

ETSI TS 136 355 V14.1.0 (2017-04)



TECHNICAL SPECIFICATION

**LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
LTE Positioning Protocol (LPP)
(3GPP TS 36.355 version 14.1.0 Release 14)**



Reference

RTS/TSGR-0236355ve10

Keywords

LTE

ETSI

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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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- [26] IEEE 802.11, Part 11: "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".
- [27] IETF RFC 6225, "Dynamic Host Configuration Protocol Options for Coordinate-Based Location Configuration Information", July 2011.
- [28] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".
- [29] "Earth Gravitational Model 96 (EGM96)", National Geospatial-Intelligence Agency, NASA.

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.

Anchor carrier: In NB-IoT, a carrier where the UE assumes that NPSS/NSSS/NPBCH/SIB-NB are transmitted.

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. A Location Server may also compute or verify the final location estimate.

NB-IoT: NB-IoT allows access to network services via E-UTRA with a channel bandwidth limited to 200 kHz.

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).

Transmission Point (TP): A set of geographically co-located transmit antennas for one cell, part of one cell or one PRS-only TP. Transmission Points can include base station (eNodeB) antennas, remote radio heads, a remote antenna of a base station, an antenna of a PRS-only TP, etc. One cell can be formed by one or multiple transmission points. For a homogeneous deployment, each transmission point may correspond to one cell.

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 TPs. If a signal from TP 1 is received at the moment t_1 , and a signal from TP 2 is received at the moment t_2 , the OTDOA is $t_2 - t_1$.

PRS-only TP: A TP which only transmits PRS signals for PRS-based TBS positioning and is not associated with a cell.

3.2 Abbreviations

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

ADR	Accumulated Delta-Range
A-GNSS	Assisted-GNSS
AP	Access Point
ARFCN	Absolute Radio Frequency Channel Number
BDS	BeiDou Navigation Satellite System
BSSID	Basic Service Set Identifier
BTS	Base Transceiver Station (GERAN)
CID	Cell-ID (positioning method)
CNAV	Civil Navigation
CRS	Cell-specific Reference Signals
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	Evolved 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
LLA	Latitude Longitude Altitude
LPP	LTE Positioning Protocol
LPPa	LTE Positioning Protocol Annex
LSB	Least Significant Bit
MBS	Metropolitan Beacon System
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
NB-IoT	NarrowBand Internet of Things
NICT	National Institute of Information and Communications Technology
NI-LR	Network Induced Location Request
NPRS	Narrowband Positioning Reference Signals
NRSRP	Narrowband Reference Signal Received Power
NRSRQ	Narrowband Reference Signal Received Quality
NTSC	National Time Service Center of Chinese Academy of Sciences
OTDOA	Observed Time Difference Of Arrival
PDU	Protocol Data Unit
PRB	Physical Resource Block
PRC	Pseudo-Range Correction
PRS	Positioning Reference Signals
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
RTT	Round Trip Time
RU	Russia
SBAS	Space Based Augmentation System
SET	SUPL Enabled Terminal
SFN	System Frame Number
SLP	SUPL Location Platform
SSID	Service Set Identifier
SUPL	Secure User Plane Location
SV	Space Vehicle
TB	Terrestrial Beacon
TBS	Terrestrial Beacon System
TLM	Telemetry
TOD	Time Of Day
TOW	Time Of Week
TP	Transmission Point
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
WLAN	Wireless Local Area Network

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]).

NB-IoT is a non backward compatible variant of E-UTRAN supporting a reduced set of functionality. In this specification, procedures and messages specified for the UE equally apply to the UE in NB-IoT.

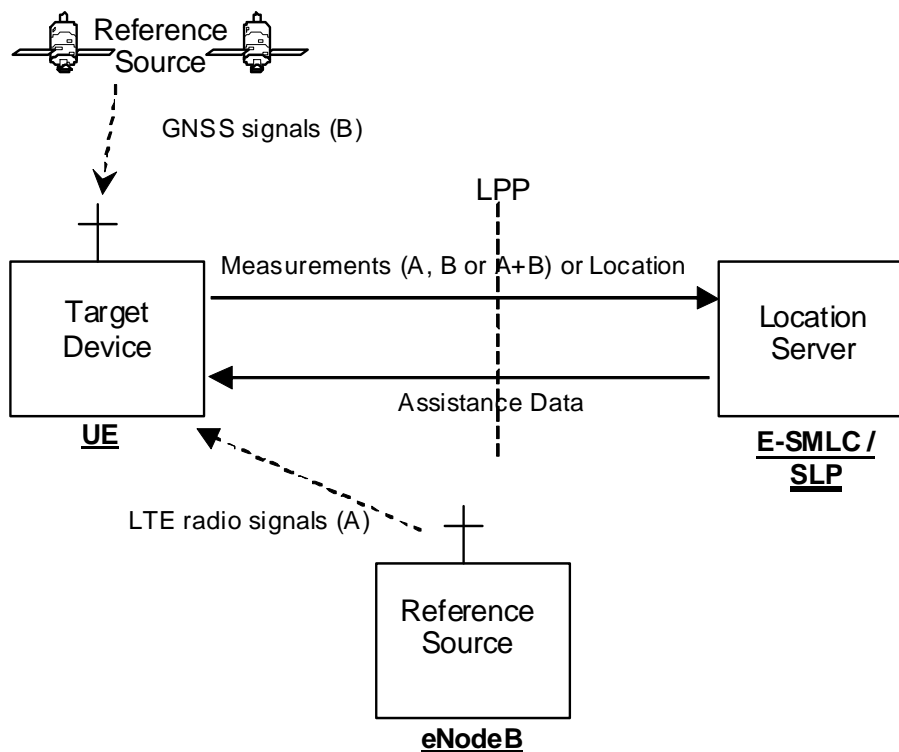


Figure 4.1.1-1: LPP Configuration for Control- and User-Plane Positioning in E-UTRAN

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, with each LPP transaction performing a single operation (capability exchange, assistance data transfer, or location information transfer). In E-UTRAN the LPP transactions are realized as LPP 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).

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, E-CID, Barometric Sensor, TBS, WLAN, and Bluetooth 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. Each message type contains information specific to one or more positioning methods and/or information common to all 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
Sequence Number	Enable detection of a duplicate LPP message at a receiver
Acknowledgement	Enable an acknowledgement to be requested and/or returned for any LPP message

NOTE: Use of the Transaction ID and Transaction End fields conform to the procedures in clause 5 and are independent of the means used to transport LPP messages (e.g., whether using a NAS MO-LR Request, NAS Generic Transport or user-plane solution).

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.

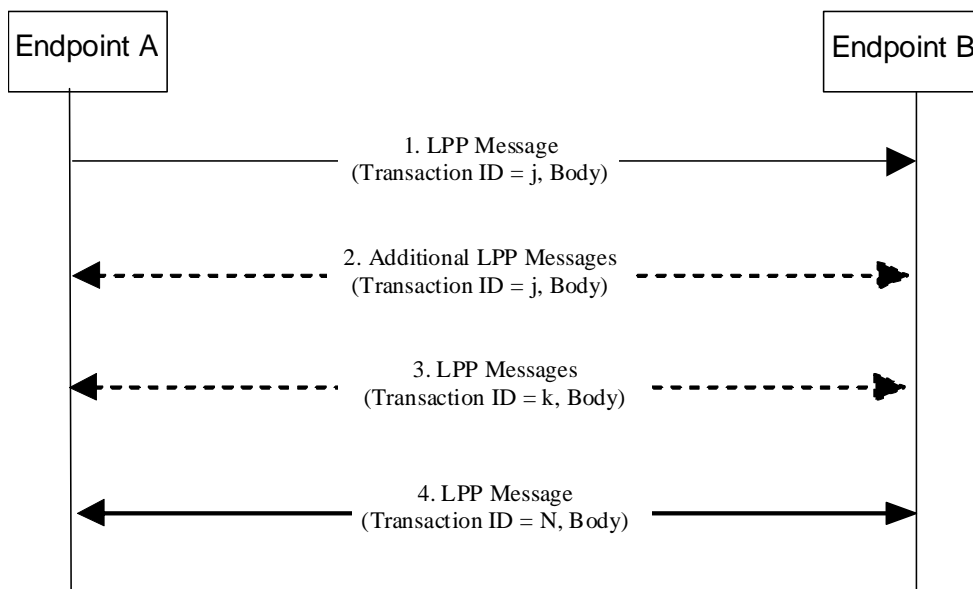


Figure 4.2-1 LPP Session Procedure

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 IE *endTransaction* 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. This section describes the transport capabilities that are available within LPP. A UE implementing LPP for the control-plane solution shall support LPP reliable transport (including all three of duplicate detection, acknowledgement, and retransmission).

LPP reliable transport functionality is not used in the user-plane solution.

The following requirements in subclauses 4.3.2, 4.3.3, and 4.3.4 for LPP reliable transport apply only when the capability is supported.

4.3.2 LPP Duplicate Detection

A sender shall include a sequence number in all LPP messages sent for a particular location session. The sequence number shall be distinct for different LPP messages sent in the same direction in the same location session (e.g., may start at zero in the first LPP message and increase monotonically in each succeeding LPP message). Sequence numbers used in the uplink and downlink are independent (e.g., can be the same).

A receiver shall record 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 Acknowledgement

4.3.3.1 General

Each LPP message may carry an acknowledgement request and/or an acknowledgement indicator. A LPP message including an acknowledgement request (i.e., that include the IE *ackRequested* set to TRUE) shall also include a sequence number. Upon reception of an LPP message which includes the IE *ackRequested* set to TRUE, a receiver returns an LPP message with an acknowledgement response (i.e., that includes the *ackIndicator* IE set to the same sequence number of the message being acknowledged). An acknowledgement response may contain no LPP message body (in which case only the sequence number being acknowledged is significant); alternatively, the acknowledgement may be sent in an LPP message along with an LPP message body. An acknowledgement is returned for each received LPP message that requested an acknowledgement including any duplicate(s). Once a sender receives an acknowledgement 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.

When an LPP message is transported via a NAS MO-LR request, the message does not request an acknowledgement.

4.3.3.2 Procedure related to Acknowledgement

Figure 4.3.3.2-1 shows the procedure related to acknowledgement.

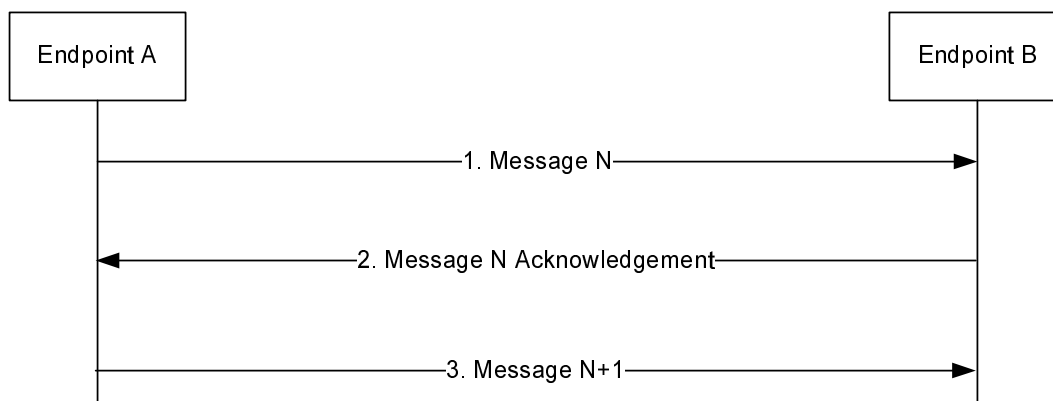


Figure 4.3.3.2-1: LPP Acknowledgement procedure

1. Endpoint A sends an LPP message N to Endpoint B which includes the IE *ackRequested* set to TRUE and a sequence number.
2. If LPP message N is received and Endpoint B is able to decode the *ackRequested* value and sequence number, Endpoint B shall return an acknowledgement for message N . The acknowledgement shall contain the IE *ackIndicator* set to the same sequence number as that in message N .
3. When the acknowledgement for LPP message N is received and provided the included *ackIndicator* IE matches the sequence number sent in message N , Endpoint A sends the next LPP message $N+1$ to Endpoint B when this message is available.

4.3.4 LPP Retransmission

4.3.4.1 General

This capability builds on the acknowledgement 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 250ms.

For NB-IoT the timeout period may be determined by the sender implementation based on the coverage level of the UE. If the coverage level is not known by the sender, the timeout period should not be less than a minimum value of [FFS] seconds.

4.3.4.2 Procedure related to Retransmission

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

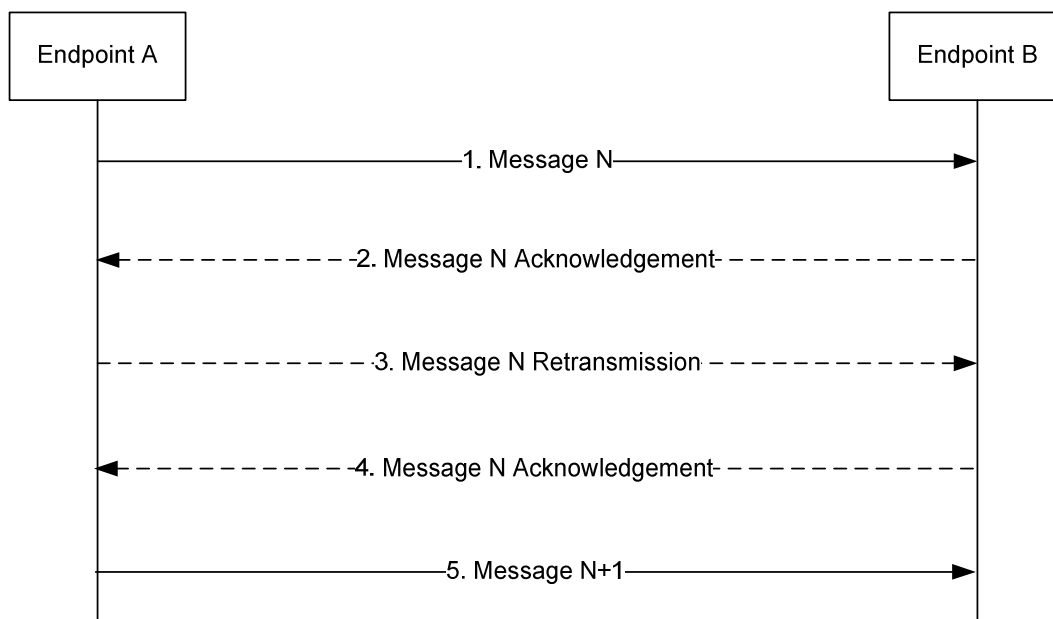


Figure 4.3.4.2-1: LPP Retransmission procedure

1. Endpoint A sends an LPP message N to Endpoint B for a particular location session and includes a request for acknowledgement along with a sequence number.
2. If LPP message N is received and Endpoint B is able to decode the *ackRequested* value and sequence number (regardless of whether the message body can be correctly decoded), Endpoint B shall return an acknowledgement for message N . If the acknowledgement is received by Endpoint A (such that the acknowledged message can be identified and sequence numbers are matching), Endpoint A skips steps 3 and 4.
3. If the acknowledgement in step 2 is not received after a timeout period, Endpoint A shall retransmit LPP message N and shall include the same sequence number as in step 1.
4. If LPP message N in step 3 is received and Endpoint B is able to decode the *ackRequested* value and sequence number (regardless of whether the message body can be correctly decoded and whether or not the message is considered a duplicate), Endpoint B shall return an acknowledgement. Steps 3 may be repeated one or more times if the acknowledgement in step 4 is not received after a timeout period by Endpoint A. If the acknowledgement in step 4 is still not received after sending three retransmissions, Endpoint A shall abort all procedures and activity associated with LPP support for the particular location session.
5. Once an acknowledgement 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 positioning 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.

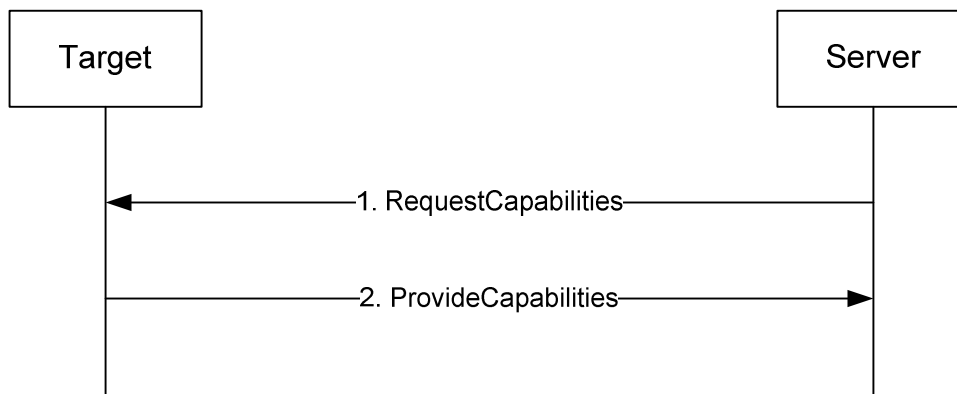


Figure 5.1.1-1: LPP Capability Transfer procedure

1. The server sends a *RequestCapabilities* message to the target. The server may indicate the types of capability needed.
2. The target responds with a *ProvideCapabilities* message to the server. The capabilities shall correspond to any capability types specified in step 1. This message shall include the *endTransaction* IE set to TRUE.

5.1.2 Capability Indication procedure

The Capability Indication procedure allows the target to provide unsolicited capabilities to the server and is shown in Figure 5.1.2-1.

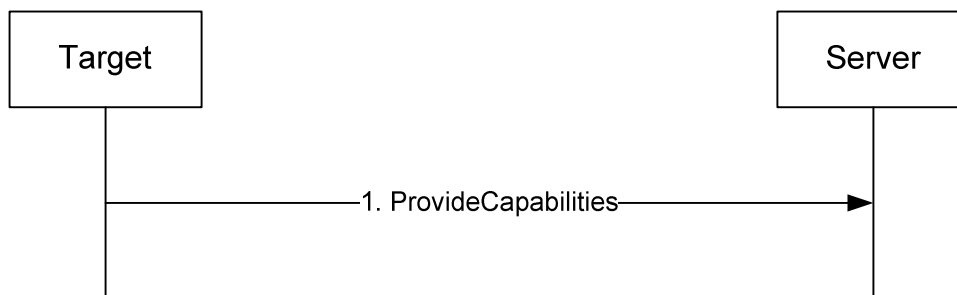


Figure 5.1.2-1: LPP Capability Indication procedure

1. The target sends a *ProvideCapabilities* message to the server. This message shall include the *endTransaction* IE set to TRUE.

5.1.3 Reception of LPP Request Capabilities

Upon receiving a *RequestCapabilities* message, the target device shall generate a *ProvideCapabilities* 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> include 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 a *ProvideCapabilities* 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;
 - 2> if OTDOA capabilities are to be indicated:
 - 3> include the IE *supportedBandListEUTRA*;
- 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.

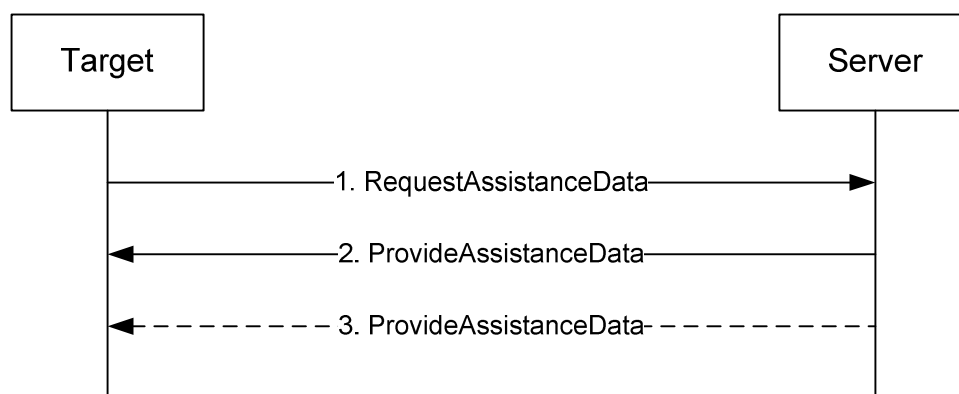


Figure 5.2.1-1: LPP Assistance data transfer procedure

1. The target sends a *RequestAssistanceData* message to the server.
2. The server responds with a *ProvideAssistanceData* 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. The server may also provide any not requested information that it considers useful to the target. If step 3 does not occur, this message shall set the *endTransaction* IE to TRUE.
3. The server may transmit one or more additional *ProvideAssistanceData* 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 server may also provide any not requested information that it considers useful to the target. The last message shall include the *endTransaction* IE set to TRUE.

5.2.2 Assistance Data Delivery procedure

The Assistance Data Delivery procedure allows the server to provide unsolicited assistance data to the target and is shown in Figure 5.2.2-1.

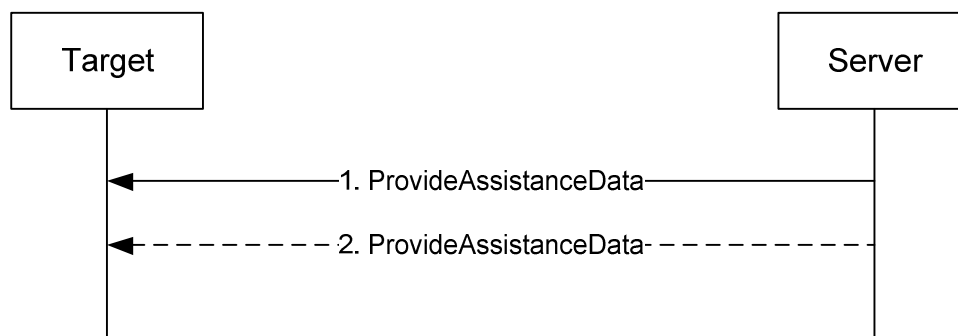


Figure 5.2.2-1: LPP Assistance data transfer procedure

1. The server sends a *ProvideAssistanceData* message to the target containing assistance data. If step 2 does not occur, this message shall set the *endTransaction* IE to TRUE.
2. The server may transmit one or more additional *ProvideAssistanceData* messages to the target containing additional assistance data. The last message shall include the *endTransaction* IE set to TRUE.

5.2.3 Transmission of LPP Request Assistance Data

When triggered to transmit a *RequestAssistanceData* 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 a *ProvideAssistanceData* message, the target device shall:

- 1> for each positioning method contained in the message:
 - 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.

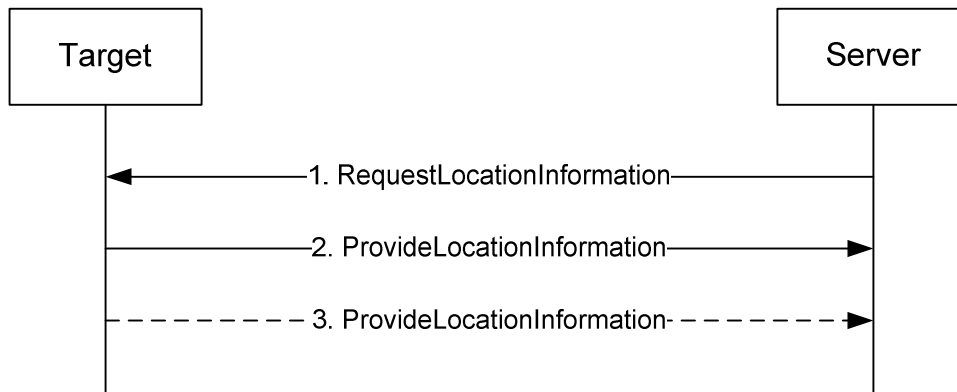


Figure 5.3.1-1: LPP Location Information transfer procedure

1. The server sends a *RequestLocationInformation* message to the target to request location information, indicating the type of location information needed and potentially the associated QoS.
2. The target sends a *ProvideLocationInformation* 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. If step 3 does not occur, this message shall set the *endTransaction* IE to TRUE.
3. If requested in step 1, the target sends additional *ProvideLocationInformation* 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 shall include the *endTransaction* IE set to TRUE.

5.3.2 Location Information Delivery procedure

The Location Information Delivery allows the target to provide unsolicited location information to the server. The procedure is shown in Figure 5.3.2-1.

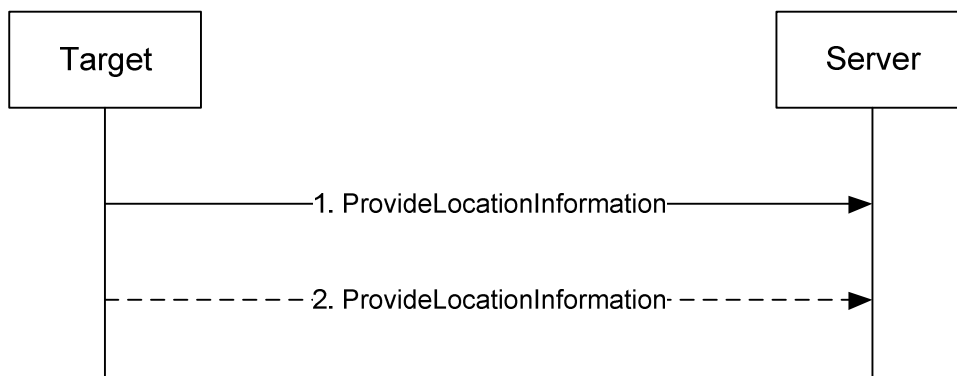


Figure 5.3.2-1: LPP Location Information Delivery procedure

1. The target sends a *ProvideLocationInformation* message to the server to transfer location information. If step 2 does not occur, this message shall set the *endTransaction* IE to TRUE.
2. The target may send one or more additional *ProvideLocationInformation* messages to the server containing additional location information data. The last message shall include the *endTransaction* IE set to TRUE.

5.3.3 Reception of Request Location Information

Upon receiving a *RequestLocationInformation* 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 a *ProvideLocationInformation* 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 *ProvideLocationInformation* 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 positioning methods;
 - 3> handle the signaling content of the unsupported positioning methods by LPP error detection as in 5.4.3.

5.3.4 Transmission of Provide Location Information

When triggered to transmit *ProvideLocationInformation* message, the target device shall:

- 1> for each positioning method contained in the message:
 - 2> set the corresponding IE to include the available location information;
- 1> deliver the response to lower layers for transmission.

5.4 Error Handling Procedures

5.4.1 General

This sub-clause describes how a receiving entity (target device or location server) 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 Error indication procedure.

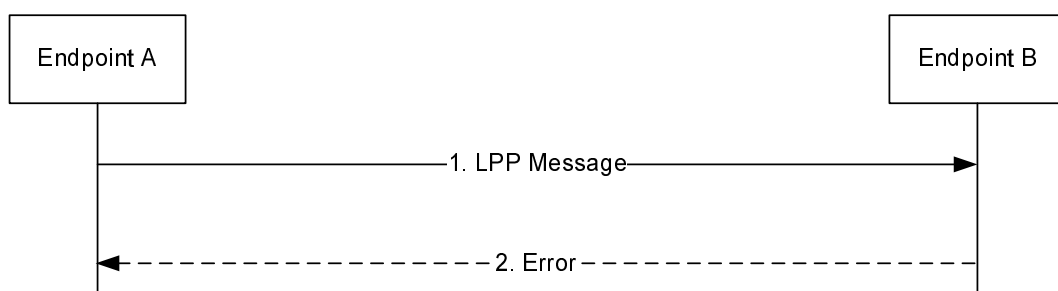


Figure 5.4.2-1: LPP Error Indication procedure

1. Endpoint A sends an LPP message to Endpoint B.
2. Endpoint B determines that the LPP message in step 1 contains an error. Endpoint B returns an *Error* message to Endpoint A indicating the error or errors and discards the message in step 1. If Endpoint B is able to determine that the erroneous LPP message in step 1 is an LPP Error or Abort Message, Endpoint B discards the message in step 1 without returning an *Error* message to Endpoint A.

5.4.3 LPP Error Detection

Upon receiving any LPP message, the receiving entity shall attempt to decode the message and verify the presence of any errors and:

- 1> if decoding errors are encountered:
 - 2> if the receiver can not determine that the received message is an LPP *Error* or *Abort* message:
 - 3> return an LPP *Error* message to the sender and include the received *LPP-TransactionID*, if this was decoded, and type of error;
 - 3> discard the received message and stop the error detection procedure;
- 1> if the message is a duplicate of a previously received message:
 - 2> discard the message and stop the error detection procedure;
- 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 LPP *Error* message to the sender and include the received transaction ID and type of error;
 - 2> discard the message and stop the error detection procedure;
- 1> if the message type is an LPP *RequestCapabilities* and some of the requested information is not supported:
 - 2> return any information that can be provided in a normal response.
- 1> if the message type is an LPP *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, which includes indications on other information that is not supported.

5.4.4 Reception of an LPP Error Message

Upon receiving an *Error* message, a device shall:

- 1> abort any ongoing procedure associated with the *LPP-TransactionID* if included in the received 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 allow the target device or location server to abort an ongoing procedure due to some unexpected event (e.g., cancellation of a location request by an LCS client). It can also be used to stop an ongoing procedure (e.g., periodic location reporting from the target device).

5.5.2 Procedures related to Abort

Figure 5.5.2-1 shows the Abort procedure.

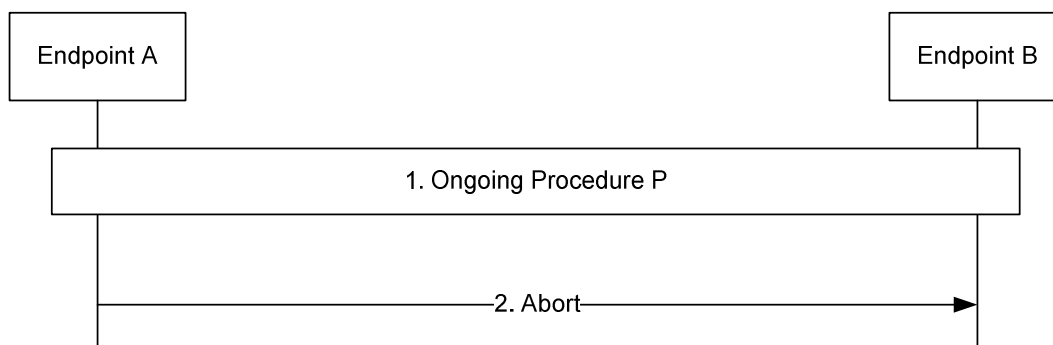


Figure 5.5.2-1: LPP Abort procedure

1. A procedure P is ongoing between endpoints A and B.
2. Endpoint A determines that the procedure must be aborted and sends an *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 *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 fields specified in the message syntax.

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

Transfer syntax for LPP messages is derived from their ASN.1 definitions by use of Basic Packed Encoding Rules (BASIC-PER), Unaligned Variant, as specified in ITU-T Rec. X.691 [22]. The encoded LPP message always contains a multiple of 8 bits.

Transfer syntax for LPP IEs is derived from their ASN.1 definitions by use of Basic Packed Encoding Rules (BASIC-PER), Unaligned Variant, as specified in ITU-T Rec. X.691 [22]. The encoded LPP IE always contains a multiple of 8 bits. This applies when a single LPP IE is encoded as the basic production, i.e. for other purposes than encoding the LPP IE within an LPP message.

The need for fields to be present in a message or an abstract type, i.e., the ASN.1 fields that are specified as OPTIONAL in the abstract notation (ASN.1), is specified by means of comment text tags attached to the OPTIONAL statement in the abstract syntax. The meaning of each tag is specified in table 6.1-1. These tags are used in the downlink (server to target) direction only.

Table 6.1-1: Meaning of abbreviations used to specify the need for fields to be present

Abbreviation	Meaning
Cond <i>conditionTag</i>	<i>Conditionally present</i> A field for which the need is specified by means of conditions. For each <i>conditionTag</i> , the need is specified in a tabular form following the ASN.1 segment. In case, according to the conditions, a field is not present, the target takes no action and where applicable shall continue to use the existing value (and/or the associated functionality) unless explicitly stated otherwise in the description of the field itself.
Need OP	<i>Optionally present</i> A field that is optional to signal. For downlink messages, the target is not required to take any special action on absence of the field beyond what is specified in the procedural text or

Abbreviation	Meaning
	the field description table following the ASN.1 segment. The target behaviour on absence should be captured either in the procedural text or in the field description.
Need ON	<i>Optionally present, No action</i> A field that is optional to signal. If the message is received by the target, and in case the field is absent, the target takes no action and where applicable shall continue to use the existing value (and/or the associated functionality).
Need OR	<i>Optionally present, Release</i> A field that is optional to signal. If the message is received by the target, and in case the field is absent, the target shall discontinue/ stop using/ delete any existing value (and/ or the associated functionality).

When specifying information elements which are to be represented by BIT STRINGS, if not otherwise specifically stated in the field description of the concerned IE or elsewhere, the following principle applies with regards to the ordering of bits:

- The first bit (leftmost bit) contains the most significant bit (MSB);
- the last bit (rightmost bit) contains the least significant bit (LSB).

