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Mobile Station (MS) - Serving Mobile Location Centre (SMLC)

Radio Resource LCS Protocol (RRLP)

(Release 16)

 

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# Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document contains the definition of the Radio Resource LCS Protocol (RRLP) to be used between the Mobile Station (MS) and the Serving Mobile Location Centre (SMLC).

Clause 2 defines the functionality of the protocol. Clause 3 describes the message structure, and Clause 4 the structure of components. Clause 5 contains the ASN.1 description of the components.

## 1.1 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 43.059: "Functional Stage 2 Description of Location Services in GERAN".

[3] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".

[4] ITU-T Recommendation X.691: "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)".

[5] ITU-T Recommendation X.680: "Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation".

[6] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".

[7] 3GPP TS 49.031: "Location Services (LCS); Base Station System Application Part LCS Extension (BSSAP-LE)".

[8] ICD-GPS-200, Navstar GPS Space Segment/Navigation User Interfaces.

[9] RTCM-SC104, RTCM Recommended Standards for Differential GNSS Service (v.2.2).

[10] 3GPP TS 44.064: "General Packet Radio Service (GPRS); Mobile Station - Serving GPRS Support Node (MS-SGSN); Logical Link Control (LLC) layer specification".

[11] Galileo OS Signal in Space ICD (OS SIS ICD), Issue 1.~~1~~2, ~~September~~ February 201~~0~~4, European Union.

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

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

[14] IS-GPS-800, Navstar GPS Space Segment/User Segment L1C Interfaces, March 31, 2008.

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

[16] IS-QZSS, Quasi Zenith Satellite System Navigation Service Interface Specifications for QZSS, Ver.1.0, June 17, 2008.

[17] Global Navigation Satellite System GLONASS Interface Control Document, Version 5, 2002.

[18] BDS-SIS-ICD-2.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal (Version 2.0)", December 2013.

## 1.2 Abbreviations

For the purposes of the present document, the following abbreviations and the abbreviations given in 3GPP TR 21.905 or in 3GPP TS 43.059 apply.

ADR Accumulated Delta-Range

BDS BeiDou Navigation Satellite System

CNAV Civil Navigation

ECEF Earth-Centered, Earth-Fixed

ECI Earth-Centered-Inertial

EGNOS European Geostationary Navigation Overlay Service

FEC Forward Error Correction

GAGAN GPS Aided Geo Augmented Navigation

ICD Interface Control Document

GANSS Galileo and Additional Navigation Satellite Systems

GLONASS GLObal'naya NAvigatsionnaya Sputnikovaya Sistema (Engl.: Global Navigation Satellite System)

GNSS Global Navigation Satellite System

IOD Issue of Data

LSB Least Significant Bit

MSAS Multi-functional Satellite Augmentation System

MSB Most Significant Bit

msd mean solar day

NAV Navigation

NICT National Institute of Information and Communications Technology

NTSC National Time Service Center

PZ-90 Parametry Zemli 1990 Goda – Parameters of the Earth Year 1990

QZSS Quasi-Zenith Satellite System

SBAS Space Based Augmentation System

SV Space Vehicle

USNO US Naval Observatory

WAAS Wide Area Augmentation System

WGS-84 World Geodetic System 1984

# 2 Functionality of Protocol

## 2.1 General

The present document defines one generic RRLP message that is used to transfer Location Services (LCS) related information between the Mobile Station (MS) and the Serving Mobile Location Centre (SMLC). Usage of the RRLP protocol on a general level is described in 3GPP TS 43.059 that includes Stage 2 description of LCS.

One message includes one of the following components:

- Measure Position Request;

- Measure Position Response;

- Assistance Data;

- Assistance Data Acknowledgement;

- Protocol Error;

- Positioning Capability Request;

- Positioning Capability Response;

- Multilateration Timing Advance Request.

Next sub-clauses describe the usage of these components.

Delivery of components may be supported in the RRLP level using pseudo-segmentation by sending several shorter messages instead of one long message. Any assistance data that is successfully delivered to an MS and acknowledged prior to the interruption of the positioning procedure by an event like handover, or by any other event that causes an MS to terminate the positioning procedure or delivery of assistance data (see 3GPP TS 43.059), shall be retained by the MS and need not be resent by the SMLC when positioning or delivery of assistance data is again re-attempted.

The RRLP maximum PDU size is 242 octets. If the amount of data that needs to be sent is larger than RRLP maximum PDU size, the RRLP pseudo-segmentation shall be used. The RRLP pseudo-segmentation is the use of several RRLP components (one in each RRLP message) to deliver a large amount of information. For SMLC to MS messages, the Assistance Data component is the one that is sent several times in order to deliver the information. For MS to SMLC messages, the Measure Position Response component may be sent twice in order to deliver the information. Legacy MS and SMLC (3GPP Rel-4 or older) may send RRLP components that are larger than the RRLP maximum PDU size. In this case lower level segmentation will be used.

## 2.2 Position Measurement Procedure

The purpose of this procedure is to enable the SMLC to request for position measurement data or location estimate from the MS, and the MS to respond to the request with measurements or location estimate.



Figure 2.1: Position Measurement procedure

1. The Measure Position Request component and any Assistance Data Delivery Procedure may be preceded by a Positioning Capability Transfer procedure (see sub-clause 2.3a) to transfer the MS positioning capabilities to the SMLC.

2. The Measure Position Request component may be preceded by an Assistance Data Delivery Procedure (see sub-clause 2.3) to deliver some or all of the entire set of assistance data that is needed by the subsequent positioning procedure (steps 3-5).

3. The SMLC sends the Measure Position Request component in a RRLP message to the MS. The component includes QoS, other instructions, and possible assistance data to the MS. The RRLP message contains a reference number and an extended reference ID of the request.

4. The MS sends a RRLP message containing the Protocol Error component to the SMLC, if there is a problem that prevents the MS to receive a complete and understandable Measure Position Request component. The RRLP message contains the reference number and, if available, the extended reference ID included in the Measure Position Request received incomplete. The Protocol Error component includes a more specific reason. When the SMLC receives the Protocol Error component, it may try to resend the Measure Position Request (go back to the step 3), abort location, or start a new position measurement procedure (e.g. with updated assistance data).

5. The MS tries to perform the requested location measurements, and possibly calculates it own position. When the MS has location measurements, location estimate, or an error indication (measurements/location estimation not possible), it sends the results in the Measure Position Response component to the SMLC. The RRLP message contains the reference number and, if received, the extended reference ID of the request originally received in the step 3. The MS may optionally send one additional Measure Position Response component in a second RRLP message to the SMLC if the amount of information it needs to transfer to the SMLC is too large to fit into one single Measure Position Response component (uplink RRLP pseudo-segmentation). This RRLP message also contains the reference number and, if received, the extended reference ID of the request originally received in the step 3. If two components are sent, the MS shall indicate in the first component that it is the first of many components and in the second one that it is the second of many components. If there is a problem that prevents the SMLC to receive a complete and understandable Measure Position Response component, the SMLC may decide to abort location, or start a new position measurement procedure instead. If additional Measure Position Response components are received by the SMLC after the 1st and optional 2nd one, they shall be ignored.

## 2.3 Assistance Data Delivery Procedure

The purpose of this procedure is to enable the SMLC to send assistance data to the MS related to position measurement and/or location calculation. Notice that RRLP protocol is not used by the MS to request assistance data, only to deliver it to the MS. The entire set of assistance data (i.e. the total amount of assistance data that the SMLC has decided to send in the current procedure) may be delivered in one or several Assistance Data components. In this case steps 1 and 3 below may be repeated several times by the SMLC. If several components are sent, the SMLC shall await the acknowledgement of each component before the next Assistance Data component is sent. If Assistance Data Delivery is used as part of the Position Measurement Procedure, as described in sub-clause 2.2, then some assistance data may be delivered in the final RRLP Measure Position Request.



Figure 2.2: Assistance Data Delivery procedure

1. The SMLC sends the Assistance Data component to the MS. The component includes assistance data for location measurement and/or location calculation. The RRLP message contains a reference number and an extended reference ID of the delivery. The More Assistance Data To Be Sent Element in the Assistance Data component is used by the SMLC to indicate to the MS if either more Assistance Data components (in the current Assistance Data Delivery procedure) or a final RRLP Measure Position Request (if the Assistance Data Delivery Procedure forms part of a Position Measurement procedure as described in sub-clause 2.2) will be sent.

2. The MS sends a RRLP message containing the Protocol Error component to the SMLC, if there is a problem that prevents the MS to receive a complete and understandable Assistance Data component. The RRLP message contains the reference number and, if available, the extended reference ID included in the Assistance Data component received incomplete. The Protocol Error component includes a more specific reason. When the SMLC receives the Protocol Error component, it may try to resend the Assistance Data component (go back to the step 1), send a new measure Assistance Data set (e.g. with updated assistance data), or abort the delivery.

3. When the MS has received a complete Assistance Data component, it send the Assistance Data Acknowledgement component to the SMLC. The RRLP message contains the reference number of the Assistance Data originally received in step 1.

## 2.3a Positioning Capability Transfer Procedure

The purpose of this procedure is to enable the SMLC to obtain the positioning capabilities of the MS, the types of assistance supported and the types of assistance data that may be needed from the SMLC. MS support for this procedure can be indicated to the SMLC using the MS Classmark 3 IE for GSM (see 3GPP TS 24.008), the PS LCS Capability IE for GERAN Gb mode (see 3GPP TS 24.008) and the MS Positioning Capability IE for GERAN Iu mode (see 3GPP TS 44.118).



Figure 2.3: Positioning Capability Transfer procedure

1. The SMLC sends the Positioning Capability Request component to the MS. The RRLP message contains a reference number and an extended reference ID of the request. The message may contain indication of GANSS positioning support.

2. The MS sends a RRLP message containing the Protocol Error component to the SMLC, if there is a problem that prevents the MS to receive a complete and understandable Positioning Capability Request component. The RRLP message contains the reference number and the extended reference ID included in the Positioning Capability Request component. The Protocol Error component includes a more specific reason. When the SMLC receives the Protocol Error component, it may try to resend the Positioning Capability Request component (go back to the step 1) or abort the request.

3. When the MS has received a complete Positioning Capability Request component, it sends the Positioning Capability Response component to the SMLC. The component shall include the positioning capabilities of the MS and the types of supported assistance data. The component may include the types of assistance needed by the MS to obtain a location estimate or positioning measurements. The RRLP message also contains the reference number and extended Reference ID of the Positioning Capability Request originally received in step 1.

## 2.4 (void)

## 2.5 Error Handling Procedures

### 2.5.1 General

In this sub-clause it is described how a receiving entity behaves in cases when it receives erroneous data or detects that certain data is missing.

### 2.5.1a Message Too Short

When MS receives a RRLP message, that is too short to contain all mandatory IEs, the MS sends a Protocol Error component with indication "Message Too Short". If the Reference Number can be found, it is included. If the Reference Number is not available, the Reference Number of the RRLP message carrying the Protocol Error component is set to '0'. If the Extended Reference IE can be found, it shall be included in the returned Protocol Error Component. If the Extended Reference IE is not available, an Extended Reference IE shall not be included. The original sending entity that receives the Protocol Error, may then resend the original message, or abort the procedure.

### 2.5.2 Unknown Reference Number

A SMLC detects that it has received a RRLP message with an unknown or invalid Reference Number, when one or more of the following conditions occur:

- a Measure Position Response, Assistance Data Acknowledgement, Positioning Capability Response or Protocol Error component is received with a Reference Number that the SMLC has not sent in a Measure Position Request, Assistance Data or Positioning Capability Request component during a pending Position Measurement, Assistance Data Delivery or Positioning Capability Transfer procedure.

- a Measure Position Response, Positioning Capability Response or Protocol Error component is received with an Extended Reference IE value that the SMLC has not sent in a Measure Position Request Assistance Data or Positioning Capability Request component during a pending Position Measurement, Assistance Data Delivery or Positioning Capability Transfer procedure.

- a Measure Position Response, Positioning Capability Response or Protocol Error component is received with a Reference Number and an Extended Reference IE value that the SMLC has not sent together in the same Measure Position Request, the same Assistance Data or the same Positioning Capability Request component during a pending Position Measurement, Assistance Data Delivery or Positioning Capability Transfer procedure.

The SMLC shall then discard the message. If the SMLC receives a Measure Position Response or a Protocol Error component containing no Extended Reference ID, then the SMLC shall assume that the target MS is for Release 4 or earlier and shall only verify the received Reference Number.

### 2.5.3 Missing Information Element or Component Element

When MS receives a RRLP message, that does not contain IEs or component elements expected to be present, the MS sends a Protocol Error component with indication "Missing Information Element or Component Element". If the Reference Number can be found, it is included. If the Reference Number is not available, the Reference Number of the RRLP message carrying the Protocol Error component is set to '0'. If the Extended Reference IE can be found, it shall be included in the returned Protocol Error Component. If the Extended Reference IE is not available, an Extended Reference IE shall not be included. The SMLC that receives the Protocol Error, may then resend the original message, or abort the procedure.

### 2.5.4 Incorrect Data

When MS receives a RRLP message, that is contains IEs or elements of components that are syntactically incorrect, the MS sends a Protocol Error component with indication "Incorrect Data". If the Reference Number can be found, it is included. If the Reference Number is not available, the Reference Number of the RRLP message carrying the Protocol Error component is set to '0'. If the Extended Reference IE can be found, it shall be included in the returned Protocol Error Component. If the Extended Reference IE is not available, an Extended Reference IE shall not be included. The SMLC that receives the Protocol Error, may then resend the original message, or abort the procedure.

### 2.5.5 Repeated Component

When after the reception of a Measure Position Request component, but before responding with a Measure Position Response or a Protocol Error component, the MS receives a new RRLP message with the Measure Position Request component, it acts as follows:

- if the old and new Measure Position Request components have the same Reference Number and, if included, the same Extended Reference IE, the MS ignores the later component;

- if the old and new Measure Position Request components have different Reference Numbers or, if included, different Extended Reference IEs or if one Measure Position Request component (old or new) contains an Extended Reference IE but the other component does not, the MS aborts activity for the former component, and starts to acts according to the later component, and sends a response to that.

When after the reception of an Assistance Data component, but before responding with an Assistance Data Acknowledgement or a Protocol Error component, the MS receives a new RRLP message with the Assistance Data component, it acts as follows:

- if the old and new Assistance Data components have the same Reference Number and, if included, the same Extended Reference IE and if pseudo-segmentation does not apply (see sub-clause 2.5.9), the MS ignores the later component;

- if the old and new Assistance Data components have different Reference Numbers or, if included, different Extended Reference IEs or if one Assistance Data component (old or new) contains an Extended Reference IE but the other component does not, the MS ignores the former component and sends an acknowledgement to the latter component.

When after the reception of a Positioning Capability Request component, but before responding with a Positioning Capability Response or a Protocol Error component, the MS receives a new RRLP message with the Positioning Capability Request component, it acts as follows:

- if the old and new Positioning Capability Request components have the same Reference Number and the same Extended Reference IE, the MS ignores the later component;

- if the old and new Positioning Capability Request components have different Reference Numbers or different Extended Reference IEs, the MS aborts activity for the former component, starts to act according to the later component and sends a response to that.

When after the reception of an Measure Position Response component, the SMLC receives a new RRLP message with the Measure Position Response component, it acts as follows:

- if the old and new Measure Position Response components have the same Reference Number and, if included, the same Extended Reference IE values, the SMLC may ignore the later component;

### 2.5.6 (void)

### 2.5.7 Missing Component

When the SMLC sends a Measure Position Request component to the MS, it starts a timer. If the timer expires before the SMLC receives the last Measure Position Response component or a Protocol Error component from the MS with the same Reference Number and, if included, the same Extended Reference IE value as in the sent component, it may abort location attempt or send a new Measure Position Request.

When the SMLC receives a Measure Position Response component with the same Reference Number and, if included, the same Extended Reference IE value as in the sent component indicating that it is the second of many segments, but the first of the many segments was never received by the SMLC, it may abort location attempt or send a new Measure Position Request.

When the SMLC sends a Assistance Data component to the MS, it starts a timer. If the timer expires before the SMLC receives a Assistance Data Acknowledgement or Protocol Error component from the MS with the same Reference Number as in the sent component and, in the case of a Protocol Error component, either the same extended reference ID as in the sent component or no extended reference ID, it may abort delivery attempt or send a new Assistance Data.

When the SMLC sends a Positioning Capability Request component to the MS, it starts a timer. If the timer expires before the SMLC receives a Positioning Capability Response or Protocol Error component from the MS with the same Reference Number and the same Extended Reference ID as in the sent component, it may abort the Positioning Capability Transfer Procedure attempt or send a new Positioning Capability Request.

### 2.5.8 Unforeseen Component

When the MS receives a complete Assistance Data pseudo-segmentation sequence or an Assistance Data component that was sent without pseudo-segmentation, that it is not expecting, MS may discard it.

### 2.5.8a RRLP Procedure

The MS and SMLC shall only support one RRLP procedure at a time for either positioning, delivery of assistance data or positioning capability transfer. The normal sequence of events for either procedure is defined in sub-clause 2.2, sub-clause 2.3 or sub-clause2.3a, respectively. If the MS is engaged in an RRLP procedure and receives a correctly encoded RRLP message from the SMLC that starts a new procedure, the MS shall abort the first procedure without sending a response and start the second.

### 2.5.9 Pseudo-Segmentation

When the SMLC employs pseudo-segmentation to send an RRLP Measure Position Request message or an RRLP Assistance Data message, the SMLC shall send one or more RRLP Assistance Data components followed by:

- a final RRLP Measure Position Request component (see sub-clause 2.2) or

- a final RRLP Assistance Data component (see sub-clause 2.3).

The SMLC shall indicate in all but the final component (Measure Position Request or Assistance Data, respectively) that more components are on the way.

When an MS receives an Assistance Data component indicating that more components are on the way, the MS may store the contents of the component. If the MS receives a subsequent Assistance Data component or a final Measure Position Request component that is correctly encoded, the MS shall assume that the new component continues the pseudo-segmentation of the earlier component and may then store the contents of the new component. If the new component is an Assistance Data component indicating that no more components are on the way or if it is a Measure Position Request, the MS shall assume that pseudo-segmentation is complete. The MS may then employ the rules defined in sub-clause 2.5.5 to verify if the new message is a repeated duplicate of a previous message.

## 2.6 Multilateration Timing Advance Procedure

The purpose of this procedure is to enable the SMLC to request an MS to perform the Multilateration Timing Advance procedure in multiple cells autonomously selected by the MS. The BSS(s) corresponding to the selected cells acquire and send timing advance related measurements to the SMLC which uses the received measurements to perform a location estimate for the MS.



Figure 2.6: Multilateration Timing Advance procedure

1. The RRLP Multilateration Timing Advance Request component is sent to the MS (see step 1 in Figure 2.6). The RRLP message contains assistance information acquired from the serving BSS which can be used by the MS to perform the Multilateration Timing Advance procedure.

2. The MS performs the Multilateration Timing Advance procedure in multiple cells that it selects autonomously which may include one or more cells for which it has received assistance information in the RRLP message (see steps 2a, 2b … 2n). After the MS performs the radio access part of the MTA procedure in a given cell the corresponding BSS sends the cell specific Multilateration timing advance information to the SMLC.

