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***3GPP***

Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis

Valbonne - FRANCE

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

Internet

http://www.3gpp.org

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# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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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.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

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

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

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

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

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

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

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

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

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

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

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[30] RTCM Standard 10403.3: "Differential GNSS (Global Navigation Satellite Systems) Services" – Version 3, October 7, 2016.

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[35] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[36] 3GPP TS 38.215: "NR; Physical layer measurements".

[37] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

# 3 Definitions and Abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], TS 36.305 [2] and TS 23.271 [3] apply. Other definitions are provided below.

**Anchor carrier:** In NB-IoT, a carrier where the UE assumes that NPSS/NSSS/NPBCH/SIB-NB for FDD or NPSS/NSSS/NPBCH for TDD 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 *t1*, and a signal from TP 2 is received at the moment *t2*, the OTDOA is *t2* – *t1*.

**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

ARP Antenna Reference Point

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

FKP (German) Flächen-Korrektur-Parameter (area correction parameter)

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

HA GNSS High-Accuracy GNSS (RTK, PPP)

ICD Interface Control Document

IGS International GNSS Service

IOD Issue of Data

IS Interface Specification

LLA Latitude Longitude Altitude

LPP LTE Positioning Protocol

LPPa LTE Positioning Protocol Annex

LSB Least Significant Bit

MAC Master Auxiliary Concept

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

NCGI NR Cell Global Identifier

NICT National Institute of Information and Communications Technology

NI-LR Network Induced Location Request

NPRS Narrowband Positioning Reference Signals

NR NR Radio Access

NRSRP Narrowband Reference Signal Received Power

NRSRQ Narrowband Reference Signal Received Quality

NTSC National Time Service Center of Chinese Academy of Sciences

OSR Observation Space Representation

OTDOA Observed Time Difference Of Arrival

PDU Protocol Data Unit

PPP Precise Point Positioning

PRB Physical Resource Block

PRC Pseudo‑Range Correction

PRS Positioning Reference Signals

posSIB Positioning System Information Block

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

RTK Real-Time Kinematic

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

SSR State Space Representation

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 TS 36.305 [2] and TS 23.271 [3]).

NB-IoT is a non-backward compatible variant of E-UTRAN supporting a reduced set of functionalities. 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 TS 23.271 [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, 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 clause 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 clauses 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.

In addition, for NB-IoT the timeout period may be determined by the sender implementation based on e.g., the coverage level of the UE.

#### 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.

### 4.3.5 LPP Message Segmentation

An LPP message body may be sent in several shorter LPP messages instead of one long LPP message to deliver a large amount of information (e.g., in case the LPP message size exceeds the maximum message size supported by lower layers). When a sender employs LPP message segmentation, the sender shall include the IE *SegmentationInfo* in each LPP message segment. The sender shall indicate in all but the final message segment that more messages are on the way.

When a receiver receives an LPP message indicating that more messages are on the way, the receiver may store the LPP message. If the receiver receives a subsequent LPP message for the same session and transaction ID, the receiver shall assume that the new LPP message continues the segmentation of the earlier message and may store the new message if the new message indicates that more messages are on the way. If the new message indicates that no more messages are on the way, the receiver shall assume that message segmentation is complete and shall process the new message and any stored message segments for the same session and transaction ID.

The reliable transport rules specified in clause 4.3.2, 4.3.3, and 4.3.4 apply to each individual LPP message segment, independently of the value of the IE *SegmentationInfo*.

The rules for setting the common fields of the LPP message specified in clause 4.1.4 (Transaction ID, Transaction End Flag, Sequence Number, Acknowledgment) apply to each individual LPP message segment, independently of the value of the IE *SegmentationInfo*.



Figure 4.3.5-1: LPP Message Segmentation procedure

1. Endpoint A sends an LPP message to Endpoint B for a particular location session and includes the IE *SegmentationInfo* set to *moreMessagesOnTheWay* to indicate that this is one of many LPP message segments used to deliver the entire LPP message body.

2 Endpoint A may send one or more additional LPP messages to Endpoint B with the IE *SegmentationInfo* set to *moreMessagesOnTheWay* to continue delivering the segmented LPP message*.*

3. Endpoint A sends the final LPP message segment to Endpoint B and includes the IE *SegmentationInfo* set to *noMoreMessages* to indicate that this is the final LPP message segment. Endpoint B assumes that the complete LPP message body has been received.

# 5 LPP Procedures

## 5.1 Procedures related to capability transfer

The purpose of the procedures that are grouped together in this clause 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 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 clause 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 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.

### 5.2.1a Periodic Assistance Data Transfer procedure

The Periodic Assistance Data Transfer procedure is shown in Figure 5.2.1a-1. This procedure enables a target to request a server to send assistance data periodically.

NOTE 1: In this version of the specification, periodic assistance data transfer is supported for HA GNSS (e.g., RTK) positioning only.



Figure 5.2.1a-1: LPP Periodic Assistance data transfer procedure

1. The target sends a *RequestAssistanceData* message to the server using some available *transactionID* T1. The message contains a *periodicSessionID* S (different to any other *periodicSessionID* currently in use between the target and server) in the IE *CommonIEsRequestAssistanceData.* The message also includes a positioning method specific assistance data request element (e.g., IE *A-GNSS-RequestAssistanceData*) identifying the type of assistance data being requested together with desired periodicity conditions for sending it and a duration for ending the assistance data transfer (e.g., in IE *GNSS-PeriodicAssistDataReq*).

2. The server responds with a *ProvideAssistanceData* message to the target. The message uses the *transactionID* T1 in step 1 and indicates the end of this transaction. The message contains the *periodicSessionID* S in IE *CommonIEsProvideAssistanceData.* If the request can be supported, the message contains the control parameters in the positioning method specific assistance data (e.g., IE *A-GNSS-ProvideAssistanceData)* which may confirm or redefine the type of assistance data or periodicity parameters requested at step 1 (e.g., in IE *GNSS‑PeriodicAssistData*). If the target requested non-periodic assistance data in addition to the periodic assistance data in step 1, the *ProvideAssistanceData* message may also include the non-periodic assistance data in this step 2 (but not any periodic assistance data).  
If the request cannot be supported (fully or partly), an error reason is provided in the positioning method specific IE (e.g., IE *A‑GNSS‑Error*). If the request cannot even partly be supported remaining steps are then not performed.

NOTE 2: The target device infers from an absence of the *periodicSessionID* that the location server does not support periodic assistance data delivery. In that case, the target device does not expect the Data Transaction (Steps 3-7).

3. When the first periodic message is available, the server sends an unsolicited *ProvideAssistanceData* message to the target containing the *periodicSessionID* S and the periodic assistance data confirmed in step 2. The message uses some available *transactionID* T2 that may be different to T1.

NOTE 3: The positioning method specific control parameters (e.g., IE *GNSS-PeriodicAssistData*) are not included in the data transaction.

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

NOTE 4: The target device expects a *ProvideAssistanceData* messages at the in Step 2 confirmed interval(s). If some or all of the assistance data is not available at each periodic interval, an error indication is provided in the positioning method specific IE (e.g., IE *A‑GNSS‑Error*).

5. If the target requires the session to end, the target sends an *Abort* message to the server for transaction T2 that may optionally include an *abortCause*. Remaining steps are then omitted.

6. If the server requires the session to end, the server sends an *Abort* message to the target for transaction T2 that may optionally include an *abortCause*. Remaining steps are then omitted.

7. When the duration or other conditions for ending the periodic assistance data transfer occur, the last *ProvideAssistanceData* message transferred indicates the end of transaction T2.

### 5.2.1b Periodic Assistance Data Transfer with Update procedure



Figure 5.2.1b-1: LPP Periodic Assistance data transfer with update procedure

1. Steps 1-2 and optionally steps 3-4 are performed for the Periodic Assistance Data Transfer procedure in clause 5.2.1a with the following exceptions:

- The *RequestAssistanceData* message in step 1 indicates the update capabilities of the target device.

- The *ProvideAssistanceData* message in step 2 indicates the update capabilities of the target device which are supported by the server.

2. If the target device changes its primary cell and if the update capabilities of the target device supported by the server in step 1 include update of a primary cell ID, the target device sends a *RequestAssistanceData* message to the server using some available *transactionID* T3, which is different from T2 (previously used in step 2). The message contains the *periodicSessionID* S (previously used in step 1) and the new primary cell ID in the IE *CommonIEsRequestAssistanceData.*

3. The server responds with a *ProvideAssistanceData* message to the target. The message uses the *transactionID* T3 in step 2 and indicates the end of this transaction. The message contains the *periodicSessionID* S in IE *CommonIEsProvideAssistanceData.* Steps 2-3 are repeated each time the target device changes its primary cell.

4. Steps 4-7 are performed for the Periodic Assistance Data Transfer procedure in clause 5.2.1a.

### 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.

### 5.2.2a Periodic Assistance Data Delivery procedure

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

NOTE 1: In this version of the specification, periodic assistance data delivery is supported for HA GNSS (e.g., RTK) positioning only.



Figure 5.2.2a-1: LPP Periodic Assistance data delivery procedure

1. The server sends a *ProvideAssistanceData* message to the target using some available *transactionID* T1 and indicates the end of this transaction. The message contains a *periodicSessionID* S (different to any other *periodicSessionID* currently in use between the server and target) in the IE *CommonIEsProvideAssistanceData.* The message includes positioning method specific assistance data control parameters (e.g., in IE *A‑GNSS‑ProvideAssistanceData*) identifying the type of periodic assistance data being delivered together with periodicity conditions for sending it and a duration for ending the assistance data delivery (e.g., in IE *GNSS‑PeriodicAssistData*). The *ProvideAssistanceData* message may also include non-periodic assistance data (but not any periodic assistance data).

2. When the first periodic message is available, the server sends an unsolicited *ProvideAssistanceData* message to the target containing the *periodicSessionID* S and the periodic assistance data announced in step 1. The message uses some available *transactionID* T2 that may be different to T1.

NOTE 2: The positioning method specific control parameters (e.g., IE *GNSS-PeriodicAssistData*) are not included in the data transaction.

3. The server may continue to send further *ProvideAssistanceData* messages to the target containing the periodic assistance data announced in step 2 when each additional periodicity condition occurs.

NOTE3: The target device expects a *ProvideAssistanceData* messages at the in Step 2 announced interval(s). If some or all of the assistance data is not available at each periodic interval, an error indication is provided in the positioning method specific IE (e.g., IE *A‑GNSS‑Error*).

4. If the target requires the session to end, the target sends an *Abort* message to the server for transaction T2 that may optionally include an *abortCause*. Remaining steps are then omitted.

5. If the server requires the session to end, the server sends an *Abort* message to the target for transaction T2 that may optionally include an *abortCause*. Remaining steps are then omitted.

6. When the duration or other conditions for ending the periodic assistance data transfer occur, the last *ProvideAssistanceData* message transferred indicates the end of transaction T2.

### 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 clause 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 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 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> if the receiver can determine the session and the *LPP-TransactionID* and the received message includes the IE *SegmentationInfo* and the receiver has previously stored message segments for this session and *LPP-TransactionID*:

4> discard all stored LPP message segments for this session and *LPP-TransactionID*;

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> if the message includes the IE *SegmentationInfo* and the receiver has previously stored message segments for this session and *LPP-TransactionID*:

3> discard all stored LPP message segments for this session and *LPP-TransactionID;*

2> discard the message and stop the error detection procedure;

1> if the message includes the IE *SegmentationInfo*:

2> if the receiver has previously stored LPP message segments for this session and *LPP-TransactionID*:

3> if the received message type is different to the stored message type:

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

4> discard the message and all stored LPP message segments for this session and *LPP-TransactionID* and stop the error detection procedure;

2> if the IE *SegmentationInfo* has the value *moreMessagesOnTheWay*:

3> store the received message;

NOTE: As an implementation option, the receiver of an LPP Provide Assistance Data or LPP Provide Location Information message may process the received message segment instead of storing the message.

2> if the IE *SegmentationInfo* has the value *noMoreMessages*:

3> continue error detection for the received message and any stored LPP message segments for this session and *LPP-TransactionID*;

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 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 clause uses the same format and coding conventions as described in Annex A of TS 36.331 [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 *conditionTag* | *Conditionally present*  A field for which the need is specified by means of conditions. For each *conditionTag*, 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 | *Optionally present*  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 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 | *Optionally present, No action*  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 | *Optionally present, Release*  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** |
| --- |
| ***transactionID***  This field is omitted if an *lpp-MessageBody* 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 *LPP-Error* 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 *lpp-MessageBody* is not present. | |
| ***endTransaction***  This field indicates whether an LPP message is the last message carrying an *lpp-MessageBody* in a transaction (TRUE) or not last (FALSE). When LPP message segmentation is used, only the final LPP message segment may indicate the end of the transaction. | |
| ***sequenceNumber***  This field may be included when LPP operates over the control plane and an *lpp-MessageBody* is included but shall be omitted otherwise. | |
| ***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. | |
| ***ackRequested***  This field indicates whether an LPP acknowledgement is requested (TRUE) or not (FALSE). A value of TRUE may only be included when an *lpp-MessageBody* is included. | |
| ***ackIndicator***  This field indicates the sequence number of the message being acknowledged. | |
| ***lpp-MessageBody***  This field may be omitted in case the message is sent only to acknowledge a previously received message. |

#### *– 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

#### – *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

#### – *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

| ***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),

nr-v1510 (4) } (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 TS 36.331 [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-ValueNR*

The IE *ARFCN-ValueNR* is used to indicate the ARFCN applicable for a downlink, uplink or bi-directional (TDD) NR global frequency raster, as defined in TS 38.101-2 [34] and TS 38.101-1 [37].

-- ASN1START

ARFCN-ValueNR-r15 ::= INTEGER (0..3279165)

-- ASN1STOP

#### *– ARFCN-ValueUTRA*

The IE *ARFCN-ValueUTRA* is used to indicate the ARFCN of the UTRA carrier frequency, as defined in TS 25.331 [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 TS 36.331 [12]. |
| ***cellIdentity***  This field defines the identity of the cell within the context of the PLMN as defined in TS 36.331 [12] and TS 25.331 [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 (TS 36.331 [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 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 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 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 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 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 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] |

#### *– HighAccuracyEllipsoidPointWithUncertaintyEllipse*

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

-- ASN1START

HighAccuracyEllipsoidPointWithUncertaintyEllipse-r15 ::= SEQUENCE {

degreesLatitude-r15 INTEGER(-2147483648..2147483647),

degreesLongitude-r15 INTEGER(-2147483648..2147483647),

uncertaintySemiMajor-r15 INTEGER (0..255),

uncertaintySemiMinor-r15 INTEGER (0..255),

orientationMajorAxis-r15 INTEGER (0..179),

confidence-r15 INTEGER (0..100)

}

-- ASN1STOP

#### *– HighAccuracyEllipsoidPointWithAltitudeAndUncertaintyEllipsoid*

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

-- ASN1START

HighAccuracyEllipsoidPointWithAltitudeAndUncertaintyEllipsoid-r15 ::= SEQUENCE {

degreesLatitude-r15 INTEGER(-2147483648..2147483647),

degreesLongitude-r15 INTEGER(-2147483648..2147483647),

altitude-r15 INTEGER(-64000..1280000),

uncertaintySemiMajor-r15 INTEGER (0..255),

uncertaintySemiMinor-r15 INTEGER (0..255),

orientationMajorAxis-r15 INTEGER (0..179),

horizontalConfidence-r15 INTEGER (0..100),

uncertaintyAltitude-r15 INTEGER (0..255),

verticalConfidence-r15 INTEGER (0..100)

}

-- ASN1STOP

#### *– HorizontalVelocity*

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

-- ASN1START

LocationCoordinateTypes ::= SEQUENCE {

ellipsoidPoint BOOLEAN,

ellipsoidPointWithUncertaintyCircle BOOLEAN,

ellipsoidPointWithUncertaintyEllipse BOOLEAN,

polygon BOOLEAN,

ellipsoidPointWithAltitude BOOLEAN,

ellipsoidPointWithAltitudeAndUncertaintyEllipsoid BOOLEAN,

ellipsoidArc BOOLEAN,

...,

[[

highAccuracyEllipsoidPointWithUncertaintyEllipse-r15 BOOLEAN OPTIONAL,

highAccuracyEllipsoidPointWithAltitudeAndUncertaintyEllipsoid-r15 BOOLEAN OPTIONAL

]]

}

-- ASN1STOP

#### *– NCGI*

The IE *NCGI* specifies the NR Cell Global Identifier (NCGI) which is used to identify NR cells globally (TS 38.331 [35]).

-- ASN1START

NCGI-r15 ::= SEQUENCE {

mcc-r15 SEQUENCE (SIZE (3)) OF INTEGER (0..9),

mnc-r15 SEQUENCE (SIZE (2..3)) OF INTEGER (0..9),

nr-cellidentity-r15 BIT STRING (SIZE (36))

}

-- ASN1STOP

#### *– PeriodicAssistanceDataControlParameters*

The IE *PeriodicAssistanceDataControlParameters* is used in a periodic assistance data delivery procedure as described in clauses 5.2.1a and 5.2.2a.

-- ASN1START

PeriodicAssistanceDataControlParameters-r15 ::= SEQUENCE {

periodicSessionID-r15 PeriodicSessionID-r15,

...,

[[

updateCapabilities-r15 UpdateCapabilities-r15 OPTIONAL

]]

}

PeriodicSessionID-r15 ::= SEQUENCE {

periodicSessionInitiator-r15 ENUMERATED { locationServer, targetDevice, ... },

periodicSessionNumber-r15 INTEGER (0..255),

...

}

UpdateCapabilities-r15 ::= BIT STRING {primaryCellID-r15 (0)} (SIZE(1..8))

-- ASN1STOP

| *PeriodicAssistanceDataControlParameters* field descriptions |
| --- |
| ***periodicSessionID***  This field identifies a particular periodic assistance data delivery session and the initiator of the session. |
| ***updateCapabilities***  This field identifies the capabilities of the sending entity to support an update of periodic assistance data. A bit value set to one indicates a capability is supported and a bit value set to zero indicates a capability is not supported. |

#### *– Polygon*

The IE *Polygon* is used to describe a geographic shape as defined in 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. |

#### – *SegmentationInfo*

The IE *SegmentationInfo* is used by a sender to indicate that LPP message segmentation is used, as specified in clause 4.3.5.

-- ASN1START

SegmentationInfo-r14 ::= ENUMERATED { noMoreMessages, moreMessagesOnTheWay }

-- ASN1STOP

| *SegmentationInfo* field descriptions |
| --- |
| ***SegmentationInfo***  *noMoreMessages* indicates that this is the only or last LPP message segment used to deliver the entire message body.  *moreMessagesOnTheWay* indicates that this is one of multiple LPP messagesegments used to deliver the entire message body. |

#### *– VelocityTypes*

The IE *VelocityTypes* defines a list of possible velocity shapes as defined in 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 {

...,

[[

lpp-message-segmentation-req-r14 BIT STRING { serverToTarget (0),

targetToServer (1) } OPTIONAL -- Need ON

]]

}

-- ASN1STOP

| *CommonIEsRequestCapabilities* field descriptions |
| --- |
| ***lpp-message-segmentation-req***  This field, if present, indicates that the target device is requested to provide its LPP message segmentation capabilities.  If bit 0 is set to value 1, it indicates that the server is able to send segmented LPP messages to the target device; if bit 0 is set to value 0 it indicates that the server is not able to send segmented LPP messages to the target device.  If bit 1 is set to value 1, it indicates that the server is able to receive segmented LPP messages from the target device; if bit 1 is set to value 0 it indicates that the server is not able to receive segmented LPP messages from the target device. |

#### – *CommonIEsProvideCapabilities*

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

-- ASN1START

CommonIEsProvideCapabilities ::= SEQUENCE {

...,

[[

segmentationInfo-r14 SegmentationInfo-r14 OPTIONAL, -- Cond Segmentation

lpp-message-segmentation-r14 BIT STRING { serverToTarget (0),

targetToServer (1) } OPTIONAL

]]

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *Segmentation* | This field is optionally present, need OP, if *lpp-message-segmentation-req* has been received from the location server with bit 1 (*targetToServer*) set to value 1. The field shall be omitted if *lpp‑message‑segmentation-req* has not been received in this location session, or has been received with bit 1 (*targetToServer*) set to value 0. |

| *CommonIEsProvideCapabilities* field descriptions |
| --- |
| ***segmentationInfo***  This field indicates whether this *ProvideCapabilities* message is one of many segments, as specified in clause 4.3.5. |
| ***lpp-message-segmentation***  This field, if present, indicates the target device's LPP message segmentation capabilities.  If bit 0 is set to value 1, it indicates that the target device supports receiving segmented LPP messages; if bit 0 is set to value 0 it indicates that the target device does not support receiving segmented LPP messages.  If bit 1 is set to value 1, it indicates that the target device supports sending segmented LPP messages; if bit 1 is set to value 0 it indicates that the target device does not support sending segmented LPP messages. |

#### – *CommonIEsRequestAssistanceData*

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

-- ASN1START

CommonIEsRequestAssistanceData ::= SEQUENCE {

primaryCellID ECGI OPTIONAL, -- Cond EUTRA

...,

[[

segmentationInfo-r14 SegmentationInfo-r14 OPTIONAL -- Cond Segmentation

]],

[[

periodicAssistanceDataReq-r15

PeriodicAssistanceDataControlParameters-r15

OPTIONAL, -- Cond PerADreq

primaryCellID-r15 NCGI-r15 OPTIONAL -- Cond NR

]]

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *EUTRA* | 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. |
| *Segmentation* | This field is optionally present, need OP, if *lpp-message-segmentation-req* has been received from the location server with bit 1 (*targetToServer*) set to value 1. The field shall be omitted if *lpp‑message‑segmentation-req* has not been received in this location session, or has been received with bit 1 (*targetToServer*) set to value 0. |
| *PerADreq* | The field is mandatory present if the target device requests periodic assistance data delivery. Otherwise it is not present. |
| *NR* | The field is mandatory present for NR access. The field shall be omitted for non-NR user plane support. |

| *CommonIEsRequestAssistanceData* field descriptions |
| --- |
| ***primaryCellID***  This parameter identifies the current primary cell for the target device. |
| ***segmentationInfo***  This field indicates whether this *RequestAssistanceData* message is one of many segments, as specified in clause 4.3.5. |
| ***periodicAssistanceDataReq***  This field indicates a request for periodic assistance data delivery, as specified in clause 5.2.1a. |

#### – *CommonIEsProvideAssistanceData*

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

-- ASN1START

CommonIEsProvideAssistanceData ::= SEQUENCE {

...,

[[

segmentationInfo-r14 SegmentationInfo-r14 OPTIONAL -- Need ON

]],

[[

periodicAssistanceData-r15 PeriodicAssistanceDataControlParameters-r15

OPTIONAL -- Cond PerAD

]]

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *PerAD* | The field is mandatory present in a periodic assistance data delivery session. Otherwise it is not present. |

| *CommonIEsRequestAssistanceData* field descriptions |
| --- |
| ***segmentationInfo***  This field indicates whether this *ProvideAssistanceData* message is one of many segments, as specified in clause 4.3.5. |
| ***periodicAssistanceData***  This field indicates a periodic assistance data delivery, as specified in clauses 5.2.1a and 5.2.2a. |

#### – *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

]],

[[

segmentationInfo-r14 SegmentationInfo-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,

mayReturnAditionalInformation,

...

}

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

]],

[[ horizontalAccuracyExt-r15 HorizontalAccuracyExt-r15 OPTIONAL, -- Need ON

verticalAccuracyExt-r15 VerticalAccuracyExt-r15 OPTIONAL -- Need ON

]]

}

HorizontalAccuracy ::= SEQUENCE {

accuracy INTEGER(0..127),

confidence INTEGER(0..100),

...

}

VerticalAccuracy ::= SEQUENCE {

accuracy INTEGER(0..127),

confidence INTEGER(0..100),

...

}

HorizontalAccuracyExt-r15 ::= SEQUENCE {

accuracyExt-r15 INTEGER(0..255),

confidence-r15 INTEGER(0..100),

...

}

VerticalAccuracyExt-r15 ::= SEQUENCE {

accuracyExt-r15 INTEGER(0..255),

confidence-r15 INTEGER(0..100),

...

}

ResponseTime ::= SEQUENCE {

time INTEGER (1..128),

...,

[[ responseTimeEarlyFix-r12 INTEGER (1..128) OPTIONAL -- Need ON

]],

[[ unit-r15 ENUMERATED { ten-seconds, ... } OPTIONAL -- Need ON

]]

}

ResponseTimeNB-r14 ::= SEQUENCE {

timeNB-r14 INTEGER (1..512),

responseTimeEarlyFixNB-r14 INTEGER (1..512) OPTIONAL, -- Need ON

...,

[[ unitNB-r15 ENUMERATED { ten-seconds, ... } 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. |

| *CommonIEsRequestLocationInformation* field descriptions |
| --- |
| ***locationInformationType***  This IE indicates whether the server requires a location estimate or measurements. For '*locationEstimateRequired*', the target device shall return a location estimate if possible, or indicate a location error if not possible. For '*locationMeasurementsRequired*', the target device shall return measurements if possible, or indicate a location error if not possible. For '*locationEstimatePreferred*', 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 '*locationMeasurementsPreferred*', 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. |
| ***triggeredReporting***  This IE indicates that triggered reporting is requested and comprises the following subfields:  - ***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 *reportingDuration* or until an LPP *Abort* or *LPP Error* message is received.  The *triggeredReporting* field should not be included by the location server and shall be ignored by the target device if the *periodicalReporting* IE or *responseTime* IE or *responseTimeNB* IE is included in *CommonIEsRequestLocationInformation.* |
| ***periodicalReporting***  This IE indicates that periodic reporting is requested and comprises the following subfields:  - ***reportingAmount*** indicates the number of periodic location information reports requested. Enumerated values correspond to 1, 2, 4, 8, 16, 32, 64, or infinite/indefinite number of reports. If the *reportingAmount* is '*infinite/indefinite'*, the target device shou-ld continue periodic reporting until an LPP *Abort* message is received. The value '*ra1*' 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 *reportingInterval* expires before a target device is able to obtain new measurements or obtain a new location estimate. The value '*noPeriodicalReporting*' shall not be used by a sender. |
| ***additionalInformation***  This IE indicates whether a target device is allowed to return additional information to that requested. If this IE indicates '*onlyReturnInformationRequested'* then the target device shall not return any additional information to that requested by the server. If this IE indicates '*mayReturnAdditionalInformation'* 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). |
| ***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 TS 23.032 [15] and '*confidence*' corresponds to confidence as defined in 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 TS 23.032 [15] and '*confidence*' corresponds to confidence as defined in TS 23.032 [15].  - ***responseTime***  - ***time*** indicates the maximum response time as measured between receipt of the *RequestLocationInformation* and transmission of a *ProvideLocationInformation*. If the *unit* field is absent, this is given as an integer number of seconds between 1 and 128. If the *unit* field is present, the maximum response time is given in units of 10-seconds, between 10 and 1280 seconds. 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. If the *unit* field is absent, this is given as an integer number of seconds between 1 and 128. If the *unit* field is present, the maximum response time is given in units of 10-seconds, between 10 and 1280 seconds. 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 shallomit 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.  - ***unit*** indicates the unit of the *time* and *responseTimeEarlyFix* fields. Enumerated value '*ten-seconds*' corresponds to a resolution of 10 seconds. If this field is absent, the unit/resolution is 1 second.  - ***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*. If the *unit* field is absent, this is given as an integer number of seconds between 1 and 512. If the *unit* field is present, the maximum response time is given in units of 10-seconds, between 10 and 5120 seconds.  - ***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. If the *unit* field is absent, this is given as an integer number of seconds between 1 and 512. If the *unit* field is present, the maximum response time is given in units of 10-seconds, between 10 and 5120 seconds. 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.  - ***unitNB*** indicates the unit of the *timeNB* and *responseTimeEarlyFixNB* fields. Enumerated value '*ten-second*' corresponds to a resolution of 10 seconds. If this field is absent, the unit/resolution is 1 second.  - ***horizontalAccuracyExt*** indicates the maximum horizontal error in the location estimate at an indicated confidence level. The '*accuracyExt*' corresponds to the encoded high accuracy uncertainty as defined in TS 23.032 [15] and 'confidence' corresponds to confidence as defined in TS 23.032 [15]. This field should not be included by the location server and shall be ignored by the target device if the *horizontalAccuracy* field is included in QoS.  - ***verticalAccuracyExt*** 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 '*accuracyExt*' corresponds to the encoded high accuracy uncertainty as defined in TS 23.032 [15] and '*confidence*' corresponds to confidence as defined in TS 23.032 [15]. This field should not be included by the location server and shall be ignored by the target device if the *verticalAccuracy* field is included in QoS.  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*.*  A target device supporting HA GNSS shall support the *HorizontalAccuracyExt*, *VerticalAccuracyEx*, and *unit* fields.  A target device supporting NB-IoT access and HA GNSS shall support the *unitNB* field. |
| ***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. |
| ***velocityTypes***  This fields provides a list of the types of velocity estimate that the target device may return when a velocity estimate is obtained by the target. |
| ***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. |
| ***segmentationInfo***  This field indicates whether this *RequestLocationInformation* message is one of many segments, as specified in clause 4.3.5 |

#### – *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

]],

[[

segmentationInfo-r14 SegmentationInfo-r14 OPTIONAL -- Cond Segmentation

]]

}

LocationCoordinates ::= CHOICE {

ellipsoidPoint Ellipsoid-Point,

ellipsoidPointWithUncertaintyCircle Ellipsoid-PointWithUncertaintyCircle,

ellipsoidPointWithUncertaintyEllipse EllipsoidPointWithUncertaintyEllipse,

polygon Polygon,

ellipsoidPointWithAltitude EllipsoidPointWithAltitude,

ellipsoidPointWithAltitudeAndUncertaintyEllipsoid

EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,

ellipsoidArc EllipsoidArc,

...,

highAccuracyEllipsoidPointWithUncertaintyEllipse-v1510

HighAccuracyEllipsoidPointWithUncertaintyEllipse-r15,

highAccuracyEllipsoidPointWithAltitudeAndUncertaintyEllipsoid-v1510

HighAccuracyEllipsoidPointWithAltitudeAndUncertaintyEllipsoid-r15

}

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),

ha-gnss-v1510 (5),

motion-sensor-v15xy (6) } (SIZE(1..16))

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *Segmentation* | This field is optionally present, need OP, if *lpp-message-segmentation-req* has been received from the location server with bit 1 (*targetToServer*) set to value 1. The field shall be omitted if *lpp‑message‑segmentation-req* has not been received in this location session, or has been received with bit 1 (*targetToServer*) set to value 0. |

| *CommonIEsProvideLocationInformation* field descriptions |
| --- |
| ***locationEstimate***  This field provides a location estimate using one of the geographic shapes defined in TS 23.032 [15]. Coding of the values of the various fields internal to each geographic shape follow the rules in TS 23.032 [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 TS 23.032 [15]. Coding of the values of the various fields internal to each velocity shape follow the rules in TS 23.032 [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).  If this field is included, the IE *SegmentationInfo* shall not be included. |
| ***locationSource***  This field provides the source positioning technology for the location estimate.  NOTE 1: In this version of the specification, the entry 'tbs' is used only for TBS positioning based on MBS signals.  NOTE 2: The entry 'sensor' is used only for positioning technology that uses barometric pressure sensor. The entry ‘motion-sensor’ is used for positioning technology that uses sensor(s) to detect displacement and movement, e.g. accelerometers, gyros, magnetometers. |
| ***locationTimestamp***  This field provides the UTC time when the location estimate is valid and should take the form of *YYMMDDhhmmssZ*. |
| ***segmentationInfo***  This field indicates whether this *ProvideLocationInformation* message is one of many segments, as specified in clause 4.3.5 |

#### *– CommonIEsAbort*

The *CommonIEsAbort* carries common IEs for an Abort LPP message Type.

-- ASN1START

CommonIEsAbort ::= SEQUENCE {

abortCause ENUMERATED {

undefined,

stopPeriodicReporting,

targetDeviceAbort,

networkAbort,

...,

stopPeriodicAssistanceDataDelivery-v1510

}

}

-- 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*.  The abort cause '*stopPeriodicAssistanceDataDelivery*' should be used by the location server or target device to stop any ongoing periodic assistance data delivery, as specified in clauses 5.2.1a and 5.2.2a. |

#### – *CommonIEsError*

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

-- ASN1START

CommonIEsError ::= SEQUENCE {

errorCause ENUMERATED {

undefined,

lppMessageHeaderError,

lppMessageBodyError,

epduError,

incorrectDataValue,

...,

lppSegmentationError-v1450

}

}

-- 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. '*lppSegmentationError*' is used if a receiver detects an error in LPP message segmentation. |

## 6.5 Positioning Method IEs

### 6.5.1 OTDOA Positioning

This clause defines the information elements for downlink OTDOA positioning, which includes TBS positioning based on PRS signals (TS 36.305 [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 clause 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 clause 6.5.1.2). "RSTD reference cell" applies only in clause 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 TS 36.211 [16].

Throughout clause 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 clause 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 clause 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 TS 36.133 [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

]],

[[

nr-LTE-SFN-Offset-r15 INTEGER (0..1023) OPTIONAL -- Cond NR

]],

[[

tdd-config-v1520 TDD-Config-v1520 OPTIONAL, -- Need ON

nr-LTE-fineTiming-Offset-r15 INTEGER (0..19) OPTIONAL -- Cond FineOffset

]]

}

maxAddPRSconfig-r14 INTEGER ::= 2

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *NotSameAsServ0* | This field is absent if *earfcnRef-v9a0* 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' current primary cell. |
| *NotSameAsServ1* | 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' current primary cell. |
| *NotSameAsServ2* | The field is absent if *earfcnRef* 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' current primary cell. |
| *PRS* | The field is mandatory present if positioning reference signals are available in the assistance data reference cell (TS 36.211 [16]); otherwise it is not present. |
| *CRS* | The field is optionally present, need ON, if *prsInfo* is present. Otherwise it is not present. |
| *NotSameAsServ3* | 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' current primary cell and if PRS frequency hopping is used in the assistance data reference cell (TS 36.211 [16]); otherwise it is not present. |
| *NR* | The field is optionally present, need ON, if the target device is served by an NR cell; otherwise it is not present. |
| *FineOffset* | The field is optionally present, need ON, if *nr-LTE-SFN-Offset* is present. 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 TS 36.331 [12]. |
| ***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 TS 36.331 [12]. The server should include this field if it considers that it is needed to resolve ambiguity in the cell indicated by *physCellId*. |
| ***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 *prsInfo* 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. |
| ***tpId***  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. |
| ***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 TS 36.211 [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, NRB in downlink, see TS 36.101 [21, table 5.6-1]. Enumerated value 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. |
| ***nr-LTE-SFN-Offset***  This field specifies the SFN offset between the serving NR cell and the LTE 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 NR serving cell to the beginning of the closest subsequent radio frame #0 of the assistance data reference cell. |
| ***tdd-config***  This field specifies the TDD specific physical channel configuration of the assistance data reference cell. The field should be present if the assistance data reference cell is a TDD cell and if the TDD UL/DL configuration of the assistance data reference cell is not the same as the target devices' current primary cell or if the target devices' current primary cell is a FDD cell. |
| ***nr-LTE-fineTiming-Offset***  This field specifies the frame boundary offset between the NR serving cell and the LTE assistance data reference cell in units of 0.5 ms. The offset is counted from the beginning of a subframe #0 of the NR serving cell to the beginning of the closest subsequent subframe #0 of the LTE assistance data reference cell, rounded down to multiples of 0.5 ms. Value 0 corresponds to 0ms, value 1 corresponds to 0.5ms, 2 to 1ms and so on. |

#### – *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-v1420},

...,

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-v1420 BIT STRING (SIZE(32)),

po64-v1420 BIT STRING (SIZE(64)),

po128-v1420 BIT STRING (SIZE(128)),

po256-v1420 BIT STRING (SIZE(256)),

po512-v1420 BIT STRING (SIZE(512)),

po1024-v1420 BIT STRING (SIZE(1024))

} OPTIONAL, -- Need OP

[[ prsID-r14 INTEGER (0..4095) OPTIONAL, -- Need ON

add-numDL-Frames-r14 INTEGER (1..160) OPTIONAL, -- Cond sf-add

prsOccGroupLen-r14 ENUMERATED {g2, g4, g8, g16, g32, g64, g128,... }

OPTIONAL, -- Cond Occ-Grp

prsHoppingInfo-r14 CHOICE {

nb2-r14 INTEGER (0.. maxAvailNarrowBands-Minus1-r14),

nb4-r14 SEQUENCE (SIZE (3))

OF INTEGER (0.. maxAvailNarrowBands-Minus1-r14)

} OPTIONAL -- Cond PRS-FH

]]

}

maxAvailNarrowBands-Minus1-r14 INTEGER ::= 15 -- Maximum number of narrowbands minus 1

-- ASN1STOP

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

| *PRS-Info* field descriptions |
| --- |
| ***prs-Bandwidth***  This field specifies the bandwidth that is used to configure the positioning reference signals on. Enumerated values are specified in number of resource blocks (n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on) and define 1.4, 3, 5, 10, 15 and 20 MHz bandwidth. |
| ***prs-ConfigurationIndex***  This field specfies the positioning reference signals configuration index IPRS as defined in TS 36.211 [16]. |
| ***numDL-Frames***  This field specifies the number of consecutive downlink subframes NPRS with positioning reference signals, as defined in TS 36.211 [16]. Enumerated values define 1, 2, 4, or 6 consecutive downlink subframes. The value *sf-add* indicates that NPRS is provided in the field *add-numDL-Frames.* |
| ***prs-MutingInfo***  This field specifies the PRS muting configuration of the cell. The PRS muting configuration is defined by a periodic PRS muting sequence with periodicity TREP where TREP, counted in the number of PRS occasion groups (TS 36.133 [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 *prsOccGroupLen*. Each PRS occasion comprises NPRS downlink positioning subframes as defined in TS 36.211 [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 *prs-MutingInfo*. If this field is not present the target device may assume that the PRS muting is not in use for the cell.  When the SFN of the assistance data reference cell is not known to the UE and *prs-MutingInfo* is provided for a cell in the *OTDOA-NeighbourCellInfoList* IE, the UE may assume no PRS is transmitted by that cell.  When the UE receives a TREP-bit muting pattern together with a PRS periodicity TPRS for the same cell which exceeds 10240 subframes (i.e., TREP × TPRS > 10240 subframes), the UE shall assume an n-bit muting pattern based on the first n‑bits, where n = 10240/TPRS. |
| ***prsID***  This field specifies the PRS-ID as defined in TS 36.211 [16]. |
| ***add-numDL-Frames***  This field specifies the number of consecutive downlink subframes NPRS with positioning reference signals, as defined in TS 36.211 [16]. Integer values define 1, 2, 3, …, 160 consecutive downlink subframes. |
| ***prsOccGroupLen***  This field specifies the PRS occasion group length, defined as the number of consecutive PRS occasions comprising a PRS occasion group. Each PRS occasion of the PRS occasion group consists of *numDL-Frames* or *add-numDL-Frames* consecutive downlink subframes with positioning reference signals. Enumerated values define 2, 4, 8, 16, 32, 64 or 128 consecutive PRS occasions. If omitted, the PRS occasion group length is 1. The product of the PRS periodicity T\_PRS from the prs-ConfigurationIndex and the PRS occasion group length cannot exceed 1280. |
| ***prsHoppingInfo***  This field specifies the PRS frequency hopping configuration (TS 36.211 [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 as specified in TS 36.211 [16]. If this field is absent, no PRS frequency hopping is used. |

#### – *TDD-Config*

The IE *TDD-Config* is used to specify the TDD specific physical channel configuration.