6.2 LPP PDU Structure

– *LPP-PDU-Definitions*

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

```
-- ASN1START
LPP-PDU-Definitions {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (21) modules (3) lpp (7) version1 (1) lpp-PDU-Definitions (1) }
DEFINITIONS AUTOMATIC TAGS ::=
BEGIN
-- ASN1STOP
```

– *LPP-Message*

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

```
-- ASN1START
LPP-Message ::= SEQUENCE {
  transactionID      LPP-TransactionID  OPTIONAL,  -- Need ON
  endTransaction     BOOLEAN,
  sequenceNumber     SequenceNumber     OPTIONAL,  -- Need ON
  acknowledgement    Acknowledgement    OPTIONAL,  -- Need ON
  lpp-MessageBody    LPP-MessageBody    OPTIONAL  -- Need ON
}
SequenceNumber ::= INTEGER (0..255)
Acknowledgement ::= SEQUENCE {
  ackRequested       BOOLEAN,
  ackIndicator       SequenceNumber     OPTIONAL
}
-- ASN1STOP
```

LPP-Message field descriptions
<p>transactionID This field is omitted if an <i>lpp-MessageBody</i> is not present (i.e. in an LPP message sent only to acknowledge a previously received message) or if it is not available to the transmitting entity (e.g., in an <i>LPP-Error</i> message triggered by a message that could not be parsed). If present, this field shall be ignored at a receiver in an LPP message for which the <i>lpp-MessageBody</i> is not present.</p>
<p>endTransaction This field indicates whether an LPP message is the last message carrying an <i>lpp-MessageBody</i> in a transaction (TRUE) or not last (FALSE).</p>
<p>sequenceNumber This field may be included when LPP operates over the control plane and an <i>lpp-MessageBody</i> is included but shall be omitted otherwise.</p>
<p>acknowledgement This field is included in an LPP acknowledgement and in any LPP message requesting an acknowledgement when LPP operates over the control plane and is omitted otherwise</p>
<p>ackRequested This field indicates whether an LPP acknowledgement is requested (TRUE) or not (FALSE). A value of TRUE may only be included when an <i>lpp-MessageBody</i> is included.</p>
<p>ackIndicator This field indicates the sequence number of the message being acknowledged.</p>
<p>lpp-MessageBody This field may be omitted in case the message is sent only to acknowledge a previously received message.</p>

– *LPP-MessageBody*

The *LPP-MessageBody* identifies the type of an LPP 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 and the initiator of the transaction.

```
-- ASN1START
LPP-TransactionID ::= SEQUENCE {
    initiator          Initiator,
    transactionNumber TransactionNumber,
    ...
}

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

TransactionNumber ::= INTEGER (0..255)
-- ASN1STOP
```

6.3 Message Body IEs

– *RequestCapabilities*

The *RequestCapabilities* message body in a LPP message is used by the location server to request the target device capability information for LPP and the supported 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, -- Need ON
    otdoa-RequestCapabilities      OTDOA-RequestCapabilities      OPTIONAL, -- Need ON
    ecid-RequestCapabilities      ECID-RequestCapabilities      OPTIONAL, -- Need ON
    epdu-RequestCapabilities      EPDU-Sequence      OPTIONAL, -- Need ON
    . . . ,
    [[ sensor-RequestCapabilities-r13      Sensor-RequestCapabilities-r13      OPTIONAL, -- Need ON
    tbs-RequestCapabilities-r13      TBS-RequestCapabilities-r13      OPTIONAL, -- Need ON
    wlan-RequestCapabilities-r13      WLAN-RequestCapabilities-r13      OPTIONAL, -- Need ON
    bt-RequestCapabilities-r13      BT-RequestCapabilities-r13      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 body in a LPP message indicates the LPP capabilities of the target device to the location server.

```
-- 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,
    a-gnss-ProvideCapabilities      A-GNSS-ProvideCapabilities      OPTIONAL,
    otdoa-ProvideCapabilities      OTDOA-ProvideCapabilities      OPTIONAL,
    ecid-ProvideCapabilities      ECID-ProvideCapabilities      OPTIONAL,
    epdu-ProvideCapabilities      EPDU-Sequence      OPTIONAL,
    . . . ,
    [[ sensor-ProvideCapabilities-r13      Sensor-ProvideCapabilities-r13      OPTIONAL,
    tbs-ProvideCapabilities-r13      TBS-ProvideCapabilities-r13      OPTIONAL,
    wlan-ProvideCapabilities-r13      WLAN-ProvideCapabilities-r13      OPTIONAL,
    bt-ProvideCapabilities-r13      BT-ProvideCapabilities-r13      OPTIONAL
    ]]
}
```

```
}
-- 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 body in a LPP message is used by the target device to request assistance data from the location server.

```
-- 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,
    a-gnss-RequestAssistanceData      A-GNSS-RequestAssistanceData      OPTIONAL,
    otdoa-RequestAssistanceData        OTDOA-RequestAssistanceData        OPTIONAL,
    epdu-RequestAssistanceData          EPDU-Sequence                      OPTIONAL,
    . . . ,
    [[ sensor-RequestAssistanceData-r14
        Sensor-RequestAssistanceData-r14    OPTIONAL,
        tbs-RequestAssistanceData-r14      TBS-RequestAssistanceData-r14      OPTIONAL,
        wlan-RequestAssistanceData-r14     WLAN-RequestAssistanceData-r14     OPTIONAL
    ]]
}

-- ASN1STOP
```

ProvideAssistanceData

The *ProvideAssistanceData* message body in a LPP message is used by the location server to provide assistance data to the target device either in response to a request from the target device or in an unsolicited manner.

```
-- 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
    . . . ,
    [[ sensor-ProvideAssistanceData-r14
        Sensor-ProvideAssistanceData-r14    OPTIONAL, -- Need ON
        tbs-ProvideAssistanceData-r14      TBS-ProvideAssistanceData-r14      OPTIONAL, -- Need ON
        wlan-ProvideAssistanceData-r14     WLAN-ProvideAssistanceData-r14     OPTIONAL, -- Need ON
    ]]
}

-- ASN1STOP
```

```
-- 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 body in a LPP message is used by the location server to request positioning measurements or a position estimate from the target device.

```
-- 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
    ...,
    [
        sensor-RequestLocationInformation-r13
            Sensor-RequestLocationInformation-r13  OPTIONAL,  -- Need ON
        tbs-RequestLocationInformation-r13  TBS-RequestLocationInformation-r13  OPTIONAL,  -- Need ON
        wlan-RequestLocationInformation-r13  WLAN-RequestLocationInformation-r13  OPTIONAL,  -- Need ON
        bt-RequestLocationInformation-r13  BT-RequestLocationInformation-r13  OPTIONAL  -- Need ON
    ]
}

-- ASN1STOP
```

RequestLocationInformation field descriptions

commonIEsRequestLocationInformation

This field specifies the location information type requested by the location server and optionally other configuration information associated with the requested location information. This field should always be included in this version of the protocol.

– *ProvideLocationInformation*

The *ProvideLocationInformation* message body in a LPP message is used by the target device to provide positioning measurements or position estimates to the location server.

```
-- 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,
a-gnss-ProvideLocationInformation A-GNSS-ProvideLocationInformation OPTIONAL,
otdoa-ProvideLocationInformation OTDOA-ProvideLocationInformation OPTIONAL,
ecid-ProvideLocationInformation ECID-ProvideLocationInformation OPTIONAL,
epdu-ProvideLocationInformation EPDU-Sequence OPTIONAL,
...,
[[
sensor-ProvideLocationInformation-r13
Sensor-ProvideLocationInformation-r13 OPTIONAL,
tbs-ProvideLocationInformation-r13 TBS-ProvideLocationInformation-r13 OPTIONAL,
wlan-ProvideLocationInformation-r13 WLAN-ProvideLocationInformation-r13 OPTIONAL,
bt-ProvideLocationInformation-r13 BT-ProvideLocationInformation-r13 OPTIONAL
]]
}
-- ASN1STOP

```

– *Abort*

The *Abort* message body in a LPP 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
  ...,
  epdu-Abort EPDU-Sequence OPTIONAL -- Need ON
}
-- ASN1STOP

```

– *Error*

The *Error* message body in a LPP 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
  ...,
  epdu-Error EPDU-Sequence OPTIONAL -- Need ON
}
-- ASN1STOP

```

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

– *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),
        nb-iot     (3) } (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.

– *ARFCN-ValueEUTRA*

The IEs *ARFCN-ValueEUTRA* and *ARFCN-ValueEUTRA-v9a0* are used to indicate the ARFCN of the E-UTRA carrier frequency, as defined in [12].

```
-- ASN1START
ARFCN-ValueEUTRA ::= INTEGER (0..maxEARFCN)
ARFCN-ValueEUTRA-v9a0 ::= INTEGER (maxEARFCN-Plus1..maxEARFCN2)
ARFCN-ValueEUTRA-r14 ::= INTEGER (0..maxEARFCN2)
maxEARFCN            INTEGER ::= 65535    -- Maximum value of EUTRA carrier frequency
maxEARFCN-Plus1     INTEGER ::= 65536    -- Lowest value extended EARFCN range
maxEARFCN2          INTEGER ::= 262143   -- Highest value extended EARFCN range
-- ASN1STOP
```

NOTE: For fields using the original value range, as defined by IE *ARFCN-ValueEUTRA* i.e. without suffix, value *maxEARFCN* indicates that the E-UTRA carrier frequency is indicated by means of an extension.

– *ARFCN-ValueUTRA*

The IE *ARFCN-ValueUTRA* is used to indicate the ARFCN of the UTRA carrier frequency, as defined in [13].

```
-- ASN1START
ARFCN-ValueUTRA ::= INTEGER (0..16383)
-- ASN1STOP
```

– *CarrierFreq-NB*

The IE *CarrierFreq-NB* is used to provide the NB-IoT carrier frequency, as defined in TS 36.101 [21].

```
-- ASN1START
CarrierFreq-NB-r14 ::= SEQUENCE {
    carrierFreq-r14    ARFCN-ValueEUTRA-r14,

```

```

    carrierFreqOffset-r14      CarrierFreqOffsetNB-r14      OPTIONAL,
    ...
}
-- ASN1STOP

```

CarrierFreq-NB field descriptions

carrierFreq

This field specifies the ARFCN applicable for the NB-IoT carrier frequency as defined in TS 36.101 [21, Table 5.7.3-1].

carrierFreqOffset

This field specifies the offset of the NB-IoT channel number to EARFCN as defined in TS 36.101 [21].

– **CarrierFreqOffsetNB**

The IE *CarrierFreqOffsetNB* is used to provide the offset of the NB-IoT channel number to EARFCN of a NB-IoT carrier.

```

-- ASN1START
CarrierFreqOffsetNB-r14 ::=      ENUMERATED {
                                v-10, v-9, v-8, v-7, v-6, v-5, v-4, v-3, v-2, v-1, v-0dot5,
                                v0, v1, v2, v3, v4, v5, v6, v7, v8, v9
                                }
-- ASN1STOP

```

CarrierFreqOffsetNB field descriptions

CarrierFreqOffsetNB

This field specifies the offset of the NB-IoT channel number to EARFCN as defined in TS 36.101 [21]. Value v-10 means -10, v-9 means -9, and so on.

– **CellGlobalIdEUTRA-AndUTRA**

The IE *CellGlobalIdEUTRA-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.

– ***ECGI***

The IE *ECGI* specifies the Evolved Cell Global Identifier (ECGI), the globally unique identity of a cell in E-UTRA [12].

NOTE: The IE *ECGI* is also used for NB-IoT access.

```

-- ASN1START
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

```

– ***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. See table External PDU Identifier Definition for a list of external PDU identifiers defined in this version of the specification.

EPDU-Name

This field provides an optional character encoding which can be used to provide a quasi-unique name for an external PDU – e.g., by containing the name of the defining organization and/or the name of the associated public or proprietary standard for the EPDU.

EPDU-Body

The content and encoding of this field are defined externally to LPP.

External PDU Identifier Definition

EPDU-ID	EPDU Defining entity	Method name	Reference
1	OMA LOC	OMA LPP extensions (LPPe)	OMA-TS-LPPe-V1_0 [20]

– *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
```

```
-- 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 LPP message Type.

```
-- ASN1START
CommonIEsRequestCapabilities ::= SEQUENCE {
```

```

}
...
}
-- ASN1STOP

```

– *CommonIEsProvideCapabilities*

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

```

-- ASN1START
CommonIEsProvideCapabilities ::= SEQUENCE {
}
...
}
-- ASN1STOP

```

– *CommonIEsRequestAssistanceData*

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

```

-- ASN1START
CommonIEsRequestAssistanceData ::= SEQUENCE {
  primaryCellID      ECGI      OPTIONAL,  -- Cond EUTRA
}
...
}
-- ASN1STOP

```

Conditional presence	Explanation
<i>EUTRA</i>	The field is mandatory present for E-UTRA or NB-IoT access. The field shall be omitted for non-EUTRA and non-NB-IoT user plane support.

<i>CommonIEsRequestAssistanceData</i> field descriptions
<i>primaryCellID</i> This parameter identifies the current primary cell for the target device.

– *CommonIEsProvideAssistanceData*

The *CommonIEsProvideAssistanceData* carries common IEs for a Provide Assistance Data LPP message Type.

```

-- ASN1START
CommonIEsProvideAssistanceData ::= SEQUENCE {
}
...
}
-- ASN1STOP

```

– *CommonIEsRequestLocationInformation*

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

```

-- ASN1START
CommonIEsRequestLocationInformation ::= SEQUENCE {
  locationInformationType      LocationInformationType,
  triggeredReporting            TriggeredReportingCriteria OPTIONAL,  -- Cond ECID
  periodicalReporting          PeriodicalReportingCriteria OPTIONAL,  -- Need ON
  additionalInformation        AdditionalInformation      OPTIONAL,  -- Need ON
  qos                          QoS                      OPTIONAL,  -- Need ON
  environment                   Environment              OPTIONAL,  -- Need ON
}

```



```

locationCoordinateTypes      LocationCoordinateTypes  OPTIONAL,  -- Need ON
velocityTypes                VelocityTypes              OPTIONAL,  -- Need ON
...
[[
    messageSizeLimitNB-r14  MessageSizeLimitNB-r14  OPTIONAL  -- Need ON
]]
}

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,
    mayReturnAdditionalInformation,
    ...
}

QoS ::= SEQUENCE {
    horizontalAccuracy      HorizontalAccuracy  OPTIONAL,  -- Need ON
    verticalCoordinateRequest  BOOLEAN,
    verticalAccuracy        VerticalAccuracy    OPTIONAL,  -- Need ON
    responseTime            ResponseTime        OPTIONAL,  -- Need ON
    velocityRequest         BOOLEAN,
    ...
    [[ responseTimeNB-r14    ResponseTimeNB-r14  OPTIONAL  -- Need ON
    ]]
}

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

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

ResponseTime ::= SEQUENCE {
    time                    INTEGER (1..128),
    ...
    [[ responseTimeEarlyFix-r12  INTEGER (1..128)    OPTIONAL  -- Need ON
    ]]
}

ResponseTimeNB-r14 ::= SEQUENCE {
    timeNB-r14              INTEGER (1..512),
    responseTimeEarlyFixNB-r14  INTEGER (1..512)    OPTIONAL,  -- Need ON
    ...
}

Environment ::= ENUMERATED {

```

```

badArea,
notBadArea,
mixedArea,
...
}

MessageSizeLimitNB-r14 ::= SEQUENCE {
    measurementLimit-r14          INTEGER (1..512)          OPTIONAL,          -- Need ON
    ...
}

-- ASN1STOP
    
```

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

CommonEsRequestLocationInformation field descriptions
<p>locationInformationType This IE indicates whether the server requires a location estimate or measurements. For '<i>locationEstimateRequired</i>', the target device shall return a location estimate if possible, or indicate a location error if not possible. For '<i>locationMeasurementsRequired</i>', the target device shall return measurements if possible, or indicate a location error if not possible. For '<i>locationEstimatePreferred</i>', the target device 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 '<i>locationMeasurementsPreferred</i>', the target device 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.</p>
<p>triggeredReporting This IE indicates that triggered reporting is requested and comprises the following subfields:</p> <ul style="list-style-type: none"> - cellChange: If this field is set to TRUE, the target device provides requested location information each time the primary 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. The target device should continue triggered reporting for the <i>reportingDuration</i> or until an LPP <i>Abort</i> or LPP <i>Error</i> message is received. <p>The <i>triggeredReporting</i> field should not be included by the location server and shall be ignored by the target device if the <i>periodicalReporting</i> IE or <i>responseTime</i> IE or <i>responseTimeNB</i> IE is included in <i>CommonEsRequestLocationInformation</i>.</p>
<p>periodicalReporting This IE indicates that periodic reporting is requested and comprises the following subfields:</p> <ul style="list-style-type: none"> - reportingAmount indicates the number of periodic location information reports requested. Enumerated values correspond to 1, 2, 4, 8, 16, 32, 64, or infinite/indefinite number of reports. If the <i>reportingAmount</i> is '<i>infinite/indefinite</i>', the target device should continue periodic reporting until an LPP <i>Abort</i> message is received. The value '<i>ra1</i>' shall not be used by a sender. - reportingInterval indicates the interval between location information reports and the response time requirement for the first location information report. Enumerated values ri0-25, ri0-5, ri1, ri2, ri4, ri8, ri16, ri32, ri64 correspond to reporting intervals of 1, 2, 4, 8, 10, 16, 20, 32, and 64 seconds, respectively. Measurement reports containing no measurements or no location estimate are required when a <i>reportingInterval</i> expires before a target device is able to obtain new measurements or obtain a new location estimate. The value '<i>noPeriodicalReporting</i>' shall not be used by a sender.
<p>additionalInformation This IE indicates whether a target device is allowed to return additional information to that requested. If this IE indicates '<i>onlyReturnInformationRequested</i>' then the target device shall not return any additional information to that requested by the server. If this IE indicates '<i>mayReturnAdditionalInformation</i>' then the target device may return additional information to that requested by the server. 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).</p>

CommonIEsRequestLocationInformation field descriptions**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' corresponds to the encoded uncertainty as defined in 3GPP TS 23.032 [15] and 'confidence' corresponds to confidence 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' corresponds to the encoded uncertainty altitude as defined in 3GPP TS 23.032 [15] and 'confidence' corresponds to confidence as defined in 3GPP TS 23.032 [15].
- **responseTime**
 - **time** 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).
 - **responseTimeEarlyFix** indicates the maximum response time as measured between receipt of the *RequestLocationInformation* and transmission of a *ProvideLocationInformation* containing early location measurements or an early location estimate. This is given as an integer number of seconds between 1 and 128. When this IE is included, a target should send a *ProvideLocationInformation* (or more than one *ProvideLocationInformation* if location information will not fit into a single message) containing early location information according to the *responseTimeEarlyFix* IE and a subsequent *ProvideLocationInformation* (or more than one *ProvideLocationInformation* if location information will not fit into a single message) containing final location information according to the *time* IE. A target shall omit sending a *ProvideLocationInformation* if the early location information is not available at the expiration of the time value in the *responseTimeEarlyFix* IE. A server should set the *responseTimeEarlyFix* IE to a value less than that for the *time* IE. A target shall ignore the *responseTimeEarlyFix* IE if its value is not less than that for the *time* IE.
- **velocityRequest** indicates whether velocity (or measurements related to velocity) is requested (TRUE) or not (FALSE).
- **responseTimeNB**

If the *periodicalReporting* IE or *responseTime* 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).
- **timeNB** 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 512.
- **responseTimeEarlyFixNB** indicates the maximum response time as measured between receipt of the *RequestLocationInformation* and transmission of a *ProvideLocationInformation* containing early location measurements or an early location estimate. This is given as an integer number of seconds between 1 and 512. When this IE is included, a target should send a *ProvideLocationInformation* (or more than one *ProvideLocationInformation* if location information will not fit into a single message) containing early location information according to the *responseTimeEarlyFixNB* IE and a subsequent *ProvideLocationInformation* (or more than one *ProvideLocationInformation* if location information will not fit into a single message) containing final location information according to the *timeNB* IE. A target shall omit sending a *ProvideLocationInformation* if the early location information is not available at the expiration of the time value in the *responseTimeEarlyFixNB* IE. A server should set the *responseTimeEarlyFixNB* IE to a value less than that for the *timeNB* IE. A target shall ignore the *responseTimeEarlyFixNB* IE if its value is not less than that for the *timeNB* IE.

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 *time* and *timeNB* which shall always be fulfilled – even if that means not fulfilling other QoS requirements.

A target device supporting NB-IoT access shall support the *responseTimeNB* IE.

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.

If this field is absent, a default value of 'mixedArea' applies.

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.

CommonIEsRequestLocationInformation field descriptions**velocityTypes**

This field provides a list of the types of velocity estimate that the target device may return when a velocity estimate is obtained by the target.

messageSizeLimitNB

This field provides an octet limit on the amount of location information a target device can return.

- **measurementLimit** indicates the maximum amount of location information the target device should return in response to the *RequestLocationInformation* message received from the location server.

The limit applies to the overall size of the LPP message at LPP level (LPP Provide Location Information), and is specified in steps of 100 octets. The message size limit is then given by the value provided in *measurementLimit* times 100 octets.

CommonIEsProvideLocationInformation

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

```
-- ASN1START
CommonIEsProvideLocationInformation ::= SEQUENCE {
    locationEstimate          LocationCoordinates    OPTIONAL,
    velocityEstimate          Velocity                OPTIONAL,
    locationError             LocationError            OPTIONAL,
    ...
    [[ 'earlyFixReport-r12    EarlyFixReport-r12    OPTIONAL
    ]],
    [[ locationSource-r13    LocationSource-r13    OPTIONAL,
    locationTimestamp-r13    UTCTime                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,
    ...
}

EarlyFixReport-r12 ::= ENUMERATED {
    noMoreMessages,
    moreMessagesOnTheWay
}

LocationSource-r13 ::= BIT STRING { a-gnss          (0),
                                     wlan             (1),
                                     bt                (2),
```

```
tbs          (3),
sensor      (4) } (SIZE(1..16))
```

```
-- 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 of 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 of 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.

earlyFixReport

This field shall be included if and only if the *ProvideLocationInformation* message contains early location measurements or an early location estimate. The target device shall set the values of this field as follows:

- noMoreMessages: This is the only or last *ProvideLocationInformation* message used to deliver the entire set of early location information.
- moreMessagesOnTheWay: This is one of multiple *ProvideLocationInformation* messages used to deliver the entire set of early location information (if early location information will not fit into a single message).

locationSource

This field provides the source positioning technology for the location estimate. NOTE: In this version of the specification, the entry 'tbs' is used only for TBS positioning based on MBS signals..

locationTimestamp

This field provides the UTC time when the location estimate is valid and should take the form of *YYMMDDhhmmssZ*.

– CommonIEsAbort

The *CommonIEsAbort* carries common IEs for an Abort LPP message 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. The abort cause 'stopPeriodicReporting' should be used by the location server to stop any ongoing location reporting configured as *periodicalReporting* or *triggeredReporting* in the *CommonIEsRequestLocationInformation*.

– CommonIEsError

The *CommonIEsError* carries common IEs for an Error LPP message Type.

```
-- ASN1START
CommonIEsError ::= SEQUENCE {
  errorCause      ENUMERATED {
    undefined,
    lppMessageHeaderError,
  }
}
-- ASN1STOP
```

```

    lppMessageBodyError,
    epduError,
    incorrectDataValue,
    ...
  }
}
-- ASN1STOP

```

CommonIEsError field descriptions

errorCause

This IE defines the cause for an error. 'lppMessageHeaderError', 'lppMessageBodyError' and 'epduError' is used if a receiver is able to detect a coding error in the LPP header (i.e., in the common fields), LPP message body or in an EPDU, respectively.

6.5 Positioning Method IEs

6.5.1 OTDOA Positioning

This subclause defines the information elements for downlink OTDOA positioning, which includes TBS positioning based on PRS signals [2].

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.

Throughout Section 6.5.1, "assistance data reference cell" refers to the cell defined by the IE *OTDOA-ReferenceCellInfo* and "NB-IoT assistance data reference cell" refers to the cell defined by the IE *OTDOA-ReferenceCellInfoNB* (see section 6.5.1.2). "RSTD reference cell" applies only in Section 6.5.1.5.

If both IEs, *OTDOA-ReferenceCellInfo* and *OTDOA-ReferenceCellInfoNB* are included in *OTDOA-ProvideAssistanceData*, the assistance data reference cell and NB-IoT assistance data reference cell correspond to the same cell, and the target device may assume that PRS and NPRS antenna ports are quasi co-located, as defined in [16].

Throughout Section 6.5.1, the term "cell" refers to "transmission point (TP)", unless distinguished in the field description.

NOTE 1: The location server should include at least one cell for which the SFN can be obtained by the target device, e.g. the serving cell, in the assistance data, either as the assistance data reference cell or in the neighbour cell list. Otherwise the target device will be unable to perform the OTDOA measurement and the positioning operation will fail.

NOTE 2: Due to support of cells containing multiple TPs and PRS-only TPs not associated with cells, the term "cell" as used in section 6.5.1 may not always correspond to a cell for the E-UTRAN.

NOTE 3: For NB-IoT access, due to support of NPRS on multiple carriers, the term "cell" as used in section 6.5.1 refers to the anchor carrier, unless otherwise stated.

```

-- ASN1START
OTDOA-ProvideAssistanceData ::= SEQUENCE {
    otdoa-ReferenceCellInfo      OTDOA-ReferenceCellInfo      OPTIONAL, -- Need ON
    otdoa-NeighbourCellInfo     OTDOA-NeighbourCellInfoList  OPTIONAL, -- Need ON
    otdoa-Error                 OTDOA-Error                OPTIONAL, -- Need ON
    ...
    [
        otdoa-ReferenceCellInfoNB-r14 OTDOA-ReferenceCellInfoNB-r14  OPTIONAL, -- Need ON
        otdoa-NeighbourCellInfoNB-r14 OTDOA-NeighbourCellInfoListNB-r14  OPTIONAL, -- Need ON
    ]
}

```

```
-- ASN1STOP
```

6.5.1.2 OTDOA Assistance Data Elements

– OTDOA-ReferenceCellInfo

The IE *OTDOA-ReferenceCellInfo* is used by the location server to provide assistance data reference cell information for OTDOA assistance data. The slot number offsets and expected RSTDs in *OTDOA-NeighbourCellInfoList* are provided relative to the cell defined by this IE. If *earfcnRef* of this assistance data reference cell is different from that of the serving cell, the LPP layer shall inform lower layers to start performing inter-frequency RSTD measurements with this cell and provide to lower layers the information about this assistance data reference cell, e.g. EARFCN and PRS positioning occasion information.

NOTE: The location server should always include the PRS configuration of the assistance data reference and neighbour cells. Otherwise the UE may not meet the accuracy requirements as defined in [18].

```
-- ASN1START
OTDOA-ReferenceCellInfo ::= SEQUENCE {
  physCellId          INTEGER (0..503),
  cellGlobalId        ECGI                               OPTIONAL,      -- Need ON
  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
  ...,
  [[ earfcnRef-v9a0    ARFCN-ValueEUTRA-v9a0            OPTIONAL      -- Cond NotSameAsServ2
  ]],
  [[ tpId-r14          INTEGER (0..4095)                  OPTIONAL,      -- Need ON
    cpLengthCRS-r14    ENUMERATED { normal, extended, ... } OPTIONAL,      -- Cond CRS
    sameMBSFNconfigRef-r14 BOOLEAN                       OPTIONAL,      -- Need ON
    dlBandwidth-r14    ENUMERATED {n6, n15, n25, n50, n75, n100} OPTIONAL,      -- Cond NotSameAsServ3
    addPRSconfigRef-r14 SEQUENCE (SIZE (1..maxAddPRSconfig-r14)) OF PRS-Info OPTIONAL      -- Need ON
  ]]
}
maxAddPRSconfig-r14    INTEGER ::= 2
-- ASN1STOP
```

Conditional presence	Explanation
<i>NotSameAsServ0</i>	This field is absent if <i>earfcnRef-v9a0</i> is present. Otherwise, the field is mandatory present if the EARFCN of the OTDOA assistance data reference cell is not the same as the EARFCN of the target devices's current primary cell.
<i>NotSameAsServ1</i>	The field is mandatory present if the antenna port configuration of the OTDOA assistance data reference cell is not the same as the antenna port configuration of the target devices's current primary cell.
<i>NotSameAsServ2</i>	The field is absent if <i>earfcnRef</i> is present. Otherwise, the field is mandatory present if the EARFCN of the OTDOA assistance data reference cell is not the same as the EARFCN of the target devices's current primary cell.
<i>PRS</i>	The field is mandatory present if positioning reference signals are available in the assistance data reference cell [16]; otherwise it is not present.
<i>CRS</i>	The field is optionally present, need ON, if <i>prsInfo</i> is present. Otherwise it is not present.
<i>NotSameAsServ3</i>	The field is mandatory present if the downlink bandwidth configuration of the assistance data reference cell is not the same as the downlink bandwidth configuration of the target devices's current primary cell and if PRS frequency hopping is used in the assistance data reference cell [16]; otherwise it is not present.

OTDOA-ReferenceCellInfo field descriptions

physCellId

This field specifies the physical cell identity of the assistance data reference cell, as defined in [12].

OTDOA-ReferenceCellInfo field descriptions	
cellGlobalId	This field specifies the ECGI, the globally unique identity of a cell in E-UTRA, of the assistance data reference cell, as defined in [12]. The server should include this field if it considers that it is needed to resolve ambiguity in the cell indicated by <i>physCellId</i> .
earfcnRef	This field specifies the EARFCN of the assistance data reference cell.
antennaPortConfig	This field specifies whether 1 (or 2) antenna port(s) or 4 antenna ports for cell specific reference signals (CRS) are used in the assistance data reference cell.
cpLength	This field specifies the cyclic prefix length of the assistance data reference cell PRS if the <i>prsInfo</i> field is present, otherwise this field specifies the cyclic prefix length of the assistance data reference cell CRS.
prsInfo	This field specifies the first PRS configuration of the assistance data reference cell.
tpld	This field specifies an identity of the transmission point. This field together with the <i>physCellId</i> and/or <i>prsID</i> may be used to identify the transmission point in case the same physical cell ID is shared by multiple transmission points.
cpLengthCRS	This field specifies the cyclic prefix length of the assistance data reference cell CRS. If this field is present, the target device may assume the CRS and PRS antenna ports of the assistance data reference cell are quasi co-located (as defined in [16]).
sameMBSFNconfigRef	This field indicates whether the MBSFN subframe configuration of the assistance data reference cell is the same as the current primary cell of the target device. TRUE means the same, and FALSE means not the same.
dlBandwidth	This field specifies the downlink bandwidth configuration of the assistance data reference cell, N_{RB} in downlink, see TS 36.101 [21, table 5.6-1]. n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on.
addPRSconfigRef	This field specifies the additional (second and possibly third) PRS configuration(s) of the assistance data reference cell.

– PRS-Info

The IE *PRS-Info* provides the information related to the configuration of PRS in a cell.

```
-- 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, ..., sf-add-v14xy},
    ...,
    prs-MutingInfo-r9     CHOICE {
        po2-r9            BIT STRING (SIZE(2)),
        po4-r9            BIT STRING (SIZE(4)),
        po8-r9            BIT STRING (SIZE(8)),
        po16-r9           BIT STRING (SIZE(16)),
        ...,
        po32-v14xy        BIT STRING (SIZE(32)),
        po64-v14xy        BIT STRING (SIZE(64)),
        po128-v14xy       BIT STRING (SIZE(128)),
        po256-v14xy       BIT STRING (SIZE(256)),
        po512-v14xy       BIT STRING (SIZE(512)),
        po1024-v14xy      BIT STRING (SIZE(1024))
    }
    [[ prsID-r14           INTEGER (0..4095)                OPTIONAL,           -- Need OP
       add-numDL-Frames-r14 INTEGER (1..160)                OPTIONAL,           -- Need ON
       prsOccGroupLen-r14  ENUMERATED {g2, g4, g8, g16, g32, g64, g128,... } OPTIONAL,           -- Cond sf-add
       prsHoppingInfo-r14 CHOICE {
           nb2-r14         INTEGER (0.. maxAvailNarrowBands-Minus1-r14),
           nb4-r14         SEQUENCE (SIZE (3))
                           OF INTEGER (1.. maxAvailNarrowBands-Minus1-r14)
       }
    ] ]
}
maxAvailNarrowBands-Minus1-r14  INTEGER ::= 15  -- Maximum number of narrowbands minus 1
```


-- ASN1STOP

Conditional presence	Explanation
<i>sf-add</i>	The field is mandatory present if the <i>numDL-Frames</i> field has the value ' <i>sf-add</i> '; otherwise it is not present.
<i>Occ-Grp</i>	The field is mandatory present if a PRS occasion group is configured; otherwise it is not present.
<i>PRS-FH</i>	The field is mandatory present if frequency hopping is used for PRS; otherwise it is not present.

PRS-Info field descriptions	
<i>prs-Bandwidth</i>	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.
<i>prs-ConfigurationIndex</i>	This field specifies the positioning reference signals configuration index I_{PRS} as defined in [16].
<i>numDL-Frames</i>	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 downlink subframes. The value <i>sf-add</i> indicates that N_{PRS} is provided in the field <i>add-numDL-Frames</i> .
<i>prs-MutingInfo</i>	<p>This field specifies the PRS muting configuration of the cell. The PRS muting configuration is defined by a periodic PRS muting sequence with periodicity T_{REP} where T_{REP}, counted in the number of PRS occasion groups [18], can be 2, 4, 8, 16, 32, 64, 128, 256, 512, or 1024 which is also the length of the selected bit string that represents this PRS muting sequence. If a bit in the PRS muting sequence is set to "0", then the PRS is muted in all the PRS occasions in the corresponding PRS occasion group. A PRS occasion group comprises one or more PRS occasions as indicated by <i>prsOccGroupLen</i>, each of N_{PRS} downlink positioning subframes as defined in [16]. The first bit of the PRS muting sequence corresponds to the first PRS occasion group that starts after the beginning of the assistance data reference cell SFN=0. The sequence is valid for all subframes after the target device has received the <i>prs-MutingInfo</i>. If this field is not present the target device may assume that the PRS muting is not in use for the cell.</p> <p>When the SFN of the assistance data reference cell is not known to the UE and <i>prs-MutingInfo</i> is provided for a cell in the <i>OTDOA-NeighbourCellInfoList</i> IE, the UE may assume no PRS is transmitted by that cell.</p> <p>When the UE receives a T_{REP}-bit muting pattern together with a PRS periodicity T_{PRS} for the same cell which exceeds 10240 subframes (i.e., $T_{REP} \times T_{PRS} > 10240$ subframes), the UE shall assume an n-bit muting pattern based on the first n-bits, where $n = 10240/T_{PRS}$.</p>
<i>prsID</i>	This field specifies the PRS-ID as defined in [16].
<i>add-numDL-Frames</i>	This field specifies the number of consecutive downlink subframes N_{PRS} with positioning reference signals, as defined in [16]. Integer values define 1, 2, 3, ..., 160 consecutive downlink subframes.
<i>prsOccGroupLen</i>	This field specifies the length of the PRS occasion group. Enumerated values define 2, 4, 8, 16, 32, 64 or 128, and the product of the PRS periodicity T_{PRS} from the <i>prs-ConfigurationIndex</i> and the PRS occasion group length cannot exceed 1280. If omitted, the PRS occasion group length is 1.
<i>prsHoppingInfo</i>	<p>This field specifies the PRS frequency hopping configuration [16]. The choice nb2 indicates hopping between 2 narrowbands; the choice nb4 indicates hopping between 4 narrowbands. The first PRS positioning occasion of the first PRS occasion group that starts after the beginning of SFN=0 of the assistance data reference cell is located at the centre of the system bandwidth. The frequency band of each subsequent PRS occasion is indicated by nb2 or nb4, respectively, which defines the narrowband index n_{NB} as specified in TS 36.211 [16]. If this field is absent, no PRS frequency hopping is used.</p>

OTDOA-NeighbourCellInfoList

The IE *OTDOA-NeighbourCellInfoList* is used by the location server to provide neighbour cell information for OTDOA assistance data. If the target device is not capable of supporting additional neighbour cells (as indicated by the absence of the IE *additionalNeighbourCellInfoList* in *OTDOA-ProvideCapabilities*), the set of cells in the *OTDOA-NeighbourCellInfoList* is grouped per frequency layer and in the decreasing order of priority for measurement to be performed by the target device, with the first cell in the list being the highest priority for measurement and with the same *earfcn* not appearing in more than one instance of *OTDOA-NeighbourFreqInfo*.

If the target device is capable of supporting additional neighbour cells (as indicated by the presence of the IE *additionalNeighbourCellInfoList* in *OTDOA-ProvideCapabilities*), the list may contain all cells (up to 3x24 cells) belonging to the same frequency layer or cells from different frequency layers with the first cell in the list still being the highest priority for measurement.

The prioritization of the cells in the list is left to server implementation. The target device should provide the available measurements in the same order as provided by the server.

If inter-frequency neighbour cells are included in *OTDOA-NeighbourCellInfoList*, where an inter-frequency is a E-UTRA frequency which is different from the E-UTRA serving cell frequency, the LPP layer shall inform lower layers to start performing inter-frequency RSTD measurements for these neighbour cells and also provide to lower layers the information about these neighbour cells, e.g. EARFCN and PRS positioning occasion information.

