconds resolution. The total GNSS TOD is *gnss-TimeOfDay* + *gnssTimeOfDayFrac-msec.*
notificationOfLeapSecond This field specifies the notification of forthcoming leap second correction, as defined by parameter KP in [9, Table 4.7].
gps-TOW-Assist This field contains several fields in the Telemetry (TLM) Word and Handover Word (HOW) that are currently being broadcast by the respective GPS satellites. Combining this information with GPS TOW enables the target device to know the entire 1.2-second (60-bit) pattern of TLM and HOW that is transmitted at the start of each six-second NAV subframe by the particular GPS satellite.

– GPS-TOW-Assist

```
-- ASN1START

GPS-TOW-Assist ::= SEQUENCE (SIZE(1..64)) OF GPS-TOW-AssistElement

GPS-TOW-AssistElement ::= SEQUENCE {
    satelliteID     INTEGER (1..64),
    tlmWord         INTEGER (0..16383),
    antiSpoof       INTEGER (0..1),
    alert           INTEGER (0..1),
    tlmRsvdBits     INTEGER (0..3),
    ...
}

-- ASN1STOP
```

***GPS-TOW-Assist* field descriptions**
satelliteID This field identifies the satellite for which the *GPS-TOW-Assist* is applicable. This field is identical to the GPS PRN Signal No. defined in [4].
tlmWord This field contains a 14-bit value representing the Telemetry Message (TLM) being broadcast by the GPS satellite identified by the particular *satelliteID*, with the MSB occurring first in the satellite transmission, as defined in [4].
antiSpoof This field contains the Anti-Spoof flag that is being broadcast by the GPS satellite identified by *satelliteID*, as defined in [1].
alert This field contains the Alert flag that is being broadcast by the GPS satellite identified by *satelliteID*, as defined in [4].
tlmRsvBits This field contains the two reserved bits in the TLM Word being broadcast by the GPS satellite identified by *satelliteID*, with the MSB occurring first in the satellite transmission, as defined in [4].

– NetworkTime

```
-- ASN1START
```

```
NetworkTime ::= SEQUENCE {
    secondsFromFrameStructureStart              INTEGER(0..12533),
    fractionalSecondsFromFrameStructureStart    INTEGER(0..3999999),
    frameDrift                                  INTEGER (-64..63)                      OPTIONAL, --
Cond GNSSsynch
    cellID              CHOICE {
                        eUTRA       SEQUENCE {
                                    physCellId          INTEGER (0..503),
                                    cellGlobalIdEUTRA   CellGlobalIdEUTRA-AndUTRA       OPTIONAL,
                                    earfcn              ARFCN-ValueEUTRA,
                                    ...
                                    },
                        uTRA        SEQUENCE {
                                    mode    CHOICE {
                                            fdd     SEQUENCE {
                                                    primary-CPICH-Info  INTEGER (0..511),
                                                    ...
                                                    },
                                            tdd     SEQUENCE {
                                                    cellParameters      INTEGER (0..127),
                                                    ...
                                                    }
                                            },
                                    cellGlobalIdUTRA    CellGlobalIdEUTRA-AndUTRA       OPTIONAL,
                                    uarfcn              ARFCN-ValueUTRA,
                                    ...
                                    },
                        gSM         SEQUENCE {
                                    bcchCarrier         INTEGER (0..1023),
                                    bsic                INTEGER (0..63),
                                    cellGlobalIdGERAN   CellGlobalIdGERAN               OPTIONAL,
                                    ...
                                    },
                        ...
                        },
    ...
}

ARFCN-ValueUTRA ::=                 INTEGER (0..16383)

-- ASN1STOP
```

Conditional presence	Explanation
GNSSsynch	The field is present and set to 0 if *NetworkTime* is synchronized to *gnss-SystemTime*; otherwise the field is optionally present, need OR.

NetworkTime field descriptions
secondsFromFrameStructureStart This field specifies the number of seconds from the beginning of the longest frame structure in the corresponding air interface. In case of E-UTRA, the SFN cycle length is 10.24 seconds. In case of UTRA, the SFN cycle length is 40.96 seconds. In case of GSM, the hyperfame length is 12533.76 seconds.
fractionalSecondsFromFrameStructureStart This field specifies the fractional part of the *secondsFromFrameStructureStart* in 250 ns resolution. The total time since the particular frame structure start is *secondsFromFrameStructureStart* + *fractionalSecondsFromFrameStructureStart*
frameDrift This field specifies the drift rate of the GNSS-network time relation with scale factor 2^{-30} seconds/second, in the range from -5.9605e-8 to +5.8673e-8 sec/sec.
cellID This field specifies the cell for which the GNSS–network time relation is provided.
physCellId This field specifies the physical cell identity of the reference cell (E-UTRA), as defined in [12], for which the GNSS network time relation is provided.
cellGlobalIdEUTRA This field specifies the Evolved Cell Global Identifier (ECGI), the globally unique identity of a cell in E-UTRA, of the reference cell for the GNSS-network time relation, as defined in [12].
primary-CPICH-Info This field specifies the physical cell identity of the reference cell (UTRA) for the GNSS-network time relation, as defined in [13].

cellParameters This field specifies the physical cell identity of the reference cell (UTRA) for the GNSS-network time relation, as defined in [13].
cellGlobalIdUTRA The filed specifies the global UTRAN Cell Identifier, the globally unique identity of a cell in UTRA, of the reference cell for the GNSS-network time relation, as defined in [13].
bcchCarrier This field specifies the absolute GSM RF channel number of the BCCH of the reference base station (GERAN) for the GNSS-network time relation, as defined in [14].
bsic This field specifies the Base Station Identity Code of the reference base station (GERAN) for the GNSS-network time relation, as defined in [14].
cellGlobalIdGERAN This field specifies the Cell Global Identification (CGI), the globally unique identity of a cell in GERAN, of the reference base station for the GNSS-network time relation.

– GNSS-ReferenceLocation

The IE *GNSS-ReferenceLocation* is used by the location server to provide the target device with a-priori knowledge of its location in order to improve GNSS receiver performance. The IE *GNSS-ReferenceLocation* is provided in WGS-84 reference system.

```
-- ASN1START

GNSS-ReferenceLocation ::= SEQUENCE {
        threeDlocation          EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,
        ...
}

-- ASN1STOP
```

– GNSS-IonosphericModel

The IE *GNSS-IonosphericModel* is used by the location server to provide 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. Two Ionospheric Models are supported: The Klobuchar model as defined in [4], and the NeQuick model as defined in [8].

```
-- ASN1START

GNSS-IonosphericModel ::= SEQUENCE {
    klobucharModel          KlobucharModelParameter     OPTIONAL,
    neQuickModel            NeQuickModelParameter       OPTIONAL,
    ...
}

-- ASN1STOP
```

– KlobucharModelParameter

```
-- ASN1START

KlobucharModelParameter ::= SEQUENCE {
    dataID          BIT STRING (SIZE (2)),
    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
```

***KlobucharModelParamater* field descriptions**
dataID When *dataID* has the value "11" it indicates that the parameters have been generated by QZSS, and the parameters have been specialized and are applicable within the area defined in [7]. When dataID has the value "00" it indicates the parameters are applicable worldwide [4,7]. All other values for *dataID* are reserved.
alpha0 This field specifies the α_0 parameter of the Klobuchar model, as specified in [4]. Scale factor 2^{-30} seconds.
alpha1 This field specifies the α_1 parameter of the Klobuchar model, as specified in [4]. Scale factor 2^{-27} seconds/semi-circle.
alpha2 This field specifies the α_2 parameter of the Klobuchar model, as specified in [4]. Scale factor 2^{-24} seconds/semi-circle^2.
alpha3 This field specifies the α_3 parameter of the Klobuchar model, as specified in [4]. Scale factor 2^{-24} seconds/semi-circle^3.
beta0 This field specifies the β_0 parameter of the Klobuchar model, as specified in [4]. Scale factor 2^{11} seconds.
beta1 This field specifies the β_1 parameter of the Klobuchar model, as specified in [4]. Scale factor 2^{14} seconds/semi-circle.
beta2 This field specifies the β_2 parameter of the Klobuchar model, as specified in [4]. Scale factor 2^{16} seconds/semi-circle^2.
beta3 This field specifies the β_3 parameter of the Klobuchar model, as specified in [4]. Scale factor 2^{16} seconds/semi-circle^3.

– NeQuickModelParameter

```
-- ASN1START

NeQuickModelParameter ::= SEQUENCE {
    ai0             INTEGER (0..4095),
    ai1             INTEGER (0..4095),
    ai2             INTEGER (0..4095),
    ionoStormFlag1  INTEGER (0..1)      OPTIONAL,
    ionoStormFlag2  INTEGER (0..1)      OPTIONAL,
    ionoStormFlag3  INTEGER (0..1)      OPTIONAL,
    ionoStormFlag4  INTEGER (0..1)      OPTIONAL,
    ionoStormFlag5  INTEGER (0..1)      OPTIONAL,
    ...
}

-- ASN1STOP
```

***NeQuickModelParameter* field descriptions**
ai0, ai1, ai2 These fields are used to estimate the ionospheric distortions on pseudoranges as described in [8] on page 71.
ionoStormFlag1, ionoStormFlag2, ionoStormFlag3, ionoStormFlag4, ionoStormFlag5 These fields specify the ionosphere storm flags (1,…,5) for five different regions as described in [8] on page 71.

– GNSS-EarthOrientationParameters

The IE *GNSS-EarthOrientationParameters* is used by the location server to provide parameters to construct the ECEF and ECI coordinate transformation as defined in [4]. The IE *GNSS-EarthOrientationParameters* indicates the relationship between the Earth"s rotational axis and WGS-84 reference system.

```
-- ASN1START

GNSS-EarthOrientationParameters ::= SEQUENCE {
```

```
    teop                INTEGER (0..65535),
    pmX                 INTEGER (-1048576..1048575),
    pmXdot              INTEGER (-16384..16383),
    pmY                 INTEGER (-1048576..1048575),
    pmYdot              INTEGER (-16384..16383),
    deltaUT1            INTEGER (-1073741824..1073741823),
    deltaUT1dot         INTEGER (-262144..262143),
    ...
}

-- ASN1STOP
```

***GNSS-EarthOrientationParameters* field descriptions**
teop This field specifies the EOP data reference time in seconds, as specified in [4]. Scale factor 2^{4} seconds.
pmX This field specifies the X-axis polar motion value at reference time in arc-seconds, as specified in [4]. Scale factor 2^{-20} arc-seconds.
pmXdot This field specifies the X-axis polar motion drift at reference time in arc-seconds/day, as specified in [4]. Scale factor 2^{-21} arc-seconds/day.
pmY This field specifies the Y-axis polar motion value at reference time in arc-seconds, as specified in [4]. Scale factor 2^{-20} arc-seconds.
pmYdot This field specifies the Y-axis polar motion drift at reference time in arc-seconds/day, as specified in [4]. Scale factor 2^{-21} arc-seconds/day.
deltaUT1 This field specifies the UT1-UTC difference at reference time in seconds, as specified in [4]. Scale factor 2^{-24} seconds.
deltaUT1dot This field specifies the Rate of UT1-UTC difference at reference time in seconds/day, as specified in [4]. Scale factor 2^{-25} seconds/day.

– GNSS-TimeModelList

The IE *GNSS-TimeModelList* is used by the location server to provide the GNSS-GNSS system time offset between the GNSS system time indicated by IE *GNSS-ID* in IE *GNSS-GenericAssistDataElement* to the GNSS system time indicated by IE *gnss-TO-ID*. Several *GNSS-TimeModelElement* IEs can be included with different *gnss-TO-ID* fields.

```
-- ASN1START

GNSS-TimeModelList ::= SEQUENCE (SIZE (1..15)) OF GNSS-TimeModelElement

GNSS-TimeModelElement ::= SEQUENCE {
    gnss-TimeModelRefTime       INTEGER (0..65535),
    tA0                         INTEGER (-67108864..67108863),
    tA1                         INTEGER (-4096..4095)                   OPTIONAL,
    tA2                         INTEGER (-64..63)                       OPTIONAL,
    gnss-TO-ID                  INTEGER (1..15),
    weekNumber                  INTEGER (0..8191)                       OPTIONAL,
    deltaT                      INTEGER (-128..127)                     OPTIONAL,
    ...
}

-- ASN1STOP
```

***GNSS-TimeModelElement* field descriptions**
gnss-TimeModelRefTime This field specifies the the reference time of week for *GNSSTimeModelElement* and it is given in GNSS specific system time. Scale factor 2^{4} seconds.
tA0 This field specifies the bias coefficient of the *GNSSTimeModelElement*. Scale factor 2^{-35} seconds.

***GNSS-TimeModelElement* field descriptions**
tA1 This field specifies the drift coefficient of the *GNSSTimeModelElement.* Scale factor of 2^{-51} seconds/second.
tA2 This field specifies the drift rate correction coefficient of the *GNSSTimeModelElement.* Scale factor of 2^{-68} seconds/second^2.
gnss-TO-ID This field specifies the GNSS system time of the GNSS for which the *GNSS-TimeModelElement* is applicable. *GNSS-TimeModelElement* contains parameters to convert GNSS system time from the system indicated by *GNSS-ID* to GNSS system time indicated by *gnss-TO-ID*. The conversion is defined in [4,5,6]. See table of gnss-TO-ID to Indication relation below.
weekNumber This field specifies the reference week of the *GNSS-TimeModelElement* given in GNSS specific system time. Scale factor 1 week.
deltaT This field specifies the integer number of seconds of the GNSS-GNSS time offset provided in the *GNSS-TimeModelElement.* Scale factor 1 second.

gnss-TO-ID to Indication relation

Value of *gnss-TOID*	Indication
1	GPS
2	Galileo
3	QZSS
4	GLONASS
5-15	reserved

– GNSS-DifferentialCorrections

The IE *GNSS-DifferentialCorrections* is used by the location server to provide differential GNSS corrections to the target device for a specific GNSS. Differential corrections can be provided for up to 3 signals per GNSS.

```
-- ASN1START

GNSS-DifferentialCorrections ::= SEQUENCE {
    dgnss-RefTime       INTEGER (0..3599),
    dgnss-SgnTypeList   DGNSS-SgnTypeList,
    ...
}

DGNSS-SgnTypeList ::= SEQUENCE (SIZE (1..3)) OF DGNSS-SgnTypeElement

DGNSS-SgnTypeElement ::= SEQUENCE {
    gnss-SignalID        GNSS-SignalID,
    gnss-StatusHealth    INTEGER (0..7),
    dgnss-SatList        DGNSS-SatList,
    ...
}

DGNSS-SatList ::= SEQUENCE (SIZE (1..64)) OF DGNSS-CorrectionsElement

DGNSS-CorrectionsElement ::= SEQUENCE {
    svID                SV-ID,
    iod                 BIT STRING (SIZE(11)),
    udre                INTEGER (0..3),
    pseudoRangeCor      INTEGER (-2047..2047),
    rangeRateCor        INTEGER (-127..127),
    udreGrowthRate      INTEGER (0..7)          OPTIONAL,
    udreValidityTime    INTEGER (0..7)          OPTIONAL,
    ...
}

-- ASN1STOP
```

***GNSS-DifferentialCorrections* field descriptions**
dgnss-RefTime This field specifies the time for which the DGNSS corrections are valid, modulo 1 hour. *dgnss-RefTime* is given in GNSS specific system time. Scale factor 1-second.
dgnss-SgnTypeList This list includes differential correction data for different GNSS signal types, identified by *GNSS-SignalID*.
gnss-StatusHealth This field specifies the status of the differential corrections. The values of this field and their respective meanings are defined as in table *gnss-StatusHealth Value to Indication relation below.* The first six values in this field indicate valid differential corrections. When using the values described below, the "UDRE Scale Factor" value is applied to the UDRE values contained in the element. The purpose is to indicate an estimate in the amount of error in the corrections. The value "110" indicates that the source of the differential corrections (e.g., reference station or external DGNSS network) is currently not being monitored. The value "111" indicates that the corrections provided by the source are invalid, as judged by the source.
dgnss-SatList This list includes differential correction data for different GNSS satellites, identified by *SV-ID*.
iod This field specifies the Issue of Data field which contains the identity for the *GNSS-NavigationModel.*
udre This field provides an estimate of the uncertainty (1-σ) in the corrections for the particular satellite. The value in this field shall be multiplied by the UDRE Scale Factor in the *gnss-StatusHealth* field to determine the final UDRE estimate for the particular satellite. The meanings of the values for this field are shown in the table *udre Value* to Indication relation below.
pseudoRangeCor This field specifies the correction to the pseudorange for the particular satellite at *dgnss-RefTime*, t_0. The value of this field is given in meters and the scale factor is 0.32 meters in the range of ±655.04 meters. The method of calculating this field is described in [11]. If the location server has received a request for GNSS assistance data from a target device which included a request for the GNSS Navigation Model and DGNSS, the location server shall determine, for each satellite, if the navigation model stored by the target device is still suitable for use with DGNSS corrections and if so and if DGNSS corrections are supported the location server should send DGNSS corrections without including the GNSS Navigation Model. The *iod* value sent for a satellite shall always be the IOD value that corresponds to the navigation model for which the pseudo-range corrections are applicable. The target device shall only use the *pseudoRangeCor* value when the IOD value received matches its available navigation model. Pseudo-range corrections are provided with respect to GNSS specific geodetic datum (e.g., PZ-90.02 if *GNSS-ID* indicates GLONASS). Scale factor 0.32 meters.
rangeRateCor This field specifies the rate-of-change of the pseudorange correction for the particular satellite, using the satellite ephemeris and clock corrections identified by the *iod* field. The value of this field is given in meters per second and the resolution is 0.032 meters/sec in the range of ±4.064 meters/sec. For some time $t_1 > t_0$, the corrections for *iod* are estimated by $PRC(t_1, IOD) = PRC(t_0, IOD) + RRC(t_0,IOD)\cdot(t_1 - t_0)$, and the target device uses this to correct the pseudorange it measures at t_1, $PR_m(t_1,IOD)$, by $PR(t_1, IOD) = PR_m(t_1, IOD) + PRC(t_1, IOD)$. The location server shall always send the RRC value that corresponds to the PRC value that it sends. The target device shall only use the RRC value when the *iod* value received matches its available navigation model. Scale factor 0.032 meters/second.
udreGrowthRate This field provides an estimate of the growth rate of uncertainty (1-σ) in the corrections for the particular satellite identified by *SV-ID*. The estimated UDRE at time value specified in the *udreValidityTime* t_1 is calculated as follows: $UDRE(t_0+t_1) = UDRE(t_0) \times$ *udreGrowthRate ,* where t_0 is the DGNSS Reference Time *dgnss-RefTime* for which the corrections are valid, t_1 is the *udreValidityTime* field, UDRE(t_0) is the value of the *udre* field, and *udreGrowthRate* field is the factor as shown in the table Value of *udreGrowthRate* to Indication relation below.
udreValidityTime This field specifies the time when the *udreGrowthRate* field applies. The meaning of the values for this field is as shown in the table Value of *udreValidityTime* to Indication relation below.

gnss-StatusHealth Value to Indication relation

gnss-StatusHealth Value	**Indication**

000	UDRE Scale Factor = 1.0
001	UDRE Scale Factor = 0.75
010	UDRE Scale Factor = 0.5
011	UDRE Scale Factor = 0.3
100	UDRE Scale Factor = 0.2
101	UDRE Scale Factor = 0.1
110	Reference Station Transmission Not Monitored
111	Data is invalid - disregard

udre Value to Indication relation

udre **Value**	**Indication**
00	UDRE ≤ 1.0 m
01	1.0 m < UDRE ≤ 4.0 m
10	4.0 m < UDRE ≤ 8.0 m
11	8.0 m < UDRE

Value of _udreGrowthRate_ to Indication relation

Value of *udreGrowthRate*	**Indication**
000	1.5
001	2
010	4
011	6
100	8
101	10
110	12
111	16

Value of _udreValidityTime_ to Indication relation

Value of *udreValidityTime*	**Indication [seconds]**
000	20
001	40
010	80
011	160
100	320
101	640
110	1280
111	2560