-- ASN1START

TDD-Config-v1520 ::= SEQUENCE {

subframeAssignment-v1520 ENUMERATED { sa0, sa1, sa2, sa3, sa4, sa5, sa6 },

...

}

-- ASN1STOP

| *TDD-Config* field descriptions |
| --- |
| ***subframeAssignment***  This field specifies the TDD UL/DL subframe configuration where *sa0* points to Configuration 0, *sa1* to Configuration 1 etc. as specified in TS 36.211 [16], table 4.2-2. The target device assumes the same value for all assistance data cells residing on same frequency band. |

#### – *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, ...}

OPTIONAL, -- Cond NotSameAsRef1

prsInfo PRS-Info OPTIONAL, -- Cond NotSameAsRef2

antennaPortConfig ENUMERATED {ports-1-or-2, ports-4, ...}

OPTIONAL, -- Cond NotsameAsRef3

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

]],

[[

tdd-config-v1520 TDD-Config-v1520 OPTIONAL -- Need ON

]]

}

Add-PRSconfigNeighbourElement-r14 ::= SEQUENCE {

add-prsInfo-r14 PRS-Info OPTIONAL, -- Cond NotSameAsRef7

...

}

maxFreqLayers INTEGER ::= 3

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *NotsameAsRef0* | The field is absent if *earfcn-v9a0* is present. If earfcn-v9a0 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. |
| *NotsameAsRef1* | 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. |
| *NotsameAsRef2* | 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. |
| *NotsameAsRef3* | 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. |
| *NotsameAsRef4* | 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. |
| *NotSameAsRef5* | The field is absent if *earfcn* is present. If *earfcn* 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. |
| *InterFreq* | 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. |
| *TBS* | The field is mandatory present if the *OTDOA-NeighbourCellInfoElement* is provided for a PRS-only TP; otherwise it is not present. |
| *CRS* | The field is optionally present, need ON, if *prsInfo* is present. Otherwise it is not present. |
| *NotSameAsRef6* | The field is mandatory present if PRS frequency hopping is used on this neighbour cell (TS 36.211 [16]) and if the downlink bandwidth configuration is not the same as for the assistance data reference cell; otherwise it is not present. |
| *NotSameAsRef7* | The field is mandatory present if any instance of the additional PRS configurations of *addPRSconfigNeighbour* is not the same as the corresponding instance of the additional PRS configuration of the *addPRSconfigRef* for the assistance data reference cell; otherwise it is not present. |

| *OTDOA-NeighbourCellInfoList* field descriptions |
| --- |
| ***physCellId***  This field specifies the physical cell identity of the neighbour cell, as defined in TS 36.331 [12]. |
| ***cellGlobalId***  This field specifies the ECGI, the globally unique identity of a cell in E-UTRA, of the neighbour cell, as defined in TS 36.331 [12]. The server should provide this field if it considers that it is needed to resolve any ambiguity in the cell identified by *physCellId*. |
| ***earfcn***  This field specifies the EARFCN of the neighbour cell. |
| ***cpLength***  This field specifies the cyclic prefix length of the neigbour cell PRS if PRS are present in this neighbour cell, otherwise this field specifies the cyclic prefix length of CRS in this neighbour cell. |
| ***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 (TPRS) as 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 are used. |
| ***slotNumberOffset***  This field specifies the slot number offset at the transmitter between this cell and the assistance data reference cell.  The *slotNumberOffset* 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. |
| ***prs-SubframeOffset***  This field specifies the offset between the first PRS subframe of the first 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 PRS configuration with the longest PRS occasion group periodicity (NOTE 1) 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. |
| ***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×Ts, with Ts=1/(15000\*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´Ts, with Ts=1/(15000\*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* togetherdefine the search window for the target device.  The scale factor of the *expectedRSTD-Uncertainty* field is 3×Ts, with Ts=1/(15000\*2048) seconds.  The target device may assume that the beginning of the PRS occasion group of the PRS configuration with the longest PRS occasion group periodicity (NOTE) of the neighbour cell is received within the search window of size  [* expectedRSTD-Uncertainty*×3×Ts*,* *expectedRSTD-Uncertainty*×3×Ts] centered at  TREF *+* 1 millisecond×N +(*expectedRSTD*8192) ×3×Ts, where TREF is the reception time of the beginning of the first 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 = *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* togetherdefine the search window for the target device. The scale factor of the *expectedRSTD-Uncertainty* field is 3×Ts, with Ts=1/(15000\*2048) seconds.  If Tx 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 [* expectedRSTD-Uncertainty*×3×Ts*,* *expectedRSTD-Uncertainty*×3×Ts] centered at Tx + (*expectedRSTD*8192) ×3×Ts, |
| ***tpId***  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 (TS 36.213 [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. |
| ***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 TS 36.211 [16]). |
| ***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. |
| ***dlBandwidth***  This field specifies the downlink bandwidth configuration of the neighbour cell, NRB in downlink, see TS 36.101 [21, table 5.6-1]. Enumerated value n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on. |
| ***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 *addPRSconfigNeighbour* in the neighbour cell at least partially overlaps with a PRS positioning occasion of the same instance of *addPRSconfigRef* 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 *addPRSconfigNeighbour* of this cell has the same PRS periodicity (TPRS) as the corresponding instance of *addPRSconfigRef* of the assistance data reference cell. |
| ***tdd-config***  This field specifies the TDD specific physical channel configuration of the neighbour cell *earfcn*. The field should be present if this neighbour cell is a TDD cell and if the TDD UL/DL configuration for assistance data cells on this *earfcn* has not been provided in any other instance of *OTDOA-NeighbourCellInfoElement* or in IE *OTDOA-ReferenceCellInfo*, and is not the same as the target device′s current primary cell when this is a TDD cell. NOTE 2. |

NOTE 1: If this cell has more than one PRS configuration with equal longest PRS occasion group periodicity (i.e., PRS occasion group length times TPRS), the first such configuration is referenced. In order to avoid ambiguity for frequency hopping, a PRS occasion group should contain at least 2 PRS occasions with hopping between 2 narrowbands and at least 4 PRS occasions with hopping between 4 narrowbands.

NOTE 2: The target device assumes the same TDD UL/DL configuration for all TDD cells residing on same frequency band specified by *earfcn*. Therefore, the location server should include the field *tdd-config* only once for assistance data cells with the same *earfcn* in IE *OTDOA-ProvideAssistanceData*. The location server does not need to include the field *tdd-config* for any assistance data cell in IE *OTDOA-ProvideAssistanceData* with the same *earfcn* or the same TDD UL/DL configuration as the target devices′ current primary cell if this is a TDD cell.

#### – *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

earfcn-r14 ARFCN-ValueEUTRA-r14 OPTIONAL, -- Cond Inband

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-Type1

...,

[[

nprsInfo-Type2-v1470 PRS-Info-NB-r14 OPTIONAL -- Cond NPRS-Type2

]],

[[ tdd-config-r15 TDD-Config-v1520 OPTIONAL -- Need ON

]]

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *NoPRS-AD1* | This field is mandatory present if the *OTDOA-ReferenceCellInfo* IE is not included in *OTDOA‑ProvideAssistanceData,* or if the *OTDOA-ReferenceCellInfo* IE is included in *OTDOA‑ProvideAssistanceData* and the narrowband physical layer cell identity is not the same as the physical cell identity provided in *OTDOA-ReferenceCellInfo* IE. Otherwise it is not present. |
| *NoPRS-AD2* | This field is optionally present, need ON, if the *OTDOA-ReferenceCellInfo* IE is not included in *OTDOA‑ProvideAssistanceData,* or if the *OTDOA-ReferenceCellInfo* IE is included in *OTDOA‑ProvideAssistanceData* and the global cell identity is not the same as provided in *OTDOA-ReferenceCellInfo* IE. |
| *NotSameAsServ1* | 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' current serving NB-IoT cell. Otherwise it is not present. |
| *Inband* | This field is mandatory present, if the NPRS is configured within the LTE spectrum allocation (inband deployment). Otherwise it is not present. |
| *NoPRS-AD3* | This field is mandatory present if the *OTDOA-ReferenceCellInfo* IE is not included in *OTDOA‑ProvideAssistanceData* and if the NB-IoT assistance data reference cell is deployed within the LTE spectrum allocation (inband deployment)*.* Otherwise it is not present. |
| *NotSameAsServ2* | 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′ current serving NB-IoT cell. Otherwise it is not present. |
| *NPRS-Type1* | The field is mandatory present if Type 1 narrowband positioning reference signals are available in the assistance data reference cell (TS 36.211 [16]); otherwise it is not present. |
| *NPRS-Type2* | The field is mandatory present if Type 2 narrowband positioning reference signals are available in the assistance data reference cell (TS 36.211 [16]); otherwise it is not present. |

| *OTDOA-ReferenceCellInfoNB* field descriptions |
| --- |
| ***physCellIdNB***  This field specifies the narrowband physical layer cell identity of the NB-IoT assistance data reference cell, as defined in TS 36.331 [12]. If this field is absent and if the *OTDOA-ReferenceCellInfo* IE is included in *OTDOA‑ProvideAssistanceData* the narrowband physical layer cell identity is the same as the *physCellId* provided in *OTDOA‑ReferenceCellInfo* IE. |
| ***cellGlobalIdNB***  This field specifies the global cell identity of the NB-IoT assistance data reference cell, as defined in TS 36.331 [12]. If this field is absent and if the *OTDOA-ReferenceCellInfo* IE with *cellGlobalId* is included in *OTDOA‑ProvideAssistanceData,* the global cell identity is the same as provided in *OTDOA‑ReferenceCellInfo* IE*.* |
| ***carrierFreqRef***  This field specifies the carrier frequency of the NB-IoT assistance data reference cell. |
| ***earfcn***  This field specifies the EARFCN of the E-UTRAN frequency, in which the NB-IoT cell is deployed. |
| ***eutra-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 *OTDOA-ReferenceCellInfo* IE is included in *OTDOA‑ProvideAssistanceData*, the number of CRS antenna ports is the same as provided in *OTDOA‑ReferenceCellInfo* IE. |
| ***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 repetions, r8 to 8 repetitions, and r16 to 16 repetions.  Note, when NPRS configuration Part B only is configured on the NB-IoT assistance data reference cell (i.e., anchor carrier), *nprs-NumSF* does also count/include subframes containing NPSS, NSSS, NPBCH, or SIB1-NB, but the UE can assume that no NPRS are transmitted in these subframes (TS 36.211 [16]). |
| ***nprsInfo***  This field specifies the Type 1 NPRS (TS 36.211 [16]) configuration of the NB-IoT assistance data reference cell.  When the target device receives this field with *operationModeInfoNPRS* set to value ′*standalone*′, the target device shall assume no NPRS are transmitted on that NB-IoT carrier. |
| ***nprsInfo-Type2***  This field specifies the Type 2 NPRS (TS 36.211 [16]) configuration of the NB-IoT assistance data reference cell. |
| ***tdd-config***  Indicates the TDD specific physical channel configuration of the NB-IoT assistance data reference cell operating in TDD mode. This field should be present if the DL/UL subframe configuration of the NB-IoT assistance data reference cell is not the same as the DL/UL subframe configuration of the current serving NB-IoT cell of the target device, or if the current serving NB-IoT cell of the target device operates in FDD mode. |

#### – *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 TS 36.211 [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 OPTIONAL, -- Cond Standalone/Guardband

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)),

...

} OPTIONAL, -- Cond MutingA

...

} OPTIONAL, -- Cond PartA

partB-r14 SEQUENCE {

nprs-Period-r14 ENUMERATED { ms160, ms320, ms640, ms1280, ... , ms2560-v1510},

nprs-startSF-r14 ENUMERATED { zero, one-eighth, two-eighths, three-eighths,

four-eighths, five-eighths, six-eighths,

seven-eighths, ...},

nprs-NumSF-r14 ENUMERATED { sf10, sf20, sf40, sf80, sf160, sf320,

sf640, sf1280, ... , sf2560-v1510},

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)),

...

} OPTIONAL, -- Cond MutingB

...,

[[ sib1-SF-TDD-r15 ENUMERATED {sf0, sf4, sf0and5} OPTIONAL -- Cond SIB1-TDD

]]

} OPTIONAL, -- Cond PartB

...,

[[

partA-TDD-r15 SEQUENCE {

nprsBitmap-r15 CHOICE {

subframePattern10-TDD-r15 BIT STRING (SIZE (8)),

subframePattern40-TDD-r15 BIT STRING (SIZE (32)),

...

},

nprs-MutingInfoA-r15 CHOICE {

po2-r15 BIT STRING (SIZE(2)),

po4-r15 BIT STRING (SIZE(4)),

po8-r15 BIT STRING (SIZE(8)),

po16-r15 BIT STRING (SIZE(16)),

...

} OPTIONAL, -- Cond MutingA

...

} OPTIONAL -- Cond PartA-TDD

]]

}

maxCarrier-r14 INTEGER ::= 5

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *Standalone/Guardband* | This field is mandatory present, if the NPRS is configured in standalone or guardband operation mode. Otherwise it is not present. |
| *Inband* | 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. |
| *NPRS-ID* | The field is mandatory present, if the NPRS is generated based on the NPRS-ID (TS 36.211 [16]), different from the PCI. Otherwise the field is not present. |
| *MutingA* | The field is mandatory present, if muting is used for the NPRS Part A or Part A TDD configuration. Otherwise the field is not present. |
| *PartA* | 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. This field is not applicable for NB-IoT operating in TDD mode. |
| *MutingB* | The field is mandatory present, if muting is used for the NPRS Part B configuration. Otherwise the field is not present. |
| *PartB* | 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. |
| *PartA-TDD* | The field is mandatory present, if NPRS is configured for NB-IoT operating in TDD mode and if NPRS is configured based on a bitmap of subframes which are not NB-IoT DL subframes (i.e., invalid DL subframes) (Part A TDD configuration). Otherwise the field is not present. |
| *SIB1-TDD* | The field is mandatory present, if NPRS is configured for NB-IoT operating in TDD mode and if SIB1-NB is transmitted on this carrier frequency. Otherwise the field is not present. |

| *PRS-Info-NB* field descriptions |
| --- |
| ***operationModeInfoNPRS***  This field specifies the operation mode of the NPRS carrier. The value ′standalone′ indicates standalone or guardband operation mode. |
| ***nprs-carrier***  This field specifies the NB-IoT carrier frequency for the NPRS. |
| ***nprsSequenceInfo***  This field specifies the index of the PRB containing the NPRS as defined in the table *nprsSequenceInfo* to E‑UTRA PRB index relation below. |
| ***nprsID***  This field specifies the NPRS-ID as defined in TS 36.211 [16]. |
| ***sib1-SF-TDD***  This field indicates the subframe(s) used to transmit SIB1-NB. Values *sf0* and *sf4* correspond with subframe #0 and #4 respectively. Value *sf0and5* corresponds with subframes #0 and #5. |
| ***subframePattern10, subframePattern40***  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 SFN mod x = 0, where x is the size of the bit string divided by 10. |
| ***nprs-MutingInfoA***  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 TREP where TREP, 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 SFN=0. The sequence is valid for all subframes after the target device has received the *nprs-MutingInfoA*.  When the SFN of the NB-IoT assistance data reference cell is not known to the target device and *nprs-MutingInfoA* is provided for a cell in the *OTDOA-NeighbourCellInfoListNB* IE, the target device may assume no NPRS is transmitted by that cell. |
| ***nprs-Period***  This field specifies the NPRS occasion period *TNPRS*(TS 36.211 [16]). Enumerated values correspond to 160ms, 320ms, 640ms, 1280ms, and 2560ms. The value *ms2560* is only applicable to TDD mode. |
| ***nprs-startSF***  This field specifies the subframe offset (TS 36.211[16]). Enumerated values correspond to  of 0, 1/8, 2/8, 3/8, 4/8, 5/8, 6/8, or 7/8. |
| ***nprs-NumSF***  This field specifies the number of consecutive downlink subframes NNPRS in one NPRS positioning occasion (TS 36.211 [16]). Enumerated values correspond to 10, 20, 40, 80, 160, 320, 640, 1280, and 2560 subframes. The values *sf10* and *sf20* are only applicable to FDD mode. The value *sf2560* is only applicable to TDD mode.  When the target device receives a *nprs-NumSF* which exceeds the *nprs-Period* (i.e., *NNPRS* > *TNPRS*), the target device may assume no NPRS is transmitted by that cell. |
| ***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 TREP where TREP, 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 NNPRS consecutive downlink positioning subframes, where NNPRS 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 TREP-bit muting pattern together with a NPRS periodicity TNPRS for the same carrier which exceeds 10240 subframes (i.e., TREP × TNPRS > 10240 subframes), the target device shall assume an n-bit muting pattern based on the first n bits, where n = 10240/TNPRS. |
| ***subframePattern10-TDD, subframePattern40-TDD***  This field specifies the NPRS subframe Part A configuration for TDD over 10ms or 40ms. The UE shall assume that subframe number 1 and 2 are not used for NPRS. The MSB of the NPRS bitmap corresponds to subframe 0, the second MSB corresponds to subframe 3, the third MSB corresponds to subframe 4 and so on, as also shown in Figure NPRS bitmap to subframe number mapping below. |

*nprsSequenceInfo* to E‑UTRA PRB index relation

|  |  |  |  |
| --- | --- | --- | --- |
| *nprsSequenceInfo* | E-UTRA PRB index for odd number of [16] | *nprsSequenceInfo* | E-UTRA PRB index for even number of [16] |
| 0 - 74 | -37, -36, …, 37 | 75 – 174 | -50, -49, …, 49 |

NOTE: Based on the above relation, in inband deployment, the carrier frequency of the NPRS carrier (*f*NB-IoT) can be calculated as follows:

where *f*EUTRA isderived from *earfcn* according to TS 36.101 [21, 5.7.3].



Figure 6.5.1.2-1: NPRS bitmap to subframe number mapping

#### – *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

earfcn-r14 ARFCN-ValueEUTRA-r14 OPTIONAL, -- Cond Inband

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

...,

[[

nprsInfo-Type2-v1470 PRS-Info-NB-r14 OPTIONAL -- Cond NotSameAsRef4

]],

[[ tdd-config-r15 TDD-Config-v1520 OPTIONAL -- Need ON

]]

}

maxCells-r14 INTEGER ::= 72

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *NoPRS-AD1* | This field is mandatory present if the *OTDOA-NeighbourCellInfoList* IE is not included in *OTDOA‑ProvideAssistanceData,* or if the *OTDOA-NeighbourCellInfoList* IE is included in *OTDOA‑ProvideAssistanceData* 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 *prsNeighbourCellIndex*) in *OTDOA‑NeighbourCellInfoList* IE. |
| *NoPRS-AD2* | This field is optionally present, need ON, if the *OTDOA-NeighbourCellInfoList* IE is not included in *OTDOA‑ProvideAssistanceData,* or if the *OTDOA-NeighbourCellInfoList* IE is included in *OTDOA‑ProvideAssistanceData* and the global cell identity of this cell is not the same as for the corresponding cell (as indicated by *prsNeighbourCellIndex*) in *OTDOA‑NeighbourCellInfoList* IE. |
| *Inband* | This field is mandatory present, if the NPRS is configured within the LTE spectrum allocation (inband deployment). Otherwise it is not present. |
| *NotSameAsRef1* | 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. |
| *NotSameAsRef2* | 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. |
| *NotSameAsRef3* | 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. |
| *NotSameAsRef4* | 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. |
| *NotSameAsRef5* | 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. |
| *NotSameAsRef6* | 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. |
| *NoPRS-AD3* | This field is mandatory present if the *OTDOA-NeighbourCellInfoList* IE is not included in *OTDOA‑ProvideAssistanceData,* or if the *OTDOA-NeighbourCellInfoList* IE is included in *OTDOA‑ProvideAssistanceData* and *prsNeighbourCellIndex* is absent for this cell. |
| *PRS-AD* | This field is optionally present, need OP, if the *OTDOA-NeighbourCellInfoList* IE is included in *OTDOA‑ProvideAssistanceData*; otherwise it is not present. |

| *OTDOA-NeighbourCellInfoListNB* field descriptions |
| --- |
| ***physCellIdNB***  This field specifies the narrowband physical cell identity of the NB-IoT neighbour cell, as defined in TS 36.331 [12]. If this field is absent and if the *OTDOA-NeighbourCellInfoList* IE is included in *OTDOA‑ProvideAssistanceData* the narrowband physical layer cell identity is the same as the *physCellId* provided for the corresponding cell (as indicated by *prsNeighbourCellIndex*) in *OTDOA‑NeighbourCellInfoList* IE. |
| ***cellGlobalIdNB***  This field specifies the global cell ID of the NB-IoT neighbour cell, as defined in TS 36.331 [12]. If this field is absent and if the *OTDOA‑NeighbourCellInfoList* IE with *cellGlobalId* is included in *OTDOA‑ProvideAssistanceData,* the global cell identity of the NB-IoT neighbour cell is the same as provided for the corresponding cell (as indicated by *prsNeighbourCellIndex*) in *OTDOA‑NeighbourCellInfoList* IE*.* |
| ***carrierFreq***  This field specifies the carrier frequency of the NB-IoT neighbour cell. |
| ***earfcn***  This field specifies the EARFCN of the E-UTRAN frequency, in which the NB-IoT cell is deployed. |
| ***eutra-NumCRS-Ports***  This field specifies whether 1 (or 2) antenna port(s) or 4 antenna ports for cell specific reference signals are used. |
| ***otdoa-SIB1-NB-repetitions***  This field specifies the repetition number of SIB1-NB of the neighbour cell. Enumerated values r4 correspond to 4 repetions, r8 to 8 repetitions, and r16 to 16 repetions.  Note, when NPRS configuration Part B only is configured on this NB-IoT neighbour cell (i.e., anchor carrier), *nprs-NumSF* does also count/include subframes containing NPSS, NSSS, NPBCH, or SIB1-NB, but the UE can assume that no NPRS are transmitted in these subframes (TS 36.211 [16]). |
| ***nprsInfo***  This field specifies the Type 1 NPRS (TS 36.211 [16]) 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 (TNPRS) as the assistance data reference cell for each NPRS carrier frequency.  When the target device receives this field with *operationModeInfoNPRS* set to value ′*standalone*′, the target device shall assume no NPRS are transmitted on that NB-IoT carrier. |
| ***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. |
| ***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.  The UE may use this field together with the *nprs-slotNumberOffset* and *otdoa-SIB1-NB-repetitions* to determine the SIB1-NB subframes of this neighbour cell. |
| ***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. |
| ***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 *expectedRSTD* 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 (*expectedRSTD*-8192). The resolution is 3×Ts, with Ts=1/(15000\*2048) seconds.  If this field is absent and if the *OTDOA-NeighbourCellInfoList* IE is included in *OTDOA‑ProvideAssistanceData*, the expected RSTD is the same as provided in *OTDOA-NeighbourCellInfoList* IE for the corresponding cell (as indicated by *prsNeighbourCellIndex*). |
| ***expectedRSTD-Uncertainty***  This field indicates the uncertainty in *expectedRSTD*value***.*** The uncertainty is related to the location server′s a‑priori estimation of the target device location. The *expectedRSTD* and *expectedRSTD-Uncertainty* togetherdefine the search window for the target device.  The scale factor of the *expectedRSTD-Uncertainty* field is 3×Ts, with Ts=1/(15000\*2048) seconds.  If this field is absent and if the *OTDOA-NeighbourCellInfoList* IE is included in *OTDOA‑ProvideAssistanceData*, the expected RSTD uncertainty is the same as provided in *OTDOA-NeighbourCellInfoList* IE for the corresponding cell (as indicated by *prsNeighbourCellIndex*).  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 [*expectedRSTD-Uncertainty*×3×Ts*,* *expectedRSTD-Uncertainty*×3×Ts] centered at  TREF *+* 1 millisecond×N +(*expectedRSTD*8192) ×3×Ts, where TREF 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 = *nprs‑SubframeOffset*. |
| ***prsNeighbourCellIndex***  This field contains an index of the entry in IE *OTDOA-NeighbourCellInfoList*. Value 1 corresponds to the first cell in *OTDOA-NeighbourCellInfoList,* value 2 to the second, and so on. If this field is absent, and if the *OTDOA‑NeighbourCellInfoList* IE is included in *OTDOA‑ProvideAssistanceData,* it means there is no corresponding cell in *OTDOA-NeighbourCellInfoList* IE for this cell.  The target device may assume the antenna ports of the PRS of the cell indicated by *prsNeighbourCellIndex*and the NPRS of this cell are quasi co-located, as defined in TS 36.211 [16]. |
| ***nprsInfo-Type2***  This field specifies the Type 2 NPRS (TS 36.211 [16]) configuration of the NB-IoT neighbour cell. |
| ***tdd-config***  Indicates the TDD specific physical channel configuration of the NB-IoT assistance data neighbour cell operating in TDD mode. This field should be present if the DL/UL subframe configuration of the NB-IoT assistance data neighbour cell is not the same as for the NB-IoT assistance data reference cell, or if the current serving NB-IoT cell of the target device operates in FDD mode. |

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

]],

[[

nrPhysCellId-r15 INTEGER (0..1007) OPTIONAL

]]

}

-- ASN1STOP

| *OTDOA-RequestAssistanceData* field descriptions |
| --- |
| ***physCellId***  This field specifies the E-UTRA 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. |
| ***nrPhysCellId***  This field specifies the NR physical cell identity of the current primary cell of the target device. If this field is present, the target device sets the *physCellId* to an arbitrary value which shall be ignored by the location server. |

#### 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,

...,

[[

otdoaSignalMeasurementInformation-NB-r14 OTDOA-SignalMeasurementInformation-NB-r14

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 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

]],

[[

motionTimeSource-r15 MotionTimeSource-r15 OPTIONAL

]]

}

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

]],

[[

delta-SFN-r15 INTEGER (-8192..8191) OPTIONAL

]]

}

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

maxPaths-r14 INTEGER ::= 2

MotionTimeSource-r15 ::= SEQUENCE {

timeSource-r15 ENUMERATED {servingCell, referenceCell, gnss, mixed,

other, none, ...}

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *NotSameAsRef0* | The field is absent if the corresponding *earfcnRef-v9a0* 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. |
| *NotSameAsRef1* | The field is absent if the corresponding *earfcnRef* 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. |
| *NotSameAsRef2* | The field is absent if the corresponding *earfcnNeighbour-v9a0* is present. Otherwise, the target device shall include this field if the EARFCN of this neighbour cell is not the same as the *earfcnRef*for the RSTD reference cell. |
| *NotSameAsRef3* | The field is absent if the corresponding *earfcnNeighbour* is present. Otherwise, the target device shall include this field if the EARFCN of this neighbour cell is not the same as the *earfcnRef*for the RSTD reference cell. |
| *ProvidedByServer0* | The target device shall include this field if a *tpId* for this transmission point is included in the *OTDOA-ProvideAssistanceData.* Otherwise the field is absent. |
| *ProvidedByServer1* | The target device shall include this field if a *prsID* for this transmission point is included in the *OTDOA-ProvideAssistanceData.* Otherwise the field is absent. |
| *ProvidedByServer2* | The target device shall include this field if an *nprsID* for this cell is included in the *OTDOA-ProvideAssistanceData* and if this cell is a NB-IoT only cell (without associated LTE PRS cell)*.* Otherwise the field is absent. |
| *NB-IoT* | 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. |
| *H-SFN* | 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 |
| --- |
| ***systemFrameNumber***  If the *deltaSFN* and *motionTimeSource* fields are not present, this field specifies the SFN of the RSTD reference cell containing the starting subframe of the PRS or NPRS positioning occasion 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.  In case of more than a single PRS configuration on the RSTD reference cell, the first PRS configuration is referenced.  If the *deltaSFN* and *motionTimeSource* fields are present, this field specifies the SFN of the RSTD reference cell when the TOA measurement for the RSTD reference cell has been made. |
| ***physCellIdRef***  This field specifies the physical cell identity of the RSTD reference cell. |
| ***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. |
| ***earfcnRef***  This field specifies the EARFCN of the RSTD reference cell. |
| ***referenceQuality***  This field specifies the target device′s best estimate of the quality of the TOA measurement from the RSTD reference cell, TSubframeRxRef, where TSubframeRxRef is the time of arrival of the signal from the RSTD reference cell.  When *deltaSFN* and *motionTimeSource* are both included, the target device shall not include measurement errors caused by motion of the target device in *referenceQuality* (e.g. the target device may assume the target device was stationary during OTDOA measurements). |
| ***neighbourMeasurementList***  This list contains the measured RSTD values for neighbour cells together with the RSTD reference cell, along with quality for each measurement. |
| ***tpIdRef***  This field specifies the transmission point ID of the RSTD reference cell. |
| ***prsIdRef***  This field specifies the PRS-ID of the first PRS configuration of the RSTD reference cell. |
| ***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 *rstd* value. If this field was requested but is not included, it means the UE did not detect any additional path timing values. |
| ***nprsIdRef***  This field specifies the NPRS-ID of the RSTD reference cell. |
| ***carrierFreqOffsetNB-Ref***  This field specifies the offset of the NB-IoT channel number to EARFCN given by *earfcnRef* as defined in TS 36.101 [21]. |
| ***hyperSFN***  This field specifies the hyper SFN as defined in TS 36.331 [12] of the RSTD reference cell for the *systemFrameNumber*. |
| ***motionTimeSource***  This field provides reference information concerning the movement of the target device and comprises the following subfields:  - ***timeSource*** specifies the external time source to which UE time was locked during the OTDOA measurements. Enumerated value "mixed" indicates that UE time was locked to more than one external time source during OTDOA measurements (e.g. is applicable to a change in serving cell when the serving cell was used as a time source). The value "other" indicates some other external time source. The value "none" indicates that UE time was not locked to an external time source.  If this field is present, the target device shall also provide the IE *Sensor-MotionInformation* in IE *Sensor‑ProvideLocationInformation*. |
| ***physCellIdNeighbour***  This field specifies the physical cell identity of the neighbour cell for which the RSTDs are provided. |
| ***cellGlobalIdNeighbour***  This field specifies the ECGI, the globally unique identity of a cell in E-UTRA, of the neighbour cell for which the RSTDs are provided. The target device shall provide this IE if it was able to determine the ECGI of the neighbour cell at the time of measurement. |
| ***earfcnNeighbour***  This field specifies the 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 TS 36.214 [17]. Mapping of the measured quantity is defined as in TS 36.133 [18] clause 9.1.10.3. |
| ***rstd-Quality***  This field specifies the target device′s best estimate of the quality of the measured *rstd*.  When *deltaSFN* and *motionTimeSource* both included, the target device shall not include measurement errors caused by motion of the target device in *rstd-Quality* (e.g. the target device may assume the target device was stationary during OTDOA measurements). |
| ***tpIdNeighbour***  This field specifies the transmission point ID for the neighbour cell for which the RSTDs are provided. |
| ***prsIdNeighbour***  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 RSTD as defined in TS 36.133 [18] clause 9.1.10.4. Mapping of the measured quantity is defined as in TS 36.133 [18] clause 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 *rstd* value. If this field was requested but is not included, it means the UE did not detect any additional path timing values. |
| ***nprsIdNeighbour***  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 *earfcnNeighbour* as defined in TS 36.101 [21]. |
| ***delta-SFN***  This field provides information concerning the movement of the target device:  Together with *systemFrameNumber* specifies the *measurementSFN* of the RSTD reference cell when the TOA measurement for this neighbour cell has been made for determining the *rstd*. The *measurementSFN* is given by *systemFrameNumber* + *delta-SFN*. (The actual SFN is the *measurementSFN* modulo 1024.). The *measurementSFN* is used in IE *Sensor-MotionInformation* to provide movement information corresponding to the TOA measurement time.  If this field is present, the target device shall also provide the IE *Sensor-MotionInformation* in IE *Sensor‑ProvideLocationInformation*. |

#### – *OTDOA-SignalMeasurementInformation-NB*

The IE *OTDOA-SignalMeasurementInformation-NB* 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-NB* to be sent, the target device may send them in multiple *ProvideLocationInformation* messages, as described under 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-NB-r14 ::= SEQUENCE {

systemFrameNumber-r14 BIT STRING (SIZE (10)),

physCellIdRef-r14 INTEGER (0..503),

cellGlobalIdRef-r14 ECGI OPTIONAL,

earfcnRef-r14 ARFCN-ValueEUTRA-r14 OPTIONAL, -- Cond NotSameAsRef0

referenceQuality-r14 OTDOA-MeasQuality OPTIONAL,

neighbourMeasurementList-r14 NeighbourMeasurementList-NB-r14,

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-NB-r14 ::= SEQUENCE (SIZE(1..24)) OF NeighbourMeasurementElement-NB-r14

NeighbourMeasurementElement-NB-r14 ::= SEQUENCE {

physCellIdNeighbour-r14 INTEGER (0..503),

cellGlobalIdNeighbour-r14 ECGI OPTIONAL,

earfcnNeighbour-r14 ARFCN-ValueEUTRA-r14 OPTIONAL, -- Cond NotSameAsRef2

rstd-r14 INTEGER (0..12711),

rstd-Quality-r14 OTDOA-MeasQuality,

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

...