3. The SMLC uses the collected timing advance information to estimate a “position” for the MS (see step 3).

# 3 Message Structure

## 3.1 General Format of RRLP Message

The general format of the RRLP message is given below, and based on:

- ITU-T Recommendation X.680;

- ITU-T Recommendation X.691;

and is consistent with these ITU-T recommendations. Also further definitions in the present document are based on ASN.1/94 defined in ITU-T Recommendation X.680 (ASN.1 1994). BASIC-PER, unaligned variant is used. Both RRLP ASN.1 modules, RRLP-Messages and RRLP-Components, are based on recommendations presented above.

ASN.1 identifiers have the same name as the corresponding parameters (information elements of the RRLP message, components, elements of components, fields of component elements etc) in other parts of the present document, except for the differences required by the ASN.1 notation (blanks between words are removed, the first letter of the first word is lower-case and the first letter of the following words are capitalized, e.g. "Reference Number" is mapped to "referenceNumber"). In addition some words may be abbreviated as follows:

msr measure

req request

rsp response

nbr number

ack acknowledgement

Ellipsis Notation shall be used in the same way as described in 3GPP TS 29.002 and shall be supported on the radio interface by the MS and the network for all operations defined in the present document.

Table 3.1.a: RRLP Message Format

|  |
| --- |
| RRLP-Messages  -- { RRLP-messages }  DEFINITIONS AUTOMATIC TAGS ::=  BEGIN  IMPORTS  MsrPosition-Req, MsrPosition-Rsp, AssistanceData,  ProtocolError, PosCapability-Req, PosCapability-Rsp,  MultilaterationOTD-Req, MultilaterationOTD-Rsp,  PosMTA-Req  FROM  RRLP-Components -- { RRLP-Components }  ;  PDU ::= SEQUENCE {  referenceNumber INTEGER (0..7),  component RRLP-Component  }  RRLP-Component ::= CHOICE {  msrPositionReq MsrPosition-Req,  msrPositionRsp MsrPosition-Rsp,  assistanceData AssistanceData,  assistanceDataAck NULL,  protocolError ProtocolError,  ...,  posCapabilityReq PosCapability-Req,  posCapabilityRsp PosCapability-Rsp,  multilaterationOTDReq MultilaterationOTD-Req,  multilaterationOTDRsp MultilaterationOTD-Rsp,  posMTAReq PosMTA-Req  }  END |

The message consists of two information elements, that are further described in the following sub-clauses.

## 3.2 Reference Number IE

This element is mandatory, and appears only once per RRLP message. It has the range from 0 to 7. Value 0 is reserved for indicating unknown Reference Number. Its ASN.1 definition is in sub-clause 3.1. This element contains the Reference Number that shall be used as follows:

- in the Position Measurement procedure the SMLC shall select any number within the range 1- 7 that it is not already using with the particular MS. The Reference Number serves as an identification of the Measure Position request component that it sends to the MS. When the MS responds either with the Measure Position Response component, or the Protocol Error component, it shall use the same Reference Number value and, if an Extended Reference ID was included by the SMLC, the same Extended Reference ID to identify to which Measure Position Request it is responding, if the Reference Number has been obtained. If the MS has not been able to decode the Reference Number (e.g. IE missing), it shall use '0' as the Reference number in the response. This mechanism helps for example in the cases where the SMLC sends a Measure Position Request to the MS, and before it receives the Response, it needs to send another Request (e.g. assistance data changes). Then the SMLC can identify to which Request the Response is related to;

- in the Assistance Data Delivery procedure the SMLC shall select any number within the range 1 - 7 that it is not already using with the MS. The Reference Number serves as an identification of the Assistance Data component that it sends to the MS. When the MS responds either with the Assistance Data Acknowledgement component or the Protocol Error component, it shall use the same Reference Number value if the Reference Number has been obtained and, in the case of Protocol Error, if an Extended Reference ID was included by the SMLC, the same Extended Reference ID to identify to which Assistance Data component it is responding. If the MS has not been able to decode the Reference Number (e.g. IE missing), it shall use '0' as the Reference number in the response.

- in the Position Capability Transfer procedure the SMLC shall select any number within the range 1 - 7 that it is not already using with the MS. The Reference Number serves as an identification of the Positioning Capability Request component that it sends to the MS. When the MS responds either with the Positioning Capability Response component, or the Protocol Error component, it shall use the same Reference Number value if the Reference Number has been obtained and the same Extended Reference ID value if that has been obtained to identify to which Positioning Capability Request component it is responding. If the MS has not been able to decode the Reference Number (e.g. IE missing), it shall use '0' as the Reference number in the response.

- the SMLC shall use the same Reference Number and same Extended Reference ID to resend any RRLP component for which a response was not received from the MS.

- the SMLC shall use a different Reference Number to that in any RRLP component for which a response was not received from the MS if the SMLC aborts an existing RRLP procedure and starts a new procedure.

- the SMLC may use the same Reference Number and same Extended Reference ID or different Reference Numbers and Extended Reference IDs for different RRLP components within the same pseudo-segmentation sequence.

In all RRLP messages except Assistance Data Acknowledgement, the Reference Number IE shall be supplemented by an Extended Reference IE in order to distinguish valid from invalid RRLP responses at the SMLC and duplicate from non-duplicate RRLP commands at the MS. In order to remain backward compatible, the receiving entity shall be able to receive Measure Position Request, Measure Position Response, Assistance Data and Protocol Error messages without the Extended Reference IE. The ASN.1 definition of the Extended Reference IE is given in sub-clause 5.1 and the procedures associated with sending and receiving it are given in clause 2 and in Annex A, sub-clauses A.2.2.5, A.3.2.7 and A.6.6.

## 3.3 Component IE

This element is mandatory, and appears only once per RRLP message. It contains the actual component to be transferred.

Different components are described further in Chapter 4. This IE contains only one component, i.e. it is not possible to include two or more components.

# 4 Components

This ASN.1 module contains the definitions of the components and datatypes defined in the components.

Table 4.a: RRLP-Components format

|  |
| --- |
| RRLP-Components  -- { RRLP-Components }  DEFINITIONS AUTOMATIC TAGS ::=  BEGIN  IMPORTS  Ext-GeographicalInformation, VelocityEstimate  FROM  MAP-LCS-DataTypes {  itu-t identified-organization (4) etsi (0) mobileDomain (0)  gsm-Network (1) modules (3) map-LCS-DataTypes (25) version10 (10)}  ExtensionContainer  FROM MAP-ExtensionDataTypes {  itu-t identified-organization (4) etsi (0) mobileDomain (0)  gsm-Network (1) modules (3) map-ExtensionDataTypes (21) version10 (10)}  ;  -- Add here other ASN.1 definitions presented below  -- in chapters 4 and 5.  END |

## 4.1 Measure Position Request

This component is used by the SMLC to request location measurements or a location estimate from the MS. It includes QoS, other instructions, and possible assistance data to the MS. This component is defined as follows:

Table 4.1.a: Measure Position Request

|  |
| --- |
| -- add this definition to RRLP-Components module  -- Measurement Position request component  MsrPosition-Req ::= SEQUENCE {  positionInstruct PositionInstruct,  referenceAssistData ReferenceAssistData OPTIONAL,  msrAssistData MsrAssistData OPTIONAL,  systemInfoAssistData SystemInfoAssistData OPTIONAL,  gps-AssistData GPS-AssistData OPTIONAL,  extensionContainer ExtensionContainer OPTIONAL,  ...,  -- Release 98 extension element  rel98-MsrPosition-Req-extension Rel98-MsrPosition-Req-Extension OPTIONAL,  -- Release 5 extension element  rel5-MsrPosition-Req-extension Rel5-MsrPosition-Req-Extension OPTIONAL,  -- Release 7 extension element  rel7-MsrPosition-Req-extension Rel7-MsrPosition-Req-Extension OPTIONAL  } |

The elements of this component are defined in clause 5.

## 4.2 Measure Position Response

This component is used by the MS to respond to a Measure Position Request from the SMLC with location measurements, a location estimate, or an error indication. This component is defined as follows:

Table 4.2.a: Measure Position Response

|  |
| --- |
| -- add this defintion to RRLP-Components module  -- Measurement Position response component  MsrPosition-Rsp ::= SEQUENCE {  multipleSets MultipleSets OPTIONAL,  referenceIdentity ReferenceIdentity OPTIONAL,  otd-MeasureInfo OTD-MeasureInfo OPTIONAL,  locationInfo LocationInfo OPTIONAL,  gps-MeasureInfo GPS-MeasureInfo OPTIONAL,  locationError LocationError OPTIONAL,  extensionContainer ExtensionContainer OPTIONAL,  ...,  -- Release extension here  rel-98-MsrPosition-Rsp-Extension  Rel-98-MsrPosition-Rsp-Extension OPTIONAL,  rel-5-MsrPosition-Rsp-Extension  Rel-5-MsrPosition-Rsp-Extension OPTIONAL,  -- When RRLP pseudo-segmentation is used, rel-5-MsrPosition-Rsp-Extension  -- and other possible future extensions should be the ones included in  -- the 2nd MsrPosition-Rsp component.  rel-7-MsrPosition-Rsp-Extension  Rel-7-MsrPosition-Rsp-Extension OPTIONAL  } |

The elements of this component are defined in clause 5.

## 4.3 Assistance Data

This component is used by the SMLC to deliver assistance data for location measurement and/or location calculation. This component is defined as follows:

Table 4.3.a: Assistance Data

|  |
| --- |
| -- add this defintion to RRLP-Components module  -- Assistance Data component  AssistanceData ::= SEQUENCE {  referenceAssistData ReferenceAssistData OPTIONAL,  msrAssistData MsrAssistData OPTIONAL,  systemInfoAssistData SystemInfoAssistData OPTIONAL,  gps-AssistData GPS-AssistData OPTIONAL,  moreAssDataToBeSent MoreAssDataToBeSent OPTIONAL, -- If not present, interpret as only  -- Assistance Data component used to  -- deliver entire set of assistance  -- data.  extensionContainer ExtensionContainer OPTIONAL,  ...,  -- Release extension here  rel98-AssistanceData-Extension Rel98-AssistanceData-Extension OPTIONAL,  rel5-AssistanceData-Extension Rel5-AssistanceData-Extension OPTIONAL,  rel7-AssistanceData-Extension Rel7-AssistanceData-Extension OPTIONAL  } |

The elements of this component are defined in clause 5.

## 4.4 Assistance Data Acknowledgement

This component does not have any information contents. It presence indicates that the MS has received the complete Assistance Data component.

## 4.5 Protocol Error

This component is used by the receiving entity (SMLC or MS) to indicate to the sending entity, that there is a problem that prevents the receiving entity to receive a complete and understandable component. This component is defined as follows:

Table 4.5.a: Protocol Error

|  |
| --- |
| -- add this defintion to RRLP-Components module  -- Protocol Error component  ProtocolError ::= SEQUENCE {  errorCause ErrorCodes,  extensionContainer ExtensionContainer OPTIONAL,  ...,  -- Release extensions here  rel-5-ProtocolError-Extension Rel-5-ProtocolError-Extension OPTIONAL  } |

The elements of this component are defined in clause 5.

## 4.6 Positioning Capability Request

This component is used by the SMLC to request the positioning capabilities of the MS and optionally indicating GANSS positioning support. This component is defined as follows:

Table 4.6.a: Positioning Capability Request

|  |
| --- |
| -- add this definition to RRLP-Components module  -- Positioning Capability request component  PosCapability-Req ::= SEQUENCE {  extended-reference Extended-reference,  gANSSPositionMethods GANSSPositionMethods OPTIONAL,  extensionContainer ExtensionContainer OPTIONAL,  ...  } |

The elements of this component are defined in clause 5.

## 4.7 Positioning Capability Response

This component is used by the MS to respond to a Positioning Capability Request from the SMLC with the positioning capabilities of the MS, the types of assistance data supported and the types of assistance data possibly needed by the MS. This component is defined as follows:

Table 4.7.a: Positioning Capability Response

|  |
| --- |
| -- add this definition to RRLP-Components module  -- Positioning Capability response component  PosCapability-Rsp ::= SEQUENCE {  extended-reference Extended-reference,  posCapabilities PosCapabilities,  -- assistanceSupported shall be included if and only if any of the assistance data is supported  assistanceSupported AssistanceSupported OPTIONAL,  assistanceNeeded AssistanceNeeded OPTIONAL,  extensionContainer ExtensionContainer OPTIONAL,  ...  } |

The elements of this component are defined in clause 5.

## 4.8 Positioning Multilateration Timing Advance Request

This component is used by the SMLC to request a MS to perform the Multilateration Timing Advance (MTA) procedure and includes up to 8 sets of cells for which assistance information is provided. Upon receiving this request the MS autonomously determines the set of cells to use to perform MTA which may include one or more of the cells identified by the assistance information. If the MS selects a cell not identified by the assistance information then it shall read system information sent therein to determine if it supports MTA and PEO or EC operation. If the MS selects a cell identified by the assistance information then it shall be the strongest cell in the corresponding set of cells. The MS sends an EC MULTILATERATION REQUEST message if EC operation is enabled for the selected cell or an EGPRS MULTILATERATION REQUEST if PEO is enabled for the selected cell. This component is defined as follows:

Table 4.8.a: Positioning Multilateration Timing Advance Request

|  |
| --- |
| -- add this definition to RRLP-Components module  -- Positioning Multilateration Timing Advance request component, see sub-clause A.9  PosMTA-Req ::= SEQUENCE {  target-Number-of-Cells INTEGER (0..7),  requested-MS-Synchronization-Accuracy INTEGER (0..15),  mta-Method MTA-Method,  random-ID-Set Random-ID-Set,  mpm-Timer INTEGER (0..7),  serving-cell BOOLEAN,  co-sited-cells Co-Sited-Cells OPTIONAL, -- identifies cells co-sited with serving cell  cell-Set1 Cell-Set, -- co-sited cells not co-sited with serving cell  cell-Set2 Cell-Set OPTIONAL, -- co-sited cells not co-sited with serving cell  cell-Set3 Cell-Set OPTIONAL, -- co-sited cells not co-sited with serving cell  cell-Set4 Cell-Set OPTIONAL, -- co-sited cells not co-sited with serving cell  cell-Set5 Cell-Set OPTIONAL, -- co-sited cells not co-sited with serving cell  cell-Set6 Cell-Set OPTIONAL, -- co-sited cells not co-sited with serving cell  cell-Set7 Cell-Set OPTIONAL, -- co-sited cells not co-sited with serving cell  cell-Set8 Cell-Set OPTIONAL -- co-sited cells not co-sited with serving cell  mta-security MTA-Security-Method OPTIONAL – identifies the MTA security method to be used  } |

The elements of this component are defined in clause 5.

## 4.9 Multilateration OTD Request

This component is used by the SMLC to trigger the MS to perform Multilateration OTD (MOTD) measurements of the difference between the observed timing of the serving cell and the observed timings of a subset of neighbour cells. This message includes up to 8 sets of neighbour cells. For each set of the neighbour cells, the MS provides at most one MOTD report which shall refer to the neighbour cell with the highest received signal level from that set of neighbour cells. The message also includes a set of cells on which MOTD measurements are not required (i.e. a Serving Cell Set). This component triggers additional measurements if only one MOTD measurement can be reported by MS (cf. subclause A.10.2.3).

Table 4.9.a: Multilateration OTD Request

|  |
| --- |
| -- add this definition to RRLP-Components module  -- Multilateration OTD Request  MultilaterationOTD-Req ::= SEQUENCE {  targetNumOTDMeasurements INTEGER,  requiredDLSyncAccuracy INTEGER,  neighbourCellSets CellSets,  servingCellSet CellSet  } |

The elements of this component are defined in clause 5.

## 4.10 Multilateration OTD Response

This component is used by MS to report the measured OTD results with neighbour cells to the SMLC. The difference between the TDMA frame timing of a neighbour cell and the TDMA frame timing of the serving cell is considered as OTD measurement of that particular neighbour cell.

Table 4.10.a: Multilateration OTD Response

|  |
| --- |
| -- add this definition to RRLP-Components module  -- Multilateration OTD Response  MultilaterationOTD-Rsp ::= SEQUENCE {  servingCellDLAccuracy INTEGER(1..16),  oTDMeasurementResults OTDMeasurementResults,  rXLEVMeasurementResults RXLEVMeasurementResults OPTIONAL  } |

The elements of this component are defined in clause 5.

# 5 Elements of Components

## 5.1 ASN.1 Description

The following ASN.1 code defines the elements of components. See the Annex A for further description of the contents of components and their elements.