```
-- 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,           -- Need ON
    earfcn                    ARFCN-ValueEUTRA    OPTIONAL,           -- Cond NotSameAsRef0
    cpLength                  ENUMERATED {normal, extended, ...}
    prsInfo                   PRS-Info            OPTIONAL,           -- Cond NotSameAsRef2
    antennaPortConfig        ENUMERATED {ports-1-or-2, ports-4, ...}
    slotNumberOffset          INTEGER (0..19)     OPTIONAL,           -- Cond NotSameAsRef4
    prs-SubframeOffset        INTEGER (0..1279)   OPTIONAL,           -- Cond InterFreq
    expectedRSTD              INTEGER (0..16383),
    expectedRSTD-Uncertainty  INTEGER (0..1023),
    ...,
    [[ earfcn-v9a0            ARFCN-ValueEUTRA-v9a0  OPTIONAL           -- Cond NotSameAsRef5
    ]],
    [[ tpId-r14              INTEGER (0..4095)       OPTIONAL,           -- Need ON
    prs-only-tp-r14          ENUMERATED { true }     OPTIONAL,           -- Cond TBS
    cpLengthCRS-r14          ENUMERATED { normal, extended, ... }
    OPTIONAL,           -- Cond CRS
    sameMBSFNconfigNeighbour-r14  BOOLEAN          OPTIONAL,           -- Need ON
    dlBandwidth-r14          ENUMERATED {n6, n15, n25, n50, n75, n100}
    OPTIONAL,           -- Cond NotSameAsRef6
    addPRSconfigNeighbour-r14 SEQUENCE (SIZE (1..maxAddPRSconfig-r14)) OF
    Add-PRSconfigNeighbourElement-r14
    OPTIONAL,           -- Need ON
    ]],
}

Add-PRSconfigNeighbourElement-r14 ::= SEQUENCE {
    add-prsInfo-r14          PRS-Info            OPTIONAL,           -- Cond NotSameAsRef7
    ...
}

maxFreqLayers  INTEGER ::= 3

-- ASN1STOP
```

Conditional presence	Explanation
<i>NotsameAsRef0</i>	The field is absent if <i>earfcn-v9a0</i> is present. If <i>earfcn-v9a0</i> is not present, the field is mandatory present if the EARFCN is not the same as for the assistance data reference cell; otherwise it is not present.
<i>NotsameAsRef1</i>	The field is mandatory present if the cyclic prefix length is not the same as for the assistance data reference cell; otherwise it is not present.
<i>NotsameAsRef2</i>	The field is mandatory present if the first PRS configuration is not the same as for the assistance data reference cell; otherwise it is not present.
<i>NotsameAsRef3</i>	The field is mandatory present if the antenna port configuration is not the same as for the assistance data reference cell; otherwise it is not present.
<i>NotsameAsRef4</i>	The field is mandatory present if the slot timing is not the same as for the assistance data reference cell; otherwise it is not present.
<i>NotSameAsRef5</i>	The field is absent if <i>earfcn</i> is present. If <i>earfcn</i> is not present, the field is mandatory present if the EARFCN is not the same as for the assistance data reference cell; otherwise it is not present.
<i>InterFreq</i>	The field is optionally present, need OP, if the EARFCN is not the same as for the assistance data reference cell; otherwise it is not present.
<i>TBS</i>	The field is mandatory present if the <i>OTDOA-NeighbourCellInfoElement</i> is provided for a PRS-only TP; otherwise it is not present.
<i>CRS</i>	The field is optionally present, need ON, if <i>prsInfo</i> is present. Otherwise it is not present.
<i>NotSameAsRef6</i>	The field is mandatory present if PRS frequency hopping is used on this neighbour cell [16] and if the downlink bandwidth configuration is not the same as for the assistance data reference cell; otherwise it is not present.
<i>NotSameAsRef7</i>	The field is mandatory present if any instance of the additional PRS configurations of <i>addPRSconfigNeighbour</i> is not the same as the corresponding instance of the additional PRS configuration of the <i>addPRSconfigRef</i> for the assistance data reference cell; otherwise it is not present.

OTDOA-NeighbourCellInfoList field descriptions

<p>physCellId This field specifies the physical cell identity of the neighbour cell, as defined in [12].</p>
<p>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 should provide this field if it considers that it is needed to resolve any ambiguity in the cell identified by <i>physCellId</i>.</p>
<p>earfcn This field specifies the EARFCN of the neighbour cell.</p>
<p>cpLength This field specifies the cyclic prefix length of the neighbour cell PRS if PRS are present in this neighbour cell, otherwise this field specifies the cyclic prefix length of CRS in this neighbour cell.</p>
<p>prsInfo This field specifies the first PRS configuration of the neighbour cell. When the EARFCN of the neighbour cell is the same as for the assistance data reference cell, the target device may assume that each PRS positioning occasion in the neighbour cell at least partially overlaps with a PRS positioning occasion in the assistance data reference cell where the maximum offset between the transmitted PRS positioning occasions may be assumed to not exceed half a subframe. When the EARFCN of the neighbour cell is the same as for the assistance data reference cell, the target may assume that this cell has the same PRS periodicity (<i>Tprs</i>) as the assistance data reference cell.</p>
<p>antennaPortConfig This field specifies whether 1 (or 2) antenna port(s) or 4 antenna ports for cell specific reference signals are used.</p>
<p>slotNumberOffset This field specifies the slot number offset at the transmitter between this cell and the assistance data reference cell. The <i>slotNumberOffset</i> together with the current slot number of the assistance data reference cell may be used to calculate the current slot number of this cell which may further be used to generate the CRS sequence by the target device. The offset corresponds to the number of full slots counted from the beginning of a radio frame of the assistance data reference cell to the beginning of the closest subsequent radio frame of this cell. If this field is absent, the slot timing is the same as for the assistance data reference cell.</p>
<p>prs-SubframeOffset This field specifies the offset between the first PRS subframe of the PRS occasion group of the first PRS configuration in the assistance data reference cell on the reference carrier frequency layer and the first PRS subframe in the closest subsequent PRS occasion group of the first PRS configuration of this cell on the other carrier frequency layer. The value is given in number of full sub-frames. If the EARFCN is not the same as for the assistance data reference cell and the field is not present but PRS are available on this cell, the receiver shall consider the PRS subframe offset for this cell to be 0.</p>

OTDOA-NeighbourCellInfoList field descriptions**expectedRSTD**

If PRS is transmitted:

This field indicates the RSTD value that the target device is expected to measure between this cell and the assistance data reference cell. The *expectedRSTD* field takes into account the expected propagation time difference as well as transmit time difference of PRS positioning occasions between the two cells. The RSTD value can be negative and is calculated as (*expectedRSTD*-8192). The resolution is $3 \times T_s$, with $T_s = 1/(15000 \times 2048)$ seconds.

If PRS is not transmitted:

This field indicates the RSTD value that the target device is expected to measure between this cell and the assistance data reference cell. The *expectedRSTD* field takes into account the expected propagation time difference as well as transmit time difference between the two cells. The RSTD value can be negative and is calculated as (*expectedRSTD*-8192). The resolution is $3 T_s$, with $T_s = 1/(15000 \times 2048)$ seconds.

expectedRSTD-Uncertainty

If PRS is transmitted:

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 *expectedRSTD* and *expectedRSTD-Uncertainty* together define the search window for the target device.

The scale factor of the *expectedRSTD-Uncertainty* field is $3 \times T_s$, with $T_s = 1/(15000 \times 2048)$ seconds.

The target device may assume that the beginning of the PRS occasion group of the first PRS configuration of the neighbour cell is received within the search window of size $[- \text{expectedRSTD-Uncertainty} \times 3 \times T_s, \text{expectedRSTD-Uncertainty} \times 3 \times T_s]$ centered at

$T_{\text{REF}} + 1 \text{ millisecond} \times N + (\text{expectedRSTD} - 8192) \times 3 \times T_s$, where T_{REF} is the reception time of the beginning of the PRS occasion group of the first PRS configuration of the assistance data reference cell at the target device antenna connector, $N = 0$ when the EARFCN of the neighbour cell is equal to that of the assistance data reference cell, and $N = \text{prs-SubframeOffset}$ otherwise.

If PRS is not transmitted:

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 *expectedRSTD* and *expectedRSTD-Uncertainty* together define the search window for the target device. The scale factor of the *expectedRSTD-Uncertainty* field is $3 \times T_s$, with $T_s = 1/(15000 \times 2048)$ seconds.

If T_x is the reception time of the beginning of the subframe X of the assistance data reference cell at the target device antenna connector, the target device may assume that the beginning of the closest subframe of this neighbour cell to subframe X is received within the search window of size $[- \text{expectedRSTD-Uncertainty} \times 3 \times T_s, \text{expectedRSTD-Uncertainty} \times 3 \times T_s]$ centered at $T_x + (\text{expectedRSTD} - 8192) \times 3 \times T_s$,

tpld

This field specifies an identity of the transmission point. This field together with the *physCellId* and/or *prsID* may be used to identify the transmission point in case the same physical cell ID is shared by multiple transmission points.

prs-only-tp

This field, if present, indicates that the *OTDOA-NeighbourCellInfoElement* is provided for a PRS-only TP.

For the purpose of RSTD measurements from a PRS-only TP, the target device shall not assume any other signals or physical channels are present other than PRS [28].

For the purpose of RSTD measurements from a PRS-only TP, the target device shall use the *physCellId* only for PRS generation, and only if no PRS-ID is provided for this TP.

OTDOA-NeighbourCellInfoList field descriptions
<p>cpLengthCRS This field specifies the cyclic prefix length of this assistance data neighbour cell CRS. If this field is present, the target device may assume the CRS and PRS antenna ports of this assistance data neighbour cell are quasi co-located (as defined in [16]).</p>
<p>sameMBSFNconfigNeighbour This field indicates whether the MBSFN subframe configuration of the neighbour cell is the same as the current primary cell of the target device. TRUE means the same, and FALSE means not the same.</p>
<p>dlBandwidth This field specifies the downlink bandwidth configuration of the neighbour cell, N_{RB} in downlink, see TS 36.101 [21, table 5.6-1]. n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on.</p>
<p>addPRSconfigNeighbour This field specifies the additional (second and possibly third) PRS configuration(s) of the neighbour cell. When the EARFCN of the neighbour cell is the same as for the assistance data reference cell, the target device may assume that each PRS positioning occasion in each instance of <i>addPRSconfigNeighbour</i> in the neighbour cell at least partially overlaps with a PRS positioning occasion of the same instance of <i>addPRSconfigRef</i> in the assistance data reference cell where the maximum offset between the transmitted PRS positioning occasions may be assumed to not exceed half a subframe. When the EARFCN of the neighbour cell is the same as for the assistance data reference cell, the target may assume that each instance of <i>addPRSconfigNeighbour</i> of this cell has the same PRS periodicity (T_{prs}) as the corresponding instance of <i>addPRSconfigRef</i> of the assistance data reference cell.</p>

OTDOA-ReferenceCellInfoNB

The IE *OTDOA-ReferenceCellInfoNB* is used by the location server to provide NB-IoT assistance data reference cell information for OTDOA assistance data.

```

-- ASN1START
OTDOA-ReferenceCellInfoNB-r14 ::= SEQUENCE {
    physCellIdNB-r14          INTEGER (0..503)          OPTIONAL, -- Cond NoPRS-AD1
    cellGlobalIdNB-r14       ECGI                     OPTIONAL, -- Cond NoPRS-AD2
    carrierFreqRef-r14       CarrierFreq-NB-r14       OPTIONAL, -- Cond NotSameAsServ1
    eutra-NumCRS-Ports-r14   ENUMERATED {ports1-or-2, ports4}
                                OPTIONAL, -- Cond NoPRS-AD3
    otdoa-SIB1-NB-repetitions-r14  ENUMERATED { r4, r8, r16 } OPTIONAL, -- Cond NotSameAsServ2
    nprsInfo-r14             PRS-Info-NB-r14          OPTIONAL, -- Cond NPRS
    ...
}
-- ASN1STOP

```

Conditional presence	Explanation
<i>NoPRS-AD1</i>	This field is mandatory present if the <i>OTDOA-ReferenceCellInfo</i> IE is not included in <i>OTDOA-ProvideAssistanceData</i> , or if the <i>OTDOA-ReferenceCellInfo</i> IE is included in <i>OTDOA-ProvideAssistanceData</i> and the narrowband physical layer cell identity is not the same as the physical cell identity provided in <i>OTDOA-ReferenceCellInfo</i> IE. Otherwise it is not present.
<i>NoPRS-AD2</i>	This field is optionally present, need ON, if the <i>OTDOA-ReferenceCellInfo</i> IE is not included in <i>OTDOA-ProvideAssistanceData</i> , or if the <i>OTDOA-ReferenceCellInfo</i> IE is included in <i>OTDOA-ProvideAssistanceData</i> and the global cell identity is not the same as provided in <i>OTDOA-ReferenceCellInfo</i> IE.
<i>NotSameAsServ1</i>	This field is mandatory present if the carrier frequency of the NB-IoT assistance data reference cell is not the same as the carrier frequency of the target devices's current serving NB-IoT cell. Otherwise it is not present.
<i>NoPRS-AD3</i>	This field is mandatory present if the <i>OTDOA-ReferenceCellInfo</i> IE is not included in <i>OTDOA-ProvideAssistanceData</i> and if the NB-IoT assistance data reference cell is deployed within the LTE spectrum allocation (inband deployment). Otherwise it is not present.
<i>NotSameAsServ2</i>	This field is mandatory present, if NPRS configuration Part B only is configured on the NB-IoT assistance data reference cell, and if the repetition number of SIB1-NB of the NB-IoT assistance data reference cell is not the same as the repetition number of SIB1-NB of the target devices's current serving NB-IoT cell. Otherwise it is not present.
<i>NPRS</i>	The field is mandatory present if narrowband positioning reference signals are available in the assistance data reference cell [16]; otherwise it is not present.

OTDOA-ReferenceCellInfoNB field descriptions
<p>physCellIdNB This field specifies the narrowband physical layer cell identity of the NB-IoT assistance data reference cell, as defined in [12]. If this field is absent and if the <i>OTDOA-ReferenceCellInfo</i> IE is included in <i>OTDOA-ProvideAssistanceData</i> the narrowband physical layer cell identity is the same as the <i>physCellId</i> provided in <i>OTDOA-ReferenceCellInfo</i> IE.</p>
<p>cellGlobalIdNB This field specifies the global cell identity of the NB-IoT assistance data reference cell, as defined in [12]. If this field is absent and if the <i>OTDOA-ReferenceCellInfo</i> IE with <i>cellGlobalId</i> is included in <i>OTDOA-ProvideAssistanceData</i>, the global cell identity is the same as provided in <i>OTDOA-ReferenceCellInfo</i> IE.</p>
<p>carrierFreqRef This field specifies the carrier frequency of the NB-IoT assistance data reference cell.</p>
<p>numCRS-Ports This field specifies whether 1 (or 2) antenna port(s) or 4 antenna ports for cell specific reference signals (CRS) are used in the NB-IoT assistance data reference cell. If this field is absent and if the <i>OTDOA-ReferenceCellInfo</i> IE is included in <i>OTDOA-ProvideAssistanceData</i>, the number of CRS antenna ports is the same as provided in <i>OTDOA-ReferenceCellInfo</i> IE.</p>
<p>otdoa-SIB1-NB-repetitions This field specifies the repetition number of SIB1-NB of the NB-IoT assistance data reference cell. Enumerated values r4 correspond to 4 repetitions, r8 to 8 repetitions, and r16 to 16 repetitions.</p>
<p>nprsInfo This field specifies the NPRS configuration of the NB-IoT assistance data reference cell.</p>

– PRS-Info-NB

The IE *PRS-Info-NB* provides the information related to the configuration of NPRS in a cell. If *PRS-Info-NB* includes configurations for multiple NPRS carrier frequencies, the target device may assume the antenna ports for the NPRS carrier are quasi co-located, as defined in [16].

```

-- ASN1START

PRS-Info-NB-r14 ::= SEQUENCE (SIZE (1..maxCarrier-r14)) OF NPRS-Info-r14

NPRS-Info-r14 ::= SEQUENCE {
    operationModeInfoNPRS-r14    ENUMERATED { inband, standalone },
    nprs-carrier-r14              CarrierFreq-NB-r14,
    nprsSequenceInfo-r14         INTEGER (0..174)                OPTIONAL,      -- Cond Inband
    nprsID-r14                   INTEGER (0..4095)              OPTIONAL,      -- Cond NPRS-ID
    partA-r14                     SEQUENCE {
        nprsBitmap-r14           CHOICE {
            subframePattern10-r14 BIT STRING (SIZE (10)),
            subframePattern40-r14 BIT STRING (SIZE (40))
        },
        nprs-MutingInfoA-r14     CHOICE {
            po2-r14               BIT STRING (SIZE(2)),
            po4-r14               BIT STRING (SIZE(4)),
            po8-r14               BIT STRING (SIZE(8)),
            po16-r14              BIT STRING (SIZE(16)),
            ...
        }
        ...
    }
    ...
}
partB-r14                     SEQUENCE {
    nprs-Period-r14              ENUMERATED { ms160, ms320, ms640, ms1280, ... },
    nprs-startSF-r14             ENUMERATED { sf0, sf1-8, sf2-8, sf3-8, sf4-8, sf5-8,
        sf6-8, sf7-8, ... },
    nprs-NumSF-r14               ENUMERATED { sf10, sf20, sf40, sf80, sf160, sf320,
        sf640, sf1280, ... },
    nprs-MutingInfoB-r14        CHOICE {
        po2-r14                  BIT STRING (SIZE(2)),
        po4-r14                  BIT STRING (SIZE(4)),
        po8-r14                  BIT STRING (SIZE(8)),
        po16-r14                 BIT STRING (SIZE(16)),
        ...
    }
    ...
}
...
}
...
}
maxCarrier-r14 INTEGER ::= 104

-- ASN1STOP

```

Conditional presence	Explanation
<i>Inband</i>	This field is mandatory present, if the NPRS is configured within the LTE spectrum allocation (inband deployment) and the LTE carrier frequency is not provided in the assistance data. Otherwise it is not present.
<i>NPRS-ID</i>	The field is mandatory present, if the NPRS is generated based on the NPRS-ID [16], different from the PCI. Otherwise the field is not present.
<i>MutingA</i>	The field is mandatory present, if muting is used for the NPRS Part A configuration. Otherwise the field is not present.
<i>PartA</i>	The field is mandatory present, if NPRS is configured based on a bitmap of subframes which are not NB-IoT DL subframes (i.e., invalid DL subframes) (Part A configuration). Otherwise the field is not present.
<i>MutingB</i>	The field is mandatory present, if muting is used for the NPRS Part B configuration. Otherwise the field is not present.
<i>PartB</i>	The field is mandatory present, if NPRS is configured based on a NPRS period, a NPRS subframe offset, and a number of consecutive NPRS downlink subframes per positioning occasion (Part B configuration). Otherwise the field is not present. If NPRS configuration Part A and Part B are both configured, then a subframe contains NPRS if both configurations indicate that it contains NPRS.

PRS-Info-NB field descriptions

<i>operationModeInfoNPRS</i>
This field specifies the operation mode of the NPRS carrier. The value 'standalone' indicates standalone or guardband operation mode.
<i>nprs-carrier</i>
This field specifies the NB-IoT carrier frequency for the NPRS.
<i>nprsSequenceInfo</i>
This field specifies the index of the PRB containing the NPRS as defined in the table <i>nprsSequenceInfo</i> to E-UTRA PRB index relation below.
<i>nprsID</i>
This field specifies the NPRS-ID as defined in [16].
<i>subframePattern10, subframePattern40</i>
This field specifies the NPRS subframe Part A configuration over 10ms or 40ms. Subframes not containing NPRS are indicated with value '0' in the bitmap; subframes containing NPRS are indicated with value '1' in the bitmap. The first/leftmost bit corresponds to the subframe #0 of the radio frame satisfying $\text{SFN mod } x = 0$, where x is the size of the bit string divided by 10.
<i>nprs-MutingInfoA</i>
This field specifies the NPRS muting configuration of the NB-IoT carrier Part A configuration. The NPRS muting configuration is defined by a periodic NPRS muting sequence with periodicity T_{REP} where T_{REP} , counted in the number of NPRS positioning occasions, can be 2, 4, 8, or 16 which is also the length of the selected bit string that represents this NPRS muting sequence. If a bit in the NPRS muting sequence is set to '0', then the NPRS is muted in the corresponding NPRS positioning occasion. A NPRS positioning occasion for Part A comprises one radio frame (i.e., 10 subframes). The first/leftmost bit of the NPRS muting sequence corresponds to the first NPRS positioning occasion that starts after the beginning of the NB-IoT assistance data reference cell $\text{SFN}=0$. The sequence is valid for all subframes after the target device has received the <i>nprs-MutingInfoA</i> . When the SFN of the NB-IoT assistance data reference cell is not known to the target device and <i>nprs-MutingInfoA</i> is provided for a cell in the <i>OTDOA-NeighbourCellInfoListNB</i> IE, the target device may assume no NPRS is transmitted by that cell.
<i>nprs-Period</i>
This field specifies the NPRS occasion period T_{NPRS} [16]. Enumerated values correspond to 160ms, 320ms, 640ms, and 1280ms.
<i>nprs-startSF</i>
This field specifies the subframe offset Δ_{NPRS} of the NPRS positioning occasion, defined by $\alpha \cdot T_{\text{NPRS}}$ [16]. Enumerated values correspond to α of 0, 1/8, 2/8, 3/8, 4/8, 5/8, 6/8, or 7/8 milli-seconds, with T_{NPRS} given by the <i>nprs-Period</i> field.
<i>nprs-NumSF</i>
This field specifies the number of consecutive downlink subframes N_{NPRS} in one NPRS positioning occasion [16]. Enumerated values correspond to 10, 20, 40, 80, 160, 320, 640, and 1280 subframes. When the target device receives a <i>nprs-NumSF</i> which exceeds the <i>nprs-Period</i> (i.e., $N_{\text{NPRS}} > T_{\text{NPRS}}$), the target device may assume no NPRS is transmitted by that cell.

PRS-Info-NB field descriptions***nprs-MutingInfoB***

This field specifies the NPRS muting configuration of the NB-IoT carrier Part B configuration. The NPRS muting configuration is defined by a periodic NPRS muting sequence with periodicity T_{REP} where T_{REP} , counted in the number of NPRS positioning occasions, can be 2, 4, 8, or 16 which is also the length of the selected bit string that represents this NPRS muting sequence. If a bit in the NPRS muting sequence is set to '0', then the NPRS is muted in the corresponding NPRS positioning occasion. A NPRS positioning occasion for Part B comprises N_{NPRS} consecutive downlink positioning subframes, where N_{NPRS} is given by the *nprs-NumSF* field. The first/leftmost bit of the NPRS muting sequence corresponds to the first NPRS positioning occasion that starts after the beginning of the NB-IoT assistance data reference cell SFN=0. The sequence is valid for all subframes after the target device has received the *nprs-MutingInfoB*.

When the SFN of the NB-IoT assistance data reference cell is not known to the UE and *nprs-MutingInfoB* is provided for a cell in the *OTDOA-NeighbourCellInfoListNB* IE, the target device may assume no NPRS is transmitted by that cell.

When the UE receives a T_{REP} -bit muting pattern together with a NPRS periodicity T_{NPRS} for the same carrier which exceeds 10240 subframes (i.e., $T_{REP} \times T_{NPRS} > 10240$ subframes), the target device shall assume an n-bit muting pattern based on the first n bits, where $n = 10240/T_{NPRS}$.

***nprsSequenceInfo* to E-UTRA PRB index relation**

<i>nprsSequenceInfo</i>	E-UTRA PRB index n'_{PRB} for odd number of N_{RB}^{DL} [16]	<i>nprsSequenceInfo</i>	E-UTRA PRB index n'_{PRB} for even number of N_{RB}^{DL} [16]
0 - 74	-37, -36, ..., 37	75 - 174	-50, -49, ..., 49

Editor's Note: Value for maxCarrier requires confirmation from RAN1.

OTDOA-NeighbourCellInfoListNB

The IE *OTDOA-NeighbourCellInfoListNB* is used by the location server to provide NB-IoT neighbour cell information for OTDOA assistance data.

```
-- ASN1START
OTDOA-NeighbourCellInfoListNB-r14 ::= SEQUENCE (SIZE (1..maxCells-r14)) OF
                                         OTDOA-NeighbourCellInfoNB-r14

OTDOA-NeighbourCellInfoNB-r14 ::= SEQUENCE {
    physCellIdNB-r14          INTEGER (0..503)      OPTIONAL,      -- Cond NoPRS-AD1
    cellGlobalIdNB-r14       ECGI                  OPTIONAL,      -- Cond NoPRS-AD2
    carrierFreq-r14          CarrierFreq-NB-r14    OPTIONAL,      -- Cond NotSameAsRef1
    eutra-NumCRS-Ports-r14   ENUMERATED {ports-1-or-2, ports-4, ...}
                                         OPTIONAL,      -- Cond NotsameAsRef2
    otdoa-SIB1-NB-repetitions-r14
                                         ENUMERATED { r4, r8, r16 }
                                         OPTIONAL,      -- Cond NotSameAsRef3
    nprsInfo-r14              PRS-Info-NB-r14       OPTIONAL,      -- Cond NotsameAsRef4
    nprs-slotNumberOffset-r14 INTEGER (0..19)        OPTIONAL,      -- Cond NotsameAsRef5
    nprs-SFN-Offset-r14      INTEGER (0..63)        OPTIONAL,      -- Cond NotsameAsRef6
    nprs-SubframeOffset-r14  INTEGER (0..1279)      OPTIONAL,      -- Need OP
    expectedRSTD-r14         INTEGER (0..16383)     OPTIONAL,      -- Cond NoPRS-AD3
    expectedRSTD-Uncertainty-r14
                                         INTEGER (0..1023) OPTIONAL,      -- Cond NoPRS-AD3
    prsNeighbourCellIndex-r14
                                         INTEGER (1..72)  OPTIONAL,      -- Cond PRS-AD
    ...
}

maxCells-r14    INTEGER ::= 72
-- ASN1STOP
```


Conditional presence	Explanation
<i>NoPRS-AD1</i>	This field is mandatory present if the <i>OTDOA-NeighbourCellInfoList</i> IE is not included in <i>OTDOA-ProvideAssistanceData</i> , or if the <i>OTDOA-NeighbourCellInfoList</i> IE is included in <i>OTDOA-ProvideAssistanceData</i> and the narrowband physical layer cell identity of this cell is not the same as the physical cell identity of the corresponding cell (as indicated by <i>prsNeighbourCellIndex</i>) in <i>OTDOA-NeighbourCellInfoList</i> IE.
<i>NoPRS-AD2</i>	This field is optionally present, need ON, if the <i>OTDOA-NeighbourCellInfoList</i> IE is not included in <i>OTDOA-ProvideAssistanceData</i> , or if the <i>OTDOA-NeighbourCellInfoList</i> IE is included in <i>OTDOA-ProvideAssistanceData</i> and the global cell identity of this cell is not the same as for the corresponding cell (as indicated by <i>prsNeighbourCellIndex</i>) in <i>OTDOA-NeighbourCellInfoList</i> IE.
<i>NotSameAsRef1</i>	The field is mandatory present if the carrier frequency is not the same as for the NB-IoT assistance data reference cell; otherwise it is not present.
<i>NotSameAsRef2</i>	The field is mandatory present if this cell is deployed within the LTE spectrum allocation (inband deployment) and if the number of E-UTRA CRS antenna ports is not the same as for the NB-IoT assistance data reference cell; otherwise it is not present.
<i>NotSameAsRef3</i>	This field is mandatory present if NPRS configuration Part B only is configured on this neighbour cell, and if the repetition number of SIB1-NB of this neighbor cell is not the same as the repetition number of SIB1-NB of the NB-IoT assistance data reference cell. Otherwise it is not present.
<i>NotSameAsRef4</i>	The field is mandatory present, if the NPRS configuration is not the same as for the NB-IoT assistance data reference cell; otherwise it is not present.
<i>NotSameAsRef5</i>	The field is mandatory present if the slot timing is not the same as for the NB-IoT assistance data reference cell; otherwise it is not present.
<i>NotSameAsRef6</i>	The field is mandatory present if the frame timing is not the same as for the NB-IoT assistance data reference cell; otherwise it is not present.
<i>NoPRS-AD3</i>	This field is mandatory present if the <i>OTDOA-NeighbourCellInfoList</i> IE is not included in <i>OTDOA-ProvideAssistanceData</i> , or if the <i>OTDOA-NeighbourCellInfoList</i> IE is included in <i>OTDOA-ProvideAssistanceData</i> and <i>prsNeighbourCellIndex</i> is absent for this cell.
<i>PRS-AD</i>	This field is optionally present, need OP, if the <i>OTDOA-NeighbourCellInfoList</i> IE is included in <i>OTDOA-ProvideAssistanceData</i> ; otherwise it is not present.

OTDOA-NeighbourCellInfoListNB field descriptions
<p><i>physCellIdNB</i> This field specifies the narrowband physical cell identity of the NB-IoT neighbour cell, as defined in [12]. If this field is absent and if the <i>OTDOA-NeighbourCellInfoList</i> IE is included in <i>OTDOA-ProvideAssistanceData</i> the narrowband physical layer cell identity is the same as the <i>physCellId</i> provided for the corresponding cell (as indicated by <i>prsNeighbourCellIndex</i>) in <i>OTDOA-NeighbourCellInfoList</i> IE.</p>
<p><i>cellGlobalIdNB</i> This field specifies the global cell ID of the NB-IoT neighbour cell, as defined in [12]. If this field is absent and if the <i>OTDOA-NeighbourCellInfoList</i> IE with <i>cellGlobalId</i> is included in <i>OTDOA-ProvideAssistanceData</i>, the global cell identity of the NB-IoT neighbour cell is the same as provided for the corresponding cell (as indicated by <i>prsNeighbourCellIndex</i>) in <i>OTDOA-NeighbourCellInfoList</i> IE.</p>
<p><i>carrierFreq</i> This field specifies the carrier frequency of the NB-IoT neighbour cell.</p>
<p><i>eutra-NumCRS-Ports</i> This field specifies whether 1 (or 2) antenna port(s) or 4 antenna ports for cell specific reference signals are used.</p>
<p><i>otdoa-SIB1-NB-repetitions</i> This field specifies the repetition number of SIB1-NB of the neighbour cell. Enumerated values r4 correspond to 4 repetitions, r8 to 8 repetitions, and r16 to 16 repetitions.</p>

OTDOA-NeighbourCellInfoListNB field descriptions
<p>nprsInfo This field specifies the NPRS configuration of the NB-IoT neighbour cell. When the carrier frequency of the NB-IoT neighbour cell is the same as for the NB-IoT assistance data reference cell, the target device may assume that each NPRS positioning occasion for each NPRS carrier frequency in the neighbour cell at least partially overlaps with a NPRS positioning occasion for each NPRS carrier frequency in the NB-IoT assistance data reference cell where the maximum offset between the transmitted NPRS positioning occasions may be assumed to not exceed half a subframe. When the carrier frequency of the neighbour cell is the same as for the NB-IoT assistance data reference cell, and NPRS configuration Part B is configured, the target may assume that this cell has the same NPRS periodicity (T_{NPRS}) as the assistance data reference cell for each NPRS carrier frequency.</p>
<p>nprs-slotNumberOffset This field specifies the slot number offset at the transmitter between this cell and the NB-IoT assistance data reference cell. The offset corresponds to the number of full slots counted from the beginning of a radio frame of the NB-IoT assistance data reference cell to the beginning of the closest subsequent radio frame of this cell. If this field is absent, the slot timing is the same as for the NB-IoT assistance data reference cell.</p>
<p>nprs-SFN-Offset This field specifies the SFN offset (modulo 64) at the transmitter between this cell and the NB-IoT assistance data reference cell. The offset corresponds to the number of full radio frames counted from the beginning of a radio frame #0 of the NB-IoT assistance data reference cell to the beginning of the closest subsequent radio frame #0 of this cell.</p>
<p>nprs-SubframeOffset This field specifies the offset between the first NPRS subframe in the NB-IoT assistance data reference cell (NOTE 1) and the first NPRS subframe in the closest subsequent NPRS positioning occasion of the NPRS carrier with the longest NPRS periodicity of this cell (NOTE 2). The value is given in number of full sub-frames. If this field is not present, the receiver shall consider the NPRS subframe offset to be 0.</p>
<p>expectedRSTD This field indicates the RSTD value that the target device is expected to measure between this cell and the NB-IoT assistance data reference cell. The <i>expectedRSTD</i> field takes into account the expected propagation time difference as well as transmit time difference of NPRS positioning occasions between the two cells. The RSTD value can be negative and is calculated as (<i>expectedRSTD</i>-8192). The resolution is $3 \times T_s$, with $T_s = 1/(15000 \times 2048)$ seconds. If this field is absent and if the <i>OTDOA-NeighbourCellInfoList</i> IE is included in <i>OTDOA-ProvideAssistanceData</i>, the expected RSTD is the same as provided in <i>OTDOA-NeighbourCellInfoList</i> IE for the corresponding cell (as indicated by <i>prsNeighbourCellIndex</i>).</p>
<p>expectedRSTD-Uncertainty This field indicates the uncertainty in <i>expectedRSTD</i> value. The uncertainty is related to the location server's a-priori estimation of the target device location. The <i>expectedRSTD</i> and <i>expectedRSTD-Uncertainty</i> together define the search window for the target device. The scale factor of the <i>expectedRSTD-Uncertainty</i> field is $3 \times T_s$, with $T_s = 1/(15000 \times 2048)$ seconds. If this field is absent and if the <i>OTDOA-NeighbourCellInfoList</i> IE is included in <i>OTDOA-ProvideAssistanceData</i>, the expected RSTD uncertainty is the same as provided in <i>OTDOA-NeighbourCellInfoList</i> IE for the corresponding cell (as indicated by <i>prsNeighbourCellIndex</i>).</p> <p>The target device may assume that the beginning of the NPRS positioning occasion of the NPRS carrier with the longest NPRS periodicity of the neighbour cell (NOTE 2) is received within the search window of size $[-\text{expectedRSTD-Uncertainty} \times 3 \times T_s, \text{expectedRSTD-Uncertainty} \times 3 \times T_s]$ centered at $T_{\text{REF}} + 1 \text{ millisecond} \times N + (\text{expectedRSTD} - 8192) \times 3 \times T_s$, where T_{REF} is the reception time of the beginning of the NPRS positioning occasion of the NB-IoT assistance data reference cell (NOTE 1) at the target device antenna connector, and $N = \text{nprs-SubframeOffset}$.</p>
<p>prsNeighbourCellIndex This field contains an index of the entry in IE <i>OTDOA-NeighbourCellInfoList</i>. Value 1 corresponds to the first cell in <i>OTDOA-NeighbourCellInfoList</i>, value 2 to the second, and so on. If this field is absent, and if the <i>OTDOA-NeighbourCellInfoList</i> IE is included in <i>OTDOA-ProvideAssistanceData</i>, it means there is no corresponding cell in <i>OTDOA-NeighbourCellInfoList</i> IE for this cell. The target device may assume the antenna ports of the PRS of the cell indicated by <i>prsNeighbourCellIndex</i> and the NPRS of this cell are quasi co-located, as defined in [16].</p>

NOTE 1: If the NB-IoT assistance data reference cell (i.e., anchor carrier) has no NPRS configured, the first NPRS carrier in *PRS-Info-NB* is referenced.

NOTE 2: "Cell" in this context may not necessarily be the anchor carrier. If this "cell" has more than one NPRS carrier with equal longest periodicity, the first such NPRS carrier in *PRS-Info-NB* is referenced. The length of a NPRS positioning occasion for Part A in this context is the length of the *nprsBitmap* bit string.

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),
    ...
    [[
        adType-r14   BIT STRING { prs (0), nprs (1) } (SIZE (1..8))      OPTIONAL
    ]]
}
-- ASN1STOP
```

***OTDOA-RequestAssistanceData* field descriptions**

physCellId

This field specifies the physical cell identity of the current primary cell of the target device.

adType

This field specifies the assistance data requested. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested.