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *NotSameAsRef0* | 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. |
| *NotSameAsRef2* | The target device shall include this field if the EARFCN of this neighbour cell is not the same as the *earfcnRef*for the RSTD reference cell. |
| *ProvidedByServer0* | The target device shall include this field if a *tpId* for this transmission point is included in the *OTDOA-ProvideAssistanceData.* Otherwise the field is absent. |
| *ProvidedByServer1* | The target device shall include this field if a *prsID* for this transmission point is included in the *OTDOA-ProvideAssistanceData.* Otherwise the field is absent. |
| *ProvidedByServer2* | The target device shall include this field if an *nprsID* for this cell is included in the *OTDOA-ProvideAssistanceData* and if this cell is a NB-IoT only cell (without associated LTE PRS cell)*.* Otherwise the field is absent. |
| *NB-IoT* | 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. |
| *H-SFN* | The target device shall include this field if it was able to determine a hyper SFN of the RSTD reference cell. |

| *OTDOA-SignalMeasurementInformation-NB* field descriptions |
| --- |
| ***systemFrameNumber***  This field specifies the SFN of the RSTD reference cell containing the starting subframe of the PRS or NPRS positioning occasion 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.  In case of more than a single PRS configuration on the RSTD reference cell, the first PRS configuration is referenced. |
| ***physCellIdRef***  This field specifies the physical cell identity of the RSTD reference cell. |
| ***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. |
| ***earfcnRef***  This field specifies the EARFCN of the RSTD reference cell. |
| ***referenceQuality***  This field specifies the target device′s best estimate of the quality of the TOA measurement from the RSTD reference cell, TSubframeRxRef, where TSubframeRxRef is the time of arrival of the signal from the RSTD reference cell. |
| ***neighbourMeasurementList***  This list contains the measured RSTD values for neighbour cells together with the RSTD reference cell, along with quality for each measurement. |
| ***tpIdRef***  This field specifies the transmission point ID of the RSTD reference cell. |
| ***prsIdRef***  This field specifies the PRS-ID of the first PRS configuration of the RSTD reference cell. |
| ***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 *rstd* value. If this field was requested but is not included, it means the UE did not detect any additional path timing values. |
| ***nprsIdRef***  This field specifies the NPRS-ID of the RSTD reference cell. |
| ***carrierFreqOffsetNB-Ref***  This field specifies the offset of the NB-IoT channel number to EARFCN given by *earfcnRef* as defined in TS 36.101 [21]. |
| ***hyperSFN***  This field specifies the hyper SFN as defined in TS 36.331 [12] of the RSTD reference cell for the *systemFrameNumber*. |
| ***physCellIdNeighbour***  This field specifies the physical cell identity of the neighbour cell for which the RSTDs are provided. |
| ***cellGlobalIdNeighbour***  This field specifies the ECGI, the globally unique identity of a cell in E-UTRA, of the neighbour cell for which the RSTDs are provided. The target device shall provide this IE if it was able to determine the ECGI of the neighbour cell at the time of measurement. |
| ***earfcnNeighbour***  This field specifies the 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 TS 36.214 [17]. Mapping of the measured quantity is defined as in TS 36.133 [18] clause 9.1.10.3. |
| ***rstd-Quality***  This field specifies the target device′s best estimate of the quality of the measured *rstd*. |
| ***tpIdNeighbour***  This field specifies the transmission point ID for the neighbour cell for which the RSTDs are provided. |
| ***prsIdNeighbour***  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 RSTD as defined in TS 36.133 [18] clause 9.1.10.4. Mapping of the measured quantity is defined as in TS 36.133 [18] clause 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 *rstd* value. If this field was requested but is not included, it means the UE did not detect any additional path timing values. |
| ***nprsIdNeighbour***  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 *earfcnNeighbour* 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 *error-Value* field. The encoding on two bits is as follows:  ′00′ 5 meters  ′01′ 10 meters  ′10′ 20 meters  ′11′ 30 meters. |
| ***error-Value***  This field specifies the target device′s best estimate of the uncertainty of the OTDOA (or TOA) measurement.  The encoding on five bits is as follows:  ′00000′ 0 to (R\*1-1) meters  ′00001′ R\*1 to (R\*2-1) meters  ′00010′ R\*2 to (R\*3-1) meters  …  ′11111′ R\*31 meters or more;  where R is the resolution defined by *error-Resolution*field.  E.g., R=20 m corresponds to 0-19 m, 20-39 m,…,620+ m. |
| ***error-NumSamples***  If the *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 (TS 36.214 [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 Ts=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

]],

[[

motionMeasurements-r15 ENUMERATED { requested } OPTIONAL -- Need ON

]]

}

-- ASN1STOP

| *OTDOA-RequestLocationInformation* field descriptions |
| --- |
| ***assistanceAvailability***  This field indicates whether the target device may request additional OTDOA assistance data from the server. TRUE means allowed and FALSE means not allowed. |
| ***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. |
| ***maxNoOfRSTDmeas***  This field, if present, indicates the maximum number of *NeighbourMeasurementElement* fields (i.e., RSTD measurements) the target device can provide in *OTDOA-SignalMeasurementInformation*. |
| ***motionMeasurements***  This field, if present, indicates that the target device is requested to report the motion measurements (*deltaSFN* and *motionTimeSource*) in *OTDOA‑SignalMeasurementInformation* as well as the IE *Sensor-MotionInformation* in IE *Sensor‑ProvideLocationInformation*. |

#### 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),

ue-assisted-NB-TDD-r15 (2) } (SIZE (1..8)),

...,

supportedBandListEUTRA SEQUENCE (SIZE (1..maxBands)) OF SupportedBandEUTRA OPTIONAL,

supportedBandListEUTRA-v9a0 SEQUENCE (SIZE (1..maxBands)) OF SupportedBandEUTRA-v9a0

OPTIONAL,

interFreqRSTDmeasurement-r10 ENUMERATED { supported } OPTIONAL,

additionalNeighbourCellInfoList-r10 ENUMERATED { supported } OPTIONAL,

prs-id-r14 ENUMERATED { supported } OPTIONAL,

tp-separation-via-muting-r14 ENUMERATED { supported } OPTIONAL,

additional-prs-config-r14 ENUMERATED { supported } OPTIONAL,

prs-based-tbs-r14 ENUMERATED { supported } OPTIONAL,

additionalPathsReport-r14 ENUMERATED { supported } OPTIONAL,

densePrsConfig-r14 ENUMERATED { supported } OPTIONAL,

maxSupportedPrsBandwidth-r14 ENUMERATED { n6, n15, n25, n50, n75, n100, ...} OPTIONAL,

prsOccGroup-r14 ENUMERATED { supported } OPTIONAL,

prsFrequencyHopping-r14 ENUMERATED { supported } OPTIONAL,

maxSupportedPrsConfigs-r14 ENUMERATED { c2, c3 } OPTIONAL,

periodicalReporting-r14 ENUMERATED { supported } OPTIONAL,

multiPrbNprs-r14 ENUMERATED { supported } OPTIONAL,

idleStateForMeasurements-r14 ENUMERATED { required } OPTIONAL,

numberOfRXantennas-r14 ENUMERATED { rx1, ... } OPTIONAL,

motionMeasurements-r15 ENUMERATED { supported } OPTIONAL,

interRAT-RSTDmeasurement-r15 ENUMERATED { supported } OPTIONAL

}

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 |
| --- |
| ***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.  ue-assisted-NB-TDD: Bit 2 indicates that the target device supports UE-assisted OTDOA and NB-IoT NPRS for TDD. |
| ***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 *bandEUTRA-v9a0*, the target device shall set the corresponding entry of *bandEUTRA* (i.e. without suffix) to *maxFBI*. |
| ***interFreqRSTDmeasurement***  This field, if present, indicates that the target device supports inter-frequency RSTD measurements within and between the frequency bands indicated in *SupportedBandEUTRA*. |
| ***additionalNeighbourCellInfoList***  This field, if present, indicates that the target device supports up to 3×24 *OTDOA-NeighbourCellInfoElement* in *OTDOA‑NeighbourCellInfoList* in *OTDOA-ProvideAssistanceData* without any restriction for the *earfcn* in each *OTDOA-NeighbourCellInfoElement* as specified in clause 6.5.1.2. |
| ***prs-id***  This field, if present, indicates that the target device supports PRS generation based on the PRS-ID as specified in TS 36.211 [16] and support for TP-ID in *OTDOA-ReferenceCellInfo* and *OTDOA-NeighbourCellInfoList*. |
| ***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 *OTDOA-ReferenceCellInfo* and *OTDOA‑NeighbourCellInfoList*. |
| ***additional-prs-config***  This field, if present, indicates that the target device supports additional PRS configurations. The additional PRS configuration in *PRS-Info* IE comprise:  - support for *prs-ConfigurationIndex* > 2399; - support for NPRS values in addition to 1, 2, 4 and 6 (*add-numDL-Frames in PRS-Info);*  - support for muting bit string lengths > 16 bits. |
| ***prs-based-tbs***  This field, if present, indicates that the target device supports RSTD measurements for PRS-only TPs. |
| ***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. |
| ***densePrsConfig***  This field, if present, indicates that the target device supports a subset of the additional PRS configurations associated with capability *additional-prs-config* which comprises:  - support for *prs-ConfigurationIndex* > 2404;  - support for NPRS values of 10, 20, 40, 80 and 160 (in addition to 1, 2, 4 and 6).  In case *additional-prs-config* is present, this field is not present. |
| ***maxSupportedPrsBandwidth***  This field, if present, indicates the maximum PRS bandwidth supported by the target device. Enumerated value n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on. If this field is 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. |
| ***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. |
| ***prsFrequencyHopping***  This field, if present, indicates that the target device supports PRS occasion frequency hopping, as specified in TS 36.211 [16]. |
| ***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. |
| ***periodicalReporting***  This field, if present, indicates that the target device supports *periodicalReporting* of RSTD measurements*.* If this field is absent, the location server may assume that the target device does not support *periodicalReporting* in *CommonIEsRequestLocationInformation*. |
| ***multiPrbNprs***  This field, if present, indicates that the target device supports NPRS configuration in more than one resource block (i.e., *maxCarrier* in *PRS-Info-NB* greater 1). |
| ***idleStateForMeasurements***  This field, if present, indicates that the target device requires idle state to perform RSTD measurements. |
| ***numberOfRXantennas***  This field is not applicable to NB-IoT devices.  This field, if present, indicates the number of UE downlink receive antennas for RSTD measurements (see TS 36.133 [18]). Enumerated value rx1 indicates a single antenna receiver. If this field is absent, the target device is assumed to support two RX antennas for RSTD measurements. |
| ***motionMeasurements***  This field, if present, indicates that the target device supports reporting of motion measurements (*deltaSFN* and *motionTimeSource*) in *OTDOA‑SignalMeasurementInformation*. The presence of this field implies presence of *sensor-MotionInformationSup* in IE *Sensor‑ProvideCapabilities*. |
| ***interRAT-RSTDmeasurement***  This field, if present, indicates that the target device supports inter-RAT RSTD measurements (TS 38.215 [36]); i.e., E-UTRA RSTD measurements when the target device is served by an NR cell. |

#### 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

### 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

...,

[[

gnss-PeriodicAssistData-r15 GNSS-PeriodicAssistData-r15 OPTIONAL -- Cond CtrTrans

]]

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *CtrTrans* | The field is mandatory present in the control transaction of a periodic assistance data delivery session as described in clauses 5.2.1a and 5.2.2a. Otherwise it is not present. |

#### – *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

...,

[[

gnss-RTK-ReferenceStationInfo-r15

GNSS-RTK-ReferenceStationInfo-r15 OPTIONAL, -- Need ON

gnss-RTK-CommonObservationInfo-r15

GNSS-RTK-CommonObservationInfo-r15 OPTIONAL, -- Cond RTK

gnss-RTK-AuxiliaryStationData-r15

GNSS-RTK-AuxiliaryStationData-r15 OPTIONAL -- Need ON

]]

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *RTK* | The field is mandatory present if the IE *GNSS-RTK-Observations* is included in IE *GNSS‑GenericAssistData*; otherwise it is not present. |

#### – *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-DifferentialCorrections-r12 OPTIONAL, -- Cond GNSS-ID-BDS

bds-GridModel-r12 BDS-GridModelParameter-r12 OPTIONAL -- Cond GNSS-ID-BDS

]],

[[

gnss-RTK-Observations-r15 GNSS-RTK-Observations-r15 OPTIONAL, -- Need ON

glo-RTK-BiasInformation-r15 GLO-RTK-BiasInformation-r15 OPTIONAL, -- Cond GNSS-ID-GLO

gnss-RTK-MAC-CorrectionDifferences-r15

GNSS-RTK-MAC-CorrectionDifferences-r15

OPTIONAL, -- Need ON

gnss-RTK-Residuals-r15 GNSS-RTK-Residuals-r15 OPTIONAL, -- Need ON

gnss-RTK-FKP-Gradients-r15 GNSS-RTK-FKP-Gradients-r15 OPTIONAL, -- Need ON

gnss-SSR-OrbitCorrections-r15

GNSS-SSR-OrbitCorrections-r15 OPTIONAL, -- Need ON

gnss-SSR-ClockCorrections-r15

GNSS-SSR-ClockCorrections-r15 OPTIONAL, -- Need ON

gnss-SSR-CodeBias-r15 GNSS-SSR-CodeBias-r15 OPTIONAL -- Need ON

]]

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *GNSS‑ID‑SBAS* | The field is mandatory present if the *GNSS‑ID* = *sbas*; otherwise it is not present. |
| *GNSS‑ID‑BDS* | The field may be present if the *GNSS‑ID* = *bds*; otherwise it is not present. |
| *GNSS-ID-GLO* | The field may be present if the *GNSS ID* = *glonass*; otherwise it is not present. |

#### *– GNSS-PeriodicAssistData*

The IE *GNSS-PeriodicAssistData* is used by the location server to provide control parameters for a periodic assistance data delivery session (e.g., interval and duration) to the target device.

NOTE: Omission of a particular assistance data type field in IE *GNSS-PeriodicAssistData* means that the location server does not provide this assistance data type in a data transaction of a periodic assistance data delivery session, as described in clauses 5.2.1a and 5.2.2a. Inclusion of no assistance data type fields in IE *GNSS-PeriodicAssistData* means that a periodic assistance data delivery session is terminated.

-- ASN1START

GNSS-PeriodicAssistData-r15 ::= SEQUENCE {

gnss-RTK-PeriodicObservations-r15 GNSS-PeriodicControlParam-r15 OPTIONAL, -- Need ON

glo-RTK-PeriodicBiasInformation-r15 GNSS-PeriodicControlParam-r15 OPTIONAL, -- Need ON

gnss-RTK-MAC-PeriodicCorrectionDifferences-r15

GNSS-PeriodicControlParam-r15 OPTIONAL, -- Need ON

gnss-RTK-PeriodicResiduals-r15 GNSS-PeriodicControlParam-r15 OPTIONAL, -- Need ON

gnss-RTK-FKP-PeriodicGradients-r15 GNSS-PeriodicControlParam-r15 OPTIONAL, -- Need ON

gnss-SSR-PeriodicOrbitCorrections-r15

GNSS-PeriodicControlParam-r15 OPTIONAL, -- Need ON

gnss-SSR-PeriodicClockCorrections-r15

GNSS-PeriodicControlParam-r15 OPTIONAL, -- Need ON

gnss-SSR-PeriodicCodeBias-r15 GNSS-PeriodicControlParam-r15 OPTIONAL, -- Need ON

...

}

-- ASN1STOP

#### 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 |
| --- | --- |
| *noFTA* | The field may be present if *gnss-ReferenceTimeForCells* is absent; otherwise it is not present. |

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

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 |
| --- | --- |
| *gnss-TimeID-glonass* | The field may be present if *gnss-TimeID*=`glonass′; otherwise it is not present. |
| *gnss-TimeID-gps* | The field may be present if *gnss-TimeID*=`gps′; otherwise it is not present. |

| *GNSS-SystemTime* field descriptions |
| --- |
| ***gnss-TimeID***  This field specifies the GNSS for which the *GNSS-SystemTime* is provided. |
| ***gnss-DayNumber***  This field specifies the sequential number of days (with day count starting at 0) from the origin of the GNSS System Time as follows:  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). |
| ***gnss-TimeOfDay***  This field specifies the integer number of seconds from the GNSS day change. |
| ***gnss-TimeOfDayFrac-msec***  This field specifies the fractional part of the *gnssTimeOfDay* field in 1‑milli‑seconds resolution. The total GNSS TOD is *gnss-TimeOfDay + gnssTimeOfDayFrac-msec.* |
| ***notificationOfLeapSecond***  This field specifies the notification of forthcoming leap second correction, as defined by parameter KP in [9, Table 4.7]. |
| ***gps-TOW-Assist***  This field contains several fields in the Telemetry (TLM) Word and Handover Word (HOW) that are currently being broadcast by the respective GPS satellites. Combining this information with GPS TOW enables the target device to know the entire 1.2-second (60-bit) pattern of TLM and HOW that is transmitted at the start of each six-second NAV subframe by the particular GPS satellite. |

#### – *GPS-TOW-Assist*

-- ASN1START

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

GPS-TOW-AssistElement ::= SEQUENCE {

satelliteID INTEGER (1..64),

tlmWord INTEGER (0..16383),

antiSpoof INTEGER (0..1),

alert INTEGER (0..1),

tlmRsvdBits INTEGER (0..3),

...

}

-- ASN1STOP

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

#### – *NetworkTime*

-- ASN1START

NetworkTime ::= SEQUENCE {

secondsFromFrameStructureStart INTEGER(0..12533),

fractionalSecondsFromFrameStructureStart INTEGER(0..3999999),

frameDrift INTEGER (-64..63) OPTIONAL, -- Cond GNSSsynch

cellID CHOICE {

eUTRA SEQUENCE {

physCellId INTEGER (0..503),

cellGlobalIdEUTRA CellGlobalIdEUTRA-AndUTRA OPTIONAL, -- 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 {

bcchCarrier 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,

...

},

nr-r15 SEQUENCE {

nrPhysCellId-r15 INTEGER (0..1007),

nrCellGlobalID-r15 NCGI-r15 OPTIONAL, -- Need ON

nrARFCN-r15 ARFCN-ValueNR-r15,

...

}

},

...

}

-- ASN1STOP

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

| *NetworkTime* field descriptions |
| --- |
| ***secondsFromFrameStructureStart***  This field specifies the number of seconds from the beginning of the longest frame structure in the corresponding air interface.  In case of E-UTRA, the SFN cycle length is 10.24 seconds.  In case of UTRA, the SFN cycle length is 40.96 seconds.  In case of GSM, the hyperfame length is 12533.76 seconds.  In case of NB-IoT, the Hyper-SFN cycle lengths is 10485.76 seconds.  In case of NR, the SFN cycle length is 10.24 seconds. |
| ***fractionalSecondsFromFrameStructureStart***  This field specifies the fractional part of the *secondsFromFrameStructureStart* in 250 ns resolution.  The total time since the particular frame structure start is *secondsFromFrameStructureStart + fractionalSecondsFromFrameStructureStart* |
| ***frameDrift***  This field specifies the drift rate of the GNSS‑network time relation with scale factor 2-30 seconds/second, in the range from ‑5.9605e-8 to +5.8673e-8 sec/sec. |
| ***cellID***  This field specifies the cell for which the GNSS–network time relation is provided. |
| ***physCellId***  This field specifies the physical cell identity of the reference cell (E-UTRA), as defined in TS 36.331 [12], for which the GNSS network time relation is provided. |
| ***cellGlobalIdEUTRA***  This field specifies the Evolved Cell Global Identifier (ECGI), the globally unique identity of a cell in E-UTRA, of the reference cell for the GNSS‑network time relation, as defined in TS 36.331 [12]. |
| ***earfcn***  This field specifies E-ARFCN of the reference cell for the GNSS‑network time relation (E-UTRA). In case the server includes *earfcn-v9a0*, the server shall set the corresponding *earfcn* (i.e. without suffix) to *maxEARFCN*. |
| ***primary-CPICH-Info***  This field specifies the physical cell identity of the reference cell (UTRA) for the GNSS‑network time relation, as defined in TS 25.331 [13]. |
| ***cellParameters***  This field specifies the physical cell identity of the reference cell (UTRA) for the GNSS‑network time relation, as defined in TS 25.331 [13]. |
| ***cellGlobalIdUTRA***  The filed specifies the global UTRAN Cell Identifier, the globally unique identity of a cell in UTRA, of the reference cell for the GNSS‑network time relation, as defined in TS 25.331 [13]. |
| ***uarfcn***  This field specifies ARFCN of the reference cell for the GNSS‑network time relation (UTRA). |
| ***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 TS 44.031 [14]. |
| ***bsic***  This field specifies the Base Station Identity Code of the reference base station (GERAN) for the GNSS‑network time relation, as defined in TS 44.031 [14]. |
| ***cellGlobalIdGERAN***  This field specifies the Cell Global Identification (CGI), the globally unique identity of a cell in GERAN, of the reference base station for the GNSS‑network time relation. |
| ***nbPhysCellId***  This field specifies the narrowband physical layer cell identity of the NB-IoT reference cell, as defined in TS 36.331 [12], for which the GNSS network time relation is provided. |
| ***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 TS 36.331 [12]. |
| ***nbCarrierFreq***  This field specifies the carrier frequency of the NB-IoT reference cell for which the GNSS‑network time relation is provided. |
| ***nrPhysCellId***  This field specifies the physical cell identity of the reference cell (NR), as defined in TS 38.331 [35], for which the GNSS network time relation is provided. |
| ***nrCellGlobalID***  This field specifies the NR Cell Global Identifier (NCGI) of the reference cell (NR) for the GNSS‑network time relation, as defined in TS 38.331 [35]. |
| ***nrARFCN***  This field specifies NR-ARFCN of the reference cell (NR) for the GNSS‑network time relation. |

#### – *GNSS-ReferenceLocation*

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

-- ASN1START

GNSS-ReferenceLocation ::= SEQUENCE {

threeDlocation EllipsoidPointWithAltitudeAndUncertaintyEllipsoid,

...

}

-- ASN1STOP

#### – *GNSS-IonosphericModel*

The IE *GNSS-IonosphericModel* is used by the location server to provide parameters to model the propagation delay of the GNSS signals through the ionosphere. Proper use of these fields allows a single‑frequency GNSS receiver to remove parts of the ionospheric delay from the pseudorange measurements. Two Ionospheric Models are supported: The Klobuchar model as defined in [4], and the NeQuick model as defined in [8].

-- ASN1START

GNSS-IonosphericModel ::= SEQUENCE {

klobucharModel KlobucharModelParameter OPTIONAL, -- 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

| *KlobucharModelParamater* field descriptions |
| --- |
| ***dataID***  When *dataID* has the value ′11′ it indicates that the parameters have been generated by QZSS, and the parameters have been specialized and are applicable within the area defined in [7]. When *dataID* has the value ′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 0 parameter of the Klobuchar model, as specified in [4], [23].  Scale factor 2-30 seconds. |
| ***alpha1***  This field specifies the 1 parameter of the Klobuchar model, as specified in [4], [23].  Scale factor 2-27 seconds/semi-circle. |
| ***alpha2***  This field specifies the 2 parameter of the Klobuchar model, as specified in [4], [23].  Scale factor 2-24 seconds/semi-circle2. |
| ***alpha3***  This field specifies the 3 parameter of the Klobuchar model, as specified in [4], [23].  Scale factor 2-24 seconds/semi-circle3. |
| ***beta0***  This field specifies the 0 parameter of the Klobuchar model, as specified in [4], [23].  Scale factor 211 seconds. |
| ***beta1***  This field specifies the 1 parameter of the Klobuchar model, as specified in [4], [23].  Scale factor 214 seconds/semi-circle. |
| ***beta2***  This field specifies the 2 parameter of the Klobuchar model, as specified in [4], [23].  Scale factor 216 seconds/semi-circle2. |
| ***beta3***  This field specifies the 3 parameter of the Klobuchar model, as specified in [4], [23].  Scale factor 216 seconds/semi-circle3. |

#### – *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 |
| --- |
| ***ai0***  Effective Ionisation Level 1st order parameter.  Scale factor 2-2 Solar Flux Units (SFUs), [8] clause 5.1.6. |
| ***ai1***  Effective Ionisation Level 2nd order parameter.  Scale factor 2-8 Solar Flux Units/degree, [8] clause 5.1.6. |
| ***ai2***  Effective Ionisation Level 3rd order parameter.  Scale factor 2-15 Solar Flux Units/degree2, [8] clause 5.1.6. |
| ***ionoStormFlag1, ionoStormFlag2, ionoStormFlag3, ionoStormFlag4, ionoStormFlag5***  These fields specify the ionosphere disturbance flags (1,…,5) for five different regions as described in [8], clause 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. |

#### – *GNSS-EarthOrientationParameters*

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

-- ASN1START

GNSS-EarthOrientationParameters ::= SEQUENCE {

teop INTEGER (0..65535),

pmX INTEGER (-1048576..1048575),

pmXdot INTEGER (-16384..16383),

pmY INTEGER (-1048576..1048575),

pmYdot INTEGER (-16384..16383),

deltaUT1 INTEGER (-1073741824..1073741823),

deltaUT1dot INTEGER (-262144..262143),

...

}

-- ASN1STOP

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

#### *– GNSS-RTK-ReferenceStationInfo*

The IE *GNSS-RTK-ReferenceStationInfo* is used by the location server to provide the Earth-centered, Earth-fixed (ECEF) coordinates of the antenna reference point (ARP) of the stationary reference station for which the *GNSS‑RTK‑Observations* assistance data are provided together with reference station antenna description.

The parameters provided in IE *GNSS-RTK-ReferenceStationInfo* are used as specified for message type 1006, 1033 and 1032 in [30].

-- ASN1START

GNSS-RTK-ReferenceStationInfo-r15 ::= SEQUENCE {

referenceStationID-r15 GNSS-ReferenceStationID-r15,

referenceStationIndicator-r15 ENUMERATED {physical, non-physical},

antenna-reference-point-ECEF-X-r15 INTEGER (-137438953472..137438953471),

antenna-reference-point-ECEF-Y-r15 INTEGER (-137438953472..137438953471),

antenna-reference-point-ECEF-Z-r15 INTEGER (-137438953472..137438953471),

antennaHeight-r15 INTEGER (0..65535) OPTIONAL, -- Need ON

antennaDescription-r15 AntennaDescription-r15 OPTIONAL, -- Need ON

antenna-reference-point-unc-r15 AntennaReferencePointUnc-r15 OPTIONAL, -- Need ON

physical-reference-station-info-r15 PhysicalReferenceStationInfo-r15 OPTIONAL, -- Cond NP

...

}

AntennaDescription-r15 ::= SEQUENCE {

antennaDescriptor-r15 VisibleString (SIZE (1..256)),

antennaSetUpID-r15 ENUMERATED { non-zero } OPTIONAL, -- Need OP

...

}

AntennaReferencePointUnc-r15 ::= SEQUENCE {

uncertainty-X-r15 INTEGER (0..255),

confidence-X-r15 INTEGER (0..100),

uncertainty-Y-r15 INTEGER (0..255),

confidence-Y-r15 INTEGER (0..100),

uncertainty-Z-r15 INTEGER (0..255),

confidence-Z-r15 INTEGER (0..100),

...

}

PhysicalReferenceStationInfo-r15 ::= SEQUENCE {

physicalReferenceStationID-r15 GNSS-ReferenceStationID-r15,

physical-ARP-ECEF-X-r15 INTEGER (-137438953472..137438953471),

physical-ARP-ECEF-Y-r15 INTEGER (-137438953472..137438953471),

physical-ARP-ECEF-Z-r15 INTEGER (-137438953472..137438953471),

physical-ARP-unc-r15 AntennaReferencePointUnc-r15 OPTIONAL, -- Need ON

...

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *NP* | The field is optionally present, need ON, if the *referenceStationIndicator* has the value ′*non-physical*′; otherwise it is not present. |

| *GNSS-RTK-ReferenceStationInfo* field descriptions |
| --- |
| ***referenceStationID***  The Reference Station ID is determined by the RTK service provider. |
| ***referenceStationIndicator***  This fields specifies type of reference station. Enumerated value *physical* indicates a real, physical reference station; value *non-physical* indicates a non-physical or computed reference station. |
| ***antenna-reference-point-ECEF-X***  This field specifies the antenna reference point X-coordinate in the World Geodetic System 1984 (WGS 84) datum.  Scale factor 0.0001 m; range ±13,743,895.3471 m. |
| ***antenna-reference-point-ECEF-Y***  This field specifies the antenna reference point Y-coordinate in the World Geodetic System 1984 (WGS 84) datum.  Scale factor 0.0001 m; range ±13,743,895.3471 m. |
| ***antenna-reference-point-ECEF-Z***  This field specifies the antenna reference point Z-coordinate in the World Geodetic System 1984 (WGS 84) datum.  Scale factor 0.0001 m; range ±13,743,895.3471 m. |
| ***antennaHeight***  This field specifies the height of the Antenna Reference Point above the marker used in the survey campaign.  Scale factor 0.0001 m; range 0–6.5535 m. |
| ***antennaDescriptor***  This field provides an ASCII descriptor of the reference station antenna using IGS naming convention [31]. The descriptor can be used to look up model specific phase center corrections of that antenna. |
| ***antennaSetUpID***  This field, if present, indicates that the standard IGS Model is not valid (≠ 0 [30]). If this field is absent the standard IGS Model is valid (′0 = Use standard IGS Model′ [30]). |
| ***antenna-reference-point-unc***  This field specifies the uncertainty of the ARP coordinates. *uncertainty-X*, *uncertainty-Y*, and *uncertainty-Z* correspond to the encoded high accuracy uncertainty of the X, Y, and Z-coordinate, respectively, as defined in TS 23.032 [15]. *confidence-X*, *confidence-Y*, and *confidence-Z* corresponds to confidence as defined in TS 23.032 [15]. |
| ***physical-reference-station-info***  This field provides the earth-centered, earth-fixed (ECEF) coordinates of the antenna reference point (ARP) for the real (or "physical") reference station used. This field may be used in case of the non-physical reference station approach to allow the target device to refer baseline vectors to a physical reference rather than to a non-physical reference without any connection to a physical point. |
| ***physicalReferenceStationID***  This field specifies the station ID of a real reference station, when the *referenceStationIndicator* has the value ′*non-physical*′. |
| ***physical-ARP-ECEF-X***  This field specifies the antenna reference point X-coordinate in the World Geodetic System 1984 (WGS 84) datum.  Scale factor 0.0001 m; range ±13,743,895.3471 m. |
| ***physical-ARP-ECEF-Y***  This field specifies the antenna reference point Y-coordinate in the World Geodetic System 1984 (WGS 84) datum.  Scale factor 0.0001 m; range ±13,743,895.3471 m. |
| ***physical-ARP-ECEF-Z***  This field specifies the antenna reference point Z-coordinate in the World Geodetic System 1984 (WGS 84) datum.  Scale factor 0.0001 m; range ±13,743,895.3471 m. |
| ***physical-ARP-unc***  This field specifies the uncertainty of the ARP coordinates. |

#### *– GNSS-RTK-CommonObservationInfo*

The IE *GNSS-RTK-CommonObservationInfo* is used by the location server to provide common information applicable to the IE *GNSS-RTK-Observations.*

The parameters provided in IE *GNSS-RTK-CommonObservationInfo* are used as specified for message type 1071-1127 in [30].

-- ASN1START

GNSS-RTK-CommonObservationInfo-r15 ::= SEQUENCE {

referenceStationID-r15 GNSS-ReferenceStationID-r15,

clockSteeringIndicator-r15 INTEGER (0..3),

externalClockIndicator-r15 INTEGER (0..3),

smoothingIndicator-r15 BIT STRING (SIZE(1)),

smoothingInterval-r15 BIT STRING (SIZE(3)),

...

}

-- ASN1STOP

| *GNSS-RTK-CommonObservationInfo* field descriptions |
| --- |
| ***referenceStationID***  This field specifies the Station ID for which the *GNSS-RTK-Observations* are provided. |
| ***clockSteeringIndicator***  This field provides the clock steering indicator. The interpretation of the value is as follows:  0 clock steering is not applied  In this case receiver clock must be kept in the range of ±1 ms (approximately ±300 km)  1 clock steering has been applied  In this case receiver clock must be kept in the range of ±1 microsecond (approximately ±300 meters).  2 unknown clock steering status  3 reserved |
| ***externalClockIndicator***  This field provides the external clock indicator. The interpretation of the value is as follows:  0 internal clock is used  1 external clock is used, clock status is "locked"  2 external clock is used, clock status is "not locked", which may indicate external clock failure and that the transmitted data may not be reliable.  3 unknown clock is used |
| ***smoothingIndicator***  This field provides the GNSS Divergence-free Smoothing Indicator. The interpretation of the value is as follows:  1 Divergence-free smoothing is used  0 Other type of smoothing is used |
| ***smoothingInterval***  The GNSS Smoothing Interval is the integration period over which the pseudorange code phase measurements are averaged using carrier phase information. Divergence-free smoothing may be continuous over the entire period for which the satellite is visible. A value of zero indicates no smoothing is used.  See table "smoothingInterval value to interpretation of Smoothing Interval relation" below. |

*smoothingInterval* value to interpretation of Smoothing Interval relation

|  |  |
| --- | --- |
| Indicator | Smoothing Interval |
| 000 (0) | No smoothing |
| 001 (1) | < 30 s |
| 010 (2) | 30-60 s |
| 011 (3) | 1-2 min |
| 100 (4) | 2-4 min |
| 101 (5) | 4-8 min |
| 110 (6) | >8 min |
| 111 (7) | Unlimited smoothing interval |

#### *– GNSS-RTK-AuxiliaryStationData*

The IE *GNSS-RTK-AuxiliaryStationData* is used by the location server to provide the coordinates of the antenna reference point (ARP) of Auxiliary Reference Stations, relative to the coordinates provided in IE *GNSS‑RTK‑ReferenceStationInfo*. The reference station provided in IE *GNSS-RTK-ReferenceStationInfo* is the Master Reference Station. Therefore, one Master Reference Station with its associated Auxiliary Stations is used in a single Provide Assistance Data message.

The parameters provided in IE *GNSS-RTK-AuxiliaryStationData* are used as specified for message type 1014 in [30].

-- ASN1START

GNSS-RTK-AuxiliaryStationData-r15 ::= SEQUENCE {

networkID-r15 GNSS-NetworkID-r15,

subNetworkID-r15 GNSS-SubNetworkID-r15 OPTIONAL, -- Need ON

master-referenceStationID-r15 GNSS-ReferenceStationID-r15,

auxiliaryStationList-r15 AuxiliaryStationList-r15,

...

}

AuxiliaryStationList-r15 ::= SEQUENCE (SIZE (1..32)) OF AuxiliaryStationElement-r15

AuxiliaryStationElement-r15 ::= SEQUENCE {

aux-referenceStationID-r15 GNSS-ReferenceStationID-r15,

aux-master-delta-latitude-r15 INTEGER (-524288..524287),

aux-master-delta-longitude-r15 INTEGER (-1048576..1048575),

aux-master-delta-height-r15 INTEGER (-4194304..4194303),

aux-ARP-unc-r15 Aux-ARP-Unc-r15 OPTIONAL, -- Need ON

...

}

Aux-ARP-Unc-r15 ::= SEQUENCE {

horizontalUncertainty-r15 INTEGER (0..255),

horizontalConfidence-r15 INTEGER (0..100),

verticalUncertainty-r15 INTEGER (0..255) OPTIONAL, -- Need ON

verticalConfidence-r15 INTEGER (0..100) OPTIONAL, -- Need ON

...

}

-- ASN1STOP

| *GNSS-RTK-AuxiliaryStationData* field descriptions |
| --- |
| ***networkID***  This field defines the network and the source of the particular set of reference stations and their observation information. The RTK service provider should ensure that the *networkID* is unique in the region serviced. The *networkID* indicates an area and its reference stations where the service providers will provide a homogenous solution with levelled integer ambiguities between its reference stations. In general, the area indicated by *networkID* will comprise one subnetwork with a unique *subNetworkID*. |
| ***subNetworkID***  This field identifies the subnetwork of a network identified by *networkID*. In general the area indicated by *networkID* will consist of one subnetwork. The *subNetworkID* indicates the actual solution number of integer ambiguity level. If one network has only one subnetwork, this indicates that an ambiguity level throughout the whole network is established. |
| ***master-referenceStationID***  This field identifies the Master Reference Station. |
| ***aux-referenceStationID***  This field identifies the Auxiliary Reference Station. |
| ***aux-master-delta-latitude***  This field provides the delta value in latitude of Antenna Reference Point of "Auxiliary Reference Station minus Master Reference Station" in geographical coordinates based on GRS80 ellipsoid parameters for the same ECEF system as used in IE *GNSS‑RTK‑ReferenceStationInfo*.  Scale factor 25×10-6 degrees; range ±13.1071 degrees. |
| ***aux-master-delta-longitude***  This field provides the delta value in longitude of Antenna Reference Point of "Auxiliary Reference Station minus Master Reference Station" in geographical coordinates based on GRS80 ellipsoid parameters for the same ECEF system as used in IE *GNSS‑RTK‑ReferenceStationInfo*.  Scale factor 25×10-6 degrees; range ±26.2142 degrees. |
| ***aux-master-delta-height***  This field provides the delta value in ellipsoidal height of Antenna Reference Point of "Auxiliary Reference Station minus Master Reference Station" in geographical coordinates based on GRS80 ellipsoid parameters for the same ECEF system as used in IE *GNSS‑RTK‑ReferenceStationInfo*.  Scale factor 1 milli-meter; range ±4194.303 m. |
| ***aux-ARP-unc***  This field specifies the uncertainty of the auxiliary station ARP coordinates and comprise the following fields:  - ***horizontalUncertainty*** indicates the horizontal uncertainty of the ARP latitude/longitude. The ′*horizontalUncertainty*′ corresponds to the encoded high accuracy uncertainty as defined in TS 23.032 [15] and ′*horizontalConfidence*′ corresponds to confidence as defined in TS 23.032 [15].  - ***verticalUncertainty*** indicates the vertical uncertainty of the ARP altitude. The '*verticalUncertainty*' corresponds to the encoded high accuracy uncertainty as defined in TS 23.032 [15] and '*verticalConfidence*' corresponds to confidence as defined in TS 23.032 [15]. |

#### – *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. The location server should provide a *GNSS-TimeModelList* for the same *GNSS-ID* as the *gnss-TimeID* in IE *GNSS-SystemTime* in *GNSS-ReferenceTime* assistance. If the location server does not provide a *GNSS-TimeModelList* for the same *GNSS-ID* as the *gnss-TimeID* in IE *GNSS-SystemTime* in *GNSS-ReferenceTime* assistance the target device assumes *tA1* and *tA2* are equal to zero.

-- 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 |
| --- |
| ***gnss-TimeModelRefTime***  This field specifies the reference time of week for *GNSS-TimeModelElement* and it is given in GNSS specific system time.  Scale factor 24 seconds. |
| ***tA0***  This field specifies the bias coefficient of the *GNSS-TimeModelElement*.  Scale factor 2-35 seconds. |
| ***tA1***  This field specifies the drift coefficient of the *GNSS-TimeModelElement.*  Scale factor of 2-51 seconds/second. |
| ***tA2***  This field specifies the drift rate correction coefficient of the *GNSS-TimeModelElement.*  Scale factor of 2-68 seconds/second2. |
| ***gnss-TO-ID***  This field specifies the GNSS system time of the GNSS for which the *GNSS-TimeModelElement* is applicable. *GNSS-TimeModelElement* contains parameters to convert GNSS system time from the system indicated by *GNSS‑ID* to GNSS system time indicated by *gnss-TO-ID*. The conversion is defined in [4,5,6]. See table of gnss-TO-ID to Indication relation below. NOTE. |
| ***weekNumber***  This field specifies the reference week of the *GNSS-TimeModelElement* given in GNSS specific system time. The location server should include this field, if *tA1* or *tA2* is included.  Scale factor 1 week. |
| ***deltaT***  This field specifies the integer number of seconds of the GNSS-GNSS time offset provided in the *GNSS-TimeModelElement.*  Scale factor 1 second. |

gnss-TO-ID to Indication relation

|  |  |
| --- | --- |
| Value of *gnss-TO-ID* | Indication |
| 1 | GPS |
| 2 | Galileo |
| 3 | QZSS |
| 4 | GLONASS |
| 5 | BDS |
| 6-15 | reserved |

NOTE: The time relationship between the system time indicated by *GNSS-ID* and system time indicated by *gnss‑TO-ID* is given by the following equation:  
  
tGNSS = tE - ( A0GGTO + A1GGTO (tE - tGGTO + 604800 (WN - WNGGTO)) + A2GGTO (tE - tGGTO +   
 604800 (WN - WNGGTO))2 )  
  
where  
  
tGNSS  is the system time of week for the GNSS indicated by *gnss-TO-ID*.  
tE is the system time of week for the GNSS indicated by *GNSS-ID*.  
WN is the week number of the GNSS system time indicated by *GNSS-ID* corresponding to the tE.   
tGGTO is the system time of week for the time model data in the GNSS time indicated by *GNSS-ID* and given by the *gnss‑TimeModelRefTime* field.  
WNGGTO is the week number for the time model data in the GNSS time indicated by *GNSS-ID* corresponding to the tGGTO and given by the *weekNumber* field.  
A0GGTO is given by the *tA0* field.  
A1GGTO is given by the *tA1* field.  
A2GGTO is given by the *tA2* field.  
  
If the *tA1*and *tA2*are not included in the *GNSS-TimeModelElement*, the target device assumes A1GGTO and A2GGTO are equal to zero.

The GNSS system times in the IE *GNSS-TimeModelList* and used in the equation above are all given in Time of Week (TOW) and Week Number (WN) in the indicted GNSS specific system time. For conversion between TOW/WN and Day Number/Time of Day (*gnss-DayNumber*/*gnss-TimeOfDay*) a GNSS week consists of 7 days since the origin of the particular GNSS System time (with the week number count starting at 0), and a day consists of 86400 seconds.