– GNSS-NavigationModel

The IE *GNSS-NavigationModel* is used by the location server to provide precise navigation data to the GNSS capable target device. In response to a request from a target device for GNSS Assistance Data, the location server shall determine whether to send the navigation model for a particular satellite to a target device based upon factors like the T-Toe limit specified by the target device and any request from the target device for DGNSS (see also *GNSS-DifferentialCorrections*). GNSS Orbit Model can be given in Keplerian parameters or as state vector in Earth-Centered Earth-Fixed coordinates, dependent on the *GNSS-ID* and the target device capabilities. The meaning of these parameters is defined in relevant ICDs of the particular GNSS and GNSS specific interpretations apply. For example, GPS and QZSS use the same model parameters but some parameters have a different interpretation [7].

```
-- ASN1START

GNSS-NavigationModel ::= SEQUENCE {
    nonBroadcastIndFlag     INTEGER (0..1),
    gnss-SatelliteList      GNSS-NavModelSatelliteList,
    ...
}
```

```
GNSS-NavModelSatelliteList ::= SEQUENCE (SIZE(1..64)) OF GNSS-NavModelSatelliteElement

GNSS-NavModelSatelliteElement ::= SEQUENCE {
    svID                SV-ID,
    svHealth            BIT STRING (SIZE(8)),
    iod                 BIT STRING (SIZE(11)),
    gnss-ClockModel     GNSS-ClockModel,
    gnss-OrbitModel     GNSS-OrbitModel,
    ...
}

GNSS-ClockModel ::= CHOICE {
    standardClockModelList  StandardClockModelList,         -- Model-1
    nav-ClockModel          NAV-ClockModel,                 -- Model-2
    cnav-ClockModel         CNAV-ClockModel,                -- Model-3
    glonass-ClockModel      GLONASS-ClockModel,             -- Model-4
    sbas-ClockModel         SBAS-ClockModel,                -- Model-5
    ...
}

GNSS-OrbitModel ::= CHOICE {
    keplerianSet            NavModelKeplerianSet,               -- Model-1
    nav-KeplerianSet        NavModelNAV-KeplerianSet,           -- Model-2
    cnav-KeplerianSet       NavModelCNAV-KeplerianSet,          -- Model-3
    glonass-ECEF            NavModel-GLONASS-ECEF,              -- Model-4
    sbas-ECEF               NavModel-SBAS-ECEF,                 -- Model-5
    ...
}

-- ASN1STOP
```

***GNSS-NavigationModel* field descriptions**
nonBroadcastIndFlag This field indicates if the *GNSS-NavigationModel* elements are not derived from satellite broadcast data or are given in a format not native to the GNSS. A value of 0 means the *GNSS-NavigationModel* data elements correspond to GNSS satellite broadcasted data; a value of 1 means the *GNSS-NavigationModel* data elements are not derived from satellite broadcast.
gnss-SatelliteList This list provides ephemeris and clock corrections for GNSS satellites indicated by *SV-ID*.
svHealth This field specifies the satellite''s current health. The health values are GNSS system specific. The interpretation of *svHealth* depends on the *GNSS-ID* and is as shown in table GNSS to svHealth Bit String(8) relation below.
iod This field specifies the Issue of Data and contains the identity for GNSS Navigation Model. In case of broadcasted GPS NAV ephemeris, the *iod* contains the IODC as described in [4]. In case of broadcasted Modernized GPS ephemeris, the *iod* contains the 11-bit parameter t_{oe} as defined in [4, Table 30-I] [6, Table 3.5-1]. In case of broadcasted SBAS ephemeris, the *iod* contains the 8 bits Issue of Data as defined in [10] Message Type 9. In case of broadcasted QZSS QZS-L1 ephemeris, the *iod* contains the IODC as described in [7]. In case of broadcasted QZSS QZS-L1C/L2C/L5 ephemeris, the *iod* contains the 11-bit parameter t_{oe} as defined in [7]. In case of broadcasted GLONASS ephemeris, the *iod* contains the parameter t_b as defined in [9]. In the case of broadcasted Galileo ephemeris, the *iod* contains the IOD index as described in [8]. The interpretation of *iod* depends on the *GNSS-ID* and is as shown in table GNSS to iod Bit String(11) relation below.

GNSS to svHealth Bit String(8) relation

GNSS	***svHealth* Bit String(8)**							
	Bit 1 (MSB)	**Bit 2**	**Bit 3**	**Bit 4**	**Bit 5**	**Bit 6**	**Bit 7**	**Bit 8 (LSB)**
GPS L1/CA(1)	SV Health [4]						"0" (reserved)	"0" (reserved)
Modernized GPS(2)	L1C Health [6]	L1 Health [4,5]	L2 Health [4,5]	L5 Health [4,5]	"0" (reserved)	"0" (reserved)	"0" (reserved)	"0" (reserved)
SBAS(3)	Ranging On (0),Off(1) [10]	Corrections On(0),Off(1) [10]	Integrity On(0),Off(1)[10]	"0" (reserved)	"0" (reserved)	"0" (reserved)	"0" (reserved)	"0" (reserved)
QZSS(4) QZS-L1	SV Health [7]						"0" (reserved)	"0" (reserved)
QZSS(5) QZS-	L1C Health [7]	L1 Health [7]	L2 Health [7]	L5 Health [7]	"0" (reserved)	"0" (reserved)	"0" (reserved)	"0" (reserved)

L1C/L2C/L5								
GLONASS	B_n (MSB) [9, page 30]	F_T [9, Table 4.4]				"0" (reserved)	"0" (reserved)	"0" (reserved)
Galileo [5, pages 75-76]	E5a Data Validity Status	E5b Data Validity Status	E1-B Data Validity Status	E5a Signal Health Status See [8], Table 67		"0" (reserved)	"0" (reserved)	"0" (reserved)
Note 1: If *GNSS-ID* indicates "gps", and GNSS Orbit Model-2 is included, this interpretation of *svHealth* applies. Note 2: If *GNSS-ID* indicates "gps", and GNSS Orbit Model-3 is included, this interpretation of *svHealth* applies. If a certain signal is not supported on the satellite indicated by *SV-ID*, the corresponding health bit shall be set to "1" (i.e., signal can not be used). Note 3: *svHealth* in case of *GNSS-ID* indicates "sbas" includes the 5 LSBs of the Health included in GEO Almanac Message Parameters (Type 17) [10]. Note 4: If *GNSS-ID* indicates "qzss", and GNSS Orbit Model-2 is included, this interpretation of *svHealth* applies. Note 5: If *GNSS-ID* indicates "qzss", and GNSS Orbit Model-3 is included, this interpretation of *svHealth* applies.								

GNSS to iod Bit String(11) relation

GNSS	***iod* Bit String(11)**										
	Bit 1 (MSB)	**Bit 2**	**Bit 3**	**Bit 4**	**Bit 5**	**Bit 6**	**Bit 7**	**Bit 8**	**Bit 9**	**Bit 10**	**Bit 11 (LSB)**
GPS L1/CA	"0"	Issue of Data, Clock [4]									
Modernized GPS	t_{oe} (seconds, scale factor 300, range 0 – 604500) [4,5,6]										
SBAS	"0"	"0"	"0"	Issue of Data ([10], Message Type 9)							
QZSS QZS-L1	"0"	Issue of Data, Clock [7]									
QZSS QZS-L1C/L2C/L5	t_{oe} (seconds, scale factor 300, range 0 – 604500) [4]										
GLONASS	"0"	"0"	"0"	"0"	t_b (minutes, scale factor 15, range 0 – 1425) [9]						
Galileo	"0"	IOD [8]									

– StandardClockModelList

```
-- ASN1START

StandardClockModelList ::= SEQUENCE (SIZE(1..2)) OF StandardClockModelElement

StandardClockModelElement ::= SEQUENCE {
    stanClockToc    INTEGER (0..16383),
    stanClockAF2    INTEGER (-2048..2047),
    stanClockAF1    INTEGER (-131072..131071),
    stanClockAF0    INTEGER (-134217728..134217727),
    stanClockTgd    INTEGER (-512..511)                  OPTIONAL,
    stanModelID     INTEGER (0..1)                       OPTIONAL,
    ...
}

-- ASN1STOP
```

***StandardClockModelList* field descriptions**
standardClockModelList *gnss-ClockModel* Model-1 contains one or two clock model elements depending on the GNSS. If included, clock Model-1 shall be included once or twice depending on the target device capability. If the target device is supporting multiple Galileo signals, the location server shall include both F/Nav and I/Nav clock models in *gnss-ClockModel* if the location server assumes the target device to perform location information calculation using multiple signals.
stanClockToc Parameter t_{oc} defined in [8]. Scale factor 60 seconds.
stanClockAF2 Parameter af_2 defined in [8]. Scale factor 2^{-65} seconds/second^2.
stanClockAF1 Parameter af_1 defined in [8]. Scale factor 2^{-45} seconds/second.
stanClockAF0 Parameter af_0 defined in [8]. Scale factor 2^{-33} seconds.

***StandardClockModelList* field descriptions**
stanClockTgd Parameter T_{GD} defined in [8]. Scale factor 2^{-32} seconds.
stanModelID This field specifies the identity of the clock model according to the table Value of stanModelID to Identity relation below.

Value of stanModelID to Identity relation

Value of *stanModelID*	Identity
0	I/Nav
1	F/Nav

– NAV-ClockModel

```
-- ASN1START

NAV-ClockModel ::= SEQUENCE {
    navToc          INTEGER (0..37799),
    navaf2          INTEGER (-128..127),
    navaf1          INTEGER (-32768..32767),
    navaf0          INTEGER (-2097152..2097151),
    navTgd          INTEGER (-128..127),
    ...
}

-- ASN1STOP
```

***NAV-ClockModel* field descriptions**
navToc Parameter t_{oc}, time of clock (seconds) [4,7] Scale factor 2^{4} seconds.
navaf2 Parameter a_{f2}, clock correction polynomial coefficient (sec/sec^2) [4,7]. Scale factor 2^{-55} seconds/second^2.
navaf1 Parameter a_{f1}, clock correction polynomial coefficient (sec/sec) [4,7]. Scale factor 2^{-43} seconds/second.
navaf0 Parameter a_{f0}, clock correction polynomial coefficient (seconds) [4,7]. Scale factor 2^{-31} seconds.
navTgd Parameter T_{GD}, group delay (seconds) [4,7]. Scale factor 2^{-31} seconds.

– CNAV-ClockModel

```
-- ASN1START

CNAV-ClockModel ::= SEQUENCE {
    cnavToc         INTEGER (0..2015),
    cnavTop         INTEGER (0..2015),
    cnavURA0        INTEGER (-16..15),
    cnavURA1        INTEGER (0..7),
    cnavURA2        INTEGER (0..7),
    cnavAf2         INTEGER (-512..511),
    cnavAf1         INTEGER (-524288..524287),
    cnavAf0         INTEGER (-33554432..33554431),
    cnavTgd         INTEGER (-4096..4095),
    cnavISCl1cp     INTEGER (-4096..4095)           OPTIONAL,
    cnavISCl1cd     INTEGER (-4096..4095)           OPTIONAL,
    cnavISCl1ca     INTEGER (-4096..4095)           OPTIONAL,
    cnavISCl2c      INTEGER (-4096..4095)           OPTIONAL,
    cnavISCl5i5     INTEGER (-4096..4095)           OPTIONAL,
```

```
    cnavISCl5q5     INTEGER (-4096..4095)           OPTIONAL,
    ...
}

-- ASN1STOP
```

***CNAV-ClockModel* field descriptions**
cnavToc Parameter t_{oc}, clock data reference time of week (seconds) [4,5,6,7][1, 2, 3, 4]. Scale factor 300 seconds.
cnavTop Parameter t_{op}, clock data predict time of week (seconds) [4,5,6,7]. Scale factor 300 seconds
cnavURA0 Parameter URA_{oc} Index, SV clock accuracy index (dimensionless) [4,5,6,7].
cnavURA1 Parameter URA_{oc1} Index, SV clock accuracy change index (dimensionless) [4,5,6,7].
cnavURA2 Parameter URA_{oc2} Index, SV clock accuracy change rate index (dimensionless) [4,5,6,7].
cnavAf2 Parameter a_{f2-n}, SV clock drift rate correction coefficient (sec/sec^2) [4,5,6,7]. Scale factor 2^{-60} seconds/second^2.
cnavAf1 Parameter a_{f1-n}, SV clock drift correction coefficient (sec/sec) [4,5,6,7]. Scale factor 2^{-48} seconds/second.
cnavAf0 Parameter a_{f0-n}, SV clock bias correction coefficient (seconds) [4,5,6,7]. Scale factor 2^{-35} seconds.
cnavTgd Parameter T_{GD}, Group delay correction (seconds) [4,5,6,7]. Scale factor 2^{-35} seconds.
cnavISCl1cp Parameter ISC_{L1CP}, inter signal group delay correction (seconds) [6,7]. Scale factor 2^{-35} seconds.
cnavISCl1cd Parameter ISC_{L1CD}, inter signal group delay correction (seconds) [6,7]. Scale factor 2^{-35} seconds.
cnavISCl1ca Parameter $ISC_{L1C/A}$, inter signal group delay correction (seconds) [4,5,7]. Scale factor 2^{-35} seconds.
cnavISCl2c Parameter ISC_{L2C}, inter signal group delay correction (seconds) [4,5,7]. Scale factor 2^{-35} seconds.
cnavISCl5i5 Parameter ISC_{L5I5}, inter signal group delay correction (seconds) [5,7]. Scale factor 2^{-35} seconds.
cnavISCl5q5 Parameter ISC_{L5Q5}, inter signal group delay correction (seconds) [5,7]. Scale factor 2^{-35} seconds.

– GLONASS-ClockModel

```
-- ASN1START

GLONASS-ClockModel ::= SEQUENCE {
    gloTau          INTEGER (-2097152..2097151),
    gloGamma        INTEGER (-1024..1023),
    gloDeltaTau     INTEGER (-16..15)               OPTIONAL,
    ...
}

-- ASN1STOP
```

***GLONASS-ClockModel* field descriptions**
gloTau Parameter $\tau_n(t_b)$, satellite clock offset (seconds) [9]. Scale factor 2^{-30} seconds.
gloGamma Parameter $\gamma_n(t_b)$, relative frequency offset from nominal value (dimensionless) [9]. Scale factor 2^{-40}.
gloDeltaTau Parameter $\Delta\tau_n$, time difference between transmission in G2 and G1 (seconds) [9]. Scale factor 2^{-30} seconds.

– SBAS-ClockModel

```
-- ASN1START

SBAS-ClockModel ::= SEQUENCE {
    sbasTo          INTEGER (0..5399),
    sbasAgfo        INTEGER (-2048..2047),
    sbasAgf1        INTEGER (-128..127),
    ...
}

-- ASN1STOP
```

***SBAS-ClockModel* field descriptions**
sbasTo Parameter t_0 [10]. Scale factor 16 seconds.
sbasAgfo Parameter a_{Gfo} [10]. Scale factor 2^{-31} seconds.
sbasAgf1 Parameter a_{Gf1} [10]. Scale factor 2^{-40} seconds/second.

– NavModelKeplerianSet

```
-- ASN1START

NavModelKeplerianSet ::= SEQUENCE {
    keplerToe        INTEGER (0 .. 16383),
    keplerW          INTEGER (-2147483648..2147483647),
    keplerDeltaN     INTEGER (-32768..32767),
    keplerM0         INTEGER (-2147483648..2147483647),
    keplerOmegaDot   INTEGER (degreesMaximumNegative..degreesMaximum),
    keplerE          INTEGER (0..4294967295),
    keplerIDot       INTEGER (-8192..8191),
    keplerAPowerHalf INTEGER (0.. 4294967295),
    keplerI0         INTEGER (-2147483648..2147483647),
    keplerOmega0     INTEGER (-2147483648..2147483647),
    keplerCrs        INTEGER (-32768..32767),
    keplerCis        INTEGER (-32768..32767),
    keplerCus        INTEGER (-32768..32767),
    keplerCrc        INTEGER (-32768..32767),
    keplerCic        INTEGER (-32768..32767),
    keplerCuc        INTEGER (-32768..32767),
    ...
}

-- ASN1STOP
```

***NavModelKeplerianSet* field descriptions**
keplerToe Parameter t_{oe}, time-of-ephemeris in seconds [8]. Scale factor 60 seconds.

***NavModelKeplerianSet* field descriptions**
keplerW Parameter ω, argument of perigee (semi-circles) [8]. Scale factor 2^{-31} semi-circles.
keplerDeltaN Parameter Δn, mean motion difference from computed value (semi-circles/sec) [8]. Scale factor 2^{-43} semi-circles/second.
keplerM0 Parameter M_0, mean anomaly at reference time (semi-circles) [8]. Scale factor 2^{-31} semi-circles.
keplerOmegaDot Parameter OMEGAdot, longitude of ascending node of orbit plane at weekly epoch (semi-circles/sec) [8]. Scale factor 2^{-43} semi-circles/second.
keplerE Parameter e, eccentricity [8]. Scale factor 2^{-33}.
KeplerIDot Parameter Idot, rate of inclination angle (semi-circles/sec) [8]. Scale factor 2^{-43} semi-circles/second.
keplerAPowerHalf Parameter sqrtA, semi-major Axis in $(\text{meters})^{½}$ [8]. Scale factor 2^{-19} $\text{meters}^{½}$.
keplerI0 Parameter i_0, inclination angle at reference time (semi-circles) [8]. Scale factor 2^{-31} semi-circles.
keplerOmega0 Parameter $OMEGA_0$, longitude of ascending node of orbit plane at weekly epoch (semi-circles) [8]. Scale factor 2^{-31} semi-circles.
keplerCrs Parameter C_{rs}, amplitude of the sine harmonic correction term to the orbit radius (meters) [8]. Scale factor 2^{-5} meters.
keplerCis Parameter C_{is}, amplitude of the sine harmonic correction term to the angle of inclination (radians) [8]. Scale factor 2^{-29} radians.
keplerCus Parameter C_{us}, amplitude of the sine harmonic correction term to the argument of latitude (radians) [8]. Scale factor 2^{-29} radians.
keplerCrc Parameter C_{rc}, amplitude of the cosine harmonic correction term to the orbit radius (meters) [8]. Scale factor 2^{-5} meters.
keplerCic Parameter C_{ic}, amplitude of the cosine harmonic correction term to the angle of inclination (radians) [8]. Scale factor 2^{-29} radians.
keplerCuc Parameter C_{uc}, amplitude of the cosine harmonic correction term to the argument of latitude (radians) [8]. Scale factor 2^{-29} radians.

– NavModelNAV-KeplerianSet

```
-- ASN1START

NavModelNAV-KeplerianSet ::= SEQUENCE {
    navURA          INTEGER (0..15),
    navFitFlag      INTEGER (0..1),
    navToe          INTEGER (0..37799),
    navOmega        INTEGER (-2147483648..2147483647),
    navDeltaN       INTEGER (-32768..32767),
    navM0           INTEGER (-2147483648..2147483647),
    navOmegaADot    INTEGER (degreesMaximumNegative..degreesMaximum),
    navE            INTEGER (0..4294967295),
    navIDot         INTEGER (-8192..8191),
    navAPowerHalf   INTEGER (0..4294967295),
    navI0           INTEGER (-2147483648..2147483647),
    navOmegaA0      INTEGER (-2147483648..2147483647),
    navCrs          INTEGER (-32768..32767),
    navCis          INTEGER (-32768..32767),
    navCus          INTEGER (-32768..32767),
```

```
    navCrc          INTEGER (-32768..32767),
    navCic          INTEGER (-32768..32767),
    navCuc          INTEGER (-32768..32767),
    addNAVparam     SEQUENCE {
        ephemCodeOnL2   INTEGER (0..3),
        ephemL2Pflag    INTEGER (0..1),
        ephemSF1Rsvd    SEQUENCE {
            reserved1       INTEGER (0..degreesMaximum),    -- 23-bit field
            reserved2       INTEGER (0..16777215),  -- 24-bit field
            reserved3       INTEGER (0..16777215),  -- 24-bit field
            reserved4       INTEGER (0..65535)      -- 16-bit field
        },
        ephemAODA       INTEGER (0..31)
    }   OPTIONAL,
    ...
}

-- ASN1STOP
```

***NavModelNAV-KeplerianSet* field descriptions**
navURA Parameter URA Index, SV accuracy (dimensionless) [4,7].
navFitFlag Parameter Fit Interval Flag, fit interval indication (dimensionless) [4,7]
navToe Parameter t_{oe}, time of ephemeris (seconds) [4,7]. Scale factor 2^4 seconds.
navOmega Parameter ω, argument of perigee (semi-circles) [4,7]. Scale factor 2^{-31} semi-circles.
navDeltaN Parameter Δn, mean motion difference from computed value (semi-circles/sec) [4,7]. Scale factor 2^{-43} semi-circles/second.
navM0 Parameter M_0, mean anomaly at reference time (semi-circles) [4,7]. Scale factor 2^{-31} semi-circles.
navOmegaADot Parameter $\dot{\Omega}$, rate of right ascension (semi-circles/sec) [4,7]. Scale factor 2^{-43} semi-circles/second.
navE Parameter e, eccentricity (dimensionless) [4,7]. Scale factor 2^{-33}.
navIDot Parameter IDOT, rate of inclination angle (semi-circles/sec) [4,7]. Scale factor 2^{-43} semi-circles/second.
navAPowerHalf Parameter $\sqrt{A}$, square root of semi-major axis (meters$^{1/2}$) [4,7]. Scale factor 2^{-19} meters ^{½} .
navI0 Parameter i_0, inclination angle at reference time (semi-circles) [4,7]. Scale factor 2^{-31} semi-circles.
navOmegaA0 Parameter Ω_0, longitude of ascending node of orbit plane at weekly epoch (semi-circles) [4,7]. Scale factor 2^{-31} semi-circles.
navCrs Parameter C_{rs}, amplitude of sine harmonic correction term to the orbit radius (meters) [4,7]. Scale factor 2^{-5} meters.
navCis Parameter C_{is}, amplitude of sine harmonic correction term to the angle of inclination (radians) [4,7]. Scale factor 2^{-29} radians.
navCus Parameter C_{us}, amplitude of sine harmonic correction term to the argument of latitude (radians) [4,7]. Scale factor 2^{-29} radians.
navCrc Parameter C_{rc}, amplitude of cosine harmonic correction term to the orbit radius (meters) [4,7]. Scale factor 2^{-5} meters.