Bit 0 indicates that PRS assistance data are requested, bit 1 indicates that NPRS assistance data are requested.

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. The RSTD measurements are provided for a neighbour cell and the RSTD reference cell, both of which are provided in the IE *OTDOA-ProvideAssistanceData*. The RSTD reference cell may or may not be the same as the assistance data reference cell provided in *OTDOA-ReferenceCellInfo* or *OTDOA-ReferenceCellInfoNB*. If the target device stops reporting inter-frequency RSTD measurements, where the inter-frequency RSTD measurement is an OTDOA RSTD measurement with at least one cell on a frequency different from the serving cell frequency, the LPP layer shall inform lower layers that inter-frequency RSTD measurements are stopped.

NOTE 1: If there are more than 24 *NeighbourMeasurementElement* to be sent, the target device may send them in multiple *ProvideLocationInformation* messages, as described under sub-clause 5.3.

NOTE 2: If NPRS/PRS antenna ports are quasi co-located, the target device provides a single RSTD measurement for the quasi co-located antenna ports of NPRS/PRS.

```
-- ASN1START
```

```

OTDOA-SignalMeasurementInformation ::= SEQUENCE {
  systemFrameNumber      BIT STRING (SIZE (10)),
  physCellIdRef          INTEGER (0..503),
  cellGlobalIdRef        ECGI                      OPTIONAL,
  earfcnRef              ARFCN-ValueEUTRA          OPTIONAL,      -- Cond NotSameAsRef0
  referenceQuality        OTDOA-MeasQuality        OPTIONAL,
  neighbourMeasurementList NeighbourMeasurementList,
  ...,
  [[ earfcnRef-v9a0       ARFCN-ValueEUTRA-v9a0    OPTIONAL      -- Cond NotSameAsRef1
  ]],
  [[ tpIdRef-r14         INTEGER (0..4095)          OPTIONAL,      -- Cond ProvidedByServer0
   prsIdRef-r14         INTEGER (0..4095)          OPTIONAL,      -- Cond ProvidedByServer1
   additionalPathsRef-r14
                       AdditionalPathList-r14     OPTIONAL,
   nprsIdRef-r14        INTEGER (0..4095)          OPTIONAL,      -- Cond ProvidedByServer2
   carrierFreqOffsetNB-Ref-r14
                       CarrierFreqOffsetNB-r14   OPTIONAL,      -- Cond NB-IoT
   hyperSFN-r14         BIT STRING (SIZE (10))    OPTIONAL      -- Cond H-SFN
  ]]
}

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

NeighbourMeasurementElement ::= SEQUENCE {
  physCellIdNeighbour    INTEGER (0..503),
  cellGlobalIdNeighbour ECGI                      OPTIONAL,
  earfcnNeighbour        ARFCN-ValueEUTRA          OPTIONAL,      -- Cond NotSameAsRef2
  rstd                   INTEGER (0..12711),
  rstd-Quality           OTDOA-MeasQuality,
  ...,
  [[ earfcnNeighbour-v9a0 ARFCN-ValueEUTRA-v9a0    OPTIONAL      -- Cond NotSameAsRef3
  ]],
  [[ tpIdNeighbour-r14   INTEGER (0..4095)          OPTIONAL,      -- Cond ProvidedByServer0
   prsIdNeighbour-r14   INTEGER (0..4095)          OPTIONAL,      -- Cond ProvidedByServer1
   delta-rstd-r14       INTEGER (0..5)             OPTIONAL,
   additionalPathsNeighbour-r14
                       AdditionalPathList-r14     OPTIONAL,
   nprsIdNeighbour-r14  INTEGER (0..4095)          OPTIONAL,      -- Cond ProvidedByServer2
   carrierFreqOffsetNB-Neighbour-r14
                       CarrierFreqOffsetNB-r14   OPTIONAL      -- Cond NB-IoT
  ]]
}

AdditionalPathList-r14 ::= SEQUENCE (SIZE(1..maxPaths-r14)) OF AdditionalPath-r14

maxPaths-r14    INTEGER ::= 2

-- ASN1STOP

```

Conditional presence	Explanation
<i>NotSameAsRef0</i>	The field is absent if the corresponding <i>earfcnRef-v9a0</i> is present. Otherwise, the target device shall include this field if the EARFCN of the RSTD reference cell is not the same as the EARFCN of the assistance data reference cell provided in the OTDOA assistance data.
<i>NotSameAsRef1</i>	The field is absent if the corresponding <i>earfcnRef</i> is present. Otherwise, the target device shall include this field if the EARFCN of the RSTD reference cell is not the same as the EARFCN of the assistance data reference cell provided in the OTDOA assistance data.
<i>NotSameAsRef2</i>	The field is absent if the corresponding <i>earfcnNeighbour-v9a0</i> is present. Otherwise, the target device shall include this field if the EARFCN of this neighbour cell is not the same as the <i>earfcnRef</i> for the RSTD reference cell.
<i>NotSameAsRef3</i>	The field is absent if the corresponding <i>earfcnNeighbour</i> is present. Otherwise, the target device shall include this field if the EARFCN of this neighbour cell is not the same as the <i>earfcnRef</i> for the RSTD reference cell.
<i>ProvidedByServer0</i>	The target device shall include this field if a <i>tpld</i> for this transmission point is included in the <i>OTDOA-ProvideAssistanceData</i> . Otherwise the field is absent.
<i>ProvidedByServer1</i>	The target device shall include this field if a <i>prsid</i> for this transmission point is included in the <i>OTDOA-ProvideAssistanceData</i> . Otherwise the field is absent.
<i>ProvidedByServer2</i>	The target device shall include this field if an <i>nprsid</i> for this cell is included in the <i>OTDOA-ProvideAssistanceData</i> and if this cell is a NB-IoT only cell (without associated LTE PRS cell). Otherwise the field is absent.
<i>NB-IoT</i>	The target device shall include this field if the cell is a NB-IoT only cell (without associated LTE PRS cell). Otherwise the field is absent.
<i>H-SFN</i>	The target device shall include this field if it was able to determine a hyper SFN of the RSTD reference cell.

OTDOA-SignalMeasurementInformation field descriptions
<p>systemFrameNumber This field specifies the SFN of the RSTD reference cell containing the starting subframe of the PRS or NPRS occasion group of the first PRS or NPRS configuration if PRS or NPRS are available on the RSTD reference cell, or subframe of the CRS for RSTD measurements if PRS and NPRS are not available on the RSTD reference cell during which the most recent neighbour cell RSTD measurement was performed.</p>
<p>physCellIdRef This field specifies the physical cell identity of the RSTD reference cell.</p>
<p>cellGlobalIdRef This field specifies the ECGI, the globally unique identity of a cell in E-UTRA, of the RSTD reference cell. The target shall provide this IE if it knows the ECGI of the RSTD reference cell.</p>
<p>earfcnRef This field specifies the EARFCN of the RSTD reference cell.</p>
<p>referenceQuality This field specifies the target device's best estimate of the quality of the TOA measurement from the RSTD reference cell, $T_{\text{SubframeRxRef}}$, where $T_{\text{SubframeRxRef}}$ is the time of arrival of the signal from the RSTD reference cell.</p>
<p>neighbourMeasurementList This list contains the measured RSTD values for neighbour cells together with the RSTD reference cell, along with quality for each measurement.</p>
<p>tpldRef This field specifies the transmission point ID of the RSTD reference cell.</p>
<p>prsidRef This field specifies the PRS-ID of the first PRS configuration of the RSTD reference cell.</p>
<p>additionalPathsRef This field specifies one or more additional detected path timing values for the RSTD reference cell, relative to the path timing used for determining the <i>rstd</i> value. If this field was requested but is not included, it means the UE did not detect any additional path timing values.</p>
<p>nprsidRef This field specifies the NPRS-ID of the RSTD reference cell.</p>
<p>carrierFreqOffsetNB-Ref This field specifies the offset of the NB-IoT channel number to EARFCN given by <i>earfcnRef</i> as defined in TS 36.101 [21].</p>
<p>hyperSFN This field specifies the hyper SFN as defined in [12] of the RSTD reference cell for the <i>systemFrameNumber</i>.</p>
<p>physCellIdNeighbour This field specifies the physical cell identity of the neighbour cell for which the RSTDs are provided.</p>
<p>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.</p>

OTDOA-SignalMeasurementInformation field descriptions	
earfcnNeighbour	This field specifies the EARFCN of the neighbour cell used for the RSTD measurements.
rstd	This field specifies the relative timing difference between this neighbour cell and the RSTD reference cell, as defined in [17]. Mapping of the measured quantity is defined as in [18] subclause 9.1.10.3.
rstd-Quality	This field specifies the target device's best estimate of the quality of the measured <i>rstd</i> .
tpldNeighbour	This field specifies the transmission point ID for the neighbour cell for which the RSTDs are provided.
prslidNeighbour	This field specifies the PRS-ID of the first PRS configuration of the neighbour cell for which the RSTDs are provided.
delta-rstd	This field specifies the higher-resolution RSTD Δ_{RSTD} as defined in [18] subclause 9.1.10.4. Mapping of the measured quantity is defined as in [18] subclause 9.1.10.4.
additionalPathsNeighbour	This field specifies one or more additional detected path timing values for the neighbour cell, relative to the path timing used for determining the <i>rstd</i> value. If this field was requested but is not included, it means the UE did not detect any additional path timing values.
nprslidNeighbour	This field specifies the NPRS-ID of the neighbour cell for which the RSTDs are provided.
carrierFreqOffsetNB-Neighbour	This field specifies the offset of the NB-IoT channel number to EARFCN given by <i>earfcnNeighbour</i> as defined in TS 36.101 [21].

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 <i>error-Value</i> field. The encoding on two bits is as follows: <table style="margin-left: 20px;"> <tr><td>'00'</td><td>5 meters</td></tr> <tr><td>'01'</td><td>10 meters</td></tr> <tr><td>'10'</td><td>20 meters</td></tr> <tr><td>'11'</td><td>30 meters.</td></tr> </table>	'00'	5 meters	'01'	10 meters	'10'	20 meters	'11'	30 meters.							
'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 (or TOA) measurement. The encoding on five bits is as follows: <table style="margin-left: 20px;"> <tr><td>'00000'</td><td>0</td><td>to (R*1-1) meters</td></tr> <tr><td>'00001'</td><td>R*1</td><td>to (R*2-1) meters</td></tr> <tr><td>'00010'</td><td>R*2</td><td>to (R*3-1) meters</td></tr> <tr><td>...</td><td></td><td></td></tr> <tr><td>'11111'</td><td>R*31</td><td>meters or more;</td></tr> </table> where R is the resolution defined by <i>error-Resolution</i> field. E.g., R=20 m corresponds to 0-19 m, 20-39 m, ..., 620+ m.	'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;
'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;														

OTDOA-MeasQuality field descriptions**error-NumSamples**

If the *error-Value* field provides the sample uncertainty of the OTDOA (or TOA) 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 (or TOA) 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'.

AdditionalPath

The IE *AdditionalPath* is used by the target device to provide information about additional paths in association to the RSTD measurements in the form of a relative time difference and a quality value. The additional path *relativeTimeDifference* is the detected path timing relative to the detected path timing used for the *rstd* value [17], and each additional path can be associated with a quality value *path-Quality*.

```
-- ASN1START
AdditionalPath-r14 ::= SEQUENCE {
    relativeTimeDifference-r14  INTEGER (-256..255),
    path-Quality-r14           OTDOA-MeasQuality           OPTIONAL,
    ...
}
-- ASN1STOP
```

AdditionalPath field descriptions**relativeTimeDifference**

This field specifies the additional detected path timing relative to the detected path timing used for the *rstd* value in units of 0.5 Ts, with $T_s=1/(15000*2048)$ seconds. A positive value indicates that the particular path is later in time than the detected path used for RSTD; a negative value indicates that the particular path is earlier in time than the detected path used for RSTD.

path-Quality

This field specifies the target device's best estimate of the quality of the detected timing of the additional path.

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 assistance data 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,
    ...
    [ [
        multipathRSTD-r14    ENUMERATED { requested }    OPTIONAL,    -- Need ON
        maxNoOfRSTDmeas-r14 INTEGER (1..32)              OPTIONAL     -- Need ON
    ] ]
}
-- ASN1STOP
```

OTDOA-RequestLocationInformation field descriptions
<p>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.</p>
<p>multipathRSTD This field, if present, indicates that the target device is requested to report additional detected path timing information per RSTD reference and neighbour cell.</p>
<p>maxNoOfRSTDmeas This field, if present, indicates the maximum number of <i>NeighbourMeasurementElement</i> fields (i.e., RSTD measurements) the target device can provide in <i>OTDOA-SignalMeasurementInformation</i>.</p>

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 positioning capabilities to the location server.

```
-- ASN1START
OTDOA-ProvideCapabilities ::= SEQUENCE {
    otdoa-Mode          BIT STRING { ue-assisted          (0),
                                   ue-assisted-NB-r14    (1) } (SIZE (1..8)),
    . . . ,
    supportedBandListEUTRA          SEQUENCE (SIZE (1..maxBands)) OF SupportedBandEUTRA          OPTIONAL,
    supportedBandListEUTRA-v9a0    SEQUENCE (SIZE (1..maxBands)) OF SupportedBandEUTRA-v9a0
    interFreqRSTDmeasurement-r10    ENUMERATED { supported }
    additionalNeighbourCellInfoList-r10  ENUMERATED { supported }
    prs-id-r14                        ENUMERATED { supported }
    tp-separation-via-muting-r14      ENUMERATED { supported }
    additional-prs-config-r14         ENUMERATED { supported }
    prs-based-tbs-r14                 ENUMERATED { supported }
    additionalPathsReport-r14        ENUMERATED { supported }
    densePrsConfig-r14               ENUMERATED { supported }
    maxSupportedPrsBandwidth-r14     ENUMERATED { n1, n6, n15, n25, n50, n75, n100, ... }
    OPTIONAL,
    prsOccGroup-r14                   ENUMERATED { supported }
    prsFrequencyHopping-r14          ENUMERATED { supported }
    maxSupportedPrsConfigs-r14       ENUMERATED { c2, c3 }
    periodicalReporting-r14          ENUMERATED { supported }
    multiPrbNprs-r14                 ENUMERATED { supported }
    idleStateForMeasurements-r14     ENUMERATED { required }
}

maxBands INTEGER ::= 64

SupportedBandEUTRA ::= SEQUENCE {
    bandEUTRA          INTEGER (1..maxFBI)
}

SupportedBandEUTRA-v9a0 ::= SEQUENCE {
    bandEUTRA-v9a0    INTEGER (maxFBI-Plus1..maxFBI2)    OPTIONAL
}

maxFBI          INTEGER ::= 64 -- Maximum value of frequency band indicator
maxFBI-Plus1    INTEGER ::= 65 -- lowest value extended FBI range
maxFBI2         INTEGER ::= 256 -- highest value extended FBI range

-- ASN1STOP
```


OTDOA-ProvideCapabilities field descriptions
<p>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. A zero-value in all bit positions in the bit string means OTDOA positioning method is not supported by the target device. ue-assisted: Bit 0 indicates that the target device supports UE-assisted OTDOA and LTE PRS. ue-assisted-NB: Bit 1 indicates that the target device supports UE-assisted OTDOA and NB-IoT NPRS.</p>
<p>SupportedBandEUTRA This field specifies the frequency bands for which the target device supports RSTD measurements. One entry corresponding to each supported E-UTRA band as defined in TS 36.101 [21]. In case the target device includes <i>bandEUTRA-v9a0</i>, the target device shall set the corresponding entry of <i>bandEUTRA</i> (i.e. without suffix) to <i>maxFBI</i>.</p>
<p>interFreqRSTDmeasurement This field, if present, indicates that the target device supports inter-frequency RSTD measurements within and between the frequency bands indicated in <i>SupportedBandEUTRA</i>.</p>
<p>additionalNeighbourCellInfoList This field, if present, indicates that the target device supports up to 3x24 <i>OTDOA-NeighbourCellInfoElement</i> in <i>OTDOA-NeighbourCellInfoList</i> in <i>OTDOA-ProvideAssistanceData</i> without any restriction for the <i>earfcn</i> in each <i>OTDOA-NeighbourCellInfoElement</i> as specified in subclause 6.5.1.2.</p>
<p>prs-id This field, if present, indicates that the target device supports PRS generation based on the PRS-ID as specified in [16] and support for TP-ID in <i>OTDOA-ReferenceCellInfo</i> and <i>OTDOA-NeighbourCellInfoList</i>.</p>
<p>tp-separation-via-muting This field, if present, indicates that the target device supports RSTD measurements for cells which have associated transmission points (e.g., Remote Radio Heads) within the cell coverage and where these associated transmission points have the same physical cell identity as the associated cell, and where these transmission points are identified via a different muting pattern. The field also indicates support for TP-ID in <i>OTDOA-ReferenceCellInfo</i> and <i>OTDOA-NeighbourCellInfoList</i>.</p>
<p>additional-prs-config This field, if present, indicates that the target device supports additional PRS configurations. The additional PRS configuration in <i>PRS-Info</i> IE comprise: - support for <i>prs-ConfigurationIndex</i> > 2399; - support for <i>N_{PRS}</i> values in addition to 1, 2, 4 and 6 (<i>add-numDL-Frames</i> in <i>PRS-Info</i>); - support for muting bit string lengths > 16 bits.</p>
<p>prs-based-tbs This field, if present, indicates that the target device supports RSTD measurements for PRS-only TPs.</p>
<p>additionalPathsReport This field, if present, indicates that the target device supports reporting of timing information for additional detected paths for RSTD reference and each neighbour cell.</p>
<p>densePrsConfig This field, if present, indicates that the target device supports a subset of the additional PRS configurations associated with capability <i>additional-prs-config</i> (PRS period 10ms, 20ms, 40ms or 80ms, and PRS occasion lengths 10, 20, 40, 80 or 160 subframes). In case <i>additional-prs-config</i> is present, this field is not present.</p>
<p>maxSupportedPrsBandwidth This field, if present, indicates the maximum PRS bandwidth supported by the target device, n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on. If not present, the target device is assumed to support the PRS bandwidth associated with the target device type, which for LTE devices including Cat-M1/M2 is 100 resource blocks and for NB-IoT devices is 1 resource block.</p>
<p>prsOccGroup This field, if present, indicates that the target device supports PRS occasion groups, which implies that each bit of a configured muting pattern applies per PRS occasion group.</p>
<p>prsFrequencyHopping This field, if present, indicates that the target device supports PRS occasion frequency hopping. If PRS occasion group is supported, the frequency hopping starts at the first PRS occasion of the PRS occasion group.</p>
<p>maxSupportedPrsConfigs This field, if present, indicates that the target device supports multiple PRS configurations per cell. Enumerated value c2 indicates support for up to 2 configurations; c3 indicates support for up to 3 configurations.</p>
<p>periodicalReporting This field, if present, indicates that the target device supports <i>periodicalReporting</i> of RSTD measurements. If this field is absent, the location server may assume that the target device does not support <i>periodicalReporting</i> in <i>CommonEsRequestLocationInformation</i>.</p>
<p>multiPrbNprs This field, if present, indicates that the target device supports NPRS configuration in more than one resource block (i.e., <i>maxCarrier</i> in <i>PRS-Info-NB</i> greater 1).</p>
<p>idleStateForMeasurements This field, if present, indicates that the target device requires idle state to perform RSTD measurements.</p>

Editor's Note: Whether the capability multiPrbNprs is needed or not is FFS.

6.5.1.8 OTDOA Capability Information Request

– *OTDOA-RequestCapabilities*

The IE *OTDOA-RequestCapabilities* is used by the location server to request the capability of the target device to support OTDOA and to request OTDOA positioning 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
```

```

    }, ...
}
...
}
-- 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, -- Need ON
  gnss-GenericAssistData     GNSS-GenericAssistData     OPTIONAL, -- Need ON
  gnss-Error                 A-GNSS-Error                OPTIONAL, -- Need ON
  ...
}
-- 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, BDS, etc.).

```

-- ASN1START
GNSS-CommonAssistData ::= SEQUENCE {
  gnss-ReferenceTime        GNSS-ReferenceTime          OPTIONAL, -- Need ON
  gnss-ReferenceLocation    GNSS-ReferenceLocation      OPTIONAL, -- Need ON
  gnss-IonosphericModel     GNSS-IonosphericModel       OPTIONAL, -- Need ON
  gnss-EarthOrientationParameters GNSS-EarthOrientationParameters OPTIONAL, -- Need ON
  ...
}
-- 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, BDS, 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, -- Need ON
  gnss-DifferentialCorrections GNSS-DifferentialCorrections OPTIONAL, -- Need ON
  gnss-NavigationModel       GNSS-NavigationModel       OPTIONAL, -- Need ON
  gnss-RealTimeIntegrity     GNSS-RealTimeIntegrity     OPTIONAL, -- Need ON
  gnss-DataBitAssistance     GNSS-DataBitAssistance     OPTIONAL, -- Need ON
  gnss-AcquisitionAssistance GNSS-AcquisitionAssistance OPTIONAL, -- Need ON
  gnss-Almanac               GNSS-Almanac               OPTIONAL, -- Need ON
  gnss-UTC-Model             GNSS-UTC-Model             OPTIONAL, -- Need ON
  gnss-AuxiliaryInformation  GNSS-AuxiliaryInformation OPTIONAL, -- Need ON
  ...
}

```

```

[[
  bds-DifferentialCorrections-r12
  bds-GridModel-r12          BDS-GridModelParameter-r12    OPTIONAL,  -- Cond GNSS-ID-BDS
]]
}
-- ASN1STOP

```

Conditional presence	Explanation
<i>GNSS-ID-SBAS</i>	The field is mandatory present if the <i>GNSS-ID = sbas</i> ; otherwise it is not present.
<i>GNSS-ID-BDS</i>	The field may be present if the <i>GNSS-ID = bds</i> ; 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,  -- Need ON
  ...
}

GNSS-ReferenceTimeForOneCell ::= SEQUENCE {
  networkTime          NetworkTime,
  referenceTimeUnc     INTEGER (0..127),
  bsAlign              ENUMERATED {true}             OPTIONAL,
  ...
}
-- ASN1STOP

```

Conditional presence	Explanation
<i>noFTA</i>	The field may be present if <i>gnss-ReferenceTimeForCells</i> 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 <i>gnss-SystemTime</i> .
referenceTimeUnc	<p>This field provides the accuracy of the relation between <i>gnssSystemTime</i> and <i>networkTime</i> time if IE <i>networkTime</i> is provided. When IE <i>networkTime</i> is not provided, this field can be included to provide the accuracy of the provided <i>gnssSystemTime</i>.</p> <p>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 - <i>referenceTimeUnc</i>, GNSS TOD + <i>referenceTimeUnc</i>].</p> <p>The uncertainty <i>r</i>, expressed in microseconds, is mapped to a number <i>K</i>, with the following formula:</p> $r = C * ((1+x)^K) - 1$ <p>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 <i>referenceTimeUnc</i> Format: see table K to uncertainty relation below.</p>
bsAlign	<p>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 target device 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.</p>

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, -- Need ON
    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
<i>gnss-TimeID=glonass</i>	The field may be present if <i>gnss-TimeID=glonass</i> ; otherwise it is not present.
<i>gnss-TimeID=gps</i>	The field may be present if <i>gnss-TimeID=gps</i> ; otherwise it is not present.

GNSS-SystemTime field descriptions	
gnss-TimeID	This field specifies the GNSS for which the <i>GNSS-SystemTime</i> is provided.

GNSS-SystemTime field descriptions
<p>gnss-DayNumber This field specifies the sequential number of days (with day count starting at 0) from the origin of the GNSS System Time as follows:</p> <ul style="list-style-type: none"> GPS, QZSS, SBAS – Days from January 6th 1980 00:00:00 UTC (USNO); Galileo – Days from Galileo System Time (GST) start epoch, defined as 13 seconds before midnight between 21st August and 22nd August 1999; i.e., GST was equal to 13 seconds at August 22nd 1999 00:00:00 UTC; GLONASS – Days from December 31st 1995 21:00:00 UTC (SU), which is local UTC Moscow January 1st 1996 00:00:00, defined as UTC(SU) + 3 hours in [9]; BDS – Days from January 1st 2006 00:00:00 UTC (NTSC).
<p>gnss-TimeOfDay This field specifies the integer number of seconds from the GNSS day change.</p>
<p>gnss-TimeOfDayFrac-msec This field specifies the fractional part of the <i>gnssTimeOfDay</i> field in 1-milli-seconds resolution. The total GNSS TOD is <i>gnss-TimeOfDay</i> + <i>gnssTimeOfDayFrac-msec</i>.</p>
<p>notificationOfLeapSecond This field specifies the notification of forthcoming leap second correction, as defined by parameter KP in [9, Table 4.7].</p>
<p>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.</p>

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

– 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,  -- Need ON
earfcn              ARFCN-ValueEUTRA,
...
[[ earfcn-v9a0      ARFCN-ValueEUTRA-v9a0 OPTIONAL  -- Cond EARFCN-max
]]
},
uTRA                SEQUENCE {
mode                CHOICE {
fdd                 SEQUENCE {
primary-CPICH-Info INTEGER (0..511),
...
},
tdd                 SEQUENCE {
cellParameters     INTEGER (0..127),
...
},
},
cellGlobalIdUTRA   CellGlobalIdEUTRA-AndUTRA  OPTIONAL,  -- Need ON
uarfcn              ARFCN-ValueUTRA,
...
},
gSM                 SEQUENCE {
bchCarrier          INTEGER (0..1023),
bsic                INTEGER (0..63),
cellGlobalIdGERAN  CellGlobalIdGERAN                    OPTIONAL,  -- Need ON
...
},
...
nBIOt-r14           SEQUENCE {
nbPhysCellId-r14   INTEGER (0..503),
nbCellGlobalId-r14 ECGI                            OPTIONAL,  -- Need ON
nbCarrierFreq-r14 CarrierFreq-NB-r14,
...
},
...
},
}
-- ASN1STOP

```

Conditional presence	Explanation
<i>EARFCN-max</i>	The field is mandatory present if the corresponding <i>earfcn</i> (i.e. without suffix) is set to <i>maxEARFCN</i> . Otherwise the field is not present.
<i>GNSSsynch</i>	The field is present and set to 0 if <i>NetworkTime</i> is synchronized to <i>gnss-SystemTime</i> ; otherwise the field is optionally present, need OR.

NetworkTime field descriptions
<p>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 hyperframe length is 12533.76 seconds. In case of NB-IoT, the Hyper-SFN cycle lengths is 10485.76 seconds.</p>
<p>fractionalSecondsFromFrameStructureStart This field specifies the fractional part of the <i>secondsFromFrameStructureStart</i> in 250 ns resolution. The total time since the particular frame structure start is <i>secondsFromFrameStructureStart</i> + <i>fractionalSecondsFromFrameStructureStart</i></p>
<p>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.</p>
<p>cellID This field specifies the cell for which the GNSS-network time relation is provided.</p>
<p>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.</p>
<p>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].</p>
<p>earfcn This field specifies E-ARFCN of the reference cell for the GNSS-network time relation (E-UTRA). In case the server includes <i>earfcn-v9a0</i>, the server shall set the corresponding <i>earfcn</i> (i.e. without suffix) to <i>maxEARFCN</i>.</p>
<p>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].</p>
<p>cellParameters This field specifies the physical cell identity of the reference cell (UTRA) for the GNSS-network time relation, as defined in [13].</p>
<p>cellGlobalIdUTRA The field 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].</p>
<p>uarfcn This field specifies ARFCN of the reference cell for the GNSS-network time relation (UTRA).</p>
<p>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].</p>
<p>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].</p>
<p>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.</p>
<p>nbPhysCellId This field specifies the narrowband physical layer cell identity of the NB-IoT reference cell, as defined in [12], for which the GNSS network time relation is provided.</p>
<p>nbCellGlobalId This field specifies the global cell identifier of the NB-IoT reference cell for which the GNSS-network time relation is provided, as defined in [12].</p>
<p>nbCarrierFreq This field specifies the carrier frequency of the NB-IoT reference cell for which the GNSS-network time relation is provided.</p>

– 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,    -- Need ON
    neQuickModel        NeQuickModelParameter        OPTIONAL,    -- Need ON
    ...
}
-- 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

```

***KlobucharModelParameter* 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 '01' it indicates that the parameters have been generated by BDS, and UE shall use these parameters according to the description given in 5.2.4.7 in [23]. 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], [23].
Scale factor 2^{-30} seconds.

alpha1

This field specifies the α_1 parameter of the Klobuchar model, as specified in [4], [23].
Scale factor 2^{-27} seconds/semi-circle.

alpha2

This field specifies the α_2 parameter of the Klobuchar model, as specified in [4], [23].
Scale factor 2^{-24} seconds/semi-circle².

alpha3

This field specifies the α_3 parameter of the Klobuchar model, as specified in [4], [23].
Scale factor 2^{-24} seconds/semi-circle³.

beta0

This field specifies the β_0 parameter of the Klobuchar model, as specified in [4], [23].
Scale factor 2^{11} seconds.

beta1

This field specifies the β_1 parameter of the Klobuchar model, as specified in [4], [23].
Scale factor 2^{14} seconds/semi-circle.