Table 5.1.a: ASN.1 Description

|  |
| --- |
| -- add these defintions to RRLP-Components module  -- Position instructions  PositionInstruct ::= SEQUENCE {  -- Method type  methodType MethodType,  positionMethod PositionMethod,  measureResponseTime MeasureResponseTime,  useMultipleSets UseMultipleSets,  environmentCharacter EnvironmentCharacter OPTIONAL  } |
| --  MethodType ::= CHOICE {  msAssisted AccuracyOpt, -- accuracy is optional  msBased Accuracy, -- accuracy is mandatory  msBasedPref Accuracy, -- accuracy is mandatory  msAssistedPref Accuracy -- accuracy is mandatory  } |
| -- Accuracy of the location estimation  AccuracyOpt ::= SEQUENCE {  accuracy Accuracy OPTIONAL  } |
| -- The values of this field are defined in 3GPP TS 23.032 (Uncertainty code)  Accuracy ::= INTEGER (0..127) |
| -- Position Method  PositionMethod ::= ENUMERATED {  eotd (0),  gps (1),  gpsOrEOTD (2)  } |
| -- Measurement request response time  MeasureResponseTime ::= INTEGER (0..7) |
| -- useMultiple Sets, FFS!  UseMultipleSets ::= ENUMERATED {  multipleSets (0), -- multiple sets are allowed  oneSet (1) -- sending of multiple is not allowed  } |
| -- Environment characterization  EnvironmentCharacter ::= ENUMERATED {  badArea (0), -- bad urban or suburban, heavy multipath and NLOS  notBadArea (1), -- light multipath and NLOS  mixedArea (2), -- not defined or mixed environment  ...  } |
| -- E-OTD reference BTS for Assitance data IE  ReferenceAssistData ::= SEQUENCE {  bcchCarrier BCCHCarrier, -- BCCH carrier  bsic BSIC, -- BSIC  timeSlotScheme TimeSlotScheme, -- Timeslot scheme  btsPosition BTSPosition OPTIONAL  } |
| -- ellipsoid point and  -- ellipsoid point with altitude and uncertainty ellipsoid shapes are supported  BTSPosition ::= Ext-GeographicalInformation |
| -- RF channel number of BCCH  BCCHCarrier ::= INTEGER (0..1023) |
| -- Base station Identity Code  BSIC ::= INTEGER (0..63) |
| -- Timeslot scheme  TimeSlotScheme ::= ENUMERATED {  equalLength (0),  variousLength (1)  } |
| -- Time slot (modulo)  ModuloTimeSlot ::= INTEGER (0..3) |
| -- E-OTD measurement assistance data IE  -- The total number of neighbors in this element (MsrAssistData)  -- and in SystemInfoAssistData element (presented neighbors  -- can be at a maximum 15!)  MsrAssistData ::= SEQUENCE {  msrAssistList SeqOfMsrAssistBTS  }  SeqOfMsrAssistBTS ::= SEQUENCE (SIZE(1..15)) OF MsrAssistBTS  MsrAssistBTS ::= SEQUENCE {  bcchCarrier BCCHCarrier, -- BCCH carrier  bsic BSIC, -- BSIC  multiFrameOffset MultiFrameOffset, -- multiframe offset  timeSlotScheme TimeSlotScheme, -- Timeslot scheme  roughRTD RoughRTD, -- rough RTD value  -- Location Calculation Assistance data is moved here  calcAssistanceBTS CalcAssistanceBTS OPTIONAL  } |
| -- Multiframe offset  MultiFrameOffset ::= INTEGER (0..51)  -- The Multiframe Offset value 51 shall not be encoded by the transmitting entity and -- shall be treated by the receiving entity as 0. |
| -- Rough RTD value between one base station and reference BTS  RoughRTD ::= INTEGER (0..1250)  -- The RoughRTD value 1250 shall not be encoded by the transmitting entity and shall -- be treated by the receiving entity as 0. |
| -- E-OTD Measurement assistance data for system information List IE  -- The total number of base stations in this element (SystemInfoAssistData  -- presented neighbors) and in MsrAssistData element can be at a maximum 15.  SystemInfoAssistData ::= SEQUENCE {  systemInfoAssistList SeqOfSystemInfoAssistBTS  }  SeqOfSystemInfoAssistBTS::= SEQUENCE (SIZE(1..32)) OF SystemInfoAssistBTS |
| -- whether n.th is present or not ?  SystemInfoAssistBTS ::= CHOICE {  notPresent NULL,  present AssistBTSData  } |
| -- Actual assistance data for system information base station  AssistBTSData ::= SEQUENCE {  bsic BSIC, -- BSIC  multiFrameOffset MultiFrameOffset, -- multiframe offset  timeSlotScheme TimeSlotScheme, -- Timeslot scheme  roughRTD RoughRTD, -- rough RTD value  -- Location Calculation Assistance data  calcAssistanceBTS CalcAssistanceBTS OPTIONAL  } |
| -- E-OTD Location calculation assistance data,  -- CalcAssistanceBTS element is optional not subfields  CalcAssistanceBTS ::= SEQUENCE {  fineRTD FineRTD, -- fine RTD value between base stations  referenceWGS84 ReferenceWGS84 -- reference coordinates  } |
| -- Coordinates of neighbour BTS, WGS-84 ellipsoid  ReferenceWGS84 ::= SEQUENCE {  relativeNorth RelDistance, -- relative distance (south negative)  relativeEast RelDistance, -- relative distance (west negative)  -- Relative Altitude is not always known  relativeAlt RelativeAlt OPTIONAL -- relative altitude  } |
| -- Fine RTD value between this BTS and the reference BTS  FineRTD ::= INTEGER (0..255) |
| -- Relative north/east distance  RelDistance ::= INTEGER (-200000..200000) |
| -- Relative altitude  RelativeAlt ::= INTEGER (-4000..4000) |
| -- Measure position response IEs  -- Reference Identity  -- Multiple sets  MultipleSets ::= SEQUENCE {  -- number of reference sets  nbrOfSets INTEGER (2..3),  -- This field actually tells the number of reference BTSs  nbrOfReferenceBTSs INTEGER (1..3),  -- This field is conditional and included optionally only if  -- nbrOfSets is 3 and number of reference BTSs is 2.  referenceRelation ReferenceRelation OPTIONAL  } |
| -- Relation between refence BTSs and sets  ReferenceRelation ::= ENUMERATED {  secondBTSThirdSet (0), -- 1st BTS related to 1st and 2nd sets  secondBTSSecondSet (1), -- 1st BTS related to 1st and 3rd sets  firstBTSFirstSet (2) -- 1st BTS related to 1st set  } |
| -- Reference BTS Identity, this element contains number of  -- BTSs told nbrOfReferenceBTSs field in Multiple sets element)  ReferenceIdentity ::= SEQUENCE {  -- Reference BTS list  refBTSList SeqOfReferenceIdentityType  }  SeqOfReferenceIdentityType ::= SEQUENCE (SIZE(1..3)) OF ReferenceIdentityType |
| -- Cell identity  ReferenceIdentityType ::= CHOICE {  bsicAndCarrier BSICAndCarrier, -- BSIC and Carrier  ci CellID, -- Cell ID, LAC not needed  requestIndex RequestIndex, -- Index to Requested Neighbor List  systemInfoIndex SystemInfoIndex, -- Index to System info list, this type of ref. identity  -- shall not be used by the MS unless it has received  -- the SystemInfoAssistData from the SMLC for this cell.  ciAndLAC CellIDAndLAC -- CI and LAC  }  BSICAndCarrier ::= SEQUENCE {  carrier BCCHCarrier,  bsic BSIC  }  RequestIndex ::= INTEGER (1..16)  SystemInfoIndex ::= INTEGER (1..32)  CellIDAndLAC ::= SEQUENCE {  referenceLAC LAC, -- Location area code  referenceCI CellID -- Cell identity  }  CellID ::= INTEGER (0..65535)  LAC ::= INTEGER (0..65535) |
| -- OTD-MeasureInfo  OTD-MeasureInfo ::= SEQUENCE {  -- Measurement info elements, OTD-MsrElement is repeated number of times  -- told in nbrOfReferenceBTSs in MultipleSets, default value is 1  otdMsrFirstSets OTD-MsrElementFirst,  -- if more than one sets are present this element is repeated  -- NumberOfSets - 1 (-1 = first set)  otdMsrRestSets SeqOfOTD-MsrElementRest OPTIONAL  }  SeqOfOTD-MsrElementRest ::= SEQUENCE (SIZE(1..2)) OF OTD-MsrElementRest |
| -- OTD measurent information for 1 set  OTD-MsrElementFirst ::= SEQUENCE {  refFrameNumber INTEGER (0..42431), -- Frame number modulo 42432  referenceTimeSlot ModuloTimeSlot,  toaMeasurementsOfRef TOA-MeasurementsOfRef OPTIONAL,  stdResolution StdResolution,  taCorrection INTEGER (0..960) OPTIONAL, -- TA correction  -- measured neighbors in OTD measurements  otd-FirstSetMsrs SeqOfOTD-FirstSetMsrs OPTIONAL  }  SeqOfOTD-FirstSetMsrs ::= SEQUENCE (SIZE(1..10)) OF OTD-FirstSetMsrs |
| -- OTD measurent information 2 and 3 sets if exist  OTD-MsrElementRest ::= SEQUENCE {  refFrameNumber INTEGER (0..42431), -- Frame number modulo 42432  referenceTimeSlot ModuloTimeSlot,  toaMeasurementsOfRef TOA-MeasurementsOfRef OPTIONAL,  stdResolution StdResolution,  taCorrection INTEGER (0..960) OPTIONAL, -- TA correction  -- measured neighbors in OTD measurements  otd-MsrsOfOtherSets SeqOfOTD-MsrsOfOtherSets OPTIONAL  }  SeqOfOTD-MsrsOfOtherSets ::= SEQUENCE (SIZE(1..10)) OF OTD-MsrsOfOtherSets |
| -- Standard deviation of the TOA measurements from the reference BTS  TOA-MeasurementsOfRef ::= SEQUENCE {  refQuality RefQuality,  numOfMeasurements NumOfMeasurements  }  RefQuality ::= INTEGER (0..31) -- St Dev of TOA of reference as defined in annex  NumOfMeasurements ::= INTEGER (0..7) -- No. of measurements for RefQuality as defined in annex  StdResolution ::= INTEGER (0..3) -- Values of resolution are defined in annex  OTD-FirstSetMsrs ::= OTD-MeasurementWithID |
| -- Neighbour info in OTD measurements 0-10 times in TD measurement info  OTD-MsrsOfOtherSets ::= CHOICE {  identityNotPresent OTD-Measurement,  identityPresent OTD-MeasurementWithID  } |
| -- For this OTD measurement identity is same as the identity of BTS  -- in the first set with same sequence number  OTD-Measurement ::= SEQUENCE {  nborTimeSlot ModuloTimeSlot,  eotdQuality EOTDQuality,  otdValue OTDValue  } |
| -- This measurement contains the BTS identity and measurement  OTD-MeasurementWithID ::=SEQUENCE {  neighborIdentity NeighborIdentity,  nborTimeSlot ModuloTimeSlot,  eotdQuality EOTDQuality,  otdValue OTDValue  }  EOTDQuality ::= SEQUENCE {  nbrOfMeasurements INTEGER (0..7),  stdOfEOTD INTEGER (0..31)  }  NeighborIdentity ::= CHOICE {  bsicAndCarrier BSICAndCarrier, -- BSIC and Carrier  ci CellID, -- Cell ID, LAC not needed  multiFrameCarrier MultiFrameCarrier, -- MultiFrameOffest and BSIC  requestIndex RequestIndex, -- Index to Requested Neighbor List  systemInfoIndex SystemInfoIndex, -- Index to System info list, this type of neighbour  -- identity shall not be used by the MS unless it has  -- received the SystemInfoAssistData from the SMLC for  -- this cell.  ciAndLAC CellIDAndLAC -- CI and LAC  } |
| -- Multiframe and carrier  MultiFrameCarrier ::= SEQUENCE {  bcchCarrier BCCHCarrier,  multiFrameOffset MultiFrameOffset  } |
| -- OTD measurement value for neighbour  OTDValue ::= INTEGER (0..39999) |
| -- Location information IE  LocationInfo ::= SEQUENCE {  refFrame INTEGER (0..65535), -- Reference Frame number  -- If refFrame is within (42432..65535), it shall be ignored by the receiver  -- in that case the MS should provide GPS TOW if available  gpsTOW INTEGER (0..14399999) OPTIONAL, -- GPS TOW  fixType FixType,  -- Note that applicable range for refFrame is 0 - 42431  -- Possible shapes carried in posEstimate are  -- ellipsoid point,  -- ellipsoid point with uncertainty circle  -- ellipsoid point with uncertainty ellipse  -- ellipsoid point with altitude and uncertainty ellipsoid  posEstimate Ext-GeographicalInformation  }  FixType ::= INTEGER {  twoDFix (0),  threeDFix (1)  } (0..1) |
| -- GPS-Measurement information  GPS-MeasureInfo ::= SEQUENCE {  -- Measurement info elements  -- user has to make sure that in this element is number of elements  -- defined in reference BTS identity  gpsMsrSetList SeqOfGPS-MsrSetElement  }  SeqOfGPS-MsrSetElement ::= SEQUENCE (SIZE(1..3)) OF GPS-MsrSetElement |
| -- OTD measurent information 1-3 times in message  GPS-MsrSetElement ::= SEQUENCE {  refFrame INTEGER (0..65535) OPTIONAL, -- Reference Frame number  gpsTOW GPSTOW24b, -- GPS TOW  -- Note that applicable range for refFrame is 0 - 42431 |
| --N\_SAT can be read from number of elements of gps-msrList  gps-msrList SeqOfGPS-MsrElement  } |
| -- 24 bit presentation for GPSTOW  GPSTOW24b ::= INTEGER (0..14399999) |
| -- measured elements in measurement parameters field  SeqOfGPS-MsrElement ::= SEQUENCE (SIZE(1..16)) OF GPS-MsrElement  GPS-MsrElement ::= SEQUENCE {  satelliteID SatelliteID, -- Satellite identifier  cNo INTEGER (0..63), -- carrier noise ratio  doppler INTEGER (-32768..32767), -- doppler, mulltiply by 0,2  wholeChips INTEGER (0..1022), -- whole value of the code phase measurement  fracChips INTEGER (0..1024), -- fractional value of the code phase measurement  -- a value of 1024 shall not be encoded by the sender  -- the receiver shall consider a value of 1024 to be  -- invalid data  mpathIndic MpathIndic, -- multipath indicator  pseuRangeRMSErr INTEGER (0..63) -- index  } |
| -- Multipath indicator  MpathIndic ::= ENUMERATED {  notMeasured (0),  low (1),  medium (2),  high (3)  } |
| -- Location error IE  LocationError ::= SEQUENCE {  locErrorReason LocErrorReason,  additionalAssistanceData AdditionalAssistanceData OPTIONAL,  ...  }  LocErrorReason ::= ENUMERATED {  unDefined (0),  notEnoughBTSs (1),  notEnoughSats (2),  eotdLocCalAssDataMissing (3),  eotdAssDataMissing (4),  gpsLocCalAssDataMissing (5),  gpsAssDataMissing (6),  methodNotSupported (7),  notProcessed (8),  refBTSForGPSNotServingBTS (9),  refBTSForEOTDNotServingBTS (10),  ...,  notEnoughGANSSSats (11),  ganssAssDataMissing (12),  refBTSForGANSSNotServingBTS (13)  } |
| -- exception handling:  -- an unrecognized value shall be treated the same as value 0  -- defines additional assistance data needed for any new location attempt  -- MS shall retain any assistance data already received  AdditionalAssistanceData ::= SEQUENCE {  gpsAssistanceData GPSAssistanceData OPTIONAL,  extensionContainer ExtensionContainer OPTIONAL,  ...,  ganssAssistanceData GANSSAssistanceData OPTIONAL  } |
| GPSAssistanceData ::= OCTET STRING (SIZE (1..maxGPSAssistanceData))  -- GPSAssistanceData has identical structure and encoding to octets 3 to n of the  -- GPS Assistance Data IE in 3GPP TS 49.031  maxGPSAssistanceData INTEGER ::= 40  GANSSAssistanceData ::= OCTET STRING (SIZE (1..maxGANSSAssistanceData))  -- GANSSAssistanceData has identical structure and encoding to octets 3 to n of the  -- GANSS Assistance Data IE in 3GPP TS 49.031  maxGANSSAssistanceData INTEGER ::= 40 |
| -- Protocol Error Causes  ErrorCodes ::= ENUMERATED {  unDefined (0),  missingComponet (1),  incorrectData (2),  missingIEorComponentElement (3),  messageTooShort (4),  unknowReferenceNumber (5),  ...  } |
| -- exception handling:  -- an unrecognized value shall be treated the same as value 0 |
| -- GPS assistance data IE  GPS-AssistData ::= SEQUENCE {  controlHeader ControlHeader  } |
| -- More Assistance Data To Be Sent IE  -- More Assistance Data Components On the Way indication for delivery of an entire set of assistance  -- data in multiple Assistance Data components.  MoreAssDataToBeSent ::= ENUMERATED {  noMoreMessages (0), -- This is the only or last Assistance Data message used to deliver  -- the entire set of assistance data.  moreMessagesOnTheWay (1) -- The SMLC will send more Assistance Data messages or a final RRLP  -- Measure Position Request message to deliver the  -- the entire set of assistance data.  } |
| -- Control header of the GPS assistance data  ControlHeader ::= SEQUENCE {  -- Field type Present information  referenceTime ReferenceTime OPTIONAL,  refLocation RefLocation OPTIONAL,  dgpsCorrections DGPSCorrections OPTIONAL,  navigationModel NavigationModel OPTIONAL,  ionosphericModel IonosphericModel OPTIONAL,  utcModel UTCModel OPTIONAL,  almanac Almanac OPTIONAL,  acquisAssist AcquisAssist OPTIONAL,  realTimeIntegrity SeqOf-BadSatelliteSet OPTIONAL  }  ReferenceTime ::= SEQUENCE {  gpsTime GPSTime,  gsmTime GSMTime OPTIONAL,  gpsTowAssist GPSTOWAssist OPTIONAL  } |
| -- GPS Time includes week number and time-of-week (TOW)  GPSTime ::= SEQUENCE {  gpsTOW23b GPSTOW23b,  gpsWeek GPSWeek  } |
| -- GPSTOW, range 0-604799,92, resolution 0,08 sec, 23-bit presentation  GPSTOW23b ::= INTEGER (0..7559999) |
| -- GPS week number GPSWeek ::= INTEGER (0..1023) |
| -- GPSTOWAssist consists of TLM message, Anti-spoof flag, Alert flag, and 2 reserved bits in TLM Word  -- for each visible satellite.  -- N\_SAT can be read from number of elements in GPSTOWAssist  GPSTOWAssist ::= SEQUENCE (SIZE(1..12)) OF GPSTOWAssistElement  GPSTOWAssistElement ::= SEQUENCE {  satelliteID SatelliteID,  tlmWord TLMWord,  antiSpoof AntiSpoofFlag,  alert AlertFlag,  tlmRsvdBits TLMReservedBits  } |
| -- TLM Word, 14 bits  TLMWord ::= INTEGER (0..16383)  -- Anti-Spoof flag  AntiSpoofFlag ::= INTEGER (0..1)  -- Alert flag  AlertFlag ::= INTEGER (0..1)  -- Reserved bits in TLM word, MSB occurs earlier in TLM Word transmitted by satellite  TLMReservedBits ::= INTEGER (0..3)  GSMTime ::= SEQUENCE {  bcchCarrier BCCHCarrier, -- BCCH carrier  bsic BSIC, -- BSIC  frameNumber FrameNumber,  timeSlot TimeSlot,  bitNumber BitNumber  } |
| -- Frame number  FrameNumber ::= INTEGER (0..2097151)  -- Time slot number  TimeSlot ::= INTEGER (0..7)  -- Bit number  BitNumber ::= INTEGER (0..156)  -- Reference Location IE  RefLocation ::= SEQUENCE {  threeDLocation Ext-GeographicalInformation  } |
| -- DGPS Corrections IE  DGPSCorrections ::= SEQUENCE {  gpsTOW INTEGER (0..604799), -- DGPS reference time  status INTEGER (0..7),  -- N\_SAT can be read from number of elements of satList  satList SeqOfSatElement  }  SeqOfSatElement ::= SEQUENCE (SIZE (1..16)) OF SatElement |
| -- number of correction for satellites  SatElement ::= SEQUENCE {  satelliteID SatelliteID, |
| --- Sequence number for ephemeris  iode INTEGER (0..239),  -- User Differential Range Error  udre INTEGER (0..3),  -- Pseudo Range Correction, range is  -- -655,04 - +655,04,  pseudoRangeCor INTEGER (-2047..2047),  -- Pseudo Range Rate Correction, range is  -- -4,064 - +4,064,  rangeRateCor INTEGER (-127..127), |
| -- Delta Pseudo Range Correction 2  deltaPseudoRangeCor2 INTEGER (-127..127), -- This IE shall be ignored by the receiver  -- and set to zero by the sender  -- Delta Pseudo Range Correction 2  deltaRangeRateCor2 INTEGER (-7..7), -- This IE shall be ignored by the receiver  -- and set to zero by the sender  -- Delta Pseudo Range Correction 3  deltaPseudoRangeCor3 INTEGER (-127..127), -- This IE shall be ignored by the receiver  -- and set to zero by the sender  -- Delta Pseudo Range Correction 3  deltaRangeRateCor3 INTEGER (-7..7) -- This IE shall be ignored by the receiver  -- and set to zero by the sender  }  SatelliteID ::= INTEGER (0..63) -- identifies satellite |
| -- Navigation Model IE  NavigationModel ::= SEQUENCE {  navModelList SeqOfNavModelElement  } |
| -- navigation model satellite list  SeqOfNavModelElement ::= SEQUENCE (SIZE(1..16)) OF NavModelElement  NavModelElement ::= SEQUENCE {  satelliteID SatelliteID,  satStatus SatStatus -- satellite status  } |