***NavModelNAV-KeplerianSet* field descriptions**
navCic Parameter C_{ic}, amplitude of cosine harmonic correction term to the angle of inclination (radians) [4,7]. Scale factor 2^{-29} radians.
navCuc Parameter C_{uc}, amplitude of cosine harmonic correction term to the argument of latitude (radians) [4,7]. Scale factor 2^{-29} radians.
addNAVparam These fields include data and reserved bits in the GPS NAV message [4,14].

– NavModelCNAV-KeplerianSet

```
-- ASN1START

NavModelCNAV-KeplerianSet ::= SEQUENCE {
    cnavTop             INTEGER (0..2015),
    cnavURAindex        INTEGER (-16..15),
    cnavDeltaA          INTEGER (-33554432..33554431),
    cnavAdot            INTEGER (-16777216..16777215),
    cnavDeltaNo         INTEGER (-65536..65535),
    cnavDeltaNoDot      INTEGER (-4194304..4194303),
    cnavMo              INTEGER (-4294967296..4294967295),
    cnavE               INTEGER (0..8589934591),
    cnavOmega           INTEGER (-4294967296..4294967295),
    cnavOMEGA0          INTEGER (-4294967296..4294967295),
    cnavDeltaOmegaDot   INTEGER (-65536..65535),
    cnavIo              INTEGER (-4294967296..4294967295),
    cnavIoDot           INTEGER (-16384..16383),
    cnavCis             INTEGER (-32768..32767),
    cnavCic             INTEGER (-32768..32767),
    cnavCrs             INTEGER (degreesMaximumNegative..degreesMaximum),
    cnavCrc             INTEGER (degreesMaximumNegative..degreesMaximum),
    cnavCus             INTEGER (-1048576..1048575),
    cnavCuc             INTEGER (-1048576..1048575),
    ...
}

-- ASN1STOP
```

***NavModelCNAV-KeplerianSet* field descriptions**
cnavTop Parameter t_{op}, data predict time of week (seconds) [4,5,6,7]. Scale factor 300 seconds.
cnavURAindex Parameter URA_{oe} Index, SV accuracy (dimensionless) [4,5,6,7].
cnavDeltaA Parameter ΔA, semi-major axis difference at reference time (meters) [4,5,6,7]. Scale factor 2^{-9} meters.
cnavAdot Parameter $\dot{A}$, change rate in semi-major axis (meters/sec) [4,5,6,7]. Scale factor 2^{-21} meters/sec.
cnavDeltaNo Parameter Δn_0, mean motion difference from computed value at reference time (semi-circles/sec) [4,5,6,7]. Scale factor 2^{-44} semi-circles/second.
cnavDeltaNoDot Parameter $\Delta\dot{n}_0$, rate of mean motion difference from computed value (semi-circles/sec^2) [4,5,6,7]. Scale factor 2^{-57} semi-circles/second^2.
cnavMo Parameter M_{0-n}, mean anomaly at reference time (semi-circles) [4,5,6,7]. Scale factor 2^{-32} semi-circles.
cnavE Parameter e_n, eccentricity (dimensionless) [4,5,6,7]. Scale factor 2^{-34}.
cnavOmega Parameter ω_n, argument of perigee (semi-circles) [4,5,6,7]. Scale factor 2^{-32} semi-circles.

***NavModelCNAV-KeplerianSet* field descriptions**
cnavOMEGA0 Parameter Ω_{0-n}, reference right ascension angle (semi-circles) [4,5,6,7]. Scale factor 2^{-32} semi-circles.
cnavDeltaOmegaDot Parameter $\Delta\dot{\Omega}$, rate of right ascension difference (semi-circles/sec) [4,5,6,7]. Scale factor 2^{-44} semi-circles/second.
cnavIo Parameter i_{o-n}, inclination angle at reference time (semi-circles) [4,5,6,7]. Scale factor 2^{-32} semi-circles.
cnavIoDot Parameter I_{0-n}-DOT, rate of inclination angle (semi-circles/sec) [4,5,6,7]. Scale factor 2^{-44} semi-circles/second..
cnavCis Parameter C_{is-n}, amplitude of sine harmonic correction term to the angle of inclination (radians) [4,5,6,7]. Scale factor 2^{-30} radians.
cnavCic Parameter C_{ic-n}, amplitude of cosine harmonic correction term to the angle of inclination (radians) [4,5,6,7]. Scale factor 2^{-30} radians.
cnavCrs Parameter C_{rs-n}, amplitude of sine harmonic correction term to the orbit radius (meters) [4,5,6,7]. Scale factor 2^{-8} meters.
cnavCrc Parameter C_{rc-n}, amplitude of cosine harmonic correction term to the orbit radius (meters) [4,5,6,7]. Scale factor 2^{-8} meters.
cnavCus Parameter C_{us-n}, amplitude of the sine harmonic correction term to the argument of latitude (radians) [4,5,6,7]. Scale factor 2^{-30} radians.
cnavCuc Parameter C_{uc-n}, amplitude of cosine harmonic correction term to the argument of latitude (radians) [4,5,6,7]. Scale factor 2^{-30} radians.

– NavModel-GLONASS-ECEF

```
-- ASN1START

NavModel-GLONASS-ECEF ::= SEQUENCE {
    gloEn               INTEGER (0..31),
    gloP1               BIT STRING (SIZE(2)),
    gloP2               BOOLEAN,
    gloM                INTEGER (0..3),
    gloX                INTEGER (-67108864..67108863),
    gloXdot             INTEGER (degreesMaximumNegative..degreesMaximum),
    gloXdotdot          INTEGER (-16..15),
    gloY                INTEGER (-67108864..67108863),
    gloYdot             INTEGER (degreesMaximumNegative..degreesMaximum),
    gloYdotdot          INTEGER (-16..15),
    gloZ                INTEGER (-67108864..67108863),
    gloZdot             INTEGER (degreesMaximumNegative..degreesMaximum),
    gloZdotdot          INTEGER (-16..15),
    ...
}

-- ASN1STOP
```

***NavModel-GLONASS-ECEF* field descriptions**
gloEn Parameter E_n, age of data (days) [9]. Scale factor 1 days.
gloP1 Parameter P1, time interval between two adjacent values of t_b (minutes) [9].
gloP2 Parameter P2, change of t_b flag (dimensionless) [9].
gloM Parameter M, type of satellite (dimensionless) [9].

***NavModel-GLONASS-ECEF* field descriptions**
gloX Parameter $x_n(t_b)$, x-coordinate of satellite at time t_b (kilometers) [9]. Scale factor 2^{-11} kilometers.
gloXdot Parameter $\dot{x}_n(t_b)$, x-coordinate of satellite velocity at time t_b (kilometers/sec) [9]. Scale factor 2^{-20} kilometers/second.
gloXdotdot Parameter $\ddot{x}_n(t_b)$, x-coordinate of satellite acceleration at time t_b (kilometers/sec^2) [9]. Scale factor 2^{-30} kilometers/second^2.
gloY Parameter $y_n(t_b)$, y-coordinate of satellite at time t_b (kilometers) [9]. Scale factor 2^{-11} kilometers.
gloYdot Parameter $\dot{y}_n(t_b)$, y-coordinate of satellite velocity at time t_b (kilometers/sec) [9]. Scale factor 2^{-20} kilometers/second.
gloYdotdot Parameter $\ddot{y}_n(t_b)$, y-coordinate of satellite acceleration at time t_b (kilometers/sec^2) [9]. Scale factor 2^{-30} kilometers/second^2.
gloZ Parameter $z_n(t_b)$, z-coordinate of satellite at time t_b (kilometers) [9]. Scale factor 2^{-11} kilometers.
gloZdot Parameter $\dot{z}_n(t_b)$, z-coordinate of satellite velocity at time t_b (kilometers/sec) [9]. Scale factor 2^{-20} kilometers/second.
gloZdotdot Parameter $\ddot{z}_n(t_b)$, z-coordinate of satellite acceleration at time t_b (kilometers/sec^2) [9]. Scale factor 2^{-30} kilometers/second^2.

– NavModel-SBAS-ECEF

```
-- ASN1START

NavModel-SBAS-ECEF ::= SEQUENCE {
    sbasTo              INTEGER (0..5399)                   OPTIONAL,   -- Cond ClockModel
    sbasAccuracy        BIT STRING (SIZE(4)),
    sbasXg              INTEGER (-536870912..536870911),
    sbasYg              INTEGER (-536870912..536870911),
    sbasZg              INTEGER (-16777216..16777215),
    sbasXgDot           INTEGER (-65536..65535),
    sbasYgDot           INTEGER (-65536..65535),
    sbasZgDot           INTEGER (-131072..131071),
    sbasXgDotDot        INTEGER (-512..511),
    sbagYgDotDot        INTEGER (-512..511),
    sbasZgDotDot        INTEGER (-512..511),
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
ClockModel	This field is mandatory present if *gnss-ClockModel* Model-5 is not included; otherwise it is not present.

***NavModel-SBAS-ECEF* field descriptions**
sbasTo Parameter t_0, time of applicability (seconds) [10]. Scale factor 16 seconds.
sbasAccuracy Parameter Accuracy, (dimensionless) [10].

***NavModel-SBAS-ECEF* field descriptions**
sbasXg Parameter X_G, (meters) [10]. Scale factor 0.08 meters.
sbasYg Parameter Y_G, (meters) [10]. Scale factor 0.08 meters.
sbasZg Parameter Z_G, (meters) [10]. Scale factor 0.4 meters.
sbasXgDot Parameter X_G , Rate-of-Change, (meters/sec) [10]. Scale factor 0.000625 meters/second.
sbasYgDot Parameter Y_G , Rate-of-Change, (meters/sec) [10] Scale factor 0.000625 meters/second.
sbasZgDot Parameter Z_G , Rate-of-Change, (meters/sec) [10]. Scale factor 0.004 meters/second.
sbasXgDotDot Parameter X_G , Acceleration, (meters/sec^2) [10]. Scale factor 0.0000125 meters/second^2.
sbagYgDotDot Parameter Y_G , Acceleration, (meters/sec^2) [10]. Scale factor 0.0000125 meters/second^2.
sbasZgDotDot Parameter Z_G Acceleration, (meters/sec^2) [10]. Scale factor 0.0000625 meters/second^2.

– GNSS-RealTimeIntegrity

The IE *GNSS-RealTimeIntegrity* is used by the location server to provide parameters that describe the real-time status of the GNSS constellations. *GNSS-RealTimeIntegrity* data communicates the health of the GNSS signals to the mobile in real-time.

The location server shall always transmit the *GNSS-RealTimeIntegrity* with the current list of unhealthy signals (i.e., not only for signals/SVs currently visible at the reference location), for any GNSS positioning attempt and whenever GNSS assistance data are sent. If the number of bad signals is zero, then the *GNSS-RealTimeIntegrity* IE shall be omitted.

```
-- ASN1START

GNSS-RealTimeIntegrity ::= SEQUENCE {
    gnss-BadSignalList  GNSS-BadSignalList,
    ...
}

GNSS-BadSignalList ::= SEQUENCE (SIZE(1..64)) OF BadSignalElement

BadSignalElement ::= SEQUENCE {
    badSVID             SV-ID,
    badSignalID         GNSS-SignalIDs  OPTIONAL,
    ...
}

-- ASN1STOP
```

***GNSS-RealTimeIntegrity* field descriptions**
gnss-BadSignalList This field specifies a list of satellites with bad signal or signals.
badSVID This field specifies the GNSS *SV-ID* of the satellite with bad signal or signals.
badSignalID This field identifies the bad signal or signals of a satellite. This is represented by a bit string in *GNSS-SignalIDs*, with a one-value at a bit position means the particular GNSS signal type of the SV is unhealthy; a zero-value means healthy. Absence of this field means that all signals on the specific SV are bad.

– GNSS-DataBitAssistance

The IE *GNSS-DataBitAssistance* is used by the location server to provide data bit assistance data for specific satellite signals for data wipe-off. The data bits included in the assistance data depends on the GNSS and its signal.

```
-- ASN1START

GNSS-DataBitAssistance ::= SEQUENCE {
    gnss-TOD                INTEGER (0..3599),
    gnss-TODfrac            INTEGER (0..999)        OPTIONAL,
    gnss-DataBitsSatList    GNSS-DataBitsSatList,
    ...
}

GNSS-DataBitsSatList ::= SEQUENCE (SIZE(1..64))OF GNSS-DataBitsSatElement

GNSS-DataBitsSatElement ::= SEQUENCE {
    svID                    SV-ID,
    gnss-DataBitsSgnList    GNSS-DataBitsSgnList,
    ...
}

GNSS-DataBitsSgnList ::= SEQUENCE (SIZE(1..8)) OF GNSS-DataBitsSgnElement

GNSS-DataBitsSgnElement ::= SEQUENCE {
    gnss-SignalType         GNSS-SignalID,
    gnss-DataBits           BIT STRING (SIZE (1..1024)),
    ...
}

-- ASN1STOP
```

***GNSS-DataBitAssistance* field descriptions**
gnss-TOD This field specifies the reference time of the first bit of the data in *GNSS-DataBitAssistance* in integer seconds in GNSS specific system time, modulo 1 hour. Scale factor 1 second.
gnss-TODfrac This field specifies the fractional part of the *gnss-TOD* in 1-milli-second resolution. Scale factor 1 millisecond. The total GNSS TOD is *gnss-TOD* + *gnss-TODfrac.*
gnss-DataBitsSatList This list specifies the data bits for a particular GNSS satellite *SV-ID* and signal *GNSS-SignalID*.
svID This field specifies the GNSS *SV-ID* of the satellite for which the *GNSS-DataBitAssistance* is given.
gnss-SignalType This field identifies the GNSS signal type of the *GNSS-DataBitAssistance.*
gnss-DataBits Data bits are contained in GNSS system and data type specific format. In case of GPS L1 C/A, it contains the NAV data modulation bits as defined in [4] . In case of Modernized GPS L1C, it contains the encoded and interleaved modulation symbols as defined in [6] section 3.2.3.1. In case of Modernized GPS L2C, it contains either the NAV data modulation bits, the FEC encoded NAV data modulation symbols, or the FEC encoded CNAV data modulation symbols, dependent on the current signal configuration of this satellite as defined in [4, Table 3-III]. In case of Modernized GPS L5, it contains the FEC encoded CNAV data modulation symbols as defined in [5]. In case of SBAS, it contains the FEC encoded data modulation symbols as defined in [10]. In case of QZSS QZS-L1, it contains the NAV data modulation bits as defined in [7] section 5.2. In case of QZSS QZS-L1C, it contains the encoded and interleaved modulation symbols as defined in [7] section 5.3. In case of QZSS QZS-L2C, it contains the encoded modulation symbols as defined in [7] section 5.5. In case of QZSS QZS-L5, it contains the encoded modulation symbols as defined in [7] section 5.6. In case of GLONASS, it contains the 100 sps differentially Manchester encoded modulation symbols as defined in [9] section 3.3.2.2. In case of Galileo, it contains the FEC encoded and interleaved modulation symbols. The logical levels 1 and 0 correspond to signal levels -1 and +1, respectively.

– GNSS-AcquisitionAssistance

The IE *GNSS-AcquisitionAssistance* is used by the location server to provide parameters that enable fast acquisition of the GNSS signals. Essentially, these parameters describe the range and derivatives from respective satellites to the reference location at the reference time *GNSS-SystemTime* provided in IE *GNSS-ReferenceTime*.

Whenever *GNSS-AcquisitionAssistance* is provided by the location server, the IE *GNSS-ReferenceTime* shall be provided as well. E.g., even if the target device request for assistance data includes only a request for *GNSS-AcquisitionAssistance,* the location server shall also provide the corresponding IE *GNSS-ReferenceTime.*

Figure 6.5.2.2-1 illustrates the relation between some of the fields, using GPS TOW as exemplary reference.

```
-- ASN1START

GNSS-AcquisitionAssistance ::= SEQUENCE {
    gnss-SignalID               GNSS-SignalID,
    gnss-AcquisitionAssistList  GNSS-AcquisitionAssistList,
    ...
}

GNSS-AcquisitionAssistList ::= SEQUENCE (SIZE(1..64)) OF GNSS-AcquisitionAssistElement

GNSS-AcquisitionAssistElement  ::= SEQUENCE {
    svID                        SV-ID,
    doppler0                    INTEGER (-2048..2047),
    doppler1                    INTEGER (0..63),
    dopplerUncertainty          INTEGER (0..4),
    codePhase                   INTEGER (0..1022),
    intCodePhase                INTEGER (0..127),
    codePhaseSearchWindow       INTEGER (0..31),
    azimuth                     INTEGER (0..511),
    elevation                   INTEGER (0..127),
    ...
}