KlobucharModelParamater field descriptions
<p>beta2 This field specifies the β_2 parameter of the Klobuchar model, as specified in [4], [23]. Scale factor 2^{16} seconds/semi-circle².</p>
<p>beta3 This field specifies the β_3 parameter of the Klobuchar model, as specified in [4], [23]. Scale factor 2^{16} seconds/semi-circle³.</p>

– *NeQuickModelParameter*

```

-- ASN1START
NeQuickModelParameter ::= SEQUENCE {
    ai0          INTEGER (0..2047),
    ai1          INTEGER (-1024..1023),
    ai2          INTEGER (-8192..8191),
    ionoStormFlag1  INTEGER (0..1)      OPTIONAL,  -- Need OP
    ionoStormFlag2  INTEGER (0..1)      OPTIONAL,  -- Need OP
    ionoStormFlag3  INTEGER (0..1)      OPTIONAL,  -- Need OP
    ionoStormFlag4  INTEGER (0..1)      OPTIONAL,  -- Need OP
    ionoStormFlag5  INTEGER (0..1)      OPTIONAL,  -- Need OP
    ...
}
-- ASN1STOP

```

NeQuickModelParameter field descriptions
<p>ai0 Effective Ionisation Level 1st order parameter. Scale factor 2^{-2} Solar Flux Units (SFUs), [8] section 5.1.6.</p>
<p>ai1 Effective Ionisation Level 2nd order parameter. Scale factor 2^{-8} Solar Flux Units/degree, [8] section 5.1.6.</p>
<p>ai2 Effective Ionisation Level 3rd order parameter. Scale factor 2^{-15} Solar Flux Units/degree², [8] section 5.1.6.</p>
<p>ionoStormFlag1, ionoStormFlag2, ionoStormFlag3, ionoStormFlag4, ionoStormFlag5 These fields specify the ionosphere disturbance flags (1,...,5) for five different regions as described in [8], section 5.1.6. If the ionosphere disturbance flag for a region is not present the target device shall treat the ionosphere disturbance condition as unknown.</p>

– *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
<p>teop This field specifies the EOP data reference time in seconds, as specified in [4]. Scale factor 2^4 seconds.</p>

GNSS-EarthOrientationParameters field descriptions
<p>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.</p>
<p>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.</p>
<p>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.</p>
<p>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.</p>
<p>deltaUT1 This field specifies the UT1-UTC difference at reference time in seconds, as specified in [4]. Scale factor 2^{24} seconds.</p>
<p>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.</p>

– 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, -- Need ON
    tA2                      INTEGER (-64..63)                   OPTIONAL, -- Need ON
    gnss-TO-ID               INTEGER (1..15),
    weekNumber               INTEGER (0..8191)                  OPTIONAL, -- Need ON
    deltaT                   INTEGER (-128..127)               OPTIONAL, -- Need ON
    ...
}
-- ASN1STOP
```

GNSS-TimeModelElement field descriptions
<p>gnss-TimeModelRefTime This field specifies the reference time of week for <i>GNSS-TimeModelElement</i> and it is given in GNSS specific system time. Scale factor 2^4 seconds.</p>
<p>tA0 This field specifies the bias coefficient of the <i>GNSS-TimeModelElement</i>. Scale factor 2^{35} seconds.</p>
<p>tA1 This field specifies the drift coefficient of the <i>GNSS-TimeModelElement</i>. Scale factor of 2^{51} seconds/second.</p>
<p>tA2 This field specifies the drift rate correction coefficient of the <i>GNSS-TimeModelElement</i>. Scale factor of 2^{68} seconds/second².</p>
<p>gnss-TO-ID This field specifies the GNSS system time of the GNSS for which the <i>GNSS-TimeModelElement</i> is applicable. <i>GNSS-TimeModelElement</i> contains parameters to convert GNSS system time from the system indicated by <i>GNSS-ID</i> to GNSS system time indicated by <i>gnss-TO-ID</i>. The conversion is defined in [4,5,6]. See table of <i>gnss-TO-ID</i> to Indication relation below.</p>
<p>weekNumber This field specifies the reference week of the <i>GNSS-TimeModelElement</i> given in GNSS specific system time. Scale factor 1 week.</p>

GNSS-TimeModelElement field descriptions
<p>deltaT This field specifies the integer number of seconds of the GNSS-GNSS time offset provided in the <i>GNSS-TimeModelElement</i>. Scale factor 1 second.</p>

gnss-TO-ID to Indication relation

Value of <i>gnss-TO-ID</i>	Indication
1	GPS
2	Galileo
3	QZSS
4	GLONASS
5	BDS
6-15	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,    -- Need ON
    udreValidityTime   INTEGER (0..7)           OPTIONAL,    -- Need ON
    ...
}

-- ASN1STOP
    
```

GNSS-DifferentialCorrections field descriptions
<p>dgnss-RefTime This field specifies the time for which the DGNSS corrections are valid, modulo 1 hour. <i>dgnss-RefTime</i> is given in GNSS specific system time. Scale factor 1-second.</p>
<p>dgnss-SgnTypeList This list includes differential correction data for different GNSS signal types, identified by <i>GNSS-SignalID</i>.</p>

GNSS-DifferentialCorrections field descriptions	
gnss-StatusHealth	<p>This field specifies the status of the differential corrections. The values of this field and their respective meanings are defined as in table <i>gnss-StatusHealth Value to Indication</i> relation below.</p> <p>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.</p> <p>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.</p>
dgncs-SatList	This list includes differential correction data for different GNSS satellites, identified by <i>SV-ID</i> .
iod	This field specifies the Issue of Data field which contains the identity for the <i>GNSS-NavigationModel</i> .
udre	<p>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 <i>gnss-StatusHealth</i> field to determine the final UDRE estimate for the particular satellite. The meanings of the values for this field are shown in the table <i>udre Value to Indication</i> relation below.</p>
pseudoRangeCor	<p>This field specifies the correction to the pseudorange for the particular satellite at <i>dgncs-RefTime</i>, 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].</p> <p>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 <i>iod</i> 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.</p> <p>The target device shall only use the <i>pseudoRangeCor</i> value when the IOD value received matches its available navigation model.</p> <p>Pseudo-range corrections are provided with respect to GNSS specific geodetic datum (e.g., PZ-90.02 if <i>GNSS-ID</i> indicates GLONASS).</p> <p>Scale factor 0.32 meters.</p>
rangeRateCor	<p>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 <i>iod</i> 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 <i>iod</i> are estimated by</p> $\text{PRC}(t_1, \text{IOD}) = \text{PRC}(t_0, \text{IOD}) + \text{RRC}(t_0, \text{IOD}) \cdot (t_1 - t_0) ,$ <p>and the target device uses this to correct the pseudorange it measures at t_1, $\text{PR}_m(t_1, \text{IOD})$, by</p> $\text{PR}(t_1, \text{IOD}) = \text{PR}_m(t_1, \text{IOD}) + \text{PRC}(t_1, \text{IOD}) .$ <p>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 <i>iod</i> value received matches its available navigation model.</p> <p>Scale factor 0.032 meters/second.</p>
udreGrowthRate	<p>This field provides an estimate of the growth rate of uncertainty (1-σ) in the corrections for the particular satellite identified by <i>SV-ID</i>. The estimated UDRE at time value specified in the <i>udreValidityTime</i> t_1 is calculated as follows:</p> $\text{UDRE}(t_0+t_1) = \text{UDRE}(t_0) \times \text{udreGrowthRate} ,$ <p>where t_0 is the DGNSS Reference Time <i>dgncs-RefTime</i> for which the corrections are valid, t_1 is the <i>udreValidityTime</i> field, $\text{UDRE}(t_0)$ is the value of the <i>udre</i> field, and <i>udreGrowthRate</i> field is the factor as shown in the table Value of <i>udreGrowthRate</i> to Indication relation below.</p>
udreValidityTime	This field specifies the time when the <i>udreGrowthRate</i> field applies and is included if <i>udreGrowthRate</i> is included. The meaning of the values for this field is as shown in the table Value of <i>udreValidityTime</i> 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

<i>udre</i> Value	Indication
00	UDRE \leq 1.0 m
01	1.0 m < UDRE \leq 4.0 m
10	4.0 m < UDRE \leq 8.0 m
11	8.0 m < UDRE

Value of *udreGrowthRate* to Indication relation

Value of <i>udreGrowthRate</i>	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 <i>udreValidityTime</i>	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,
```

```

    . . .
    [[ svHealthExt-v1240 BIT STRING (SIZE(4))          OPTIONAL          -- Need ON
    ]]
}

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
    . . .
    bds-ClockModel-r12     BDS-ClockModel-r12          -- Model-6
}

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
    . . .
    bds-KeplerianSet-r12    NavModel-BDS-KeplerianSet-r12 -- Model-6
}

-- ASN1STOP

```

GNSS-NavigationModel field descriptions	
nonBroadcastIndFlag	This field indicates if the <i>GNSS-NavigationModel</i> 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 <i>GNSS-NavigationModel</i> data elements correspond to GNSS satellite broadcasted data; a value of 1 means the <i>GNSS-NavigationModel</i> data elements are not derived from satellite broadcast.
gnss-SatelliteList	This list provides ephemeris and clock corrections for GNSS satellites indicated by <i>SV-ID</i> .
svHealth	This field specifies the satellite's current health. The health values are GNSS system specific. The interpretation of <i>svHealth</i> depends on the <i>GNSS-ID</i> and is as shown in table GNSS to <i>svHealth</i> 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 <i>iod</i> contains the IODC as described in [4]. In case of broadcasted Modernized GPS ephemeris, the <i>iod</i> contains the 11-bit parameter <i>t_{oe}</i> as defined in [4, Table 30-I] [6, Table 3.5-1]. In case of broadcasted SBAS ephemeris, the <i>iod</i> contains the 8 bits Issue of Data as defined in [10] Message Type 9. In case of broadcasted QZSS QZS-L1 ephemeris, the <i>iod</i> contains the IODC as described in [7]. In case of broadcasted QZSS QZS-L1C/L2C/L5 ephemeris, the <i>iod</i> contains the 11-bit parameter <i>t_{oe}</i> as defined in [7]. In case of broadcasted GLONASS ephemeris, the <i>iod</i> contains the parameter <i>t_b</i> as defined in [9]. In the case of broadcasted Galileo ephemeris, the <i>iod</i> contains the IOD index as described in [8]. In the case of broadcasted BDS ephemeris, the <i>iod</i> contains 11 MSB bits of the <i>t_{oe}</i> as defined in [23]. The interpretation of <i>iod</i> depends on the <i>GNSS-ID</i> and is as shown in table GNSS to <i>iod</i> Bit String(11) relation below.
svHealthExt	This field specifies the satellite's additional current health. The health values are GNSS system specific. The interpretation of <i>svHealthExt</i> depends on the <i>GNSS-ID</i> and is as shown in table GNSS to <i>svHealthExt</i> Bit String(4) 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⁾	L1C Health	L1 Health	L2 Health	L5 Health	'0'	'0'	'0'	'0'

QZS-L1C/L2C/L5	[7]	[7]	[7]	[7]	(reserved)	(reserved)	(reserved)	(reserved)
GLONASS	B _n (MSB) [9, page 30]	F _T [9, Table 4.4]				'0' (reserved)	'0' (reserved)	'0' (reserved)
Galileo [8, section 5.1.9.3]	E5a Data Validity Status	E5b Data Validity Status	E1-B Data Validity Status	E5a Signal Health Status		'0' (reserved)	'0' (reserved)	'0' (reserved)
BDS [23]	B1I Health (SatH1) [23]	'0' (reserved)	'0' (reserved)	'0' (reserved)	'0' (reserved)	'0' (reserved)	'0' (reserved)	'0' (reserved)
Note 1:	If GNSS-ID indicates 'gps', and GNSS Orbit Model-2 is included, this interpretation of <i>svHealth</i> applies.							
Note 2:	If GNSS-ID indicates 'gps', and GNSS Orbit Model-3 is included, this interpretation of <i>svHealth</i> 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:	<i>svHealth</i> 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 <i>svHealth</i> applies.							
Note 5:	If GNSS-ID indicates 'qzss', and GNSS Orbit Model-3 is included, this interpretation of <i>svHealth</i> 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) [7]										
GLONASS	'0'	'0'	'0'	'0'	t _b (minutes, scale factor 15) [9]						
Galileo	'0'	IODnav [8]									
BDS	11 MSB bits of t _{oe} (seconds, scale factor 512, range 0 – 604672) [23]										

GNSS to svHealthExt Bit String(4) relation

GNSS	svHealthExt Bit String(4)			
	Bit 1 (MSB)	Bit 2	Bit 3	Bit 4 (LSB)
Galileo [8, section 5.1.9.3]	E5b Signal Health Status		E1-B Signal Health Status	

StandardClockModelList

```

-- ASN1START
StandardClockModelList ::= SEQUENCE (SIZE(1..2)) OF StandardClockModelElement

StandardClockModelElement ::= SEQUENCE {
    stanClockToc          INTEGER (0..16383),
    stanClockAF2          INTEGER (-32..31),
    stanClockAF1          INTEGER (-1048576..1048575),
    stanClockAF0          INTEGER (-1073741824..1073741823),
    stanClockTgd          INTEGER (-512..511) OPTIONAL, -- Need ON
    sisa                  INTEGER (0..255),
    stanModelID           INTEGER (0..1) OPTIONAL, -- Need ON
    ...
}
-- ASN1STOP
    
```


StandardClockModelList field descriptions
<p>standardClockModelList <i>gnss-ClockModel</i> Model-1 contains one or two clock model elements. 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 <i>gnss-ClockModel</i> if the location server assumes the target device to perform location information calculation using multiple signals.</p>
<p>stanClockToc Parameter t_{oc} defined in [8]. Scale factor 60 seconds.</p>
<p>stanClockAF2 Parameter af_2 defined in [8]. Scale factor 2^{-59} seconds/second².</p>
<p>stanClockAF1 Parameter af_1 defined in [8]. Scale factor 2^{-46} seconds/second.</p>
<p>stanClockAF0 Parameter af_0 defined in [8]. Scale factor 2^{-34} seconds.</p>
<p>stanClockTgd Parameter T_{GD}, Broadcast Group Delay (BGD), defined in [8]. Scale factor 2^{-32} seconds. This field is required if the target device supports only single frequency Galileo signal.</p>
<p>sisa Signal-In-Space Accuracy (SISA), defined in [8] section 5.1.11.</p>
<p>stanModelID This field specifies the identity of the clock model according to the table Value of stanModelID to Identity relation below. This field is required if the location server includes both F/Nav and I/Nav Galileo clock models in <i>gnss-ClockModel</i>.</p>

Value of stanModelID to Identity relation

Value of <i>stanModelID</i>	Identity
0	I/Nav (E1,E5b)
1	F/Nav (E1,E5a)

– *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
<p>navToc Parameter t_{oc}, time of clock (seconds) [4,7] Scale factor 2^4 seconds.</p>
<p>navaf2 Parameter a_2, clock correction polynomial coefficient (sec/sec²) [4,7]. Scale factor 2^{-55} seconds/second².</p>
<p>navaf1 Parameter a_1, clock correction polynomial coefficient (sec/sec) [4,7]. Scale factor 2^{-43} seconds/second.</p>
<p>navaf0 Parameter a_0, clock correction polynomial coefficient (seconds) [4,7]. Scale factor 2^{-31} seconds.</p>

NAV-ClockModel field descriptions**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, -- Need ON
    cnavISCl1cd      INTEGER (-4096..4095)      OPTIONAL, -- Need ON
    cnavISCl1ca      INTEGER (-4096..4095)      OPTIONAL, -- Need ON
    cnavISCl2c       INTEGER (-4096..4095)      OPTIONAL, -- Need ON
    cnavISCl5i5      INTEGER (-4096..4095)      OPTIONAL, -- Need ON
    cnavISCl5q5      INTEGER (-4096..4095)      OPTIONAL, -- Need ON
    ...
}
-- ASN1STOP
```

CNAV-ClockModel field descriptions**cnavToc**

Parameter t_{oc} , clock data reference time of week (seconds) [4,5,6,7].
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_{2-n} , SV clock drift rate correction coefficient (sec/sec²) [4,5,6,7].
Scale factor 2^{-60} seconds/second².

cnavAf1

Parameter a_{1-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.

The location server should include this field if the target device is GPS capable and supports the L1c signal.

cnavISCl1cd

Parameter ISC_{L1CD} , inter signal group delay correction (seconds) [6,7].
Scale factor 2^{-35} seconds.

The location server should include this field if the target device is GPS capable and supports the L1c signal.

cnavISCl1ca

Parameter ISC_{L1CA} , inter signal group delay correction (seconds) [4,5,7].
Scale factor 2^{-35} seconds.

The location server should include this field if the target device is GPS capable and supports the L1CA signal.

CNAV-ClockModel field descriptions
<p><i>cnavISCI2c</i> Parameter ISC_{L2c}, inter signal group delay correction (seconds) [4,5,7]. Scale factor 2^{-35} seconds. The location server should include this field if the target device is GPS capable and supports the L2c signal.</p>
<p><i>cnavISCI5i5</i> Parameter ISC_{L5i5}, inter signal group delay correction (seconds) [5,7]. Scale factor 2^{-35} seconds. The location server should include this field if the target device is GPS capable and supports the L5 signal.</p>
<p><i>cnavISCI5q5</i> Parameter ISC_{L5Q5}, inter signal group delay correction (seconds) [5,7]. Scale factor 2^{-35} seconds. The location server should include this field if the target device is GPS capable and supports the L5 signal.</p>

— *GLONASS-ClockModel*

```

-- ASN1START
GLONASS-ClockModel ::= SEQUENCE {
    gloTau          INTEGER (-2097152..2097151),
    gloGamma        INTEGER (-1024..1023),
    gloDeltaTau     INTEGER (-16..15)           OPTIONAL, -- Need ON
    ...
}
-- ASN1STOP

```

GLONASS-ClockModel field descriptions
<p><i>gloTau</i> Parameter $\tau_n(t_b)$, satellite clock offset (seconds) [9]. Scale factor 2^{-30} seconds.</p>
<p><i>gloGamma</i> Parameter $\gamma_n(t_b)$, relative frequency offset from nominal value (dimensionless) [9]. Scale factor 2^{-40}.</p>
<p><i>gloDeltaTau</i> Parameter $\Delta\tau_n$, time difference between transmission in G2 and G1 (seconds) [9]. Scale factor 2^{-30} seconds. The location server should include this parameter if the target device is dual frequency GLONASS receiver capable.</p>

— *SBAS-ClockModel*

```

-- ASN1START
SBAS-ClockModel ::= SEQUENCE {
    sbasTo          INTEGER (0..5399),
    sbasAgfo        INTEGER (-2048..2047),
    sbasAgf1        INTEGER (-128..127),
    ...
}
-- ASN1STOP

```

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

BDS-ClockModel

```

-- ASN1START
BDS-ClockModel-r12 ::= SEQUENCE {
    bdsAODC-r12      INTEGER (0..31),
    bdsToc-r12      INTEGER (0..131071),
    bdsA0-r12       INTEGER (-8388608..8388607),
    bdsA1-r12       INTEGER (-2097152..2097151),
    bdsA2-r12       INTEGER (-1024..1023),
    bdsTgd1-r12     INTEGER (-512..511),
    ...
}
-- ASN1STOP

```

BDS-ClockModel field descriptions

bdsAODC

Parameter Age of Data, Clock (AODC), see [23, Table 5-6].

bdsToc

Parameter T_{oc} , Time of clock (seconds) [23].
Scale factor 2^3 seconds.

bdsA0

Parameter a_0 , Clock correction polynomial coefficient (seconds) [23].
Scale factor 2^{-33} seconds.

bdsA1

Parameter a_1 , Clock correction polynomial coefficient (sec/sec) [23].
Scale factor 2^{-50} sec/sec.

bdsA2

Parameter a_2 , Clock correction polynomial coefficient (sec/sec²) [23].
Scale factor 2^{-66} sec/sec².

bdsTgd1

Parameter Equipment group delay differential T_{GD1} [23].
Scale factor is 0.1 nanosecond.

NavModelKeplerianSet

```

-- ASN1START
NavModelKeplerianSet ::= SEQUENCE {
    keplerToe      INTEGER (0 .. 16383),
    keplerW        INTEGER (-2147483648..2147483647),
    keplerDeltaN   INTEGER (-32768..32767),
    keplerM0       INTEGER (-2147483648..2147483647),
    keplerOmegaDot INTEGER (-8388608..8388607),
    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.

keplerW

Parameter ω , argument of perigee (semi-circles) [8].
Scale factor 2^{-31} semi-circles.

<i>NavModelKeplerianSet</i> field descriptions
<p>keplerDeltaN Parameter Δn, mean motion difference from computed value (semi-circles/sec) [8]. Scale factor 2^{-43} semi-circles/second.</p>
<p>keplerM0 Parameter M_0, mean anomaly at reference time (semi-circles) [8]. Scale factor 2^{-31} semi-circles.</p>
<p>keplerOmegaDot Parameter OMEGADot, rate of change of right ascension (semi-circles/sec) [8]. Scale factor 2^{-43} semi-circles/second.</p>
<p>keplerE Parameter e, eccentricity [8]. Scale factor 2^{-33}.</p>
<p>KeplerIDot Parameter Idot, rate of change of inclination angle (semi-circles/sec) [8]. Scale factor 2^{-43} semi-circles/second.</p>
<p>keplerAPowerHalf Parameter sqrtA, square root of semi-major Axis in (meters)^{1/2} [8]. Scale factor 2^{-19} meters^{1/2}.</p>
<p>keplerI0 Parameter i_0, inclination angle at reference time (semi-circles) [8]. Scale factor 2^{-31} semi-circles.</p>
<p>keplerOmega0 Parameter OMEGA₀, longitude of ascending node of orbit plane at weekly epoch (semi-circles) [8]. Scale factor 2^{-31} semi-circles.</p>
<p>keplerCrs Parameter C_{rs}, amplitude of the sine harmonic correction term to the orbit radius (meters) [8]. Scale factor 2^{-5} meters.</p>
<p>keplerCis Parameter C_{is}, amplitude of the sine harmonic correction term to the angle of inclination (radians) [8]. Scale factor 2^{-29} radians.</p>
<p>keplerCus Parameter C_{us}, amplitude of the sine harmonic correction term to the argument of latitude (radians) [8]. Scale factor 2^{-29} radians.</p>
<p>keplerCrc Parameter C_{rc}, amplitude of the cosine harmonic correction term to the orbit radius (meters) [8]. Scale factor 2^{-5} meters.</p>
<p>keplerCic Parameter C_{ic}, amplitude of the cosine harmonic correction term to the angle of inclination (radians) [8]. Scale factor 2^{-29} radians.</p>
<p>keplerCuc Parameter C_{uc}, amplitude of the cosine harmonic correction term to the argument of latitude (radians) [8]. Scale factor 2^{-29} radians.</p>

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 (-8388608..8388607),
    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..8388607),    -- 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, -- Need ON
...
}
-- 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 ^{1/2} .
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.
navCic Parameter C_{ic} , amplitude of cosine harmonic correction term to the angle of inclination (radians) [4,7]. Scale factor 2^{29} radians.

NavModelNAV-KeplerianSet field descriptions
<p>navCuc Parameter C_{uc}, amplitude of cosine harmonic correction term to the argument of latitude (radians) [4,7]. Scale factor 2^{-29} radians.</p>
<p>addNAVparam These fields include data and reserved bits in the GPS NAV message [4,14]. These additional navigation parameters, if provided by the location server, allow the target device to perform data wipe-off similar to what is done by the target device with the <i>GNSS-DataBitAssistance</i>.</p>

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 (-8388608..8388607),
    cnavCrC                 INTEGER (-8388608..8388607),
    cnavCus                 INTEGER (-1048576..1048575),
    cnavCuc                 INTEGER (-1048576..1048575),
    ...
}
-- ASN1STOP

```

NavModelCNAV-KeplerianSet field descriptions
<p>cnavTop Parameter t_{op}, data predict time of week (seconds) [4,5,6,7]. Scale factor 300 seconds.</p>
<p>cnavURAindex Parameter URA_{oe} Index, SV accuracy (dimensionless) [4,5,6,7].</p>
<p>cnavDeltaA Parameter ΔA, semi-major axis difference at reference time (meters) [4,5,6,7]. Scale factor 2^{-9} meters.</p>
<p>cnavAdot Parameter \dot{A}, change rate in semi-major axis (meters/sec) [4,5,6,7]. Scale factor 2^{-21} meters/sec.</p>
<p>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.</p>
<p>cnavDeltaNoDot Parameter $\Delta \dot{n}_0$, rate of mean motion difference from computed value (semi-circles/sec²) [4,5,6,7]. Scale factor 2^{-57} semi-circles/second².</p>
<p>cnavMo Parameter M_{0-n}, mean anomaly at reference time (semi-circles) [4,5,6,7]. Scale factor 2^{-32} semi-circles.</p>
<p>cnavE Parameter e_n, eccentricity (dimensionless) [4,5,6,7]. Scale factor 2^{-34}.</p>
<p>cnavOmega Parameter ω_n, argument of perigee (semi-circles) [4,5,6,7]. Scale factor 2^{-32} semi-circles.</p>

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

– *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 (-8388608..8388607),
    gloXdotdot    INTEGER (-16..15),
    gloY          INTEGER (-67108864..67108863),
    gloYdot       INTEGER (-8388608..8388607),
    gloYdotdot    INTEGER (-16..15),
    gloZ          INTEGER (-67108864..67108863),
    gloZdot       INTEGER (-8388608..8388607),
    gloZdotdot    INTEGER (-16..15),
    ...
}
-- ASN1STOP

```

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

NavModel-GLONASS-ECEF field descriptions
<p>gloX Parameter $x_n(t_b)$, x-coordinate of satellite at time t_b (kilometers) [9]. Scale factor 2^{-11} kilometers.</p>
<p>gloXdDot Parameter $\dot{x}_n(t_b)$, x-coordinate of satellite velocity at time t_b (kilometers/sec) [9]. Scale factor 2^{-20} kilometers/second.</p>
<p>gloXdDotDot Parameter $\ddot{x}_n(t_b)$, x-coordinate of satellite acceleration at time t_b (kilometers/sec²) [9]. Scale factor 2^{-30} kilometers/second².</p>
<p>gloY Parameter $y_n(t_b)$, y-coordinate of satellite at time t_b (kilometers) [9]. Scale factor 2^{-11} kilometers.</p>
<p>gloYdDot Parameter $\dot{y}_n(t_b)$, y-coordinate of satellite velocity at time t_b (kilometers/sec) [9]. Scale factor 2^{-20} kilometers/second.</p>
<p>gloYdDotDot Parameter $\ddot{y}_n(t_b)$, y-coordinate of satellite acceleration at time t_b (kilometers/sec²) [9]. Scale factor 2^{-30} kilometers/second².</p>
<p>gloZ Parameter $z_n(t_b)$, z-coordinate of satellite at time t_b (kilometers) [9]. Scale factor 2^{-11} kilometers.</p>
<p>gloZdDot Parameter $\dot{z}_n(t_b)$, z-coordinate of satellite velocity at time t_b (kilometers/sec) [9]. Scale factor 2^{-20} kilometers/second.</p>
<p>gloZdDotDot Parameter $\ddot{z}_n(t_b)$, z-coordinate of satellite acceleration at time t_b (kilometers/sec²) [9]. Scale factor 2^{-30} kilometers/second².</p>

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),
    sbasYgDotDot    INTEGER (-512..511),
    sbasZgDotDot    INTEGER (-512..511),
    ...
}
-- ASN1STOP

```

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

NavModel-SBAS-ECEF field descriptions
<p>sbasTo Parameter t_0, time of applicability (seconds) [10]. Scale factor 16 seconds.</p>

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

– *NavModel-BDS-KeplerianSet*

```

-- ASN1START
NavModel-BDS-KeplerianSet-r12 ::= SEQUENCE {
    bdsAODE-r12          INTEGER (0..31),
    bdsURAI-r12         INTEGER (0..15),
    bdsToe-r12          INTEGER (0..131071),
    bdsAPowerHalf-r12  INTEGER (0..4294967295),
    bdsE-r12            INTEGER (0..4294967295),
    bdsW-r12            INTEGER (-2147483648..2147483647),
    bdsDeltaN-r12      INTEGER (-32768..32767),
    bdsM0-r12           INTEGER (-2147483648..2147483647),
    bdsOmega0-r12      INTEGER (-2147483648..2147483647),
    bdsOmegaDot-r12    INTEGER (-8388608..8388607),
    bdsI0-r12           INTEGER (-2147483648..2147483647),
    bdsIDot-r12        INTEGER (-8192..8191),
    bdsCuc-r12          INTEGER (-131072..131071),
    bdsCus-r12          INTEGER (-131072..131071),
    bdsCrc-r12          INTEGER (-131072..131071),
    bdsCrs-r12          INTEGER (-131072..131071),
    bdsCic-r12          INTEGER (-131072..131071),
    bdsCis-r12          INTEGER (-131072..131071),
    ...
}
-- ASN1STOP

```

NavModel-BDS-KeplerianSet field descriptions
bdsAODE Parameter Age of Data, Ephemeris (AODE), see [23, Table 5-8].
bdsURAI Parameter URA Index, URA is used to describe the signal-in-space accuracy in meters as defined in [23].
bdsToe Parameter t_{oe} , Ephemeris reference time (seconds) [23]. Scale factor 2^3 seconds.
bdsAPowerHalf Parameter $A^{1/2}$, Square root of semi-major axis (meters ^{1/2})[23]. Scale factor 2^{-19} meters ^{1/2} .
bdsE Parameter e , Eccentricity, dimensionless [23]. Scale factor 2^{-33} .
bdsW Parameter ω , Argument of perigee (semi-circles) [23]. Scale factor 2^{-31} semi-circles.
bdsDeltaN Parameter Δn , Mean motion difference from computed value (semi-circles/sec) [23]. Scale factor 2^{-43} semi-circles/sec.
bdsM0 Parameter M_0 , Mean anomaly at reference time (semi-circles) [23]. Scale factor 2^{-31} semi-circles.
bdsOmega0 Parameter Ω_0 , Longitude of ascending node of orbital of plane computed according to reference time (semi-circles) [23]. Scale factor 2^{-31} semi-circles.
bdsOmegaDot Parameter $\dot{\Omega}$, Rate of right ascension (semi-circles/sec) [23]. Scale factor 2^{-43} semi-circles/sec.
bdsI0 Parameter i_0 , Inclination angle at reference time (semi-circles) [23]. Scale factor 2^{-31} semi-circles.
bdsIDot Parameter \dot{i} , Rate of inclination angle (semi-circles/sec) [23]. Scale factor 2^{-43} semi-circles/sec.
bdsCuc Parameter C_{uc} , Amplitude of cosine harmonic correction term to the argument of latitude (radians) [23]. Scale factor 2^{-31} radians.
bdsCus Parameter C_{us} , Amplitude of sine harmonic correction term to the argument of latitude (radians) [23]. Scale factor 2^{-31} radians.
bdsCrc Parameter C_{rc} , Amplitude of cosine harmonic correction term to the orbit radius (meters) [23]. Scale factor 2^{-6} meters.
bdsCrs Parameter C_{rs} , Amplitude of sine harmonic correction term to the orbit radius (meters) [23]. Scale factor 2^{-6} meters.
bdsCic Parameter C_{ic} , Amplitude of cosine harmonic correction term to the angle of inclination (radians) [23]. Scale factor 2^{-31} radians.
bdsCis Parameter C_{is} , Amplitude of sine harmonic correction term to the angle of inclination (radians) [23]. Scale factor 2^{-31} radians.

– 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,  -- Need OP
    ...
}
-- 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,  -- Need ON
    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*.

<i>GNSS-DataBitAssistance</i> field descriptions
<p><i>svID</i> This field specifies the GNSS SV-ID of the satellite for which the <i>GNSS-DataBitAssistance</i> is given.</p>
<p><i>gnss-SignalType</i> This field identifies the GNSS signal type of the <i>GNSS-DataBitAssistance</i>.</p>
<p><i>gnss-DataBits</i> Data bits are contained in GNSS system and data type specific format.</p> <p>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].</p> <p>In case of SBAS, it contains the FEC encoded data modulation symbols as defined in [10].</p> <p>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.</p> <p>In case of GLONASS, it contains the 100 sps differentially Manchester encoded modulation symbols as defined in [9] section 3.3.2.2.</p> <p>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.</p> <p>In case of BDS, it contains the encoded and interleaved modulation symbols as defined in [23, section 5.1.3].</p>

– *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,
    ...,
    confidence-r10          INTEGER (0..100)    OPTIONAL    -- Need ON
}

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),
    ...,
    codePhase1023         BOOLEAN              OPTIONAL,    -- Need OP
    dopplerUncertaintyExt-r10  ENUMERATED { d60,
                                             d80,
                                             d100,
                                             d120,
                                             noInformation, ... }  OPTIONAL    -- Need ON
}

```

```
}
-- ASN1STOP
```

GNSS-AcquisitionAssistance field descriptions
<p>gnss-SignalID This field specifies the GNSS signal for which the acquisition assistance are provided.</p>
<p>gnss-AcquisitionAssistList These fields provide a list of acquisition assistance data for each GNSS satellite.</p>
<p>confidence This field specifies the confidence level of the reference location area or volume used to calculate the acquisition assistance parameters (search windows). A high percentage value (e.g., 98% or more) indicates to the target device that the provided search windows are reliable. The location server should include this field to indicate the confidence level of the provided information.</p>
<p>svID This field specifies the GNSS SV-ID of the satellite for which the <i>GNSS-AcquisitionAssistance</i> is given.</p>
<p>doppler0 This field specifies the Doppler (0th 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.</p>
<p>doppler1 This field specifies the Doppler (1st 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/s² in the range from -0.2 m/s² to +0.1 m/s². Actual value of Doppler (1st order term) is calculated as $(-42 + \text{doppler1}) * 1/210 \text{ m/s}^2$, with <i>doppler1</i> in the range of 0...63.</p>
<p>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 <i>n</i> in the range 0-4 according to: $2^{-n}(40) \text{ m/s}; n = 0 - 4$. If the <i>dopplerUncertaintyExt</i> field is present, the target device that supports the <i>dopplerUncertaintyExt</i> shall ignore this field.</p>
<p>codePhase This field together with the <i>codePhase1023</i> 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. Note: The value $(1-2^{-10})$ ms is encoded using the <i>codePhase1023</i> IE.</p>
<p>intCodePhase This field contains integer code phase (expressed modulo 128 ms). The satellite integer milli-seconds code phase currently being transmitted at the reference time, as seen by a receiver at the reference location is calculated as reference time (expressed in milli-seconds) minus (<i>intCodePhase</i> + (<i>n</i>×128 ms)), as shown in Figure 6.5.2.2-1, with <i>n</i> = ...-2,-1,0,1,2... Scale factor 1 ms in the range from 0 to 127 ms.</p>
<p>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 <i>codePhaseSearchWindow Value to Interpretation Code Phase Search Window [ms]</i> relation shown below.</p>
<p>azimuth This field specifies the azimuth angle. An angle of <i>x</i> degrees means the satellite azimuth <i>a</i> is in the range $(x \leq a < x+0.703125)$ degrees. Scale factor 0.703125 degrees.</p>
<p>elevation This field specifies the elevation angle. An angle of <i>y</i> degrees means the satellite elevation <i>e</i> is in the range $(y \leq e < y+0.703125)$ degrees. Scale factor 0.703125 degrees.</p>

GNSS-AcquisitionAssistance field descriptions**codePhase1023**

This field if set to TRUE indicates that the code phase has the value $1023 \times 2^{-10} = (1-2^{-10})$ ms. This field may only be set to TRUE if the value provided in the *codePhase* IE is 1022. If this field is set to FALSE, the code phase is the value provided in the *codePhase* IE in the range from 0 to $(1 - 2 \times 2^{-10})$ ms. If this field is not present and the *codePhase* IE has the value 1022, the target device may assume that the code phase is between $(1 - 2 \times 2^{-10})$ and $(1 - 2^{-10})$ ms.

dopplerUncertaintyExt

If this field is present, the target device that supports this field shall ignore the *dopplerUncertainty* field. The location server should include this field only if supported by the target device.
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.
Enumerated values define 60 m/s, 80 m/s, 100 m/s, 120 m/s, and "No Information".

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

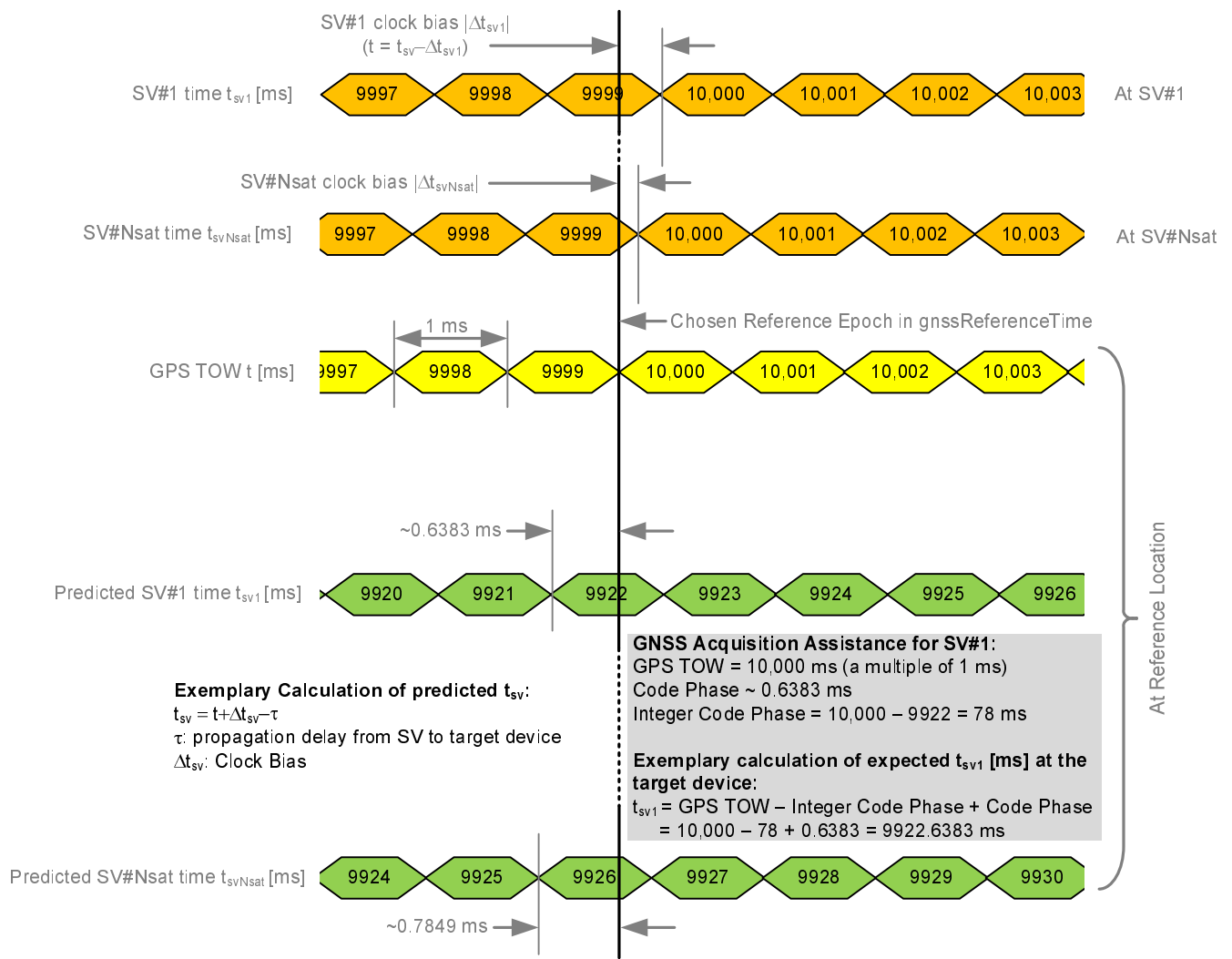


Figure 6.5.2.2-1: Exemplary calculation of some GNSS Acquisition Assistance fields.

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,  -- Need ON
    toa                 INTEGER (0..255)    OPTIONAL,  -- Need ON
    ioda               INTEGER (0..3)      OPTIONAL,  -- Need ON
    completeAlmanacProvided  BOOLEAN,
    gnss-AlmanacList   GNSS-AlmanacList,
    ...
    [ [ toa-ext-v1240    INTEGER (256..1023)  OPTIONAL,  -- Need ON
      [ ioda-ext-v1240  INTEGER (4..15)     OPTIONAL,  -- Need ON
      ] ] ]
}

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
  ...,
  keplerianBDS-Almanac-r12 AlmanacBDS-AlmanacSet-r12 -- Model-7
}
-- 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. This field is required for non-GLONASS GNSS.

Note, in case of Galileo, the almanac reference week number WN_a natively contains only the 2 LSB's [8, section 5.1.10].

toa, toa-ext

In case of *GNSS-ID* does not indicate Galileo, this field specifies the almanac reference time given in GNSS specific system time, in units of seconds with a scale factor of 2^{12} . *toa* is required for non-GLONASS GNSS.

In case of *GNSS-ID* does indicate Galileo, this field specifies the almanac reference time given in GNSS specific system time, in units of seconds with a scale factor of 600 seconds. Either *toa* or *toa-ext* is required for Galileo GNSS.

ioda, ioda-ext

This field specifies the issue of data. Either *ioda* or *ioda-ext* is required for Galileo GNSS.

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),
  kepSV-StatusINAV    BIT STRING (SIZE (4)),
  kepSV-StatusFNAV    BIT STRING (SIZE (2))          OPTIONAL,  -- Need ON
  kepAlmanacAPowerHalf  INTEGER (-4096..4095),
  kepAlmanacOmega0      INTEGER (-32768..32767),
  kepAlmanacW           INTEGER (-32768..32767),
  kepAlmanacM0          INTEGER (-32768..32767),
  kepAlmanacAF0         INTEGER (-32768..32767),
  kepAlmanacAF1         INTEGER (-4096..4095),
  ...
}
-- 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 δ_i , inclination at reference time relative to $i_0=56^\circ$; semi-circles [8].
Scale factor 2^{-14} semi-circles.

kepAlmanacOmegaDot

Parameter $\dot{\Omega}$, rate of change of right ascension (semi-circles/sec) [8].
Scale factor 2^{-33} semi-circles/seconds.

<i>AlmanacKeplerianSet</i> field descriptions
<p><i>kepSV-StatusINAV</i> This field contains the I/NAV signal health status [8, section 5.1.10] , E5b_{HS} and E1-B_{HS}, where E5b_{HS} occupies the 2 MSBs in <i>kepSV-StatusINAV</i>, and E1-B_{HS} the two LSBs.</p>
<p><i>kepSV-StatusFNAV</i> This field contains the F/NAV signal health status [8, section 5.1.10] ,E5a_{HS}. If the target device is supporting multiple Galileo signals, the location server shall include this field.</p>
<p><i>kepAlmanacAPowerHalf</i> Parameter $\Delta(a^{1/2})$, difference with respect to the square root of the nominal semi-major axis, (meters)^{1/2} [8]. Scale factor 2⁻⁹ meters^{1/2}.</p>
<p><i>kepAlmanacOmega0</i> Parameter OMEGA₀, longitude of ascending node of orbital plane at weekly epoch (semi-circles) [8]. Scale factor 2⁻¹⁵ semi-circles.</p>
<p><i>kepAlmanacW</i> Parameter ω, argument of perigee (semi-circles) [8]. Scale factor 2⁻¹⁵ semi-circles.</p>
<p><i>kepAlmanacM0</i> Parameter M₀, mean anomaly at reference time (semi-circles) [8]. Scale factor 2⁻¹⁵ semi-circles.</p>
<p><i>kepAlmanacAF0</i> Parameter af₀, satellite clock correction bias, seconds [8]. Scale factor 2⁻¹⁹ seconds.</p>
<p><i>kepAlmanacAF1</i> Parameter af₁, satellite clock correction linear, sec/sec [8]. Scale factor 2⁻³⁸ seconds/second.</p>

– *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 (-8388608..8388607),
    navAlmOmega          INTEGER (-8388608..8388607),
    navAlmMo             INTEGER (-8388608..8388607),
    navAlmaf0            INTEGER (-1024..1023),
    navAlmaf1            INTEGER (-1024..1023),
    ...
}
-- ASN1STOP