#### – *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 |
| --- |
| ***dgnss-RefTime***  This field specifies the time for which the DGNSS corrections are valid, modulo 1 hour. *dgnss-RefTime* is given in GNSS specific system time.  Scale factor 1‑second. |
| ***dgnss-SgnTypeList***  This list includes differential correction data for different GNSS signal types, identified by *GNSS-SignalID*. |
| ***gnss-StatusHealth***  This field specifies the status of the differential corrections. The values of this field and their respective meanings are defined as in table *gnss-StatusHealth* Value to Indication relation below.  The first six values in this field indicate valid differential corrections. When using the values described below, the "UDRE Scale Factor" value is applied to the UDRE values contained in the element. The purpose is to indicate an estimate in the amount of error in the corrections.  The value "110" indicates that the source of the differential corrections (e.g., reference station or external DGNSS network) is currently not being monitored. The value "111" indicates that the corrections provided by the source are invalid, as judged by the source. |
| ***dgnss-SatList***  This list includes differential correction data for different GNSS satellites, identified by *SV-ID*. |
| ***iod***  This field specifies the Issue of Data field which contains the identity for the *GNSS-NavigationModel.* |
| ***udre***  This field provides an estimate of the uncertainty (1-σ) in the corrections for the particular satellite. The value in this field shall be multiplied by the UDRE Scale Factor in the *gnss-StatusHealth* field to determine the final UDRE estimate for the particular satellite. The meanings of the values for this field are shown in the table *udre Value* to Indication relation below. |
| ***pseudoRangeCor***  This field specifies the correction to the pseudorange for the particular satellite at *dgnss-RefTime*, t0. The value of this field is given in meters and the scale factor is 0.32 meters in the range of ±655.04 meters. The method of calculating this field is described in [11].  If the location server has received a request for GNSS assistance data from a target device which included a request for the GNSS Navigation Model and DGNSS, the location server shall determine, for each satellite, if the navigation model stored by the target device is still suitable for use with DGNSS corrections and if so and if DGNSS corrections are supported the location server should send DGNSS corrections without including the GNSS Navigation Model.  The *iod* value sent for a satellite shall always be the IOD value that corresponds to the navigation model for which the pseudo-range corrections are applicable.  The target device shall only use the *pseudoRangeCor*value when the IOD value received matches its available navigation model.  Pseudo-range corrections are provided with respect to GNSS specific geodetic datum (e.g., PZ-90.02 if *GNSS‑ID* indicates GLONASS).  Scale factor 0.32 meters. |
| ***rangeRateCor***  This field specifies the rate-of-change of the pseudorange correction for the particular satellite, using the satellite ephemeris and clock corrections identified by the *iod* field. The value of this field is given in meters per second and the resolution is 0.032 meters/sec in the range of ±4.064 meters/sec. For some time t1 > t0, the corrections for *iod* are estimated by  PRC(t1,IOD) = PRC(t0, IOD) + RRC(t0,IOD)⋅(t1 - t0),  and the target device uses this to correct the pseudorange it measures at t1, PRm(t1,IOD), by  PR(t1, IOD) = PRm(t1, IOD) + PRC(t1, IOD) .  The location server shall always send the RRC value that corresponds to the PRC value that it sends. The target device shall only use the RRC value when the *iod* value received matches its available navigation model.  Scale factor 0.032 meters/second. |
| ***udreGrowthRate***  This field provides an estimate of the growth rate of uncertainty (1-σ) in the corrections for the particular satellite identified by *SV-ID*. The estimated UDRE at time value specified in the *udreValidityTime**t1* is calculated as follows:  UDRE(*t0*+*t1*) = UDRE(*t0*) × *udreGrowthRate ,*  where *t0* is the DGNSS Reference Time *dgnss-RefTime*for which the corrections are valid, *t1* is the *udreValidityTime*  field, UDRE(*t0*) is the value of the *udre* field, and *udreGrowthRate* field is the factor as shown in the table Value of *udreGrowthRate* to Indication relation below. |
| ***udreValidityTime***  This field specifies the time when the *udreGrowthRate* field applies and is included if *udreGrowthRate* is included. The meaning of the values for this field is as shown in the table Value of *udreValidityTime* to Indication relation below. |

*gnss-StatusHealth* Value to Indication relation

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

*udre Value* to Indication relation

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

Value of *udreGrowthRate* to Indication relation

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

Value of *udreValidityTime* to Indication relation

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

#### – *GNSS-NavigationModel*

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

-- ASN1START

GNSS-NavigationModel ::= SEQUENCE {

nonBroadcastIndFlag INTEGER (0..1),

gnss-SatelliteList GNSS-NavModelSatelliteList,

...

}

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

GNSS-NavModelSatelliteElement ::= SEQUENCE {

svID SV-ID,

svHealth BIT STRING (SIZE(8)),

iod BIT STRING (SIZE(11)),

gnss-ClockModel GNSS-ClockModel,

gnss-OrbitModel GNSS-OrbitModel,

...,

[[ 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 *GNSS-NavigationModel* elements are not derived from satellite broadcast data or are given in a format not native to the GNSS. A value of 0 means the *GNSS-NavigationModel* data elements correspond to GNSS satellite broadcasted data; a value of 1 means the *GNSS-NavigationModel* data elements are not derived from satellite broadcast. |
| ***gnss-SatelliteList***  This list provides ephemeris and clock corrections for GNSS satellites indicated by *SV‑ID*. |
| ***svHealth***  This field specifies the satellite's current health. The health values are GNSS system specific. The interpretation of *svHealth* depends on the *GNSS‑ID* and is as shown in table GNSS to svHealth Bit String(8) relation below. |
| ***iod***  This field specifies the Issue of Data and contains the identity for GNSS Navigation Model.  In case of broadcasted GPS NAV ephemeris, the *iod* contains the IODC as described in [4].  In case of broadcasted Modernized GPS ephemeris, the *iod* contains the 11-bit parameter toe as defined in [4, Table 30-I] [6, Table 3.5-1].  In case of broadcasted SBAS ephemeris, the *iod* contains the 8 bits Issue of Data as defined in [10] Message Type 9.  In case of broadcasted QZSS QZS-L1 ephemeris, the *iod* contains the IODC as described in [7].  In case of broadcasted QZSS QZS-L1C/L2C/L5 ephemeris, the *iod* contains the 11-bit parameter toe as defined in [7].  In case of broadcasted GLONASS ephemeris, the *iod* contains the parameter tb as defined in [9].  In the case of broadcasted Galileo ephemeris, the *iod* contains the IOD index as described in [8].  In the case of broadcasted BDS ephemeris, the *iod* contains 11 MSB bits of the toe as defined in [23].  The interpretation of *iod* depends on the *GNSS‑ID* and is as shown in table GNSS to iod 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 *svHealthExt* depends on the *GNSS‑ID* and is as shown in table GNSS to svHealthExt 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)  QZS‑  L1C/L2C/L5 | L1C Health  [7] | L1 Health  [7] | L2 Health  [7] | L5 Health  [7] | '0'  (reserved) | '0'  (reserved) | '0'  (reserved) | '0'  (reserved) |
| GLONASS | Bn (MSB)  [9, page 30] | FT [9, Table 4.4] | | | | '0'  (reserved) | '0'  (reserved) | '0'  (reserved) |
| Galileo  [8, clause 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 *svHealth* applies.  Note 2: If *GNSS‑ID* indicates 'gps', and GNSS Orbit Model-3 is included, this interpretation of *svHealth* applies. If a certain signal is not supported on the satellite indicated by *SV‑ID*, the corresponding health bit shall be set to '1' (i.e., signal can not be used).  Note 3: *svHealth* in case of *GNSS‑ID* indicates 'sbas' includes the 5 LSBs of the Health included in GEO Almanac Message Parameters (Type 17) [10].  Note 4: If *GNSS‑ID* indicates 'qzss', and GNSS Orbit Model-2 is included, this interpretation of *svHealth* applies.  Note 5: If *GNSS‑ID* indicates 'qzss', and GNSS Orbit Model-3 is included, this interpretation of *svHealth* applies. | | | | | | | | |

GNSS to iod Bit String(11) relation

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GNSS | *iod* Bit String(11) | | | | | | | | | | |
| Bit 1  (MSB) | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Bit 8 | Bit 9 | Bit 10 | Bit 11  (LSB) |
| GPS L1/CA | '0' | Issue of Data, Clock [4] | | | | | | | | | |
| Modernized GPS | toe (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 | toe (seconds, scale factor 300, range 0 – 604500) [7] | | | | | | | | | | |
| GLONASS | '0' | '0' | '0' | '0' | tb (minutes, scale factor 15) [9] | | | | | | |
| Galileo | '0' | IODnav [8] | | | | | | | | | |
| BDS | 11 MSB bits of toe (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, clause 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 |
| --- |
| ***standardClockModelList***  *gnss-ClockModel* 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 *gnss-ClockModel* if the location server assumes the target device to perform location information calculation using multiple signals. |
| ***stanClockToc***  Parameter toc defined in [8].  Scale factor 60 seconds. |
| ***stanClockAF2***  Parameter af2 defined in [8].  Scale factor 2-59 seconds/second2. |
| ***stanClockAF1***  Parameter af1 defined in [8].  Scale factor 2-46 seconds/second. |
| ***stanClockAF0***  Parameter af0 defined in [8].  Scale factor 2-34 seconds. |
| ***stanClockTgd***  Parameter TGD, 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. |
| ***sisa***  Signal-In-Space Accuracy (SISA), defined in [8] clause 5.1.11. |
| ***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 *gnss-ClockModel.* |

Value of stanModelID to Identity relation

|  |  |
| --- | --- |
| Value of *stanModelID* | 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 |
| --- |
| ***navToc***  Parameter toc, time of clock (seconds) [4,7]  Scale factor 24 seconds. |
| ***navaf2***  Parameter af2, clock correction polynomial coefficient (sec/sec2) [4,7].  Scale factor 2-55 seconds/second2. |
| ***navaf1***  Parameter af1, clock correction polynomial coefficient (sec/sec) [4,7].  Scale factor 2-43 seconds/second. |
| ***navaf0***  Parameter af0, clock correction polynomial coefficient (seconds) [4,7].  Scale factor 2-31 seconds. |
| ***navTgd***  Parameter TGD, 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 toc, clock data reference time of week (seconds) [4,5,6,7].  Scale factor 300 seconds. |
| ***cnavTop***  Parameter top, clock data predict time of week (seconds) [4,5,6,7].  Scale factor 300 seconds |
| ***cnavURA0***  Parameter URAoc Index, SV clock accuracy index (dimensionless) [4,5,6,7]. |
| ***cnavURA1***  Parameter URAoc1 Index, SV clock accuracy change index (dimensionless) [4,5,6,7]. |
| ***cnavURA2***  Parameter URAoc2 Index, SV clock accuracy change rate index (dimensionless) [4,5,6,7]. |
| ***cnavAf2***  Parameter af2-n, SV clock drift rate correction coefficient (sec/sec2) [4,5,6,7].  Scale factor 2-60 seconds/second2. |
| ***cnavAf1***  Parameter af1-n, SV clock drift correction coefficient (sec/sec) [4,5,6,7].  Scale factor 2-48 seconds/second. |
| ***cnavAf0***  Parameter af0-n, SV clock bias correction coefficient (seconds) [4,5,6,7].  Scale factor 2-35 seconds. |
| ***cnavTgd***  Parameter TGD, Group delay correction (seconds) [4,5,6,7].  Scale factor 2-35 seconds. |
| ***cnavISCl1cp***  Parameter ISCL1CP, 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 ISCL1CD, 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 ISCL1C/A, 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. |
| ***cnavISCl2c***  Parameter ISCL2C, 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. |
| ***cnavISCl5i5***  Parameter ISCL5I5, 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. |
| ***cnavISCl5q5***  Parameter ISCL5Q5, 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. |

#### – *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 |
| --- |
| ***gloTau***  Parameter n(tb), satellite clock offset (seconds) [9].  Scale factor 2-30 seconds. |
| ***gloGamma***  Parameter n(tb), relative frequency offset from nominal value (dimensionless) [9].  Scale factor 2-40. |
| ***gloDeltaTau***  Parameter 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. |

#### – *SBAS-ClockModel*

-- ASN1START

SBAS-ClockModel ::= SEQUENCE {

sbasTo INTEGER (0..5399),

sbasAgfo INTEGER (-2048..2047),

sbasAgf1 INTEGER (-128..127),

...

}

-- ASN1STOP

| *SBAS-ClockModel* field descriptions |
| --- |
| ***sbasTo***  Parameter t0 [10].  Scale factor 16 seconds. |
| ***sbasAgfo***  Parameter aGfo [10].  Scale factor 2-31 seconds. |
| ***sbasAgf1***  Parameter aGf1 [10].  Scale factor 2-40 seconds/second. |

#### – *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 Toc, Time of clock (seconds) [23].  Scale factor 23 seconds. |
| ***bdsA0***  Parameter a0, Clock correction polynomial coefficient (seconds) [23].  Scale factor 2-33 seconds. |
| ***bdsA1***  Parameter a1, Clock correction polynomial coefficient (sec/sec) [23].  Scale factor 2-50 sec/sec. |
| ***bdsA2***  Parameter a2, Clock correction polynomial coefficient (sec/sec2) [23].  Scale factor 2-66 sec/sec2. |
| ***bdsTgd1***  Parameter Equipment group delay differential TGD1 [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 toe, 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. |
| ***keplerDeltaN***  Parameter n, mean motion difference from computed value (semi-circles/sec) [8].  Scale factor 2-43 semi-circles/second. |
| ***keplerM0***  Parameter M0, mean anomaly at reference time (semi-circles) [8].  Scale factor 2-31 semi-circles. |
| ***keplerOmegaDot***  Parameter OMEGAdot, rate of change of right ascension (semi-circles/sec) [8].  Scale factor 2-43 semi-circles/second. |
| ***keplerE***  Parameter e, eccentricity [8].  Scale factor 2-33. |
| ***KeplerIDot***  Parameter Idot, rate of change of inclination angle (semi-circles/sec) [8].  Scale factor 2-43 semi-circles/second. |
| ***keplerAPowerHalf***  Parameter sqrtA, square root of semi-major Axis in (meters) ½ [8].  Scale factor 2-19 meters ½. |
| ***keplerI0***  Parameter i0, inclination angle at reference time (semi-circles) [8].  Scale factor 2-31 semi-circles. |
| ***keplerOmega0***  Parameter OMEGA0, longitude of ascending node of orbit plane at weekly epoch (semi-circles) [8].  Scale factor 2-31 semi-circles. |
| ***keplerCrs***  Parameter Crs, amplitude of the sine harmonic correction term to the orbit radius (meters) [8].  Scale factor 2-5 meters. |
| ***keplerCis***  Parameter Cis, amplitude of the sine harmonic correction term to the angle of inclination (radians) [8].  Scale factor 2-29 radians. |
| ***keplerCus***  Parameter Cus, amplitude of the sine harmonic correction term to the argument of latitude (radians) [8].  Scale factor 2-29 radians. |
| ***keplerCrc***  Parameter Crc, amplitude of the cosine harmonic correction term to the orbit radius (meters) [8].  Scale factor 2-5 meters. |
| ***keplerCic***  Parameter Cic, amplitude of the cosine harmonic correction term to the angle of inclination (radians) [8].  Scale factor 2-29 radians. |
| ***keplerCuc***  Parameter Cuc, amplitude of the cosine harmonic correction term to the argument of latitude (radians) [8].  Scale factor 2-29 radians. |

#### – *NavModelNAV-KeplerianSet*

-- ASN1START

NavModelNAV-KeplerianSet ::= SEQUENCE {

navURA INTEGER (0..15),

navFitFlag INTEGER (0..1),

navToe INTEGER (0..37799),

navOmega INTEGER (-2147483648..2147483647),

navDeltaN INTEGER (-32768..32767),

navM0 INTEGER (-2147483648..2147483647),

navOmegaADot INTEGER (-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 toe, time of ephemeris (seconds) [4,7].  Scale factor 24 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 M0, mean anomaly at reference time (semi-circles) [4,7].  Scale factor 2-31 semi-circles. |
| ***navOmegaADot***  Parameter , 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 , square root of semi-major axis (meters1/2) [4,7].  Scale factor 2-19 meters ½. |
| ***navI0***  Parameter i0, inclination angle at reference time (semi-circles) [4,7].  Scale factor 2-31 semi-circles. |
| ***navOmegaA0***  Parameter 0, longitude of ascending node of orbit plane at weekly epoch (semi-circles) [4,7].  Scale factor 2-31 semi-circles. |
| ***navCrs***  Parameter Crs, amplitude of sine harmonic correction term to the orbit radius (meters) [4,7].  Scale factor 2-5 meters. |
| ***navCis***  Parameter Cis, amplitude of sine harmonic correction term to the angle of inclination (radians) [4,7].  Scale factor 2-29 radians. |
| ***navCus***  Parameter Cus, amplitude of sine harmonic correction term to the argument of latitude (radians) [4,7].  Scale factor 2-29 radians. |
| ***navCrc***  Parameter Crc, amplitude of cosine harmonic correction term to the orbit radius (meters) [4,7].  Scale factor 2-5 meters. |
| ***navCic***  Parameter Cic, amplitude of cosine harmonic correction term to the angle of inclination (radians) [4,7].  Scale factor 2-29 radians. |
| ***navCuc***  Parameter Cuc, amplitude of cosine harmonic correction term to the argument of latitude (radians) [4,7].  Scale factor 2-29 radians. |
| ***addNAVparam***  These fields include data and reserved bits in the GPS NAV message [4,14].  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 *GNSS-DataBitAssistance.* |

#### – *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 |
| --- |
| ***cnavTop***  Parameter top, data predict time of week (seconds) [4,5,6,7].  Scale factor 300 seconds. |
| ***cnavURAindex***  Parameter URAoe Index, SV accuracy (dimensionless) [4,5,6,7]. |
| ***cnavDeltaA***  Parameter A, semi-major axis difference at reference time (meters) [4,5,6,7].  Scale factor 2-9 meters. |
| ***cnavAdot***  Parameter , change rate in semi-major axis (meters/sec) [4,5,6,7].  Scale factor 2-21 meters/sec. |
| ***cnavDeltaNo***  Parameter n0, mean motion difference from computed value at reference time (semi-circles/sec) [4,5,6,7].  Scale factor 2-44 semi-circles/second. |
| ***cnavDeltaNoDot***  Parameter , rate of mean motion difference from computed value (semi-circles/sec2) [4,5,6,7].  Scale factor 2-57 semi-circles/second2. |
| ***cnavMo***  Parameter M0-n, mean anomaly at reference time (semi-circles) [4,5,6,7].  Scale factor 2-32 semi-circles. |
| ***cnavE***  Parameter en, eccentricity (dimensionless) [4,5,6,7].  Scale factor 2-34. |
| ***cnavOmega***  Parameter n, argument of perigee (semi-circles) [4,5,6,7].  Scale factor 2-32 semi-circles. |
| ***cnavOMEGA0***  Parameter 0-n, reference right ascension angle (semi-circles) [4,5,6,7].  Scale factor 2-32 semi-circles. |
| ***cnavDeltaOmegaDot***  Parameter , rate of right ascension difference (semi-circles/sec) [4,5,6,7].  Scale factor 2-44 semi-circles/second. |
| ***cnavIo***  Parameter io-n, inclination angle at reference time (semi-circles) [4,5,6,7].  Scale factor 2-32 semi-circles. |
| ***cnavIoDot***  Parameter I0-n-DOT, rate of inclination angle (semi-circles/sec) [4,5,6,7].  Scale factor 2-44 semi-circles/second. |
| ***cnavCis***  Parameter Cis-n, amplitude of sine harmonic correction term to the angle of inclination (radians) [4,5,6,7].  Scale factor 2-30 radians. |
| ***cnavCic***  Parameter Cic-n, amplitude of cosine harmonic correction term to the angle of inclination (radians) [4,5,6,7].  Scale factor 2-30 radians. |
| ***cnavCrs***  Parameter Crs-n, amplitude of sine harmonic correction term to the orbit radius (meters) [4,5,6,7].  Scale factor 2-8 meters. |
| ***cnavCrc***  Parameter Crc-n, amplitude of cosine harmonic correction term to the orbit radius (meters) [4,5,6,7].  Scale factor 2-8 meters. |
| ***cnavCus***  Parameter Cus-n, amplitude of the sine harmonic correction term to the argument of latitude (radians) [4,5,6,7].  Scale factor 2-30 radians. |
| ***cnavCuc***  Parameter Cuc-n, amplitude of cosine harmonic correction term to the argument of latitude (radians) [4,5,6,7].  Scale factor 2-30 radians. |

#### – *NavModel-GLONASS-ECEF*

-- ASN1START

NavModel-GLONASS-ECEF ::= SEQUENCE {

gloEn INTEGER (0..31),

gloP1 BIT STRING (SIZE(2)),

gloP2 BOOLEAN,

gloM INTEGER (0..3),

gloX INTEGER (-67108864..67108863),

gloXdot INTEGER (-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

| *NavModel-GLONASS-ECEF* field descriptions |
| --- |
| ***gloEn***  Parameter En, age of data (days) [9].  Scale factor 1 days. |
| ***gloP1***  Parameter P1, time interval between two adjacent values of tb (minutes) [9]. |
| ***gloP2***  Parameter P2, change of tb flag (dimensionless) [9]. |
| ***gloM***  Parameter M, type of satellite (dimensionless) [9]. |
| ***gloX***  Parameter , x-coordinate of satellite at time tb (kilometers) [9].  Scale factor 2-11 kilometers. |
| ***gloXdot***  Parameter , x-coordinate of satellite velocity at time tb (kilometers/sec) [9].  Scale factor 2-20 kilometers/second. |
| ***gloXdotdot***  Parameter , x-coordinate of satellite acceleration at time tb (kilometers/sec2) [9].  Scale factor 2-30 kilometers/second2. |
| ***gloY***  Parameter , y-coordinate of satellite at time tb (kilometers) [9].  Scale factor 2-11 kilometers. |
| ***gloYdot***  Parameter , y-coordinate of satellite velocity at time tb (kilometers/sec) [9].  Scale factor 2-20 kilometers/second. |
| ***gloYdotdot***  Parameter , y-coordinate of satellite acceleration at time tb (kilometers/sec2) [9].  Scale factor 2-30 kilometers/second2. |
| ***gloZ***  Parameter , z-coordinate of satellite at time tb (kilometers) [9].  Scale factor 2-11 kilometers. |
| ***gloZdot***  Parameter , z-coordinate of satellite velocity at time tb (kilometers/sec) [9].  Scale factor 2-20 kilometers/second. |
| ***gloZdotdot***  Parameter , z-coordinate of satellite acceleration at time tb (kilometers/sec2) [9].  Scale factor 2-30 kilometers/second2. |

#### – *NavModel-SBAS-ECEF*

-- ASN1START

NavModel-SBAS-ECEF ::= SEQUENCE {

sbasTo INTEGER (0..5399) OPTIONAL, -- Cond ClockModel

sbasAccuracy BIT STRING (SIZE(4)),

sbasXg INTEGER (-536870912..536870911),

sbasYg INTEGER (-536870912..536870911),

sbasZg INTEGER (-16777216..16777215),

sbasXgDot INTEGER (-65536..65535),

sbasYgDot INTEGER (-65536..65535),

sbasZgDot INTEGER (-131072..131071),

sbasXgDotDot INTEGER (-512..511),

sbagYgDotDot INTEGER (-512..511),

sbasZgDotDot INTEGER (-512..511),

...

}

-- ASN1STOP

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

| *NavModel-SBAS-ECEF* field descriptions |
| --- |
| ***sbasTo***  Parameter t0, time of applicability (seconds) [10].  Scale factor 16 seconds. |
| ***sbasAccuracy***  Parameter Accuracy, (dimensionless) [10]. |
| ***sbasXg***  Parameter XG, (meters) [10].  Scale factor 0.08 meters. |
| ***sbasYg***  Parameter YG, (meters) [10].  Scale factor 0.08 meters. |
| ***sbasZg***  Parameter ZG, (meters) [10].  Scale factor 0.4 meters. |
| ***sbasXgDot***  Parameter XG, Rate‑of‑Change, (meters/sec) [10].  Scale factor 0.000625 meters/second. |
| ***sbasYgDot***  Parameter YG, Rate‑of‑Change, (meters/sec) [10]  Scale factor 0.000625 meters/second. |
| ***sbasZgDot***  Parameter ZG, Rate‑of‑Change, (meters/sec) [10].  Scale factor 0.004 meters/second. |
| ***sbasXgDotDot***  Parameter XG,Acceleration, (meters/sec2) [10].  Scale factor 0.0000125 meters/second2. |
| ***sbagYgDotDot***  Parameter YG, Acceleration, (meters/sec2) [10].  Scale factor 0.0000125 meters/second2. |
| ***sbasZgDotDot***  Parameter ZG Acceleration, (meters/sec2) [10].  Scale factor 0.0000625 meters/second2. |

#### – *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 toe, Ephemeris reference time (seconds) [23].  Scale factor 23 seconds. |
| ***bdsAPowerHalf***  Parameter A1/2, Square root of semi-major axis (meters1/2) [23].  Scale factor 2-19 meters1/2. |
| ***bdsE***  Parameter e, Eccentricity, dimensionless [23].  Scale factor 2-33. |
| ***bdsW***  Parameter , Argument of perigee (semi-circles) [23].  Scale factor 2-31 semi-circles. |
| ***bdsDeltaN***  Parameter n, Mean motion difference from computed value (semi-circles/sec) [23].  Scale factor 2-43 semi-circles/sec. |
| ***bdsM0***  Parameter M0, Mean anomaly at reference time (semi-circles) [23].  Scale factor 2-31 semi-circles. |
| ***bdsOmega0***  Parameter 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  Rate of right ascension (semi-circles/sec) [23].  Scale factor 2-43 semi-circles/sec. |
| ***bdsI0***  Parameter i0, Inclination angle at reference time (semi-circles) [23]  Scale factor 2-31 semi-circles. |
| ***bdsIDot***  Parameter Idot, Rate of inclination angle (semi-circles/sec) [23].  Scale factor 2-43 semi-circles/sec. |
| ***bdsCuc***  Parameter Cuc, Amplitude of cosine harmonic correction term to the argument of latitude (radians) [23].  Scale factor 2-31 radians. |
| ***bdsCus***  Parameter Cus, Amplitude of sine harmonic correction term to the argument of latitude (radians) [23].  Scale factor 2-31 radians. |
| ***bdsCrc***  Parameter Crc, Amplitude of cosine harmonic correction term to the orbit radius (meters) [23].  Scale factor 2-6 meters. |
| ***bdsCrs***  Parameter Crs, Amplitude of sine harmonic correction term to the orbit radius (meters) [23].  Scale factor 2-6 meters. |
| ***bdsCic***  Parameter Cic, Amplitude of cosine harmonic correction term to the angle of inclination (radians) [23].  Scale factor 2-31 radians. |
| ***bdsCis***  Parameter Cis, 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*. |
| ***svID***  This field specifies the GNSS *SV‑ID* of the satellite for which the *GNSS-DataBitAssistance* is given. |
| ***gnss-SignalType***  This field identifies the GNSS signal type of the *GNSS-DataBitAssistance.* |
| ***gnss-DataBits***  Data bits are contained in GNSS system and data type specific format.  In case of GPS L1 C/A, it contains the NAV data modulation bits as defined in [4] .  In case of Modernized GPS L1C, it contains the encoded and interleaved modulation symbols as defined in [6] clause 3.2.3.1. In case of Modernized GPS L2C, it contains either the NAV data modulation bits, the FEC encoded NAV data modulation symbols, or the FEC encoded CNAV data modulation symbols, dependent on the current signal configuration of this satellite as defined in [4, Table 3-III]. In case of Modernized GPS L5, it contains the FEC encoded CNAV data modulation symbols as defined in [5].  In case of SBAS, it contains the FEC encoded data modulation symbols as defined in [10].  In case of QZSS QZS-L1, it contains the NAV data modulation bits as defined in [7] clause 5.2. In case of QZSS QZS-L1C, it contains the encoded and interleaved modulation symbols as defined in [7] clause 5.3. In case of QZSS QZS-L2C, it contains the encoded modulation symbols as defined in [7] clause 5.5. In case of QZSS QZS-L5, it contains the encoded modulation symbols as defined in [7] clause 5.6.  In case of GLONASS, it contains the 100 sps differentially Manchester encoded modulation symbols as defined in [9] clause 3.3.2.2.  In case of Galileo, it contains the FEC encoded and interleaved modulation symbols. The logical levels 1 and 0 correspond to signal levels -1 and +1, respectively.  In case of BDS, it contains the encoded and interleaved modulation symbols as defined in [23, clause 5.1.3]. |

#### – *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 |
| --- |
| ***gnss-SignalID***  This field specifies the GNSS signal for which the acquisition assistance are provided. |
| ***gnss-AcquisitionAssistList***  These fields provide a list of acquisition assistance data for each GNSS satellite. |
| ***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. |
| ***svID***  This field specifies the GNSS *SV‑ID* of the satellite for which the *GNSS-AcquisitionAssistance* is given. |
| ***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. |
| ***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 + *doppler1*) \* 1/210 m/s2, with *doppler1* in the range of 0…63. |
| ***dopplerUncertainty***  This field specifies the Doppler uncertainty value. It is defined such that the Doppler experienced by a stationary target device is in the range [DopplerDoppler Uncertainty] to [DopplerDoppler Uncertainty]. Doppler Uncertainty is given in unit of m/s by multiplying the Doppler Uncertainty value in Hz by the nominal wavelength of the assisted signal.  Defined values: 2.5 m/s, 5 m/s, 10 m/s, 20 m/s, 40 m/s as encoded by an integer *n* in the range 0-4 according to:  2-n(40) m/s; n = 0 – 4.  If the *dopplerUncertaintyExt* field is present, the target device that supports the *dopplerUncertaintyExt* shall ignore this field. |
| ***codePhase***  This field together with the *codePhase1023* 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 *a priori* estimate of the target device location.  Scale factor 2-10 msin the range from 0 to (1-2-10) ms.  Note: The value (1-2-10) ms is encoded using the *codePhase1023* IE. |
| ***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 (*intCodePhase* + (n×128 ms)), as shown in Figure 6.5.2.2-1, with n = …-2,-1,0,1,2….  Scale factor 1 msin the range from 0 to 127 ms. |
| ***codePhaseSearchWindow***  This field contains the code phase search window. The code phase search window accounts for the uncertainty in the estimated target device location but not any uncertainty in reference time. It is defined such that the expected code phase is in the range [Code PhaseCode Phase Search Window] to [Code PhaseCode Phase Search Window] given in units of milli‑seconds.  Range 0-31, mapping according to the table codePhaseSearchWindow Value to Interpretation Code Phase Search Window [ms] relation shown below. |
| ***azimuth***  This field specifies the azimuth angle. An angle of x degrees means the satellite azimuth a is in the range  (x ≤ a < x+0.703125) degrees.  Scale factor 0.703125 degrees. |
| ***elevation***  This field specifies the elevation angle. An angle of y degrees means the satellite elevation e is in the range  (y ≤ e < y+0.703125) degrees.  Scale factor 0.703125 degrees. |
| ***codePhase1023***  This field if set to TRUE indicates that the code phase has the value 1023 × 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 - 2×2-10) 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 - 2×2-10) 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 ms, 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 WNa natively contains only the 2 LSB's [8], clause 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 212. *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 δi, inclination at reference time relative to i0=56°; semi-circles [8].  Scale factor 2-14 semi-circles. |
| ***kepAlmanacOmegaDot***  Parameter , rate of change of right ascension (semi-circles/sec) [8].  Scale factor 2-33 semi-circles/seconds. |
| ***kepSV-StatusINAV***  This field contains the I/NAV signal health status [8], clause 5.1.10 , E5bHS and E1-BHS, where E5bHS occupies the 2 MSBs in *kepSV-StatusINAV*, and E1-BHS the two LSBs. |
| ***kepSV-StatusFNAV***  This field contains the F/NAV signal health status [8], clause 5.1.10 ,E5aHS. If the target device is supporting multiple Galileo signals, the location server shall include this field. |
| ***kepAlmanacAPowerHalf***  Parameter (a1/2), difference with respect to the square root of the nominal semi-major axis, (meters)1/2 [8].  Scale factor 2-9 meters ½ . |
| ***kepAlmanacOmega0***  Parameter OMEGA0, longitude of ascending node of orbital plane at weekly epoch (semi-circles) [8].  Scale factor 2-15 semi-circles. |
| ***kepAlmanacW***  Parameter ω, argument of perigee (semi-circles) [8].  Scale factor 2-15 semi-circles. |
| ***kepAlmanacM0***  Parameter M0, mean anomaly at reference time (semi-circles) [8].  Scale factor 2-15 semi-circles. |
| ***kepAlmanacAF0***  Parameter af0, satellite clock correction bias, seconds [8].  Scale factor 2-19 seconds. |
| ***kepAlmanacAF1***  Parameter af1, satellite clock correction linear, sec/sec [8].  Scale factor 2-38 seconds/second. |

#### – *AlmanacNAV-KeplerianSet*

-- ASN1START

AlmanacNAV-KeplerianSet ::= SEQUENCE {

svID SV-ID,

navAlmE INTEGER (0..65535),

navAlmDeltaI INTEGER (-32768..32767),

navAlmOMEGADOT INTEGER (-32768..32767),

navAlmSVHealth INTEGER (0..255),

navAlmSqrtA INTEGER (0..16777215),

navAlmOMEGAo INTEGER (-8388608..8388607),

navAlmOmega INTEGER (-8388608..8388607),

navAlmMo INTEGER (-8388608..8388607),

navAlmaf0 INTEGER (-1024..1023),

navAlmaf1 INTEGER (-1024..1023),

...

}

-- ASN1STOP

| *AlmanacNAV-KeplerianSet* field descriptions |
| --- |
| ***svID***  This field identifies the satellite for which the GNSS Almanac Model is given. |
| ***navAlmE***  Parameter e, eccentricity, dimensionless [4,7].  Scale factor 2-21. |
| ***navAlmDeltaI***  Parameter δi, correction to inclination, semi-circles [4,7].  Scale factor 2-19 semi-circles. |
| ***navAlmOMEGADOT***  Parameter , 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 , square root of the semi-major axis, meters1/2 [4,7]  Scale factor 2-11 meters1/2. |
| ***navAlmOMEGAo***  Parameter 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 M0, mean anomaly at reference time semi-circles [4,7].  Scale factor 2-23 semi-circles. |
| ***navAlmaf0***  Parameter af0, apparent satellite clock correction seconds [4,7].  Scale factor 2-20 seconds. |
| ***navAlmaf1***  Parameter af1, apparent satellite clock correction sec/sec [4,7].  Scale factor 2-38 semi-circles seconds/second. |

#### – *AlmanacReducedKeplerianSet*

-- ASN1START

AlmanacReducedKeplerianSet ::= SEQUENCE {

svID SV-ID,

redAlmDeltaA INTEGER (-128..127),

redAlmOmega0 INTEGER (-64..63),

redAlmPhi0 INTEGER (-64..63),

redAlmL1Health BOOLEAN,

redAlmL2Health BOOLEAN,

redAlmL5Health BOOLEAN,

...

}

-- ASN1STOP

| *AlmanacReducedKeplerianSet* field descriptions |
| --- |
| ***svID***  This field identifies the satellite for which the GNSS Almanac Model is given. |
| ***redAlmDeltaA***  Parameter A, meters [4,5,6,7].  Scale factor 2+9 meters. |
| ***redAlmOmega0***  Parameter 0, semi-circles [4,5,6,7].  Scale factor 2-6 semi-circles. |
| ***redAlmPhi0***  Parameter 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 i, semi-circles [4,5,6,7].  Scale factor 2-14 semi-circles. |
| ***midiAlmOmegaDot***  Parameter , semi-circles/sec [4,5,6,7].  Scale factor 2-33 semi-circles/second. |
| ***midiAlmSqrtA***  Parameter , meters1/2 [4,5,6,7].  Scale factor 2-4 meters1/2. |
| ***midiAlmOmega0***  Parameter 0, semi-circles [4,5,6,7].  Scale factor 2-15 semi-circles. |
| ***midiAlmOmega***  Parameter , semi-circles [4,5,6,7].  Scale factor 2-15 semi-circles. |
| ***midiAlmMo***  Parameter M0, semi-circles [4,5,6,7].  Scale factor 2-15 semi-circles. |
| ***midiAlmaf0***  Parameter afo, seconds [4,5,6,7].  Scale factor 2-20 seconds. |
| ***midiAlmaf1***  Parameter af1, 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

| *AlmanacGLONASS-AlmanacSet* field descriptions |
| --- |
| ***gloAlm-NA***  Parameter NA, days [9].  Scale factor 1 days. |
| ***gloAlmnA***  Parameter nA, dimensionless [9]. |
| ***gloAlmHA***  Parameter HnA, dimensionless [9]. |
| ***gloAlmLambdaA***  Parameter nA, semi-circles [9].  Scale factor 2-20 semi-circles. |
| ***gloAlmtlambdaA***  Parameter tnA, seconds [9].  Scale factor 2-5 seconds. |
| ***gloAlmDeltaIa***  Parameter inA, semi-circles [9].  Scale factor 2-20 semi-circles. |
| ***gloAlmDeltaTA***  Parameter TnA, sec/orbit period [9].  Scale factor 2-9 seconds/orbit period. |
| ***gloAlmDeltaTdotA***  Parameter T\_DOTnA, sec/orbit period2 [9].  Scale factor 2-14 seconds/orbit period2. |
| ***gloAlmEpsilonA***  Parameter nA, dimensionless [9].  Scale factor 2-20. |
| ***gloAlmOmegaA***  Parameter nA, semi-circles [9].  Scale factor 2-15 semi-circles. |
| ***gloAlmTauA***  Parameter nA, seconds [9].  Scale factor 2-18 seconds. |
| ***gloAlmCA***  Parameter CnA, dimensionless [9]. |
| ***gloAlmMA***  Parameter MnA, dimensionless [9]. This parameter is present if its value is nonzero; otherwise it is not present. |

#### – *AlmanacECEF-SBAS-AlmanacSet*

-- ASN1START

AlmanacECEF-SBAS-AlmanacSet ::= SEQUENCE {

sbasAlmDataID INTEGER (0..3),

svID SV-ID,

sbasAlmHealth BIT STRING (SIZE(8)),

sbasAlmXg INTEGER (-16384..16383),

sbasAlmYg INTEGER (-16384..16383),

sbasAlmZg INTEGER (-256..255),

sbasAlmXgdot INTEGER (-4..3),

sbasAlmYgDot INTEGER (-4..3),

sbasAlmZgDot INTEGER (-8..7),

sbasAlmTo INTEGER (0..2047),

...

}

-- ASN1STOP

| *AlmanacECEF-SBAS-AlmanacSet* field descriptions |
| --- |
| ***sbasAlmDataID***  Parameter Data ID, dimensionless [10]. |
| ***svID***  This field identifies the satellite for which the GNSS Almanac Model is given. |
| ***sbasAlmHealth***  Parameter Health, dimensionless [10]. |
| ***sbasAlmXg***  Parameter XG, meters [10].  Scale factor 2600 meters. |
| ***sbasAlmYg***  Parameter YG, meters [10].  Scale factor 2600 meters. |
| ***sbasAlmZg***  Parameter ZG, meters [10].  Scale factor 26000 meters. |
| ***sbasAlmXgdot***  Parameter XG Rat-of-Change, meters/sec [10].  Scale factor 10 meters/second. |
| ***sbasAlmYgDot***  Parameter YG Rate-of-Change, meters/sec [10].  Scale factor 10 meters/second. |
| ***sbasAlmZgDot***  Parameter ZG Rate-of-Change, meters/sec [10].  Scale factor 40.96 meters/second. |
| ***sbasAlmTo***  Parameter t0, 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 |
| --- | --- |
| *NotSameForAllSV* | This field may be present if the toa is not the same for all SVs; otherwise it is not present and the toa is provided in *GNSS-Almanac*. |
| *SV-ID* | This field is mandatory present if *SV-ID* is between 0 and 29; otherwise it is not present. |

| *AlmanacBDS-AlmanacSet* field descriptions |
| --- |
| ***svID***  This field identifies the satellite for which the GNSS Almanac Model is given. |
| ***bdsAlmToa***  Parameter toa, Almanac reference time(seconds) [23]  Scale factor 212 seconds. |
| ***bdsAlmSqrtA***  Parameter A1/2, Square root of semi-major axis (meters1/2) [23]  Scale factor 2-11 meters1/2. |
| ***bdsAlmE***  Parameter e, Eccentricity, dimensionless [23]  Scale factor 2-21. |
| ***bdsAlmW***  Parameter , Argument of Perigee (semi-circles) [23]  Scale factor 2-23 semi-circles. |
| ***bdsAlmM0***  Parameter M0, Mean anomaly at reference time (semi-circles) [23]  Scale factor 2-23 semi-circles. |
| ***bdsAlmOmega0***  Parameter 0, Longitude of ascending node of orbital plane computed according to reference time (semi-circles) [23]  Scale factor 2-23 semi-circles. |
| ***bdsAlmOmegaDot***  Parameter  Rate of right ascension (semi-circles/sec) [23]  Scale factor 2-38 semi-circles/sec. |
| ***bdsAlmDeltaI***  Parameter i, Correction of orbit reference inclination at reference time (semi-circles) [23]  Scale factor 2-19 semi-circles. |
| ***bdsAlmA0***  Parameter a0, Satellite clock bias (seconds) [23]  Scale factor 2-20 seconds. |
| ***bdsAlmA1***  Parameter a1, Satellite clock rate (sec/sec) [23]  Scale factor 2-38 sec/sec. |
| ***bdsSvHealth***  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 A1, scale factor 2-50 seconds/second [4,7,8]. |
| ***gnss-Utc-A0***  Parameter A0, scale factor 2-30 seconds [4,7,8]. |
| ***gnss-Utc-Tot***  Parameter tot, scale factor 212 seconds [4,7,8]. |
| ***gnss-Utc-WNt***  Parameter WNt, scale factor 1 week [4,7,8]. |
| ***gnss-Utc-DeltaTls***  Parameter ΔtLS, scale factor 1 second [4,7,8]. |
| ***gnss-Utc-WNlsf***  Parameter WNLSF, scale factor 1 week [4,7,8]. |
| ***gnss-Utc-DN***  Parameter DN, scale factor 1 day [4,7,8]. |
| ***gnss-Utc-DeltaTlsf***  Parameter ΔtLSF, scale factor 1 second [4,7,8]. |

#### – *UTC-ModelSet2*

-- ASN1START

UTC-ModelSet2 ::= SEQUENCE {

utcA0 INTEGER (-32768..32767),

utcA1 INTEGER (-4096..4095),

utcA2 INTEGER (-64..63),

utcDeltaTls INTEGER (-128..127),

utcTot INTEGER (0..65535),

utcWNot INTEGER (0..8191),

utcWNlsf INTEGER (0..255),

utcDN BIT STRING (SIZE(4)),

utcDeltaTlsf INTEGER (-128..127),

...