-- ASN1STOP
```

***GNSS-AcquisitionAssistance* field descriptions**
gnss-SignalID This field specifies the GNSS signal for which the acquisition assistance are provided.
gnss-AcquisitionAssistList These fields provide a list of acquisition assistance data for each GNSS satellite.
svID This field specifies the GNSS *SV-ID* of the satellite for which the *GNSS-AcquisitionAssistance* is given.
doppler0 This field specifies the Doppler (0^{th} order term) value. A positive value in Doppler defines the increase in satellite signal frequency due to velocity towards the target device. A negative value in Doppler defines the decrease in satellite signal frequency due to velocity away from the target device. Doppler is given in unit of m/s by multiplying the Doppler value in Hz by the nominal wavelength of the assisted signal. Scale factor 0.5 m/s in the range from -1024 m/s to +1023.5 m/s.
doppler1 This field specifies the Doppler (1^{st} order term) value. A positive value defines the rate of increase in satellite signal frequency due to acceleration towards the target device. A negative value defines the rate of decrease in satellite signal frequency due to acceleration away from the target device. Scale factor 1/210 m/s^2 in the range from -0.2 m/s^2 to +0.1 m/s^2.
dopplerUncertainty This field specifies the Doppler uncertainty value. It is defined such that the Doppler experienced by a stationary target device is in the range [Doppler–Doppler Uncertainty] to [Doppler+Doppler Uncertainty]. Doppler Uncertainty is given in unit of m/s by multiplying the Doppler Uncertainty value in Hz by the nominal wavelength of the assisted signal. Defined values: 2.5 m/s, 5 m/s, 10 m/s, 20 m/s, 40 m/s as encoded by an integer *n* in the range 0-4 according to: $2^{-n}(40)$ m/s; n = 0 – 4.
codePhase This field specifies the code phase, in units of milli-seconds, in the range from 0 to 1 millisecond scaled by the nominal chipping rate of the GNSS signal, where increasing values of the field signify increasing predicted signal code phases, as seen by a receiver at the reference location at the reference time. The reference location would typically be an apriori estimate of the target device location. Scale factor 2^{-10} ms in the range from 0 to $(1-2^{-10})$ ms.

***GNSS-AcquisitionAssistance* field descriptions**
intCodePhase This field contains integer code phase (expressed modulo 128 ms) currently being transmitted at the reference time, as seen by a receiver at the reference location. Scale factor 1 ms in the range from 0 to 127 ms.
codePhaseSearchWindow This field contains the code phase search window. The code phase search window accounts for the uncertainty in the estimated target device location but not any uncertainty in reference time. It is defined such that the expected code phase is in the range [Code Phase−Code Phase Search Window] to [Code Phase+Code Phase Search Window] given in units of milli-seconds. Range 0-31, mapping according to the table codePhaseSearchWindow Value to Interpretation Code Phase Search Window [ms] relation shown below.
azimuth This field specifies the azimuth angle. An angle of x degrees means the satellite azimuth a is in the range ($x \le a < x+0.703125$) degrees. Scale factor 0.703125 degrees.
elevation This field specifies the elevation angle. An angle of y degrees means the satellite elevation e is in the range ($y \le e < y+0.703125$) degrees. Scale factor 0.703125 degrees.

codePhaseSearchWindow Value to Interpretation Code Phase Search Window [ms] relation

codePhaseSearchWindow Value	Interpretation Code Phase Search Window [ms]
'00000'	No information
'00001'	0,002
'00010'	0,004
'00011'	0,008
'00100'	0,012
'00101'	0,016
'00110'	0,024
'00111'	0,032
'01000'	0,048
'01001'	0,064
'01010'	0,096
'01011'	0,128
'01100'	0,164
'01101'	0,200
'01110'	0,250
'01111'	0,300
'10000'	0,360
'10001'	0,420
'10010'	0,480
'10011'	0,540
'10100'	0,600
'10101'	0,660
'10110'	0,720
'10111'	0,780
'11000'	0,850
'11001'	1,000
'11010'	1,150
'11011'	1,300
'11100'	1,450
'11101'	1,600
'11110'	1,800
'11111'	2,000

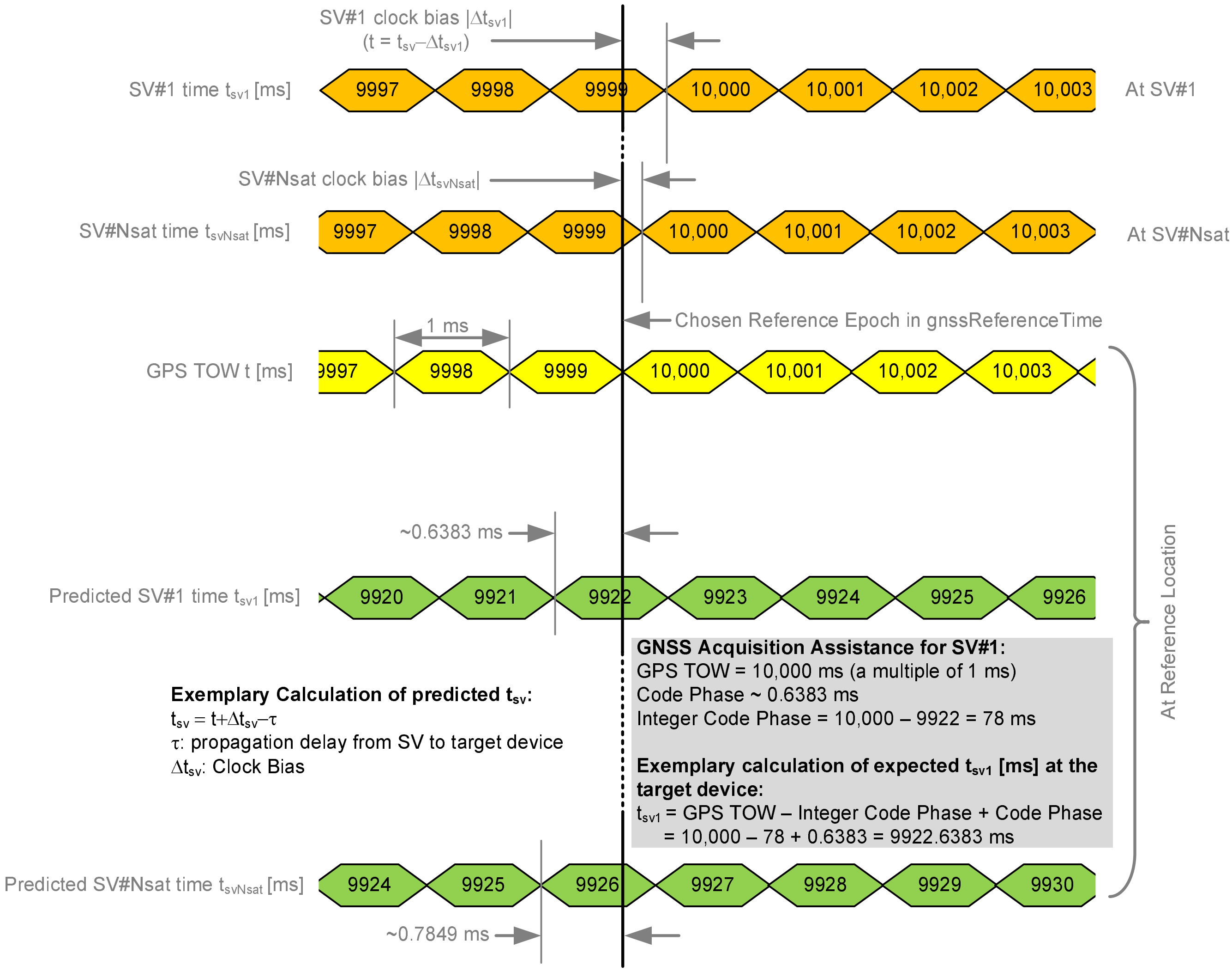

Figure 6.5.2.2-1: Exemplary calculation of some GNSS Acquisition Assistance fields.

– GNSS-Almanac

The IE *GNSS-Almanac* is used by the location server to provide the coarse, long-term model of the satellite positions and clocks. The meaning of these parameters is defined in relevant ICDs of the particular GNSS and GNSS specific interpretations apply. For example, GPS and QZSS use the same model parameters but some parameters have a different interpretation [7]. *GNSS-Almanac* is useful for receiver tasks that require coarse accuracy, such as determining satellite visibility. The model is valid for up to a few weeks, typically. Since it is a long-term model, the field should be provided for all satellites available in the GNSS constellation (i.e., not only for SVs visible at the reference location and including SVs flagged as unhealthy in almanac). The *completeAlmanacProvided* field indicates whether or not the location server provided almanacs for the complete GNSS constellation.

```
-- ASN1START

GNSS-Almanac ::= SEQUENCE {
    weekNumber                  INTEGER (0..255)    OPTIONAL,
    toa                         INTEGER (0..255)    OPTIONAL,
    ioda                        INTEGER (0..3)      OPTIONAL,
    completeAlmanacProvided     BOOLEAN,
    gnss-AlmanacList            GNSS-AlmanacList,
    ...
}

GNSS-AlmanacList ::= SEQUENCE (SIZE(1..64)) OF GNSS-AlmanacElement

GNSS-AlmanacElement ::= CHOICE {
    keplerianAlmanacSet     AlmanacKeplerianSet,        -- Model-1
    keplerianNAV-Almanac    AlmanacNAV-KeplerianSet,    -- Model-2
```

```
    keplerianReducedAlmanac AlmanacReducedKeplerianSet, -- Model-3
    keplerianMidiAlmanac    AlmanacMidiAlmanacSet,      -- Model-4
    keplerianGLONASS        AlmanacGLONASS-AlmanacSet,  -- Model-5
    ecef-SBAS-Almanac       AlmanacECEF-SBAS-AlmanacSet,-- Model-6
    ...
}

-- ASN1STOP
```

***GNSS-Almanac* field descriptions**
weekNumber This field specifies the almanac reference week number in GNSS specific system time to which the almanac reference time *toa* is referenced, modulo 256 weeks.
toa This field specifies the almanac reference time given in GNSS specific system time, in units of seconds with a scale factor of 212.
ioda This field specifies the issue of data.
completeAlmanacProvided If set to TRUE, the *gnss-AlmanacList* contains almanacs for the complete GNSS constellation indicated by *GNSS-ID*.
gnss-AlmanacList This list contains the almanac model for each GNSS satellite in the GNSS constellation.

– AlmanacKeplerianSet

```
-- ASN1START

AlmanacKeplerianSet ::= SEQUENCE {
    svID                    SV-ID,
    kepAlmanacE             INTEGER (0..2047),
    kepAlmanacDeltaI        INTEGER (-1024..1023),
    kepAlmanacOmegaDot      INTEGER (-1024..1023),
    kepSVHealth             INTEGER (0..15),
    kepAlmanacAPowerHalf    INTEGER (-65536..65535),
    kepAlmanacOmega0        INTEGER (-32768..32767),
    kepAlmanacW             INTEGER (-32768..32767),
    kepAlmanacM0            INTEGER (-32768..32767),
    kepAlmanacAF0           INTEGER (-8192..8191),
    kepAlmanacAF1           INTEGER (-1024..1023),
    ...
}

-- ASN1STOP
```

***AlmanacKeplerianSet* field descriptions**
svID This field identifies the satellite for which the GNSS Almanac Model is given.
kepAlmanacE Parameter e, eccentricity, dimensionless [8]. Scale factor 2^{-16}.
kepAlmanacDeltaI Parameter δi, semi-circles [8]. Scale factor 2^{-14} semi-circles.
kepAlmanacOmegaDot Parameter OMEGADOT, longitude of ascending node of orbit plane at weekly epoch (semi-circles/sec) [8]. Scale factor 2^{-33} semi-circles/seconds.
kepSVHealth Parameter SV Health KP, dimensionless. This field specifies the SV Health status in GNSS almanac model using Keplerian parameters. In Galileo case this field shall contain the I/NAV health status bits [8].
kepAlmanacAPowerHalf Parameter delta $A^{1/2}$, Semi-Major Axis delta $(\text{meters})^{1/2}$ [8]. Scale factor 2^{-9} meters ^{½} .
kepAlmanacOmega0 Parameter $OMEGA_0$, longitude of ascending node of orbit plane at weekly epoch (semi-circles) [8]. Scale factor 2^{-15} semi-circles.

***AlmanacKeplerianSet* field descriptions**
kepAlmanacW Parameter ω, argument of perigee (semi-circles) [8]. Scale factor 2^{-15} semi-circles.
kepAlmanacM0 Parameter M_0, mean anomaly at reference time (semi-circles) [8]. Scale factor 2^{-15} semi-circles.
kepAlmanacAF0 Parameter af_0, seconds [8]. Scale factor 2^{-19} seconds.
kepAlmanacAF1 Parameter af_1, sec/sec [8]. Scale factor 2^{-38} seconds/second.

– AlmanacNAV-KeplerianSet

```
-- ASN1START

AlmanacNAV-KeplerianSet ::= SEQUENCE {
    svID                    SV-ID,
    navAlmE                 INTEGER (0..65535),
    navAlmDeltaI            INTEGER (-32768..32767),
    navAlmOMEGADOT          INTEGER (-32768..32767),
    navAlmSVHealth          INTEGER (0..255),
    navAlmSqrtA             INTEGER (0..16777215),
    navAlmOMEGAo            INTEGER (degreesMaximumNegative..degreesMaximum),
    navAlmOmega             INTEGER (degreesMaximumNegative..degreesMaximum),
    navAlmMo                INTEGER (degreesMaximumNegative..degreesMaximum),
    navAlmaf0               INTEGER (-1024..1023),
    navAlmaf1               INTEGER (-1024..1023),
    ...
}

-- ASN1STOP
```

***AlmanacNAV-KeplerianSet* field descriptions**
svID This field identifies the satellite for which the GNSS Almanac Model is given.
navAlmE Parameter e, eccentricity, dimensionless [4,7]. Scale factor 2^{-21}.
navAlmDeltaI Parameter δi, correction to inclination, semi-circles [4,7]. Scale factor 2^{-19} semi-circles.
navAlmOMEGADOT Parameter $\dot{\Omega}$, rate of right ascension, semi-circles/sec [4,7]. Scale factor 2^{-38} semi-circles/second.
navAlmSVHealth Parameter SV Health, satellite health [4,7].
navAlmSqrtA Parameter $\sqrt{A}$, square root of the semi-major axis, $meters^{1/2}$ [4,7] Scale factor 2^{-11} $meters^{1/2}$.
navAlmOMEGAo Parameter Ω_0, longitude of ascending node of orbit plane at weekly epoch, semi-circles [4,7]. Scale factor 2^{-23} semi-circles.
navAlmOmega Parameter ω, argument of perigee semi-circles [4,7]. Scale factor 2^{-23} semi-circles.
navAlmMo Parameter M_0, mean anomaly at reference time semi-circles [4,7]. Scale factor 2^{-23} semi-circles.
navAlmaf0 Parameter a_{f0}, apparent satellite clock correction seconds [4,7]. Scale factor 2^{-20} seconds.
navAlmaf1 Parameter a_{f1}, apparent satellite clock correction sec/sec [4,7]. Scale factor 2^{-38} semi-circles seconds/second.

– AlmanacReducedKeplerianSet

```
-- ASN1START

AlmanacReducedKeplerianSet ::= SEQUENCE {
    svID                     SV-ID,
    redAlmDeltaA             INTEGER (-128..127),
    redAlmOmega0             INTEGER (-64..63),
    redAlmPhi0               INTEGER (-64..63),
    redAlmL1Health           BOOLEAN,
    redAlmL2Health           BOOLEAN,
    redAlmL5Health           BOOLEAN,
    ...
}

-- ASN1STOP
```

***AlmanacReducedKeplerianSet* field descriptions**
svID This field identifies the satellite for which the GNSS Almanac Model is given.
redAlmDeltaA Parameter δ_A, meters [4,5,6,7]. Scale factor 2^{+9} meters.
redAlmOmega0 Parameter Ω_0, semi-circles [4,5,6,7]. Scale factor 2^{-6} semi-circles.
redAlmPhi0 Parameter Φ_0, semi-circles [4,5,6,7]. Scale factor 2^{-6} semi-circles.
redAlmL1Health Parameter L1 Health, dimensionless [4,5,6,7].
redAlmL2Health Parameter L2 Health, dimensionless [4,5,6,7].
redAlmL5Health Parameter L5 Health, dimensionless [4,5,6,7].

– AlmanacMidiAlmanacSet

```
-- ASN1START

AlmanacMidiAlmanacSet ::= SEQUENCE {
    svID                    SV-ID,
    midiAlmE                INTEGER (0..2047),
    midiAlmDeltaI           INTEGER (-1024..1023),
    midiAlmOmegaDot         INTEGER (-1024..1023),
    midiAlmSqrtA            INTEGER (0..131071),
    midiAlmOmega0           INTEGER (-32768..32767),
    midiAlmOmega            INTEGER (-32768..32767),
    midiAlmMo               INTEGER (-32768..32767),
    midiAlmaf0              INTEGER (-1024..1023),
    midiAlmaf1              INTEGER (-512..511),
    midiAlmL1Health         BOOLEAN,
    midiAlmL2Health         BOOLEAN,
    midiAlmL5Health         BOOLEAN,
    ...
}

-- ASN1STOP
```

***AlmanacMidiAlmanacSet* field descriptions**
svID This field identifies the satellite for which the GNSS Almanac Model is given.
midiAlmE Parameter e, dimensionless [4,5,6,7]. Scale factor 2^{-16}.
midiAlmDeltaI Parameter δ_i, semi-circles [4,5,6,7]. Scale factor 2^{-14} semi-circles.
midiAlmOmegaDot Parameter $\dot{\Omega}$, semi-circles/sec [4,5,6,7]. Scale factor 2^{-33} semi-circles/second.
midiAlmSqrtA Parameter $\sqrt{A}$, meters$^{1/2}$ [4,5,6,7]. Scale factor 2^{-4} meters$^{1/2}$.
midiAlmOmega0 Parameter Ω_0, semi-circles [4,5,6,7]. Scale factor 2^{-15} semi-circles.
midiAlmOmega Parameter ω, semi-circles [4,5,6,7]. Scale factor 2^{-15} semi-circles.
midiAlmMo Parameter M_0, semi-circles [4,5,6,7]. Scale factor 2^{-15} semi-circles.
midiAlmaf0 Parameter a_{f0}, seconds [4,5,6,7]. Scale factor 2^{-20} seconds.
midiAlmaf1 Parameter a_{f1}, sec/sec [4,5,6,7]. Scale factor 2^{-37} seconds/second.
midiAlmL1Health Parameter L1 Health, dimensionless [4,5,6,7].
midiAlmL2Health Parameter L2 Health, dimensionless [4,5,6,7].
midiAlmL5Health Parameter L5 Health, dimensionless [4,5,6,7].

– AlmanacGLONASS-AlmanacSet

```
-- ASN1START

AlmanacGLONASS-AlmanacSet ::= SEQUENCE {
    gloAlm-NA               INTEGER (1..1461),
    gloAlmnA                INTEGER (1..24),
    gloAlmHA                INTEGER (0..31),
    gloAlmLambdaA           INTEGER (-1048576..1048575),
    gloAlmtlambdaA          INTEGER (0..2097151),
    gloAlmDeltaIa           INTEGER (-131072..131071),
    gloAlmDeltaTA           INTEGER (-2097152..2097151),
    gloAlmDeltaTdotA        INTEGER (-64..63),
    gloAlmEpsilonA          INTEGER (0..32767),
    gloAlmOmegaA            INTEGER (-32768..32767),
    gloAlmTauA              INTEGER (-512..511),
    gloAlmCA                INTEGER (0..1),
    gloAlmMA                BIT STRING (SIZE(2))            OPTIONAL,
    ...
}

-- ASN1STOP
```

***AlmanacGLONASS-AlmanacSet* field descriptions**
gloAlmNA Parameter N^A, days [9]. Scale factor 1 days.
gloAlmnA Parameter n^A, dimensionless [9].
gloAlmHA Parameter H_n^A, dimensionless [9].
gloAlmLambdaA Parameter λ_n^A, semi-circles [9]. Scale factor 2^{-20} semi-circles.
gloAlmtlambdaA Parameter $t_{\lambda n}^A$, seconds [9]. Scale factor 2^{-5} seconds.
gloAlmDeltaIa Parameter Δi_n^A, semi-circles [9]. Scale factor 2^{-20} semi-circles.
gloAlmDeltaTA Parameter ΔT_n^A, sec/orbit period [9]. Scale factor 2^{-9} seconds/orbit period.
gloAlmDeltaTdotA Parameter $\Delta T\_DOT_n^A$, sec/orbit period^2 [9]. Scale factor 2^{-14} seconds/orbit period^2.
gloAlmEpsilonA Parameter ε_n^A, dimensionless [9]. Scale factor 2^{-20}.
gloAlmOmegaA Parameter ω_n^A, semi-circles [9]. Scale factor 2^{-15} semi-circles.
gloAlmTauA Parameter τ_n^A, seconds [9]. Scale factor 2^{-18} seconds.
gloAlmCA Parameter C_n^A, dimensionless [9].
gloAlmMA Parameter M_n^A, dimensionless [9]. This parameter is present if its value is nonzero; otherwise it is not present.

– AlmanacECEF-SBAS-AlmanacSet

```
-- ASN1START

AlmanacECEF-SBAS-AlmanacSet ::= SEQUENCE {
    sbasAlmDataID           INTEGER (0..3),
    svID                    SV-ID,
    sbasAlmHealth           BIT STRING (SIZE(8)),
    sbasAlmXg               INTEGER (-16384..16383),
    sbasAlmYg               INTEGER (-16384..16383),
    sbasAlmZg               INTEGER (-256..255),
    sbasAlmXgdot            INTEGER (-4..3),
    sbasAlmYgDot            INTEGER (-4..3),
    sbasAlmZgDot            INTEGER (-8..7),
    sbasAlmTo               INTEGER (0..2047),
    ...
}

-- ASN1STOP
```

***AlmanacECEF-SBAS-AlmanacSet* field descriptions**
sbasAlmDataID Parameter Data ID, dimensionless [10].
svID This field identifies the satellite for which the GNSS Almanac Model is given.
sbasAlmHealth Parameter Health, dimensionless [10].
sbasAlmXg Parameter X_G, meters [10]. Scale factor 2600 meters.
sbasAlmYg Parameter Y_G, meters [10]. Scale factor 2600 meters.
sbasAlmZg Parameter Z_G, meters [10]. Scale factor 26000 meters.
sbasAlmXgdot Parameter X_G Rat-of-Change, meters/sec [10]. Scale factor 10 meters/second.
sbasAlmYgDot Parameter Y_G Rate-of-Change, meters/sec [10]. Scale factor 10 meters/second.
sbasAlmZgDot Parameter Z_G Rate-of-Change, meters/sec [10]. Scale factor 40.96 meters/second.
sbasAlmTo Parameter t_0, seconds [10]. Scale factor 64 meters/seconds.

– GNSS-UTC-Model

The IE *GNSS-UTC-Model* is used by the location server to provide several sets of parameters needed to relate GNSS system time to Universal Time Coordinate (UTC), as defined in [4,5,6,7,8,9,10].

The UTC time standard, UTC(k), is GNSS specific. E.g., if *GNSS-ID* indicates GPS, *GNSS-UTC-Model* contains a set of parameters needed to relate GPS system time to UTC(USNO); if *GNSS-ID* indicates QZSS, *GNSS-UTC-Model* contains a set of parameters needed to relate QZST to UTC(NICT); if *GNSS-ID* indicates GLONASS, *GNSS-UTC-Model* contains a set of parameters needed to relate GLONASS system time to UTC(RU); if *GNSS-ID* indicates SBAS, *GNSS-UTC-Model* contains a set of parameters needed to relate SBAS network time for the SBAS indicated by *SBAS-ID* to the UTC standard defined by the UTC Standard ID.