```

<i>AlmanacNAV-KeplerianSet</i> 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 δ_i , 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_0 , apparent satellite clock correction seconds [4,7]. Scale factor 2^{-20} seconds.
navAlmaf1	Parameter a_1 , 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
```

<i>AlmanacReducedKeplerianSet</i> 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,  -- Need ON
    ...
}
-- ASN1STOP

```

<i>AlmanacGLONASS-AlmanacSet</i> field descriptions
<i>gloAlmNA</i> Parameter N^A , days [9]. Scale factor 1 days.
<i>gloAlmna</i> Parameter n^A , dimensionless [9].
<i>gloAlmHA</i> Parameter H_n^A , dimensionless [9].
<i>gloAlmLambdaA</i> Parameter λ_n^A , semi-circles [9]. Scale factor 2^{-20} semi-circles.
<i>gloAlmtlambdaA</i> Parameter $t_{\lambda_n}^A$, seconds [9]. Scale factor 2^{-5} seconds.
<i>gloAlmDeltala</i> Parameter Δi_n^A , semi-circles [9]. Scale factor 2^{-20} semi-circles.
<i>gloAlmDeltaTA</i> Parameter ΔT_n^A , sec/orbit period [9]. Scale factor 2^{-9} seconds/orbit period.
<i>gloAlmDeltaTdotA</i> Parameter $\Delta T_DOT_n^A$, sec/orbit period ² [9]. Scale factor 2^{-14} seconds/orbit period ² .
<i>gloAlmEpsilonA</i> Parameter ϵ_n^A , dimensionless [9]. Scale factor 2^{-20} .
<i>gloAlmOmegaA</i> Parameter ω_n^A , semi-circles [9]. Scale factor 2^{-15} semi-circles.
<i>gloAlmTauA</i> Parameter τ_n^A , seconds [9]. Scale factor 2^{-18} seconds.
<i>gloAlmCA</i> Parameter C_n^A , dimensionless [9].
<i>gloAlmMA</i> 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

```

<i>AlmanacECEF-SBAS-AlmanacSet</i> field descriptions
<i>sbasAlmDataID</i> Parameter Data ID, dimensionless [10].
<i>svID</i> This field identifies the satellite for which the GNSS Almanac Model is given.
<i>sbasAlmHealth</i> Parameter Health, dimensionless [10].
<i>sbasAlmXg</i> Parameter X _G , meters [10]. Scale factor 2600 meters.
<i>sbasAlmYg</i> Parameter Y _G , meters [10]. Scale factor 2600 meters.
<i>sbasAlmZg</i> Parameter Z _G , meters [10]. Scale factor 26000 meters.
<i>sbasAlmXgdot</i> Parameter X _G Rat-of-Change, meters/sec [10]. Scale factor 10 meters/second.
<i>sbasAlmYgDot</i> Parameter Y _G Rate-of-Change, meters/sec [10]. Scale factor 10 meters/second.
<i>sbasAlmZgDot</i> Parameter Z _G Rate-of-Change, meters/sec [10]. Scale factor 40.96 meters/second.
<i>sbasAlmTo</i> Parameter t ₀ , seconds [10]. Scale factor 64 meters/seconds.

AlmanacBDS-AlmanacSet

```

-- ASN1START
AlmanacBDS-AlmanacSet-r12 ::= SEQUENCE {
    svID                SV-ID,
    bdsAlmToa-r12       INTEGER (0..255)                OPTIONAL,  -- Cond NotSameForAllSV
    bdsAlmSqrtA-r12     INTEGER (0..16777215),
    bdsAlmE-r12         INTEGER (0..131071),
    bdsAlmW-r12         INTEGER (-8388608..8388607),
    bdsAlmM0-r12        INTEGER (-8388608..8388607),
    bdsAlmOmega0-r12    INTEGER (-8388608..8388607),
    bdsAlmOmegaDot-r12  INTEGER (-65536..65535),
    bdsAlmDeltaI-r12    INTEGER (-32768..32767),
    bdsAlmA0-r12        INTEGER (-1024..1023),
    bdsAlmA1-r12        INTEGER (-1024..1023),
    bdsSvHealth-r12     BIT STRING (SIZE(9))          OPTIONAL,  -- Cond SV-ID
    ...
}
-- ASN1STOP
    
```

Conditional presence	Explanation
<i>NotSameForAllSV</i>	This field may be present if the t _{0a} is not the same for all SVs; otherwise it is not present and the t _{0a} is provided in <i>GNSS-Almanac</i> .
<i>SV-ID</i>	This field is mandatory present if <i>SV-ID</i> is between 0 and 29; otherwise it is not present.

<i>AlmanacBDS-AlmanacSet</i> field descriptions
<i>svID</i> This field identifies the satellite for which the GNSS Almanac Model is given.
<i>bdsAlmToa</i> Parameter t_{oa} , Almanac reference time(seconds) [23] Scale factor 2^{12} seconds.
<i>bdsAlmSqrtA</i> Parameter $A^{1/2}$, Square root of semi-major axis (meters ^{1/2}) [23] Scale factor 2^{11} meters ^{1/2} .
<i>bdsAlmE</i> Parameter e , Eccentricity , dimensionless [23] Scale factor 2^{21} .
<i>bdsAlmW</i> Parameter ω , Argument of Perigee (semi-circles) [23] Scale factor 2^{23} semi-circles.
<i>bdsAlmM0</i> Parameter M_0 , Mean anomaly at reference time (semi-circles) [23] Scale factor 2^{23} semi-circles.
<i>bdsAlmOmega0</i> Parameter Ω_0 , Longitude of ascending node of orbital plane computed according to reference time (semi-circles) [23] Scale factor 2^{23} semi-circles.
<i>bdsAlmOmegaDot</i> Parameter $\dot{\Omega}$, Rate of right ascension (semi-circles/sec) [23] Scale factor 2^{38} semi-circles/sec.
<i>bdsAlmDeltaI</i> Parameter δ_i , Correction of orbit reference inclination at reference time (semi-circles) [23] Scale factor 2^{19} semi-circles.
<i>bdsAlmA0</i> Parameter a_0 , Satellite clock bias (seconds) [23] Scale factor 2^{20} seconds.
<i>bdsAlmA1</i> Parameter a_1 , Satellite clock rate (sec/sec) [23] Scale factor 2^{38} sec/sec.
<i>bdsSvHealth</i> This field indicates satellites health information as defined in [23] Table 5-15. The left most bit is the MSB.

– *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], [23].

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; if *GNSS-ID* indicates BDS, *GNSS-UTC-Model* contains a set of parameters needed to relate BDS system time to UTC (NTSC).

```
-- 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
    . . . ,
    utcModel5-r12  UTC-ModelSet5-r12      -- Model-5
}
-- ASN1STOP
```

– *UTC-ModelSet1*

```
-- ASN1START
```



```

UTC-ModelSet1 ::= SEQUENCE {
    gnss-Utc-A1      INTEGER (-8388608..8388607),
    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),
    utcWNt     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/sec²) [4,5,6,7].
Scale factor 2^{-68} seconds/second².

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.

<i>UTC-ModelSet2</i> field descriptions
<p>utcWNot Parameter WN_{ot}, time data reference week number (weeks) [4,5,6,7]. Scale factor 1 week.</p>
<p>utcWNlsf Parameter WN_{LSF}, leap second reference week number (weeks) [4,5,6,7]. Scale factor 1 week.</p>
<p>utcDN Parameter DN, leap second reference day number (days) [4,5,6,7]. Scale factor 1 day.</p>
<p>utcDeltaTlsf Parameter Δt_{LSF}, current or future leap second count (seconds) [4,5,6,7]. Scale factor 1 second.</p>

– *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
<i>GLONASS-M</i>	The field is mandatory present if GLONASS-M satellites are present in the current GLONASS constellation; otherwise it is not present.

<i>UTC-ModelSet3</i> field descriptions
<p>nA Parameter N^A, calendar day number within four-year period beginning since the leap year (days) [9]. Scale factor 1 day.</p>
<p>tauC Parameter τ_c, GLONASS time scale correction to UTC(SU) (seconds) [9]. Scale factor 2^{-31} seconds.</p>
<p>b1 Parameter B1, coefficient to determine $\Delta UT1$ (seconds) [9]. Scale factor 2^{-10} seconds.</p>
<p>b2 Parameter B2, coefficient to determine $\Delta UT1$ (seconds/msd) [9]. Scale factor 2^{-16} seconds/msd.</p>
<p>kp Parameter KP, notification of expected leap second correction (dimensionless) [9].</p>

– *UTC-ModelSet4*

```

-- ASN1START
UTC-ModelSet4 ::= SEQUENCE {
    utcAlwnt          INTEGER (-8388608..8388607),
    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
<p>utcA1wnt Parameter A_{1WNT}, sec/sec ([10], Message Type 12). Scale factor 2^{50} seconds/second.</p>
<p>utcA0wnt Parameter A_{0WNT}, seconds ([10], Message Type 12). Scale factor 2^{30} seconds.</p>
<p>utcTot Parameter t_{tot}, seconds ([10], Message Type 12). Scale factor 2^{12} seconds.</p>
<p>utcWNt Parameter WN_t, weeks ([10], Message Type 12). Scale factor 1 week.</p>
<p>utcDeltaTls Parameter Δt_{LS}, seconds ([10], Message Type 12). Scale factor 1 second.</p>
<p>utcWNlsf Parameter WN_{LSF}, weeks ([10], Message Type 12). Scale factor 1 week.</p>
<p>utcDN Parameter DN, days ([10], Message Type 12). Scale factor 1 day.</p>
<p>utcDeltaTlsf Parameter Δt_{LSF}, seconds ([10], Message Type 12). Scale factor 1 second.</p>
<p>utcStandardID If <i>GNSS-ID</i> indicates 'sbas', this field indicates the UTC standard used for the SBAS network time indicated by <i>SBAS-ID</i> to UTC relation as defined in the table Value of UTC Standard ID to UTC Standard relation shown below ([10], Message Type 12).</p>

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

UTC-ModelSet5

-- ASN1START

```

UTC-ModelSet5-r12 ::= SEQUENCE {
    utcA0-r12          INTEGER (-2147483648..2147483647),
    utcA1-r12          INTEGER (-8388608..8388607),
    utcDeltaTls-r12    INTEGER (-128..127),
    utcWNlsf-r12       INTEGER (0..255),
    utcDN-r12          INTEGER (0..255),
    utcDeltaTlsf-r12   INTEGER (-128..127),
    ...
}
    
```

-- ASN1STOP

UTC-ModelSet5 field descriptions
<p>utcA0 Parameter A_{0UTC}, BDS clock bias relative to UTC, seconds [23]. Scale factor 2^{30} seconds.</p>

<i>UTC-ModelSet5</i> field descriptions
<p><i>utcA1</i> Parameter A_{UTC}, BDS clock rate relative to UTC, sec/sec [23]. Scale factor 2^{50} sec/sec.</p>
<p><i>utcDeltaTls</i> Parameter Δ_{LS}, delta time due to leap seconds before the new leap second effective, seconds [23]. Scale factor 1 second.</p>
<p><i>utcWNlsf</i> Parameter WN_{LSF}, week number of the new leap second, weeks [23]. Scale factor 1 week.</p>
<p><i>utcDN</i> Parameter DN, day number of week of the new leap second, days [23]. Scale factor 1 day.</p>
<p><i>utcDeltaTlsf</i> Parameter Δ_{LSF}, delta time due to leap seconds after the new leap second effective, seconds [23]. Scale factor 1 second.</p>

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), the *GNSS-AuxiliaryInformation* should be provided for the same satellites and in the same LPP message 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
<i>FDMA</i>	The field is mandatory present if the GLONASS SV indicated by <i>svID</i> broadcasts FDMA signals; otherwise it is not present.

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

– *BDS-DifferentialCorrections*

The IE *BDS-DifferentialCorrections* is used by the location server to provide differential corrections to the target device.

```

-- ASN1START
BDS-DifferentialCorrections-r12 ::= SEQUENCE {
    dbds-RefTime-r12          INTEGER (0..3599),
    bds-SgnTypeList-r12      BDS-SgnTypeList-r12,
    ...
}
BDS-SgnTypeList-r12 ::= SEQUENCE (SIZE (1..3)) OF BDS-SgnTypeElement-r12
BDS-SgnTypeElement-r12 ::= SEQUENCE {
    gnss-SignalID            GNSS-SignalID          OPTIONAL,    -- Need ON
    dbds-CorrectionList-r12 DBDS-CorrectionList-r12,
    ...
}
DBDS-CorrectionList-r12 ::= SEQUENCE (SIZE (1..64)) OF DBDS-CorrectionElement-r12
DBDS-CorrectionElement-r12 ::= SEQUENCE {
    svID                    SV-ID,
    bds-UDREI-r12           INTEGER (0..15),
    bds-RURAI-r12           INTEGER (0..15),
    bds-ECC-DeltaT-r12      INTEGER (-4096..4095),
    ...
}
-- ASN1STOP

```

BDS-DifferentialCorrections field descriptions
<p>dbds-RefTime This field <i>specifies</i> the time for which the differential corrections are valid, modulo 1 hour. <i>dbds-RefTime</i> is given in BDS system time. Scale factor 1-second.</p>
<p>bds-UDREI This field indicates user differential range error information by user differential range error index (UDREI) as defined in [23], 5.3.3.7.2.</p>
<p>bds-RURAI This field indicates Regional User Range Accuracy (RURA) information by Regional User Range Accuracy Index (UDREI) as defined in [23, 5.3.3.6].</p>
<p>bds-ECC-DeltaT This field indicates the BDS differential correction information which is expressed in equivalent clock correction (Δt). Add the value of Δt to the observed pseudo-range to correct the effect caused by the satellite clock offset and ephemeris error. Value -4096 means the Δt is not available. The scale factor is 0.1 meter.</p>

– *BDS-GridModelParameter*

```

-- ASN1START
BDS-GridModelParameter-r12 ::= SEQUENCE {
    bds-RefTime-r12          INTEGER (0..3599),
    gridIonList-r12         GridIonList-r12,
    ...
}

GridIonList-r12 ::= SEQUENCE (SIZE (1..320)) OF GridIonElement-r12

GridIonElement-r12 ::= SEQUENCE {
    igp-ID-r12              INTEGER (1..320),
    dt-r12                  INTEGER (0..511),
    givei-r12               INTEGER (0..15),
    ...
}
-- ASN1STOP

```

***BDS-GridModelParameter* field descriptions**

bds-RefTime

This field specifies the time for which the grid model parameters are valid, modulo 1 hour. *bds-RefTime* is given in BDS system time.
Scale factor 1-second.

gridIonList

This list provides ionospheric grid point information for each grid point. Up to 16 instances are used in this version of the specification. The values 17 to 320 are reserved for future use.

igp-ID

This field indicates the ionospheric grid point (IGP) number as defined in [23, 5.3.3.8].

dt

This field indicates d_T as defined in [23, 5.3.3.8.1], i.e. the vertical delay at the corresponding IGP indicated by *igp-ID*. The scale factor is 0.125 meter.

givei

This field indicates the Grid Ionospheric Vertical Error Index (GIVEI) which is used to describe the delay correction accuracy at ionospheric grid point indicated by *igp-ID*, the mapping between GIVEI and GIVE is defined in [23, 5.3.3.8.2].

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
<i>CommonADReq</i>	The field is mandatory present if the target device requests <i>GNSS-CommonAssistData</i> ; otherwise it is not present.
<i>GenADReq</i>	This field is mandatory present if the target device requests <i>GNSS-GenericAssistData</i> 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
<i>RefTimeReq</i>	The field is mandatory present if the target device requests <i>GNSS-ReferenceTime</i> ; otherwise it is not present.
<i>RefLocReq</i>	This field is mandatory present if the target device requests <i>GNSS-ReferenceLocation</i> ; otherwise it is not present.
<i>IonoModReq</i>	This field is mandatory present if the target device requests <i>GNSS-IonosphericModel</i> ; otherwise it is not present.
<i>EOPReq</i>	This field is mandatory present if the target device requests <i>GNSS-EarthOrientationParameters</i> ; 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, BDS, 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
  ...
  [[
    bds-DifferentialCorrectionsReq-r12
                                BDS-DifferentialCorrectionsReq-r12
                                OPTIONAL, -- Cond DBDS-Req
    bds-GridModelReq-r12        BDS-GridModelReq-r12
                                OPTIONAL -- Cond BDS-GridModReq
  ]]
}
-- ASN1STOP
```

Conditional presence	Explanation
<i>GNSS-ID-SBAS</i>	The field is mandatory present if the <i>GNSS-ID</i> = <i>sbas</i> ; otherwise it is not present.
<i>TimeModReq</i>	The field is mandatory present if the target device requests <i>GNSS-TimeModelList</i> ; otherwise it is not present.

Conditional presence	Explanation
<i>DGNSS-Req</i>	The field is mandatory present if the target device requests <i>GNSS-DifferentialCorrections</i> ; otherwise it is not present.
<i>NavModReq</i>	The field is mandatory present if the target device requests <i>GNSS-NavigationModel</i> ; otherwise it is not present.
<i>RTIReq</i>	The field is mandatory present if the target device requests <i>GNSS-RealTimeIntegrity</i> ; otherwise it is not present.
<i>DataBitsReq</i>	The field is mandatory present if the target device requests <i>GNSS-DataBitAssistance</i> ; otherwise it is not present.
<i>AcquAssistReq</i>	The field is mandatory present if the target device requests <i>GNSS-AcquisitionAssistance</i> ; otherwise it is not present.
<i>AlmanacReq</i>	The field is mandatory present if the target device requests <i>GNSS-Almanac</i> ; otherwise it is not present.
<i>UTCModReq</i>	The field is mandatory present if the target device requests <i>GNSS-UTCModel</i> ; otherwise it is not present.
<i>AuxInfoReq</i>	The field is mandatory present if the target device requests <i>GNSS-AuxiliaryInformation</i> ; otherwise it is not present.
<i>DBDS-Req</i>	The field is mandatory present if the target device requests <i>BDS-DifferentialCorrections</i> ; otherwise it is not present. This field may only be present if <i>gnss-ID</i> indicates 'bds'.
<i>BDS-GridModReq</i>	The field is mandatory present if the target device requests <i>BDS-GridModel</i> ; otherwise it is not present. This field may only be present if <i>gnss-ID</i> indicates 'bds'.

6.5.2.4 GNSS Assistance Data Request Elements

– *GNSS-ReferenceTimeReq*

The IE *GNSS-ReferenceTimeReq* is used by the target device to request the *GNSS-ReferenceTime* 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
<i>gps</i>	The field is mandatory present if <i>gnss-TimeReqPrefList</i> includes a <i>GNSS-ID</i> = 'gps'; otherwise it is not present.
<i>glonass</i>	The field is mandatory present if <i>gnss-TimeReqPrefList</i> includes a <i>GNSS-ID</i> = 'glonass'; otherwise it is not present.

<i>GNSS-ReferenceTimeReq</i> field descriptions	
<i>gnss-TimeReqPrefList</i>	This field is used by the target device to request the system time for a specific GNSS, specified by <i>GNSS-ID</i> in the order of preference. The first <i>GNSS-ID</i> in the list is the most preferred GNSS for reference time, the second <i>GNSS-ID</i> is the second most preferred, etc.
<i>gps-TOW-assistReq</i>	This field is used by the target device to request the <i>gps-TOW-Assist</i> field in <i>GNSS-SystemTime</i> . TRUE means requested.
<i>notOfLeapSecReq</i>	This field is used by the target device to request the <i>notificationOfLeapSecond</i> field in <i>GNSS-SystemTime</i> . 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
<i>klobuchar</i>	The field is mandatory present if the target device requests <i>klobucharModel</i> ; otherwise it is not present. The BIT STRING defines the dataID requested, defined in IE <i>KlobucharModelParameter</i> .
<i>nequick</i>	The field is mandatory present if the target device requests <i>neQuickModel</i> ; 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 *GNSS-TimeModelListReq* 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 *GNSS-TimeModelElement* IE.

GNSS-TimeModelElementReq field descriptions**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 *GNSS-DifferentialCorrectionsReq* 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**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
<i>orbitModelID-2</i>	The field is mandatory present if <i>orbitModelID-PrefList</i> 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 <i>GNSS-NavigationModel</i> data the target device has currently stored for the particular GNSS indicated by <i>GNSS-ID</i> .
reqNavList	This list provides information to the location server which <i>GNSS-NavigationModel</i> data are requested by the target device.
gnss-WeekOrDay	If <i>GNSS-ID</i> does not indicate 'glonass', this field defines the GNSS Week number of the assistance currently held by the target device. If <i>GNSS-ID</i> is set to 'glonass', this field defines the calendar number of day within the four-year interval starting from 1 st 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-Toe	If <i>GNSS-ID</i> 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 <i>GNSS-ID</i> 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 <i>GNSS-ID</i> does not indicate 'glonass', this IE defines the ephemeris age tolerance of the target device in units of hours. If <i>GNSS-ID</i> 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. This field is not included if the target device does not have any stored clock and orbit models for any 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 <i>SV-ID</i> . Bit 0 represents <i>SV-ID</i> =0 and bit 63 represents <i>SV-ID</i> =63. A one-value at a bit position means the navigation model data for the corresponding <i>SV-ID</i> is requested, a zero-value means not requested.
clockModelIDPrefList, orbitModelID-PrefList	These fields define the Model-IDs of the clock and orbit models that 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 <i>addNAVparam</i> fields in <i>GNSS-NavigationModel</i> IE (<i>NavModel-NAVKeplerianSet</i> 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
bds	6	6

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
bds	Model-6	Model-6

– 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

<i>GNSS-ID</i>	<i>modelID</i>
gps	2
sbas	6
qzss	2
galileo	1
glonass	5
bds	7

– *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, the default 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
bds	5

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
```

BDS-DifferentialCorrectionsReq

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

```
-- ASN1START
BDS-DifferentialCorrectionsReq-r12 ::= SEQUENCE {
    dgnss-SignalsReq          GNSS-SignalIDs,
    ...
}
-- ASN1STOP
```

BDS-DifferentialCorrectionsReq field descriptions**dgnss-SignalsReq**

This field specifies the BDS Signal(s) for which the *BDS-DifferentialCorrections* are requested. A one-value at a bit position means BDS differential 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'.

BDS-GridModelReq

The IE *BDS-GridModelReq* is used by the target device to request the *BDS-GridModel* assistance from the location server.

```
-- ASN1START
BDS-GridModelReq-r12 ::= 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_0 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-ProvideLocationInformation* 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)),
            ...
        }
    }
}
-- ASN1STOP
```

```

    },
    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,
        ...
    },
    ...
    nbIoT-r14 SEQUENCE {
        nbPhysCellId-r14 INTEGER (0..503),
        nbCellGlobalId-r14 ECGI OPTIONAL,
        sfn-r14 BIT STRING (SIZE (10)),
        hyperSFN-r14 BIT STRING (SIZE (10)) OPTIONAL,
        ...
    }
    }
    OPTIONAL,
    ...
}
-- ASN1STOP

```

MeasurementReferenceTime field descriptions	
gnss-TOD-msec	<p>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.</p> <p>The value for GNSS TOD is derived from the GNSS specific system time indicated in <i>gnss-TimeID</i> rounded down to the nearest millisecond unit.</p> <p>Scale factor 1 millisecond.</p>
gnss-TOD-frac	<p>This field specifies the fractional part of the GNSS TOD in 250 ns resolution. The total GNSS TOD is given by <i>gnss-TOD-msec</i> + <i>gnss-TOD-frac</i>.</p> <p>Scale factor 250 nanoseconds.</p>
gnss-TOD-unc	<p>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 <i>gnss-TOD-msec</i>.</p> <p>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 – <i>gnss-TOD-unc</i>, GNSS TOD + <i>gnss-TOD-unc</i>].</p> <p>The uncertainty <i>r</i>, expressed in microseconds, is mapped to a number K, with the following formula:</p> $r = C * ((1+x)^K - 1)$ <p>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 <i>gnss-TOD-unc</i> value are as in the table Value of K to Value of uncertainty relation below.</p> <p>This field shall be included if the target device provides GNSS-network time relationship.</p>
gnss-TimeID	<p>This field specifies the GNSS system time for which the <i>gnss-TOD-msec</i> (and <i>gnss-TOD-frac</i> if applicable) is provided.</p>

MeasurementReferenceTime field descriptions
<p>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.</p>
<p>physCellId This field identifies the reference cell, as defined in [12], that is used for the GNSS-network time relation.</p>
<p>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.</p>
<p>systemFrameNumber This field specifies the system frame number in E-UTRA which the GNSS time time stamps, as defined in [12].</p>
<p>mode This field identifies the reference cell for the GNSS-network time relation, as defined in [13].</p>
<p>referenceSystemFrameNumber This field specifies the system frame number in UTRA, as defined in [13], which is used for time stamping.</p>
<p>bcchCarrier, bsic This field identifies the reference cell for the GNSS-network time relation in GERAN, as defined in [14].</p>
<p>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 <i>referenceFNMSB</i> field indicates the most significant bits of the frame number of the reference BTS corresponding to the <i>GNSS-MeasurementList</i>. Starting from the complete GSM frame number denoted FN, the target device calculates Reference FN MSB as</p> $\text{Reference FN MSB} = \text{floor}(\text{FN}/42432)$ <p>The complete GSM frame number FN can then be reconstructed in the location server by combining the fields <i>referenceFN</i> with <i>referenceFNMSB</i> in the following way</p> $\text{FN} = \text{referenceFNMSB} * 42432 + \text{referenceFN}$
<p>deltaGNSS-TOD This field specifies the difference in milliseconds between <i>gnss-TOD-msec</i> reported and the milli-second part of the SV time <i>tsv_1</i> of the first SV in the list reported from the target device, as defined in [14]. The <i>deltaGNSS-TOD</i> is defined as</p> $\text{deltaGNSS-TOD} = \text{gnss-TOD-msec} - \text{fix}(\text{tsv}_1)$ <p>where <i>fix()</i> denotes rounding to the nearest integer towards zero.</p>
<p>nbPhysCellId This field identifies the reference cell, as defined in [12] that is used for the GNSS-network time relation.</p>
<p>nbCellGlobalId This field specifies the global cell identifier of the NB-IoT reference cell, as defined in [12], for which the GNSS network time relation is provided.</p>
<p>sfn This field specifies the system frame number in NB-IoT which the GNSS time time stamps, as defined in [12].</p>
<p>hyperSFN This field specifies the hyper-SFN in NB-IoT which the GNSS time time stamps, as defined in [12].</p>

Value of K to Value of uncertainty relation

Value of K	Value of uncertainty
0	0 microseconds
1	0.07 microseconds
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_0 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 0 and 127 milli-seconds.

The total code phase for a satellite k (Satk) is given modulo this *gnss-CodePhaseAmbiguity* and is reconstructed with: $Code_Phase_Tot(Satk) = codePhase(Satk) + integerCodePhase(Satk) + n * gnss-CodePhaseAmbiguity$, $n = 0, 1, 2, \dots$

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 but shall be included if the *adr* field is included. See table Bit to Polarity 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.

GNSS-MeasurementList field descriptions	
<i>integerCodePhase</i>	This field indicates the integer milli-second part of the code phase that is expressed modulo the <i>gnss-CodePhaseAmbiguity</i> . The value of the ambiguity is given in the <i>gnss-CodePhaseAmbiguity</i> field. The <i>integerCodePhase</i> is optional. If <i>integerCodePhase</i> is absent, the default value is 0 milli-second. Scale factor 1 milli-second, in the range from 0 to 127 milli-seconds.
<i>codePhaseRMSError</i>	This field contains the pseudorange RMS error value. This parameter is specified according to a floating-point representation shown in the table below.
<i>doppler</i>	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. This field is optional, but shall be included, if the <i>velocityRequest</i> in <i>CommonIEsRequestLocationInformation</i> is set to TRUE.
<i>adr</i>	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. This field is optional, but shall be included, if the <i>adrMeasReq</i> in <i>GNSS-PositioningInstructions</i> is set to TRUE and if ADR measurements are supported by the target device (i.e., <i>adr-Support</i> is set to TRUE in <i>A-GNSS-ProvideCapabilities</i>).

Value of *mpathDet* to Multipath Indication relation

Value of <i>mpathDet</i>	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 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	$0.5 \leq P < 0.5625$
I	x	y	$0.5 * (1 + x/8) * 2^y$	$x_{i-1} \leq P < x_i$
62	110	111	112	$104 \leq P < 112$
63	111	111	--	$112 \leq P$

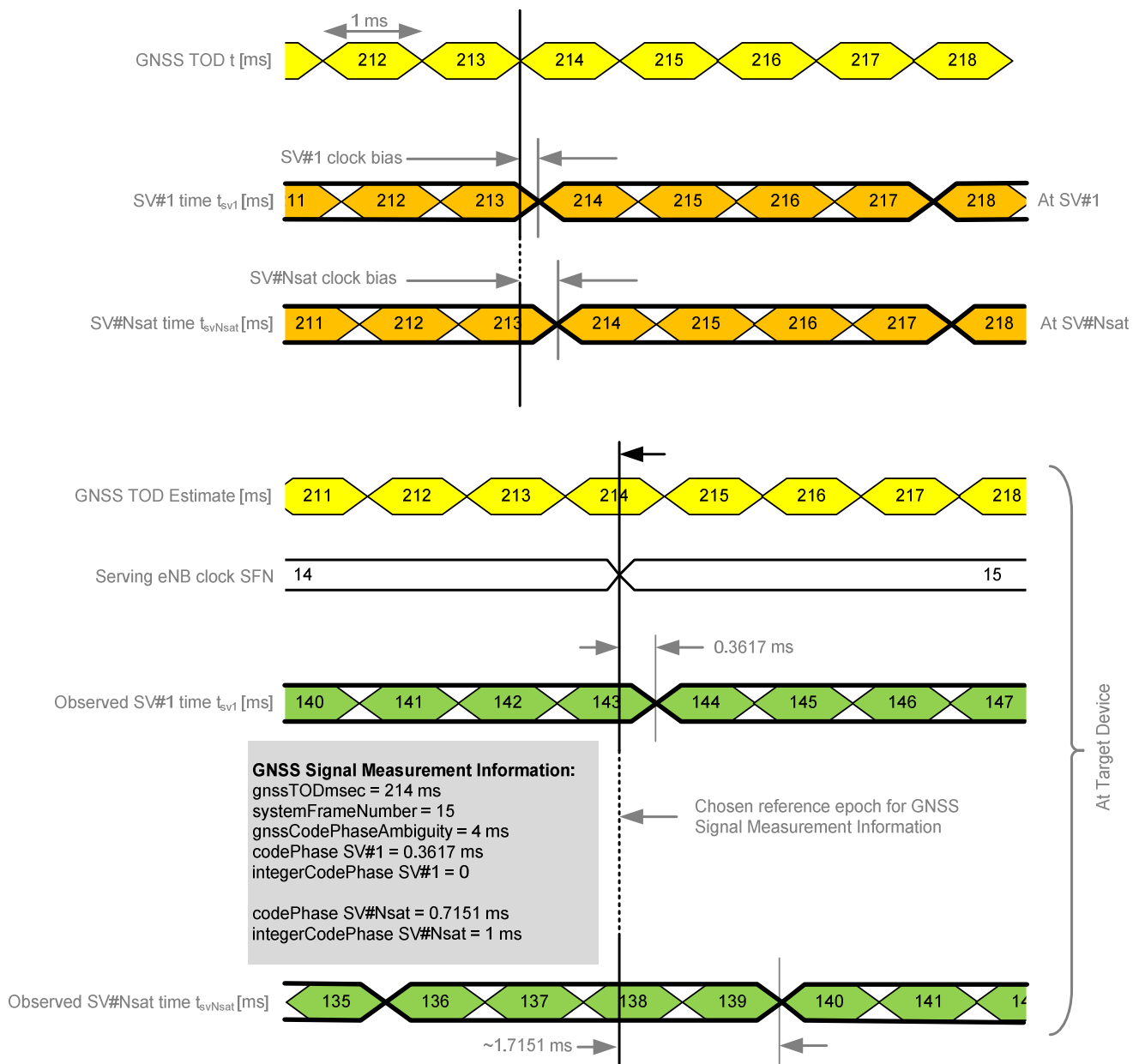


Figure 6.5.2.6-1: Exemplary calculation of some GNSS Signal Measurement Information fields.

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
<p>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.</p>
<p>agnss-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 <i>GNSS-ID-Bitmap</i>, with a one-value at the bit position means the particular method has been used; a zero-value means not used.</p>

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
<p>gnssMethods This field indicates the satellite systems allowed by the location server. This is represented by a bit string in <i>GNSS-ID-Bitmap</i>, 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. At least one of the bits in this bit map shall be set to value one.</p>
<p>fineTimeAssistanceMeasReq This field indicates whether the target device is requested to report GNSS-network time association. TRUE means requested.</p>
<p>adrMeasReq This field indicates whether the target device is requested to include ADR measurements in <i>GNSS-MeasurementList</i> IE or not. TRUE means requested.</p>
<p>multiFreqMeasReq This field indicates whether the target device is requested to report measurements on multiple supported GNSS signal types in <i>GNSS-MeasurementList</i> IE or not. TRUE means requested.</p>
<p>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.</p>

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,
    ...,
    [[ periodicalReportingNotSupported-r14
        PositioningModes          OPTIONAL,
        idleStateForMeasurements-r14
        ENUMERATED { required }  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
<i>GNSS-ID-SBAS</i>	The field is mandatory present if the <i>GNSS-ID = sbas</i> ; otherwise it is not present.
<i>fta</i>	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	
<i>gnss-SupportList</i>	This field specifies the list of GNSS supported by the target device and the target device capabilities associated with each of the supported GNSS. This field shall be present if the <i>gnss-SupportListReq</i> in the A-GNSS - <i>RequestCapabilities</i> IE is set to TRUE and if the target device supports the A-GNSS positioning method. If the IE <i>A-GNSS-Provide-Capabilities</i> is provided unsolicited, this field shall be included if the target device supports the assisted GNSS positioning method.
<i>gnss-ID</i>	This field specifies the GNSS supported by the target device for which the capabilities in <i>GNSS-SupportElement</i> are provided.
<i>sbas-IDs</i>	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.
<i>agnss-Modes</i>	This field specifies the GNSS mode(s) supported by the target device for the GNSS indicated by <i>gnss-ID</i> . 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.

A-GNSS-ProvideCapabilities field descriptions
<p><i>gnss-Signals</i> This field specifies the GNSS signal(s) supported by the target device for the GNSS indicated by <i>gnss-ID</i>. 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.</p>
<p><i>fta-MeasSupport</i> This field specifies that the target device is capable of performing fine time assistance measurements (i.e., GNSS-cellular time association reporting). The <i>cellTime</i> 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 <i>mode</i> 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.</p>
<p><i>adr-Support</i> This field specifies whether the target device supports ADR measurement reporting. TRUE means supported.</p>
<p><i>velocityMeasurementSupport</i> This field specifies whether the target device supports measurement reporting related to velocity. TRUE means supported.</p>
<p><i>assistanceDataSupportList</i> This list defines the assistance data and assistance data choices supported by the target device. This field shall be present if the <i>assistanceDataSupportListReq</i> in the A-GNSS-RequestCapabilities IE is set to TRUE and if the target device supports GNSS assistance data. If the IE A-GNSS-Provide-Capabilities is provided unsolicited, this field shall be included if the target device supports any GNSS assistance data.</p>
<p><i>locationCoordinateTypes</i> 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 present if the <i>locationVelocityTypesReq</i> in the A-GNSS-RequestCapabilities IE is set to TRUE and if the target device supports UE-based or standalone GNSS positioning method. If the IE A-GNSS-Provide-Capabilities is provided unsolicited, this field shall be included if the target device supports UE-based or standalone GNSS positioning method.</p>
<p><i>velocityTypes</i> 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 reporting is not supported. This field shall be present if the <i>locationVelocityTypesReq</i> in the A-GNSS-RequestCapabilities IE is set to TRUE and if the target device supports UE-based or standalone GNSS positioning method. If the IE A-GNSS-Provide-Capabilities is provided unsolicited, this field shall be included if the target device supports UE-based or standalone GNSS positioning method.</p>
<p><i>periodicalReportingNotSupported</i> This field, if present, specifies the positioning modes for which the target device does not support <i>periodicalReporting</i>. This is represented by a bit string, with a one-value at the bit position means <i>periodicalReporting</i> for the positioning mode is not supported; a zero-value means supported. If this field is absent, the location server may assume that the target device supports <i>periodicalReporting</i> in <i>CommonIEsRequestLocationInformation</i> for each supported positioning mode.</p>
<p><i>idleStateForMeasurements</i> This field, if present, indicates that the target device requires idle state to perform GNSS measurements.</p>

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
<i>RefTimeSup</i>	The field is mandatory present if the target device supports <i>GNSS-ReferenceTime</i> ; otherwise it is not present.
<i>RefLocSup</i>	This field is mandatory present if the target device supports <i>GNSS-ReferenceLocation</i> ; otherwise it is not present.
<i>IonoModSup</i>	This field is mandatory present if the target device supports <i>GNSS-IonosphericModel</i> ; otherwise it is not present.
<i>EOPSup</i>	This field is mandatory present if the target device supports <i>GNSS-EarthOrientationParameters</i> ; 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
<i>fta</i>	The field is mandatory present if the target device supports fine time assistance in <i>GNSSReferenceTime</i> 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 ionospheric model(s) supported by the target device. This is represented by a bit string, with a one-value at the bit position means the particular ionospheric model is supported; a zero-value means not supported.

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
    ...
    [[
        bds-DifferentialCorrectionsSupport-r12
                                BDS-DifferentialCorrectionsSupport-r12
                                OPTIONAL, -- Cond DBDS-Sup
        bds-GridModelSupport-r12
                                BDS-GridModelSupport-r12
                                OPTIONAL -- Cond BDS-GridModSup
    ]]
}
-- ASN1STOP
```