}

-- ASN1STOP

| *UTC-ModelSet2* field descriptions |
| --- |
| ***utcA0***  Parameter A0-n, bias coefficient of GNSS time scale relative to UTC time scale (seconds) [4,5,6,7].  Scale factor 2-35 seconds. |
| ***utcA1***  Parameter A1-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 A2-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 ΔtLS, current or past leap second count (seconds) [4,5,6,7].  Scale factor 1 second. |
| ***utcTot***  Parameter tot, time data reference time of week (seconds) [4,5,6,7].  Scale factor 24 seconds. |
| ***utcWNot***  Parameter WNot, time data reference week number (weeks) [4,5,6,7].  Scale factor 1 week. |
| ***utcWNlsf***  Parameter WNLSF, leap second reference week number (weeks) [4,5,6,7].  Scale factor 1 week. |
| ***utcDN***  Parameter DN, leap second reference day number (days) [4,5,6,7].  Scale factor 1 day. |
| ***utcDeltaTlsf***  Parameter ΔtLSF, current or future leap second count (seconds) [4,5,6,7].  Scale factor 1 second. |

#### – *UTC-ModelSet3*

-- ASN1START

UTC-ModelSet3 ::= SEQUENCE {

nA INTEGER (1..1461),

tauC INTEGER (-2147483648..2147483647),

b1 INTEGER (-1024..1023) OPTIONAL, -- Cond GLONASS-M

b2 INTEGER (-512..511) OPTIONAL, -- Cond GLONASS-M

kp BIT STRING (SIZE(2)) OPTIONAL, -- Cond GLONASS-M

...

}

-- ASN1STOP

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

| *UTC-ModelSet3* field descriptions |
| --- |
| ***nA***  Parameter NA, calendar day number within four-year period beginning since the leap year (days) [9].  Scale factor 1 day. |
| ***tauC***  Parameter c, GLONASS time scale correction to UTC(SU) (seconds) [9].  Scale factor 2-31 seconds. |
| ***b1***  Parameter B1, coefficient to determine UT1 (seconds) [9].  Scale factor 2-10 seconds. |
| ***b2***  Parameter B2, coefficient to determine UT1 (seconds/msd) [9].  Scale factor 2-16 seconds/msd. |
| ***kp***  Parameter KP, notification of expected leap second correction (dimensionless) [9]. |

#### – *UTC-ModelSet4*

-- ASN1START

UTC-ModelSet4 ::= SEQUENCE {

utcA1wnt INTEGER (-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 |
| --- |
| ***utcA1wnt***  Parameter A1WNT, sec/sec ([10], Message Type 12).  Scale factor 2-50 seconds/second. |
| ***utcA0wnt***  Parameter A0WNT, seconds ([10], Message Type 12).  Scale factor 2-30 seconds. |
| ***utcTot***  Parameter tot, seconds ([10], Message Type 12).  Scale factor 212 seconds. |
| ***utcWNt***  Parameter WNt, weeks ([10], Message Type 12).  Scale factor 1 week. |
| ***utcDeltaTls***  Parameter ΔtLS, seconds ([10], Message Type 12).  Scale factor 1 second. |
| ***utcWNlsf***  Parameter WNLSF, weeks ([10], Message Type 12).  Scale factor 1 week. |
| ***utcDN***  Parameter DN, days ([10], Message Type 12).  Scale factor 1 day. |
| ***utcDeltaTlsf***  Parameter ΔtLSF, seconds ([10], Message Type 12).  Scale factor 1 second. |
| ***utcStandardID***  If *GNSS-ID* indicates 'sbas', this field indicates the UTC standard used for the SBAS network time indicated by *SBAS‑ID* to UTC relation as defined in the table Value of UTC Standard ID to UTC Standard relation shown below ([10], Message Type 12). |

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 |
| --- |
| ***utcA0***  Parameter A0UTC, BDS clock bias relative to UTC, seconds [23].  Scale factor 2-30 seconds. |
| ***utcA1***  Parameter A1UTC, BDS clock rate relative to UTC, sec/sec [23].  Scale factor 2-50 sec/sec. |
| ***utcDeltaTls***  Parameter ΔtLS, delta time due to leap seconds before the new leap second effective, seconds [23].  Scale factor 1 second. |
| ***utcWNlsf***  Parameter WNLSF, week number of the new leap second, weeks [23].  Scale factor 1 week. |
| ***utcDN***  Parameter DN, day number of week of the new leap second, days [23].  Scale factor 1 day. |
| ***utcDeltaTlsf***  Parameter ΔtLSF, delta time due to leap seconds after the new leap second effective, seconds [23].  Scale factor 1 second. |

#### – *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 |
| --- | --- |
| *FDMA* | The field is mandatory present if the GLONASS SV indicated by *svID* broadcasts FDMA signals; otherwise it is not present. |

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

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

#### – *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-GridModelParamater* 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], clause 5.3.3.8. |
| ***dt***  This field indicates dT as defined in [23], clause 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], clause 5.3.3.8.2. |

#### *– GNSS-RTK-Observations*

The IE *GNSS-RTK-Observations* is used by the location server to provide GNSS reference station observables (pseudorange, phaserange, phaserange-rate (Doppler), and carrier-to-noise ratio) of the GNSS signals. Essentially, these parameters describe the range and derivatives from respective satellites to the reference station location provided in IE *GNSS-RTK-ReferenceStationInfo*.

The parameters provided in IE *GNSS-RTK-Observations* are used as specified for message type 1071-1127 in [30].

-- ASN1START

GNSS-RTK-Observations-r15 ::= SEQUENCE {

epochTime-r15 GNSS-SystemTime,

gnss-ObservationList-r15 GNSS-ObservationList-r15,

...

}

GNSS-ObservationList-r15 ::= SEQUENCE (SIZE(1..64)) OF GNSS-RTK-SatelliteDataElement-r15

GNSS-RTK-SatelliteDataElement-r15 ::= SEQUENCE{

svID-r15 SV-ID,

integer-ms-r15 INTEGER (0..254) OPTIONAL, -- Need ON

rough-range-r15 INTEGER (0..1023),

rough-phase-range-rate-r15 INTEGER (-8192..8191) OPTIONAL, -- Need ON

gnss-rtk-SatelliteSignalDataList-r15 GNSS-RTK-SatelliteSignalDataList-r15,

...

}

GNSS-RTK-SatelliteSignalDataList-r15 ::= SEQUENCE (SIZE(1..24)) OF

GNSS-RTK-SatelliteSignalDataElement-r15

GNSS-RTK-SatelliteSignalDataElement-r15 ::= SEQUENCE {

gnss-SignalID-r15 GNSS-SignalID,

fine-PseudoRange-r15 INTEGER (-524288..524287),

fine-PhaseRange-r15 INTEGER (-8388608..8388607),

lockTimeIndicator-r15 INTEGER (0..1023),

halfCycleAmbiguityIndicator-r15 BIT STRING (SIZE (1)),

carrier-to-noise-ratio-r15 INTEGER (0..1023) OPTIONAL, -- Need ON

fine-PhaseRangeRate-r15 INTEGER (-16384..16383) OPTIONAL, -- Need ON

...

}

-- ASN1STOP

| *GNSS-RTK-Observations* field descriptions |
| --- |
| ***epochTime***  This field specifies the epoch time of the observations. The *gnss-TimeID* in *GNSS SystemTime* shall be the same as the *GNSS-ID* in IE *GNSS-GenericAssistDataElement.* |
| ***svID***  This field specifies the GNSS *SV‑ID* of the satellite for which the GNSS Observations are provided. |
| ***integer-ms***  This field contains the integer number of milliseconds in the satellite rough range. Rough range can be used to restore complete observables for a given satellite.  Scale factor 1 milli-second in the range from 0 to 254 milli-seconds. |
| ***rough-range***  This field contains the sub-milliseconds in the satellite rough range (modulo 1 millisecond).  Scale factor 2-10 milli-seconds in the range from 0 to (1-2-10) milli-seconds. |
| ***rough-phase-range-rate***  This field contains the GNSS satellite rough phaserange rate.  Scale factor 1 m/s. Range ±8191 m/s. |
| ***gnss-SignalID***  This field specifies the GNSS signal for which the GNSS observations are provided. |
| ***fine-PseudoRange***  This field contains the GNSS signal fine pseudorange.  Being added to fields *integer-ms* and *rough-range* allows getting the full pseudorange observable corresponding to given signal. NOTE 1.  Scale factor 2–29 milli-seconds. Range ±(2–10–2–29) milli-seconds. |
| ***fine-PhaseRange***  This field contains the GNSS signal fine phaserange.  Being added to fields *integer-ms* and *rough-range* allows getting the full phaserange observable corresponding to given signal. NOTE 2.  Scale factor 2–31 milli-seconds. Range ±(2–8–2–31) milli-seconds. |
| ***lockTimeIndicator***  This field provides a measure of the amount of time during which the receiver has maintained continuous lock on that satellite signal. If a cycle slip occurs during the previous measurement cycle, the lock time indicator shall be reset to zero.  Mapping according to the table *lockTimeIndicator* value to interpretation lock-time relation shown below. |
| ***halfCycleAmbiguityIndicator***  Value 0 indicates no half-cycle ambiguity. Value 1 indicates half-cycle ambiguity.  When providing phaserange with unresolved polarity encoding this bit shall be set to 1. A target device that is not capable of handling half-cycle ambiguities shall skip such phaserange observables. If polarity resolution forced phaserange to be corrected by half-a-cycle, then the *lockTimeIndicator* must be reset to zero, indicating that despite continuous tracking the final phaserange experienced non-continuity. |
| ***carrier-to-noise-ratio***  This field provides the GNSS signal carrier-to-noise-ratio in dB-Hz.  Scale factor 2–4 dB-Hz in the range from 0.0625 to 63.9375 dB-Hz. |
| ***fine-PhaseRangeRate***  This field contains the GNSS signal fine Phase Range Rate.  Full phaserange rate is the sum of this field and the *rough-phase-range-rate* field. NOTE 3.  Scale factor 0.0001 m/s. Range ±1.6383 m/s. |

NOTE 1: Complete Pseudorange for each signal (i) of given satellite can be restored as follows:   
Pseudorange(i) = c/1000 × (*integer-ms* + *rough\_range*/1024 + 2–29 × *fine\_Pseudorange*(i)), meter.

NOTE 2: Complete Phaserange for each signal (i) of given satellite can be restored as follows:  
Phaserange(i) = c/1000 × (*integer-ms* + *rough\_range*/1024 + 2–31 × *fine\_Phaserange*(i)), meter.

NOTE 3: Complete PhaseRangeRate for each signal (i) of given satellite can be restored as follows:  
PhaseRangeRate(i) = *rough-phase-range-rate* + 0.0001\**fine-PhaseRangeRate* (i), meter/sec.

NOTE 4: The speed of light c is 299,792,458 meters per second.

*lockTimeIndicator* value to interpretation lock-time relation

|  |  |  |  |
| --- | --- | --- | --- |
| Indicator (i) | Supplementary coefficient (k) | Minimum Lock Time (ms) | Range of Indicated Lock Times (t) (ms) |
| 0 – 63 | 1 | i | 0 ≤ t < 64 |
| 64 – 95 | 2 | 2 × i – 64 | 64 ≤ t < 128 |
| 96 – 127 | 4 | 4 × i – 256 | 128 ≤ t < 256 |
| 128 – 159 | 8 | 8 × i – 768 | 256 ≤ t < 512 |
| 160 – 191 | 16 | 16 × i – 2048 | 512 ≤ t < 1024 |
| 192 – 223 | 32 | 32 × i – 5120 | 1024 ≤ t < 2048 |
| 224 – 255 | 64 | 64 × i – 12288 | 2048 ≤ t < 4096 |
| 256 – 287 | 128 | 128 × i – 28672 | 4096 ≤ t < 8192 |
| 288 – 319 | 256 | 256 × i – 65536 | 8192 ≤ t < 16384 |
| 320 – 351 | 512 | 512 × i – 147456 | 16384 ≤ t < 32768 |
| 352 – 383 | 1024 | 1024 × i – 327680 | 32768 ≤ t < 65536 |
| 384 – 415 | 2048 | 2048 × i – 720896 | 65536 ≤ t < 131072 |
| 416 – 447 | 4096 | 4096 × i – 1572864 | 131072 ≤ t < 262144 |
| 448 – 479 | 8192 | 8192 × i – 3407872 | 262144 ≤ t < 524288 |
| 480 – 511 | 16384 | 16384 × i – 7340032 | 524288 ≤ t < 1048576 |
| 512 – 543 | 32768 | 32768 × i – 15728640 | 1048576 ≤ t < 2097152 |
| 544 – 575 | 65536 | 65536 × i – 33554432 | 2097152 ≤ t < 4194304 |
| 576 – 607 | 131072 | 131072 × i – 71303168 | 4194304 ≤ t < 8388608 |
| 608 – 639 | 262144 | 262144 × i – 150994944 | 8388608 ≤ t < 16777216 |
| 640 – 671 | 524288 | 524288 × i – 318767104 | 16777216 ≤ t < 33554432 |
| 672 – 703 | 1048576 | 1048576 × i – 671088640 | 33554432 ≤ t < 67108864 |
| 704 | 2097152 | 2097152 × i – 1409286144 | 67108864 ≤ t |
| 705 – 1023 | Reserved | | |

#### *– GLO-RTK-BiasInformation*

The IE *GLO-RTK-BiasInformation* is used by the location server to provide the so-called "GLONASS Code-Phase bias values" (CPB) for up to all FDMA GLONASS observations.

If IE *GNSS-RTK-Observations* for *gnss-ID* = *glonass* are provided, but IE *GLO-RTK-BiasInformation* is not provided, the target device assumes that the CPB information has been applied to the GLONASS observation data a priori.

The parameters provided in IE *GLO-RTK-BiasInformation* are used as specified for message type 1230 in [30].

-- ASN1START

GLO-RTK-BiasInformation-r15 ::= SEQUENCE{

referenceStationID-r15 GNSS-ReferenceStationID-r15,

cpbIndicator-r15 BIT STRING (SIZE(1)),

l1-ca-cpBias-r15 INTEGER (-32768..32767) OPTIONAL, -- Need ON

l1-p-cpBias-r15 INTEGER (-32768..32767) OPTIONAL, -- Need ON

l2-ca-cpBias-r15 INTEGER (-32768..32767) OPTIONAL, -- Need ON

l2-p-cpBias-r15 INTEGER (-32768..32767) OPTIONAL, -- Need ON

...

}

-- ASN1STOP

| *GLO-RTK-BiasInformation* field descriptions |
| --- |
| ***referenceStationID***  This field specifies the Station ID for which the *GLO-RTK-BiasInformation* is provided. |
| ***cpbIndicator***  This field specifies the GLONASS Code-Phase Bias Indicator. The interpretation of the value is as follows:  0 – The GLONASS Pseudorange and Phaserange observations in IE *GNSS-RTK-Observations* are not aligned to the same measurement epoch.  1 – The GLONASS Pseudorange and Phaserange observations in IE *GNSS-RTK-Observations* are aligned to the same measurement epoch. |
| ***l1-ca-cpBias***  This field specifies the GLONASS L1 C/A Code-Phase Bias, which represents the offset between the L1 C/A Pseudorange and L1 Phaserange measurement epochs in meters.  If *cpbIndicator* is set to 0, the measurement epoch of the GLONASS L1 Phaserange measurements may be aligned using:  Aligned GLONASS L1 Phaserange = Full GLONASS L1 Phaserange + GLONASS L1 C/A Code-Phase Bias.  If *cpbIndicator* is set to 1, the measurement epoch of the GLONASS L1 Phaserange measurements may be unaligned using:  Unaligned GLONASS L1 Phaserange = Full GLONASS L1 Phaserange – GLONASS L1 C/A Code-Phase Bias.  Scale factor 0.02 m. Range ±655.34 m. |
| ***l1-p-cpBias***  This field specifies the GLONASS L1 P Code-Phase Bias, which represents the offset between the L1 P Pseudorange and L1 Phaserange measurement epochs in meters.  If *cpbIndicator* is set to 0, the measurement epoch of the GLONASS L1 Phaserange measurements may be aligned using:  Aligned GLONASS L1 Phaserange = Full GLONASS L1 Phaserange + GLONASS L1 P Code-Phase Bias.  If *cpbIndicator* is set to 1, the measurement epoch of the GLONASS L1 Phaserange measurements may be unaligned using:  Unaligned GLONASS L1 Phaserange = Full GLONASS L1 Phaserange – GLONASS L1 P Code-Phase Bias.  Scale factor 0.02 m. Range ±655.34 m. |
| ***l2-ca-cpBias***  This field specifies the GLONASS L2 C/A Code-Phase Bias, which represents the offset between the L2 C/A Pseudorange and L2 Phaserange measurement epochs in meters.  If *cpbIndicator* is set to 0, the measurement epoch of the GLONASS L2 Phaserange measurements may be aligned using:  Aligned GLONASS L2 Phaserange = Full GLONASS L2 Phaserange + GLONASS L2 C/A Code-Phase Bias.  If *cpbIndicator* is set to 1, the measurement epoch of the GLONASS L2 Phaserange measurements may be unaligned using:  Unaligned GLONASS L2 Phaserange = Full GLONASS L2 Phaserange – GLONASS L2 C/A Code-Phase Bias.  Scale factor 0.02 m. Range ±655.34 m. |
| ***l2-p-cpBias***  This field specifies the GLONASS L2 P Code-Phase Bias, which represents the offset between the L2 P Pseudorange and L2 Phaserange measurement epochs in meters.  If *cpbIndicator* is set to 0, the measurement epoch of the GLONASS L2 Phaserange measurements may be aligned using:  Aligned GLONASS L2 Phaserange = Full GLONASS L2 Phaserange + GLONASS L2 P Code-Phase Bias.  If *cpbIndicator* is set to 1, the measurement epoch of the GLONASS L2 Phaserange measurements may be unaligned using:  Unaligned GLONASS L2 Phaserange = Full GLONASS L2 Phaserange – GLONASS L2 P Code-Phase Bias.  Scale factor 0.02 m. Range ±655.34 m. |

#### *– GNSS-RTK-MAC-CorrectionDifferences*

The IE *GNSS-RTK-MAC-CorrectionDifferences* is used by the location server to provide dispersive (ionospheric) and non-dispersive (geometric) correction difference components for up to 32 pairs of Auxiliary and Master Reference Stations. The Master Reference Station coordinates are provided in IE *GNSS-RTK-ReferenceStationInfo* and the Auxiliary Station coordinates are provided in IE *GNSS-RTK-AuxiliaryStationData*.

The parameters provided in IE *GNSS-RTK-MAC-CorrectionDifferences* are used as specified for message type 1017 and 1039 in [30] and apply to all GNSS.

-- ASN1START

GNSS-RTK-MAC-CorrectionDifferences-r15 ::= SEQUENCE {

networkID-r15 GNSS-NetworkID-r15,

subNetworkID-r15 GNSS-SubNetworkID-r15 OPTIONAL, -- Need ON

master-ReferenceStationID-r15 GNSS-ReferenceStationID-r15,

l1-r15 GNSS-FrequencyID-r15 OPTIONAL, -- Need OP

l2-r15 GNSS-FrequencyID-r15 OPTIONAL, -- Need OP

rtkCorrectionDifferencesList-r15 RTK-CorrectionDifferencesList-r15,

...

}

RTK-CorrectionDifferencesList-r15 ::= SEQUENCE (SIZE (1..32)) OF

RTK-CorrectionDifferencesElement-r15

RTK-CorrectionDifferencesElement-r15 ::= SEQUENCE {

epochTime-r15 GNSS-SystemTime,

auxiliary-referenceStationID-r15 GNSS-ReferenceStationID-r15,

geometric-ionospheric-corrections-differences-r15

Geometric-Ionospheric-Corrections-Differences-r15,

...

}

Geometric-Ionospheric-Corrections-Differences-r15 ::= SEQUENCE (SIZE(1..64)) OF

Geometric-Ionospheric-Corrections-Differences-Element-r15

Geometric-Ionospheric-Corrections-Differences-Element-r15 ::= SEQUENCE {

svID-r15 SV-ID,

ambiguityStatusFlag-r15 INTEGER (0..3),

non-synch-count-r15 INTEGER (0..7),

geometricCarrierPhaseCorrectionDifference-r15 INTEGER (-65536..65535),

iod-r15 BIT STRING (SIZE(11)),

ionosphericCarrierPhaseCorrectionDifference-r15 INTEGER (-65536..65535),

...

}

-- ASN1STOP

| *GNSS-RTK-MAC-CorrectionDifferences* field descriptions |
| --- |
| ***networkID***  This field provides the network ID. |
| ***subNetworkID***  This field identifies the subnetwork of a network identified by *networkID*. |
| ***master-ReferenceStationID***  This field specifies the station ID of the Master Reference Station. |
| ***l1, l2***  These fields specify the dual-frequency combination of L1 and L2 link/frequencies for which the *rtkCorrectionDifferencesList* is provided. If the fields are absent, the default interpretation in table 'L1/L2 default interpretation' applies. |
| ***rtkCorrectionDifferencesList***  This field provides the correction differences for Auxiliary-Master Reference Station pairs. |
| ***epochTime***  This field specifies the epoch time of observations used to derive the correction differences. The *gnss-TimeID* in *GNSS‑SystemTime* shall be the same as the *GNSS-ID* in IE *GNSS-GenericAssistDataElement*. |
| ***auxiliary-referenceStationID***  This field specifies the station ID of the Auxiliary Reference Station. |
| ***svID***  This field specifies the satellite for which the data is provided. |
| ***ambiguityStatusFlag***  This field provides the ambiguity status. 'L1' below corresponds to the link indicated by the *l1* field; 'L2' below corresponds to the link indicated by the *l2* field.  0 - Reserved for future use (artificial observations)  1 - Correct Integer Ambiguity Level for L1 and L2  2 - Correct Integer Ambiguity Level for L1-L2 widelane  3 - Uncertain Integer Ambiguity Level. Only a likely guess is used. |
| ***non-synch-count***  This field provides the count of unrecoverable cycle slips. Whenever an unrecoverable cycle slip occurs this count shall be increased. The counter shall not be increased more than once per minute. Data for satellites with cycle slips more frequent than once per minute should not be provided. |
| ***geometricCarrierPhaseCorrectionDifference***  This field provides the Geometric Carrier Phase Correction Difference (GCPCD), which is the Correction Difference for the geometric part (troposphere and orbits) calculated based on integer leveled L1 and L2 correction differences (L1CD and L2CD).    L1CD, L2CD, and ICPCD are presented in meters. 'L1' below corresponds to the link indicated by the *l1* field; 'L2' below corresponds to the link indicated by the *l2* field.  Scale factor 0.5 milli-meter; range ±32.767 meters. |
| ***iod***  This field specifies the IOD value of the broadcast ephemeris used for calculation of Correction Differences (see IE *GNSS-NavigationModel*). |
| ***ionosphericCarrierPhaseCorrectionDifference***  This field provides the Ionospheric Carrier Phase Correction Difference (ICPCD), which is the Correction Difference for the ionospheric part calculated based on integer leveled L1 and L2 correction differences (L1CD and L2CD).    L1CD, L2CD, and ICPCD are presented in meters. 'L1' below corresponds to the link indicated by the *l1* field; 'L2' below corresponds to the link indicated by the *l2* field.  Scale factor 0.5 milli-meter; range ±32.767 meters. |

L1/L2 default interpretation

|  |  |  |
| --- | --- | --- |
| GNSS | *l1* | *l2* |
| GPS | L1 | L2 |
| SBAS | L1 | L5 |
| QZSS | L1 | L2 |
| Galileo | E1 | E5a |
| GLONASS | G1 | G2 |
| BDS | B1 | B2 |

#### *– GNSS-RTK-Residuals*

The IE *GNSS-RTK-Residuals* is used by the location server to provide Network RTK correction residual error information.

If the interpolation of the corrections for the target device location is performed at the location server, resulting in a non-physical reference station, the *GNSS-RTK-Residuals* are referenced to the non-physical reference station.

If the interpolation of the corrections is performed by the target device (e.g., using *GNSS‑RTK‑MAC‑CorrectionDifferences)*, the *GNSS-RTK-Residuals* are referenced to the closest master or auxiliary station to the target device.

The parameters provided in IE *GNSS-RTK-Residuals* are used as specified for message type 1030 and 1031 in [30] and apply to all GNSS.

-- ASN1START

GNSS-RTK-Residuals-r15 ::= SEQUENCE {

epochTime-r15 GNSS-SystemTime,

referenceStationID-r15 GNSS-ReferenceStationID-r15,

n-Refs-r15 INTEGER (0..127),

l1-r15 GNSS-FrequencyID-r15 OPTIONAL, -- Need OP

l2-r15 GNSS-FrequencyID-r15 OPTIONAL, -- Need OP

rtk-residuals-list-r15 RTK-Residuals-List-r15,

...

}

RTK-Residuals-List-r15 ::= SEQUENCE (SIZE(1..64)) OF RTK-Residuals-Element-r15

RTK-Residuals-Element-r15 ::= SEQUENCE {

svID-r15 SV-ID,

s-oc-r15 INTEGER (0..255),

s-od-r15 INTEGER (0..511),

s-oh-r15 INTEGER (0..63),

s-lc-r15 INTEGER (0..1023),

s-ld-r15 INTEGER (0..1023),

...

}

-- ASN1STOP

| *GNSS-RTK-Residuals* field descriptions |
| --- |
| ***epochTime***  This field specifies the epoch time of the Network RTK Residual Error data. The *gnss-TimeID* in *GNSS‑SystemTime* shall be the same as the *GNSS-ID* in IE *GNSS-GenericAssistDataElement*. |
| ***referenceStationID***  This field specifies the Reference Station ID. The Reference Station may be a physical or non-physical station. |
| ***n-Refs***  This field specifies the number of reference stations used to derive the residual statistics (1 to 127; 127 indicates 127 or more stations). The number of reference stations should never be zero. If zero is encountered the target device should ignore the message. |
| ***l1, l2***  These fields specify the dual-frequency combination of L1 and L2 link/frequencies for which the *rtk residuals-list* is provided. If the fields are absent, the default interpretation in table 'L1/L2 default interpretation' in IE *GNSS‑RTK‑MAC‑CorrectionDifferences* applies. |
| **svID**  This field specifies the satellite for which the data is provided. |
| ***s-oc***  This field specifies the constant term of standard deviation (1 sigma) for non-dispersive interpolation residuals, *s0c*.  Scale factor 0.5 milli-meter; range 0–127 milli-meter. NOTE 1. |
| ***s-od***  This field specifies the distance dependent term of standard deviation (1 sigma) for nondispersive interpolation residuals, *s0d*.  Scale factor 0.01 ppm; range 0–5.11 ppm. NOTE 1. |
| ***s-oh***  This field specifies the height dependent term of standard deviation (1 sigma) for nondispersive interpolation residuals, *s0h*.  Scale factor 0.1 ppm; range 0–5.1 ppm. NOTE 1. |
| ***s-lc***  This field specifies the constant term of standard deviation (1 sigma) for dispersive interpolation residuals (as affecting L1 frequency), *slc*. 'L1' corresponds to the link indicated by the *l1* field.  Scale factor 0.5 milli-meter; range 0–511 milli-meter |
| ***s-ld***  This field specifies the distance dependent term of standard deviation (1 sigma) for dispersive interpolation residuals (as affecting L1 frequency), *sld*. 'L1' corresponds to the link indicated by the *l1* field. NOTE 2. |

NOTE 1: The complete standard deviation for the expected non-dispersive interpolation residual is computed from *s-oc*, *s-od* and *s-oh* using the formula:  
  
where *dRef* is the distance of the target device from the nearest physical reference station in [km] and |*dhRef*| is the absolute value of the height difference between the nearest physical reference station and the target device in [km].

NOTE 2: The complete standard deviation for the expected dispersive interpolation residual is computed from *s-lc* and *s-ld* using the formula:  
  
where *dRef* is the distance of the target device from the nearest physical reference station in [km].   
The standard deviation for the L2 frequency is calculated using the formula:  
. 'L2' corresponds to the link indicated by the *l2* field; *c/f1c/f2* are the nominal wavelengths of the links indicated by the *l1*, *l2* fields, respectively.

#### *– GNSS-RTK-FKP-Gradients*

The IE *GNSS-RTK-FKP-Gradients* is used by the location server to provide the FKP Network RTK gradients of distance-dependent errors like ionosphere, troposphere and orbits. The target device may use the gradients to compute the influence of the distance dependent errors for its own position.

The parameters provided in IE *GNSS-RTK-FKP-Gradients* are used as specified for message type 1034 and 1035 in [30] and apply to all GNSS.

-- ASN1START

GNSS-RTK-FKP-Gradients-r15 ::= SEQUENCE {

referenceStationID-r15 GNSS-ReferenceStationID-r15,

epochTime-r15 GNSS-SystemTime,

l1-r15 GNSS-FrequencyID-r15 OPTIONAL, -- Need OP

l2-r15 GNSS-FrequencyID-r15 OPTIONAL, -- Need OP

fkp-gradients-list-r15 FKP-Gradients-List-r15,

...

}

FKP-Gradients-List-r15 ::= SEQUENCE (SIZE(1..64)) OF FKP-Gradients-Element-r15

FKP-Gradients-Element-r15 ::= SEQUENCE {

svID-r15 SV-ID,

iod-r15 BIT STRING (SIZE(11)),

north-geometric-gradient-r15 INTEGER (-2048..2047),

east-geometric-gradient-r15 INTEGER (-2048..2047),

north-ionospheric-gradient-r15 INTEGER (-8192..8191),

east-ionospheric-gradient-r15 INTEGER (-8192..8191),

...

}

-- ASN1STOP

| *GNSS-RTK-FKP-Gradients* field descriptions |
| --- |
| ***referenceStationID***  This field specifies the Reference Station ID. The Reference Station may be a physical or non-physical station. |
| ***epochTime***  This field specifies the epoch time of the FKP data. The *gnss-TimeID* in *GNSS‑SystemTime* shall be the same as the *GNSS-ID* in IE *GNSS-GenericAssistDataElement*. |
| ***l1, l2***  These fields specify the dual-frequency combination of L1 and L2 link/frequencies for which the *fkp-gradients-list* is provided. If the fields are absent, the default interpretation in table 'L1/L2 default interpretation' in IE *GNSS‑RTK‑MAC‑CorrectionDifferences* applies. NOTE. |
| ***svID***  This field specifies the satellite for which the data is provided. |
| ***iod***  This field specifies the IOD value of the broadcast ephemeris used for calculation of FKP data (see IE *GNSS‑NavigationModel*). |
| ***north-geometric-gradient***  This field specifies the gradient (FKP) of the geometric (non-dispersive) error components in South-North direction in parts per million of the south-north distance to the reference station.  Scale factor 0.01 ppm; range ±20.47 ppm. |
| ***east-geometric-gradient***  This field specifies the gradient (FKP) of the geometric (non-dispersive) error components in West-East direction in parts per million of the west-east distance to the reference station.  Scale factor 0.01 ppm; range ±20.47 ppm. |
| ***north-ionospheric-gradient***  This field specifies the gradient (FKP) of the ionospheric (dispersive) error component in South-North direction.  Scale factor 0.01 ppm; range ±81.91 ppm. |
| ***east-ionospheric-gradient***  This field specifies the gradient (FKP) of the ionospheric (dispersive) error component in West-East direction.  Scale factor 0.01 ppm; range ±81.91 ppm. |

NOTE: As described in [30], the distance dependent error for the geometric part *0* and ionospheric part *I* is computed from the gradients provided in *FKP-Gradients-Element*. The distance dependent error for a carrier phase measurements *Ф* on a signal with frequency *f* can be computed by:  


where *f1*, *f* is the link/frequency indicated by the *l1*, *l2* fields, respectively.

#### *– GNSS-SSR-OrbitCorrections*

The IE *GNSS-SSR-OrbitCorrections* is used by the location server to provide radial, along-track and cross-track orbit corrections. The target device may use the parameters to compute a satellite position correction to be combined with the satellite position calculated from broadcast ephemeris.

The parameters provided in IE *GNSS-SSR-OrbitCorrections* are used as specified for SSR Clock Messages (e.g., message type 1057 and 1063) in [30] and apply to all GNSS.

-- ASN1START

GNSS-SSR-OrbitCorrections-r15 ::= SEQUENCE {

epochTime-r15 GNSS-SystemTime,

ssrUpdateInterval-r15 INTEGER (0..15),

satelliteReferenceDatum-r15 ENUMERATED { itrf, regional, ... },

iod-ssr-r15 INTEGER (0..15),

ssr-OrbitCorrectionList-r15 SSR-OrbitCorrectionList-r15,

...

}

SSR-OrbitCorrectionList-r15 ::= SEQUENCE (SIZE(1..64)) OF SSR-OrbitCorrectionSatelliteElement-r15

SSR-OrbitCorrectionSatelliteElement-r15 ::= SEQUENCE {

svID-r15 SV-ID,

iod-r15 BIT STRING (SIZE(11)),

delta-radial-r15 INTEGER (-2097152..2097151),

delta-AlongTrack-r15 INTEGER (-524288..524287),

delta-CrossTrack-r15 INTEGER (-524288..524287),

dot-delta-radial-r15 INTEGER (-1048576..1048575) OPTIONAL,

dot-delta-AlongTrack-r15 INTEGER (-262144..262143) OPTIONAL,

dot-delta-CrossTrack-r15 INTEGER (-262144..262143) OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-SSR-OrbitCorrections* field descriptions |
| --- |
| ***epochTime***  This field specifies the epoch time of the orbit corrections. The *gnss-TimeID* in *GNSS-SystemTime* shall be the same as the *GNSS-ID* in IE *GNSS-GenericAssistDataElement*. |
| ***ssrUpdateInterval***  This field specifies the SSR Update Interval. The SSR Update Intervals for all SSR parameters start at time 00:00:00 of the GPS time scale. A change of the SSR Update Interval during the transmission of SSR data should ensure consistent data for a target device. See table Value to SSR Update Interval Relation below. NOTE 1. |
| ***satelliteReferenceDatum***  This field specifies the satellite refence datum for the orbit corrections. |
| ***iod-ssr***  This field specifies the Issue of Data number for the SSR data. A change of *iod-ssr* is used to indicate a change in the SSR generating configuration. |
| ***svID***  This field specifies the satellite for which the orbit corrections are provided. |
| ***iod***  This field specifies the IOD value of the broadcast ephemeris for which the orbit corrections are valid (see IE *GNSS‑NavigationModel*). NOTE 2. |
| ***delta-radial***  This field specifies the radial orbit correction for broadcast ephemeris. NOTE 3.  Scale factor 0.1 mm; range ±209.7151 m. |
| ***delta-AlongTrack***  This field specifies the along-track orbit correction for broadcast ephemeris. NOTE 3.  Scale factor 0.4 mm; range ±209.7148 m. |
| ***delta-CrossTrack***  This field specifies the cross-track orbit correction for broadcast ephemeris. NOTE 3.  Scale factor 0.4 mm; range ±209.7148 m. |
| ***dot-delta-radial***  This field specifies the velocity of radial orbit correction for broadcast ephemeris. NOTE 3.  Scale factor 0.001 mm/s; range ±1.048575 m/s. |
| ***dot-delta-AlongTrack***  This field specifies the velocity of along-track orbit correction for broadcast ephemeris. NOTE 3.  Scale factor 0.004 mm/s; range ±1.048572 m/s. |
| ***dot-delta-CrossTrack***  This field specifies the velocity of cross-track orbit correction for broadcast ephemeris. NOTE 3.  Scale factor 0.004 mm/s; range ±1.048572 m/s. |

NOTE 1: The update intervals are aligned to the GPS time scale for all GNSS in order to allow synchronous operation for multiple GNSS services. This means that the update intervals may not be aligned to the beginning of the day for another GNSS. Due to the leap seconds, this is generally the case for GLONASS.

NOTE 2: In case the *gnss-ID* indicates 'gps' or 'qzss', the *iod* refers to the NAV broadcast ephemeris (GPS L1 C/A or QZSS QZS-L1, respectively, in table GNSS to iod Bit String(11) relation in IE *GNSS‑NavigationModel).*

NOTE 3: The reference time *t0* is *epochTime* + ½ × *ssrUpdateInterval*. The reference time *t0* for *ssrUpdateInterval* '0' is *epochTime*.

Value to SSR Update Interval Relation

|  |  |
| --- | --- |
| Value of ssrUpdateInterval | SSR Update Interval |
| 0 | 1 second |
| 1 | 2 seconds |
| 2 | 5 seconds |
| 3 | 10 seconds |
| 4 | 15 seconds |
| 5 | 30 seconds |
| 6 | 60 seconds |
| 7 | 120 seconds |
| 8 | 240 seconds |
| 9 | 300 seconds |
| 10 | 600 seconds |
| 11 | 900 seconds |
| 12 | 1800 seconds |
| 13 | 3600 seconds |
| 14 | 7200 seconds |
| 15 | 10800 seconds |

#### *– GNSS-SSR-ClockCorrections*

The IE *GNSS-SSR-ClockCorrections* is used by the location server to provide clock correction parameters. The target device may use the parameters to compute a clock correction to be applied to the broadcast satellite clock parameters, identified by *iod* of corresponding *GNSS-SSR-OrbitCorrections*.