```
-- ASN1START

GNSS-UTC-Model ::= CHOICE {
    utcModel1           UTC-ModelSet1,  -- Model-1
    utcModel2           UTC-ModelSet2,  -- Model-2
    utcModel3           UTC-ModelSet3,  -- Model-3
    utcModel4           UTC-ModelSet4,  -- Model-4
    ...
}

-- ASN1STOP
```

– UTC-ModelSet1

```
-- ASN1START

UTC-ModelSet1 ::= SEQUENCE {
    gnss-Utc-A1         INTEGER (degreesMaximumNegative..degreesMaximum),
    gnss-Utc-A0         INTEGER (-2147483648..2147483647),
    gnss-Utc-Tot        INTEGER (0..255),
    gnss-Utc-WNt        INTEGER (0..255),
    gnss-Utc-DeltaTls   INTEGER (-128..127),
    gnss-Utc-WNlsf      INTEGER (0..255),
    gnss-Utc-DN         INTEGER (-128..127),
    gnss-Utc-DeltaTlsf  INTEGER (-128..127),
    ...
```

```
}

-- ASN1STOP
```

***UTC-ModelSet1* field descriptions**
gnss-Utc-A1 Parameter A_1, scale factor 2^{-50} seconds/second [4,7,8].
gnss-Utc-A0 Parameter A_0, scale factor 2^{-30} seconds [4,7,8].
gnss-Utc-Tot Parameter t_{ot}, scale factor 2^{12} seconds [4,7,8].
gnss-Utc-WNt Parameter WN_t, scale factor 1 week [4,7,8].
gnss-Utc-DeltaTls Parameter Δt_{LS}, scale factor 1 second [4,7,8].
gnss-Utc-WNlsf Parameter WN_{LSF}, scale factor 1 week [4,7,8].
gnss-Utc-DN Parameter DN, scale factor 1 day [4,7,8].
gnss-Utc-DeltaTlsf Parameter Δt_{LSF}, scale factor 1 second [4,7,8].

– UTC-ModelSet2

```
-- ASN1START

UTC-ModelSet2 ::= SEQUENCE {
    utcA0               INTEGER (-32768..32767),
    utcA1               INTEGER (-4096..4095),
    utcA2               INTEGER (-64..63),
    utcDeltaTls         INTEGER (-128..127),
    utcTot              INTEGER (0..65535),
    utcWNot             INTEGER (0..8191),
    utcWNlsf            INTEGER (0..255),
    utcDN               BIT STRING (SIZE(4)),
    utcDeltaTlsf        INTEGER (-128..127),
    ...
}

-- ASN1STOP
```

***UTC-ModelSet2* field descriptions**
utcA0 Parameter A_{0-n}, bias coefficient of GNSS time scale relative to UTC time scale (seconds) [4,5,6,7]. Scale factor 2^{-35} seconds.
utcA1 Parameter A_{1-n}, drift coefficient of GNSS time scale relative to UTC time scale (sec/sec) [4,5,6,7]. Scale factor 2^{-51} seconds/second.
utcA2 Parameter A_{2-n}, drift rate correction coefficient of GNSS time scale relative to UTC time scale (sec/sec^2) [4,5,6,7]. Scale factor 2^{-68} seconds/second^2.
utcDeltaTls Parameter Δt_{LS}, current or past leap second count (seconds) [4,5,6,7]. Scale factor 1 second.
utcTot Parameter t_{ot}, time data reference time of week (seconds) [4,5,6,7]. Scale factor 2^4 seconds.
utcWNot Parameter WN_{ot}, time data reference week number (weeks) [4,5,6,7]. Scale factor 1 week.
utcWNlsf Parameter WN_{LSF}, leap second reference week number (weeks) [4,5,6,7]. Scale factor 1 week.
utcDN Parameter DN, leap second reference day number (days) [4,5,6,7]. Scale factor 1 day.

***UTC-ModelSet2* field descriptions**
utcDeltaTlsf Parameter Δt_{LSF}, current or future leap second count (seconds) [4,5,6,7]. Scale factor 1 second.

– UTC-ModelSet3

```
-- ASN1START

UTC-ModelSet3 ::= SEQUENCE {
    nA                  INTEGER (1..1461),
    tauC                INTEGER (-2147483648..2147483647),
    b1                  INTEGER (-1024..1023)                   OPTIONAL,   -- Cond GLONASS-M
    b2                  INTEGER (-512..511)                     OPTIONAL,   -- Cond GLONASS-M
    kp                  BIT STRING (SIZE(2))                    OPTIONAL,   -- Cond GLONASS-M
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
GLONASS-M	The field is mandatory present if GLONASS-M satellites are present in the current GLONASS constellation; otherwise it is not present.

***UTC-ModelSet3* field descriptions**
nA Parameter N^A, callendar day number within four-year period beginning since the leap year (days) [9]. Scale factor 1 day.
tauC Parameter τ_c, GLONASS time scale correction to UTC(SU) (seconds) [9]. Scale factor 2^{-31} seconds.
b1 Parameter B1, coefficient to determine ΔUT1 (seconds) [9]. Scale factor 2^{-10} seconds.
b2 Parameter B2, coefficient to determine ΔUT1 (seconds/msd) [9]. Scale factor 2^{-16} seconds/msd.
kp Parameter KP, notification of expected leap second correction (dimensionless) [9].

– UTC-ModelSet4

```
-- ASN1START

UTC-ModelSet4 ::= SEQUENCE {
    utcA1wnt            INTEGER (degreesMaximumNegative..degreesMaximum),
    utcA0wnt            INTEGER (-2147483648..2147483647),
    utcTot              INTEGER (0..255),
    utcWNt              INTEGER (0..255),
    utcDeltaTls         INTEGER (-128..127),
    utcWNlsf            INTEGER (0..255),
    utcDN               INTEGER (-128..127),
    utcDeltaTlsf        INTEGER (-128..127),
    utcStandardID       INTEGER (0..7),
    ...
}

-- ASN1STOP
```

***UTC-ModelSet4* field descriptions**
utcA1wnt Parameter A_{1WNT}, sec/sec ([10], Message Type 12). Scale factor 2^{-50} seconds/second.

UTC-ModelSet4 **field descriptions**
utcA0wnt Parameter A_{0WNT}, seconds ([10], Message Type 12). Scale factor 2^{-30} seconds.
utcTot Parameter t_{ot}, seconds ([10], Message Type 12). Scale factor 2^{12} seconds.
utcWNt Parameter WN_t, weeks ([10], Message Type 12). Scale factor 1 week.
utcDeltaTls Parameter Δt_{LS}, seconds ([10], Message Type 12). Scale factor 1 second.
utcWNlsf Parameter WN_{LSF}, weeks ([10], Message Type 12). Scale factor 1 week.
utcDN Parameter DN, days ([10], Message Type 12). Scale factor 1 day.
utcDeltaTlsf Parameter Δt_{LSF}, seconds ([10], Message Type 12). Scale factor 1 second.
utcStandardID If *GNSS-ID* indicates "sbas", this field indicates the UTC standard used for the SBAS network time indicated by *SBAS-ID* to UTC relation as defined as ([7], Message Type 12) in the table Value of UTC Standard ID to UTC Standard relation shown below.

Value of UTC Standard ID to UTC Standard relation

Value of UTC Standard ID	UTC Standard
0	UTC as operated by the Communications Research Laboratory (CRL), Tokyo, Japan
1	UTC as operated by the National Institute of Standards and Technology (NIST)
2	UTC as operated by the U. S. Naval Observatory (USNO)
3	UTC as operated by the International Bureau of Weights and Measures (BIPM)
4-7	Reserved for future definition

– GNSS-AuxiliaryInformation

The IE *GNSS-AuxiliaryInformation* is used by the location server to provide additional information dependent on the *GNSS-ID*. If *GNSS-AuxiliaryInformation* is provided together with other satellite dependent GNSS assistance data (i.e., any of *GNSS-DifferentialCorrections*, *GNSS-NavigationModel*, *GNSS-DataBitAssistance*, or *GNSS-AcquisitionAssistance* IEs) and LPP pseudo-segmentation is used, the *GNSS-AuxiliaryInformation* should be provided for the same satellites and in the same LPP segment as the other satellite dependent GNSS assistance data.

```
-- ASN1START

GNSS-AuxiliaryInformation ::= CHOICE {
    gnss-ID-GPS     GNSS-ID-GPS,
    gnss-ID-GLONASS GNSS-ID-GLONASS,
    ...
}

GNSS-ID-GPS ::= SEQUENCE    (SIZE(1..64)) OF GNSS-ID-GPS-SatElement

GNSS-ID-GPS-SatElement ::= SEQUENCE {
    svID                SV-ID,
    signalsAvailable    GNSS-SignalIDs,
    ...
}

GNSS-ID-GLONASS ::= SEQUENCE (SIZE(1..64)) OF GNSS-ID-GLONASS-SatElement

GNSS-ID-GLONASS-SatElement ::= SEQUENCE {
    svID                SV-ID,
    signalsAvailable    GNSS-SignalIDs,
    channelNumber       INTEGER (-7..13)        OPTIONAL,       -- Cond FDMA
```

```
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
FDMA	The field is mandatory present if the GLONASS SV indicated by *svID* broadcasts FDMA signals; otherwise it is not present.

***GNSS-AuxiliaryInformation* field descriptions**
gnss-ID-GPS This choice may only be present if *GNSS-ID* indicates GPS.
gnss-ID-GLONASS This choice may only be present if *GNSS-ID* indicates GLONASS.
svID This field specifies the GNSS SV for which the *GNSS-AuxiliaryInformation* is given.
signalsAvailable This field indicates the ranging signals supported by the satellite indicated by *svID*. This field is given as a bit string as defined in *GNSS-SignalIDs* for a particular GNSS. If a bit is set to "1" it indicates that the satellite identified by *svID* transmits ranging signals according to the signal correspondence in *GNSS-SignalIDs*. If a bit is set to "0" it indicates that the corresponding signal is not supported on the satellite identified by *svID*.
channelNumber This field indicates the GLONASS carrier frequency number of the satellite identified by *svID*, as defined in [9].

6.5.2.3 GNSS Assistance Data Request

– A-GNSS-RequestAssistanceData

The IE *A-GNSS-RequestAssistanceData* is used by the target device to request GNSS assistance data from a location server.

```
-- ASN1START

A-GNSS-RequestAssistanceData ::= SEQUENCE {
    gnss-CommonAssistDataReq        GNSS-CommonAssistDataReq        OPTIONAL, -- Cond CommonADReq
    gnss-GenericAssistDataReq       GNSS-GenericAssistDataReq       OPTIONAL, -- Cond GenADReq
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
CommonADReq	The field is mandatory present if the target device requests *GNSS-CommonAssistData*; otherwise it is not present.
GenADReq	This field is mandatory present if the target device requests *GNSS-GenericAssistData* for one or more specific GNSS; otherwise it is not present.

– GNSS-CommonAssistDataReq

The IE *GNSS-CommonAssistDataReq* is used by the target device to request assistance data that are applicable to any GNSS from a location server.

```
-- ASN1START

GNSS-CommonAssistDataReq ::= SEQUENCE {
    gnss-ReferenceTimeReq               GNSS-ReferenceTimeReq
                                                        OPTIONAL, -- Cond RefTimeReq
    gnss-ReferenceLocationReq           GNSS-ReferenceLocationReq
                                                        OPTIONAL, -- Cond RefLocReq
    gnss-IonosphericModelReq                GNSS-IonosphericModelReq
                                                        OPTIONAL, -- Cond IonoModReq
    gnss-EarthOrientationParametersReq  GNSS-EarthOrientationParametersReq
                                                        OPTIONAL, -- Cond EOPReq
    ...
```

```
}

-- ASN1STOP
```

Conditional presence	Explanation
RefTimeReq	The field is mandatory present if the target device requests *GNSS-ReferenceTime*; otherwise it is not present.
RefLocReq	This field is mandatory present if the target device requests *GNSS-ReferenceLocation*; otherwise it is not present.
IonoModReq	This field is mandatory present if the target device requests *GNSS-IonosphericModel*; otherwise it is not present.
EOPReq	This field is mandatory present if the target device requests *GNSS-EarthOrientationParameters*; otherwise it is not present.

– GNSS-GenericAssistDataReq

The IE *GNSS-GenericAssistDataReq* is used by the target device to request assistance data from a location server for one or more specific GNSS (e.g., GPS, Galileo, GLONASS, etc.). The specific GNSS for which the assistance data are requested is indicated by the IE *GNSS-ID* and (if applicable) by the IE *SBAS-ID*. Assistance for up to 16 GNSSs can be requested.

```
-- ASN1START

GNSS-GenericAssistDataReq ::= SEQUENCE (SIZE (1..16)) OF GNSS-GenericAssistDataReqElement

GNSS-GenericAssistDataReqElement ::= SEQUENCE {
    gnss-ID                         GNSS-ID,
    sbas-ID                         SBAS-ID                         OPTIONAL, -- Cond GNSS-ID-SBAS
    gnss-TimeModelsReq              GNSS-TimeModelListReq           OPTIONAL, -- Cond TimeModReq
    gnss-DifferentialCorrectionsReq GNSS-DifferentialCorrectionsReq OPTIONAL, -- Cond DGNSS-Req
    gnss-NavigationModelReq         GNSS-NavigationModelReq         OPTIONAL, -- Cond NavModReq
    gnss-RealTimeIntegrityReq       GNSS-RealTimeIntegrityReq       OPTIONAL, -- Cond RTIReq
    gnss-DataBitAssistanceReq       GNSS-DataBitAssistanceReq       OPTIONAL, -- Cond DataBitsReq
    gnss-AcquisitionAssistanceReq   GNSS-AcquisitionAssistanceReq   OPTIONAL, -- Cond AcquAssistReq
    gnss-AlmanacReq                 GNSS-AlmanacReq                 OPTIONAL, -- Cond AlmanacReq
    gnss-UTCModelReq                GNSS-UTC-ModelReq               OPTIONAL, -- Cond UTCModReq
    gnss-AuxiliaryInformationReq    GNSS-AuxiliaryInformationReq    OPTIONAL, -- Cond AuxInfoReq
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
GNSS-ID-SBAS	The field is mandatory present if the *GNSS-ID = sbas*; otherwise it is not present.
TimeModReq	The field is mandatory present if the target device requests *GNSS-TimeModelList*; otherwise it is not present.
DGNSS-Req	The field is mandatory present if the target device requests *GNSS-DifferentialCorrections*; otherwise it is not present.
NavModReq	The field is mandatory present if the target device requests *GNSS-NavigationModel*; otherwise it is not present.
RTIReq	The field is mandatory present if the target device requests *GNSS-RealTimeIntegrity*; otherwise it is not present.
DataBitsReq	The field is mandatory present if the target device requests *GNSS-DataBitAssistance*; otherwise it is not present.
AcquAssistReq	The field is mandatory present if the target device requests *GNSS-AcquisitionAssistance*; otherwise it is not present.
AlmanacReq	The field is mandatory present if the target device requests *GNSS-Almanac*; otherwise it is not present.
UTCModReq	The field is mandatory present if the target device requests *GNSS-UTCModel*; otherwise it is not present.
AuxInfoReq	The field is mandatory present if the target device requests *GNSS-AuxiliaryInformation*; otherwise it is not present.

6.5.2.4 GNSS Assistance Data Request Elements

– GNSS-ReferenceTimeReq

The IE *GNSSReferenceTimeReq* is used by the target device to request the *GNSSReferenceTime* assistance from the location server.

```
-- ASN1START

GNSS-ReferenceTimeReq ::= SEQUENCE {
    gnss-TimeReqPrefList    SEQUENCE (SIZE (1..8)) OF GNSS-ID,
    gps-TOW-assistReq       BOOLEAN                             OPTIONAL, -- Cond gps
    notOfLeapSecReq         BOOLEAN                             OPTIONAL, -- Cond glonass
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
gps	The field is mandatory present if *gnss-TimeReqPrefList* includes a *GNSS-ID*= "gps"; otherwise it is not present.
glonass	The field is mandatory present if *gnss-TimeReqPrefList* includes a *GNSS-ID*= "glonass"; otherwise it is not present.

***GNSS-ReferenceTimeReq* field descriptions**
gnss-TimeReqPrefList This field is used by the target device to request the system time for one or more specific GNSSs, specified by GNSS-ID in the order of preference. The first *GNSS-ID* in the list is the most preferred GNSS for reference time, the second *GNSS-ID* is the second most preferred, etc.
gps-TOW-assistReq This field is used by the target device to request the *gps-Tow-Assist* field in *GNSS-SystemTime*. TRUE means requested.
notOfLeapSecReq This field is used by the target device to request the *notificationOfLeapSecond* field in *GNSS-SystemTime*. TRUE means requested.

– GNSS-ReferenceLocationReq

The IE *GNSS-ReferenceLocationReq* is used by the target device to request the *GNSS-ReferenceLocation* assistance from the location server.

```
-- ASN1START

GNSS-ReferenceLocationReq ::=   SEQUENCE {
    ...
}

-- ASN1STOP
```

– GNSS-IonosphericModelReq

The IE *GNSS-IonosphericModelReq* is used by the target device to request the *GNSS-IonosphericModel* assistance from the location server.

```
-- ASN1START

GNSS-IonosphericModelReq ::=    SEQUENCE {
    klobucharModelReq       BIT STRING (SIZE(2))    OPTIONAL,   -- Cond klobuchar
    neQuickModelReq         NULL                    OPTIONAL,   -- Cond nequick
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
klobuchar	The field is mandatory present if the target device requests *klobucharModel*; otherwise it is not present. The BIT STRING defines the dataID requested, defined in IE *KlobucharModelParameter*.
nequick	The field is mandatory present if the target device requests *neQuickModel*; otherwise it is not present.

– GNSS-EarthOrientationParametersReq

The IE *GNSS-EarthOrientationParametersReq* is used by the target device to request the *GNSS-EarthOrientationParameters* assistance from the location server.

```
-- ASN1START

GNSS-EarthOrientationParametersReq ::=  SEQUENCE {
    ...
}

-- ASN1STOP
```

– GNSS-TimeModelListReq

The IE *GNSSTimeModelListReq* is used by the target device to request the *GNSS-TimeModelElement* assistance from the location server.

```
-- ASN1START

GNSS-TimeModelListReq ::= SEQUENCE (SIZE(1..15)) OF GNSS-TimeModelElementReq

GNSS-TimeModelElementReq ::= SEQUENCE {
    gnss-TO-IDsReq  INTEGER (1..15),
    deltaTreq       BOOLEAN,
    ...
}

-- ASN1STOP
```

***GNSS-TimeModelElementReq* field descriptions**
gnss-TO-IDsReq This field specifies the requested *gnss-TO-ID*. The meaning and encoding is the same as the *gnss-TO-ID* field in the *GNSSTimeModelElement* IE.
deltaTreq This field specifies whether or not the location server is requested to include the *deltaT* field in the *GNSS-TimeModelElement* IE. TRUE means requested.

– GNSS-DifferentialCorrectionsReq

The IE *GNSSDifferentialCorrectionsReq* is used by the target device to request the *GNSS-DifferentialCorrections* assistance from the location server.

```
-- ASN1START

GNSS-DifferentialCorrectionsReq ::=     SEQUENCE {
    dgnss-SignalsReq            GNSS-SignalIDs,
    dgnss-ValidityTimeReq       BOOLEAN,
    ...
}

-- ASN1STOP
```

***GNSS-DifferentialCorrectionsReq* field descriptions**

GNSS-DifferentialCorrectionsReq field descriptions
dgnss-SignalsReq This field specifies the GNSS Signal(s) for which the *GNSS-DifferentialCorrections* are requested. A one-value at a bit position means DGNSS corrections for the specific signal are requested; a zero-value means not requested. The target device shall set a maximum of three bits to value "one".
dgnss-ValidityTimeReq This field specifies whether the *udreGrowthRate* and *udreValidityTime* in *GNSS-DifferentialCorrections* are requested or not. TRUE means requested.

– GNSS-NavigationModelReq

The IE *GNSS-NavigationModelReq* is used by the target device to request the *GNSS-NavigationModel* assistance from the location server.