Conditional presence	Explanation
<i>GNSS-ID-SBAS</i>	The field is mandatory present if the <i>GNSS-ID = sbas</i> ; otherwise it is not present.
<i>TimeModSup</i>	The field is mandatory present if the target device supports <i>GNSS-TimeModelList</i> ; otherwise it is not present.
<i>DGNSS-Sup</i>	The field is mandatory present if the target device supports <i>GNSS-DifferentialCorrections</i> ; otherwise it is not present.
<i>NavModSup</i>	The field is mandatory present if the target device supports <i>GNSS-NavigationModel</i> ; otherwise it is not present.
<i>RTISup</i>	The field is mandatory present if the target device supports <i>GNSS-RealTimeIntegrity</i> ; otherwise it is not present.

Conditional presence	Explanation
<i>DataBitsSup</i>	The field is mandatory present if the target device supports <i>GNSS-DataBitAssistance</i> ; otherwise it is not present.
<i>AcquAssistSup</i>	The field is mandatory present if the target device supports <i>GNSS-AcquisitionAssistance</i> ; otherwise it is not present.
<i>AlmanacSup</i>	The field is mandatory present if the target device supports <i>GNSS-Almanac</i> ; otherwise it is not present.
<i>UTCModSup</i>	The field is mandatory present if the target device supports <i>GNSS-UTC-Model</i> ; otherwise it is not present.
<i>AuxInfoSup</i>	The field is mandatory present if the target device supports <i>GNSS-AuxiliaryInformation</i> ; otherwise it is not present.
<i>DBDS-Sup</i>	The field is mandatory present if the target device supports <i>BDS-DifferentialCorrections</i> ; otherwise it is not present. This field may only be present if <i>gnss-ID</i> indicates 'bds'.
<i>BDS-GridModSup</i>	The field is mandatory present if the target device supports <i>BDS-GridModel</i> ; otherwise it is not present. This field may only be present if <i>gnss-ID</i> indicates 'bds'.

– *GNSS-TimeModelListSupport*

```
-- ASN1START
GNSS-TimeModelListSupport ::= SEQUENCE {
    ...
}
-- ASN1STOP
```

– *GNSS-DifferentialCorrectionSupport*

```
-- ASN1START
GNSS-DifferentialCorrectionsSupport ::= SEQUENCE {
    gnssSignalIDs      GNSS-SignalIDs,
    dgnss-ValidityTimeSup  BOOLEAN,
    ...
}
-- ASN1STOP
```

***GNSS-DifferentialCorrectionsSupport* field descriptions**

gnssSignalIDs

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),
        model-6      (5) } (SIZE (1..8))      OPTIONAL,
    orbitModel      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
```

```
-- 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 the target device supports BDS and *GNSS-NavigationModel* assistance, it shall support *clockModel* Model-6.

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 the target device supports BDS and *GNSS-NavigationModel* assistance, it shall support *orbitModel* Model-6.

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 {
    ...
    confidenceSupport-r10          ENUMERATED { true }      OPTIONAL,
    dopplerUncertaintyExtSupport-r10  ENUMERATED { true }  OPTIONAL
}
```

```
-- ASN1STOP
```

GNSS-AcquisitionAssistanceSupport field descriptions**confidenceSupport**

If this field is present, the target device supports the *confidence* field in *GNSS-AcquisitionAssistance*.

dopplerUncertaintyExtSupport

If this field is present, the target device supports the *dopplerUncertaintyExt* field in *GNSS-AcquisitionAssistance*.

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),
        model-7 (6) } (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 the target device supports BDS and *GNSS-Almanac* assistance, it shall support Model-7.

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),
        model-5 (4) } (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 the target device supports BDS and *GNSS-UTC-Model* assistance, it shall support Model-5.

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
```

– *BDS-DifferentialCorrectionsSupport*

```
-- ASN1START
BDS-DifferentialCorrectionsSupport-r12 ::= SEQUENCE {
    gnssSignalIDs          GNSS-SignalIDs,
    ...
}
-- ASN1STOP
```

***BDS-DifferentialCorrectionsSupport* field descriptions**

gnssSignalIDs

This field specifies the BDS 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 BDS signal type is supported; a zero-value means not supported.

– *BDS-GridModelSupport*

```
-- ASN1START
BDS-GridModelSupport-r12 ::= 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.

A-GNSS-RequestCapabilities field descriptions**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,
  multiFrequencyMeasurementsNotPossible          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 '*multiFrequencyMeasurementsNotPossible*' fields, as applicable.

6.5.2.13 Common GNSS Information Elements

– **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, ..., bds },
    ...
}
-- 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),
        bds      (5) } (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
<p>gnss-SignalID This field specifies a particular GNSS signal. The interpretation of <i>gnss-SignalID</i> depends on the <i>GNSS-ID</i> and is as shown in the table System to Value & Explanation relation below.</p>

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
BDS	0	B1I
	1-7	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
<p>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 <i>gnssSignalIDs</i> depends on the <i>GNSS-ID</i> and is shown in the table below. Unfilled table entries indicate no assignment and shall be set to zero.</p>

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			
BDS	B1I							

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

sbas-IDs

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 <i>satellite-id</i>	Interpretation of <i>satellite-id</i>
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	'0' – '35' '36' – '63'	Code No. 1 to 36 Reserved
BDS	'0' – '36' '37' – '63'	Satellite ranging code number signal No.1 to 37 [23] Reserved

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 {
    primaryCellMeasuredResults    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,
    rsrp-Result       INTEGER (0..97)              OPTIONAL,
    rsrq-Result       INTEGER (0..34)              OPTIONAL,
    ue-RxTxTimeDiff  INTEGER (0..4095)            OPTIONAL,
    ...,
    [[ arfcnEUTRA-v9a0    ARFCN-ValueEUTRA-v9a0    OPTIONAL        -- Cond EARFCN-max
    ]],
    [[ nrsrp-Result-r14   INTEGER (0..97)           OPTIONAL,
```

```

nrsrq-Result-r14      INTEGER (0..34)          OPTIONAL,
nue-RxTxTimeDiff-r14 INTEGER (0..4095)    OPTIONAL,
carrierFreqOffsetNB-r14
CarrierFreqOffsetNB-r14  OPTIONAL,      -- Cond NB-IoT
hyperSFN-r14          BIT STRING (SIZE (10))  OPTIONAL
]]
}
-- ASN1STOP

```

Conditional presence	Explanation
<i>EARFCN-max</i>	The field is mandatory present if the corresponding <i>arfcnEUTRA</i> (i.e. without suffix) is set to <i>maxEARFCN</i> . Otherwise the field is not present.
<i>NB-IoT</i>	The field is mandatory present if the measured cell is a NB-IoT cell. Otherwise it is not present.

ECID-SignalMeasurementInformation field descriptions
<p>primaryCellMeasuredResults This field contains measurements for the primary cell, when the target device reports measurements for both primary cell and neighbour cells. This field shall be omitted when the target device reports measurements for the primary cell only, in which case the measurements the primary cell is reported in the <i>measuredResultsList</i>.</p>
<p>measuredResultsList This list contains the E-CID measurements for up to 32 cells.</p>
<p>physCellId This field specifies the physical cell identity of the measured cell.</p>
<p>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.</p>
<p>arfcnEUTRA This field specifies the ARFCN of the measured E-UTRA carrier frequency, as defined in [12]. In case the target device includes <i>arfcnEUTRA-v9a0</i>, the target device shall set the corresponding <i>arfcnEUTRA</i> (i.e. without suffix) to <i>maxEARFCN</i>.</p>
<p>systemFrameNumber This field specifies the system frame number of the measured cell during which the measurements have been performed. The target device shall include this field if it was able to determine the SFN of the cell at the time of measurement.</p>
<p>rsrp-Result This field specifies the reference signal received power (RSRP) measurement, as defined in [12],[17].</p>
<p>rsrq-Result This field specifies the reference signal received quality (RSRQ) measurement, as defined in [12],[17].</p>
<p>ue-RxTxTimeDiff This field specifies the UE Rx-Tx time difference measurement, as defined in [17]. It is provided only for measurements on the UE's primary cell. Measurement report mapping is according to 3GPP TS 36.133 [18].</p>
<p>nrsrp-Result This field specifies the narrowband reference signal received power (NRSRP) measurement, as defined in [17].</p>
<p>nrsrq-Result This field specifies the narrowband reference signal received quality (NRSRQ) measurement, as defined in [17].</p>
<p>nue-RxTxTimeDiff This field specifies the narrowband UE Rx-Tx time difference measurement, as defined in [17].</p>
<p>carrierFreqOffsetNB This field specifies the offset of the NB-IoT channel number to ARFCN given by <i>arfcnEUTRA</i> as defined in TS 36.101 [21].</p>
<p>hyperSFN This field specifies the hyper-SFN of the measured cell during which the measurements have been performed. The target device shall include this field if it was able to determine the hyper-SFN of the cell at the time of measurement.</p>

Editor's Note:

- *FFS whether NB UE Rx-Tx time difference measurements is supported.*
- *Value range for nrsrp-Result, nrsrq-Result, nue-RxTxTimeDiff need confirmation from RAN4.*

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),
    nrsrpReq-r14 (3),
    nrsrqReq-r14 (4),
    nueRxTxReq-r14 (5) } (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),
    nrsrpSup-r14 (3),
    nrsrqSup-r14 (4),
    nueRxTxSup-r14 (5) } (SIZE(1..8)),
  ...
  [[ ueRxTxSupTDD-r13 ENUMERATED { true } OPTIONAL
  ]],
  [[ periodicalReporting-r14 ENUMERATED { supported } OPTIONAL,
    triggeredReporting-r14 ENUMERATED { supported } OPTIONAL,
    idleStateForMeasurements-r14 ENUMERATED { required } OPTIONAL
  ]]
}
-- 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. A zero-value in all bit positions in the bit string means only the basic Cell ID positioning method is supported by the target device.

If the UE Rx-Tx time difference measurement is supported by the target device (i.e., *ueRxTxSup* field is set to one), it means that the UE supports the UE Rx-Tx time difference measurement reporting via both LPP signaling and RRC signalling.

If a target device doesn't support LPP, the E-SMLC may assume the target device can not report the UE Rx-Tx time difference measurement results via RRC signalling.

ECID-Provide-Capabilities field descriptions
<p><i>ueRxTxSupTDD</i> This field, if present, indicates that any UE Rx-Tx time difference measurement reporting for TDD from the target device includes the $N_{TAoffset}$ according to [16][17] and uses the UE Rx-Tx time difference measurement report mapping for TDD as specified in 3GPP TS 36.133 [18]. This field may only be included if the <i>ueRxTxSup</i> field in <i>ecid-MeasSupported</i> is set to value one.</p>
<p><i>periodicalReporting</i> This field, if present, indicates that the target device supports <i>periodicalReporting</i> of ECID measurements. If this field is absent, the location server may assume that the target device does not support <i>periodicalReporting</i> in <i>CommonEsRequestLocationInformation</i>.</p>
<p><i>triggeredReporting</i> This field, if present, indicates that the target device supports <i>triggeredReporting</i> for the <i>cellChange</i> event. If this field is absent, the location server may assume that the target device does not support <i>triggeredReporting</i> in <i>CommonEsRequestLocationInformation</i>.</p>
<p><i>idleStateForMeasurements</i> This field, if present, indicates that the target device requires idle state to perform ECID measurements.</p>

6.5.3.5 E-CID Capability Information Request

– *ECID-RequestCapabilities*

The IE *ECID-RequestCapabilities* is used by the location server to request E-CID positioning 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,
  ...
  [[
    nrsrpMeasurementNotPossible-r14    NULL          OPTIONAL,
    nrsrqMeasurementNotPossible-r14    NULL          OPTIONAL,
    nueRxTxMeasurementNotPossible-r14  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*', '*ueRxTxMeasurementNotPossible*', '*nrsrpMeasurementNotPossible*', '*nrsrqMeasurementNotPossible*', or '*nueRxTxMeasurementNotPossible*' fields, as applicable.

6.5.4 Terrestrial Beacon System Positioning

6.5.4.1 TBS Location Information

– *TBS-ProvideLocationInformation*

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

```
-- ASN1START
TBS-ProvideLocationInformation-r13 ::= SEQUENCE {
  tbs-MeasurementInformation-r13    TBS-MeasurementInformation-r13    OPTIONAL,
  tbs-Error-r13                    TBS-Error-r13                    OPTIONAL,
  ...
}
-- ASN1STOP
```

6.5.4.2 TBS Location Information Elements

– *TBS-MeasurementInformation*

The IE *TBS-MeasurementInformation* is used by the target device to provide TBS location measurements to the location server.

```
-- ASN1START
```

```

TBS-MeasurementInformation-r13 ::= SEQUENCE {
    measurementReferenceTime-r13    UTCTime                OPTIONAL,
    mbs-SgnMeasList-r13             MBS-BeaconMeasList-r13  OPTIONAL, -- Cond MBS
    ...
}
-- ASN1STOP

```

Conditional presence	Explanation
MBS	The field is mandatory present if the <i>TBS-MeasurementInformation</i> is provided for an MBS system; otherwise it is not present.

***TBS-MeasurementInformation* field descriptions**

measurementReferenceTime

This field provides the UTC time when the TBS measurements are performed and should take the form of *YYMMDDhhmmssZ*.

mbs-SgnMeasList

This field provides the MBS measurements for up to 64 MBS beacons.

MBS-BeaconMeasList

The IE *MBS-BeaconMeasList* is used by the target device to provide MBS location measurements to the location server, as defined in the MBS ICD [24].

```

-- ASN1START
MBS-BeaconMeasList-r13 ::= SEQUENCE (SIZE(1..64)) OF MBS-BeaconMeasElement-r13
MBS-BeaconMeasElement-r13 ::= SEQUENCE {
    transmitterID-r13             INTEGER (0..32767),
    codePhase-r13                 INTEGER (0..2097151),
    codePhaseRMSError-r13        INTEGER (0..63),
    ...
    [[ rssi-r14                   INTEGER (-130..-30)    OPTIONAL
    ]]
}
-- ASN1STOP

```

***MBS-BeaconMeasList* field descriptions**

transmitterID

This field contains the MBS transmitter identifier.

codePhase

This field contains the value of the code-phase measurement made by the target device for the particular beacon signal at the time of measurement in the units of ms. MBS 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 $(1 \cdot 2^{-21})$ milli-seconds.

codePhaseRMSError

This field contains the pseudorange RMS error value. This parameter is specified according to a floating-point representation shown in the table below.

rssi

This field provides an estimate of the received signal strength from the MBS beacon as referenced to the UE antenna connector.

If the estimated received signal strength for the MBS beacon is less than -130 dBm, the UE shall report an RSSI value of -130. If the estimated received signal strength for the MBS beacon is greater than -30 dBm, the UE shall report an RSSI value of -30.

Scale factor 1 dBm.

floating-point representation

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

6.5.4.3 TBS Location Information Request

– *TBS-RequestLocationInformation*

The IE *TBS-RequestLocationInformation* is used by the location server to request location information for TBS-based methods from the target device.

```
-- ASN1START
TBS-RequestLocationInformation-r13 ::= SEQUENCE {
  mbsSgnMeasListReq-r13          BOOLEAN,
  . . . ,
  [ [ mbsAssistanceAvailability-r14  BOOLEAN                OPTIONAL,    -- Need ON
      mbsRequestedMeasurements-r14  BIT STRING {
        rssi          (0)} (SIZE(1..8))  OPTIONAL    -- Need ON
    ] ]
}
-- ASN1STOP
```

TBS-RequestLocationInformation field descriptions***mbsSgnMeasListReq***

This field indicates whether the target device is requested to report MBS measurements in *TBS-MeasurementInformation* IE or not. TRUE means requested.

mbsAssistanceAvailability

This field indicates whether the target device may request additional MBS assistance data from the server. TRUE means allowed and FALSE means not allowed.

mbsRequestedMeasurements

This field indicates the additional MBS measurements requested and may only be included if *mbsSgnMeasListReq-r13* is set to TRUE. This field is represented by a bit string, with a one-value at the bit position means the particular measurement is requested; a zero-value means not requested. The following measurement requests can be included.

rssi: Beacon signal strength at the target

6.5.4.4 TBS Capability Information

– *TBS-ProvideCapabilities*

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

```
-- ASN1START
TBS-ProvideCapabilities-r13 ::= SEQUENCE {
  tbs-Modes-r13          BIT STRING {
    standalone          (0),
    ue-assisted         (1),
    ue-based             (2)} (SIZE (1..8)),
  . . . ,
  [ [ mbs-AssistanceDataSupportList-r14  MBS-AssistanceDataSupportList-r14  OPTIONAL,
      periodicalReportingSupported-r14  PositioningModes                OPTIONAL,
      mbs-ConfigSupport-r14             BIT STRING {
        tb1          (0),
        tb2          (1),
        tb3          (2),
        tb4          (3)} (SIZE (1..8))                OPTIONAL,
    ] ]
}
-- ASN1STOP
```



```

        mbs-IdleStateForMeasurements-r14      ENUMERATED { required }      OPTIONAL
    ]]
}
-- ASN1STOP

```

TBS-ProvideCapabilities field descriptions

tbs-Modes

This field specifies the TBS 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 TBS mode is supported; a zero-value means not supported.

mbs-AssistanceDataSupportList

This list defines the MBS assistance data supported by the target device. This field shall be present if the target device supports MBS assistance data.

periodicalReportingSupported

This field, if present, specifies the positioning modes for which the target device supports *periodicalReporting*. This is represented by a bit string, with a one-value at the bit position means *periodicalReporting* for the positioning mode is supported; a zero-value means not supported. If this field is absent, the location server may assume that the target device does not support *periodicalReporting* in *CommonEsRequestLocationInformation*.

mbs-ConfigSupport

This field specifies the MBS configurations supported by the target device. This field shall be present if the target device supports MBS [24].

mbs-IdleStateForMeasurements

This field, if present, indicates that the target device requires idle state to perform MBS measurements.

- **MBS-AssistanceDataSupportList**

The IE *MBS-AssistanceDataSupportList* is used by the target device to indicate its capability to support MBS Assistance Data and to provide its capabilities to the location server.

```

-- ASN1START
MBS-AssistanceDataSupportList-r14 ::= SEQUENCE {
    mbs-AcquisitionAssistanceDataSupport-r14    BOOLEAN,
    mbs-AlmanacAssistanceDataSupport-r14        BOOLEAN,
    ...
}
-- ASN1STOP

```

MBS-AssistanceDataSupportList field descriptions

mbs-AcquisitionAssistanceDataSupport

This field specifies whether the target device supports MBS Acquisition Assistance Data. TRUE means supported.

mbs-AlmanacAssistanceDataSupport

This field specifies whether the target device supports MBS Almanac Assistance Data. TRUE means supported.

6.5.4.5 TBS Capability Information Request

- **TBS-RequestCapabilities**

The IE *TBS-RequestCapabilities* is used by the location server to request TBS positioning capabilities from a target device.

```

-- ASN1START
TBS-RequestCapabilities-r13 ::= SEQUENCE {
    ...
}
-- ASN1STOP

```

6.5.4.6 TBS Error Elements

– *TBS-Error*

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

```
-- ASN1START
TBS-Error-r13 ::= CHOICE {
    locationServerErrorCauses-r13      TBS-LocationServerErrorCauses-r13,
    targetDeviceErrorCauses-r13       TBS-TargetDeviceErrorCauses-r13,
    ...
}
-- ASN1STOP
```

– *TBS-LocationServerErrorCauses*

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

```
-- ASN1START
TBS-LocationServerErrorCauses-r13 ::= SEQUENCE {
    cause-r13      ENUMERATED {
        undefined,
        ...,
        assistanceDataNotSupportedByServer-v14xy,
        assistanceDataSupportedButCurrentlyNotAvailableByServer-v14xy
    },
    ...
}
-- ASN1STOP
```

– *TBS-TargetDeviceErrorCauses*

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

```
-- ASN1START
TBS-TargetDeviceErrorCauses-r13 ::= SEQUENCE {
    cause-r13      ENUMERATED {
        undefined,
        thereWereNotEnoughMBSBeaconsReceived,
        ...,
        assistanceDataMissing-v14xy
    },
    ...
}
-- ASN1STOP
```

<i>TBS-TargetDeviceErrorCauses</i> field descriptions
<p>cause This field provides a TBS specific error cause.</p>

6.5.4.7 TBS Assistance Data

– *TBS-ProvideAssistanceData*

The IE *TBS-ProvideAssistanceData* is used by the location server to provide assistance data to assist in position estimation at the UE (e.g. for UE-based mode) and/or to expedite the acquisition of TBS signals. It may also be used to provide TBS positioning specific error reasons.

```

-- ASN1START
TBS-ProvideAssistanceData-r14 ::= SEQUENCE {
    tbs-AssistanceDataList-r14  TBS-AssistanceDataList-r14  OPTIONAL,    -- Need ON
    tbs-Error-r14                TBS-Error-r13              OPTIONAL,    -- Need ON
    ...
}
-- ASN1STOP

```

6.5.4.8 TBS Assistance Data Elements

– *TBS-AssistanceDataList*

The IE *TBS-AssistanceDataList* is used by the location server to provide the TBS specific assistance data to the UE.

```

-- ASN1START
TBS-AssistanceDataList-r14 ::= SEQUENCE {
    mbs-AssistanceDataList-r14  MBS-AssistanceDataList-r14  OPTIONAL,    -- Need ON
    ...
}
MBS-AssistanceDataList-r14 ::= SEQUENCE (SIZE (1..maxMBS-r14)) OF MBS-AssistanceDataElement-r14
MBS-AssistanceDataElement-r14 ::= SEQUENCE {
    mbs-AlmanacAssistance-r14    MBS-AlmanacAssistance-r14    OPTIONAL,    -- Need ON
    mbs-AcquisitionAssistance-r14 MBS-AcquisitionAssistance-r14  OPTIONAL,    -- Need ON
    ...
}
maxMBS-r14    INTEGER ::= 64
-- ASN1STOP

```

– *MBS-AlmanacAssistance*

The IE *MBS-AlmanacAssistance* is used by the location server to provide LLA of MBS transmitters to enable position estimation at the UE.

```

-- ASN1START
MBS-AlmanacAssistance-r14 ::= SEQUENCE {
    transmitterID-r14            INTEGER (0..32767),
    transmitterLatitude-r14      BIT STRING (SIZE (26)),
    transmitterLongitude-r14     BIT STRING (SIZE (27)),
    transmitterAltitude-r14      BIT STRING (SIZE (15)),
    timeCorrection-r14           INTEGER (0..25)    OPTIONAL,    -- Need ON
    ...
}
-- ASN1STOP

```

***MBS-AlmanacAssistance* field descriptions**

transmitterID

This field specifies the MBS transmitter ID [24].

transmitterLatitude

This field specifies latitude of the MBS transmitter, degrees. Scale factor $4/2^{20}$ decimal degrees, added to -90° . Valid range -90° to 90° [24].

transmitterLongitude

This field specifies longitude of the MBS transmitter, degrees. Scale factor $4/2^{20}$ decimal degrees, added to -180° . Valid range -180° to 180° [24].

transmitterAltitude

This field specifies altitude of the MBS transmitter, meters. Scale factor 0.29 meters, added to -500 meters. Valid range -500 to 9002.43 meters [24].

MBS-AlmanacAssistance field descriptions**timeCorrection**

This field contains the residual timing error for a particular beacon, in units of nano-seconds, in the range from 0 to 25. This field is used for UE-based mode only, by subtracting from the *codePhase* measurement made by the target device [24].

MBS-AcquisitionAssistance

The IE *MBS-AcquisitionAssistance* is used by the location server to provide parameters that support acquisition of the MBS signals [24].

```
-- ASN1START
MBS-AcquisitionAssistance-r14 ::= SEQUENCE {
    transmitterID-r14          INTEGER (0..32767)          OPTIONAL,  -- Need ON
    mbsConfiguration-r14      ENUMERATED {tb1, tb2, tb3, tb4, ...}  OPTIONAL,  -- Need ON
    pnCodeIndex-r14          INTEGER (1..128)          OPTIONAL,  -- Need ON
    freq-r14                  INTEGER (919750000..927250000)  OPTIONAL,  -- Need ON
    ...
}
-- ASN1STOP
```

MBS-AcquisitionAssistance field descriptions**transmitterID**

This field contains the MBS transmitter identifier [24].

mbsConfiguration

This field specifies MBS configuration as defined in the MBS ICD [24].

pnCodeIndex

This field specifies the index of the MBS PN code [24].

freq

This field specifies the MBS signal center frequency in units of Hz [24].

6.5.4.9 TBS Assistance Data Request

TBS-RequestAssistanceData

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

```
-- ASN1START
TBS-RequestAssistanceData-r14 ::= SEQUENCE {
    mbs-AlmanacAssistanceDataReq-r14  BOOLEAN,
    mbs-AcquisitionAssistanceDataReq-r14  BOOLEAN,
    ...
}
-- ASN1STOP
```

6.5.5 Sensor based Positioning

6.5.5.1 Sensor Location Information

Sensor-ProvideLocationInformation

The IE *Sensor-ProvideLocationInformation* is used by the target device to provide location information for sensor-based methods to the location server. It may also be used to provide sensor specific error reason.

```
-- ASN1START
Sensor-ProvideLocationInformation-r13 ::= SEQUENCE {
    sensor-MeasurementInformation-r13  Sensor-MeasurementInformation-r13  OPTIONAL,
```

```

    sensor-Error-r13                Sensor-Error-r13                OPTIONAL,
    ...
}
-- ASN1STOP

```

6.5.5.2 Sensor Location Information Elements

– *Sensor-MeasurementInformation*

The IE *Sensor-MeasurementInformation* is used by the target device to provide UE sensor measurements to the location server.

```

-- ASN1START
Sensor-MeasurementInformation-r13 ::= SEQUENCE {
    measurementReferenceTime-r13      UTCTime                OPTIONAL,
    uncompensatedBarometricPressure-r13  INTEGER (30000..115000)  OPTIONAL,  -- Cond
    Barometer
    ...
    [[
        uncertainty-r14                SEQUENCE {
            range-r14                  INTEGER (0..1000),
            confidence-r14              INTEGER (1..100)
        }
        OPTIONAL
    ]]
}
-- ASN1STOP

```

Conditional presence	Explanation
<i>Barometer</i>	The field is mandatory present if the <i>Sensor-MeasurementInformation</i> is provided for barometric pressure; otherwise it is not present.

<i>Sensor-MeasurementInformation</i> field descriptions
<i>measurementReferenceTime</i> This field provides the UTC time when the sensor measurements are performed and should take the form of <i>YYMMDDhhmmssZ</i> .
<i>uncompensatedBarometricPressure</i> This field provides the uncompensated barometric pressure as measured by the UE sensor, in units of Pa.
<i>uncertainty</i> This field provides the expected range for the pressure measurement in units of Pa and the confidence as a percentage that the true pressure lies in a range of (measurement – range) to (measurement + range).