| -- the Status of the navigation model  SatStatus ::= CHOICE {  -- New satellite, new Navigation Model  newSatelliteAndModelUC UncompressedEphemeris,  -- Existing satellite, Existing Navigation Model  oldSatelliteAndModel NULL,  -- Existing satellite, new Navigation Model  newNaviModelUC UncompressedEphemeris,  ...  } |
| -- Uncompressed satellite emhemeris and clock corrections  UncompressedEphemeris ::= SEQUENCE {  ephemCodeOnL2 INTEGER (0..3),  ephemURA INTEGER (0..15),  ephemSVhealth INTEGER (0..63),  ephemIODC INTEGER (0..1023),  ephemL2Pflag INTEGER (0..1),  ephemSF1Rsvd EphemerisSubframe1Reserved,  ephemTgd INTEGER (-128..127),  ephemToc INTEGER (0..37799),  ephemAF2 INTEGER (-128..127),  ephemAF1 INTEGER (-32768..32767),  ephemAF0 INTEGER (-2097152..2097151),  ephemCrs INTEGER (-32768..32767),  ephemDeltaN INTEGER (-32768..32767),  ephemM0 INTEGER (-2147483648..2147483647),  ephemCuc INTEGER (-32768..32767),  ephemE INTEGER (0..4294967295),  ephemCus INTEGER (-32768..32767),  ephemAPowerHalf INTEGER (0..4294967295),  ephemToe INTEGER (0..37799),  ephemFitFlag INTEGER (0..1),  ephemAODA INTEGER (0..31),  ephemCic INTEGER (-32768..32767),  ephemOmegaA0 INTEGER (-2147483648..2147483647),  ephemCis INTEGER (-32768..32767),  ephemI0 INTEGER (-2147483648..2147483647),  ephemCrc INTEGER (-32768..32767),  ephemW INTEGER (-2147483648..2147483647),  ephemOmegaADot INTEGER (-8388608..8388607),  ephemIDot INTEGER (-8192..8191)  } |
| -- Reserved bits in subframe 1 of navigation message  EphemerisSubframe1Reserved ::= 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  } |
| -- Ionospheric Model IE  IonosphericModel ::= SEQUENCE {  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)  } |
| -- Universal Time Coordinate Model  UTCModel ::= SEQUENCE {  utcA1 INTEGER (-8388608..8388607),  utcA0 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)  } |
| -- Almanac, Long term model  -- NOTE: These are parameters are subset of the ephemeris  -- NOTE: But with reduced resolution and accuracy  Almanac ::= SEQUENCE {  alamanacWNa INTEGER (0..255), -- Once per message  -- navigation model satellite list.  -- The size of almanacList is actually Nums\_Sats\_Total field  almanacList SeqOfAlmanacElement  }  SeqOfAlmanacElement ::= SEQUENCE (SIZE(1..64)) OF AlmanacElement |
| -- Almanac info once per satellite  AlmanacElement ::= SEQUENCE {  satelliteID SatelliteID,  almanacE INTEGER (0..65535),  alamanacToa INTEGER (0..255),  almanacKsii INTEGER (-32768..32767),  almanacOmegaDot INTEGER (-32768..32767),  almanacSVhealth INTEGER (0..255),  almanacAPowerHalf INTEGER (0..16777215),  almanacOmega0 INTEGER (-8388608..8388607),  almanacW INTEGER (-8388608..8388607),  almanacM0 INTEGER (-8388608..8388607),  almanacAF0 INTEGER (-1024..1023),  almanacAF1 INTEGER (-1024..1023)  } |
| -- Acquisition Assistance  AcquisAssist ::= SEQUENCE {  -- Number of Satellites can be read from acquistList  timeRelation TimeRelation,  -- Acquisition assistance list  -- The size of Number of Satellites is actually Number of Satellites field  acquisList SeqOfAcquisElement  }  SeqOfAcquisElement ::= SEQUENCE (SIZE(1..16)) OF AcquisElement |
| -- the relationship between GPS time and air-interface timing  TimeRelation ::= SEQUENCE {  --  gpsTOW GPSTOW23b, -- 23b presentation  gsmTime GSMTime OPTIONAL  } |
| -- data occuring per number of satellites  AcquisElement ::= SEQUENCE {  svid SatelliteID,  -- Doppler 0th order term,  -- -5120,0 - 5117,5 Hz (= -2048 - 2047 with 2,5 Hz resolution)  doppler0 INTEGER (-2048..2047),  addionalDoppler AddionalDopplerFields OPTIONAL,  codePhase INTEGER (0..1022), -- Code Phase  intCodePhase INTEGER (0..19), -- Integer Code Phase  gpsBitNumber INTEGER (0..3), -- GPS bit number  codePhaseSearchWindow INTEGER (0..15), -- Code Phase Search Window  addionalAngle AddionalAngleFields OPTIONAL  } |
| AddionalDopplerFields ::= SEQUENCE {  -- Doppler 1st order term, -1,0 - +0,5 Hz/sec  -- (= -42 + (0 to 63) with 1/42 Hz/sec. resolution)  doppler1 INTEGER (0..63),  dopplerUncertainty INTEGER (0..7)  -- a sender shall not encode any DopplerUncertainty value in the range 5 to 7  -- a receiver shall ignore any value between 5 and 7.  } |
| AddionalAngleFields ::= SEQUENCE {  -- azimuth angle, 0 - 348,75 deg (= 0 - 31 with 11,25 deg resolution)  azimuth INTEGER (0..31),  -- elevation angle, 0 - 78,75 deg (= 0 - 7 with 11,25 deg resolution)  elevation INTEGER (0..7)  } |
| -- Real-Time Integrity  -- number of bad satellites can be read from this element  SeqOf-BadSatelliteSet ::= SEQUENCE (SIZE(1..16)) OF SatelliteID |
| -- Extension Elements  -- Release 98 Extensions here  Rel98-MsrPosition-Req-Extension ::= SEQUENCE {  rel98-Ext-ExpOTD Rel98-Ext-ExpOTD OPTIONAL, -- ExpectedOTD extension  ...,  gpsTimeAssistanceMeasurementRequest NULL OPTIONAL,  gpsReferenceTimeUncertainty GPSReferenceTimeUncertainty OPTIONAL  -- Further R98 extensions here  }  Rel98-AssistanceData-Extension ::= SEQUENCE {  rel98-Ext-ExpOTD Rel98-Ext-ExpOTD OPTIONAL, -- ExpectedOTD extension  ...,  gpsTimeAssistanceMeasurementRequest NULL OPTIONAL,  gpsReferenceTimeUncertainty GPSReferenceTimeUncertainty OPTIONAL  -- Further R98 extensions here  } |
| -- Release 98 ExpOTD extension  Rel98-Ext-ExpOTD ::= SEQUENCE {  -- If MsrAssistBTS is included in message, msrAssistData-R98-ExpOTD shall be included.  msrAssistData-R98-ExpOTD MsrAssistData-R98-ExpOTD OPTIONAL, |
| -- If SystemInfoAssistaData is included in message, systemInfoAssistData-R98-ExpOTD shall be -- included.  systemInfoAssistData-R98-ExpOTD SystemInfoAssistData-R98-ExpOTD OPTIONAL  } |
| -- MsrAssistData R98 extension  MsrAssistData-R98-ExpOTD ::= SEQUENCE {  msrAssistList-R98-ExpOTD SeqOfMsrAssistBTS-R98-ExpOTD  } |
| -- Indexes in SeqOfMsrAssistBTS-R98-ExpOTD refer to SeqOfMsrAssistBTS  -- If the index exceeds the SegOfMsrAssistBTS range or if there is other  -- inconsistencies between the BTS indices, the MS shall apply protocol  -- error cause incorrectData  SeqOfMsrAssistBTS-R98-ExpOTD ::= SEQUENCE (SIZE(1..15)) OF MsrAssistBTS-R98-ExpOTD |
| -- This element completes MsrAssistBTS IE  MsrAssistBTS-R98-ExpOTD ::= SEQUENCE {  expectedOTD ExpectedOTD,  expOTDUncertainty ExpOTDUncertainty  } |
| -- SystemInfoAssistData R98 extension  SystemInfoAssistData-R98-ExpOTD ::= SEQUENCE {  systemInfoAssistListR98-ExpOTD SeqOfSystemInfoAssistBTS-R98-ExpOTD  } |
| -- SeqOfSystemInfoAssistBTS-R98-ExpOTD index refer to SeqOfSystemInfoAssistBTS  -- If the index exceeds the SegOfSystemInfoAssistBTS range or if there is other  -- inconsistencies between the BTS indices, the MS shall apply protocol  -- error cause incorrectData  SeqOfSystemInfoAssistBTS-R98-ExpOTD ::= SEQUENCE (SIZE(1..32)) OF SystemInfoAssistBTS-R98-ExpOTD |
| -- whether n.th is present or not ?  SystemInfoAssistBTS-R98-ExpOTD ::= CHOICE {  notPresent NULL,  present AssistBTSData-R98-ExpOTD  } |
| -- This element completes AssistBTSData IE  AssistBTSData-R98-ExpOTD ::= SEQUENCE {  expectedOTD ExpectedOTD,  expOTDuncertainty ExpOTDUncertainty -- Uncertainty of expected OTD  } |
| -- Expected OTD value between nbor base station and reference BTS  -- at MS's current estimated location.  ExpectedOTD ::= INTEGER (0..1250)  -- The ExpectedOTD value 1250 shall not be encoded by the transmitting entity and  -- shall be treated by the receiving entity as 0.  -- Uncertainty of Exptected OTD in bits  ExpOTDUncertainty ::= INTEGER(0..7) |
| -- Release 98 extensions  GPSReferenceTimeUncertainty ::= INTEGER (0 .. 127) -- Coding according to Annex  GPSTimeAssistanceMeasurements ::= SEQUENCE {  referenceFrameMSB INTEGER (0 .. 63) OPTIONAL, -- MSB of frame number  gpsTowSubms INTEGER (0 .. 9999) OPTIONAL, -- in units of 100ns, for MS based AGPS  deltaTow INTEGER (0 .. 127) OPTIONAL, -- for MS assisted AGPS  gpsReferenceTimeUncertainty GPSReferenceTimeUncertainty OPTIONAL  }  Rel-98-MsrPosition-Rsp-Extension ::= SEQUENCE {  -- First extension to Release 98  rel-98-Ext-MeasureInfo SEQUENCE {  otd-MeasureInfo-R98-Ext OTD-MeasureInfo-R98-Ext OPTIONAL  },  ...,  timeAssistanceMeasurements GPSTimeAssistanceMeasurements OPTIONAL  -- Further R98 extensions here  } |
| -- This is an addition to OTD-MeasureInfo element defined in original message,  -- If OTD-MeasureInfo is absent, or if one or more OTD-MsrElementRest are present  -- OTD-MeasureInfo-R98-Ext shall be absent.  -- OTD-MeasureInfo-R98-Ext  OTD-MeasureInfo-R98-Ext ::= SEQUENCE {  -- Measurement info elements  otdMsrFirstSets-R98-Ext OTD-MsrElementFirst-R98-Ext  } |
| -- OTD measurement information Ext for the first set only  OTD-MsrElementFirst-R98-Ext ::= SEQUENCE {  -- additional measured neighbors in OTD measurements  otd-FirstSetMsrs-R98-Ext SeqOfOTD-FirstSetMsrs-R98-Ext OPTIONAL  }  SeqOfOTD-FirstSetMsrs-R98-Ext ::= SEQUENCE (SIZE(1..5)) OF OTD-FirstSetMsrs  Rel-5-MsrPosition-Rsp-Extension ::= SEQUENCE {  extended-reference Extended-reference OPTIONAL,  -- The extended-reference shall be included by the MS if and only if previously  -- received from the SMLC in a Measure Position Request. When included, the value sent  -- by the MS shall equal the value received from the SMLC.  -- extension to Release 5, for RRLP pseudo-segmentation here  otd-MeasureInfo-5-Ext OTD-MeasureInfo-5-Ext OPTIONAL,  ulPseudoSegInd UlPseudoSegInd OPTIONAL, -- Included when uplink RRLP  -- Pseudo-segmentation is used, not included when no uplink pseudo-segmentation is used  ...  -- Possibly more extensions for Release 5 here later  } |
| Extended-reference ::= SEQUENCE {  smlc-code INTEGER (0..63),  transaction-ID INTEGER (0..262143)  } |
| OTD-MeasureInfo-5-Ext ::= SeqOfOTD-MsrElementRest  -- if more than one measurement sets are present this element is repeated  -- NumberOfSets - 1 (-1 = first set) combined in OTD-MeasureInfo-5-Ext and  -- OTD-MeasureInfo (e.g. if NumberOfSets is 3, then one otdMsrRestSets may  -- be sent in OTD-MeasureInfo-5-Ext and one in OTD-MeasureInfo)  -- First part of Uplink RRLP Pseudo-segmentation indication, possibly more may be defined  -- in the future for segmentation with more than two segments.  UlPseudoSegInd ::= ENUMERATED {  firstOfMany (0),  secondOfMany(1)  } |
| Rel5-MsrPosition-Req-Extension ::= SEQUENCE {  extended-reference Extended-reference,  ...  -- Possibly more extensions for Release 5 here later  } |
| Rel5-AssistanceData-Extension ::= SEQUENCE {  extended-reference Extended-reference,  ...  -- Possibly more extensions for Release 5 here later  } |
| Rel-5-ProtocolError-Extension::= SEQUENCE {  extended-reference Extended-reference OPTIONAL,  -- The extended-reference shall be included by the MS if and only if previously  -- received from the SMLC.  -- When included, the value sent by the MS shall equal the value received from the SMLC.  ...  -- Possibly more extensions for Release 5 here later  } |
| -- Release 7 Extensions here  Rel7-MsrPosition-Req-Extension ::= SEQUENCE {  velocityRequested NULL OPTIONAL,  ganssPositionMethod GANSSPositioningMethod OPTIONAL,  ganss-AssistData GANSS-AssistData OPTIONAL,  ganssCarrierPhaseMeasurementRequest NULL OPTIONAL,  ganssTODGSMTimeAssociationMeasurementRequest NULL OPTIONAL,  requiredResponseTime RequiredResponseTime OPTIONAL,  add-GPS-AssistData Add-GPS-AssistData OPTIONAL,  ganssMultiFreqMeasurementRequest NULL OPTIONAL,  ...  -- Further Release 7 extentions here  } |
| -- additional satellite systems may be added in future versions of the protocol  -- Bit 0 of GANSSPositioningMethod bit map shall not be the only one set to TRUE ('1')  GANSSPositioningMethod ::= BIT STRING {  gps (0),  galileo (1),  sbas (2),  modernizedGPS (3),  qzss (4),  glonass (5),  bds (6)} (SIZE (2..16))  GANSS-AssistData ::= SEQUENCE {  ganss-controlHeader GANSS-ControlHeader  }  GANSS-ControlHeader ::= SEQUENCE {  ganssCommonAssistData GANSSCommonAssistData OPTIONAL,  ganssGenericAssistDataList SeqOfGANSSGenericAssistDataElement OPTIONAL  } |
| -- GANSS Common Assistance Data Elements  GANSSCommonAssistData ::= SEQUENCE {  ganssReferenceTime GANSSReferenceTime OPTIONAL,  ganssRefLocation GANSSRefLocation OPTIONAL,  ganssIonosphericModel GANSSIonosphericModel OPTIONAL,  ... ,  ganssAddIonosphericModel GANSSAddIonosphericModel OPTIONAL,  ganssEarthOrientParam GANSSEarthOrientParam OPTIONAL,  -- If GANSSReferenceTime is included, GANSSReferenceTime-R10-Ext shall also be included.  ganssReferenceTime-R10-Ext GANSSReferenceTime-R10-Ext OPTIONAL  } |
| -- List of GANSS Generic Assistance Data Elements, up to 8 GANSS  SeqOfGANSSGenericAssistDataElement ::= SEQUENCE (SIZE (1..8)) OF GANSSGenericAssistDataElement |
| -- GANSS Generic Assistance Data Elements  GANSSGenericAssistDataElement ::= SEQUENCE {  ganssID INTEGER (0..7) OPTIONAL, -- Coding according to Annex  ganssTimeModel SeqOfGANSSTimeModel OPTIONAL,  ganssDiffCorrections GANSSDiffCorrections OPTIONAL,  ganssNavigationModel GANSSNavModel OPTIONAL,  ganssRealTimeIntegrity GANSSRealTimeIntegrity OPTIONAL,  ganssDataBitAssist GANSSDataBitAssist OPTIONAL,  ganssRefMeasurementAssist GANSSRefMeasurementAssist OPTIONAL,  ganssAlmanacModel GANSSAlmanacModel OPTIONAL,  ganssUTCModel GANSSUTCModel OPTIONAL,  ganssEphemerisExtension GANSSEphemerisExtension OPTIONAL,  ganssEphemerisExtCheck GANSSEphemerisExtensionCheck OPTIONAL,  ... ,  sbasID INTEGER (0..7) OPTIONAL, -- Coding according to Annex  ganssAddUTCModel GANSSAddUTCModel OPTIONAL,  ganssAuxiliaryInfo GANSSAuxiliaryInformation OPTIONAL,  ganssDiffCorrectionsValidityPeriod GANSSDiffCorrectionsValidityPeriod OPTIONAL,  -- If SeqOfGANSSTimeModel is included, SeqOfGANSSTimeModel-R10-Ext shall also be included.  ganssTimeModel-R10-Ext SeqOfGANSSTimeModel-R10-Ext OPTIONAL,  -- If GANSSRefMeasurementAssist is included, GANSSRefMeasurementAssist-R10-Ext shall also be  -- included.  ganssRefMeasurementAssist-R10-Ext GANSSRefMeasurementAssist-R10-Ext OPTIONAL,  -- If GANSSAlmanacModel is included, GANSSAlmanacModel-R10-Ext shall also be included.  ganssAlmanacModel-R10-Ext GANSSAlmanacModel-R10-Ext OPTIONAL,  ganssAlmanacModel-R12-Ext GANSSAlmanacModel-R12-Ext OPTIONAL,  ganssRefMeasurementAssist-R12-Ext GANSSRefMeasurementAssist-R12-Ext OPTIONAL,  --The field may be present if the ganssID indicates BDS, otherwise it is not present.  bdsDifferentialCorrections-r12 BDS-DiffCorrections-r12 OPTIONAL,  --The field may be present if the ganssID indicates BDS, otherwise it is not present.  bdsGridModel-r12 BDS-GridModelParameter-r12 OPTIONAL  } |
| -- GANSS COMMON ASSISTANCE DATA ELEMENTS |
| -- GANSS Reference Time IE  GANSSReferenceTime ::= SEQUENCE {  ganssRefTimeInfo GANSSRefTimeInfo,  ganssTOD-GSMTimeAssociation GANSSTOD-GSMTimeAssociation OPTIONAL  } |
| -- GANSS Reference Time includes GANSS TOD, GANSS Day, uncertainty  GANSSRefTimeInfo ::= SEQUENCE {  -- ganssDay shall be present in this version of the protocol  ganssDay INTEGER(0 .. 8191) OPTIONAL,  ganssTOD GANSSTOD,  ganssTODUncertainty GANSSTODUncertainty OPTIONAL,  ganssTimeID INTEGER (0 .. 7) OPTIONAL  } |
| -- GANSS TOD integer seconds  GANSSTOD ::= INTEGER (0 .. 86399) |
| -- GANSS TOD uncertainty  GANSSTODUncertainty ::= INTEGER (0 .. 127) -- Coding according to Annex  -- GANSS Reference Time Rel-10 Extension:  GANSSReferenceTime-R10-Ext ::= SEQUENCE {  ganssDayCycleNumber INTEGER(0..7) -- coding according to annex  } |
| -- GANSS TOD-GSM Time association  GANSSTOD-GSMTimeAssociation ::= SEQUENCE {  bcchCarrier BCCHCarrier, -- BCCH carrier  bsic BSIC, -- BSIC  frameNumber FrameNumber,  timeSlot TimeSlot,  bitNumber BitNumber,  frameDrift FrameDrift OPTIONAL  } |
| -- Frame drift  FrameDrift ::= INTEGER(-64 .. 63) |
| -- GANSS Reference Location IE  GANSSRefLocation ::= SEQUENCE {  threeDLocation Ext-GeographicalInformation  } |
| -- GANSS Ionospheric Model IE  -- GANSS Ionospheric Model consists of NeQuick model parameters and storm flags  GANSSIonosphericModel ::= SEQUENCE {  ganssIonoModel GANSSIonosphereModel,  ganssIonoStormFlags GANSSIonoStormFlags OPTIONAL,  ...  }  -- GANSS ionosphere model. Coding according to Annex  GANSSIonosphereModel ::= SEQUENCE {  ai0 INTEGER (0 .. 2047),  ai1 INTEGER (-1024 .. 1023),  ai2 INTEGER (-8192 .. 8191)  }  -- GANSS ionosphere storm flags  GANSSIonoStormFlags ::= SEQUENCE {  ionoStormFlag1 INTEGER (0 .. 1),  ionoStormFlag2 INTEGER (0 .. 1),  ionoStormFlag3 INTEGER (0 .. 1),  ionoStormFlag4 INTEGER (0 .. 1),  ionoStormFlag5 INTEGER (0 .. 1)  }  -- GANSS Additional Ionospheric Model IE  -- GANSS Additional Ionospheric Model consists of Klobuchar model parameters  GANSSAddIonosphericModel ::= SEQUENCE {  dataID BIT STRING (SIZE (2)), -- Coding according to Annex  ionoModel IonosphericModel  }  -- GANSS Earth Orientation Paramaters IE  GANSSEarthOrientParam ::= 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)  } |
| -- GANSS GENERIC ASSISTANCE DATA ELEMENTS |
| -- GANSS Time Model IE consists of time offset and first and second order parameters to relate GNSS  -- specific system time to selected time reference  SeqOfGANSSTimeModel ::= SEQUENCE (SIZE(1..7)) OF GANSSTimeModelElement  GANSSTimeModelElement ::= SEQUENCE {  ganssTimeModelRefTime INTEGER(0 .. 65535),  tA0 TA0,  tA1 TA1 OPTIONAL,  tA2 TA2 OPTIONAL,  gnssTOID INTEGER (0 .. 7), -- coding according to annex  weekNumber INTEGER (0 .. 8191) OPTIONAL  }  -- GANSS time model parameter A0  TA0 ::= INTEGER (-2147483648 .. 2147483647)  -- GANSS time model parameter A1  TA1 ::= INTEGER (-8388608 .. 8388607)  -- GANSS time model parameter A2  TA2 ::= INTEGER (-64 .. 63)  -- GANSS Time Model Rel-10 Extension:  SeqOfGANSSTimeModel-R10-Ext ::= SEQUENCE (SIZE(1..7)) OF GANSSTimeModelElement-R10-Ext  GANSSTimeModelElement-R10-Ext ::= SEQUENCE {  gnssTOID INTEGER (0 .. 7), -- coding according to annex  deltaT INTEGER (-128..127)  } |
| -- DGANSS Corrections IE  GANSSDiffCorrections ::= SEQUENCE {  dganssRefTime INTEGER (0 .. 119), -- DGANSS reference time  -- N\_SGN\_TYPE can be read from number of elements of sgnTypeList  sgnTypeList SeqOfSgnTypeElement  }  SeqOfSgnTypeElement ::= SEQUENCE (SIZE (1..3)) OF SgnTypeElement -- max three signals per GNSS |