```
-- ASN1START

GNSS-NavigationModelReq ::=     CHOICE {
    storedNavList       StoredNavListInfo,
    reqNavList          ReqNavListInfo,
    ...
}


StoredNavListInfo ::= SEQUENCE {
    gnss-WeekOrDay          INTEGER (0..4095),
    gnss-Toe                INTEGER (0..255),
    t-toeLimit              INTEGER (0..15),
    satListRelatedDataList  SatListRelatedDataList  OPTIONAL,
    ...
}

SatListRelatedDataList ::= SEQUENCE (SIZE (1..64)) OF SatListRelatedDataElement

SatListRelatedDataElement ::= SEQUENCE {
    svID                SV-ID,
    iod                 BIT STRING (SIZE(11)),
    clockModelID        INTEGER (1..8)          OPTIONAL,
    orbitModelID        INTEGER (1..8)          OPTIONAL,
    ...
}

ReqNavListInfo ::=  SEQUENCE {
    svReqList               BIT STRING (SIZE (64)),
    clockModelID-PrefList   SEQUENCE (SIZE (1..8)) OF   INTEGER (1..8)      OPTIONAL,
    orbitModelID-PrefList   SEQUENCE (SIZE (1..8)) OF   INTEGER (1..8)      OPTIONAL,
    addNavparamReq          BOOLEAN             OPTIONAL,   -- Cond orbitModelID-2
    ...
}


-- ASN1STOP
```

Conditional presence	Explanation
orbitModelID-2	The field is mandatory present if *orbitModelID-PrefList* is absent or includes a Model-ID = "2"; otherwise it is not present.

GNSS-NavigationModelReq field descriptions
storedNavList This list provides information to the location server about which *GNSS-NavigationModel* data the target device has currently stored for the particular GNSS indicated by *GNSS-ID*.
reqNavList This list provides information to the location server which *GNSS-NavigationModel* data are requested by the target device.
gnss-WeekOrDay If *GNSS-ID* does not indicate "glonass", this field defines the GNSS Week number of the assistance currently held by the target device. If *GNSS-ID* is set to "glonass", this field defines the calendar number of day within the four-year interval starting from 1st of January in a leap year, as defined by the parameter N_T in [9] of the assistance currently held by the target device.

***GNSS-NavigationModelReq* field descriptions**
gnss-Toe If *GNSS-ID* does not indicate "glonass", this field defines the GNSS time of ephemeris in hours of the latest ephemeris set contained by the target device. If *GNSS-ID* is set to "glonass", this field defines the time of ephemeris in units of 15 minutes of the latest ephemeris set contained by the target device (range 0 to 95 representing time values between 0 and 1425 minutes). In this case, values 96 to 255 shall not be used by the sender.
t-toeLimit If *GNSS-ID* does not indicate "glonass", this IE defines the ephemeris age tolerance of the target device in units of hours. If *GNSS-ID* is set to "glonass", this IE defines the ephemeris age tolerance of the target device in units of 30 minutes.
satListRelatedDataList This list defines the clock and orbit models currently held by the target device for each SV.
svID This field identifies the particular GNSS satellite.
iod This field identifies the issue of data currently held by the target device.
clockModelID, orbitModelID These fields define the clock and orbit model number currently held by the target device. If these fields are absent, the default interpretation of the table GNSS-ID to clockModelID & orbitModelID relation below applies.
svReqList This field defines the SV for which the navigation model assistance is requested. Each bit position in this BIT STRING represents a *SV-ID*. Bit 1 represents *SV-ID*=1 and bit 64 represents *SV-ID*=64. A one-value at a bit position means the navigation model data for the corresponding *SV-ID* is requested, a zero-value means not requested.
clockModelIDPrefList, orbitModelID-PrefList These fields define the Model-IDs for the clock and orbit models the target device wishes to obtain in the order of preference. The first Model-ID in the list is the most preferred model, the second Model-ID the second most preferred, etc. If these fields are absent, the default interpretation of the table GNSS-ID to clockModelID-PrefList & orbitModelIDPrefList relation below applies.
addNavparamReq This field specifies whether the location server is requested to include the *addNAVparam* fields in *GNSS-NavigationModel* IE (*NavModel-NAVKeplerianSet* field) or not. TRUE means requested.

GNSS-ID to clockModelID & orbitModelID relation

GNSS-ID	*clockModelID*	*orbitModelID*
gps	2	2
sbas	5	5
qzss	2	2
galileo	1	1
glonass	4	4

GNSS-ID to clockModelID-PrefList & orbitModelID-PrefList relation

GNSS-ID	*clockModelID-PrefList*	*orbitModelID-PrefList*
gps	Model-2	Model-2
sbas	Model-5	Model-5
qzss	Model-2	Model-2
galileo	Model-1	Model-1
glonass	Model-4	Model-4

– GNSS-RealTimeIntegrityReq

The IE *GNSS-RealTimeIntegrityReq* is used by the target device to request the *GNSS-RealTimeIntegrity* assistance from the location server.

```
-- ASN1START

GNSS-RealTimeIntegrityReq ::=   SEQUENCE {
    ...
}
```

```
-- ASN1STOP
```

– GNSS-DataBitAssistanceReq

The IE *GNSS-DataBitAssistanceReq* is used by the target device to request the *GNSS-DataBitAssistance* assistance from the location server.

```
-- ASN1START

GNSS-DataBitAssistanceReq ::=   SEQUENCE {
    gnss-TOD-Req        INTEGER (0..3599),
    gnss-TOD-FracReq    INTEGER (0..999)        OPTIONAL,
    dataBitInterval     INTEGER (0..15),
    gnss-SignalType     GNSS-SignalIDs,
    gnss-DataBitsReq    GNSS-DataBitsReqSatList OPTIONAL,
    ...
}

GNSS-DataBitsReqSatList ::= SEQUENCE (SIZE(1..64)) OF GNSS-DataBitsReqSatElement

GNSS-DataBitsReqSatElement ::= SEQUENCE {
    svID                SV-ID,
    ...
}

-- ASN1STOP
```

***GNSS-DataBitAssistanceReq* field descriptions**
gnss-TOD-Req This field specifies the reference time for the first data bit requested in GNSS specific system time, modulo 1 hour. Scale factor 1 second.
gnss-TOD-FracReq This field specifies the fractional part of *gnss-TOD-Req* in 1-milli-second resolution. Scale factor 1 millisecond.
dataBitInterval This field specifies the time length for which the Data Bit Assistance is requested. The *GNSS-DataBitAssistance* shall be relative to the time interval (*gnss-TOD-Req*, *gnss-TOD-Req* + *dataBitInterval*). The *dataBitInterval r*, expressed in seconds, is mapped to a binary number K with the following formula: $r = 0.1 \times 2^{K}$ Value K=15 means that the time interval is not specified.
gnss-SignalType This field specifies the GNSS Signal(s) for which the *GNSS-DataBitAssistance* are requested. A one-value at a bit position means *GNSS-DataBitAssistance* for the specific signal is requested; a zero-value means not requested.
gnss-DataBitsReq This list contains the SV-IDs for which the *GNSS-DataBitAssistance* is requested.

– GNSS-AcquisitionAssistanceReq

The IE *GNSS-AcquisitionAssistanceReq* is used by the target device to request the *GNSS-AcquisitionAssistance* assistance from the location server.

```
-- ASN1START

GNSS-AcquisitionAssistanceReq ::=   SEQUENCE {
    gnss-SignalID-Req       GNSS-SignalID,
    ...
}

-- ASN1STOP
```

***GNSS-AcquisitionAssistanceReq* field descriptions**
gnss-SignalID-Req This field specifies the GNSS signal type for which *GNSSAcquisitionAssistance* is requested.

– GNSS-AlmanacReq

The IE *GNSS-AlmanacReq* is used by the target device to request the *GNSS-Almanac* assistance from the location server.

```
-- ASN1START

GNSS-AlmanacReq ::= SEQUENCE {
    modelID             INTEGER(1..8)   OPTIONAL,
    ...
}

-- ASN1STOP
```

***GNSS-AlmanacReq* field descriptions**
modelID This field specifies the Almanac Model ID requested. If this field is absent, the default interpretation as in the table GNSS-ID to modelID relation below applies.

GNSS-ID to modelID relation

GNSS-ID	***modelID***
gps	2
sbas	6
qzss	2
galileo	1
glonass	5

– GNSS-UTC-ModelReq

The IE *GNSS-UTC-ModelReq* is used by the target device to request the *GNSS-UTC-Model* assistance from the location server.

```
-- ASN1START

GNSS-UTC-ModelReq ::=   SEQUENCE {
    modelID             INTEGER(1..8)   OPTIONAL,
    ...
}

-- ASN1STOP
```

***GNSS-UTC-ModelReq* field descriptions**
modelID This field specifies the *GNSS-UTCModel* set requested. If this field is absent, thedefault interpretation as in the table GNSS-ID to modelID relation below applies.

GNSS-ID to modelID relation

GNSS-ID	***modelID***
gps	1
sbas	4
qzss	1
galileo	1
glonass	3

– GNSS-AuxiliaryInformationReq

The IE *GNSS-AuxiliaryInformationReq* is used by the target device to request the *GNSS-AuxiliaryInformation* assistance from the location server.

```
-- ASN1START

GNSS-AuxiliaryInformationReq ::=    SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.2.5 GNSS Location Information

– A-GNSS-ProvideLocationInformation

The IE *A-GNSS-ProvideLocationInformation* is used by the target device to provide location measurements (e.g., pseudo-ranges, location estimate, velocity) to the location server, together with time information. It may also be used to provide GNSS positioning specific error reason.

```
-- ASN1START

A-GNSS-ProvideLocationInformation ::= SEQUENCE {
    gnss-SignalMeasurementInformation   GNSS-SignalMeasurementInformation       OPTIONAL,
    gnss-LocationInformation            GNSS-LocationInformation                OPTIONAL,
    gnss-Error                          A-GNSS-Error                            OPTIONAL,
    ...
}

-- ASN1STOP
```

6.5.2.6 GNSS Location Information Elements

– GNSS-SignalMeasurementInformation

The IE *GNSS-SignalMeasurementInformation* is used by the target device to provide GNSS signal measurement information to the location server and GNSS-network time association if requested by the location server. This information includes the measurements of code phase, Doppler, C/N_o and optionally accumulated carrier phase, also called accumulated deltarange (ADR), which enable the UE-assisted GNSS method where position is computed in the location server. Figure 6.5.2.6-1 illustrates the relation between some of the fields.

```
-- ASN1START

GNSS-SignalMeasurementInformation ::= SEQUENCE {
    measurementReferenceTime        MeasurementReferenceTime,
    gnss-MeasurementList            GNSS-MeasurementList,
    ...
}

-- ASN1STOP
```

***GNSS-SignalMeasurementInformation* field descriptions**
measurementReferenceTime This field specifies the GNSS system time for which the information provided in *gnss-MeasurementList* is valid. It may also include network time, if requested by the location server and supported by the target device.
gnss-MeasurementList This field provides GNSS signal measurement information for up to 16 GNSSs.

– MeasurementReferenceTime

The IE *MeasurementReferenceTime* is used to specify the time when the measurements provided in *A-GNSS-Provide-Location-Information* are valid. It may also include GNSS-network time association, in which case reported measurements shall be valid for the cellular frame boundary defined in the network time association.

```
-- ASN1START

MeasurementReferenceTime  ::= SEQUENCE {
```

```
    gnss-TOD-msec       INTEGER (0..3599999),
    gnss-TOD-frac       INTEGER (0..3999)           OPTIONAL,
    gnss-TOD-unc        INTEGER (0..127)            OPTIONAL,
    gnss-TimeID         GNSS-ID,
    networkTime         CHOICE {
        eUTRA   SEQUENCE {
                physCellId          INTEGER (0..503),
                cellGlobalId        CellGlobalIdEUTRA-AndUTRA       OPTIONAL,
                systemFrameNumber   BIT STRING (SIZE (10)),
                ...
                },
        uTRA    SEQUENCE {
                mode                        CHOICE {
                                            fdd         SEQUENCE {
                                                        primary-CPICH-Info  INTEGER (0..511),
                                                        ...
                                                        },
                                            tdd         SEQUENCE {
                                                        cellParameters      INTEGER (0..127),
                                                        ...
                                                        }
                                            },
                cellGlobalId                CellGlobalIdEUTRA-AndUTRA       OPTIONAL,
                referenceSystemFrameNumber
                                            INTEGER (0..4095),
                ...
                },
        gSM     SEQUENCE {
                bcchCarrier         INTEGER (0..1023),
                bsic                INTEGER (0..63),
                cellGlobalId        CellGlobalIdGERAN                   OPTIONAL,
                referenceFrame      SEQUENCE {
                                    referenceFN         INTEGER (0..65535),
                                    referenceFNMSB      INTEGER (0..63)     OPTIONAL,
                                    ...
                                    },
                deltaGNSS-TOD       INTEGER (0 .. 127)      OPTIONAL,
                ...
                },
        ...
        }       OPTIONAL,
    ...
}

-- ASN1STOP
```

***MeasurementReferenceTime* field descriptions**
gnss-TOD-msec This field specifies the GNSS TOD for which the measurements and/or location estimate are valid. The 22 bits of GNSS TOD are the least significant bits. The most significant bits shall be derived by the location server to unambiguously derive the GNSS TOD. The value for GNSS TOD is derived from the GNSS specific system time indicated in *gnss-TimeID* rounded down to the nearest millisecond unit. Scale factor 1 millisecond.
gnss-TOD-frac This field specifies the fractional part of the GNSS TOD in 250 ns resolution. The total GNSS TOD is given by *gnss-TOD-msec* + *gnss-TOD-frac*. Scale factor 250 nanoseconds.
gnss-TOD-unc This field provides the accuracy of the relation GNSS-network time when GNSS-network time association is provided. When GNSS-network time association is not provided, this element can be included to provide the accuracy of the reported *gnss-TOD-msec*. If GNSS TOD is the given GNSS time, then the true GNSS time, corresponding to the provided network time if applicable, as observed at the target device location, lies in the interval [GNSS TOD – *gnss-TOD-unc*, GNSS TOD + *gnss-TOD-unc*]. The uncertainty *r*, expressed in microseconds, is mapped to a number K, with the following formula: $r = C*(((1+x)^K)-1)$ with C = 0.5 and x = 0.14. To encode any higher value of uncertainty than that corresponding in the above formula to K=127, the same value, K=127, shall also be used. The uncertainty is then coded on 7 bits, as the binary encoding of K. Examples of *gnss-TOD-unc* value are as in the table Value of K to Value of uncertainty relation below. This field shall be included if the target device provides GNSS-network time relationship.

MeasurementReferenceTime field descriptions
gnss-TimeID This field specifies the GNSS system time for which the *gnss-TOD-msec* (and *gnss-TOD-frac* if applicable) is provided.
networkTime These fields specify the network time event which the GNSS TOD time stamps. This field shall be included if the target device provides GNSS-network time relationship.
physCellId This field identifies the reference cell, as defined in [12], that is used for the GNSS-network time relation.
cellGlobalId This field specifies the globally unique cell identifier (Evolved Cell Global Identifier (ECGI) in E-UTRA, global UTRAN Cell Identifier in UTRA, or Cell Global Identification (CGI) in GERAN) of the reference cell, as defined in [12] for E-UTRA and [13] for UTRA, for which the GNSS network time relation is provided.
systemFrameNumber This field specifies the system frame number in E-UTRA which the GNSS time time stamps, as defined in [12].
mode This field identifies the reference cell for the GNSS-network time relation, as defined in [13].
referenceSystemFrameNumber This field specifies the system frame number in UTRA, as defined in [13], which is used for time stamping.
bcchCarrier, bsic This field identifies the reference cell for the GNSS-network time relation in UTRA, as defined in [14].
referenceFN, referenceFNMSB These fields specify the frame number in GERAN which the GNSS time time stamps, as defined in [14]. The time of the reference frame boundary is as observed by the target device, i.e. without Timing Advance compensation. The *referenceFNMSB* field indicates the most significant bits of the frame number of the reference BTS corresponding to the *GNSS-MeasurementList*. Starting from the complete GSM frame number denoted FN, the target device calculates Reference FN MSB as Reference FN MSB = floor(FN/42432) The complete GSM frame number FN can then be reconstructed in the location server by combining the fields *referenceFN* with *referenceFNMSB* in the following way FN = *referenceFNMSB* *42432 + *referenceFN*
deltaGNSS-TOD This field specifies the difference in milliseconds between *gnss-TOD-msec* reported and the milli-second part of the SV time tsv_1 of the first SV in the list reported from the target device, as defined in [14]. The *deltaGNSS-TOD* is defined as *deltaGNSS-TOD* = *gnss-TOD-msec* - fix(tsv_1) where fix() denotes rounding to the nearest integer towards zero.

Value of K to Value of uncertainty relation

Value of K	Value of uncertainty
0	0 microseconds
1	0.07 microoseconds
2	0.1498 microseconds
-	-
50	349.62 microseconds
-	-
127	≥ 8430000 microseconds

– GNSS-MeasurementList

The IE *GNSS-MeasurementList* is used by the target device to provide measurements of code phase, Doppler, C/N_o and optionally accumulated carrier phase, also called accumulated deltarange (ADR).

```
-- ASN1START

GNSS-MeasurementList  ::= SEQUENCE (SIZE(1..16)) OF GNSS-MeasurementForOneGNSS

GNSS-MeasurementForOneGNSS ::= SEQUENCE {
    gnss-ID                 GNSS-ID,
    gnss-SgnMeasList        GNSS-SgnMeasList,
    ...
}

GNSS-SgnMeasList ::= SEQUENCE (SIZE(1..8)) OF GNSS-SgnMeasElement
```

```
GNSS-SgnMeasElement ::= SEQUENCE {
    gnss-SignalID           GNSS-SignalID,
    gnss-CodePhaseAmbiguity INTEGER (0..127)        OPTIONAL,
    gnss-SatMeasList        GNSS-SatMeasList,
    ...
}

GNSS-SatMeasList ::= SEQUENCE (SIZE(1..64)) OF GNSS-SatMeasElement

GNSS-SatMeasElement ::= SEQUENCE {
    svID                SV-ID,
    cNo                 INTEGER (0..63),
    mpathDet            ENUMERATED {notMeasured (0), low (1), medium (2), high (3), ...},
    carrierQualityInd   INTEGER (0..3)              OPTIONAL,
    codePhase           INTEGER (0..2097151),
    integerCodePhase    INTEGER (0..127)            OPTIONAL,
    codePhaseRMSError   INTEGER (0..63),
    doppler             INTEGER (-32768..32767)     OPTIONAL,
    adr                 INTEGER (0..33554431)       OPTIONAL,
    ...
}

-- ASN1STOP
```

***GNSS-MeasurementList* field descriptions**
gnss-ID This field identifies the GNSS constellation on which the GNSS signal measurements were measured. Measurement information for up to 16 GNSSs can be included.
gnss-SgnMeasList This list provides GNSS signal measurement information for up to 8 GNSS signal types per GNSS.
gnss-SignalID This field identifies the signal on which GNSS signal measurement parameters were measured.
gnss-CodePhaseAmbiguity This field provides the ambiguity of the code phase measurement. It is given in units of milli-seconds in the range between between 0 and 127 milli-seconds. The total code phase for a satellite k (Satk) is given modulo this *gnss-CodePhaseAmbiguity* and is reconstructed with: Code_Phase_Tot(Satk) = *codePhase*(Satk) + *integerCodePhase*(Satk) + n * *gnss-CodePhaseAmbiguity*, n= 0,1,2,... If there is no code phase ambiguity, the *gnss-CodePhaseAmbiguity* shall be set to 0. The field is optional. If *gnss-CodePhaseAmbiguity* is absent, the default value is 1 milli-second.
gnss-SatMeasList This list provides GNSS signal measurement information for up to 64 GNSS satellites.
svID This field identifies the satellite on which the GNSS signal measurements were measured.
cNo This field provides an estimate of the carrier-to-noise ratio of the received signal from the particular satellite. The target device shall set this field to the value of the satellite C/N_0, as referenced to the antenna connector, in units of 1 dB-Hz, in the range from 0 to 63 dB-Hz. Scale factor 1 dB-Hz.
mpathDet This field contains the multipath indicator value, defined in the table Value of mpathDet to Multipath Indication relation below.
carrierQualityInd This field indicates the quality of a carrier phase measurement. The LSB indicates the data polarity, that is, if the data from a specific satellite is received inverted, this is indicated by setting the LSB value to "1". In the case the data is not inverted, the LSB is set to "0". The MSB indicates if accumulation of the carrier phase has been continuous, that is, without cycle slips since the previous measurement report. If the carrier phase accumulation has been continuous, the MSB value is set to "1X". Otherwise, the MSB is set to "0X". This field is optional and shall be included only when carrier phase measurements are provided. See table Bit toPolarity Indication relation below.
codePhase This field contains the whole and fractional value of the code-phase measurement made by the target device for the particular satellite signal at the time of measurement in the units of ms. GNSS specific code phase measurements (e.g. chips) are converted into unit of ms by dividing the measurements by the nominal values of the measured signal chipping rate. Scale factor 2^{-21} milli-seconds, in the range from 0 to $(1-2^{-21})$ milli-seconds.
integerCodePhase This field indicates the integer milli-second part of the code phase that is expressed modulo the *gnss-CodePhaseAmbiguity*. The value of the ambiguity is given in the *gnss-CodePhaseAmbiguity* field. The *integerCodePhase* is optional. If *integerCodePhase* is absent, the default value is 0 milli-second. Scale factor 1 milli-second, in the range from 0 to 127 milli-seconds.

***GNSS-MeasurementList* field descriptions**
codePhaseRMSError This field contains the pseudorange RMS error value. This parameter is specified according to a floating-point representation shown in the table below.
doppler This field contains the Doppler measured by the target device for the particular satellite signal. This information can be used to compute the 3-D velocity of the target device. Doppler measurements are converted into unit of m/s by multiplying the Doppler measurement in Hz by the nominal wavelength of the measured signal. Scale factor 0.04 meter/seconds.
adr This field contains the ADR measurement measured by the target device for the particular satellite signal. This information can be used to compute the 3-D velocity or high-accuracy position of the target device. ADR measurements are converted into units of meter by multiplying the ADR measurement by the nominal wavelength of the measured signal. Scale factor 2^{-10} meters, in the range from 0 to 32767.5 meters.