The parameters provided in IE *GNSS-SSR-ClockCorrections* are used as specified for SSR Clock Messages (e.g., message type 1058 and 1064) in [30] and apply to all GNSS.

-- ASN1START

GNSS-SSR-ClockCorrections-r15 ::= SEQUENCE {

epochTime-r15 GNSS-SystemTime,

ssrUpdateInterval-r15 INTEGER (0..15),

iod-ssr-r15 INTEGER (0..15),

ssr-ClockCorrectionList-r15 SSR-ClockCorrectionList-r15,

...

}

SSR-ClockCorrectionList-r15 ::= SEQUENCE (SIZE(1..64)) OF SSR-ClockCorrectionSatelliteElement-r15

SSR-ClockCorrectionSatelliteElement-r15 ::= SEQUENCE {

svID-r15 SV-ID,

delta-Clock-C0-r15 INTEGER (-2097152..2097151),

delta-Clock-C1-r15 INTEGER (-1048576..1048575) OPTIONAL,

delta-Clock-C2-r15 INTEGER (-67108864..67108863) OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-SSR-ClockCorrections* field descriptions |
| --- |
| ***epochTime***  This field specifies the epoch time of the clock corrections. The gnss-TimeID in *GNSS-SystemTime* shall be the same as the *GNSS-ID* in IE *GNSS-GenericAssistDataElement.* |
| ***ssrUpdateInterval***  This field specifies the SSR Update Interval. The SSR Update Intervals for all SSR parameters start at time 00:00:00 of the GPS time scale. A change of the SSR Update Interval during the transmission of SSR data should ensure consistent data for a target device. See table Value to SSR Update Interval Relation in IE *GNSS‑SSR‑OrbitCorrections*. |
| ***iod-ssr***  This field specifies the Issue of Data number for the SSR data. A change of iod-ssr is used to indicate a change in the SSR generating configuration. |
| ***svID***  This field specifies the satellite for which the clock corrections are provided. |
| ***delta-Clock-C0***  This field specifies the C0 polynomial coefficient for correction of broadcast satellite clock. NOTE 1.  Scale factor 0.1 mm; range ±209.7151 m. |
| ***delta-Clock-C1***  This field specifies the C1 polynomial coefficient for correction of broadcast satellite clock. NOTE 1.  Scale factor 0.001 mm/s; range ±1.048575 m/s. |
| ***delta-Clock-C2***  This field specifies the C2 polynomial coefficient for correction of broadcast satellite clock. NOTE 1.  Scale factor 0.00002 mm/s2; range ±1.34217726 m/s2. |

NOTE 1: The reference time *t0* is *epochTime* + ½ × *ssrUpdateInterval*. The reference time *t0* for *ssrUpdateInterval* '0' is *epochTime*.

#### *– GNSS-SSR-CodeBias*

The IE *GNSS-SSR-CodeBias* is used by the location server to provide GNSS signal code bias. The target device may add the code bias to the pseudo-range measurement of the corresponding code signal to get corrected pseudo-ranges.

NOTE: Any code biases transmitted in the broadcast messages (e.g., the GPS group delay differential TGD [4] (*NAV‑ClockModel*)) are not applied at all by the target device.

The parameters provided in IE *GNSS-SSR-CodeBias* are used as specified for SSR Code Bias Messages (e.g., message type 1059 and 1065) in [30] and apply to all GNSS.

-- ASN1START

GNSS-SSR-CodeBias-r15 ::= SEQUENCE {

epochTime-r15 GNSS-SystemTime,

ssrUpdateInterval-r15 INTEGER (0..15),

iod-ssr-r15 INTEGER (0..15),

ssr-CodeBiasSatList-r15 SSR-CodeBiasSatList-r15,

...

}

SSR-CodeBiasSatList-r15 ::= SEQUENCE (SIZE(1..64)) OF SSR-CodeBiasSatElement-r15

SSR-CodeBiasSatElement-r15 ::= SEQUENCE {

svID-r15 SV-ID,

ssr-CodeBiasSignalList-r15 SSR-CodeBiasSignalList-r15,

...

}

SSR-CodeBiasSignalList-r15 ::= SEQUENCE (SIZE(1..16)) OF SSR-CodeBiasSignalElement-r15

SSR-CodeBiasSignalElement-r15 ::= SEQUENCE {

signal-and-tracking-mode-ID-r15 GNSS-SignalID,

codeBias-r15 INTEGER (-8192..8191),

...

}

-- ASN1STOP

| *GNSS-SSR-CodeBias* field descriptions |
| --- |
| ***epochTime***  This field specifies the epoch time of the code bias data. The *gnss-TimeID* in *GNSS-SystemTime* shall be the same as the *GNSS-ID* in IE *GNSS-GenericAssistDataElement*. |
| ***ssrUpdateInterval***  This field specifies the SSR Update Interval. The SSR Update Intervals for all SSR parameters start at time 00:00:00 of the GPS time scale. A change of the SSR Update Interval during the transmission of SSR data should ensure consistent data for a target device. See table Value to SSR Update Interval Relation in IE *GNSS‑SSR‑OrbitCorrections*. |
| ***iod-ssr***  This field specifies the Issue of Data number for the SSR data. A change of *iod-ssr* is used to indicate a change in the SSR generating configuration. |
| ***svID***  This field specifies the GNSS satellite for which the code biases are provided. |
| ***signal-and-tracking-mode-ID***  This field specifies the GNSS signal for which the code biases are provided. |
| ***codeBias***  This field provides the code bias for the GNSS signal indicated by *signal-and-tracking-mode-ID*.  Scale factor 0.01 m; range ±81.91 m. |

#### 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

...,

[[

gnss-PeriodicAssistDataReq-r15

GNSS-PeriodicAssistDataReq-r15 OPTIONAL -- Cond PerADReq

]]

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *CommonADReq* | The field is mandatory present if the target device requests *GNSS-CommonAssistData*; otherwise it is not present. |
| *GenADReq* | This field is mandatory present if the target device requests *GNSS-GenericAssistData* for one or more specific GNSS; otherwise it is not present. |
| *PerADReq* | This field is mandatory present if the target device requests periodic GNSS assistance data delivery. This field may only be included if any of the fields are included in IE *GNSS‑GenericAssistDataReq:*  - *GNSS-RTK-ObservationsReq*,  - *GLO-RTK-BiasInformationReq*,  - *GNSS-RTK-MAC-CorrectionDifferencesReq*,  - *GNSS-RTK-ResidualsReq,*  - *GNSS-RTK-FKP-GradientsReq*,  - *GNSS-SSR-OrbitCorrectionsReq*,  - *GNSS-SSR-ClockCorrectionsReq*, or  - *GNSS-SSR-CodeBiasReq.* |

#### – *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

...,

[[

gnss-RTK-ReferenceStationInfoReq-r15

GNSS-RTK-ReferenceStationInfoReq-r15

OPTIONAL, -- Cond ARPReq

gnss-RTK-AuxiliaryStationDataReq-r15

GNSS-RTK-AuxiliaryStationDataReq-r15

OPTIONAL -- Cond AuxARPReq

]]

}

-- ASN1STOP

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

]],

[[

gnss-RTK-ObservationsReq-r15

GNSS-RTK-ObservationsReq-r15 OPTIONAL, -- Cond RTK-OSR-Req

glo-RTK-BiasInformationReq-r15

GLO-RTK-BiasInformationReq-r15 OPTIONAL, -- Cond GLO-CPB-Req

gnss-RTK-MAC-CorrectionDifferencesReq-r15

GNSS-RTK-MAC-CorrectionDifferencesReq-r15

OPTIONAL, -- Cond MAC-Req

gnss-RTK-ResidualsReq-r15 GNSS-RTK-ResidualsReq-r15 OPTIONAL, -- Cond Res-Req

gnss-RTK-FKP-GradientsReq-r15

GNSS-RTK-FKP-GradientsReq-r15 OPTIONAL, -- Cond FKP-Req

gnss-SSR-OrbitCorrectionsReq-r15

GNSS-SSR-OrbitCorrectionsReq-r15

OPTIONAL, -- Cond OC-Req

gnss-SSR-ClockCorrectionsReq-r15

GNSS-SSR-ClockCorrectionsReq-r15

OPTIONAL, -- Cond CC-Req

gnss-SSR-CodeBiasReq-r15 GNSS-SSR-CodeBiasReq-r15 OPTIONAL -- Cond CB-Req

]]

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *GNSS‑ID‑SBAS* | The field is mandatory present if the *GNSS‑ID* = *sbas*; otherwise it is not present. |
| *TimeModReq* | The field is mandatory present if the target device requests *GNSS-TimeModelList*; otherwise it is not present. |
| *DGNSS-Req* | The field is mandatory present if the target device requests *GNSS-DifferentialCorrections*; otherwise it is not present. |
| *NavModReq* | The field is mandatory present if the target device requests *GNSS-NavigationModel*; otherwise it is not present. |
| *RTIReq* | The field is mandatory present if the target device requests *GNSS-RealTimeIntegrity*; otherwise it is not present. |
| *DataBitsReq* | The field is mandatory present if the target device requests *GNSS-DataBitAssistance*; otherwise it is not present. |
| *AcquAssistReq* | The field is mandatory present if the target device requests *GNSS-AcquisitionAssistance*; otherwise it is not present. |
| *AlmanacReq* | The field is mandatory present if the target device requests *GNSS-Almanac*; otherwise it is not present. |
| *UTCModReq* | The field is mandatory present if the target device requests *GNSS-UTCModel*; otherwise it is not present. |
| *AuxInfoReq* | The field is mandatory present if the target device requests *GNSS-AuxiliaryInformation*; otherwise it is not present. |
| *DBDS-Req* | The field is mandatory present if the target device requests *BDS-DifferentialCorrections*; otherwise it is not present. This field may only be present if *gnss-ID* indicates 'bds'. |
| *BDS-GridModReq* | The field is mandatory present if the target device requests *BDS-GridModel*; otherwise it is not present. This field may only be present if *gnss-ID* indicates 'bds'. |
| *RTK-OSR-Req* | The field is mandatory present if the target device requests *GNSS-RTK-Observations*; otherwise it is not present. |
| *GLO-CPB-Req* | The field is mandatory present if the target device requests *GLO-RTK-BiasInformation*; otherwise it is not present. |
| *MAC-Req* | The field is mandatory present if the target device requests *GNSS‑RTK‑MAC‑CorrectionDifferences*; otherwise it is not present. |
| *Res-Req* | The field is mandatory present if the target device requests *GNSS-RTK-Residuals*; otherwise it is not present. |
| *FKP-Req* | The field is mandatory present if the target device requests *GNSS-RTK-FKP-Gradients*; otherwise it is not present. |
| *OC-Req* | The field is mandatory present if the target device requests *GNSS-SSR-OrbitCorrections*; otherwise it is not present. |
| *CC-Req* | The field is mandatory present if the target device requests *GNSS-SSR-ClockCorrections*; otherwise it is not present. |
| *CB-Req* | The field is mandatory present if the target device requests *GNSS-SSR-CodeBias*; otherwise it is not present. |

#### *– GNSS-PeriodicAssistDataReq*

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

-- ASN1START

GNSS-PeriodicAssistDataReq-r15 ::= SEQUENCE {

gnss-RTK-PeriodicObservationsReq-r15 GNSS-PeriodicControlParam-r15 OPTIONAL, -- Cond pOSR

glo-RTK-PeriodicBiasInformationReq-r15 GNSS-PeriodicControlParam-r15 OPTIONAL, -- Cond pCPB

gnss-RTK-MAC-PeriodicCorrectionDifferencesReq-r15

GNSS-PeriodicControlParam-r15 OPTIONAL, -- Cond pMAC

gnss-RTK-PeriodicResidualsReq-r15 GNSS-PeriodicControlParam-r15 OPTIONAL, -- Cond pRes

gnss-RTK-FKP-PeriodicGradientsReq-r15 GNSS-PeriodicControlParam-r15 OPTIONAL, -- Cond pFKP

gnss-SSR-PeriodicOrbitCorrectionsReq-r15

GNSS-PeriodicControlParam-r15 OPTIONAL, -- Cond pOC

gnss-SSR-PeriodicClockCorrectionsReq-r15

GNSS-PeriodicControlParam-r15 OPTIONAL, -- Cond pCC

gnss-SSR-PeriodicCodeBiasReq-r15 GNSS-PeriodicControlParam-r15 OPTIONAL, -- Cond pCB

...

}

-- ASN1STOP

| *Conditional presence* | Explanation |
| --- | --- |
| *pOSR* | The field is mandatory present if the target device requests periodic *GNSS‑RTK‑Observations*; otherwise it is not present. |
| *pCPB* | The field is mandatory present if the target device requests periodic *GLO‑RTK‑BiasInformation*; otherwise it is not present. |
| *pMAC* | The field is mandatory present if the target device requests periodic *GNSS‑RTK‑MAC‑CorrectionDifferences*; otherwise it is not present. |
| *pRes* | The field is mandatory present if the target device requests periodic *GNSS‑RTK‑Residuals*; otherwise it is not present. |
| *pFKP* | The field is mandatory present if the target device requests periodic *GNSS‑RTK‑FKP‑Gradients*; otherwise it is not present. |
| *pOC* | The field is mandatory present if the target device requests periodic *GNSS‑SSR‑OrbitCorrections*; otherwise it is not present. |
| *pCC* | The field is mandatory present if the target device requests periodic *GNSS‑SSR‑ClockCorrections*; otherwise it is not present. |
| *pCB* | The field is mandatory present if the target device requests periodic *GNSS‑SSR‑CodeBias*; otherwise it is not present. |

#### 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 |
| --- | --- |
| *gps* | The field is mandatory present if *gnss-TimeReqPrefList* includes a *GNSS-ID*= 'gps'; otherwise it is not present. |
| *glonass* | The field is mandatory present if *gnss-TimeReqPrefList* includes a *GNSS-ID*= 'glonass'; otherwise it is not present. |

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

#### – *GNSS-ReferenceLocationReq*

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

-- ASN1START

GNSS-IonosphericModelReq ::= SEQUENCE {

klobucharModelReq BIT STRING (SIZE(2)) OPTIONAL, -- Cond klobuchar

neQuickModelReq NULL OPTIONAL, -- Cond nequick

...

}

-- ASN1STOP

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

#### – *GNSS-EarthOrientationParametersReq*

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

-- ASN1START

GNSS-EarthOrientationParametersReq ::= SEQUENCE {

...

}

-- ASN1STOP

#### *– GNSS-RTK-ReferenceStationInfoReq*

The IE *GNSS-RTK-ReferenceStationInfoReq* is used by the target device to request the *GNSS‑RTK‑ReferenceStationInfo* assistancefrom the location server.

-- ASN1START

GNSS-RTK-ReferenceStationInfoReq-r15 ::= SEQUENCE {

antennaDescriptionReq-r15 BOOLEAN,

antennaHeightReq-r15 BOOLEAN,

physicalReferenceStationReq-r15 BOOLEAN,

stationID-r15 GNSS-ReferenceStationID-r15 OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-RTK-ReferenceStationInfoReq* field descriptions |
| --- |
| ***antennaDescriptionReq***  This field specifies whether or not the location server is requested to include the field *AntennaDescription* in the *GNSS-RTK-ReferenceStationInfo* IE. TRUE means requested. |
| ***antennaHeightReq***  This field specifies whether or not the location server is requested to include the field *antennaHeight* in the *GNSS‑RTK-ReferenceStationInfo* IE. TRUE means requested. |
| ***physicalReferenceStationReq***  This field specifies whether or not the location server is requested to include the field *physical-reference-station-info* in the *GNSS‑RTK-ReferenceStationInfo* IE. TRUE means requested. |
| ***stationID***  This field specifies the Station ID for which the *GNSS-RTK-ReferenceStationInfo* is requested. |

#### *– GNSS-RTK-AuxiliaryStationDataReq*

The IE *GNSS-RTK-AuxiliaryStationDataReq* is used by the target device to request the *GNSS‑RTK‑AuxiliaryStationData* assistancefrom the location server.

-- ASN1START

GNSS-RTK-AuxiliaryStationDataReq-r15 ::= SEQUENCE {

master-referenceStationID-r15 GNSS-ReferenceStationID-r15 OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-RTK-AuxiliaryStationDataReq* field descriptions |
| --- |
| ***master-referenceStationID***  This field specifies the Master Reference Station ID for which the Auxiliary Stations are requested. |

#### – *GNSS-TimeModelListReq*

The IE *GNSS-TimeModelListReq* is used by the target device to request the *GNSS-TimeModelElement* assistancefrom 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. |
| ***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* assistancefrom 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* assistancefrom the location server.

-- ASN1START

GNSS-NavigationModelReq ::= CHOICE {

storedNavList StoredNavListInfo,

reqNavList ReqNavListInfo,

...

}

StoredNavListInfo ::= SEQUENCE {

gnss-WeekOrDay INTEGER (0..4095),

gnss-Toe INTEGER (0..255),

t-toeLimit INTEGER (0..15),

satListRelatedDataList SatListRelatedDataList OPTIONAL,

...

}

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

SatListRelatedDataElement ::= SEQUENCE {

svID SV-ID,

iod BIT STRING (SIZE(11)),

clockModelID INTEGER (1..8) OPTIONAL,

orbitModelID INTEGER (1..8) OPTIONAL,

...

}

ReqNavListInfo ::= SEQUENCE {

svReqList BIT STRING (SIZE (64)),

clockModelID-PrefList SEQUENCE (SIZE (1..8)) OF INTEGER (1..8) OPTIONAL,

orbitModelID-PrefList SEQUENCE (SIZE (1..8)) OF INTEGER (1..8) OPTIONAL,

addNavparamReq BOOLEAN OPTIONAL, -- Cond orbitModelID-2

...

}

-- ASN1STOP

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

| *GNSS-NavigationModelReq* field descriptions |
| --- |
| ***storedNavList***  This list provides information to the location server about which *GNSS-NavigationModel* data the target device has currently stored for the particular GNSS indicated by *GNSS-ID*. |
| ***reqNavList***  This list provides information to the location server which *GNSS-NavigationModel* data are requested by the target device. |
| ***gnss-WeekOrDay***  If *GNSS-ID* does not indicate 'glonass', this field defines the GNSS Week number of the assistance currently held by the target device.  If *GNSS-ID* is set to 'glonass', this field defines the calendar number of day within the four-year interval starting from 1st of January in a leap year, as defined by the parameter NT in [9] of the assistance currently held by the target device. |
| ***gnss-Toe***  If *GNSS-ID* does not indicate 'glonass', this field defines the GNSS time of ephemeris in hours of the latest ephemeris set contained by the target device.  If *GNSS-ID* is set to 'glonass', this field defines the time of ephemeris in units of 15 minutes of the latest ephemeris set contained by the target device (range 0 to 95 representing time values between 0 and 1425 minutes). In this case, values 96 to 255 shall not be used by the sender. |
| ***t-toeLimit***  If *GNSS-ID* does not indicate 'glonass', this IE defines the ephemeris age tolerance of the target device in units of hours.  If *GNSS-ID* is set to 'glonass', this IE defines the ephemeris age tolerance of the target device in units of 30 minutes. |
| ***satListRelatedDataList***  This list defines the clock and orbit models currently held by the target device for each SV. 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 *SV-ID*. Bit 0 represents *SV-ID*=0 and bit 63 represents *SV-ID*=63. A one-value at a bit position means the navigation model data for the corresponding *SV-ID* is requested, a zero-value means not requested. |
| ***clockModelIDPrefList, orbitModelID-PrefList***  These fields define the Model-IDs 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 *addNAVparam* fields in *GNSS-NavigationModel* IE (*NavModel-NAVKeplerianSet* field) or not. TRUE means requested. |

GNSS-ID to clockModelID & orbitModelID relation

|  |  |  |
| --- | --- | --- |
| *GNSS-ID* | *clockModelID* | *orbitModelID* |
| gps | 2 | 2 |
| sbas | 5 | 5 |
| qzss | 2 | 2 |
| galileo | 1 | 1 |
| glonass | 4 | 4 |
| 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* assistancefrom 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* assistancefrom 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 × 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* assistancefrom 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* assistancefrom the location server.

-- ASN1START

GNSS-AlmanacReq ::= SEQUENCE {

modelID INTEGER(1..8) OPTIONAL,

...

}

-- ASN1STOP

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

GNSS-ID to modelID relation

|  |  |
| --- | --- |
| *GNSS-ID* | *modelID* |
| gps | 2 |
| sbas | 6 |
| qzss | 2 |
| galileo | 1 |
| glonass | 5 |
| bds | 7 |

#### – *GNSS-UTC-ModelReq*

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

-- ASN1START

BDS-GridModelReq-r12 ::= SEQUENCE {

...

}

-- ASN1STOP

#### *– GNSS-RTK-ObservationsReq*

The IE *GNSS-RTK-ObservationsReq* is used by the target device to request the *GNSS-RTK-Observations* assistancefrom the location server.

-- ASN1START

GNSS-RTK-ObservationsReq-r15::= SEQUENCE {

gnss-RTK-SignalsReq-r15 GNSS-SignalIDs,

gnss-RTK-Integer-ms-Req-r15 BOOLEAN,

gnss-RTK-PhaseRangeRateReq-r15 BOOLEAN,

gnss-RTK-CNR-Req-r15 BOOLEAN,

stationID-r15 GNSS-ReferenceStationID-r15 OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-RTK-ObservationsReq* field descriptions |
| --- |
| ***gnss-RTK-SignalsReq***  This field specifies the GNSS Signal(s) for which the *GNSS-RTK-Observations* are requested. A one‑value at a bit position means RTK observations for the specific signal are requested; a zero‑value means not requested. |
| ***gnss-RTK-Integer-ms-Req***  This field specifies whether the integer-ms is requested or not. TRUE means requested. |
| ***gnss-RTK-PhaseRangeRateReq***  This field specifies whether the *rough-phase-range-rate* and *fine-PhaseRangeRate* are requested or not. TRUE means requested. |
| ***gnss-RTK-CNR-Req***  This field specifies whether the *carrier-to-noise-ratio* is requested or not. TRUE means requested. |
| ***stationID***  This field specifies the Station ID for which the GNSS-RTK-Observations are requested. |

#### *– GLO-RTK-BiasInformationReq*

The IE *GLO-RTK-BiasInformationReq* is used by the target device to request the *GLO-RTK-BiasInformation* assistancefrom the location server.

-- ASN1START

GLO-RTK-BiasInformationReq-r15 ::= SEQUENCE {

stationID-r15 GNSS-ReferenceStationID-r15 OPTIONAL,

...

}

-- ASN1STOP

| *GLO-RTK-BiasInformationReq* field descriptions |
| --- |
| ***stationID***  This field specifies the Station ID for which the *GLO-RTK-BiasInformation* is requested. |

#### *– GNSS-RTK-MAC-CorrectionDifferencesReq*

The IE *GNSS-RTK-MAC-CorrectionDifferencesReq* is used by the target device to request the *GNSS‑RTK‑MAC‑CorrectionDifferences* assistancefrom the location server.

-- ASN1START

GNSS-RTK-MAC-CorrectionDifferencesReq-r15 ::= SEQUENCE {

master-ReferenceStationID-r15 GNSS-ReferenceStationID-r15 OPTIONAL,

aux-ReferenceStationList-r15 AUX-ReferenceStationList-r15 OPTIONAL,

linkCombinations-PrefList-r15 GNSS-Link-CombinationsList-r15 OPTIONAL,

...

}

AUX-ReferenceStationList-r15 ::= SEQUENCE (SIZE (1..32)) OF AUX-ReferenceStationID-Element-r15

AUX-ReferenceStationID-Element-r15 ::= SEQUENCE {

aux-stationID-r15 GNSS-ReferenceStationID-r15,

...

}

-- ASN1STOP

| *GNSS-RTK-MAC-CorrectionDifferencesReq* field descriptions |
| --- |
| ***master-ReferenceStationID, aux-ReferenceStationList***  These fields specify the Master and Auxiliary Reference Station IDs for which the *GNSS‑RTK‑MAC‑CorrectionDifferences* are requested. |
| ***linkCombinations-PrefList***  This field specifies the dual-frequency combination of L1 and L2 link/frequencies for which the target device wishes to obtain the *GNSS‑RTK‑MAC‑CorrectionDifferences* in the order of preference. The first *GNSS‑Link‑Combinations* in *GNSS-Link-CombinationsList* is the most preferred combination, the second *GNSS‑Link‑Combinations* in *GNSS‑Link‑CombinationsList* is the second most preferred, etc. |

#### *– GNSS-RTK-ResidualsReq*

The IE *GNSS-RTK-ResidualsReq* is used by the target device to request the *GNSS-RTK-Residuals* assistancefrom the location server.

-- ASN1START

GNSS-RTK-ResidualsReq-r15 ::= SEQUENCE {

stationID-r15 GNSS-ReferenceStationID-r15 OPTIONAL,

linkCombinations-PrefList-r15 GNSS-Link-CombinationsList-r15 OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-RTK-ResidualsReq* field descriptions |
| --- |
| ***stationID***  This field specifies the Station ID for which the *GNSS-RTK-Residuals* are requested. |
| ***linkCombinations-PrefList***  This field specifies the dual-frequency combination of L1 and L2 link/frequencies for which the target device wishes to obtain the *GNSS-RTK-Residuals* in the order of preference. The first *GNSS‑Link‑Combinations* in *GNSS‑Link‑CombinationsList* is the most preferred combination, the second *GNSS‑Link‑Combinations* in *GNSS‑Link‑CombinationsList* is the second most preferred, etc. |

#### *– GNSS-RTK-FKP-GradientsReq*

The IE *GNSS-RTK-FKP-GradientsReq* is used by the target device to request the *GNSS-RTK-FKP-Gradients* assistancefrom the location server.

-- ASN1START

GNSS-RTK-FKP-GradientsReq-r15 ::= SEQUENCE {

stationID-r15 GNSS-ReferenceStationID-r15 OPTIONAL,

linkCombinations-PrefList-r15 GNSS-Link-CombinationsList-r15 OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-RTK-FKP-GradientsReq* field descriptions |
| --- |
| ***stationID***  This field specifies the Station ID for which the *GNSS-RTK-FKP-Gradients* are requested. |
| ***linkCombinations-PrefList***  This field specifies the dual-frequency combination of L1 and L2 link/frequencies for which the target device wishes to obtain the *GNSS-RTK-FKP-Gradients* in the order of preference. The first *GNSS‑Link‑Combinations* in *GNSS‑Link‑CombinationsList* is the most preferred combination, the second *GNSS‑Link‑Combinations* in *GNSS‑Link‑CombinationsList* is the second most preferred, etc. |

#### *– GNSS-SSR-OrbitCorrectionsReq*

The IE *GNSS-SSR-OrbitCorrectionsReq* is used by the target device to request the *GNSS-SSR-OrbitCorrections* assistancefrom the location server.

-- ASN1START

GNSS-SSR-OrbitCorrectionsReq-r15 ::= SEQUENCE {

storedNavList-r15 GNSS-NavListInfo-r15 OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-SSR-OrbitCorrectionsReq* field descriptions |
| --- |
| ***storedNavList***  This list provides information to the location server about which NAV data the target device has currently stored for the particular GNSS indicated by *GNSS-ID*. |

#### *– GNSS-SSR-ClockCorrectionsReq*

The IE *GNSS-SSR-ClockCorrectionsReq* is used by the target device to request the *GNSS-SSR-ClockCorrections* assistancefrom the location server.

-- ASN1START

GNSS-SSR-ClockCorrectionsReq-r15 ::= SEQUENCE {

storedNavList-r15 GNSS-NavListInfo-r15 OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-SSR-ClockCorrectionsReq* field descriptions |
| --- |
| ***storedNavList***  This list provides information to the location server about which NAV data the target device has currently stored for the particular GNSS indicated by *GNSS-ID*. |

#### *– GNSS-SSR-CodeBiasReq*

The IE *GNSS-SSR-CodeBiasReq* is used by the target device to request the *GNSS-SSR-CodeBias* assistancefrom the location server.

-- ASN1START

GNSS-SSR-CodeBiasReq-r15 ::= SEQUENCE {

signal-and-tracking-mode-ID-Map-r15 GNSS-SignalIDs,

storedNavList-r15 GNSS-NavListInfo-r15 OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-SSR-CodeBiasReq* field descriptions |
| --- |
| ***signal-and-tracking-mode-ID-Map***  This field specifies the GNSS signal(s) for which the *GNSS-SSR-CodeBias* is requested. |
| ***storedNavList***  This list provides information to the location server about which NAV data the target device has currently stored for the particular GNSS indicated by *GNSS-ID*. |

#### 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 GNSSsignal 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/No 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 fieldprovides 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)),

...

},

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,

...

},

nr-r15 SEQUENCE {

nrPhysCellId-r15 INTEGER (0..1007),

nrCellGlobalID-r15 NCGI-r15 OPTIONAL,

nr-sfn-r15 BIT STRING (SIZE (10)),

...

}

} OPTIONAL,

...

}

-- ASN1STOP

| *MeasurementReferenceTime* field descriptions |
| --- |
| ***gnss-TOD-msec***  This field specifies the GNSS TOD for which the measurements and/or location estimate are valid. The 22 bits of GNSS TOD are the least significant bits. The most significant bits shall be derived by the location server to unambiguously derive the GNSS TOD.  The value for GNSS TOD is derived from the GNSS specific system time indicated in *gnss-TimeID* rounded down to the nearest millisecond unit.  Scale factor 1 millisecond. |
| ***gnss-TOD-frac***  This field specifies the fractional part of the GNSS TOD in 250 ns resolution. The total GNSS TOD is given by *gnss-TOD-msec* + *gnss-TOD-frac*.  Scale factor 250 nanoseconds. |
| ***gnss-TOD-unc***  This field provides the accuracy of the relation GNSS-network time when GNSS-network time association is provided. When GNSS-network time association is not provided, this element can be included to provide the accuracy of the reported *gnss-TOD-msec*.  If GNSS TOD is the given GNSS time, then the true GNSS time, corresponding to the provided network time if applicable, as observed at the target device location, lies in the interval [GNSS TOD – *gnss-TOD-unc*, GNSS TOD + *gnss-TOD-unc*].  The uncertainty *r*, expressed in microseconds, is mapped to a number K, with the following formula:  *r* = C\*(((1+x)K)-1)  with C = 0.5 and x = 0.14. To encode any higher value of uncertainty than that corresponding in the above formula to K=127, the same value, K=127, shall also be used. The uncertainty is then coded on 7 bits, as the binary encoding of K. Examples of *gnss-TOD-unc* value are as in the table Value of K to Value of uncertainty relation below.  This field shall be included if the target device provides GNSS-network time relationship. |
| ***gnss-TimeID***  This field specifies the GNSS system time for which the *gnss-TOD-msec* (and *gnss-TOD-frac* if applicable) is provided. |
| ***networkTime***  These fields specify the network time event which the GNSS TOD time stamps.  This field shall be included if the target device provides GNSS-network time relationship. |
| ***physCellId***  This field identifies the reference cell (E-UTRA), as defined in TS 36.331 [12], that is used for the GNSS-network time relation. |
| ***cellGlobalId***  This field specifies the globally unique cell identifier (Evolved Cell Global Identifier (ECGI) in E-UTRA, global UTRAN Cell Identifier in UTRA, or Cell Global Identification (CGI) in GERAN) of the reference cell, as defined in TS 36.331 [12] for E-UTRA and in TS 25.331 [13] for UTRA, for which the GNSS network time relation is provided. |
| ***systemFrameNumber***  This field specifies the system frame number in E-UTRA which the GNSS time time stamps, as defined in TS 36.331 [12]. |
| ***mode***  This field identifies the reference cell for the GNSS-network time relation, as defined in TS 25.331 [13]. |
| ***referenceSystemFrameNumber***  This field specifies the system frame number in UTRA, as defined in TS 25.331 [13], which is used for time stamping. |
| ***bcchCarrier, bsic***  This field identifies the reference cell for the GNSS-network time relation in GERAN, as defined in TS 44.031 [14]. |
| ***referenceFN, referenceFNMSB***  These fields specify the frame number in GERAN which the GNSS time time stamps, as defined in TS 44.031 [14]. The time of the reference frame boundary is as observed by the target device, i.e. without Timing Advance compensation. The *referenceFNMSB* field indicates the most significant bits of the frame number of the reference BTS corresponding to the *GNSS-MeasurementList*. Starting from the complete GSM frame number denoted FN, the target device calculates Reference FN MSB as  Reference FN MSB = floor(FN/42432)  The complete GSM frame number FN can then be reconstructed in the location server by combining the fields *referenceFN* with *referenceFNMSB* in the following way  FN = *referenceFNMSB* \*42432 + *referenceFN* |
| ***deltaGNSS-TOD***  This field specifies the difference in milliseconds between *gnss-TOD-msec*reported and the milli-second part of the SV time tsv\_1 of the first SV in the list reported from the target device, as defined in TS 44.031 [14]. The *deltaGNSS-TOD* is defined as  *deltaGNSS-TOD* = *gnss-TOD-msec* - fix(tsv\_1)  where fix() denotes rounding to the nearest integer towards zero. |
| ***nbPhysCellId***  This field identifies the reference cell, as defined in TS 36.331 [12] that is used for the GNSS-network time relation. |
| ***nbCellGlobalId***  This field specifies the global cell identifier of the NB-IoT reference cell, as defined in TS 36.331 [12], for which the GNSS network time relation is provided. |
| ***sfn***  This field specifies the system frame number in NB-IoT which the GNSS time time stamps, as defined in TS 36.331 [12]. |
| ***hyperSFN***  This field specifies the hyper-SFN in NB-IoT which the GNSS time time stamps, as defined in TS 36.331 [12]. |
| ***nrPhysCellId***  This field identifies the reference cell (NR), as defined in TS 38.331 [35], that is used for the GNSS-network time relation. |
| ***nrCellGlobalID***  This field specifies the NR Cell Global Identifier (NCGI) of the reference cell, as defined in TS 38.331 [35], for which the GNSS network time relation is provided. |
| ***nr-sfn***  This field specifies the system frame number in NR which the GNSS time time stamps, as defined in TS 38.331 [35], |

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/No 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,

...,

[[

adrMSB-r15 INTEGER (0..15) OPTIONAL,

adrSign-r15 ENUMERATED {positive, negative} OPTIONAL,

adrRMSerror-r15 INTEGER (0..127) OPTIONAL,

delta-codePhase-r15 INTEGER (0..7) OPTIONAL

]]

}

-- ASN1STOP

| *GNSS-MeasurementList* field descriptions |
| --- |
| ***gnss-ID***  This field identifies the GNSS constellation on which the GNSS signal measurements were measured. Measurement information for up to 16 GNSSs can be included. |
| ***gnss-SgnMeasList***  This list provides GNSS signal measurement information for up to 8 GNSS signal types per GNSS. |
| ***gnss-SignalID***  This field identifies the signal on which GNSS signal measurement parameters were measured. |
| ***gnss-CodePhaseAmbiguity***  This field provides the ambiguity of the code phase measurement. It is given in units of milli-seconds in the range between between 0 and 127 milli-seconds.  The total code phase for a satellite k (Satk) is given modulo this *gnss-CodePhaseAmbiguity* and is reconstructed with:  Code\_Phase\_Tot(Satk) = *codePhase*(Satk) + *integerCodePhase*(Satk) + n \* *gnss-CodePhaseAmbiguity*, n= 0,1,2,...  If there is no code phase ambiguity, the *gnss-CodePhaseAmbiguity* shall be set to 0.  The field is optional. If *gnss-CodePhaseAmbiguity* is absent, the default value is 1 milli-second. |
| ***gnss-SatMeasList***  This list provides GNSS signal measurement information for up to 64 GNSS satellites. |
| ***svID***  This field identifies the satellite on which the GNSS signal measurements were measured. |
| ***cNo***  This field provides an estimate of the carrier‑to‑noise ratio of the received signal from the particular satellite. The target device shall set this field to the value of the satellite C/N0, 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***  If the fields *adrMSB*, *adrSign*, *adrRMSerror*, and *delta-codePhase* are not present:  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.  If any of the fields *adrMSB*, *adrSign*, *adrRMSerror*, or *delta-codePhase* are present:  This field indicates the quality of a carrier phase measurement. The LSB indicates the half-cycle ambiguity, that is, if there are no half-cycle ambiguities present in the ADR measurement report the LSB is set to '0'. In case there are half-cycle ambiguities present in the ADR measurement report the LSB is set to '1'. When reporting ADR with unresolved polarity encoding the target device shall set this bit to 1.  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 (no cycle slips), the MSB value is set to '1X'. Otherwise, the MSB is set to '0X'. If polarity resolution forced the ADR measurement to be corrected by half-a-cycle, then the MSB must be set to '0', indicating that despite continuous tracking the reported ADR experienced non-continuity. See table Bit to Ambiguity Indication relation below.  The target device shall include this field if the *adr* field is included. |
| ***codePhase***  This field contains the whole and fractional value of the code-phase measurement made by the target device for the particular satellite signal at the time of measurement in the units of ms. GNSS specific code phase measurements (e.g. chips) are converted into unit of ms by dividing the measurements by the nominal values of the measured signal chipping rate.  Scale factor 2-21 milli‑seconds, in the range from 0 to (1-2-21) milli‑seconds. |
| ***integerCodePhase***  This field indicates the integer milli‑second part of the code phase that is expressed modulo the *gnss-CodePhaseAmbiguity*. The value of the ambiguity is given in the *gnss-CodePhaseAmbiguity* field.  The *integerCodePhase*is optional. If *integerCodePhase* is absent, the default value is 0 milli-second.  Scale factor 1 milli-second, in the range from 0 to 127 milli‑seconds. |
| ***codePhaseRMSError***  This field contains the pseudorange RMS error value. This parameter is specified according to a floating-point representation shown in the table below. |
| ***doppler***  This field contains the Doppler measured by the target device for the particular satellite signal. This information can be used to compute the 3-D velocity of the target device. Doppler measurements are converted into unit of m/s by multiplying the Doppler measurement in Hz by the nominal wavelength of the measured signal.  Scale factor 0.04 meter/seconds. This field is optional, but shall be included, if the *velocityRequest* in *CommonIEsRequestLocationInformation* is set to TRUE. |
| ***adr***  This field contains the absolute value of 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 *adrMeasReq* in *GNSS-PositioningInstructions* is set to TRUE and if ADR measurements are supported by the target device (i.e., *adr-Support* is set to TRUE in *A-GNSS-ProvideCapabilities*). |
| ***adrMSB***  This field contains the 4-MSBs of the ADR measurement in case the ADR measurement is outside the range of the field *adr* alone. Scale factor 32768 meters.  If present, the full ADR measurement is constructed as *adrMSB* × 32768 + *adr* × 2-10 meters, representing measurements in the range from 0 to 524287.9990234375 meters.  This field is optional, but shall be included, if the capability *adrEnhancementsSupport* is set to TRUE and the ADR measurement is outside the range of the *adr* field. |
| ***adrSign***  This field indicates the sign of the ADR measurement. |
| ***adrRMSerror***  This field contains the ADR root mean squared error value. Scale factor 2-10 meters. |
| ***delta-codePhase***  This field specifies the higher resolution of the *codePhase* measurement. Scale factor 2-24 milli‑seconds.  The full code phase measurement is constructed as *codePhase* × 2-21 + *delta-codePhase* × 2-24 milli-seconds, in the range from 0 to (1-2-24) milli‑seconds. |

Value of mpathDet to Multipath Indication relation

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

Bit to Polarity 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 |

Bit to Ambiguity Indication relation

|  |  |  |
| --- | --- | --- |
| Value | Value MSB, LSB | Polarity Indication |
| 0 | 00 | carrier phase not continuous, no half-cycle ambiguity |
| 1 | 01 | carrier phase not continuous, half-cycle ambiguity |
| 2 | 10 | carrier phase continuous, no half-cycle ambiguity |
| 3 | 11 | carrier phase continuous, half-cycle ambiguity |

floating-point representation

| Index | Mantissa | Exponent | Floating-Point value, xi | Pseudorange value, P |
| --- | --- | --- | --- | --- |
| 0 | 000 | 000 | 0.5 | P < 0.5 |
| 1 | 001 | 000 | 0.5625 | 0.5 <= P < 0.5625 |
| I | x | y | 0.5 \* (1 + x/8) \* 2y | xi-1 <= P < xi |
| 62 | 110 | 111 | 112 | 104 <= P < 112 |
| 63 | 111 | 111 | -- | 112 <= P |



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

#### – *GNSS-LocationInformation*

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

-- ASN1START

GNSS-LocationInformation ::= SEQUENCE {

measurementReferenceTime MeasurementReferenceTime,

agnss-List GNSS-ID-Bitmap,

...