| -- DGANSS signal type element, once per GNSS signal type included in DGANSS  SgnTypeElement ::= SEQUENCE {  ganssSignalID GANSSSignalID, -- signal type identity  ganssStatusHealth INTEGER (0 .. 7),  -- N\_SAT can be read from number of elements of dganssSgnList  dganssSgnList SeqOfDGANSSSgnElement  } |
| GANSSSignalID ::= INTEGER (0 .. 7) -- Coding according to Annex  SeqOfDGANSSSgnElement ::= SEQUENCE (SIZE (1..16)) OF DGANSSSgnElement |
| -- number of correction for signals  DGANSSSgnElement ::= SEQUENCE {  svID SVID, -- Satellite identity |
| --- Sequence number for GANSS Navigation Model that matches the DGANSS correction set  iod INTEGER (0 .. 1023),  -- User Differential Range Error  udre INTEGER (0..3),  -- Pseudo Range Correction, range is  -- -655,04 - +655,04,  pseudoRangeCor INTEGER (-2047..2047),  -- Pseudo Range Rate Correction, range is  -- -4,064 - +4,064,  rangeRateCor INTEGER (-127..127)  }  SVID ::= INTEGER (0 .. 63) -- Coding according to Annex |
| -- GANSS Navigation Model IE  GANSSNavModel ::= SEQUENCE {  nonBroadcastIndFlag INTEGER (0 .. 1),  ganssSatelliteList SeqOfGANSSSatelliteElement  }  SeqOfGANSSSatelliteElement ::= SEQUENCE (SIZE(1..32)) OF GANSSSatelliteElement  GANSSSatelliteElement ::= SEQUENCE {  svID SVID,  svHealth BIT STRING (SIZE(5)), -- Coding according to Annex  iod INTEGER (0 .. 1023), -- Coding according to Annex  ganssClockModel GANSSClockModel,  ganssOrbitModel GANSSOrbitModel,  ...,  svHealthMSB BIT STRING (SIZE(1)) OPTIONAL, -- Coding according to Annex  iodMSB INTEGER (0 .. 1) OPTIONAL, -- Coding according to Annex  svHealthExt BIT STRING (SIZE(4)) OPTIONAL -- Coding according to Annex  } |
| -- GANSS orbit model for the GNSS satellite according to the choice  GANSSOrbitModel ::= CHOICE {  keplerianSet NavModel-KeplerianSet, -- Model-1  ... ,  navKeplerianSet NavModel-NAVKeplerianSet, -- Model-2  cnavKeplerianSet NavModel-CNAVKeplerianSet, -- Model-3  glonassECEF NavModel-GLONASSecef, -- Model-4  sbasECEF NavModel-SBASecef, -- Model-5  bdsKeplerianSet-r12 NavModel-BDSKeplerianSet-r12 -- Model-6  } |
| -- Navigation model in Keplerian parameters  NavModel-KeplerianSet ::= 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)  } |
| NavModel-NAVKeplerianSet ::= 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)  } |
| NavModel-CNAVKeplerianSet ::= 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)  } |
| NavModel-GLONASSecef ::= 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)  } |
| NavModel-SBASecef ::= SEQUENCE {  sbasTo INTEGER (0..5399) OPTIONAL,  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)  }  NavModel-BDSKeplerianSet-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)  } |
| -- GANSS clock model for the GNSS satellite according to the choice  GANSSClockModel ::= CHOICE {  standardClockModelList SeqOfStandardClockModelElement, -- Model-1  ... ,  navClockModel NAVclockModel, -- Model-2  cnavClockModel CNAVclockModel, -- Model-3  glonassClockModel GLONASSclockModel, -- Model-4  sbasClockModel SBASclockModel , -- Model-5  bdsClockModel-r12 BDSClockModel-r12 -- Model-6  } |
| SeqOfStandardClockModelElement ::= 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,  stanModelID INTEGER (0 .. 1) OPTIONAL,  ...  } |
| NAVclockModel ::= SEQUENCE {  navToc INTEGER (0.. 37799),  navaf2 INTEGER (-128..127),  navaf1 INTEGER (-32768..32767),  navaf0 INTEGER (-2097152..2097151),  navTgd INTEGER (-128..127)  } |
| CNAVclockModel ::= SEQUENCE {  cnavToc INTEGER (0..2015),  cnavTop INTEGER (0..2015),  cnavURA0 INTEGER (-16..15),  cnavURA1 INTEGER (0..7),  cnavURA2 INTEGER (0..7),  cnavAf2 INTEGER (-512..511),  cnavAf1 INTEGER (-524288..524287),  cnavAf0 INTEGER (-33554432..33554431),  cnavTgd INTEGER (-4096..4095),  cnavISCl1cp INTEGER (-4096..4095) OPTIONAL,  cnavISCl1cd INTEGER (-4096..4095) OPTIONAL,  cnavISCl1ca INTEGER (-4096..4095) OPTIONAL,  cnavISCl2c INTEGER (-4096..4095) OPTIONAL,  cnavISCl5i5 INTEGER (-4096..4095) OPTIONAL,  cnavISCl5q5 INTEGER (-4096..4095) OPTIONAL  } |
| GLONASSclockModel ::= SEQUENCE {  gloTau INTEGER (-2097152..2097151),  gloGamma INTEGER (-1024..1023),  gloDeltaTau INTEGER (-16..15) OPTIONAL  } |
| SBASclockModel ::= SEQUENCE {  sbasTo INTEGER (0..5399),  sbasAgfo INTEGER (-2048..2047),  sbasAgf1 INTEGER (-128..127)  }  BDSClockModel-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)  } |
| -- GANSS Real-Time Integrity IE  GANSSRealTimeIntegrity ::= SEQUENCE {  -- list of satellites with bad signals  -- NBS can be read from number of elements in SeqOf-BadSignalSet  ganssBadSignalList SeqOfBadSignalElement  }  SeqOfBadSignalElement ::= SEQUENCE (SIZE(1..16)) OF BadSignalElement  BadSignalElement ::= SEQUENCE {  badSVID SVID, -- Coding according to Annex  badSignalID GANSSSignals OPTIONAL -- Coding according to Annex  } |
| -- GANSS Data Bit Assistance IE  GANSSDataBitAssist ::= SEQUENCE {  ganssTOD INTEGER (0 .. 59),  -- N\_SAT can be read from number of elements in SeqOfGanssDataBitsElement  ganssDataBitsSatList SeqOfGanssDataBitsElement,  ...  } |
| SeqOfGanssDataBitsElement ::= SEQUENCE (SIZE(1 .. 32))OF GanssDataBitsElement  GanssDataBitsElement ::= SEQUENCE {  svID SVID,  -- N\_SGN can be read from number of elements in Seq-OfGANSSDataBitsSgn  ganssDataBitsSgnList Seq-OfGANSSDataBitsSgn,  ...  } |
| Seq-OfGANSSDataBitsSgn ::= SEQUENCE (SIZE(1..8)) OF GANSSDataBitsSgnElement  GANSSDataBitsSgnElement ::= SEQUENCE {  ganssSignalType GANSSSignalID,  -- N\_BIT can be read from number of elements in SeqOf-DataBits  ganssDataBits SeqOf-GANSSDataBits,  ...  }  SeqOf-GANSSDataBits ::= SEQUENCE (SIZE(1 .. 1024)) OF GANSSDataBit  GANSSDataBit ::= INTEGER(0 .. 1) |
| -- GANSS Reference Measurement Assistance IE  -- Code and Doppler assistance from the network.  GANSSRefMeasurementAssist ::= SEQUENCE {  ganssSignalID GANSSSignalID, -- Coding according to Annex  ganssRefMeasAssistList SeqOfGANSSRefMeasurementElement  }  SeqOfGANSSRefMeasurementElement ::= SEQUENCE (SIZE(1 .. 16)) OF GANSSRefMeasurementElement  GANSSRefMeasurementElement ::= SEQUENCE {  svID SVID,  -- Doppler 0th order term,  -- -1024 m/s to 1023,5 m/s with 0,5 m/s resolution)  doppler0 INTEGER (-2048 .. 2047), -- Coding according to Annex  additionalDoppler AdditionalDopplerFields OPTIONAL,  codePhase INTEGER (0 .. 1022), -- Code Phase in ms  intCodePhase INTEGER (0 .. 127), -- Integer Code Phase in ms  codePhaseSearchWindow INTEGER (0 .. 31), -- Code Phase Search Window, see Annex  additionalAngle AddionalAngleFields OPTIONAL,  ...,  codePhase1023 BOOLEAN OPTIONAL  }  AdditionalDopplerFields ::= SEQUENCE {  -- Doppler 1st order term, -0,2 - +0,1 m/s2  -- ( = -42 + (0 to 63) with 1/210 m/s2 resolution)  doppler1 INTEGER (0..63),  dopplerUncertainty INTEGER (0..4)  }  -- GANSS Reference Measurement Rel-10 Extension:  -- GANSSRefMeasurementAssist-R10-Ext shall contain the same number of elements as the  -- SeqOfGANSSRefMeasurementElement included in GANSSRefMeasurementAssist IE  GANSSRefMeasurementAssist-R10-Ext ::= SEQUENCE (SIZE(1 .. 16)) OF  GANSSRefMeasurement-R10-Ext-Element  GANSSRefMeasurement-R10-Ext-Element ::= SEQUENCE {  svID SVID,  azimuthLSB INTEGER(0..15),  elevationLSB INTEGER(0..15)  }  -- GANSS Reference Measurement Rel-12 Extension:  GANSSRefMeasurementAssist-R12-Ext ::= SEQUENCE {  ganssSignalID GANSSSignalID,  confidence INTEGER (0..100) OPTIONAL,  ganssRefMeasAssistList SeqOfGANSSRefMeasurementElement-R12 OPTIONAL  }  SeqOfGANSSRefMeasurementElement-R12 ::= SEQUENCE (SIZE(1 .. 16)) OF  GANSSRefMeasurement-R12-Ext-Element  GANSSRefMeasurement-R12-Ext-Element ::= SEQUENCE {  svID SVID,  dopplerUncertaintyExt ENUMERATED { d60,  d80,  d100,  d120,  noInformation, ...}  } |
| -- GANSS Almanac Model IE  GANSSAlmanacModel ::= SEQUENCE {  weekNumber INTEGER (0 .. 255),  toa INTEGER (0 .. 255) OPTIONAL,  ioda INTEGER (0 .. 3) OPTIONAL,  ganssAlmanacList SeqOfGANSSAlmanacElement  } |
| SeqOfGANSSAlmanacElement ::= SEQUENCE (SIZE(1 .. 36)) OF GANSSAlmanacElement |
| -- GANSS Almanac Model  GANSSAlmanacElement ::= CHOICE {  keplerianAlmanacSet Almanac-KeplerianSet, -- Model-1  ...,  keplerianNAVAlmanac Almanac-NAVKeplerianSet, -- Model-2  keplerianReducedAlmanac Almanac-ReducedKeplerianSet, -- Model-3  keplerianMidiAlmanac Almanac-MidiAlmanacSet, -- Model-4  keplerianGLONASS Almanac-GlonassAlmanacSet, -- Model-5  ecefSBASAlmanac Almanac-ECEFsbasAlmanacSet, -- Model-6  keplerianBDSAlmanac-r12 Almanac-BDSAlmanacSet-r12 -- Model-7  } |
| -- Almanac parameters according to Keplerian parameters  Almanac-KeplerianSet ::= SEQUENCE {  svID SVID,  kepAlmanacE INTEGER (0 .. 2047),  kepAlmanacDeltaI INTEGER (-1024 .. 1023),  kepAlmanacOmegaDot INTEGER (-1024 .. 1023),  kepSVStatusINAV BIT STRING (SIZE (4)),  kepSVStatusFNAV BIT STRING (SIZE (2)) OPTIONAL,  kepAlmanacAPowerHalf INTEGER (-4096..4095),  kepAlmanacOmega0 INTEGER (-32768 .. 32767),  kepAlmanacW INTEGER (-32768 .. 32767),  kepAlmanacM0 INTEGER (-32768 .. 32767),  kepAlmanacAF0 INTEGER (-32768..32767),  kepAlmanacAF1 INTEGER (-4096..4095)  } |
| Almanac-NAVKeplerianSet ::= SEQUENCE {  svID SVID,  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)  } |
| Almanac-ReducedKeplerianSet ::= SEQUENCE {  svID SVID,  redAlmDeltaA INTEGER (-128..127),  redAlmOmega0 INTEGER (-64..63),  redAlmPhi0 INTEGER (-64..63),  redAlmL1Health BOOLEAN,  redAlmL2Health BOOLEAN,  redAlmL5Health BOOLEAN  } |
| Almanac-MidiAlmanacSet ::= SEQUENCE {  svID SVID,  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  } |
| Almanac-GlonassAlmanacSet ::= SEQUENCE {  gloAlmNA 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  } |
| Almanac-ECEFsbasAlmanacSet ::= SEQUENCE {  sbasAlmDataID INTEGER (0..3),  svID SVID,  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)  }  Almanac-BDSAlmanacSet-r12 ::= SEQUENCE {  svID SVID,  --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 GANSSAlmanacModel  bdsAlmToa-r12 INTEGER (0..255) OPTIONAL,  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),  --This field is mandatory present if SV-ID is between 0 and 29; otherwise it is not present.  bdsSvHealth-r12 BIT STRING (SIZE(9)) OPTIONAL  }  -- GANSS Almanac Model Rel-10 Extension  GANSSAlmanacModel-R10-Ext ::= SEQUENCE {  completeAlmanacProvided BOOLEAN -- TRUE means that complete Almanac is provided  }  -- GANSS Almanac Model Rel-12 Extension  GANSSAlmanacModel-R12-Ext ::= SEQUENCE {  -- Either toa in GANSSAlmanacModel or toa-ext shall be present if GANSS-ID indicates Galileo  toa-ext INTEGER (256..1023) OPTIONAL,  -- Either ioda in GANSSAlmanacModel or ioda-ext shall be present if GANSS-ID indicates Galileo  ioda-ext INTEGER (4..15) OPTIONAL  } |
| -- GANSS Universal Time Coordinate Model (Model-1)  GANSSUTCModel ::= SEQUENCE {  ganssUtcA1 INTEGER (-8388608..8388607),  ganssUtcA0 INTEGER (-2147483648..2147483647),  ganssUtcTot INTEGER (0..255),  ganssUtcWNt INTEGER (0..255),  ganssUtcDeltaTls INTEGER (-128..127),  ganssUtcWNlsf INTEGER (0..255),  ganssUtcDN INTEGER (-128..127),  ganssUtcDeltaTlsf INTEGER (-128..127)  } |
| --GANSS Ephemeris Extension  GANSSEphemerisExtension ::= SEQUENCE {  ganssEphemerisHeader GANSSEphemerisExtensionHeader OPTIONAL,  ganssReferenceSet SeqOfGANSSRefOrbit OPTIONAL,  ganssephemerisDeltasMatrix GANSSEphemerisDeltaMatrix OPTIONAL,  ...  }  -- The ganssEphemerisHeader and the ganssReferenceSet are mandatory only once in the delivery of the  -- GANSS Ephemeris Extension. The ganssReferenceSet shall include all healthy satellite vehicles  -- at the time of message construction. |
| GANSSEphemerisExtensionHeader ::= SEQUENCE {  timeAtEstimation GANSSEphemerisExtensionTime,  validityPeriod INTEGER(1..8),  -- The validity period, represented in hours, is the validity period of each individual ephemeris  -- delta payload  ephemerisExtensionDuration INTEGER(1..512),  -- If the ephemerisExtensionDuration does not match the request duration made by the MS, the MS  -- should regard the provided ephemerisExtensionDuration as the limit of the SMLC ephemeris  -- extension capability at this time.  ...  } |
| GANSSEphemerisExtensionTime ::= SEQUENCE {  ganssEphExtDay INTEGER(0..8191),  ganssEphExtTOD GANSSTOD,  ...  } |
| -- Reference Nav Model for Ephepmeris Extension  ReferenceNavModel ::= SEQUENCE {  keplerToe INTEGER (0..37799),  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)  } |
| SeqOfGANSSRefOrbit ::= SEQUENCE (SIZE(1..32)) OF GANSSReferenceOrbit  --The number of reference orbits can be read from number of elements in this sequence |
| GANSSReferenceOrbit ::= SEQUENCE {  svID SVID,  ganssOrbitModel ReferenceNavModel,  ganssClockModel GANSSClockModel,  ...  } |
| GANSSEphemerisDeltaMatrix ::= SEQUENCE (SIZE(1 .. 128)) OF GANSSEphemerisDeltaEpoch |
| GANSSEphemerisDeltaEpoch ::= SEQUENCE {  ganssDeltaEpochHeader GANSSDeltaEpochHeader OPTIONAL,  ganssDeltaElementList GANSSDeltaElementList,  ...  }  -- Each GANSSDeltaEpoch element contains a header and the delta values for a particular time window  -- for all PRN's. |
| GANSSDeltaEpochHeader ::= SEQUENCE {  validityPeriod INTEGER(1..8) OPTIONAL,  ephemerisDeltaSizes GANSSEphemerisDeltaBitSizes OPTIONAL,  ephemerisDeltaScales GANSSEphemerisDeltaScales OPTIONAL,  ...  }  -- In each of the GANSSDeltaEpochs, if the optional element, validityPeriod is not included, the  -- value in GANSSEphemerisExtensionHeader shall be used. If the optional elements  -- ephemerisDeltaSizes or ephemerisDeltaScales are not included, then the default ephemeris delta  -- sizes and scales shall be used. The default sizes and scales are found in the annex in the  -- table 55.11. |
| GANSSDeltaElementList ::= SEQUENCE (SIZE(1 .. 32)) OF OCTET STRING(SIZE (1..49))  -- Each octet string element in GANSSDeltaElementList corresponds to one PRN within one epoch  -- Table 55.11 of the annex shows the organization of the delta ephemeris octet string.  -- Decoding of each of the octet strings is accomplished by consulting the ephemerisDeltaSizes  -- table to learn the length and order of each of the parameters in the ephemerisDelta payload.  -- Post decode scaling is accomplished by consulting the ephemerisDeltaScales table to learn the  -- scale factors to apply to the terms in the delta ephemeris. |
| -- Ephemeris Delta Bit Sizes.  GANSSEphemerisDeltaBitSizes ::= SEQUENCE {  -- This structure defines the order and sizes of the fields in the GANSSDeltaEpoch octet string  -- seqNum and svID are the first two elements of each GANSS Ephemeris Delta Element Structure  -- seqNum is always 7 bits, and svID is always 6 bits long and are thus not included in  -- the GANSSEphemerisDeltaBitSizes table. The value of seqNum indicates the GANSSDeltaEpoch number  -- The Ephemeris delta element payload mimics the bitsize table, but also includes the svID and  -- seqNum as the first two elements (in that order),in each block.  bitsize-delta-omega INTEGER(1..32),  bitsize-delta-deltaN INTEGER(1..16),  bitsize-delta-m0 INTEGER(1..32),  bitsize-delta-omegadot INTEGER(1..24),  bitsize-delta-e INTEGER(1..32),  bitsize-delta-idot INTEGER(1..14),  bitsize-delta-sqrtA INTEGER(1..32),  bitsize-delta-i0 INTEGER(1..32),  bitsize-delta-omega0 INTEGER(1..32),  bitsize-delta-crs INTEGER(1..16),  bitsize-delta-cis INTEGER(1..16),  bitsize-delta-cus INTEGER(1..16),  bitsize-delta-crc INTEGER(1..16),  bitsize-delta-cic INTEGER(1..16),  bitsize-delta-cuc INTEGER(1..16),  bitsize-delta-tgd1 INTEGER(1..10),  bitsize-delta-tgd2 INTEGER(1..10),  ...  } |
| GANSSEphemerisDeltaScales ::= SEQUENCE {  scale-delta-omega INTEGER(-16..15),  scale-delta-deltaN INTEGER(-16..15),  scale-delta-m0 INTEGER(-16..15),  scale-delta-omegadot INTEGER(-16..15),  scale-delta-e INTEGER(-16..15),  scale-delta-idot INTEGER(-16..15),  scale-delta-sqrtA INTEGER(-16..15),  scale-delta-i0 INTEGER(-16..15),  scale-delta-omega0 INTEGER(-16..15),  scale-delta-crs INTEGER(-16..15),  scale-delta-cis INTEGER(-16..15),  scale-delta-cus INTEGER(-16..15),  scale-delta-crc INTEGER(-16..15),  scale-delta-cic INTEGER(-16..15),  scale-delta-cuc INTEGER(-16..15),  scale-delta-tgd1 INTEGER(-16..15),  scale-delta-tgd2 INTEGER(-16..15),  ...  } |
| -- GANSS Ephemeris Extension Check  GANSSEphemerisExtensionCheck ::= SEQUENCE {  ganssBeginTime GANSSEphemerisExtensionTime,  ganssEndTime GANSSEphemerisExtensionTime,  ganssSatEventsInfo GANSSSatEventsInfo,  ...  } |
| GANSSSatEventsInfo ::= SEQUENCE {  eventOccured BIT STRING (SIZE (64)),  futureEventNoted BIT STRING (SIZE (64)),  ...  }  -- If a bit is clear in the eventOccured field it indicates that no known errors have occured  -- between the current time and the ganssBeginTime nor is a maneuver planned for the next sixty  -- minutes.  -- If a bit is set in the futureEventNoted field it indicates that a maneuver is planned during the  -- time period between current time plus sixty minutes and the ganssEndTime  -- GANSS Additional Universal Time Coordinate Model  GANSSAddUTCModel ::= CHOICE {  utcModel2 UTCmodelSet2,  utcModel3 UTCmodelSet3,  utcModel4 UTCmodelSet4,  ... ,  utcModel5-r12 UTCmodelSet5-r12  } |
| UTCmodelSet2 ::= 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)  } |
| UTCmodelSet3 ::= SEQUENCE {  nA INTEGER (1..1461),  tauC INTEGER (-2147483648..2147483647),  b1 INTEGER (-1024..1023) OPTIONAL,  b2 INTEGER (-512..511) OPTIONAL,  kp BIT STRING (SIZE(2)) OPTIONAL  } |
| UTCmodelSet4 ::= 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) -- coding according to annex  }  UTCmodelSet5-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)  } |
| -- GANSS Auxiliary Information  GANSSAuxiliaryInformation ::= CHOICE{  ganssID1 GANSS-ID1, -- This choice may only be present if GANSS ID indicates Modernized GPS  ganssID3 GANSS-ID3, -- This choice may only be present if GANSS ID indicates GLONASS  ...  } |
| GANSS-ID1 ::= SEQUENCE (SIZE(1..64)) OF GANSS-ID1-element  GANSS-ID1-element ::= SEQUENCE {  svID SVID,  signalsAvailable GANSSSignals,  ...  } |
| GANSS-ID3 ::= SEQUENCE (SIZE(1..64)) OF GANSS-ID3-element  GANSS-ID3-element ::= SEQUENCE {  svID SVID,  signalsAvailable GANSSSignals,  channelNumber INTEGER (-7..13),  ...  } |