Value of mpathDet to Multipath Indication relation

Value of *mpathDet*	Multipath Indication
00	Not measured
01	Low, MP error < 5m
10	Medium, 5m < MP error < 43m
11	High, MP error > 43m

Bit toPolarity Indication relation

Value	Polarity Indication
0	Data Direct, carrier phase not continuous
1	Data Inverted, carrier phase not continuous
2	Data Direct, carrier phase not continuous
3	Data Inverted, carrier phase continuous

floating-point representation

Index	Mantissa	Exponent	Floating-Point value, x_i	Pseudorange value, P
0	000	000	0.5	P < 0.5
1	001	000	0.5625	0.5 <= P < 0.5625
I	x	y	$0.5 * (1 + x/8) * 2^y$	$x_{i-1} <= P < x_i$
62	110	111	112	104 <= P < 112
63	111	111	--	112 <= P

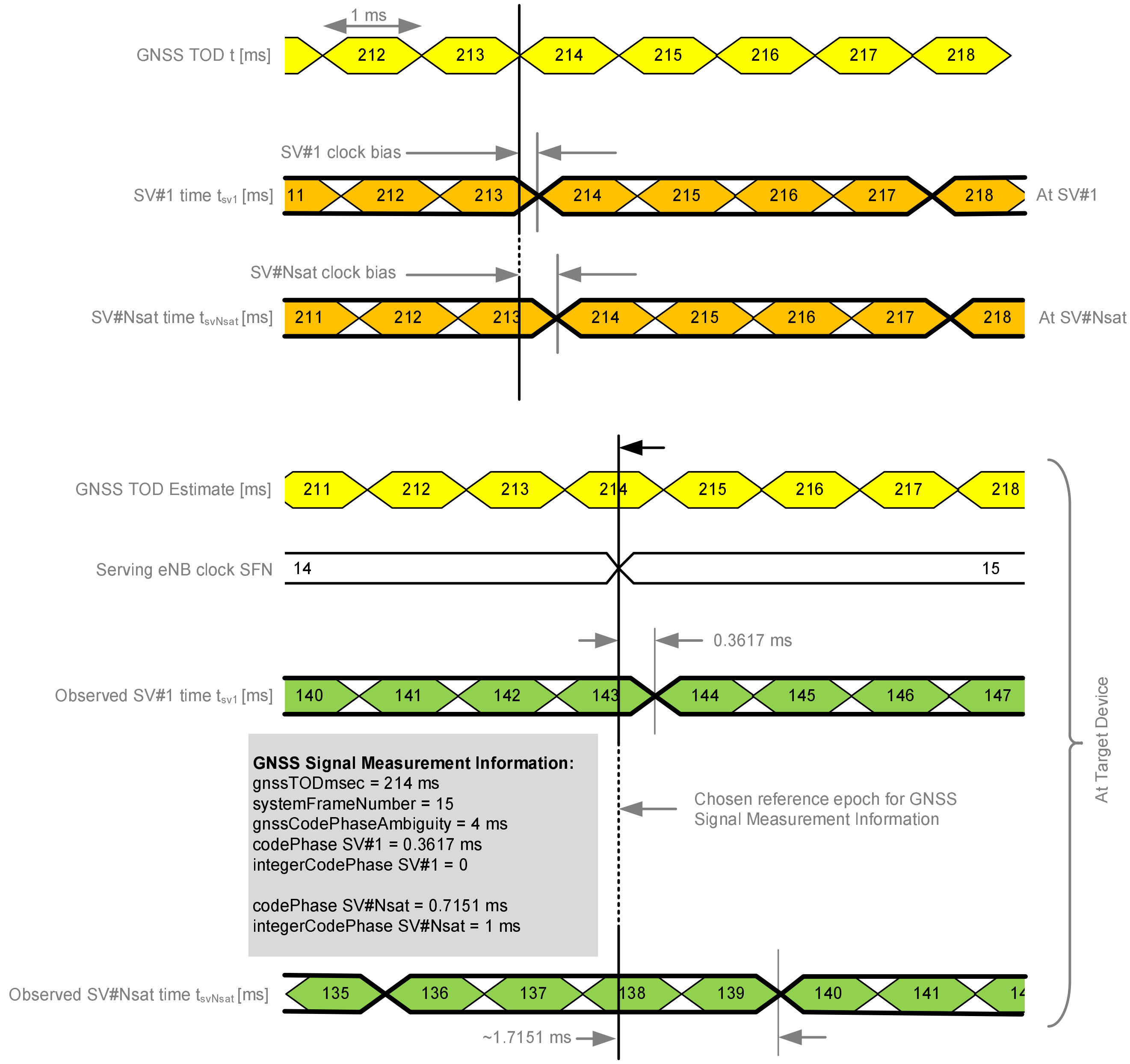

Figure 6.5.2.6-1: Exemplary calculation of some GNSS Signal Measurement Information fields.

– GNSS-LocationInformation

The IE *GNSS-LocationInformation* is included by the target device when location and optionally velocity information derived using GNSS or hybrid GNSS and other measurements is provided to the location server.

```
-- ASN1START

GNSS-LocationInformation ::= SEQUENCE {
    measurementReferenceTime        MeasurementReferenceTime,
    agnss-List                      GNSS-ID-Bitmap,
    ...
}

-- ASN1STOP
```

***GNSS-LocationInformation* field descriptions**

***GNSS-LocationInformation* field descriptions**
measurementReferenceTime This field specifies the GNSS system time for which the location estimate and optionally velocity are valid. It may also include GNSS-network time relationship, if requested by the location server and supported by the target device.
gnss-List This field provides a list of satellite systems used by the target device to calculate the location estimate and velocity estimate, if included. This is represented by a bit string in *GNSS-ID-Bitmap*, with a one-value at the bit position means the particular method has been used; a zero-value means not used.

6.5.2.7 GNSS Location Information Request

– A-GNSS-RequestLocationInformation

The IE *A-GNSS-RequestLocationInformation* is used by the location server to request location information from the target device using GNSS.

```
-- ASN1START

A-GNSS-RequestLocationInformation ::= SEQUENCE {
    gnss-PositioningInstructions        GNSS-PositioningInstructions,
    ...
}

-- ASN1STOP
```

6.5.2.8 GNSS Location Information Request Elements

– GNSS-PositioningInstructions

The IE *GNSS-PositioningInstructions* is used to provide GNSS measurement instructions.

```
-- ASN1START

GNSS-PositioningInstructions ::= SEQUENCE {
    gnss-Methods                    GNSS-ID-Bitmap,
    fineTimeAssistanceMeasReq   BOOLEAN,
    adrMeasReq                  BOOLEAN,
    multiFreqMeasReq            BOOLEAN,
    assistanceAvailability      BOOLEAN,
    ...
}

-- ASN1STOP
```

***GNSS-PositioningInstructions* field descriptions**
gnssMethods This field indicates the satellite systems allowed by the location server. This is represented by a bit string in *GNSS-IDs*, with a one-value at the bit position means the particular GNSS is allowed; a zero-value means not allowed.The target device shall not request assistance data or report or obtain measurements for systems that are not indicated in this bit map.
fineTimeAssistanceMeasReq This field indicates whether the target device is requested to report GNSS-network time association. TRUE means requested.
adrMeasReq This field indicates whether the target device is requested to include ADR measurements in *GNSSMeasurementList* IE or not. TRUE means requested.
multiFreqMeasReq This field indicates whether the target device is requested to report measurements on multiple supported GNSS signal types in *GNSSMeasurementList* IE or not. TRUE means requested.
assistanceAvailability This field indicates whether the target device may request additional GNSS assistance data from the server. TRUE means allowed and FALSE means not allowed.

6.5.2.9 GNSS Capability Information

– A-GNSS-ProvideCapabilities

The IE *A-GNSS-Provide-Capabilities* is used by the target device to indicate its capability to support A-GNSS and to provide it''s A-GNSS location capabilities (e.g., GNSSs and assistance data supported) to the location server.

```
-- ASN1START

A-GNSS-ProvideCapabilities ::= SEQUENCE {
    gnss-SupportList            GNSS-SupportList                OPTIONAL,
    assistanceDataSupportList   AssistanceDataSupportList       OPTIONAL,
    locationCoordinateTypes     LocationCoordinateTypes         OPTIONAL,
    velocityTypes               VelocityTypes                   OPTIONAL,
    ...
}

GNSS-SupportList ::= SEQUENCE (SIZE(1..16)) OF GNSS-SupportElement

GNSS-SupportElement ::= SEQUENCE {
    gnss-ID                         GNSS-ID,
    sbas-IDs                        SBAS-IDs                    OPTIONAL,   -- Cond GNSS-ID-SBAS
    agnss-Modes                     PositioningModes,
    gnss-Signals                    GNSS-SignalIDs,
    fta-MeasSupport                 SEQUENCE {
                                        cellTime    AccessTypes,
                                        mode        PositioningModes,
                                        ...
                                    }                           OPTIONAL,   -- Cond fta
    adr-Support                     BOOLEAN,
    velocityMeasurementSupport      BOOLEAN,
    ...
}

AssistanceDataSupportList ::= SEQUENCE {
    gnss-CommonAssistanceDataSupport    GNSS-CommonAssistanceDataSupport,
    gnss-GenericAssistanceDataSupport   GNSS-GenericAssistanceDataSupport,
    ...
}


-- ASN1STOP
```

Conditional presence	Explanation
GNSS-ID-SBAS	The field is mandatory present if the *GNSS-ID* = *sbas*; otherwise it is not present.
fta	The field is mandatory present if the target device supports the reporting of fine time assistance measurements; otherwise it is not present.

***A-GNSS-ProvideCapabilities* field descriptions**
gnss-ID This field specifies the GNSS supported by the target device for which the capabilities in *GNSS-SupportElement* are provided. This field shall be included if the target device supports at least one GNSS.
sbas-IDs This field specifies the SBAS(s) supported by the target device. This is represented by a bit string, with a one-value at the bit position means the particular SBAS is supported; a zero-value means not supported.
agnss-Modes This field specifies the GNSS mode(s) supported by the target device for the GNSS indicated by *gnss-ID*. This is represented by a bit string, with a one-value at the bit position means the particular GNSS mode is supported; a zero-value means not supported.
gnss-Signals This field specifies the GNSS signal(s) supported by the target device for the GNSS indicated by *gnss-ID*. This is represented by a bit string, with a one-value at the bit position means the particular GNSS signal type is supported; a zero-value means not supported.

***A-GNSS-ProvideCapabilities* field descriptions**
fta-MeasSupport This field specifies that the target device is capable of performing fine time assistance measurements (i.e., GNSS-cellular time association reporting). The *cellTime* field specifies for which cellular network(s) this capability is supported. This is represented by a bit string, with a one-value at the bit position means FTA measurements for the specific cellular network time is supported; a zero-value means not supported. The *mode* field specifies for which GNSS mode(s) FTA measurements are supported by the target device. This is represented by a bit string, with a one-value at the bit position means FTA measurements for the GNSS mode is supported; a zero-value means not supported.
adr-Support This field specifies whether the target device supports ADR measurement reporting. TRUE means supported.
velocityMeasurementSupport This field specifies whether the target device supports measurement reporting related to velocity. TRUE means supported.
assistanceDataSupportList This list defines the assistance data and assistance data choices supported by the target device. This field shall be present if assisted GNSS is supported.
locationCoordinateTypes This parameter identifies the geographical location coordinate types that a target device supports for GNSS. TRUE indicates that a location coordinate type is supported and FALSE that it is not. This field shall be included if the target device supports UE-based or standalone A-GNSS.
velocityTypes This parameter identifies the velocity types that a target device supports for GNSS. TRUE indicates that a velocity type is supported and FALSE that it is not. FALSE for all velocity types indicates that velocity is not supported.

6.5.2.10 GNSS Capability Information Elements

– GNSS-CommonAssistanceDataSupport

The IE *GNSS-CommonAssistanceDataSupport* is used by the target device to provide information on supported GNSS common assistance data types to the location server.

```
-- ASN1START

GNSS-CommonAssistanceDataSupport ::= SEQUENCE {
    gnss-ReferenceTimeSupport               GNSS-ReferenceTimeSupport
                                                                OPTIONAL, -- Cond RefTimeSup
    gnss-ReferenceLocationSupport           GNSS-ReferenceLocationSupport
                                                                OPTIONAL, -- Cond RefLocSup
    gnss-IonosphericModelSupport            GNSS-IonosphericModelSupport
                                                                OPTIONAL, -- Cond IonoModSup
    gnss-EarthOrientationParametersSupport  GNSS-EarthOrientationParametersSupport
                                                                OPTIONAL, -- Cond EOPSup
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
RefTimeSup	The field is mandatory present if the target device supports *GNSS-ReferenceTime*; otherwise it is not present.
RefLocSup	This field is mandatory present if the target device supports *GNSS-ReferenceLocation*; otherwise it is not present.
IonoModSup	This field is mandatory present if the target device supports *GNSS-IonosphericModel*; otherwise it is not present.
EOPSup	This field is mandatory present if the target device supports *GNSS-EarthOrientationParameters*; otherwise it is not present.

– GNSS-ReferenceTimeSupport

```
-- ASN1START

GNSS-ReferenceTimeSupport ::=   SEQUENCE {
    gnss-SystemTime     GNSS-ID-Bitmap,
    fta-Support         AccessTypes                                     OPTIONAL, -- Cond fta
```

```
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
fta	The field is mandatory present if the target device supports fine time assistance in *GNSSReferenceTime* IE; otherwise it is not present.

***GNSS-ReferenceTimeSupport* field descriptions**
gnss-SystemTime This field specifies the GNSS system time(s) supported by the target device. This is represented by a bit string in *GNSS-ID-Bitmap*, with a one-value at the bit position means the particular GNSS system time is supported; a zero-value means not supported.
fta-Support This field specifies that the target device supports fine time assistance (i.e., GNSS-cellular time association) in *GNSS-ReferenceTime* IE. This is represented by a bit string in *AccessTypes*, with a one-value at the bit position means FTA for the specific cellular network time is supported; a zero-value means not supported.

– GNSS-ReferenceLocationSupport

```
-- ASN1START

GNSS-ReferenceLocationSupport ::=   SEQUENCE {
    ...
}

-- ASN1STOP
```

– GNSS-IonosphericModelSupport

```
-- ASN1START

GNSS-IonosphericModelSupport ::=    SEQUENCE {
    ionoModel       BIT STRING {    klobuchar   (0),
                                    neQuick     (1) } (SIZE (1..8)),
    ...
}

-- ASN1STOP
```

***GNSS-IonosphericModelSupport* field descriptions**
ionoModel This field specifies the ionsospheric 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.

– GNSS-EarthOrientationParametersSupport

```
-- ASN1START

GNSS-EarthOrientationParametersSupport ::=  SEQUENCE {
    ...
}

-- ASN1STOP
```

– GNSS-GenericAssistanceDataSupport

The IE *GNSS-GenericAssistanceDataSupport* is used by the target device to provide information on supported GNSS generic assistance data types to the location server for each supported GNSS.

```
-- ASN1START

GNSS-GenericAssistanceDataSupport ::=
                                SEQUENCE (SIZE (1..16)) OF GNSS-GenericAssistDataSupportElement

GNSS-GenericAssistDataSupportElement ::= SEQUENCE {
    gnss-ID                             GNSS-ID,
    sbas-ID                             SBAS-ID                     OPTIONAL, -- Cond GNSS-ID-SBAS
    gnss-TimeModelsSupport              GNSS-TimeModelListSupport
                                                                    OPTIONAL, -- Cond TimeModSup
    gnss-DifferentialCorrectionsSupport GNSS-DifferentialCorrectionsSupport
                                                                    OPTIONAL, -- Cond DGNSS-Sup
    gnss-NavigationModelSupport         GNSS-NavigationModelSupport
                                                                    OPTIONAL, -- Cond NavModSup
    gnss-RealTimeIntegritySupport       GNSS-RealTimeIntegritySupport
                                                                    OPTIONAL, -- Cond RTISup
    gnss-DataBitAssistanceSupport       GNSS-DataBitAssistanceSupport
                                                                    OPTIONAL, -- Cond DataBitsSup
    gnss-AcquisitionAssistanceSupport   GNSS-AcquisitionAssistanceSupport
                                                                    OPTIONAL, -- Cond AcquAssistSup
    gnss-AlmanacSupport                 GNSS-AlmanacSupport
                                                                    OPTIONAL, -- Cond AlmanacSup
    gnss-UTC-ModelSupport               GNSS-UTC-ModelSupport
                                                                    OPTIONAL, -- Cond UTCModSup
    gnss-AuxiliaryInformationSupport    GNSS-AuxiliaryInformationSupport
                                                                    OPTIONAL, -- Cond AuxInfoSup
    ...
}

-- ASN1STOP
```

Conditional presence	Explanation
GNSS-ID-SBAS	The field is mandatory present if the *GNSS-ID* = *sbas*; otherwise it is not present.
TimeModSup	The field is mandatory present if the target device supports *GNSS-TimeModelList*; otherwise it is not present.
DGNSS-Sup	The field is mandatory present if the target device supports *GNSS-DifferentialCorrections*; otherwise it is not present.
NavModSup	The field is mandatory present if the target device supports *GNSS-NavigationModel*; otherwise it is not present.
RTISup	The field is mandatory present if the target device supports *GNSS-RealTimeIntegrity*; otherwise it is not present.
DataBitsSup	The field is mandatory present if the target device supports *GNSS-DataBitAssistance*; otherwise it is not present.
AcquAssistSup	The field is mandatory present if the target device supports *GNSS-AcquisitionAssistance*; otherwise it is not present.
AlmanacSup	The field is mandatory present if the target device supports *GNSS-Almanac*; otherwise it is not present.
UTCModSup	The field is mandatory present if the target device supports *GNSS-UTC-Model*; otherwise it is not present.
AuxInfoSup	The field is mandatory present if the target device supports *GNSS-AuxiliaryInformation*; otherwise it is not present.

– GNSS-TimeModelListSupport

```
-- ASN1START

GNSS-TimeModelListSupport ::=   SEQUENCE {
    ...
}

-- ASN1STOP
```

– GNSS-DifferentialCorrectionSupport

```
-- ASN1START

GNSS-DifferentialCorrectionsSupport ::=     SEQUENCE {
    gnssSignalIDs       GNSS-SignalIDs,
    dgnss-ValidityTimeSup   BOOLEAN,
```

```
    ...
}

-- ASN1STOP
```

GNSS-DifferentialCorrectionsSupport field descriptions
gnss-SignalIDs This field specifies the GNSS signal types for which differential corrections 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 differential corrections for the particular GNSS signal type is supported; a zero-value means not supported.
dgnss-ValidityTimeSup This field specifies if the target device supports estimation of UDRE based on growth rate and validity time for differential corrections. TRUE means supported.

– GNSS-NavigationModelSupport

```
-- ASN1START

GNSS-NavigationModelSupport ::= SEQUENCE {
    clockModel      BIT STRING {    model-1     (0),
                                    model-2     (1),
                                    model-3     (2),
                                    model-4     (3),
                                    model-5     (4) } (SIZE (1..8))     OPTIONAL,
    orbitModel      BIT STRING {    model-1     (0),
                                    model-2     (1),
                                    model-3     (2),
                                    model-4     (3),
                                    model-5     (4) } (SIZE (1..8))     OPTIONAL,
    ...
}

-- ASN1STOP
```

GNSS-NavigationModelSupport field descriptions
clockModel This field specifies the *gnss-ClockModel* choice(s) in *GNSS-NavigationModel* IE supported by the target device for the GNSS indicated by *GNSS-ID*. This is represented by a bit string, with a one-value at the bit position means the particular clock model is supported; a zero-value means not supported. If the target device supports GPS and *GNSS-NavigationModel* assistance, it shall support *clockModel* Model-2. If the target device supports SBAS and *GNSS-NavigationModel* assistance, it shall support *clockModel* Model-5. If the target device supports QZSS and *GNSS-NavigationModel* assistance, it shall support *clockModel* Model-2. If the target device supports Galileo and *GNSS-NavigationModel* assistance, it shall support *clockModel* Model-1. If the target device supports GLONASS and *GNSS-NavigationModel* assistance, it shall support *clockModel* Model-4. If this field is absent, the target device supports the mandatory (native) *clockModel* choice only as listed above for the GNSS indicated by *GNSS-ID*.
orbitModel This field specifies the *gnss-OrbitModel* choice(s) in *GNSS-NavigationModel* IE supported by the target device for the GNSS indicated by *GNSS-ID*. This is represented by a bit string, with a one-value at the bit position means the particular orbit model is supported; a zero-value means not supported. If the target device supports GPS and *GNSS-NavigationModel* assistance, it shall support *orbitModel* Model-2. If the target device supports SBAS and *GNSS-NavigationModel* assistance, it shall support *orbitModel* Model-5. If the target device supports QZSS and *GNSS-NavigationModel* assistance, it shall support *orbitModel* Model-2. If the target device supports Galileo and *GNSS-NavigationModel* assistance, it shall support*orbitModel* Model-1. If the target device supports GLONASS and *GNSS-NavigationModel* assistance, it shall support *orbitModel* Model-4. If this field is absent, the target device supports the mandatory (native) *orbitModel* choice only as listed above for the GNSS indicated by *GNSS-ID*.