}

-- ASN1STOP

| *GNSS-LocationInformation* field descriptions |
| --- |
| ***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. |
| ***agnss-List***  This fieldprovides a list of satellite systems used by the target device to calculate the location estimate and velocity estimate, if included. This is represented by a bit string in *GNSS-ID-Bitmap*, with a one‑value at the bit position means the particular method has been used; a zero‑value means not used. |

#### 6.5.2.7 GNSS Location Information Request

#### – *A-GNSS-RequestLocationInformation*

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

-- ASN1START

A-GNSS-RequestLocationInformation ::= SEQUENCE {

gnss-PositioningInstructions GNSS-PositioningInstructions,

...

}

-- ASN1STOP

#### 6.5.2.8 GNSS Location Information Request Elements

#### – *GNSS-PositioningInstructions*

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

-- ASN1START

GNSS-PositioningInstructions ::= SEQUENCE {

gnss-Methods GNSS-ID-Bitmap,

fineTimeAssistanceMeasReq BOOLEAN,

adrMeasReq BOOLEAN,

multiFreqMeasReq BOOLEAN,

assistanceAvailability BOOLEAN,

...,

[[

ha-GNSS-Req-r15 ENUMERATED { true } OPTIONAL -- Cond UEB

]]

}

-- ASN1STOP

| **Conditional presence** | **Explanation** |
| --- | --- |
| *UEB* | The field is optionally present, need OP, if the *locationInformationType* is set to *locationEstimateRequired, locationEstimatePreferred, or* *locationMeasurementsPreferred*; oltherwise it is not present. |

| *GNSS-PositioningInstructions* field descriptions |
| --- |
| ***gnssMethods***  This field indicates the satellite systems allowed by the location server. This is represented by a bit string in *GNSS-ID-Bitmap*, 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. |
| ***fineTimeAssistanceMeasReq***  This field indicates whether the target device is requested to report GNSS-network time association. TRUE means requested. |
| ***adrMeasReq***  This field indicates whether the target device is requested to include ADR measurements in *GNSS-MeasurementList* IE or not. TRUE means requested. |
| ***multiFreqMeasReq***  This field indicates whether the target device is requested to report measurements on multiple supported GNSS signal types in *GNSS-MeasurementList* IE or not. TRUE means requested. |
| ***assistanceAvailability***  This field indicates whether the target device may request additional GNSS assistance data from the server. TRUE means allowed and FALSE means not allowed. |
| ***ha-GNSS-Req***  This field, if present, indicates that any location estimate provided by the target device should be obtained using high accuracy RTK/PPP methods. |

#### 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 its 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

]],

[[ periodicAssistanceData-r15

BIT STRING { solicited (0),

unsolicited (1) } (SIZE (1..8)) 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,

...,

[[

adrEnhancementsSupport-r15 ENUMERATED { true } OPTIONAL,

ha-gnss-Modes-r15 PositioningModes OPTIONAL

]]

}

AssistanceDataSupportList ::= SEQUENCE {

gnss-CommonAssistanceDataSupport GNSS-CommonAssistanceDataSupport,

gnss-GenericAssistanceDataSupport GNSS-GenericAssistanceDataSupport,

...

}

-- ASN1STOP

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

| *A-GNSS-ProvideCapabilities* field descriptions |
| --- |
| ***gnss-SupportList***  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 *gnss-SupportListReq* in the A-GNSS *-RequestCapabilities* IE is set to TRUE and if the target device supports the A-GNSS positioning method. If the IE *A-GNSS-Provide-Capabilities* is provided unsolicited, this field shall be included if the target device supports the assisted GNSS positioning method. |
| ***gnss-ID***  This field specifies the GNSS supported by the target device for which the capabilities in *GNSS-SupportElement* are provided. |
| ***sbas-IDs***  This field specifies the SBAS(s) supported by the target device. This is represented by a bit string, with a one‑value at the bit position means the particular SBAS is supported; a zero‑value means not supported. |
| ***agnss-Modes***  This field specifies the GNSS mode(s) supported by the target device for the GNSS indicated by *gnss-ID*. This is represented by a bit string, with a one‑value at the bit position means the particular GNSS mode is supported; a zero‑value means not supported. |
| ***gnss-Signals***  This field specifies the GNSS signal(s) supported by the target device for the GNSS indicated by *gnss-ID*. This is represented by a bit string, with a one‑value at the bit position means the particular GNSS signal type is supported; a zero‑value means not supported. |
| ***fta-MeasSupport***  This field specifies that the target device is capable of performing fine time assistance measurements (i.e., GNSS‑cellular time association reporting). The *cellTime* field specifies for which cellular network(s) this capability is supported. This is represented by a bit string, with a one‑value at the bit position means FTA measurements for the specific cellular network time is supported; a zero‑value means not supported. The *mode* field specifies for which GNSS mode(s) FTA measurements are supported by the target device. This is represented by a bit string, with a one‑value at the bit position means FTA measurements for the GNSS mode is supported; a zero‑value means not supported. |
| ***adr-Support***  This field specifies whether the target device supports ADR measurement reporting. TRUE means supported. |
| ***velocityMeasurementSupport***  This field specifies whether the target device supports measurement reporting related to velocity. TRUE means supported. |
| ***assistanceDataSupportList***  This list defines the assistance data and assistance data choices supported by the target device. This field shall be present if the *assistanceDataSupportListReq* 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. |
| ***locationCoordinateTypes***  This parameter identifies the geographical location coordinate types that a target device supports for GNSS. TRUE indicates that a location coordinate type is supported and FALSE that it is not. This field shall be present if the *locationVelocityTypesReq* 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. |
| ***velocityTypes***  This parameter identifies the velocity types that a target device supports for GNSS. TRUE indicates that a velocity type is supported and FALSE that it is not. FALSE for all velocity types indicates that velocity reporting is not supported. This field shall be present if the *locationVelocityTypesReq* 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. |
| ***periodicalReportingNotSupported***  This field, if present, specifies the positioning modes for which the target device does not support *periodicalReporting.* This is represented by a bit string, with a one‑value at the bit position means *periodicalReporting* 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 *periodicalReporting* in *CommonIEsRequestLocationInformation* for each supported positioning mode. |
| ***idleStateForMeasurements***  This field, if present, indicates that the target device requires idle state to perform GNSS measurements. |
| ***periodicAssistanceData***  This field identifies the periodic assistance data delivery procedures supported by the target device. This is represented by a bit string, with a one value at the bit position means the periodic assistance data delivery procedure is supported; a zero value means not supported. Bit 0 (solicited) represents the procedure according to clause 5.2.1a; bit (1) (unsolicited) represents the procedure according to clause 5.2.2a. |
| ***adrEnhancementsSupport***  This field, if present, indicates that the target device supports the fields *adrMSB*, *adrSign*, *adrRMSerror*, and *delta‑codePhase* in IE *GNSS-MeasurementList*.  This field may only be present if *adr-Support* is set to TRUE, and shall be absent if *adr-Support* is set to FALSE. |
| **ha-gnss-Modes**  This field specifies the High-Accuracy GNSS mode(s) supported by the target device for the GNSS indicated by *gnss‑ID*. This is represented by a bit string, with a one‑value at the bit position means the particular GNSS mode is supported; a zero‑value means not supported. |

#### 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

...,

[[

gnss-RTK-ReferenceStationInfoSupport-r15

GNSS-RTK-ReferenceStationInfoSupport-r15

OPTIONAL, -- Cond ARPSup

gnss-RTK-AuxiliaryStationDataSupport-r15

GNSS-RTK-AuxiliaryStationDataSupport-r15

OPTIONAL -- Cond AuxARPSup

]]

}

-- ASN1STOP

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

#### – *GNSS-ReferenceTimeSupport*

-- ASN1START

GNSS-ReferenceTimeSupport ::= SEQUENCE {

gnss-SystemTime GNSS-ID-Bitmap,

fta-Support AccessTypes OPTIONAL, -- Cond fta

...

}

-- ASN1STOP

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

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

#### – *GNSS-ReferenceLocationSupport*

-- ASN1START

GNSS-ReferenceLocationSupport ::= SEQUENCE {

...

}

-- ASN1STOP

#### – *GNSS-IonosphericModelSupport*

-- ASN1START

GNSS-IonosphericModelSupport ::= SEQUENCE {

ionoModel BIT STRING { klobuchar (0),

neQuick (1) } (SIZE (1..8)),

...

}

-- ASN1STOP

| *GNSS-IonosphericModelSupport* field descriptions |
| --- |
| ***ionoModel***  This field specifies the 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-RTK-ReferenceStationInfoSupport*

-- ASN1START

GNSS-RTK-ReferenceStationInfoSupport-r15 ::= SEQUENCE {

...

}

-- ASN1STOP

#### – *GNSS-RTK-AuxiliaryStationDataSupport*

-- ASN1START

GNSS-RTK-AuxiliaryStationDataSupport-r15 ::= 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

]],

[[

gnss-RTK-ObservationsSupport-r15

GNSS-RTK-ObservationsSupport-r15

OPTIONAL, -- Cond RTK-OSR-Sup

glo-RTK-BiasInformationSupport-r15

GLO-RTK-BiasInformationSupport-r15

OPTIONAL, -- Cond GLO-CPB-Sup

gnss-RTK-MAC-CorrectionDifferencesSupport-r15

GNSS-RTK-MAC-CorrectionDifferencesSupport-r15

OPTIONAL, -- Cond MAC-Sup

gnss-RTK-ResidualsSupport-r15 GNSS-RTK-ResidualsSupport-r15

OPTIONAL, -- Cond Res-Sup

gnss-RTK-FKP-GradientsSupport-r15

GNSS-RTK-FKP-GradientsSupport-r15

OPTIONAL, -- Cond FKP-Sup

gnss-SSR-OrbitCorrectionsSupport-r15

GNSS-SSR-OrbitCorrectionsSupport-r15

OPTIONAL, -- Cond OC-Sup

gnss-SSR-ClockCorrectionsSupport-r15

GNSS-SSR-ClockCorrectionsSupport-r15

OPTIONAL, -- Cond CC-Sup

gnss-SSR-CodeBiasSupport-r15 GNSS-SSR-CodeBiasSupport-r15

OPTIONAL -- Cond CB-Sup

]]

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *GNSS‑ID‑SBAS* | The field is mandatory present if the *GNSS‑ID* = *sbas*; otherwise it is not present. |
| *TimeModSup* | The field is mandatory present if the target device supports *GNSS-TimeModelList*; otherwise it is not present. |
| *DGNSS-Sup* | The field is mandatory present if the target device supports *GNSS-DifferentialCorrections*; otherwise it is not present. |
| *NavModSup* | The field is mandatory present if the target device supports *GNSS-NavigationModel*; otherwise it is not present. |
| *RTISup* | The field is mandatory present if the target device supports *GNSS-RealTimeIntegrity*; otherwise it is not present. |
| *DataBitsSup* | The field is mandatory present if the target device supports *GNSS-DataBitAssistance*; otherwise it is not present. |
| *AcquAssistSup* | The field is mandatory present if the target device supports *GNSS-AcquisitionAssistance*; otherwise it is not present. |
| *AlmanacSup* | The field is mandatory present if the target device supports *GNSS-Almanac*; otherwise it is not present. |
| *UTCModSup* | The field is mandatory present if the target device supports *GNSS-UTC-Model*; otherwise it is not present. |
| *AuxInfoSup* | The field is mandatory present if the target device supports *GNSS-AuxiliaryInformation*; otherwise it is not present. |
| *DBDS-Sup* | The field is mandatory present if the target device supports *BDS-DifferentialCorrections*; otherwise it is not present. This field may only be present if *gnss-ID* indicates 'bds'. |
| *BDS-GridModSup* | The field is mandatory present if the target device supports *BDS-GridModel*; otherwise it is not present. This field may only be present if *gnss-ID* indicates 'bds'. |
| *RTK-OSR-Sup* | The field is mandatory present if the target device supports *GNSS-RTK-Observations*; otherwise it is not present. Note, support for *GNSS-RTK-Observations* implies support for *GNSS-RTK-CommonObservationInfo* as well. |
| *GLO-CPB-Sup* | The field is mandatory present if the target device supports *GLO‑RTK‑BiasInformation*; otherwise it is not present. This field may only be present if *gnss-ID* indicates 'glonass'. |
| *MAC-Sup* | The field is mandatory present if the target device supports *GNSS‑RTK‑MAC‑CorrectionDifferences*; otherwise it is not present. |
| *Res-Sup* | The field is mandatory present if the target device supports *GNSS‑RTK‑Residuals*; otherwise it is not present. |
| *FKP-Sup* | The field is mandatory present if the target device supports *GNSS‑RTK‑FKP‑Gradients*; otherwise it is not present. |
| *OC-Sup* | The field is mandatory present if the target device supports *GNSS‑SSR‑OrbitCorrections*; otherwise it is not present. |
| *CC-Sup* | The field is mandatory present if the target device supports *GNSS‑SSR‑ClockCorrections*; otherwise it is not present. |
| *CB-Sup* | The field is mandatory present if the target device supports *GNSS‑SSR‑CodeBias*; otherwise it is not present. |

#### – *GNSS-TimeModelListSupport*

-- ASN1START

GNSS-TimeModelListSupport ::= SEQUENCE {

...

}

-- ASN1STOP

#### – *GNSS-DifferentialCorrectionSupport*

-- ASN1START

GNSS-DifferentialCorrectionsSupport ::= SEQUENCE {

gnssSignalIDs GNSS-SignalIDs,

dgnss-ValidityTimeSup BOOLEAN,

...

}

-- ASN1STOP

| *GNSS-DifferentialCorrectionsSupport* field descriptions |
| --- |
| ***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

| *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

#### – *GNSS-RTK-ObservationsSupport*

-- ASN1START

GNSS-RTK-ObservationsSupport-r15 ::= SEQUENCE {

gnssSignalIDs-r15 GNSS-SignalIDs,

...

}

-- ASN1STOP

| *GNSS-RTK-ObservationsSupport* field descriptions |
| --- |
| ***gnssSignalIDs***  This field specifies the GNSS signal types for which *GNSS-RTK-Observations* 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 *GNSS‑RTK‑Observations* for the particular GNSS signal type is supported; a zero‑value means not supported. |

#### – *GLO-RTK-BiasInformationSupport*

-- ASN1START

GLO-RTK-BiasInformationSupport-r15 ::= SEQUENCE {

...

}

-- ASN1STOP

#### – *GNSS-RTK-MAC-CorrectionDifferencesSupport*

-- ASN1START

GNSS-RTK-MAC-CorrectionDifferencesSupport-r15 ::= SEQUENCE {

link-combinations-support-r15 GNSS-Link-CombinationsList-r15,

...

}

-- ASN1STOP

| *GNSS-RTK-MAC-CorrectionDifferencesSupport* field descriptions |
| --- |
| ***link-combinations-support***  This field specifies the GNSS link/frequency combinations for which *GNSS-RTK-MAC-CorrectionDifferences* are supported by the target device for the GNSS indicated by *GNSS-ID*. |

#### – *GNSS-RTK-ResidualsSupport*

-- ASN1START

GNSS-RTK-ResidualsSupport-r15 ::= SEQUENCE {

link-combinations-support-r15 GNSS-Link-CombinationsList-r15,

...

}

-- ASN1STOP

| *GNSS-RTK-ResidualsSupport* field descriptions |
| --- |
| ***link-combinations-support***  This field specifies the GNSS link/frequency combinations for which *GNSS-RTK-Residuals* are supported by the target device for the GNSS indicated by *GNSS-ID*. |

#### – *GNSS-RTK-FKP-GradientsSupport*

-- ASN1START

GNSS-RTK-FKP-GradientsSupport-r15 ::= SEQUENCE {

link-combinations-support-r15 GNSS-Link-CombinationsList-r15,

...

}

-- ASN1STOP

| *GNSS-RTK-FKP-GradientsSupport* field descriptions |
| --- |
| ***link-combinations-support***  This field specifies the GNSS link/frequency combinations for which *GNSS-RTK-FKP-Gradients* are supported by the target device for the GNSS indicated by *GNSS-ID*. |

#### – *GNSS-SSR-OrbitCorrectionsSupport*

-- ASN1START

GNSS-SSR-OrbitCorrectionsSupport-r15 ::= SEQUENCE {

...

}

-- ASN1STOP

#### – *GNSS-SSR-ClockCorrectionsSupport*

-- ASN1START

GNSS-SSR-ClockCorrectionsSupport-r15 ::= SEQUENCE {

...

}

-- ASN1STOP

– *GNSS-SSR-CodeBiasSupport*

-- ASN1START

GNSS-SSR-CodeBiasSupport-r15 ::= SEQUENCE {

signal-and-tracking-mode-ID-Sup-r15 GNSS-SignalIDs,

...

}

-- ASN1STOP

| GNSS-SSR-CodeBiasSupport field descriptions |
| --- |
| ***signal-and-tracking-mode-ID-Sup***  This field specifies the GNSS signal(s) for which the *GNSS-SSR-CodeBias* is supported by the target device. |

#### 6.5.2.11 GNSS Capability Information Request

#### – *A-GNSS-RequestCapabilities*

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

-- ASN1START

A-GNSS-RequestCapabilities ::= SEQUENCE {

gnss-SupportListReq BOOLEAN,

assistanceDataSupportListReq BOOLEAN,

locationVelocityTypesReq BOOLEAN,

...

}

-- ASN1STOP

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

#### 6.5.2.12 GNSS Error Elements

#### – *A-GNSS-Error*

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

-- ASN1START

A-GNSS-Error ::= CHOICE {

locationServerErrorCauses GNSS-LocationServerErrorCauses,

targetDeviceErrorCauses GNSS-TargetDeviceErrorCauses,

...

}

-- ASN1STOP

#### – *GNSS-LocationServerErrorCauses*

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

-- ASN1START

GNSS-LocationServerErrorCauses ::= SEQUENCE {

cause ENUMERATED {

undefined,

undeliveredAssistanceDataIsNotSupportedByServer,

undeliveredAssistanceDataIsSupportedButCurrentlyNotAvailableByServer, undeliveredAssistanceDataIsPartlyNotSupportedAndPartlyNotAvailableByServer,

...,

unconfirmedPeriodicAssistanceDataIsNotSupported-v1510,

unconfirmedPeriodicAssistanceDataIsSupportedButCurrentlyNotAvailable-v1510,

unconfirmedPeriodicAssistanceDataIsPartlyNotSupportedAndPartlyNotAvailable-v1510,

undeliveredPeriodicAssistanceDataIsCurrentlyNotAvailable-v1510

},

...

}

-- ASN1STOP

| *GNSS-LocationServerErrorCauses* field descriptions |
| --- |
| ***cause***  This field provides a GNSS specific error cause. The cause values '*unconfirmedPeriodicAssistanceDataIsNotSupported'*, '*unconfirmedPeriodicAssistanceDataIsSupportedButCurrentlyNotAvailable*' and '*unconfirmedPeriodicAssistanceDataIsPartlyNotSupportedAndPartlyNotAvailable*' may only be included in the control transaction of a periodic assistance data transfer procedure, as described in clause 5.2.1a.  The cause value '*undeliveredPeriodicAssistanceDataIsCurrentlyNotAvailable*' may only be included in the data transaction of a periodic assistance data transfer procedure when periodic assistance data are not available when the periodicity condition occurs, as described in clauses 5.2.1a and 5.2.2a. |

#### – *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 *multiFrequenceMeasurementsNotPossible* fields, as applicable. |

#### 6.5.2.13 Common GNSS Information Elements

#### – *GNSS-FrequencyID*

The IE *GNSS-FrequencyID* is used to indicate a specific GNSS link/frequency. The interpretation of *GNSS‑FrequencyID* depends on the *GNSS‑ID.*

-- ASN1START

GNSS-FrequencyID-r15 ::= SEQUENCE {

gnss-FrequencyID-r15 INTEGER (0 .. 7),

...

}

-- ASN1STOP

| *GNSS-FrequencyID* field descriptions |
| --- |
| ***gnss-FrequencyID***  This field specifies a particular GNSS link/frequency. The interpretation of *gnss-FrequencyID* depends on the *GNSS‑ID* and is as shown in the table Value & Explanation relation below. |

Value & Explanation relation

|  |  |  |  |
| --- | --- | --- | --- |
| System | Value | Explanation | |
| Link | Centre Frequency  [MHz] |
| GPS | 0 | L1 | 1575.42 |
| 1 | L2 | 1227.60 |
| 2 | L5 | 1176.45 |
| 3-7 | reserved | |
| SBAS | 0 | L1 | 1575.42 |
| 1 | L5 | 1176.45 |
| 2-7 | reserved | |
| QZSS | 0 | L1 | 1575.42 |
| 1 | L2 | 1227.60 |
| 2 | L5 | 1176.45 |
| 3-7 | reserved | |
| GLONASS  k = -7..13 | 0 | G1 | 1602+k×0.5625 |
| 1 | G2 | 1246+k×0.4375 |
| 2 | G3 | 1202.025 |
| 3-7 | reserved | |
| Galileo | 0 | E1 | 1575.420 |
| 1 | E6 | 1278.750 |
| 2 | E5a | 1176.450 |
| 3 | E5b | 1207.140 |
| 4 | E5 | 1191.795 |
|  | 5-7 | reserved | |
| BDS | 0 | B1 (Phase II) | 1561.098 |
| 1 | B1 (Phase III) | 1575.420 |
| 2 | B2 | 1207.140 |
|  | 3 | B3 | 1268.520 |
|  | 4-7 | reserved | |

#### – *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-Link-CombinationsList*

-- ASN1START

GNSS-Link-CombinationsList-r15 ::= SEQUENCE (SIZE(1..8)) OF GNSS-Link-Combinations-r15

GNSS-Link-Combinations-r15 ::= SEQUENCE {

l1-r15 GNSS-FrequencyID-r15,

l2-r15 GNSS-FrequencyID-r15,

...

}

-- ASN1STOP

#### – *GNSS-NavListInfo*

-- ASN1START

GNSS-NavListInfo-r15 ::= SEQUENCE (SIZE (1..64)) OF SatListElement-r15

SatListElement-r15 ::= SEQUENCE {

svID-r15 SV-ID,

iod-r15 BIT STRING (SIZE(11)),

...

}

-- ASN1STOP

#### – *GNSS-NetworkID*

The IE *GNSS-NetworkID* defines the reference network and the source of the particular set of reference stations and their observation information. This IE is used for MAC Network RTK as described in [30].

-- ASN1START

GNSS-NetworkID-r15 ::= SEQUENCE {

networkID-r15 INTEGER (0..255),

...

}

-- ASN1STOP

#### – *GNSS-PeriodicControlParam*

The IE *GNSS-PeriodicControlParam* is used to specify control parameters for a periodic assistance data delivery.

-- ASN1START

GNSS-PeriodicControlParam-r15 ::= SEQUENCE {

deliveryAmount-r15 INTEGER (1..32),

deliveryInterval-r15 INTEGER (1..64),

...

}

-- ASN1STOP

| *GNSS-PeriodicControlParam* field descriptions |
| --- |
| ***deliveryAmount***  This field specifies the number of periodic assistance data deliveries. Integer values *N*=1…31 correspond to an amount of 2*N*. Integer value *N*=32 indicates an 'infinite/indefinite' amount, which means that the assistance data delivery should continue until a LPP *Abort* message is received. |
| ***deliveryInterval***  This field specifies the interval between assistance data deliveries in seconds. |

#### – *GNSS-ReferenceStationID*

The IE *GNSS-ReferenceStationID* is used to identify a specific GNSS Reference Station.

-- ASN1START

GNSS-ReferenceStationID-r15 ::= SEQUENCE {

referenceStationID-r15 INTEGER (0..65535),

providerName-r15 VisibleString (SIZE (1..32)) OPTIONAL,

...

}

-- ASN1STOP

| *GNSS-ReferenceStationID* field descriptions |
| --- |
| ***referenceStationID***  This field provides the reference station identity. |
| ***providerName***  This field is associated to a GNSS correction data provider to ensure that the *referenceStationID*'s are unique from a target device perspective. |

#### – *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),

...,

[[

gnss-SignalID-Ext-r15 INTEGER (8..23) OPTIONAL

]]

}

-- ASN1STOP

| *GNSS-SignalID* field descriptions |
| --- |
| ***gnss-SignalID, gnss-SignalID-Ext***  This field specifies a particular GNSS signal. The interpretation of *gnss-SignalID* and *gnss-SignalID-Ext* depends on the *GNSS‑ID* and is as shown in the table System to Value & Explanation relation below.  If the field *gnss-SignalID-Ext* is present, the *gnss-SignalID* should be set to value 7 and shall be ignored by the receiver. |

System to Value & Explanation relation

|  |  |  |
| --- | --- | --- |
| System | Value | Explanation |
| GPS | 0 | GPS L1 C/A |
| 1 | GPS L1C |
| 2 | GPS L2C |
| 3 | GPS L5 |
| 4 | GPS L1 P |
| 5 | GPS L1 Z-tracking |
| 6 | GPS L2 C/A |
| 7 | GPS L2 P |
| 8 | GPS L2 Z-tracking |
| 9 | GPS L2 L2C(M) |
| 10 | GPS L2 L2C(L) |
| 11 | GPS L2 L2C(M+L) |
| 12 | GPS L5 I |
| 13 | GPS L5 Q |
| 14 | GPS L5 I+Q |
| 15 | GPS L1 L1C(D) |
| 16 | GPS L1 L1C(P) |
| 17 | GPS L1 L1C(D+P) |
| 18-23 | Reserved |
| SBAS | 0 | L1 C/A |
| 1 | L5 I |
| 2 | L5 Q |
| 3 | L5 I+Q |
| 4-7 | Reserved |
| QZSS | 0 | QZS-L1 C/A |
| 1 | QZS-L1C |
| 2 | QZS-L2C |
| 3 | QZS-L5 |
| 4 | QZS-LEX S |
| 5 | QZS-LEX L |
| 6 | QZS-LEX S+L |
| 7 | QZS-L2 L2C(M) |
| 8 | QZS-L2 L2C(L) |
| 9 | QZS-L2 L2C(M+L) |
| 10 | QZS-L5 I |
| 11 | QZS-L5 Q |
| 12 | QZS-L5 I+Q |
| 13 | QZS L1 L1C(D) |
| 14 | QZS L1 L1C(P) |
| 15 | QZS L1 L1C(D+P) |
| 16-23 | Reserved |
| GLONASS | 0 | GLONASS G1 C/A |
| 1 | GLONASS G2 C/A |
| 2 | GLONASS G3 |
| 3 | GLONASS G1 P |
| 4 | GLONASS G2 P |
| 5-23 | Reserved |
| Galileo | 0 | Galileo E1 |
| 1 | Galileo E5A |
| 2 | Galileo E5B |
| 3 | Galileo E6 |
| 4 | Galileo E5A + E5B |
| 5 | Galileo E1 C No data |
| 6 | Galileo E1 A |
| 7 | Galileo E1 B I/NAV OS/CS/SoL |
| 8 | Galileo E1 B+C |
| 9 | Galileo E1 A+B+C |
| 10 | Galileo E6 C |
| 11 | Galileo E6 A |
| 12 | Galileo E6 B |
| 13 | Galileo E6 B+C |
| 14 | Galileo E6 A+B+C |
| 15 | Galileo E5B I |
| 16 | Galileo E5B Q |
| 17 | Galileo E5B I+Q |
| 18 | Galileo E5(A+B) I |
| 19 | Galileo E5(A+B) Q |
| 20 | Galileo E5(A+B) I+Q |
| 21 | Galileo E5A I |
| 22 | Galileo E5A Q |
| 23 | Galileo E5A I+Q |
| BDS | 0 | B1 I |
| 1 | B1 Q |
| 2 | B1 I+Q |
| 3 | B3 I |
| 4 | B3 Q |
| 5 | B3 I+Q |
| 6 | B2 I |
| 7 | B2 Q |
| 8 | B2 I+Q |
| 9-23 | 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)),

...,

[[

gnss-SignalIDs-Ext-r15 BIT STRING (SIZE(16)) OPTIONAL

]]

}

-- ASN1STOP

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

interpretation of the bit map in *gnssSignalIDs*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GNSS | Bit 1  (MSB) | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Bit 8  (LSB) |
| GPS | L1 C/A | L1C | L2C | L5 | L1P | L1 Z | L2 C/A | L2 P |
| SBAS | L1 C/A | L5 I | L5 Q | L5 I+Q |  |  |  |  |
| QZSS | QZS-L1 C/A | QZS-L1C | QZS-L2C | QZS-L5 | LEX S | LEX L | LEX S+L | L2C(M) |
| GLONASS | G1 C/A | G2 C/A | G3 | G1 P | G2 P |  |  |  |
| Galileo | E1 | E5a | E5b | E6 | E5a+E5b | E1 C No Data | E1 A | E1 B I/NAV OS/CS/SoL |
| BDS | B1 I | B1 Q | B1 I+Q | B3 I | B3 Q | B3 I+Q | B2 I | B2 Q |

interpretation of the bit map in *gnssSignalIDs-Ext*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GNSS | Bit 1  (MSB) | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Bit 8 |
| GPS | L2 Z | L2C(M) | L2C(L) | L2C(M+L) | L5 I | L5 Q | L5 I+Q | L1C(D) |
| SBAS |  |  |  |  |  |  |  |  |
| QZSS | L2C(L) | L2C(M+L) | L5 I | L5 Q | L5 I+Q | L1C(D) | L1C(P) | L1C(D+P) |
| GLONASS |  |  |  |  |  |  |  |  |
| Galileo | E1 B+C | E1 A+B+C | E6C | E6A | E6B | E6 B+C | E6 A+B+C | E5B I |
| BDS | B2 I+Q |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GNSS | Bit 9 | Bit 10 | Bit 11 | Bit 12 | Bit 13 | Bit 14 | Bit 15 | Bit 16  (LSB) |
| GPS | L1C(P) | L1C(D+P) |  |  |  |  |  |  |
| SBAS |  |  |  |  |  |  |  |  |
| QZSS |  |  |  |  |  |  |  |  |
| GLONASS |  |  |  |  |  |  |  |  |
| Galileo | E5B Q | E5B I+Q | E5(A+B) I | E5(A+B) Q | E5(A+B) I+Q | E5A I | E5A Q | E5A I+Q |
| BDS |  |  |  |  |  |  |  |  |

#### – *GNSS-SubNetworkID*

The IE *GNSS-SubNetworkID* defines the subnetwork of a network identified by *GNSS-NetworkID*. This IE is used for MAC Network RTK as described in [30].

-- ASN1START

GNSS-SubNetworkID-r15 ::= SEQUENCE {

subNetworkID-r15 INTEGER (0..15),

...

}

-- ASN1STOP

#### – *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 *satellite‑id* | Interpretation of *satellite‑id* |
| GPS | '0' – '62'  '63' | Satellite PRN Signal No. 1 to 63  Reserved |
| SBAS | '0' – '38'  '39' – '63' | Satellite PRN Signal No. 120 to 158  Reserved |
| QZSS | '0' – '4'  '5 – '63' | Satellite PRN Signal No. 193 to 197  Reserved |
| GLONASS | '0' – '23'  '24 – '63' | Slot Number 1 to 24  Reserved |
| Galileo | '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..113) OPTIONAL,

nrsrq-Result-r14 INTEGER (0..74) OPTIONAL,

carrierFreqOffsetNB-r14 CarrierFreqOffsetNB-r14 OPTIONAL, -- Cond NB-IoT

hyperSFN-r14 BIT STRING (SIZE (10)) OPTIONAL

]],

[[

rsrp-Result-v1470 INTEGER (-17..-1) OPTIONAL,

rsrq-Result-v1470 INTEGER (-30..46) OPTIONAL

]]

}

-- ASN1STOP

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

| *ECID-SignalMeasurementInformation* field descriptions |
| --- |
| ***primaryCellMeasuredResults***  This field contains measurements for the primary cell (if the primary cell is a E-UTRA or NB-IoT cell), when the target device reports measurements for both primary cell (E-UTRA or NB-IoT) and neighbour cells. This field shall be omitted when the target device reports measurements for the primary cell (E-UTRA or NB-IoT) only, in which case the measurements for the primary cell (E-UTRA or NB-IoT) is reported in the *measuredResultsList*. This field shall be omitted when the primary cell is not a E-UTRA or NB-IoT cell. |
| ***measuredResultsList***  This list contains the E‑CID measurements for up to 32 E-UTRA or NB-IoT cells. |
| ***physCellId***  This field specifies the physical cell identity of the measured cell. |
| ***cellGlobalId***  This field specifies cell global ID of the measured cell. The target device shall provide this field if it was able to determine the ECGI of the measured cell at the time of measurement. |
| ***arfcnEUTRA***  This field specifies the ARFCN of the measured E-UTRA carrier frequency, as defined in TS 36.331 [12]. In case the target device includes *arfcnEUTRA-v9a0*, the target device shall set the corresponding *arfcnEUTRA* (i.e. without suffix) to *maxEARFCN*. |
| ***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. |
| ***rsrp-Result***  This field specifies the reference signal received power (RSRP) measurement, as defined in TS 36.331 [12], TS 36.214 [17]. In case the target device includes *rsrp-Result-v1470*, the target device shall set the corresponding *rsrp-Result* (i.e. without suffix) to value 0. |
| ***rsrq-Result***  This field specifies the reference signal received quality (RSRQ) measurement, as defined in TS 36.331 [12], TS 36.214 [17]. In case the target device includes *rsrq-Result-v1470*, the target device shall set the corresponding *rsrq-Result* (i.e. without suffix) to value 0 or 34. |
| ***ue-RxTxTimeDiff***  This field specifies the UE Rx–Tx time difference measurement, as defined in TS 36.214 [17]. It is provided only for measurements on the UE's primary cell.  Measurement report mapping is according to TS 36.133 [18]. |
| ***nrsrp-Result***  This field specifies the narrowband reference signal received power (NRSRP) measurement, as defined in TS 36.214 [17]. Measurement report mapping is according to TS 36.133 [18]. |
| ***nrsrq-Result***  This field specifies the narrowband reference signal received quality (NRSRQ) measurement, as defined in TS 36.214 [17].  Measurement report mapping to the value defined in TS 36.133 [18]. Values 0..29 map to values  NRSRQ\_-30..NRSRQ\_-1. Values 30..62 map to NRSRQ\_01..NRSRQ\_33. Values 63..74 map to NRSRQ\_35..NRSRQ\_46. The UE does not report NRSRQ\_00 nor NRSRQ\_34. |
| ***carrierFreqOffsetNB***  This field specifies the offset of the NB-IoT channel number to ARFCN given by *arfcnEUTRA* as defined in TS 36.101 [21]. |
| ***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. |

#### 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)} (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)} (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. |
| ***ueRxTxSupTDD***  This field, if present, indicates that any UE Rx-Tx time difference measurement reporting for TDD from the target device includes the *NTAoffset*according to TS 36.211 [16], TS 36.214 [17] and uses the UE Rx-Tx time difference measurement report mapping for TDD as specified in TS 36.133 [18]. This field may only be included if the *ueRxTxSup* field in *ecid‑MeasSupported* is set to value one. |
| ***periodicalReporting***  This field, if present, indicates that the target device supports *periodicalReporting* of ECID measurements*.* If this field is absent, the location server may assume that the target device does not support *periodicalReporting* in *CommonIEsRequestLocationInformation*. |
| ***triggeredReporting***  This field, if present, indicates that the target device supports *triggeredReporting* for the *cellChange* event. If this field is absent, the location server may assume that the target device does not support *triggeredReporting* in *CommonIEsRequestLocationInformation*. |
| ***idleStateForMeasurements***  This field, if present, indicates that the target device requires idle state to perform ECID measurements. |

#### 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

]]

}

-- 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*, or *nrsrqMeasurementNotPossible* 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 *TBS-MeasurementInformation* 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 (1-2-21) 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, xi | Pseudorange value, P [m] |
| --- | --- | --- | --- | --- |
| 0 | 000 | 000 | 0.5 | P < 0.5 |
| 1 | 001 | 000 | 0.5625 | 0.5 <= P < 0.5625 |
| i | x | y | 0.5 \* (1 + x/8) \* 2y | xi-1 <= P < xi |
| 62 | 110 | 111 | 112 | 104 <= P < 112 |
| 63 | 111 | 111 | -- | 112 <= 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* 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,

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 *CommonIEsRequestLocationInformation*. |
| ***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-v1420,

assistanceDataSupportedButCurrentlyNotAvailableByServer-v1420

},

...

}

-- 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-v1420

},

...

}

-- ASN1STOP

| *TBS-TargetDeviceErrorCauses* field descriptions |
| --- |
| ***cause***  This field provides a TBS specific error cause. |

#### 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 4/220 decimal degrees, added to -90°. Valid range -90° to 90° [24]. |
| ***transmitterLongitude***  This field specifies longitude of the MBS transmitter, degrees. Scale factor 4/220 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]. |
| ***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

#### 6.5.5.0 Introduction

This clause defines support for sensor-based positioning. The supported sensor methods are "Barometric pressure sensor" and "Motion sensor" as described in TS 36.305, clauses 8.6 and 8.10 respectively [2].