| -- DGANSS Corrections Validity Period:  -- This element may only be included if GANSSDiffCorrections IE is included in  -- GANSSGenericAssistDataElement element.  -- GANSSDiffCorrectionsValidityPeriod shall contain the same number of elements as the  -- SeqOfSgnTypeElement included in GANSSDiffCorrections IE  GANSSDiffCorrectionsValidityPeriod ::= SEQUENCE (SIZE (1..3)) OF DGANSSExtensionSgnTypeElement  DGANSSExtensionSgnTypeElement ::= SEQUENCE {  ganssSignalID GANSSSignalID, -- signal type identity  dganssExtensionSgnList SeqOfDGANSSExtensionSgnElement  }  -- SeqOfDGANSSExtensionSgnElement shall contain the same number of elements as the  -- SeqOfDGANSSSgnElement included in GANSSDiffCorrections IE  SeqOfDGANSSExtensionSgnElement ::= SEQUENCE (SIZE (1..16)) OF DGANSSExtensionSgnElement  DGANSSExtensionSgnElement ::= SEQUENCE {  svID SVID, -- Satellite identity  udreGrowthRate INTEGER(0..7), -- coding according to annex  udreValidityTime INTEGER(0..7), -- coding according to annex  ...  } |
| --Required Measurement Request Response Time, range is 1 to 128 seconds.  RequiredResponseTime ::= INTEGER (1..128) |
| -- Control header for additional GPS assistance data  Add-GPS-AssistData ::= SEQUENCE {  add-GPS-controlHeader Add-GPS-ControlHeader  } |
| Add-GPS-ControlHeader ::= SEQUENCE {  gpsEphemerisExtension GPSEphemerisExtension OPTIONAL,  gpsEphemerisExtensionCheck GPSEphemerisExtensionCheck OPTIONAL,  ... ,  dgpsCorrectionsValidityPeriod DGPSCorrectionsValidityPeriod OPTIONAL,  -- If ReferenceTime is included in ControlHeader, GPSReferenceTime-R10-Ext  -- shall also be included.  gpsReferenceTime-R10-Ext GPSReferenceTime-R10-Ext OPTIONAL,  -- If AcquisAssist is included in ControlHeader, GPSAcquisAssist-R10-Ext  -- shall also be included.  gpsAcquisAssist-R10-Ext GPSAcquisAssist-R10-Ext OPTIONAL,  -- If Almanac is included in ControlHeader, GPSAlmanac-R10-Ext  -- shall also be included.  gpsAlmanac-R10-Ext GPSAlmanac-R10-Ext OPTIONAL,  gpsAcquisAssist-R12-Ext GPSAcquisAssist-R12-Ext OPTIONAL  } |
| GPSClockModel ::= SEQUENCE {  af2 INTEGER (-128..127),  af1 INTEGER (-32768..32767),  af0 INTEGER (-2097152..2097151),  tgd INTEGER (-128..127)  } |
| --GPS Ephemeris Extension  GPSEphemerisExtension ::= SEQUENCE {  gpsEphemerisHeader GPSEphemerisExtensionHeader OPTIONAL,  gpsReferenceSet SeqOfGPSRefOrbit OPTIONAL,  gpsephemerisDeltaMatrix GPSEphemerisDeltaMatrix OPTIONAL,  ...  }  -- The gpsEphemerisHeader and the gpsReferenceSet are mandatory only once in the delivery of the  -- GPS Ephemeris Extension. The gpsReferenceSet shall include all healthy satellite vehicles at the  -- time of message construction  -- The SMLC is required to deliver the gpsReferenceSet for all healthy satellite vehicles  -- at the time of message construction. |
| GPSEphemerisExtensionHeader ::= SEQUENCE {  timeofEstimation GPSEphemerisExtensionTime,  validityPeriod INTEGER(1..8),  -- The validity period, represented in hours is the validity period of each individual ephemeris  -- delta payload  ephemerisExtensionDuration INTEGER(1..512),  -- If the ephemerisExtensionDuration does not match the request duration made by the MS, the MS  -- should regard the provided ephemerisExtensionDuration as the limit of the SMLC ephemeris  -- extension capability at this time.  ...  } |
| GPSEphemerisExtensionTime ::= SEQUENCE {  gpsWeek GPSWeek,  gpsTOW INTEGER (0..604799),  ...  } |
| SeqOfGPSRefOrbit ::= SEQUENCE (SIZE(1..32)) OF GPSReferenceOrbit  --The number of reference orbits can be read from number of elements in this sequence |
| GPSReferenceOrbit ::= SEQUENCE {  svID SVID,  gpsOrbitModel ReferenceNavModel,  gpsClockModel GPSClockModel,  ...  } |
| GPSEphemerisDeltaMatrix ::= SEQUENCE (SIZE(1 .. 128)) OF GPSEphemerisDeltaEpoch |
| GPSEphemerisDeltaEpoch ::= SEQUENCE {  gpsDeltaEpochHeader GPSDeltaEpochHeader OPTIONAL,  gpsDeltaElementList GPSDeltaElementList,  ...  }  -- Each GPSDeltaEpoch element contains a header and the delta values for a particular time window  -- for all PRN's. |
| GPSDeltaEpochHeader ::= SEQUENCE {  validityPeriod INTEGER(1..8) OPTIONAL,  ephemerisDeltaSizes GPSEphemerisDeltaBitSizes OPTIONAL,  ephemerisDeltaScales GPSEphemerisDeltaScales OPTIONAL,  ...  }  -- In each of the GPSDeltaEpochs, if the optional element validityPeriod is not included,  -- the value in GPSEphemerisExtensionHeader shall be used. if the optional elements  -- ephemerisDeltaSizes or ephemerisDeltaScales are not included, then the default ephemeris delta  -- sizes and scales shall be used. The default sizes and scales are found in the annex in section  -- A.29.m |
| GPSDeltaElementList ::= SEQUENCE (SIZE(1 .. 32)) OF OCTET STRING(SIZE (1..47))  -- Each octet string element in GPSDeltaElementList corresponds to one PRN within one epoch  -- Table A.29.m of the annex shows the organization of the delta ephemeris octet string.  -- Decoding of each of the octet strings is accomplished by consulting the ephemerisDeltaSizes  -- table to learn the length and order of each of the parameters in the ephemerisDelta payload  -- Post decode scaling is accomplished by consulting the ephemerisDeltaScales table to learn the.  -- scale factors to apply to the terms in the delta ephemeris  -- Ephemeris Delta Bit Sizes. |
| GPSEphemerisDeltaBitSizes ::= SEQUENCE {  -- This structure defines the order and sizes of the fields in the GPSsDeltaEpoch octet string  -- seqNum and svID are the first two elements of each GPS Ephemeris Delta Element Structure  -- seqNum is always 7 bits, and svID is always 5 bits long and are thus not included in  -- the GPSEphemerisDeltaBitSizes table. seqNum indicates the GPSDeltaEpoch number.  -- The Ephemeris delta element payload mimics the bitsize table, but also includes the svID and  -- seqNum as the first two elements (in that order),in each block.  bitsize-delta-omega INTEGER(1..32),  bitsize-delta-deltaN INTEGER(1..16),  bitsize-delta-m0 INTEGER(1..32),  bitsize-delta-omegadot INTEGER(1..24),  bitsize-delta-e INTEGER(1..32),  bitsize-delta-idot INTEGER(1..14),  bitsize-delta-sqrtA INTEGER(1..32),  bitsize-delta-i0 INTEGER(1..32),  bitsize-delta-omega0 INTEGER(1..32),  bitsize-delta-crs INTEGER(1..16),  bitsize-delta-cis INTEGER(1..16),  bitsize-delta-cus INTEGER(1..16),  bitsize-delta-crc INTEGER(1..16),  bitsize-delta-cic INTEGER(1..16),  bitsize-delta-cuc INTEGER(1..16),  bitsize-delta-tgd INTEGER(1..10),  ...  } |
| GPSEphemerisDeltaScales ::= SEQUENCE {  scale-delta-omega INTEGER(-16..15),  scale-delta-deltaN INTEGER(-16..15),  scale-delta-m0 INTEGER(-16..15),  scale-delta-omegadot INTEGER(-16..15),  scale-delta-e INTEGER(-16..15),  scale-delta-idot INTEGER(-16..15),  scale-delta-sqrtA INTEGER(-16..15),  scale-delta-i0 INTEGER(-16..15),  scale-delta-omega0 INTEGER(-16..15),  scale-delta-crs INTEGER(-16..15),  scale-delta-cis INTEGER(-16..15),  scale-delta-cus INTEGER(-16..15),  scale-delta-crc INTEGER(-16..15),  scale-delta-cic INTEGER(-16..15),  scale-delta-cuc INTEGER(-16..15),  scale-delta-tgd INTEGER(-16..15),  ...  } |
| GPSEphemerisExtensionCheck ::= SEQUENCE {  gpsBeginTime GPSEphemerisExtensionTime,  gpsEndTime GPSEphemerisExtensionTime,  gpsSatEventsInfo GPSSatEventsInfo,  ...  } |
| GPSSatEventsInfo ::= SEQUENCE {  eventOccured BIT STRING (SIZE (32)),  futureEventNoted BIT STRING (SIZE (32)),  ...  }  -- If a bit is clear in the eventOccured field it indicates that no known errors have occured since  -- the gpsBeginTime nor is a maneuver planned for the next sixty minutes.  -- If a bit is set in the futureEventNoted field it indicates that a maneuver is planned during the  -- time period between current time plus sixty minutes and gpsEndTime  -- DGPS Corrections Validity Period:  -- This element may only be included if DGPSCorrections IE is included in ControlHeader element.  -- DGPSCorrectionsValidityPeriod shall contain the same number of elements as the SeqOfSatElement  -- included in DGPSCorrections IE  DGPSCorrectionsValidityPeriod ::= SEQUENCE (SIZE (1..16)) OF DGPSExtensionSatElement  DGPSExtensionSatElement ::= SEQUENCE {  satelliteID SatelliteID,  udreGrowthRate INTEGER(0..7), -- coding according to annex  udreValidityTime INTEGER(0..7), -- coding according to annex  ...  }  -- GPS Reference Time Rel-10 Extension:  GPSReferenceTime-R10-Ext ::= SEQUENCE {  gpsWeekCycleNumber INTEGER(0..7) -- coding according to annex  }  -- GPS Acquisition Assistance Rel-10 Extension:  -- GPSAcquisAssist-R10-Ext shall contain the same number of elements as the SeqOfAcquisElement  -- included in AcquisAssist IE  GPSAcquisAssist-R10-Ext ::= SEQUENCE(SIZE (1..16)) OF GPSAcquisAssist-R10-Ext-Element  GPSAcquisAssist-R10-Ext-Element::= SEQUENCE {  satelliteID SatelliteID,  azimuthLSB INTEGER(0..15),  elevationLSB INTEGER(0..15)  }  -- GPS Acquisition Assistance Rel-12 Extension:  GPSAcquisAssist-R12-Ext ::= SEQUENCE {  confidence INTEGER (0..100) OPTIONAL,  acquisList SeqOfGPSAcquisAssist-R12-Ext OPTIONAL  }  SeqOfGPSAcquisAssist-R12-Ext ::= SEQUENCE (SIZE(1..16)) OF GPSAcquisAssist-R12-Ext-Element  GPSAcquisAssist-R12-Ext-Element ::= SEQUENCE {  satelliteID SatelliteID,  dopplerUncertaintyExt ENUMERATED { d300,  d400,  d500,  d600,  noInformation, ...}  }  -- GPS Almanac Rel-10 Extension:  GPSAlmanac-R10-Ext ::= SEQUENCE {  completeAlmanacProvided BOOLEAN -- TRUE means that complete Almanac is provided  } |
| Rel-7-MsrPosition-Rsp-Extension ::= SEQUENCE {  velEstimate VelocityEstimate OPTIONAL,  -- Horizontal Velocity  -- Horizontal with Vertical Velocity  -- Horizontal Velocity with Uncertainty  -- Horizontal with Vertical Velocity and Uncertainty  ganssLocationInfo GANSSLocationInfo OPTIONAL,  ganssMeasureInfo GANSSMeasureInfo OPTIONAL,  ...  -- Further Release 7 extensions here  } |
| -- GANSS Location Information contains location estimate, time stamp with uncertainty  -- and optionally Reference Frame field  GANSSLocationInfo ::= SEQUENCE {  referenceFrame ReferenceFrame OPTIONAL, -- Reference Frame Number  ganssTODm GANSSTODm OPTIONAL, -- GNSS TOD modulo  ganssTODFrac INTEGER (0 .. 16384) OPTIONAL, -- Coding according to Annex  -- a value of 16384 shall not be encoded by the sender  -- the receiver shall consider a value of 16384 to be invalid data  ganssTODUncertainty GANSSTODUncertainty OPTIONAL, -- Coding according to Annex  ganssTimeID INTEGER (0 .. 7) OPTIONAL, -- Coding according to Annex  fixType FixType,  posData PositionData,  stationaryIndication INTEGER(0 .. 1) OPTIONAL, -- '0' if moving or motion not  -- known  -- Possible shapes carried in posEstimate are  -- ellipsoid point,  -- ellipsoid point with uncertainty circle  -- ellipsoid point with uncertainty ellipse  -- ellipsoid point with altitude and uncertainty ellipsoid  posEstimate Ext-GeographicalInformation,  ...  } |
| PositionData ::= BIT STRING {  e-otd (0),  gps (1),  galileo (2),  sbas (3),  modernizedGPS (4),  qzss (5),  glonass (6),  bds (7)} (SIZE (3..16)) |
| -- GANSS TOD modulo 1 hour  GANSSTODm ::= INTEGER (0 .. 3599999)  ReferenceFrame ::= SEQUENCE {  referenceFN INTEGER (0 .. 65535),  -- Note that applicable range for referenceFN is 0 - 42431  referenceFNMSB INTEGER (0 .. 63) OPTIONAL -- MSB of Reference Frame Number  } |
| -- GANSS Measurement Information  GANSSMeasureInfo ::= SEQUENCE {  -- Measurement info elements  ganssMsrSetList SeqOfGANSS-MsrSetElement  }  SeqOfGANSS-MsrSetElement ::= SEQUENCE (SIZE(1..3)) OF GANSS-MsrSetElement |
| -- GANSS measurement information 1-3 times in a message  GANSS-MsrSetElement ::= SEQUENCE {  referenceFrame ReferenceFrame OPTIONAL, -- Reference Frame Number  -- if ganssTODm is included, it is the GNSS specific system time of the GANSS reported  -- first in ganss-SgnTypeList. If GPS Measurement Information element is not included in  -- a Measure Position Response component, this field shall be present.  ganssTODm GANSSTODm OPTIONAL, -- GANSS TOD modulo 1 hour  deltaGANSSTOD INTEGER (0 .. 127) OPTIONAL,  ganssTODUncertainty GANSSTODUncertainty OPTIONAL, -- Coding according to Annex  --N\_GANSS can be read from number of elements of SeqOfGANSS-MsrElement  ganss-MsrElementList SeqOfGANSS-MsrElement  }  SeqOfGANSS-MsrElement ::= SEQUENCE (SIZE(1..8)) OF GANSS-MsrElement  GANSS-MsrElement ::= SEQUENCE {  ganssID INTEGER (0..7) OPTIONAL, --Absence means Galileo  ganss-SgnTypeList SeqOfGANSS-SgnTypeElement  } |
| -- Measurements can be returned up to 8 different signal types  -- N\_SGN\_TYPE can be read from number of elements of SeqOfGANSS-SgnTypeElement  -- Reporting of multiple signal types as defined in A.2.2.4g  SeqOfGANSS-SgnTypeElement ::= SEQUENCE (SIZE(1..8)) OF GANSS-SgnTypeElement  GANSS-SgnTypeElement ::= SEQUENCE {  ganssSignalID GANSSSignalID, -- Coding according to Annex  ganssCodePhaseAmbiguity INTEGER (0 .. 127) OPTIONAL,  --N\_SGN can be read from number of elements of SeqOfGANSS-SgnElement  ganss-SgnList SeqOfGANSS-SgnElement,  ...  } |
| -- Up to 16 Measurements can be returned per signal type  SeqOfGANSS-SgnElement ::= SEQUENCE (SIZE(1..16)) OF GANSS-SgnElement  GANSS-SgnElement ::= SEQUENCE {  svID SVID,  cNo INTEGER (0 .. 63),  mpathDet MpathIndic, -- Coding according to Annex  carrierQualityInd INTEGER (0 .. 3) OPTIONAL, -- Coding according to Annex  codePhase INTEGER (0 .. 2097151),  integerCodePhase INTEGER (0 .. 127) OPTIONAL,  codePhaseRMSError INTEGER (0..63), -- Coding according to Annex  doppler INTEGER (-32768 .. 32767) OPTIONAL,  adr INTEGER (0 .. 33554431) OPTIONAL  } |
| Rel7-AssistanceData-Extension ::= SEQUENCE {  ganss-AssistData GANSS-AssistData OPTIONAL,  ganssCarrierPhaseMeasurementRequest NULL OPTIONAL,  ganssTODGSMTimeAssociationMeasurementRequest NULL OPTIONAL,  add-GPS-AssistData Add-GPS-AssistData OPTIONAL,  ...  -- Possibly more extensions for Release 7 here  }  BDS-DiffCorrections-r12 ::= SEQUENCE {  dbds-RefTime-r12 INTEGER (0..3599),  -- N\_SGN\_TYPE can be read from number of elements of bds-SgnTypeList-r12  bds-SgnTypeList-r12 BDS-SgnTypeList-r12,  ...  }  BDS-SgnTypeList-r12 ::= SEQUENCE (SIZE (1..3)) OF BDS-SgnTypeElement-r12  BDS-SgnTypeElement-r12 ::= SEQUENCE {  ganssSignalID GANSSSignalID OPTIONAL,  -- N\_SAT can be read from number of elements of dbds-CorrectionList-r12  dbds-CorrectionList-r12 DBDS-CorrectionList-r12,  ...  }  DBDS-CorrectionList-r12 ::= SEQUENCE (SIZE (1..64)) OF DBDS-CorrectionElement-r12  DBDS-CorrectionElement-r12 ::= SEQUENCE {  svID SVID,  bds-UDREI-r12 INTEGER (0..15),  bds-RURAI-r12 INTEGER (0..15),  bds-ECC-DeltaT-r12 INTEGER (-4096..4095),  ...  }  BDS-GridModelParameter-r12 ::= SEQUENCE {  bds-RefTime-r12 INTEGER (0..3599),  --N\_IGP can be read from number of elements of GridIonList-r12  gridIonList-r12 GridIonList-r12,  ...  }  --Up to 16 instances are used in this version of the specification. The values 17 to 320 are reserved for future use.  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) ,  ...  } |
| -- Rel-7 Positioning Capability parameters here  PosCapabilities ::= SEQUENCE {  -- nonGANSSpositionMethods shall be included if and only if any  -- of the non-GANSS methods is supported.  nonGANSSpositionMethods NonGANSSPositionMethods OPTIONAL,  -- gANSSpositionMethods shall be included if and only if any of the GANSS methods is supported.  gANSSPositionMethods GANSSPositionMethods OPTIONAL,  -- multipleMeasurementSets shall be present if and only if 'multiple sets' is supported  -- for any of the positioning methods  multipleMeasurementSets MultipleMeasurementSets OPTIONAL,  ...  }  NonGANSSPositionMethods ::= BIT STRING {  msAssistedEOTD (0),  msBasedEOTD (1),  msAssistedGPS (2), -- If this bit is set, gpsAssistance in AssistanceSupported IE  -- shall be present  msBasedGPS (3), -- If this bit is set, gpsAssistance in AssistanceSupported IE  -- shall be present  standaloneGPS (4) } (SIZE (1..16))  GANSSPositionMethods ::= SEQUENCE (SIZE(1..16)) OF GANSSPositionMethod  GANSSPositionMethod ::= SEQUENCE {  ganssID INTEGER (0..7) OPTIONAL, --Absence means Galileo  -- gANSSPositioningMethodTypes may be present for PosCapability-Req  -- and shall be present for PosCapability-Rsp  gANSSPositioningMethodTypes GANSSPositioningMethodTypes OPTIONAL,  gANSSSignals GANSSSignals,  ... ,  -- sbasID shall be present if and only if ganssID indicates SBAS  sbasID SBASID OPTIONAL  } |
| GANSSPositioningMethodTypes ::= BIT STRING {  msAssisted (0), -- If this bit is set, gANSSAssistanceSet in AssistanceSupported IE  -- shall be present.  msBased (1), -- If this bit is set, gANSSAssistanceSet in AssistanceSupported IE  -- shall be present.  standalone (2) } (SIZE (1..8))  -- indicates MS support for particular GANSS signals and frequencies  GANSSSignals ::= BIT STRING {  signal1 (0),  signal2 (1),  signal3 (2),  signal4 (3),  signal5 (4),  signal6 (5),  signal7 (6),  signal8 (7) } (SIZE (1..8))  SBASID ::= BIT STRING {  waas (0),  egnos (1),  masas (2),  gagan (3) } (SIZE (1..8)) |
| -- indicates MS support of multiple measurement sets for MS assisted position methods  MultipleMeasurementSets ::= BIT STRING {  eotd (0),  gps (1),  ganss (2) } (SIZE (1..8))  -- indicates MS support of different types of assistance data  AssistanceSupported ::= SEQUENCE {  gpsAssistance GPSAssistance OPTIONAL,  gANSSAssistanceSet GANSSAssistanceSet OPTIONAL,  ... ,  -- gANSSAdditionalAssistanceChoices shall be present if the MS supports other than native models  gANSSAdditionalAssistanceChoices GANSSAdditionalAssistanceChoices OPTIONAL  } |
| -- GPS assistance data supported  GPSAssistance ::= BIT STRING {  almanac (0),  uTCmodel (1),  ionosphericModel (2),  navigationmodel (3),  dGPScorrections (4),  referenceLocation (5),  referenceTime (6),  acquisitionAssistance (7),  realTimeIntegrity (8),  ephemerisExtension (9),  ephemerisExtensionCheck (10),  gPSAcquisAssist-R12-Ext (11) } (SIZE (1..16)) |
| -- GANSS assistance data supported  GANSSAssistanceSet ::= SEQUENCE {  commonGANSSAssistance CommonGANSSAssistance,  specificGANSSAssistance SpecificGANSSAssistance,  ...  } |
| -- Common GANSS assistance data supported  CommonGANSSAssistance ::= BIT STRING {  referenceTime (0),  referenceLocation (1),  ionosphericModel (3),  addIonosphericModel (4),  earthOrientationParam (5) } (SIZE (1..8))  SpecificGANSSAssistance ::= SEQUENCE (SIZE(1..16)) OF GANSSAssistanceForOneGANSS |
| -- assistance data supported for a particular GANSS system  GANSSAssistanceForOneGANSS ::= SEQUENCE {  ganssID INTEGER (0..7) OPTIONAL, --Absence means Galileo  gANSSAssistance GANSSAssistance,  ...  } |