– GNSS-RealTimeIntegritySupport

```
-- ASN1START

GNSS-RealTimeIntegritySupport ::=   SEQUENCE {
    ...
}
```

```
-- ASN1STOP
```

– GNSS-DataBitAssistanceSupport

```
-- ASN1START

GNSS-DataBitAssistanceSupport ::=   SEQUENCE {
    ...
}

-- ASN1STOP
```

– GNSS-AcquisitionAssistanceSupport

```
-- ASN1START

GNSS-AcquisitionAssistanceSupport ::=   SEQUENCE {
    ...
}

-- ASN1STOP
```

– GNSS-AlmanacSupport

```
-- ASN1START

GNSS-AlmanacSupport ::=     SEQUENCE {
    almanacModel        BIT STRING {    model-1     (0),
                                        model-2     (1),
                                        model-3     (2),
                                        model-4     (3),
                                        model-5     (4),
                                        model-6     (5) } (SIZE (1..8))     OPTIONAL,
    ...
}

-- ASN1STOP
```

***GNSS-AlmanacSupport* field descriptions**
almanacModel This field specifies the *almanacModel* choice(s) in *GNSS-Almanac* IE supported by the target device for the GNSS indicated by *GNSS-ID*. This is represented by a bit string, with a one-value at the bit position means the particular almanac model is supported; a zero-value means not supported. If the target device supports GPS and *GNSS-Almanac* assistance, it shall support Model-2. If the target device supports SBAS and *GNSS-Almanac* assistance, it shall support Model-6. If the target device supports QZSS and *GNSS-Almanac* assistance, it shall support Model-2. If the target device supports Galileo and *GNSS-Almanac* assistance, it shall support Model-1. If the target device supports GLONASS and *GNSS-Almanac* assistance, it shall support Model-5. If this field is absent, the target device supports the mandatory (native) *almanacModel* choice only as listed above for the GNSS indicated by *GNSS-ID*.

– GNSS-UTC-ModelSupport

```
-- ASN1START

GNSS-UTC-ModelSupport ::=   SEQUENCE {
    utc-Model       BIT STRING {    model-1     (0),
                                    model-2     (1),
                                    model-3     (2),
                                    model-4     (3) } (SIZE (1..8))     OPTIONAL,
    ...
}

-- ASN1STOP
```

***GNSS-UTC-ModelSupport* field descriptions**
utc-Model This field specifies the *GNSS-UTC-Model* choice(s) in *GNSS-UTC-Model* IE supported by the target device for the GNSS indicated by *GNSS-ID*. This is represented by a bit string, with a one-value at the bit position means the particular UTC model is supported; a zero-value means not supported. If the target device supports GPS and *GNSS-UTC-Model* assistance, it shall support Model-1. If the target device supports SBAS and *GNSS-UTC-Model* assistance, it shall support Model-4. If the target device supports QZSS and *GNSS-UTC-Model* assistance, it shall support Model-1. If the target device supports Galileo and *GNSS-UTC-Model* assistance, it shall support Model-1. If the target device supports GLONASS and *GNSS-UTC-Model* assistance, it shall support Model-3. If this field is absent, the target device supports the mandatory (native) *utc-Model* choice only as listed above for the GNSS indicated by *GNSS-ID*.

– GNSS-AuxiliaryInformationSupport

```
-- ASN1START

GNSS-AuxiliaryInformationSupport ::=    SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.2.11 GNSS Capability Information Request

– A-GNSS-RequestCapabilities

The IE *A-GNSS-Request-Capabilities* is used by the location server to request A-GNSS location capabilities (e.g., GNSSs and assistance data supported) from the target device.

```
-- ASN1START

A-GNSS-RequestCapabilities ::= SEQUENCE {
    gnss-SupportListReq             BOOLEAN,
    assistanceDataSupportListReq    BOOLEAN,
    locationVelocityTypesReq        BOOLEAN,
    ...
}

-- ASN1STOP
```

***A-GNSS-RequestCapabilities* field descriptions**
gnss-SupportListReq This field specifies whether the target device is requested to include the *gnss-SupportList* field in the *A-GNSS-ProvideCapabilities* IE or not. TRUE means requested.
assistanceDataSupportListReq This field specifies whether the target device is requested to include the *assistanceDataSupportList* field in the *A-GNSS-ProvideCapabilities* IE or not. TRUE means requested.
locationVelocityTypesReq This field specifies whether the target device is requested to include the *locationCoordinateTypes* field and *velocityTypes* field in the *A-GNSS-ProvideCapabilities* IE or not. TRUE means requested.

6.5.2.12 GNSS Error Elements

– A-GNSS-Error

The IE *A-GNSS-Error* is used by the location server or target device to provide GNSS error reasons.

```
-- ASN1START

A-GNSS-Error ::= CHOICE {
    locationServerErrorCauses       GNSS-LocationServerErrorCauses,
    targetDeviceErrorCauses         GNSS-TargetDeviceErrorCauses,
```

```
    ...
}

-- ASN1STOP
```

– GNSS-LocationServerErrorCauses

The IE *GNSS-LocationServerErrorCauses* is used by the location server to provide GNSS error reasons to the target device.

```
-- ASN1START

GNSS-LocationServerErrorCauses ::= SEQUENCE {
    cause       ENUMERATED  {
                    undefined,
                    undeliveredAssistanceDataIsNotSupportedByServer,
                    undeliveredAssistanceDataIsSupportedButCurrentlyNotAvailableByServer,
                    undeliveredAssistanceDataIsPartlyNotSupportedAndPartlyNotAvailableByServer,
                    ...
                    },
    ...
}

-- ASN1STOP
```

– GNSS-TargetDeviceErrorCauses

The IE *GNSS-TargetDeviceErrorCauses* is used by the target device to provide GNSS error reasons to the location server.

```
-- ASN1START

GNSS-TargetDeviceErrorCauses ::= SEQUENCE {
    cause       ENUMERATED {    undefined,
                                thereWereNotEnoughSatellitesReceived,
                                assistanceDataMissing,
                                notAllRequestedMeasurementsPossible,
                                ...
                            },
    fineTimeAssistanceMeasurementsNotPossible       NULL        OPTIONAL,
    adrMeasurementsNotPossible                      NULL        OPTIONAL,
    multiFrequenceMeasurementsNotPossible           NULL        OPTIONAL,
    ...
}

-- ASN1STOP
```

***GNSS-TargetDeviceErrorCauses* field descriptions**
cause This field provides a GNSS specific error cause. If the cause value is "*notAllRequestedMeasurementsPossible*", the target device was not able to provide all requested GNSS measurements (but may be able to report a location estimate or location measurements). In this case, the target device should include any of the "*fineTimeAssistanceMeasurementsNotPossible*", "*adrMeasurementsNotPossible*", or "*multiFrequenceMeasurementsNotPossible*" fields, as applicable.

6.5.2.13 Common GNSS Information Elements

– AccessTypes

The IE *AccessTypes* is used to indicate several cellular access types using a bit map.

```
-- ASN1START

AccessTypes ::= SEQUENCE {
    accessTypes     BIT STRING {    eutra       (0),
                                    utra        (1),
```

```
                                    gsm         (2)  } (SIZE (1..8)),
    ...
}

-- ASN1STOP
```

***AccessTypes* field descriptions**
accessTypes This field specifies the cellular access type(s). This is represented by a bit string, with a one-value at the bit position means the particular access type is addressed; a zero-value means not addressed.

– GNSS-ID

The IE *GNSS-ID* is used to indicate a specific GNSS.

```
-- ASN1START

GNSS-ID ::= SEQUENCE {
    gnss-id             ENUMERATED{ gps, sbas, qzss, galileo, glonass, ...},
    ...
}

-- ASN1STOP
```

– GNSS-ID-Bitmap

The IE *GNSS-ID-Bitmap* is used to indicate several GNSSs using a bit map.

```
-- ASN1START

GNSS-ID-Bitmap ::= SEQUENCE {
    gnss-ids            BIT STRING {    gps         (0),
                                        sbas        (1),
                                        qzss        (2),
                                        galileo     (3),
                                        glonass     (4)  } (SIZE (1..16)),
    ...
}

-- ASN1STOP
```

***GNSS-ID-Bitmap* field descriptions**
gnss-ids This field specifies the GNSS(s). This is represented by a bit string, with a one-value at the bit position means the particular GNSS is addressed; a zero-value means not addressed.

– GNSS-SignalID

The IE *GNSS-SignalID* is used to indicate a specific GNSS signal type. The interpretation of *GNSS-SignalID* depends on the *GNSS-ID.*

```
-- ASN1START

GNSS-SignalID   ::= SEQUENCE {
    gnss-SignalID       INTEGER (0 .. 7),
    ...
}

-- ASN1STOP
```

***GNSS-SignalID* field descriptions**
gnss-SignalID This field specifies a particular GNSS signal. The interpretation of *gnss-SignalID* depends on the *GNSS-ID* and is as shown in the table System to Value & Explanation relation below.

System to Value & Explanation relation

System	Value	Explanation
GPS	0	GPS L1 C/A
	1	GPS L1C
	2	GPS L2C
	3	GPS L5
	4-7	Reserved
SBAS	0	L1
	1-7	Reserved
QZSS	0	QZS-L1
	1	QZS-L1C
	2	QZS-L2C
	3	QZS-L5
	4-7	Reserved
GLONASS	0	GLONASS G1
	1	GLONASS G2
	2	GLONASS G3
	3-7	Reserved
Galileo	0	Galileo E1
	1	Galileo E5A
	2	Galileo E5B
	3	Galileo E6
	4	Galileo E5A + E5B
	5-7	Reserved

– GNSS-SignalIDs

The IE *GNSSSignal-IDs* is used to indicate several GNSS signals using a bit map. The interpretation of *GNSSSignal-IDs* depends on the *GNSS-ID.*

```
-- ASN1START

GNSS-SignalIDs  ::= SEQUENCE {
    gnss-SignalIDs      BIT STRING (SIZE(8)),
    ...
}

-- ASN1STOP
```

***GNSS-SignalIDs* field descriptions**
gnss-SignalIDs This field specifies one or several GNSS signals using a bit map. A one-value at the bit position means the particular signal is addressed; a zero-value at the particular bit position means the signal is not addressed. The interpretation of the bit map in *gnssSignalIDs* depends on the *GNSS-ID* and is shown in the table below. Unfilled table entries indicate no assignment and shall be set to zero.

interpretation of the bit map in *gnssSignalIDs*

GNSS	Bit 1 (MSB)	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8 (LSB)
GPS	L1 C/A	L1C	L2C	L5				
SBAS	L1							
QZSS	QZS-L1	QZS-L1C	QZS-L2C	QZS-L5				
GLONASS	G1	G2	G3					
Galileo	E1	E5a	E5b	E6	E5a+E5b			

– SBAS-ID

The IE *SBAS-ID* is used to indicate a specific SBAS.

```
-- ASN1START

SBAS-ID ::= SEQUENCE {
    sbas-id             ENUMERATED { waas, egnos, msas, gagan, ...},
    ...
}

-- ASN1STOP
```

– SBAS-IDs

The IE *SBAS-IDs* is used to indicate several SBASs using a bit map.

```
-- ASN1START

SBAS-IDs ::= SEQUENCE {
    sbas-IDs        BIT STRING {    waas        (0),
                                    egnos       (1),
                                    msas        (2),
                                    gagan       (3)   } (SIZE (1..8)),
    ...
}

-- ASN1STOP
```

***SBAS-IDs* field descriptions**
sbasIDs This field specifies one or several SBAS(s) using a bit map. A one-value at the bit position means the particular SBAS is addressed; a zero-value at the particular bit position means the SBAS is not addressed.

– SV-ID

The IE *SV-ID* is used to indicate a specific GNSS satellite. The interpretation of *SV-ID* depends on the *GNSS-ID.*

```
-- ASN1START

SV-ID ::= SEQUENCE {
    satellite-id        INTEGER(0..63),
    ...
}

-- ASN1STOP
```

***SV-ID* field descriptions**
satellite-id This field specifies a particular satellite within a specific GNSS. The interpretation of *satellite-id* depends on the *GNSS-ID* see the table below.

interpretation of *satellite-id*

System	Value of *satellite-id*	Interpretation of *satellite-id*
GPS	"0" – "62" "63"	Satellite PRN Signal No. 1 to 63 Reserved
SBAS	"0" – "38" "39" – "63"	Satellite PRN Signal No. 120 to 158 Reserved
QZSS	"0" – "4" "5 – "63"	Satellite PRN Signal No. 193 to 197 Reserved
GLONASS	"0" – "23" "24 – "63"	Slot Number 1 to 24 Reserved
Galileo	TBD	TBD

6.5.3 Enhanced Cell ID Positioning

6.5.3.1 E-CID Location Information

– ECID-ProvideLocationInformation

The IE *ECID-ProvideLocationInformation* is used by the target device to provide E-CID location measurements to the location server. It may also be used to provide ECID positioning specific error reason.

```
-- ASN1START

ECID-ProvideLocationInformation ::= SEQUENCE {
    ecid-SignalMeasurementInformation   ECID-SignalMeasurementInformation       OPTIONAL,
    ecid-Error                          ECID-Error                              OPTIONAL,
    ...
}

-- ASN1STOP
```

6.5.3.2 E-CID Location Information Elements

– ECID-SignalMeasurementInformation

The IE *ECID-SignalMeasurementInformation* is used by the target device to provide various UE-measurements to the location server.

```
-- ASN1START

ECID-SignalMeasurementInformation ::= SEQUENCE {
    servingCellMeasuredResults  MeasuredResultsElement  OPTIONAL,
    measuredResultsList         MeasuredResultsList,
    ...
}

MeasuredResultsList ::= SEQUENCE (SIZE(1..32)) OF MeasuredResultsElement

MeasuredResultsElement ::= SEQUENCE {
    physCellId      INTEGER (0..503),
    cellGlobalId    CellGlobalIdEUTRA-AndUTRA           OPTIONAL,
    arfcnEUTRA      ARFCN-ValueEUTRA,
    systemFrameNumber
                    BIT STRING (SIZE (10))              OPTIONAL,
    rsrpResult      INTEGER (0..97)                     OPTIONAL,
    rsrqResult      INTEGER (0..34)                     OPTIONAL,
```

```
    ueRxTxTimeDiff  INTEGER (0..4095)                   OPTIONAL,
    ...
}

-- ASN1STOP
```

ECID-SignalMeasurementInformation field descriptions
measuredResultsList This list contains the E-CID measurements for up to 32 cells.
physCellId This field specifies the physical cell identity of the measured cell.
cellGlobalId This field specifies cell global ID of the measured cell. The target device shall provide this field if it was able to determine the ECGI of the measured cell at the time of measurement.
arfcnEUTRA This field specifies the ARFCN of the measured E-UTRA carrier frequency, as defined in [12].
sfn This field specifies the system frame number of the measured neighbour cell. The target device shall include this field if it was able to determine the SFN of the neighbour cell at the time of measurement.
rsrpResult This field specifies the reference signal received power (RSRP) measurement, as defined in [12],[17].
rsrqResult This field specifies the reference signal received quality (RSRQ) measurement, as defined in [12],[17].
ueRxTxTimeDiff This field specifies the UE Rx–Tx time difference measurement, as defined in [17]. It is provided only for measurements on the UE"s serving cell. Measurement report mapping is according to 3GPP TS 36.133 [18]. Editor"s Note: The exact range of the parameter is FFS and should be aligned with RAN4 specifications.

6.5.3.3 E-CID Location Information Request

– ECID-RequestLocationInformation

The IE *ECID-RequestLocationInformation* is used by the location server to request E-CID location measurements from a target device.

```
-- ASN1START

ECID-RequestLocationInformation ::= SEQUENCE {
    requestedMeasurements       BIT STRING {    rsrpReq     (0),
                                                rsrqReq     (1),
                                                ueRxTxReq   (2) } (SIZE(1..8)),
    ...
}

-- ASN1STOP
```

ECID-RequestLocationInformation field descriptions
requestedMeasurements This field specifies the 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.

6.5.3.4 E-CID Capability Information

– ECID-ProvideCapabilities

The IE *ECID-ProvideCapabilities* is used by the target device to indicate its capability to support E-CID and to provide its E-CID location capabilities to the location server.

```
-- ASN1START

ECID-ProvideCapabilities ::= SEQUENCE {
    ecid-MeasSupported  BIT STRING {    rsrpSup     (0),
```

```
                                        rsrqSup     (1),
                                        ueRxTxSup   (2) } (SIZE(1..8)),
    ...
}

-- ASN1STOP
```

***ECID-Provide-Capabilities* field descriptions**
ecid-MeasSupported This field specifies the E-CID measurements supported by the target device. 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. The *ueRxTxSup* field specifies that reporting UE Rx-Tx time difference measurement results via RRC signalling is supported by the target device, as well as reporting UE Rx-Tx time difference measurement results via LPP signalling for downlink E-CID positioning is supported. If a target device doesn"t support LPP, E-SMLC may consider the target device can not report the UE Rx-Tx time difference measurement results via RRC signalling.

6.5.3.5 E-CID Capability Information Request

– ECID-RequestCapabilities

The IE *ECID-Request-Capabilities* is used by the location server to request E-CID location capabilities from a target device.

```
-- ASN1START

ECID-RequestCapabilities ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.5.3.6 E-CID Error Elements

– ECID-Error

The IE *ECID-Error* is used by the location server or target device to provide E-CID error reasons to the target device or location server, respectively.

```
-- ASN1START

ECID-Error ::= CHOICE {
    locationServerErrorCauses       ECID-LocationServerErrorCauses,
    targetDeviceErrorCauses         ECID-TargetDeviceErrorCauses,
    ...
}

-- ASN1STOP
```

– ECID-LocationServerErrorCauses

The IE *ECID-LocationServerErrorCauses* is used by the location server to provide E-CID error reasons to the target device.

```
-- ASN1START

ECID-LocationServerErrorCauses ::= SEQUENCE {
    cause       ENUMERATED  {   undefined,
                                ...
                            },
    ...
}

-- ASN1STOP
```

– ECID-TargetDeviceErrorCauses

The IE *ECID-TargetDeviceErrorCauses* is used by the target device to provide E-CID error reasons to the location server.

```
-- ASN1START

ECID-TargetDeviceErrorCauses ::= SEQUENCE {
    cause       ENUMERATED {    undefined,
                                requestedMeasurementNotAvailable,
                                notAllrequestedMeasurementsPossible,
                                ...
                            },
    rsrpMeasurementNotPossible              NULL        OPTIONAL,
    rsrqMeasurementNotPossible              NULL        OPTIONAL,
    ueRxTxMeasurementNotPossible            NULL        OPTIONAL,
    ...
}

-- ASN1STOP
```

***ECID-TargetDeviceErrorCauses* field descriptions**
cause This field provides a ECID specific error cause. If the cause value is "*notAllRequestedMeasurementsPossible*", the target device was not able to provide all requested ECID measurements (but may be able to provide some measurements). In this case, the target device should include any of the "*rsrpMeasurementNotPossible*", "*rsrqMeasurementNotPossible*", or "*ueRxTxMeasurementNotPossible*" fields, as applicable.

– End of LPP-PDU-Definitions

```
-- ASN1START

END

-- ASN1STOP
```

Annex A (informative): Change History

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2009-10	RAN2 #67bis	R2-096252			RAN2 agreed TS 36.355 v0.1.0	-	0.1.0
2009-11	RAN2 #68	R2-097492			RAN2 agreed TS 36.355 v2.0.0	0.1.0	2.0.0
2009-12	RP-46	RP-091208			RAN #46 approval of TS 36.355	2.0.0	9.0.0
2010-03	RP-47	RP-100304	0001	-	Clarification on Position location	9.0.0	9.1.0
	RP-47	RP-100304	0002	-	Clarification on UE Rx-Tx time difference supporting capability	9.0.0	9.1.0
	RP-47	RP-100304	0003	2	Completion of LPP common material	9.0.0	9.1.0
	RP-47	RP-100304	0004	5	Completion of OTDOA in LPP	9.0.0	9.1.0
	RP-47	RP-100304	0006	-	Provision of Frame Drift Information in Network Time	9.0.0	9.1.0
	RP-47	RP-100304	0007	-	Clarification of measurement reference point	9.0.0	9.1.0
	RP-47	RP-100304	0010	-	GNSS-DifferentialCorrectionsSupport	9.0.0	9.1.0
	RP-47	RP-100304	0011	-	BSAlign Indication in GNSS Reference Time	9.0.0	9.1.0
	RP-47	RP-100304	0012	1	Changes to reflect LPP ASN.1 review	9.0.0	9.1.0
	RP-47	RP-100304	0013	1	Introduction of LPP reliability sublayer	9.0.0	9.1.0
	RP-47	RP-100304	0015	-	LPP error procedures and conditions	9.0.0	9.1.0
	RP-47	RP-100304	0016	-	Triggered Location Information Transfer due to Cell Change	9.0.0	9.1.0

History

Document history		
V9.0.0	February 2010	Publication
V9.1.0	May 2010	Publication