#### 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,

...,

[[

sensor-MotionInformation-r15 Sensor-MotionInformation-r15 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 |
| --- | --- |
| *Barometer* | The field is mandatory present if the *Sensor-MeasurementInformation* is provided for barometric pressure; otherwise it is not present. |

| *Sensor-MeasurementInformation* field descriptions |
| --- |
| ***measurementReferenceTime***  This field provides the UTC time when the sensor measurements are performed and should take the form of *YYMMDDhhmmssZ.* |
| ***uncompensatedBarometricPressure***  This field provides the uncompensated barometric pressure as measured by the UE sensor, in units of Pa. |
| ***uncertainty***  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). |

#### – *Sensor-MotionInformation*

The IE *Sensor-MotionInformation* is used by the target device to provide UE movement information to the location server. The movement information comprises an ordered series of points. This information may be obtained by the target device using one or more motion sensors.

-- ASN1START

Sensor-MotionInformation-r15 ::= SEQUENCE {

refTime-r15 DisplacementTimeStamp-r15,

displacementInfoList-r15 DisplacementInfoList-r15,

...

}

DisplacementInfoList-r15 ::= SEQUENCE (SIZE (1..128)) OF DisplacementInfoListElement-r15

DisplacementInfoListElement-r15 ::= SEQUENCE {

deltaTimeStamp-r15 DeltaTime-r15,

displacement-r15 Displacement-r15 OPTIONAL,

...

}

DisplacementTimeStamp-r15 ::= CHOICE {

utcTime-r15 UTC-Time-r15,

gnssTime-r15 MeasurementReferenceTime,

systemFrameNumber-r15 SFN-r15,

measurementSFN-r15 INTEGER(-8192..9214),

...

}

DeltaTime-r15 ::= CHOICE {

deltaTimeSec-r15 INTEGER (1..16384),

deltaTimeSFN-r15 INTEGER (1..4096),

...

}

SFN-r15 ::= SEQUENCE {

sfn-r15 BIT STRING (SIZE (10)),

hyperSFN-r15 BIT STRING (SIZE (10)) OPTIONAL,

...

}

Displacement-r15 ::= SEQUENCE {

bearing-r15 INTEGER (0..3599),

bearingUncConfidence-r15 INTEGER (0..100) OPTIONAL,

bearingRef-r15 ENUMERATED { geographicNorth, magneticNorth, local },

horizontalDistance-r15 INTEGER (0..8191),

horizontalDistanceUnc-r15 INTEGER (0..255) OPTIONAL,

horizontalUncConfidence-r15 INTEGER (0..100) OPTIONAL,

verticalDirection-r15 ENUMERATED{upward, downward} OPTIONAL,

verticalDistance-r15 INTEGER(0..8191) OPTIONAL,

verticalDistanceUnc-r15 INTEGER (0..255) OPTIONAL,

verticalUncConfidence-r15 INTEGER (0..100) OPTIONAL,

...

}

UTC-Time-r15 ::= SEQUENCE {

utcTime-r15 UTCTime,

utcTime-ms-r15 INTEGER (0..999),

...

}

-- ASN1STOP

| *Sensor-MotionInformation* field descriptions |
| --- |
| ***refTime***  This field provides the reference time *t0* associated to the starting position of the first displacement in the displacement list. |
| ***displacementInfoList***  This field provides an ordered series of direction and distance travelled by the target device and comprises the following subfields:  - ***deltaTimeStamp*** specifies the time between *tn-1* and *tn*, were *n* corresonds to the order of entry in the *DispacementInfoList* (*n*=0 correspond to the time provided in *refTime*).  - ***displacement*** provides the direction and distance travelled between time *tn-1* and *tn*. |
| ***utcTime***  This field provides the time stamp of the *refTime* in UTC time and comprises the following subfields:  - *utcTime* in the form of YYMMDDhhmmssZ.  - *utcTime-ms* specifies the fractional part of the UTC time in ms resolution. |
| ***gnssTime***  This field provides the time stamp of the *refTime* in GNSS time. |
| ***systemFrameNumber***  This field provides the time stamp of the *refTime* in serving cell SFN time. |
| ***measurementSFN***  This field provides the time stamp of the *refTime* in form of the measurement SFN as defined in *deltaSFN* in IE *OTDOA-SignalMeasurementInformation*. This field may be included when OTDOA measurements are included. |
| ***deltaTimeSec***  This field provides the time between *tn-1* and *tn* in units of milliseconds. |
| ***deltaTimeSFN***  This field provides the time between *tn-1* and *tn* in units of system frame numbers. |
| ***bearing***  This field specifies the direction (heading) of the horizontal displacement measured clockwise from *bearingRef*.  Scale factor 0.1 degree. |
| ***bearingRef***  This field specifies the reference direction for the *bearing*. Enumerated value '*geographicNorth*' indicates that the *bearing* is measured clockwise from the Geographic North; '*magneticNorth*' indicates that the *bearing* is measured clockwise from the Magnetic North; '*local*' indicates that the *bearing* is measured clockwise from an arbitrary (undefined) reference direction. |
| ***horizontalDistance***  This field specifies the horizonal distance travelled between time *tn-1* and *tn*.  Scale factor 1 cm. |
| ***horizontalDistanceUnc, horizontalUncConfidence***  This field specifies the horizontal uncertainty of the displacement (corresponding to *tn*). *horizontalDistanceUnc* correspond to the encoded high accuracy uncertainty as defined in TS 23.032 [15]*. horizontalUncConfidence* corresponds to confidence as defined in TS 23.032 [15]. |
| ***verticalDistance***  This field specifies the vertical distance travelled between time *tn-1* and *tn*.  Scale factor 1 cm. |
| ***verticalDistanceUnc, verticalUncConfidence***  This field specifies the vertical uncertainty of the displacement (corresponding to *tn*). *verticalDistanceUnc* correspond to the encoded high accuracy uncertainty as defined in TS 23.032 [15]. *verticalUncConfidence* corresponds to confidence as defined in TS 23.032 [15]. |

#### 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

]],

[[ sensor-MotionInformationReq-r15 BOOLEAN OPTIONAL -- Need ON

]]

}

-- ASN1STOP

| *Sensor-RequestLocationInformation* field descriptions |
| --- |
| ***uncompensatedBarometricPressureReq***  This field indicates whether the target device is requested to report Barometric pressure measurements in *Sensor‑MeasurementInformation* IE or not. TRUE means requested. |
| ***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. |
| ***sensor-MotionInformationReq***  This field indicates whether the target device is requested to report movement information in IE *Sensor‑MotionInformation* or not. TRUE means requested. |

#### 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-MotionInformationSup-r15 ENUMERATED { true } OPTIONAL

]]

}

Sensor-AssistanceDataSupportList-r14 ::= SEQUENCE {

...,

[[ validityPeriodSupported-v1520 ENUMERATED { true } OPTIONAL,

validityAreaSupported-v1520 ENUMERATED { true } OPTIONAL

]]

}

-- ASN1STOP

| *Sensor-ProvideCapabilities* field descriptions |
| --- |
| ***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. |
| ***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. |
| ***validityPeriodSupported***  This field, if present, indicates that the target device supports *period* i.e. pressure validity period and pressure rate as part of the *Sensor-AssistanceDataList*. |
| ***valitidyAreaSupported***  This field, if present, indicates that the target device supports *area* i.e. pressure validity area and North/East pressure gradient as part of the *Sensor-AssistanceDataList*. |
| ***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 sensor measurements. |
| ***sensor-MotionInformationSup***  This field, if present, indicates that the target device supports displacement reporting in IE *Sensor-MotionInformation*. |

#### 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-v1420,

assistanceDataSupportedButCurrentlyNotAvailableByServer-v1420

},

...

}

-- 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-v1420

},

...

}

-- 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

...,

[[

period-v1520 SEQUENCE {

pressureValidityPeriod-v1520 PressureValidityPeriod-v1520,

referencePressureRate-v1520 INTEGER (-128..127) OPTIONAL, -- Need ON

...

} OPTIONAL, -- Need ON

area-v1520 SEQUENCE {

pressureValidityArea-v1520 PressureValidityArea-v1520,

gN-pressure-v1520 INTEGER (-1024..1023) OPTIONAL, -- Need ON

gE-pressure-v1520 INTEGER (-1024..1023) OPTIONAL, -- Need ON

...

} OPTIONAL -- Need ON

]]

}

PressureValidityArea-v1520 ::= SEQUENCE {

centerPoint-v1520 Ellipsoid-Point,

validityAreaWidth-v1520 INTEGER (1..128),

validityAreaHeight-v1520 INTEGER (1..128),

...

}

PressureValidityPeriod-v1520 ::= SEQUENCE {

beginTime-v1520 GNSS-SystemTime,

beginTimeAlt-v1520 INTEGER (0..2881) OPTIONAL, -- Need ON

duration-v1520 INTEGER (1..2881),

...

}

-- 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. |
| ***period***  This field specifies the pressure validity period and reference pressure rate. |
| ***pressureValidityPeriod***  - ***beginTime***: this field specifies the start time of the pressure validity period in *GNSS System Time*.  - ***beginTimeAlt***: this field specifies an alternative start time. It may be used by the target device if *GNSS-System Time* is not available. The alternative start time is relative to the time the message was received. The scale factor is 15 min. The range is from 0 minutes to 43215 minutes = 30 days.  - ***duration***: this field specifies the duration of the validity period after the begin time. The scale factor is 15 minutes. The range is from 15 minutes to 43215 minutes = 30 days. |
| ***referencePressureRate***  This field specifies the rate of change of pressure. When this field is included, the reference pressure applies only at the start of the pressure validity period. The scale factor is 10Pa/hour. |
| ***area***  This field specifies the area within which the provided atmospheric reference pressure is valid and any spatial drift. |
| ***pressureValidityArea***  - ***centerPoint***: this field specifies the coordinates of the center of the rectangular validity area.  - ***validityAreaWidth***: this field specifies the width of the rectangular validity area. Width is measured from the center along the latitude and is measured as the total width of the rectangle. The scale factor is 1km. The range is from 1km to 128km.  - ***validityAreaHeight***: this fields specifies the height of the rectangular validity area. Height is measured from the center along the longitude and is measured as the total height of the rectangle. The scale factor is 1km. The range is from 1km to 128km.  If this field is present, *refPosition* should not be provided by the location server and if provided, shall be ignored by the target device. |
| ***gN-pressure***  This field specifies the northward gradient of the reference pressure calculated from the center of the *pressureValidityArea*. The scale factor is 1 Pa/Km. If this field is not provided, the gradient is assumed to be zero. |
| ***gE-pressure***  This field specifies the eastward gradient of the reference pressure calculated from the center of the *pressureValidityArea*. The scale factor is 1 Pa/Km. If this field is not provided, the gradient is assumed to be zero. |

#### 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 clause 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,

tenthsofnanoseconds,

... },

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 *YYMMDDhhmmssZ*. |
| ***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 *rttUnits*. |
| ***rttUnits***  This field specifies the Units for the fields *rttValue* and *rttAccuracy****.*** The available Units are 1000ns, 100ns, 10ns, 1ns, and 0.1ns. |
| ***rttAccuracy***  This field provides the estimated accuracy of the provided *rttValue* expressed as the standard deviation in units given by the field *rttUnits*. |

#### 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-ProvideCapabilites* 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 OPTIONAL,

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-v1420,

notAllrequestedADAvailable-v1420

},

...,

[[ 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,

...

},

wlan-AP-RSSI-MeasurementNotPossible-r13 NULL OPTIONAL,

wlan-AP-RTT-MeasurementNotPossible-r13 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*, or *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: latitudeUncertainty = 8 - ceil(log2(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: longitudeUncertainty = 8 - ceil(log2(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: altitudeUncertainty = 21 - ceil(log2( 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: 8-bits indicating the map datum used for the coordinates. Defined codes are: Bit 1: World Geodetic System 1984 (WGS-84) Bit 2: North American Datum 1983 (NAD-83) with North American Vertical Datum 1988 (NAVD-88) Bit 3: North American Datum 1983 (NAD-83) with Mean Lower Low Water (MLLW) vertical datum.  Bits 4 – 8 are reserved. |

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

| ***WLAN-RequestAssistanceData* field descriptions** |
| --- |
| ***requestedAD*** 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:  ap-identifier: WLAN AP identity information ap-location: WLAN AP location information |
| ***visibleAPs*** 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. |
| ***wlan-AP-StoredData*** 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. |

### 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

| *BT-MeasurementInformation* field descriptions |
| --- |
| ***measurementReferenceTime***  This field provides the UTC time when the Bluetooth measurements are performed and should take the form of *YYMMDDhhmmssZ*. |
| ***bt-MeasurementList***  This field provides the Bluetooth measurements for up to 32 Bluetooth beacons. |
| ***btAddr***  This field specifies the Bluetooth public address of the Bluetooth beacon [25]. |
| ***rssi***  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

| *BT-RequestLocationInformation* field descriptions |
| --- |
| ***requestedMeasurements***  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-ProvideCapabilites* 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 } OPTIONAL,

periodicalReportingSupported-r14

PositioningModes OPTIONAL

]]

}

-- ASN1STOP

| *BT-ProvideCapabilities* field descriptions |
| --- |
| ***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. |
| ***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.  rssi: Bluetooth beacon signal strength at the target device |
| ***idleStateForMeasurements***  This field, if present, indicates that the target device requires idle state to perform BT measurements. |
| ***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*. |

#### 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

| *BT-TargetDeviceErrorCauses* field descriptions |
| --- |
| ***cause***  This field provides a Bluetooth specific error cause. If the cause value is 'notAllRequestedMeasurementsPossible', 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 *bt-Beacon-rssiMeasurementNotPossible* field. |

#### *– End of LPP-PDU-Definitions*

-- ASN1START

END

-- ASN1STOP

# 7 Broadcast of assistance data

## 7.1 General

Broadcast of positioning assistance data is supported via Positioning System Information Blocks (posSIBs) as specified in TS 36.331 [12]. The posSIBs are carried in RRC System Information (SI) messages (TS 36.331 [12]).

A single *SystemInformationBlockPos* IE is defined in TS 36.331 [12] which is carried in IE *PosSystemInformation-r15-IEs* specified in TS 36.331 [12]. The mapping of positioning SIB type (*posSibType*) to assistance data carried in *SystemInformationBlockPos* is specified in clause 7.2.

## 7.2 Mapping of *posSibType* to assistance data element

The supported *posSibType*'s are specified in Table 7.2-1. The GNSS Common and Generic Assistance Data IEs are defined in clause 6.5.2.2. The OTDOA Assistance Data IEs are defined in clause 7.4.2.

Table 7.2-1: Mapping of posSibType to assistanceDataElement

|  |  |  |
| --- | --- | --- |
|  | *posSibType* [12] | *assistanceDataElement* |
| GNSS Common Assistance Data (clause 6.5.2.2) | *posSibType1-1* | *GNSS-ReferenceTime* |
| *posSibType1-2* | *GNSS-ReferenceLocation* |
| *posSibType1-3* | *GNSS-IonosphericModel* |
| *posSibType1-4* | *GNSS-EarthOrientationParameters* |
| *posSibType1-5* | *GNSS-RTK-ReferenceStationInfo* |
| *posSibType1-6* | *GNSS-RTK-CommonObservationInfo* |
| *posSibType1-7* | *GNSS-RTK-AuxiliaryStationData* |
| GNSS Generic Assistance Data (clause 6.5.2.2) | *posSibType2-1* | *GNSS-TimeModelList* |
| *posSibType2-2* | *GNSS-DifferentialCorrections* |
| *posSibType2-3* | *GNSS-NavigationModel* |
| *posSibType2-4* | *GNSS-RealTimeIntegrity* |
| *posSibType2-5* | *GNSS-DataBitAssistance* |
| *posSibType2-6* | *GNSS-AcquisitionAssistance* |
| *posSibType2-7* | *GNSS-Almanac* |
| *posSibType2-8* | *GNSS-UTC-Model* |
| *posSibType2-9* | *GNSS-AuxiliaryInformation* |
| *posSibType2-10* | *BDS-DifferentialCorrections* |
| *posSibType2-11* | *BDS-GridModelParameter* |
| *posSibType2-12* | *GNSS-RTK-Observations* |
| *posSibType2-13* | *GLO-RTK-BiasInformation* |
| *posSibType2-14* | *GNSS-RTK-MAC-CorrectionDifferences* |
| *posSibType2-15* | *GNSS-RTK-Residuals* |
| *posSibType2-16* | *GNSS-RTK-FKP-Gradients* |
| *posSibType2-17* | *GNSS-SSR-OrbitCorrections* |
| *posSibType2-18* | *GNSS-SSR-ClockCorrections* |
| *posSibType2-19* | *GNSS-SSR-CodeBias* |
| OTDOA Assistance Data (clause 7.4.2) | *posSibType3-1* | *OTDOA-UE-Assisted* |

## 7.3 Procedures related to broadcast information elements

Upon receiving *AssistanceDataSIBelement*, the target device shall:

1> if the *segmentationInfo* is not included:

2> if the *cipheringKeyData* is included:

3> if the UE has obtained a valid cipher key value and the first portion of the initial Counter denoted C0 corresponding to the *cipherSetID* using NAS signalling:

4> if the *d0* field contains less than 128-bits:

5> pad out the bit string with zeroes in least significant bit positions to achieve 128 bits, denoted D0.

4> determine the initial Counter C1 = (C0 + D0) mod 2128 (where all values are treated as non-negative integers);

4> determine any subsequent counter Ci from the previous counter Ci-1 as Ci = (Ci-1 + 1) mod 2128;

4> use the sequence of counters <C1, C2, C3, …> and the cipher key value to decipher the *assistanceDataElement;*

4> decode the deciphered *assistanceDataElement* and deliver the related assistance data to upper layers.

3> else:

4> discard the *AssistanceDataSIBelement.*

2> else:

3> decode the *assistanceDataElement* and deliver the related assistance data to upper layers.

1> else:

2> if *segmentationOption* indicates '*pseudo-seg*':

3> if the *cipheringKeyData* is included:

4> if the UE has obtained a valid cipher key value and the first portion of the initial Counter denoted C0 corresponding to the *cipherSetID* using NAS signalling:

5> if the *d0* field contains less than 128-bits:

6> pad out the bit string with zeroes in least significant bit positions to achieve 128 bits, denoted D0.

5> determine the initial Counter C1 = (C0 + D0) mod 2128 (where all values are treated as non-negative integers);

5> determine any subsequent counter Ci from the previous counter Ci-1 as Ci = (Ci-1 + 1) mod 2128;

5> use the sequence of counters <C1, C2, C3, …> and the cipher key value to decipher the *assistanceDataElement* segment*;*

5> decode the deciphered *assistanceDataElement* segment and deliver the related assistance data portion together with the *assistanceDataSegmentType* and *assistanceDataSegmentNumber* to upper layers.

4> else:

5> discard the *AssistanceDataSIBelement* segment.

3> else:

4> decode the *assistanceDataElement* segment and deliver the related assistance data portion together with the *assistanceDataSegmentType* and *assistanceDataSegmentNumber* to upper layers.

2> if *segmentationOption* indicates '*octet-string-seg*':

3> if all segments of *assistanceDataElement* have been received:

4> assemble the assistance data element from the received *assistanceDataElement* segments;

5> if the *cipheringKeyData* is included in the first segment:

6> if the UE has obtained a valid cipher key value and the first portion of the initial Counter denoted C0 corresponding to the *cipherSetID* using NAS signalling:

7> if the *d0* field contains less than 128-bits:

8> pad out the bit string with zeroes in least significant bit positions to achieve 128 bits, denoted D0.

7> determine the initial Counter C1 = (C0 + D0) mod 2128 (where all values are treated as non-negative integers);

7> determine any subsequent counter Ci from the previous counter Ci-1 as Ci = (Ci-1 + 1) mod 2128;

7> use the sequence of counters <C1, C2, C3, …> and the cipher key value to decipher the assembled assistance data element;

7> decode the assembled and deciphered assistance data element and deliver the related assistance data to upper layers.

6> else:

7> discard the assembled assistance data element.

5> else:

6> decode the assembled assistance data element and deliver the related assistance data to upper layers.

NOTE: As an optional optimisation when *segmentationOption* indicates '*octet-string-seg*', a target device may verify if the *cipheringKeyData* is included in the first segment as soon as the first segment is received and, if included, may verify that the UE has obtained a valid cipher key value and the first portion of the initial Counter denoted C0 corresponding to the *cipherSetID* using NAS signalling. When the UE has not obtained a valid cipher key value and initial Counter C0 using NAS signalling, the UE may discard the first segment and ignore all subsequent segments.

The value for D0 shall be different for different *AssistanceDataSIBelement*'s to ensure that the counters derived from C1 for any *assistanceDataElement* are different to the counters for any other *assistanceDataElement* for a given ciphering key.

D0 shall contain at least 16 least significant bits (LSBs) set to zero to ensure that the values of D0 differ from another by a large value.

## 7.4 Broadcast information elements

### 7.4.1 Basic production

This clause defines the broadcast information elements which are encoded as 'basic production' for other purposes than encoding the IE within an LPP message.

The 'basic production' is obtained 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]. It always contains a multiple of 8 bits.

### 7.4.2 Element definitions

#### – *AssistanceDataSIBelement*

The IE *AssistanceDataSIBelement* is used in the IE *SystemInformationBlockPos* as specified in TS 36.331 [12].

-- ASN1START

AssistanceDataSIBelement-r15 ::= SEQUENCE {

valueTag-r15 INTEGER (0..63) OPTIONAL,

expirationTime-r15 UTCTime OPTIONAL,

cipheringKeyData-r15 CipheringKeyData-r15 OPTIONAL,

segmentationInfo-r15 SegmentationInfo-r15 OPTIONAL,

assistanceDataElement-r15 OCTET STRING,

...

}

CipheringKeyData-r15 ::= SEQUENCE {

cipherSetID-r15 INTEGER (0..65535),

d0-r15 BIT STRING (SIZE (1..128)),

...

}

SegmentationInfo-r15 ::= SEQUENCE {

segmentationOption-r15 ENUMERATED {pseudo-seg, octet-string-seg},

assistanceDataSegmentType-r15 ENUMERATED {notLastSegment, lastSegment},

assistanceDataSegmentNumber-r15 INTEGER (0..63),

...

}

-- ASN1STOP

| *AssistanceDataSIBelement* field descriptions |
| --- |
| ***valueTag***  This field is used to indicate to the target device any changes in the broadcast assistance data content. The *valueTag* is incremented by one, by the location server, every time a modified assistance data content is provided. This field is not included if the broadcast assistance data changes too frequently. If *valueTag* and *expirationTime* are absent, the UE assumes that the broadcast assistance data content changes at every broadcast interval. |
| ***expirationTime***  This field indicates how long the broadcast assistance data content is valid. It is specified as UTC time and indicates when the broadcast assistance data content will expire. |
| ***cipheringKeyData***  If present, indicates that the *assistanceDataElement* octet string is ciphered. |
| ***segmentationInfo***  If present, indicates that the *assistanceDataElement* is one of many segments. |
| ***assistanceDataElement***  The *assistanceDataElement* OCTET STRING depends on the *posSibType* and is specified in Table 7.2-1. NOTE. |
| ***cipherSetID***  This field identifies a cipher set comprising a cipher key value and the first component C0 of the initial counter C1. |
| ***d0***  This field provides the second component for the initial ciphering counter C1. This field is defined as a bit string with a length of 1 to 128 bits. A target device first pads out the bit string if less than 128 bits with zeroes in least significant bit positions to achieve 128 bits. C1 is then obtained from D0 and C0 (defined by the *cipherSetID*) as:  C1 = (D0 + C0) mod 2128 (with all values treated as non-negative integers). |
| ***segmentationOption***  Indicates the used segmentation option. |
| ***assistanceDataSegmentType***  Indicates whether the included *assistanceDataElement* segment is the last segment or not. |
| ***assistanceDataSegmentNumber***  Segment number of the *assistanceDataElement* segment. A segment number of zero corresponds to the first segment, one corresponds to the second segment, and so on. Segments numbers wraparound should there be more than 64 segments |

NOTE: For example, if the *posSibType* in IE *PosSIB-Type* defined in TS 36.331 [12] indicates '*posSibType1-7*', the *assistanceDataElement* OCTET STRING includes the LPP IE *GNSS‑RTK‑AuxiliaryStationData*.

#### – *OTDOA-UE-Assisted*

The IE *OTDOA-UE-Assisted* is used in the *assistanceDataElement* if the *posSibType* in IE *PosSIB-Type* defined in TS 36.331 [12] indicates '*posSibType3-1*'.

-- ASN1START

OTDOA-UE-Assisted-r15 ::= SEQUENCE {

otdoa-ReferenceCellInfo-r15 OTDOA-ReferenceCellInfo,

otdoa-NeighbourCellInfo-r15 OTDOA-NeighbourCellInfoList,

...

}

-- ASN1STOP

| *OTDOA-UE-Assisted* field descriptions |
| --- |
| ***otdoa-ReferenceCellInfo***  LPP IE *OTDOA-ReferenceCellInfo* as defined in clause 6.5.1.2. |
| ***otdoa-NeighbourCellInfo***  LPP IE *OTDOA-NeighbourCellInfoList* as defined in clause 6.5.1.2. |

## 7.5 Broadcast ciphering (informative)

The *assistanceDataElement* OCTET STRING included in IE *AssistanceDataSIBelement* may be ciphered using the 128-bit Advanced Encryption Standard (AES) algorithm (with counter mode).

AES as specified in [32] and [33] is a block mode cipher algorithm that ciphers blocks of 128 bits at a time. However, Counter mode enables usage for a bit string that is not an exact multiple of 128 bits. Further, Counter mode enables a target (or a server) to perform most of the deciphering (or ciphering) processing independently of receipt of the data to be deciphered (or ciphered) which may enable more efficient processing. Provided counters are chosen in a non‑repeating manner by the server (which is a requirement for Counter mode), every block of data will be ciphered in a unique manner.

The algorithm makes use of a sequence of counters <C1, C2, C3, …> each containing 128 bits, where C1 is specified by the server and each subsequent counter (C2, C3 etc.) is obtained from the previous counter by adding one modulo 2128. Each counter Ci is ciphered using the AES algorithm with a common 128-bit key to produce an output block Oi of 128 bits. To perform ciphering, the *assistanceDataElement* is divided into blocks B1, B2, … Bn of 128 bits each, except for the last block Bn which may contain fewer than 128 bits. The ciphered *assistanceDataElement* is obtained as a sequence of *n* blocks containing 128 bits each (except possibly for the last block) given by (O1 XOR B1), (O2 XOR B2), … (On XOR Bn), where XOR denotes bitwise exclusive OR. In the case of the last block, if Bn contains *m* bits (*m*<128), then the *m* most significant bits of On would be used for the exclusive OR. Deciphering is performed in the same way except that the blocks B1, B2, … Bn are now obtained from the ciphered message and the result of the exclusive OR operations yields the original unciphered message. Figure 7.5-1 provides an illustration of Counter mode for the generic case of an arbitrary block cipher algorithm CIPHk.



Figure 7.5-1: Illustration of Block Ciphering with Counter Mode [33].

The algorithms require specific conventions for bit ordering. The bit ordering applicable to ciphering for a ASN.1 PER encoded *assistanceDataElement* is the bit ordering produced by the ASN.1 PER encoding where the first bit is the leading bit number zero, the second bit is bit one etc..

The initial counter C1 used to cipher an entire *assistanceDataElement* is provided to a target by a server in two portions. The first portion, denoted C0, is provided using point to point mode along with the 128-bit ciphering key and an identifier for both of these values as specified in TS 23.271 [3]. The second portion, denoted D0 (*d0*), is provided in unciphered form in IE *CipheringKeyData*. A target then obtains C1 as:

C1 = (C0 + D0) mod 2128 (where all values are treated as non-negative integers)

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

Ci = (Ci1 + 1) mod 2128

NOTE: As specified in clause 7.3 the value for D0 is different for different *AssistanceDataSIBelement*'s to ensure that the counters derived from C1 for any *assistanceDataElement* can be different to the counters for any other *assistanceDataElement*. However, a long *assistanceDataElement* or a segmented *assistanceDataElement* would require the use of consecutive counter values C1 to Cn, where *n* is the *assistanceDataElement* size in bits divided by 128 (and rounded up). There would then be a danger of small changes in the value of D0 for ciphering of different *assistanceDataElement*'s (e.g. D0 being chosen as 1 larger than a previous D0 value) reusing previous counter values. To avoid this, the values of D0 contain 16 least significant bits (LSBs) set to zero, as specified in clause 7.3.

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 |
|  | RP-50 | RP-101207 | 0044 | 2 |  | Correction to the ODTOA assistance data | 9.4.0 |
|  | RP-50 | RP-101226 | 0040 | - |  | Update of 'serving cell' terminology in 36.355 | 10.0.0 |
| 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 |
|  | RP-53 | RP-111279 | 0064 | - |  | Mandatory support of PRS for OTDOA measurements | 10.3.0 |
| 2011-12 | RP-54 | RP-111709 | 0066 | - |  | Clarification of packed encoding rules of LPP | 10.4.0 |
|  | RP-54 | RP-111709 | 0068 | - |  | Clarification of first bit in BIT STRING definitions | 10.4.0 |
| 2012-06 | RP-56 | RP-120808 | 0071 | - |  | Usage of additionalInformation IE | 10.5.0 |
| 2012-09 | RP-57 | RP-121424 | 0074 | 2 |  | Corrections to GNSS Acquisition Assistance Data | 10.6.0 |
|  | RP-57 | - | - | - |  | Upgrade to the Release 11 - no technical change | 11.0.0 |

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| 2012-12 | RP-58 | RP-121931 | 0077 | - |  | Correcting the referencing of QoS parameters | 11.1.0 |
|  | RP-58 | RP-121931 | 0080 | - |  | Correction to missing field description in GNSS-AcquisitionAssistance IE | 11.1.0 |
| 2013-03 | RP-59 | RP-130237 | 0083 | 1 |  | Extending E-UTRA Frequency Band and EARFCN value range | 11.2.0 |
|  | RP-59 | RP-130230 | 0086 | - |  | Correction to PRS Muting Configuration | 11.2.0 |
| 2013-06 | RP-60 | RP-130803 | 0088 | - |  | Correction for ASN.1 errors from CR0083r1 | 11.3.0 |
|  | RP-60 | RP-130803 | 0091 | - |  | Correction to integer code phase field description in GNSS Acquisition Assistance | 11.3.0 |
|  | RP-60 | RP-130803 | 0093 | - |  | Correction to serving cell terminology | 11.3.0 |
|  | RP-60 | RP-130803 | 0094 | - |  | Encoding of LPP IEs | 11.3.0 |
| 2013-09 | RP-61 | RP-131314 | 0098 | - |  | Correction on svReqList | 11.4.0 |
| 2013-12 | RP-62 | RP-131984 | 0103 | - |  | Correction to missing capability indication for inter-frequency RSTD measurements | 11.5.0 |
|  | RP-62 | RP-131984 | 0107 | 1 |  | Correction to Galileo assistance data elements | 11.5.0 |
|  | RP-62 | RP-132000 | 0104 | 1 |  | Stage 3 CR of TS 36.355 for introducing BDS in LTE | 12.0.0 |
|  | RP-62 | RP-131984 | 0108 | - |  | Correction to Galileo assistance data elements | 12.0.0 |
| 2014-03 | RP-63 | RP-140342 | 0112 | 1 |  | Clarification to gnss-DayNumber | 12.1.0 |
| 2014-06 | RP-64 | RP-140871 | 0119 | - |  | Signaling of OTDOA Neighbour Cell Information and Measurements | 12.2.0 |
| 2014-12 | RP-66 | RP-142114 | 0122 | - |  | Correction to Galileo Assistance Data | 12.3.0 |
|  | RP-66 | RP-142114 | 0123 | - |  | Addition of an Early Position Fix to LPP | 12.3.0 |
|  | RP-66 | RP-142120 | 0124 | - |  | BDS update to version 2.0 | 12.3.0 |
| 2015-03 | RP-67 | RP-150369 | 0126 | 2 |  | Correction of GLONASS system time | 12.4.0 |
|  | RP-67 | RP-150376 | 0125 | 1 |  | LPP clean-up | 12.4.0 |
| 2015-12 | RP-70 | RP-152055 | 0134 | 1 |  | Correction to the definition of Need codes | 12.5.0 |
| 2015-12 | RP-70 | RP-152068 | 0137 | 3 |  | RAT-Independent positioning enhancements | 13.0.0 |
| 2016-03 | RP-71 | RP-160463 | 0138 | 1 |  | Correction to GLONASS IOD value range | 13.1.0 |
|  | RP-71 | RP-160470 | 0140 | 1 |  | r13 Information Element correction | 13.1.0 |
|  | RP-71 | RP-160470 | 0141 | - |  | WLAN AP Identifier correction | 13.1.0 |
|  | RP-71 | RP-160470 | 0142 | 1 |  | LPP clean-up | 13.1.0 |
| 2016-09 | RP-73 | RP-161750 | 0143 | 4 |  | Correction of ECID positioning for TDD | 13.2.0 |
| 2016-12 | RP-74 | RP-162317 | 0160 | 1 |  | Clarification of WLAN RSSI value range | 13.3.0 |
| 2016-12 | RP-74 | RP-162326 | 0155 | 1 |  | CR for 36.355 Further Indoor positioning enhancements | 14.0.0 |
|  | RP-74 | RP-162327 | 0157 | - |  | Barometric Pressure Uncertainty IEs | 14.0.0 |
|  | RP-74 | RP-162326 | 0161 | 1 |  | Introduction of Further Indoor Positioning Enhancements | 14.0.0 |
| 2017-03 | RP-75 | RP-170636 | 0162 | 3 | B | Introduction of positioning for further enhanced MTC | 14.1.0 |
|  | RP-75 | RP-170642 | 0163 | - | C | Addition of periodical and triggered reporting capabilitiy signalling | 14.1.0 |
|  | RP-75 | RP-170642 | 0165 | 2 | F | Further Indoor positioning enhancements corrections | 14.1.0 |
|  | RP-75 | RP-170637 | 0166 | - | B | Introduction of positioning support for NB-IoT | 14.1.0 |
| 2017-06 | RP-76 | RP-171224 | 0169 | 3 | F | Compact Signal Measurement Information for OTDOA | 14.2.0 |
|  | RP-76 | RP-171223 | 0171 | 1 | F | Correction to PRS Subframe Offset | 14.2.0 |
|  | RP-76 | RP-171223 | 0173 | 1 | F | Correction to SFN time stamp in OTDOA Signal Measurement Information | 14.2.0 |
|  | RP-76 | RP-171223 | 0174 | 1 | F | Correction to OTDOA capabilities | 14.2.0 |
|  | RP-76 | RP-171224 | 0175 | 1 | F | Correction to NPRS | 14.2.0 |
|  | RP-76 | RP-171225 | 0176 | 2 | F | LPP clean-up | 14.2.0 |
|  | RP-76 | RP-171224 | 0177 | - | F | Corrections to number of NPRS carriers and ECID measurements for NB-IoT | 14.2.0 |
|  | RP-76 | RP-171224 | 0178 | 1 | F | Removal of FFS for retransmission timer in LPP | 14.2.0 |
|  | RP-76 | RP-171224 | 0181 | 1 | F | Signalling optimisation for NB-IoT Enhancements | 14.2.0 |
| 2017-09 | RP-77 | RP-171913 | 0182 | 2 | F | Clarification on definition of PRS Occasion Group | 14.3.0 |
|  | RP-77 | RP-171914 | 0183 | 1 | F | Additional OTDOA Capabilities | 14.3.0 |
|  | RP-77 | RP-171911 | 0184 | - | F | Clarification to *GNSS-TimeModelList* | 14.3.0 |
|  | RP-77 | RP-171913 | 0185 | 1 | F | Minor corrections on TS 36.355 for Rel-14 MTC | 14.3.0 |
| 2017-12 | RP-78 | RP-172616 | 0187 | 2 | F | Correction on PRS hopping configuration | 14.4.0 |
| 2018-03 | RP-79 | RP-180446 | 0189 | 1 | F | Segmentation of LPP Messages | 14.5.0 |
| 2018-04 | RP-79 |  |  |  |  | New version to fix ASN.1 formatting | 14.5.1 |
| 2018-06 | RP-80 | RP-181235 | 0202 | 2 | F | Clarification for NRSRQ reporting with E-CID | 14.6.0 |
| 2018-06 | RP-80 | RP-181219 | 0204 | 2 | B | Introduction of IMU support for OTDOA | 15.0.0 |
|  | RP-80 | RP-181219 | 0205 | 1 | B | Addition of RTK and PPP support | 15.0.0 |
|  | RP-80 | RP-181219 | 0207 | 1 | B | Addition of broadcast of positioning assistance data | 15.0.0 |
|  | RP-80 | RP-181215 | 0209 | 1 | B | Addition of NR Support | 15.0.0 |
|  | RP-80 | RP-181252 | 0210 | 1 | B | Addition of NB-IoT TDD support | 15.0.0 |
| 2018-09 | RP-81 | RP-181963 | 0215 | 1 | A | Support for NPRS enhancements | 15.1.0 |
|  | RP-81 | RP-181945 | 0218 | 1 | F | Corrections to TDD in 36.355 | 15.1.0 |
|  | RP-81 | RP-181961 | 0221 | 3 | A | Correction to RSRQ range in 36.355 | 15.1.0 |
|  | RP-81 | RP-181942 | 0222 | 1 | F | OTDOA Assistance Data Request for NR | 15.1.0 |
|  | RP-81 | RP-181960 | 0223 | - | F | LPP clean-up | 15.1.0 |
|  | RP-81 | RP-181952 | 0224 | 1 | F | GAD shapes for high accuracy positioning | 15.1.0 |
|  | RP-81 | RP-181952 | 0226 | 1 | B | Positioning SIB value tag and expiration time | 15.1.0 |
| 2018-12 | RP-82 | RP-182672 | 0213 | 3 | F | Addition of TDD UL/DL configuration to OTDOA assistance data | 15.2.0 |
|  | RP-82 | RP-182681 | 0228 | 2 | F | Introduction of TDD UL/DL configuration for NB-IoT in 36.355 | 15.2.0 |
|  | RP-82 | RP-182659 | 0229 | 3 | F | SFN offset for OTDOA | 15.2.0 |
|  | RP-82 | RP-182674 | 0230 | 1 | F | Alignment of IE/field names between LPP and RRC specifications | 15.2.0 |
|  | RP-82 | RP-182672 | 0232 | 1 | F | Sensor Assistance Data Elements Correction | 15.2.0 |
| 2019-03 | RP-83 | RP-190550 | 0234 | 3 | F | Stage 2 and stage 3 sensor methods description alignment | 15.3.0 |
| 2019-06 | RP-84 | RP-191376 | 0239 | 1 | F | Minor corrections on NR Support | 15.4.0 |
|  | RP-84 | RP-191384 | 0240 | 4 | F | Periodic assistance data transfer with cell ID change procedure | 15.4.0 |
| 2019-09 | RP-85 | RP-192196 | 0243 | 1 | F | Distinguishing Location Source when sensor method is used | 15.5.0 |