-- specific GANSS assistance data supported

GANSSAssistance ::= BIT STRING {

realTimeIntegrity (0),

differentialCorrections (1),

almanac (2),

referenceMeasurementInformation (3),

navigationModel (4),

timeModelGNSS-UTC (5),

timeModelGNSS-GNSS (6),

databitassistance (7),

ephemerisExtension (8),

ephemerisExtensionCheck (9),

addUTCmodel (10),

auxiliaryInformation (11),

gANSSRefMeasurementAssist-R12-Ext (12),

bdsDifferentialCorrections-r12 (13),

bdsGridModel-r12 (14) } (SIZE (1..16))

GANSSAdditionalAssistanceChoices ::= SEQUENCE (SIZE(1..16)) OF GANSSAdditionalAssistanceChoicesForOneGANSS

GANSSAdditionalAssistanceChoicesForOneGANSS ::= SEQUENCE {

ganssID INTEGER (0..7) OPTIONAL, --Absence means Galileo

ganssClockModelChoice GANSSModelID OPTIONAL,

gannsOrbitModelChoice GANSSModelID OPTIONAL,

ganssAlmanacModelChoice GANSSModelID OPTIONAL,

ganssAdditionalUTCModelChoice GANSSModelID OPTIONAL,

...

}

|  |
| --- |
| GANSSModelID ::= BIT STRING {  model1 (0),  model2 (1),  model3 (2),  model4 (3),  model5 (4),  model6 (5),  model7 (6),  model8 (7) } (SIZE (1..8))  -- indicates assistance data that may be needed by the MS  -- These elements are coded as defined in TS 49.031 with the exceptions defined in section A.8.2.3  AssistanceNeeded ::= SEQUENCE {  gpsAssistanceData GPSAssistanceData OPTIONAL,  ganssAssistanceData GANSSAssistanceData OPTIONAL,  ...  }  CellSets ::= SEQUENCE {  cellSet1 CellSet, -- set 1  cellSet2 CellSet OPTIONAL, -- set 2  cellSet3 CellSet OPTIONAL, -- set 3  cellSet4 CellSet OPTIONAL, -- set 4  cellSet5 CellSet OPTIONAL, -- set 5  cellSet6 CellSet OPTIONAL, -- set 6  cellSet7 CellSet OPTIONAL, -- set 7  cellSet8 CellSet OPTIONAL -- set 8  }  CellSet ::= SEQUENCE {      cell1          CellInfo, -- provides a GSM ARFCN value      cell2          CellInfo      OPTIONAL, -- provides a GSM ARFCN and BSIC value      cell3          CellInfo      OPTIONAL, -- provides a GSM ARFCN and BSIC value      cell4          CellInfo      OPTIONAL, -- provides a GSM ARFCN and BSIC value  cell5          CellInfo      OPTIONAL, -- provides a GSM ARFCN and BSIC value  cell6          CellInfo      OPTIONAL -- provides a GSM ARFCN and BSIC value  }  CellInfo ::= SEQUENCE {  bsic INTEGER (0..511),  arfcn INTEGER (0..1023) OPTIONAL  }  OTDMeasurementResults ::= SEQUENCE {  oTDMeasurementInfo1 OTDMeasurementInfo, -- Measurement 1  oTDMeasurementInfo2 OTDMeasurementInfo OPTIONAL, -- Measurement 2  oTDMeasurementInfo3 OTDMeasurementInfo OPTIONAL, -- Measurement 3  oTDMeasurementInfo4 OTDMeasurementInfo OPTIONAL, -- Measurement 4  oTDMeasurementInfo5 OTDMeasurementInfo OPTIONAL, -- Measurement 5  oTDMeasurementInfo6 OTDMeasurementInfo OPTIONAL, -- Measurement 6  oTDMeasurementInfo7 OTDMeasurementInfo OPTIONAL -- Measurement 7    }  OTDMeasurementInfo ::= SEQUENCE  {  reportedCell CellType,  msSyncAccuracy INTEGER(0..15),  observedTimeDiff INTEGER(0..999)  }    CellType ::= CHOICE  {  configuredNeighbourCellIdx INTEGER(1..48), --The cell is part of assistance info  detectedNeighbourCell CellInfo --The cell is not part of assistance info  }  RXLEVMeasurementResults ::= SEQUENCE {  rxLEVMeasurementInfo1 RXLEVMeasurementInfo, --Rxlevel Measurement 1  rxLEVMeasurementInfo2 RXLEVMeasurementInfo OPTIONAL, --Rxlevel Measurement 2  rxLEVMeasurementInfo3 RXLEVMeasurementInfo OPTIONAL, --Rxlevel Measurement 3  rxLEVMeasurementInfo4 RXLEVMeasurementInfo OPTIONAL, --Rxlevel Measurement 4  rxLEVMeasurementInfo5 RXLEVMeasurementInfo OPTIONAL, --Rxlevel Measurement 5  rxLEVMeasurementInfo6 RXLEVMeasurementInfo OPTIONAL --Rxlevel Measurement 6  } |
| RXLEVMeasurementInfo ::= SEQUENCE {  reportedCell CellType,  rxLEV INTEGER(0..63)  }  MTA-Method ::= CHOICE {  rlc-Data-Block NULL,  access-Burst NULL,  extended-Access-Burst Extended-Access-Burst,  spare NULL  }  Random-ID-Set ::= SEQUENCE {  random-ID1 INTEGER (0..65535),  random-ID2 INTEGER (0..65535),  random-ID3 INTEGER (0..65535) OPTIONAL,  random-ID4 INTEGER (0..65535) OPTIONAL,  random-ID5 INTEGER (0..65535) OPTIONAL,  random-ID6 INTEGER (0..65535) OPTIONAL,  random-ID7 INTEGER (0..65535) OPTIONAL,  random-ID8 INTEGER (0..65535) OPTIONAL,  random-ID9 INTEGER (0..65535) OPTIONAL  }  Extended-Access-Burst ::= SEQUENCE {  short-BSS-ID INTEGER (0..7)  }  Co-Sited-Cells ::= SEQUENCE {  co-sited-cell-Set-Member1 Co-Sited-Cell-Set-Member OPTIONAL,  co-sited-cell-set-Member2 Co-Sited-Cell-Set-Member OPTIONAL,  co-sited-cell-set-Member3 Co-Sited-Cell-Set-Member OPTIONAL,  co-sited-cell-set-Member4 Co-Sited-Cell-Set-Member OPTIONAL,  co-sited-cell-set-Member5 Co-Sited-Cell-Set-Member OPTIONAL,  co-sited-cell-set-Member6 Co-Sited-Cell-Set-Member OPTIONAL  }  Co-Sited-Cell-Set-Member ::= SEQUENCE {  arfcn INTEGER (0..1023),  bsic-Info BSIC-Info  }  Cell-Set ::= SEQUENCE {  cell-Set-Member1 Cell-Set-Member,  cell-set-Member2 Cell-Set-Member OPTIONAL,  cell-set-Member3 Cell-Set-Member OPTIONAL,  cell-set-Member4 Cell-Set-Member OPTIONAL,  cell-set-Member5 Cell-Set-Member OPTIONAL,  cell-set-Member6 Cell-Set-Member OPTIONAL  }  Cell-Set-Member ::= SEQUENCE {  arfcn INTEGER (0..1023),  bsic-Info BSIC-Info,  short-ID INTEGER (0..255) OPTIONAL,  ec-cell-information CHOICE {  ec-RACH-Control-Parameters EC-RACH-Control-Parameters, -- May be included for any member of  -- a Cell-Set that supports EC-GSM-IoT (see sub-clause A.9).  default-ec-RACH-Control-Parameters NULL -- Indicates a member uses the same ec-RACH-Control  -- Parameters as any other member of the Cell-Set for which this information is provided.  },  peo-cell-information CHOICE {  rach-Control-Parameters RACH-Control-Parameters, -- May be included for any member of  -- a Cell-Set that supports PEO (see sub-clause A.9).  default-rach-Control-Parameters NULL -- Indicates a member uses the same rach-Control  -- Parameters as any other member of the Cell-Set for which this information is provided.  }  }  BSIC-Info ::= SEQUENCE {  radio-Frequency-Colour-Code INTEGER (0..7),  network-Colour-Code INTEGER (0..7),  base-station-Colour-Code INTEGER (0..7)  } |
| EC-RACH-Control-Parameters ::= SEQUENCE {  ec-BS-CC-CHANS INTEGER (0..3),  ec-RXLEV-ACCESS-MIN INTEGER (0..63),  ms-TXPWR-MAX-CCH INTEGER (0..31),  lb-MS-TXPWR-MAX-CCH INTEGER (0..31) OPTIONAL,  cell-SELECTION-RLA-MARGIN INTEGER (0..7) OPTIONAL,  dl-CC-Selection BOOLEAN,  bt-Threshold-DL INTEGER (0..31),  cc2-Range-DL INTEGER (0..31) OPTIONAL,  cc3-Range-DL INTEGER (0..31) OPTIONAL,  bt-Threshold-UL INTEGER (0..31),   cc2-Range-UL INTEGER (0..31) OPTIONAL,  cc3-Range-UL INTEGER (0..31) OPTIONAL,  cc4-Range-UL INTEGER (0..31) OPTIONAL,  bsPWR INTEGER (0..63),  dl-Signal-Strength-Step-Size INTEGER (0..3) OPTIONAL,  ec-Reduced-PDCH-Allocation BOOLEAN,  ec-Max-Retrans INTEGER ,  sm INTEGER (0..3),  tm INTEGER (0..3),  access-Timeslots BOOLEAN,  alpha INTEGER (0..15) OPTIONAL,  t3168 INTEGER (0..7) OPTIONAL,  t3192 INTEGER (0..7) OPTIONAL,  t3226 INTEGER (0..7) OPTIONAL,  t3248 INTEGER (0..3),  mta-BITMAP MTA-BITMAP  } |
| RACH-Control-Parameters ::= SEQUENCE {  rxlev-ACCESS-MIN INTEGER (0..63),  ms-TXPWR-MAX-CCH INTEGER (0..31),  max-Retrans INTEGER (0..3),  tx-integer INTEGER (0..15),  mta-BITMAP MTA-BITMAP  }  MTA-BITMAP ::= SEQUENCE {  mta-RLC-Data-Block-method BOOLEAN,  mta-Access-Burst-method BOOLEAN,  mta-Extended-Access-Burst-method BOOLEAN,  mta-spare BOOLEAN  }  MTA-Security ::= CHOICE {  mta-access-security-method NULL,  bss-duplication-detection-method NULL,  spare NULL  } |

# 6 TOM Protocol Header for RRLP Transport

## 6.1 General

For the specification of the TOM protocol, see 3GPP TS 44.064.