6.5.5.3 Sensor Location Information Request

– *Sensor-RequestLocationInformation*

The IE *Sensor-RequestLocationInformation* is used by the location server to request location information for sensor-based methods from a target device.

```

-- ASN1START
Sensor-RequestLocationInformation-r13 ::= SEQUENCE {
    uncompensatedBarometricPressureReq-r13  BOOLEAN,
    ...
    [[ assistanceAvailability-r14            BOOLEAN    OPTIONAL  -- Need ON
    ]]
}
-- ASN1STOP

```

Sensor-RequestLocationInformation field descriptions
<p>uncompensatedBarometricPressureReq This field indicates whether the target device is requested to report Barometric pressure measurements in <i>Sensor-MeasurementInformation</i> IE or not. TRUE means requested.</p>
<p>assistanceAvailability This field indicates whether the target device may request additional Sensor assistance data from the server. TRUE means allowed and FALSE means not allowed.</p>

6.5.5.4 Sensor Capability Information

– *Sensor-ProvideCapabilities*

The IE *Sensor-ProvideCapabilities* is used by the target device to provide capabilities for sensor-based methods from to the location server.

```

-- ASN1START
Sensor-ProvideCapabilities-r13 ::= SEQUENCE {
    sensor-Modes-r13          BIT STRING {
        standalone (0),
        ue-assisted (1),
        ue-based (2)} (SIZE (1..8)),
    ...,
    [ [ sensor-AssistanceDataSupportList-r14  Sensor-AssistanceDataSupportList-r14  OPTIONAL,
        periodicalReportingSupported-r14     PositioningModes                       OPTIONAL,
        idleStateForMeasurements-r14        ENUMERATED { required }                OPTIONAL
    ] ]
}

Sensor-AssistanceDataSupportList-r14 ::= SEQUENCE {
    ...
}
-- ASN1STOP

```

Sensor-ProvideCapabilities field descriptions
<p>sensor-Modes This field specifies the sensor 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 sensor mode is supported; a zero-value means not supported.</p>
<p>sensor-AssistanceDataSupportList This field specifies a list of sensor assistance data supported by the target device. This field shall be present if the target device supports assistance data for Barometric pressure sensor.</p>
<p>periodicalReportingSupported This field, if present, specifies the positioning modes for which the target device supports <i>periodicalReporting</i>. This is represented by a bit string, with a one-value at the bit position means <i>periodicalReporting</i> for the positioning mode is supported; a zero-value means not supported. If this field is absent, the location server may assume that the target device does not support <i>periodicalReporting</i> in <i>CommonEsRequestLocationInformation</i>.</p>
<p>idleStateForMeasurements This field, if present, indicates that the target device requires idle state to perform sensor measurements.</p>

6.5.5.5 Sensor Capability Information Request

– *Sensor-RequestCapabilities*

The IE *Sensor-RequestCapabilities* is used by the location server to request capabilities for sensor-based methods from the target device.

```

-- ASN1START
Sensor-RequestCapabilities-r13 ::= SEQUENCE {
    ...
}
-- ASN1STOP

```

6.5.5.6 Sensor Error Elements

– *Sensor-Error*

The IE *Sensor-Error* is used by the location server or target device to provide Sensor Error Reasons to the target device or location server, respectively.

```
-- ASN1START
Sensor-Error-r13 ::= CHOICE {
    locationServerErrorCauses-r13      Sensor-LocationServerErrorCauses-r13,
    targetDeviceErrorCauses-r13       Sensor-TargetDeviceErrorCauses-r13,
    ...
}
-- ASN1STOP
```

– *Sensor-LocationServerErrorCauses*

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

```
-- ASN1START
Sensor-LocationServerErrorCauses-r13 ::= SEQUENCE {
    cause-r13      ENUMERATED { undefined,
    ...,
    assistanceDataNotSupportedByServer-v14xy,
    assistanceDataSupportedButCurrentlyNotAvailableByServer-v14xy
    },
    ...
}
-- ASN1STOP
```

– *Sensor-TargetDeviceErrorCauses*

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

```
-- ASN1START
Sensor-TargetDeviceErrorCauses-r13 ::= SEQUENCE {
    cause-r13      ENUMERATED { undefined,
    ...,
    assistanceDataMissing-v14xy
    },
    ...
}
-- ASN1STOP
```

6.5.5.7 Sensor Assistance Data

– *Sensor-ProvideAssistanceData*

The IE *Sensor-ProvideAssistanceData* is used by the location server to provide assistance data to assist in altitude computation at the UE (e.g. for UE-based mode). It may also be used to provide Sensor positioning specific error reasons.

```
-- ASN1START
Sensor-ProvideAssistanceData-r14 ::= SEQUENCE {
    sensor-AssistanceDataList-r14      Sensor-AssistanceDataList-r14      OPTIONAL,  -- Need ON
    sensor-Error-r14                   Sensor-Error-r13                  OPTIONAL,  -- Need ON
    ...
}
```

```
}
-- ASN1STOP
```

6.5.5.8 Sensor Assistance Data Elements

– *Sensor-AssistanceDataList*

The IE *Sensor-AssistanceDataList* is used by the location server to provide the Sensor specific assistance data to the UE.

```
-- ASN1START
Sensor-AssistanceDataList-r14 ::= SEQUENCE {
  refPressure-r14      INTEGER (-20000..10000),
  refPosition-r14     EllipsoidPointWithAltitudeAndUncertaintyEllipsoid  OPTIONAL,  -- Need ON
  refTemperature-r14  INTEGER (-64..63)                                OPTIONAL,  -- Need ON
  ...
}
-- ASN1STOP
```

***Sensor-AssistanceDataList* field descriptions**

refPressure

This field specifies the atmospheric pressure (Pa) nominal at sea level, EGM96 [29] to the target. The scale factor is 1 Pa. The value is added to the nominal pressure of 101325 Pa.

refPosition

This field specifies the reference position at which the pressure measurement is made, as an ellipsoid point with altitude and uncertainty ellipsoid.

refTemperature

Local temperature measurement at the reference where the pressure measurement is made. The scale factor 1K. The value is added to 273K.

6.5.5.9 Sensor Assistance Data Request

– *Sensor-RequestAssistanceData*

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

```
-- ASN1START
Sensor-RequestAssistanceData-r14 ::= SEQUENCE {
  ...
}
-- ASN1STOP
```

6.5.6 WLAN-based Positioning

This section defines support for positioning using measurements related to WLAN access points.

6.5.6.1 WLAN Location Information

– *WLAN-ProvideLocationInformation*

The IE *WLAN-ProvideLocationInformation* is used by the target device to provide measurements for one or more WLANs to the location server. It may also be used to provide WLAN positioning specific error reason.

```
-- ASN1START
```



```

WLAN-ProvideLocationInformation-r13 ::= SEQUENCE {
  wlan-MeasurementInformation-r13  WLAN-MeasurementInformation-r13  OPTIONAL,
  wlan-Error-r13                   WLAN-Error-r13              OPTIONAL,
  ...
}
-- ASN1STOP

```

6.5.6.2 WLAN Location Information Elements

– *WLAN-MeasurementInformation*

```

-- ASN1START
WLAN-MeasurementInformation-r13 ::= SEQUENCE {
  measurementReferenceTime-r13  UTCTime                OPTIONAL,
  wlan-MeasurementList-r13       WLAN-MeasurementList-r13  OPTIONAL,
  ...
}

WLAN-MeasurementList-r13 ::= SEQUENCE (SIZE(1..maxWLAN-AP-r13)) OF WLAN-MeasurementElement-r13

WLAN-MeasurementElement-r13 ::= SEQUENCE {
  wlan-AP-Identifier-r13        WLAN-AP-Identifier-r13,
  rssi-r13                      INTEGER (-127..128)          OPTIONAL,
  rtt-r13                       WLAN-RTT-r13              OPTIONAL,
  apChannelFrequency-r13        INTEGER (0..256)           OPTIONAL,
  servingFlag-r13               BOOLEAN                   OPTIONAL,
  ...
}

WLAN-AP-Identifier-r13 ::= SEQUENCE {
  bssid-r13                     OCTET STRING (SIZE (6)),
  ssid-r13                      OCTET STRING (SIZE (1..32))  OPTIONAL,
  ...
}

WLAN-RTT-r13 ::= SEQUENCE {
  rttValue-r13                  INTEGER (0..16777215),
  rttUnits-r13                  ENUMERATED { microseconds,
                                           hundredsofnanoseconds,
                                           tensofnanoseconds,
                                           nanoseconds,
                                           tenthssofnanoseconds,
                                           ... },
  rttAccuracy-r13              INTEGER (0..255)              OPTIONAL,
  ...
}

maxWLAN-AP-r13                 INTEGER ::= 64
-- ASN1STOP

```

WLAN-MeasurementInformation field descriptions	
measurementReferenceTime	This field provides the UTC time when the WLAN measurements are performed and should take the form of <i>YYMMDDhhmmssZ</i> .
wlan-MeasurementList	This field provides the WLAN measurements for up to 64 WLAN APs.
wlan-AP-Identifier	This field provides the BSSID and optionally the SSID of the wireless network served by the WLAN AP [26].
rsSI	This field provides the AP signal strength (RSSI) of a beacon frame, probe response frame or measurement pilot frame measured at the target in dBm as defined in Table 6-7 of [26].
rtt	This field provides the measured round trip time between the target device and WLAN AP and optionally the accuracy expressed as the standard deviation of the delay. Units for each of these are 1000ns, 100ns, 10ns, 1ns, and 0.1ns.
apChannelFrequency	This field provides the AP channel number identification of the reported WLAN AP.
servingFlag	This parameter indicates whether a set of WLAN AP measurements were obtained for a serving WLAN AP (TRUE) or a non-serving WLAN AP (FALSE). A target device with multiple radio support may indicate more than one type of serving access for the same time instant.
rttValue	This field specifies the Round Trip Time (RTT) measurement between the target device and WLAN AP in units given by the field <i>rttUnits</i> .
rttUnits	This field specifies the Units for the fields <i>rttValue</i> and <i>rttAccuracy</i> . The available Units are 1000ns, 100ns, 10ns, 1ns, and 0.1ns.
rttAccuracy	This field provides the estimated accuracy of the provided <i>rttValue</i> expressed as the standard deviation in units given by the field <i>rttUnits</i> .

6.5.6.3 WLAN Location Information Request

– *WLAN-RequestLocationInformation*

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

```
-- ASN1START
WLAN-RequestLocationInformation-r13 ::= SEQUENCE {
    requestedMeasurements-r13 BIT STRING {
        rssi          (0),
        rtt           (1)} (SIZE(1..8)),
    ...
    [[ assistanceAvailability-r14 BOOLEAN OPTIONAL -- Need ON
    ]]
}
-- ASN1STOP
```

WLAN-RequestLocationInformation field descriptions	
requestedMeasurements	This field specifies the WLAN measurements requested. This is represented by a bit string, with a one-value at the bit position means the particular measurement is requested; a zero-value means not requested. The following measurement requests can be included. rssi: AP signal strength at the target rtt: Round Trip Time between target and AP
assistanceAvailability	This field indicates whether the target device may request additional WLAN assistance data from the server. TRUE means allowed and FALSE means not allowed.

6.5.6.4 WLAN Capability Information

– *WLAN-ProvideCapabilities*

The IE *WLAN-ProvideCapabilities* is used by the target device to provide its capabilities for WLAN positioning to the location server.

```
-- ASN1START
WLAN-ProvideCapabilities-r13 ::= SEQUENCE {
  wlan-Modes-r13          BIT STRING {  standalone      (0),
                                         ue-assisted     (1),
                                         ue-based       (2) }      (SIZE (1..8)),
  wlan-MeasSupported-r13 BIT STRING {
                                         rssi-r13       (0),
                                         rtt-r13       (1) }      (SIZE(1..8)),
  ... ,
  [[ wlan-AP-AD-Supported-r14
     BIT STRING {  ap-identifier(0),
                  ap-location  (1) }      (SIZE (1..8))
     OPTIONAL,
     periodicalReportingSupported-r14 PositioningModes
     idleStateForMeasurements-r14   ENUMERATED {  required   }
     OPTIONAL
  ]]
}
-- ASN1STOP
```

WLAN-ProvideCapabilities field descriptions

wlan-Modes

This field specifies the WLAN mode(s) supported by the target device. This is represented by a bit string, with a one value at the bit position means the WLAN mode is supported; a zero value means not supported.

wlan-MeasSupported

This field specifies the measurements supported by the target device when accessing a WLAN. This is represented by a bit string, with a one-value at the bit position means the particular measurement is supported; a zero-value means not supported. A zero-value in all bit positions in the bit string means only the basic WLAN positioning method is supported by the target device which is reporting of the WLAN identity. The following bits are assigned for the indicated measurements.

rssi: AP signal strength at the target
rtt: Round Trip Time between target and AP

wlan-AP-AD-Supported

This field specifies the WLAN AP assistance data supported by the target device. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is supported; a zero-value means not supported. A zero-value in all bit positions or absence of this field means no assistance data is supported. The following bits are assigned for the indicated assistance data.

ap-identifier: WLAN AP identity information
ap-location: WLAN AP location information

periodicalReportingSupported

This field, if present, specifies the positioning modes for which the target device supports *periodicalReporting*. This is represented by a bit string, with a one value at the bit position means *periodicalReporting* for the positioning mode is supported; a zero value means not supported. If this field is absent, the location server may assume that the target device does not support *periodicalReporting* in *CommonIEsRequestLocationInformation*.

idleStateForMeasurements

This field, if present, indicates that the target device requires idle state to perform WLAN measurements.

6.5.6.5 WLAN Capability Information Request

– *WLAN-RequestCapabilities*

The IE *WLAN-RequestCapabilities* is used by the location server to request WLAN positioning capabilities information from a target device.

```
-- ASN1START
WLAN-RequestCapabilities-r13 ::= SEQUENCE {
    ...
}
-- ASN1STOP
```

6.5.6.6 WLAN Error Elements

– *WLAN-Error*

The IE *WLAN-Error* is used by the location server or target device to provide error reasons for WLAN positioning to the target device or location server, respectively.

```
-- ASN1START
WLAN-Error-r13 ::= CHOICE {
    locationServerErrorCauses-r13          WLAN-LocationServerErrorCauses-r13,
    targetDeviceErrorCauses-r13           WLAN-TargetDeviceErrorCauses-r13,
    ...
}
-- ASN1STOP
```

– *WLAN-LocationServerErrorCauses*

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

```
-- ASN1START
WLAN-LocationServerErrorCauses-r13 ::= SEQUENCE {
    cause-r13                               ENUMERATED {undefined,
    ...
    requestedADNotAvailable-v14xy,
    notAllrequestedADAvailable-v14xy
    },
    ...
    [[ apLocationDataUnavailable-r14        NULL        OPTIONAL        -- Need ON
    ]]
}
-- ASN1STOP
```

WLAN-LocationServerErrorCauses field descriptions

cause

This field provides a WLAN AP specific error cause for the server applicable to provision of assistance data. If the cause value is '*requestedADNotAvailable*', none of the requested assistance data could be provided and no further information needs to be included. If the cause value is '*notAllRequestedADAvailable*', the server was able to provide some but not all requested WLAN AP assistance data. In this case, the server should include any of the specific error indications as applicable. Note that inclusion of these fields is applicable when some of the associated information can be provided for some WLAN APs but not for all WLAN APs.

– *WLAN-TargetDeviceErrorCauses*

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

```
-- ASN1START
WLAN-TargetDeviceErrorCauses-r13 ::= SEQUENCE {
    cause-r13                               ENUMERATED {undefined,
    requestedMeasurementsNotAvailable,
    notAllrequestedMeasurementsPossible,
    ...
}
-- ASN1STOP
```

```

    wlan-AP-RSSI-MeasurementNotPossible-r13    },
    wlan-AP-RTT-MeasurementNotPossible-r13    NULL      OPTIONAL,
    ...                                       NULL      OPTIONAL,
}
-- ASN1STOP

```

WLAN-TargetDeviceErrorCauses field descriptions

cause

This field provides a WLAN specific error cause. If the cause value is '*notAllRequestedMeasurementsPossible*', the target device was not able to provide all requested WLAN measurements (but may be able to provide some measurements). In this case, the target device should include any of the '*wlan-AP-RSSI-MeasurementNotPossible*', '*wlan-AP-RTT-MeasurementNotPossible*' fields, as applicable.

6.5.6.7 WLAN Assistance Data

– *WLAN-ProvideAssistanceData*

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

```

-- ASN1START
WLAN-ProvideAssistanceData-r14 ::= SEQUENCE {
    wlan-DataSet-r14      SEQUENCE (SIZE (1..maxWLAN-Datasets-r14)) OF WLAN-DataSet-r14
                          OPTIONAL,      -- Need ON
    wlan-Error-r14       WLAN-Error-r13      OPTIONAL,      -- Need ON
    ...
}
maxWLAN-Datasets-r14    INTEGER ::= 8
-- ASN1STOP

```

WLAN-ProvideAssistanceData field descriptions

wlan-DataSet

This field provides data for sets of WLAN APs.

wlan-Error

This field provides error information and may be included when a Provide Assistance Data is sent in response to a Request Assistance Data. It is allowed to include both a *wlan-DataSet* field and a *wlan-Error* field (e.g. when only some requested WLAN assistance data is provided).

6.5.6.8 WLAN Assistance Data Elements

– *WLAN-DataSet*

The IE *WLAN-DataSet* is used by the location server to provide WLAN AP information for one set of WLAN APs.

```

-- ASN1START
WLAN-DataSet-r14 ::= SEQUENCE {
    wlan-AP-List-r14      SEQUENCE (SIZE (1..maxWLAN-AP-r14)) OF WLAN-AP-Data-r14,
    supportedChannels-11a-r14 SupportedChannels-11a-r14      OPTIONAL,      -- Need ON
    supportedChannels-11bg-r14 SupportedChannels-11bg-r14      OPTIONAL,      -- Need ON
    ...
}
SupportedChannels-11a-r14 ::= SEQUENCE {
    ch34-r14      BOOLEAN,
    ch36-r14      BOOLEAN,
    ch38-r14      BOOLEAN,
    ch40-r14      BOOLEAN,
    ch42-r14      BOOLEAN,
    ch44-r14      BOOLEAN,
    ch46-r14      BOOLEAN,
}

```

```

    ch48-r14      BOOLEAN,
    ch52-r14      BOOLEAN,
    ch56-r14      BOOLEAN,
    ch60-r14      BOOLEAN,
    ch64-r14      BOOLEAN,
    ch149-r14     BOOLEAN,
    ch153-r14     BOOLEAN,
    ch157-r14     BOOLEAN,
    ch161-r14     BOOLEAN
  }

SupportedChannels-11bg-r14 ::= SEQUENCE {
  ch1-r14        BOOLEAN,
  ch2-r14        BOOLEAN,
  ch3-r14        BOOLEAN,
  ch4-r14        BOOLEAN,
  ch5-r14        BOOLEAN,
  ch6-r14        BOOLEAN,
  ch7-r14        BOOLEAN,
  ch8-r14        BOOLEAN,
  ch9-r14        BOOLEAN,
  ch10-r14       BOOLEAN,
  ch11-r14       BOOLEAN,
  ch12-r14       BOOLEAN,
  ch13-r14       BOOLEAN,
  ch14-r14       BOOLEAN
}

maxWLAN-AP-r14    INTEGER ::= 128

-- ASN1STOP

```

WLAN-DataSet field descriptions

wlan-AP-List

This field provides information for WLAN APs in the data set.

supportedChannels-11a

This field defines the superset of all channels supported by all WLAN APs in the data set of type 801.11a (5GHz band).

supportedChannels-11bg

This field defines the superset of all channels supported by all WLAN APs in the data set of type 801.11b or 802.11g (2.4 GHz band).

– WLAN-AP-Data

The IE *WLAN-AP-Data* is used by the location server to provide information for one WLAN AP as part of WLAN AP assistance data.

```

-- ASN1START

WLAN-AP-Data-r14 ::= SEQUENCE {
  wlan-AP-Identifier-r14      WLAN-AP-Identifier-r13,
  wlan-AP-Location-r14        WLAN-AP-Location-r14      OPTIONAL,  -- Need ON
  ...
}

WLAN-AP-Location-r14 ::= SEQUENCE {
  locationDataLCI-r14         LocationDataLCI-r14,
  ...
}

LocationDataLCI-r14 ::= SEQUENCE {
  latitudeUncertainty-r14     BIT STRING (SIZE (6)),
  latitude-r14                BIT STRING (SIZE (34)),
  longitudeUncertainty-r14    BIT STRING (SIZE (6)),
  longitude-r14               BIT STRING (SIZE (34)),
  altitudeUncertainty-r14     BIT STRING (SIZE (6))      OPTIONAL,  -- Need ON
  altitude-r14                BIT STRING (SIZE (30))      OPTIONAL,  -- Need ON
  datum-r14                   BIT STRING (SIZE (8)),
  ...
}

-- ASN1STOP

```

WLAN-AP-Data field descriptions**wlan-AP-Location****- locationDataLCI**

This field provides the location of the WLAN AP in the form of Location Configuration Information (LCI) defined in [27] and includes the following subfields:

- latitudeUncertainty: 6-bits quantifying the amount of uncertainty in latitude. A value of 0 is reserved to indicate that the uncertainty is unknown; values greater than 34 are reserved. Its relation with the corresponding value in degrees is expressed with the following formula:

$$\text{latitudeUncertainty} = 8 - \text{ceil}(\log_2(\text{uncertainty in degrees}))$$
- latitude: A 34-bits fixed point value consisting of 9-bits of integer and 25-bits of fraction indicating the Latitude (+/- 90 degrees) of the AP.
- longitudeUncertainty: 6-bits quantifying the amount of uncertainty in longitude. A value of 0 is reserved to indicate that the uncertainty is unknown; values greater than 34 are reserved. Its relation with the corresponding value in degrees is expressed with the following formula:

$$\text{longitudeUncertainty} = 8 - \text{ceil}(\log_2(\text{uncertainty in degrees}))$$
- longitude: A 34-bits fixed point value consisting of 9-bits of integer and 25-bits of fraction indicating the Longitude (+/- 180 degrees) of the AP.
- altitudeUncertainty: 6-bits value quantifying the amount of uncertainty in the altitude value. A value of 0 is reserved to indicate that the uncertainty is unknown; values greater than 30 are reserved. Its relation with the corresponding value in meters is expressed with the following formula:

$$\text{altitudeUncertainty} = 21 - \text{ceil}(\log_2(\text{uncertainty in meters}))$$
- altitude: A 30-bit fixed point value consisting of 22-bits of integer and 8-bits of fraction indicating the altitude of the AP in meters.
- datum: 3-bits indicating the map datum used for the coordinates. Defined codes are:
 1: World Geodetic System 1984 (WGS-84)
 2: North American Datum 1983 (NAD-83) with North American Vertical Datum 1988 (NAVD-88)
 3: North American Datum 1983 (NAD-83) with Mean Lower Low Water (MLLW) vertical datum.

6.5.6.9 WLAN Assistance Data Request**– WLAN-RequestAssistanceData**

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

```
-- ASN1START
WLAN-RequestAssistanceData-r14 ::= SEQUENCE {
  requestedAD-r14      BIT STRING {
    ap-identifier      (0),
    ap-location        (1) } (SIZE (1..8)),
  visibleAPs-r14      SEQUENCE (SIZE (1..maxVisibleAPs-r14)) OF WLAN-AP-Identifier-r13
  OPTIONAL,
  wlan-AP-StoredData-r14 SEQUENCE (SIZE (1..maxKnownAPs-r14)) OF WLAN-AP-Identifier-r13
  OPTIONAL,
  ...
}
maxVisibleAPs-r14      INTEGER ::= 32
maxKnownAPs-r14       INTEGER ::= 2048
-- ASN1STOP
```

<i>WLAN-RequestAssistanceData</i> field descriptions
<p><i>requestedAD</i> This field specifies the WLAN AP assistance data requested. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested. The following assistance data types are included:</p> <p style="padding-left: 40px;">ap-identifier: WLAN AP identity information ap-location: WLAN AP location information</p>
<p><i>visibleAPs</i> This field enables a target to indicate to a server the identities of currently visible WLAN APs. This may assist a server to provide assistance data for WLAN APs nearby to the target. A target shall provide visible APs in order of received signal strength with the AP with the highest signal strength provided first.</p>
<p><i>wlan-AP-StoredData</i> This field enables a target to indicate to a server the identities of WLAN APs for which the target has stored assistance data received previously from the server. This may enable the server to avoid resending data for the same APs.</p>

6.5.7 Bluetooth-based Positioning

6.5.7.1 Bluetooth Location Information

– *BT-ProvideLocationInformation*

The IE *BT-ProvideLocationInformation* is used by the target device to provide measurements for one or more Bluetooth beacons to the location server. It may also be used to provide Bluetooth positioning specific error reason.

```
-- ASN1START
BT-ProvideLocationInformation-r13 ::= SEQUENCE {
    bt-MeasurementInformation-r13    BT-MeasurementInformation-r13    OPTIONAL,
    bt-Error-r13                    BT-Error-r13                OPTIONAL,
    ...
}
-- ASN1STOP
```

6.5.7.2 Bluetooth Location Information Elements

– *BT-MeasurementInformation*

```
-- ASN1START
BT-MeasurementInformation-r13 ::= SEQUENCE {
    measurementReferenceTime-r13    UTCTime                    OPTIONAL,
    bt-MeasurementList-r13          BT-MeasurementList-r13    OPTIONAL,
    ...
}
BT-MeasurementList-r13 ::= SEQUENCE (SIZE(1..maxBT-Beacon-r13)) OF BT-MeasurementElement-r13

BT-MeasurementElement-r13 ::= SEQUENCE {
    btAddr-r13                      BIT STRING (SIZE (48)),
    rssi-r13                        INTEGER (-128..127)        OPTIONAL,
    ...
}
maxBT-Beacon-r13                  INTEGER ::= 32
-- ASN1STOP
```


<i>BT-MeasurementInformation</i> field descriptions
<i>measurementReferenceTime</i> This field provides the UTC time when the Bluetooth measurements are performed and should take the form of YYMMDDhhmmssZ.
<i>bt-MeasurementList</i> This field provides the Bluetooth measurements for up to 32 Bluetooth beacons.
<i>btAddr</i> This field specifies the Bluetooth public address of the Bluetooth beacon [25].
<i>rsi</i> This field provides the beacon received signal strength indicator (RSSI) in dBm.

6.5.7.3 Bluetooth Location Information Request

– *BT-RequestLocationInformation*

The IE *BT-RequestLocationInformation* is used by the location server to request Bluetooth measurements from a target device.

```
-- ASN1START
BT-RequestLocationInformation-r13 ::= SEQUENCE {
    requestedMeasurements-r13  BIT STRING {
                                rssi          (0)} (SIZE(1..8)),
    ...
}
-- ASN1STOP
```

<i>BT-RequestLocationInformation</i> field descriptions
<i>requestedMeasurements</i> This field specifies the Bluetooth measurements requested. This is represented by a bit string, with a one-value at the bit position means the particular measurement is requested; a zero-value means not requested. The following measurement requests can be included. rssi: Bluetooth beacon signal strength at the target

6.5.7.4 Bluetooth Capability Information

– *BT-ProvideCapabilities*

The IE *BT-ProvideCapabilities* is used by the target device to provide its capabilities for Bluetooth positioning to the location server.

```
-- ASN1START
BT-ProvideCapabilities-r13 ::= SEQUENCE {
    bt-Modes-r13          BIT STRING {
                            standalone      (0),
                            ue-assisted    (1)} (SIZE (1..8)),
    bt-MeasSupported-r13 BIT STRING {
                            rssi-r13       (0)} (SIZE (1..8)),
    ...
    [[
        idleStateForMeasurements-r14
        ENUMERATED { required }
        periodicalReportingSupported-r14
        PositioningModes
    ]]
}
-- ASN1STOP
```

BT-ProvideCapabilities field descriptions
<p>bt-Modes This field specifies the Bluetooth mode(s) supported by the target device. This is represented by a bit string, with a one value at the bit position means the Bluetooth mode is supported; a zero value means not supported.</p>
<p>bt-MeasSupported This field specifies the Bluetooth 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. A zero-value in all bit positions in the bit string means only the basic Bluetooth positioning method is supported by the target device which is reporting of the Bluetooth beacon identity. The following bits are assigned for the indicated measurements.</p> <p style="padding-left: 40px;">rssi: Bluetooth beacon signal strength at the target device</p>
<p>idleStateForMeasurements This field, if present, indicates that the target device requires idle state to perform BT measurements.</p>
<p>periodicalReportingSupported This field, if present, specifies the positioning modes for which the target device supports <i>periodicalReporting</i>. This is represented by a bit string, with a one value at the bit position means <i>periodicalReporting</i> for the positioning mode is supported; a zero value means not supported. If this field is absent, the location server may assume that the target device does not support <i>periodicalReporting</i> in <i>CommonIEsRequestLocationInformation</i>.</p>

6.5.7.5 Bluetooth Capability Information Request

– *BT-RequestCapabilities*

The IE *BT-RequestCapabilities* is used by the location server to request Bluetooth positioning capabilities from a target device.

```
-- ASN1START
BT-RequestCapabilities-r13 ::= SEQUENCE {
    ...
}
-- ASN1STOP
```

6.5.7.6 BT Error Elements

– *BT-Error*

The IE *BT-Error* is used by the location server or target device to provide error reasons for Bluetooth positioning to the target device or location server, respectively.

```
-- ASN1START
BT-Error-r13 ::= CHOICE {
    locationServerErrorCauses-r13      BT-LocationServerErrorCauses-r13,
    targetDeviceErrorCauses-r13       BT-TargetDeviceErrorCauses-r13,
    ...
}
-- ASN1STOP
```

– *BT-LocationServerErrorCauses*

The IE *BT-LocationServerErrorCauses* is used by the location server to provide error reasons for Bluetooth positioning to the target device.

```
-- ASN1START
BT-LocationServerErrorCauses-r13 ::= SEQUENCE {
    cause-r13          ENUMERATED {undefined, ...},
    ...
}
-- ASN1STOP
```

– *BT-TargetDeviceErrorCauses*

The IE *BT-TargetDeviceErrorCauses* is used by the target device to provide error reasons for Bluetooth positioning to the location server.

```
-- ASN1START
BT-TargetDeviceErrorCauses-r13 ::= SEQUENCE {
  cause-r13          ENUMERATED {undefined,
                                requestedMeasurementsNotAvailable,
                                notAllrequestedMeasurementsPossible,
                                ...
                                },
  bt-Beacon-rssiMeasurementNotPossible-r13  NULL      OPTIONAL,
  ...
}
-- ASN1STOP
```

<i>BT-TargetDeviceErrorCauses</i> field descriptions
<p>cause This field provides a Bluetooth specific error cause. If the cause value is '<i>notAllRequestedMeasurementsPossible</i>', the target device was not able to provide all requested Bluetooth measurements (but may be able to provide some measurements). In this case, the target device should include '<i>bt-Beacon-rssiMeasurementNotPossible</i>' field.</p>

– *End of LPP-PDU-Definitions*

```
-- ASN1START
END
-- ASN1STOP
```

Annex A (informative): Change History

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Cat	Subject/Comment	New version
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	2.0.0
2009-12	RP-46	RP-091208				RAN #46 approval of TS 36.355	9.0.0
2010-03	RP-47	RP-100304	0001	-		Clarification on Position location	9.1.0
	RP-47	RP-100304	0002	-		Clarification on UE Rx-Tx time difference supporting capability	9.1.0
	RP-47	RP-100304	0003	2		Completion of LPP common material	9.1.0
	RP-47	RP-100304	0004	5		Completion of OTDOA in LPP	9.1.0
	RP-47	RP-100304	0006	-		Provision of Frame Drift Information in Network Time	9.1.0
	RP-47	RP-100304	0007	-		Clarification of measurement reference point	9.1.0
	RP-47	RP-100304	0010	-		GNSS-DifferentialCorrectionsSupport	9.1.0
	RP-47	RP-100304	0011	-		BSAlign Indication in GNSS Reference Time	9.1.0
	RP-47	RP-100304	0012	1		Changes to reflect LPP ASN.1 review	9.1.0
	RP-47	RP-100304	0013	1		Introduction of LPP reliability sublayer	9.1.0
	RP-47	RP-100304	0015	-		LPP error procedures and conditions	9.1.0
	RP-47	RP-100304	0016	-		Triggered Location Information Transfer due to Cell Change	9.1.0
2010-06	RP-48	RP-100558	0018	2		Addition of need codes to optional LPP information elements	9.2.0
	RP-48	RP-100558	0019	1		Miscellaneous corrections to LPP stage 3	9.2.0
	RP-48	RP-100558	0020	1		Small corrections to LPP specification	9.2.0
	RP-48	RP-100558	0021	-		Clarifications of OTDOA parameters	9.2.0
	RP-48	RP-100558	0022	1		Signalling support for PRS muting in OTDOA	9.2.0
	-	-	-	-		Two times capital R replaced by lower case r in "MeasuredResultsElement" (undoing not intended change)	9.2.1
2010-09	RP-49	RP-100852	0024	-		Addition of an EPDU to an LPP Error and LPP Abort	9.3.0
	RP-49	RP-100852	0026	-		Division of LPP into Separate ASN.1 Modules with a Global Identifier	9.3.0
	RP-49	RP-100852	0028	-		Proposed Corrections to LPP Reliable Transport	9.3.0
	RP-49	RP-100852	0029	-		Proposed Corrections to the PeriodicalReportingCriteria in LPP	9.3.0
	RP-49	RP-100852	0030	1		Various corrections and clarifications to LPP	9.3.0
	RP-49	RP-100852	0031	-		Support of functional components for LPP reliable transport	9.3.0
	RP-49	RP-100852	0032	1		Introduction of EPDU ID requested by OMA LOC	9.3.0
	RP-49	RP-100852	0035	1		Several corrections in LPP	9.3.0
	RP-49	RP-100852	0036	-		Clarification to Assistance Data Transfer Procedure	9.3.0
2010-12	RP-50	RP-101207	0037	-		Correction of reliable transport terminology in description of LPP-Message	9.4.0
	RP-50	RP-101207	0038	-		One cell with known SFN in OTDOA assistance data	9.4.0
	RP-50	RP-101207	0039	1		UE frequency capability for LPP	9.4.0
	RP-50	RP-101207	0041	-		Correction to LPP reliable transport	9.4.0
	RP-50	RP-101207	0042	-		Correction to LPP Error procedure	9.4.0
	RP-50	RP-101207	0043	-		Addition of missing reference to LPPe	9.4.0
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2011-03	RP-51	RP-110269	0046	-		Editorial corrections to 36.355	10.1.0
	RP-51	RP-110269	0048	-		Removal of FFS for retransmission timer in LPP	10.1.0
	RP-51	RP-110269	0050	-		Correction to code phase encoding in GNSS acquisition assistance	10.1.0
	RP-51	RP-110269	0052	1		Clarification on SFN provided with OTDOA measurement	10.1.0
	RP-51	RP-110269	0053	1		Introduction of OTDOA inter-freq RSTD measurement indication procedure	10.1.0
	RP-51	RP-110269	0057	-		Small corrections in 36.355	10.1.0
	RP-51	RP-110269	0058	3		Further corrections to the OTDOA assistance data	10.1.0
2011-06	RP-52	RP-110830	0060	-		Clarifications to description of OTDOA positioning fields	10.2.0
2011-09	RP-53	RP-111279	0062	1		Various corrections to LPP	10.3.0
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2012-09	RP-57	RP-121424	0074	2		Corrections to GNSS Acquisition Assistance Data	10.6.0
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	RP-75	RP-170637	0166	-	B	Introduction of positioning support for NB-IoT	14.1.0

History

Document history		
V14.1.0	April 2017	Publication