## 6.2 Remaining Octets of TOM Protocol Header for RRLP

The number of remaining octet following the first octets of the TOM protocol header for RRLP is one. The encoding of this octet is defined in the figure 6.1 and the table 6.1.



Figure 6.1: Remaining Octets of TOM Protocol Header for RRLP

Table 6.1: C/R bit content

|  |  |
| --- | --- |
| C/R | UI frame information field |
| 0 | Command (SMLC to MS) or Final Response (MS to SMLC) |
| 1 | Not Command or Final Response |

The setting of the C/R flag is provided by the sending RRLP entity, for further details see 3GPP TS 43.059.

The Spare bits shall be ignored by the receiver and set to 0 by the sender. If a protocol header with more than one remaining octet of the TOM protocol header is received, the additional octets after the first remaining octet shall be ignored by the receiver.

Annex A (informative):  
Description of Components

## A.1 Introduction

This annex describes the contents of components.

## A.2 Measure Position Request

### A.2.1 General

The Measure Position Request is a RRLP component from the SMLC to the MS. This component is common to E-OTD,GPS and GANSS (Galileo and Additional Navigation Satellite Systems) location methods. As a response to this component, the MS performs E-OTD,GPS or GANSS measurements and possibly calculates its own position, if the MS and/or the network support these options. It contains the following elements.

Table A.1: Measure Position Request component content

|  |  |  |
| --- | --- | --- |
| Element | Type/Reference | Presence |
| Positioning Instructions | Positioning Instructions 2.2.1 | M |
| E-OTD Reference BTS for Assistance Data | E-OTD Reference BTS for Assistance Data 2.2.2 | O |
| E-OTD Measurement Assistance Data | E-OTD Measurement Assistance Data 2.2.3 | O |
| E-OTD Measurement Assistance Data for System Information List | E-OTD Measurement Assistance Data for System Information List 2.2.4 | O |
| GPS Assistance Data | GPS Assistance Data 4.2.4 | O |
| Additional GPS Assistance Data | Additional GPS Assistance Data 4.2.4c | O |
| GPS Time Assistance Measurement Request | GPS Time Assistance Measurement Request 2.2.4a | O |
| GPS Reference Time Uncertainty | GPS Reference Time Uncertainty 2.2.4b | O |
| Velocity Request | Velocity Request 2.2.4c | O |
| Extended Reference | Extended Reference 2.2.5 | O |
| GANSS Positioning Method Element | GANSS Positioning Method Element 2.2.1a | O |
| GANSS Carrier-Phase Measurement Request | GANSS Carrier-Phase Measurement Request 2.2.4d | O |
| GANSS TOD - GSM Time Association Request | GANSS TOD - GSM Time Association Request 2.2.4e | O |
| GANSS Multi-frequency Measurement Request | GANSS Multi-frequency Measurement Request 2.2.4g | O |
| GANSS Assistance Data | GANSS Assistance Data 4.2.6 | O |
| Required Response Time | Required Response Time 2.2.4f | O |

### A.2.2 Elements

#### A.2.2.1 Positioning Instructions Element

The purpose of Positioning Instructions element is to express the allowed/required location method(s), and to provide information required QoS. This element is mandatory in the Measure Position Request message, and contains the following fields:

**Method Type**

This field indicates whether MS based or assisted version is allowed/requested. If the Positioning Methods field includes more than one method, the Method Type applies to all of them. This field is mandatory, and has the following values:

'0': MS assisted;

'1': MS based;

'2': MS based is preferred, but MS assisted is allowed;

'3': MS assisted is preferred, but MS based is allowed.

In GPS positioning methods, 'MS based' may indicate either MS Based Assisted GPS method or Conventional GPS method. If 'MS based is indicated with no GPS assistance data then the MS may interpret this as either Conventional GPS or MS based A-GPS without assistance data. The same interpretation applies also to the GANSS positioning method.

**Positioning Methods**

This field indicates which location method or methods should be used. This field is mandatory.

'0': E-OTD;

'1': GPS;

'2': E-OTD or GPS (i.e. both can be reported).

NOTE: If the selected positioning method is 'GPS' or 'E-OTD or GPS', the field GANSS Positioning Method, if present in a Measure Position Request component, indicates request of GANSS method and indicates the allowed satellite systems.

**Response Time**

This field indicates the desired response time. However, when performing measurements, the desired response time may be exceeded. This field is mandatory.

The response time is 2N seconds, where N is the value in this field. Thus the desired maximum response time can be 1, 2, 4, 8, 16, 32, 64, or 128 seconds.

Range: 0-7

**Accuracy**

This field indicates the required accuracy of the location estimate. This is field is mandatory when Method Type is '1', '2', or '3' and optional when Method Type is '0'.

This field is 7 bit Uncertainty Code as defined in 3GPP TS 23.032.

**Multiple Sets**

This field indicates whether MS is requested to send multiple *E-OTD/GPS/GANSS Measurement Information Sets*. The maximum number of measurement sets is three. This is field is mandatory. MS is expected to include the current measurement set. Additionally MS may include historical measurement sets, or measure new additional sets if the response time allows that.

'0': multiple IEs can be send;

'1': sending of multiple sets is not allowed.

**Environment Characterization**

Environment Characterization field provides the MS with information about expected multipath and NLOS in the current area. This field is optional.

'0': possibly heavy multipath and NLOS conditions (e.g. bad urban or urban).

'1': no or light multipath and usually LOS conditions (e.g. suburban or rural).

'2': not defined or mixed environment.

'3': reserved for future use.

#### A.2.2.1a GANSS Positioning Method Element

This bit map indicates the satellite systems allowed by the SMLC corresponding to allowance of 'GPS' in the Positioning Methods field. Each bit is of type Boolean, where TRUE ('1') means the particular satellite system is allowed. For example EOTD + Galileo method can be indicated by setting 'E-OTD or GPS' in Positioning Methods and setting only the 'bit 1' to TRUE value in the GANSS Positioning Method element. The MS shall not request assistance data or report measurements for the systems that are not indicated in the bit map.

NOTE: Bit 0 of this bit map shall not be the only one set to TRUE ('1').

'bit 0': GPS;

'bit 1': Galileo;

'bit 2': SBAS (WAAS, EGNOS, MSAS, GAGAN);

'bit 3': Modernized GPS (L1C, L2C, L5);

'bit 4': QZSS;

'bit 5': GLONASS;

'bit 6': BDS;

'bit 7-15': Reserved for future GNSSes.

#### A.2.2.2 E-OTD Reference BTS for Assistance Data Element

The RTD and 51 multiframe offset values in the E-OTD Measurement Assistance Data element and the E-OTD Measurement Assistance Data for System Information List element are calculated relative to the BTS indicated in this element. Also the E-OTD Measurement Assistance data for System Information List element, if present, refers to the System Information Neighbor List of this reference BTS.

Inclusion of this parameter is mandatory for E-OTD since it is not possible to reliably default to the current serving BTS for the target MS, as there is a small chance that the SMLC does not know this. If the E-OTD Measurement Assistance data for System Information List element is present, the current serving cell must be the same as reference BTS identified in this element.

**BCCH Carrier**

This field indicates the absolute RF channel number of BCCH of the reference BTS. This field is mandatory.

Range: 0 - 1023

**BSIC**

This field indicates the BSIC (Base Station Identity Code) of the reference BTS. This field is mandatory.

Range: 0 - 63

**Time Slot Scheme**

The Time Slot Scheme field indicates the type of transmission scheme the reference BTS is using. If the MS measures BTSs signals from time slots other than 0 or 4, and it is informed about the burst length schemes used by BTSs, then it can compensate for the possible error. (This is necessary if the MS averages bursts from different time slots, and the BTS uses varying lengths of bursts.) This field is mandatory.

'0' = all time slots are 156,25 bits long.

'1' = time slots 0 and 4 are 157 bits long and other time slots are 156 bits long.

**BTS Position**

This field contains the BTS position in the format defined in 3GPP TS 23.032. This field is optional, but should be present for MS based E-OTD positioning. The allowed shapes are:

- ellipsoid point;

- ellipsoid point with altitude and uncertainty ellipsoid.

#### A.2.2.3 E-OTD Measurement Assistance Data Element

This element identifies BTSs that are used for E-OTD measurements. This element helps the MS to make measurements from neighbor BTS (even below decoding level). This element is optional in the Measure Position Request component. The presence of this element means that the MS should try to measure the E-OTD values between the reference BTS and the BTSs identified in this element.

This element is used to deliver E-OTD measurement assistance data for those BTSs, that are not included in the System Information Neighbor List of the reference BTS, if necessary.

The RTD and 51 multiframe offset values are calculated relative to the BTS indicated in the E-OTD Reference BTS for Assistance Data element. This elementcontains the following fields.

**Number of BTSs**

This field indicates how many BTSs are included in this IE. This field is mandatory. The maximum number of BTSs in this message for whom the assistance data can be given is 16 (reference BTS and 15 neigbour BTSs). Thus the sum of **Number of BTSs** field in this IE and total amount of **E-OTD Neighbor present** bits with value '1' in **E-OTD Measurement Assistance Data for System Information List IE** can be at a maximum 15.

Range: 1 to 15.

The following fields are repeated for the number of BTSs included in the Number of BTSs field.

**BCCH Carrier**

This field indicates the absolute RF channel number of BCCH of the particular BTS. This field is mandatory.

Range: 0 - 1023

**BSIC**

This field indicates the BSIC (Base Station Identity Code) of the particular BTS. This field is mandatory.

Range: 0 - 63

**Multiframe Offset**

This field indicates the frame difference between the start of the 51 multiframes frames being transmitted from this BTS and the reference BTS. The multiframe offset is defined as TBTS - TRef, where TBTS is the time of the start of the 51 multiframe in the BTS in question, and TRef is the time of the start of the 51 multiframe in the reference BTS. This field is mandatory. Multiframe Offset may be used to calculate the Expected Multiframe Offset (the Multiframe Offset value that MS is expected to measure between this BTS and reference BTS in its current estimated location).

Expected Multiframe Offset = (Multiframe Offset + Adjustment) modulo 51

Adjustment = 1 if Rough RTD - Expected OTD >= 850

Adjustment = -1 if Rough RTD - Expected OTD =< -850

Adjustment = 0 if -400 =< Rough RTD - Expected OTD =< 400

If the Rough RTD - Expected OTD is not within any of the ranges above, an error has occurred and the Expected OTD should be ignored and no Expected Multiframe Offset can be calculated.

Range: 0 - 51

Usable range of Multiframe Offset value is 0 - 50. The Multiframe Offset value 51 shall not be encoded by the transmitting entity and shall be treated by the receiving entity as 0.

**Time Slot Scheme**

The Time Slot Scheme field indicates the type of transmission scheme the particular BTS is using. If the MS measures BTSs signals from time slots other than 0 or 4, and it is informed about the burst length schemes used by BTSs, then it can compensate for the possible error. (This is necessary if the MS averages bursts from different time slots, and the BTS uses varying lengths of bursts.) This field is mandatory.

'0' = all time slots are 156,25 bits long.

'1' = time slots 0 and 4 are 157 bits long and other time slots are 156 bits long.

**Rough RTD**

This field indicates the rough RTD value between this BTS and reference BTS. The used resolution is 1 bits. This RTD value is the RTD value of TS0s (i.e. the difference in starting of TS0), not only the RTD between starts of bursts. The RTD is defined as TBTS - TRef, where TBTS is the time of the start of TS0 in the BTS in question, and TRef is the time of the start of the TS0 in the reference BTS. This field is mandatory.

Range: 0 - 1250

Usable range of Rough RTD value is 0 - 1249. The Rough RTD value 1250 shall not be encoded by the transmitting entity and shall be treated by the receiving entity as 0.

Accurate RTD values are needed for MS based E-OTD, i.e. when the MS calculates its own position.

**Expected OTD**

This field indicates the OTD value that MS is expected to measure between this BTS and reference BTS in its current estimated location. SMLC can estimate MS's location roughly e.g. based on serving BTS coordinates, TA, and possibly some other information. The used resolution is 1 bits. This OTD value is the OTD value of TS0s (i.e. the difference in starting of TS0), not only the OTD between starts of bursts. The OTD is defined as TBTS - TRef, where TBTS is the time of the start of TS0 in the BTS in question, and TRef is the time of the start of the TS0 in the reference BTS. This is element is Release 98 extension and it is an optional element included in Release98-Ext IE. SMLC shall send this element to MS supporting MS Assisted or MS Based E-OTD.

Range: 0 - 1250

Usable range of Expected OTD value is 0 - 1249. The Expected OTD value 1250 shall not be encoded by the transmitting entity and shall be treated by the receiving entity as 0.

**Uncertainty Of Expected OTD**

This field indicates the uncertainty in Expected OTD value. The uncertainty is related to SMLC's estimation of MS's location. The uncertainty defines following search window for MS, that it can use to speed up the OTD measurements:

Expected OTD - Uncertainty < measured OTD < Expected OTD + Uncertainty.

This is element is Release 98 extension and it is an optional element included in Release98-Ext IE. SMLC shall send this element to MS supporting MS Assisted or MS Based E-OTD.

Range is 0 - 7 with following encoding:

'0' 0 < uncertainty <= 2 bit;

'1' 2 < uncertainty <= 4 bit;

'2' 4 < uncertainty <= 8 bit;

'3' 8 < uncertainty <= 12 bit;

'4' 12 < uncertainty <= 16 bit;

'5' 16 < uncertainty <= 22 bit;

'6' 22 < uncertainty <= 30 bit;

'7' uncertainty > 30 bit.

NOTE: If uncertainty in MS's location is x bits, uncertainty in Expected OTD is 2\*x (in the worst case). When the uncertainty is given with value '7' no upper bound exist for the uncertainty.

The following fields tell the coordinates of neighbor BTSs that are used for E-OTD measurements, and also fine RTD values. This information allows the MS to calculate its own location. These fields (Fine RTD, Relative north, Relative east and Relative altitude) are optional. All of Fine RTD, Relative north, and Relative east fields must be present, if some of them is included.

**Fine RTD**

This field indicates the fine RTD value between this BTS and reference BTS. It provides the 1/256 bit duration resolution to the value expressed in the corresponding Rough RTD field. This RTD value is the RTD value of TS0s (i.e. the difference in starting of TS0), not only the RTD between starts of bursts. The RTD is defined as TBTS - TRef, where TBTS is the time of the start of TS0 in the BTS in question, and TRef is the time of the start of the TS0 in the reference BTS. This field is optional.

Range: 0 - 255

**Relative North**

This field indicates the distance of the neighbor BTS from the reference BTS in north- (negative values mean south) direction. This field is optional. The units are 0,03 seconds. The used reference ellipsoid is WGS 84 ellipsoid.

Range: -200000…200000

**Relative East**

This field indicates the distance of the neighbor BTS from the reference BTS in east (negative values mean west) direction. This field is optional. The units are 0,03 seconds. The used reference ellipsoid is WGS 84 ellipsoid.

Range: -200000 … 200000

**Relative Altitude**

This field indicates the altitude of the neighbor BTS relative to the reference BTS in meters. This field is optional.

Range: -4000 .. 4000 meters

#### A.2.2.4 E-OTD Measurement Assistance Data for System Information List Element

This element identifies those BTSs in the System Information Neighbor List that are used for E-OTD measurements. The System Information Neighbor Lists, to which this assistance data is given, are System Information Neighbor Lists that are sent in the dedicated mode, packet idle mode, packet transfer mode, or dual transfer mode. This element helps the MS to make measurements from those neighbor BTS (even below decoding level). This element is optional in the Measure Position Request component. The presence of this element means that the MS should use the BTSs identified here to the E-OTD measurements.

The RTD and 51 multiframe offset values are calculated relative to the reference BTS. This element contains the following fields.

**Number of Neighbors**

This field indicates how many neighbors are included in this IE.

Range: 1-32

The following fields are repeated for the number indicated in the Number of Neighbors field.

**E-OTD Neighbor present**

This field indicates whether the information concerning a certain BTS in the Neighbor List is present. Altogether no more than 15 BTS can have the indication "Neighbor is included". The maximum number of BTSs in this message for whom the assistance data can be given is 16 (reference BTS and 15 neigbour BTSs). Thus the sum of total amount of **E-OTD Neighbor present** bits with value '1' in this IE and **Number of BTSs** field in **E-OTD Measurement Assistance Data IE** can be at a maximum 15.

'0' Neighbor not included;

'1' Neighbor is included.

The following fields (BSIC, Multiframe Offset, Time Slot Sscheme and Rough RTD) are included if E-OTD neighbor present field is set to '1'.

**BSIC**

This field indicates the BSIC (Base Station Identity Code) of the particular BTS. This field is mandatory.

Range: 0 - 63

**Multiframe Offset**

This field indicates the frame difference between the start of the 51 multiframes frames being transmitted from this BTS and the reference BTS. The multiframe offset is defined as TBTS - TRef, where TBTS is the time of the start of the 51 multiframe in the BTS in question, and TRef is the time of the start of the 51 multiframe in the reference BTS. This field is mandatory. Multiframe Offset may be used to calculate the Expected Multiframe Offset (the Multiframe Offset value that MS is expected to measure between this BTS and reference BTS in its current estimated location).

Expected Multiframe Offset = (Multiframe Offset + Adjustment) modulo 51

Adjustment = 1 if Rough RTD - Expected OTD >= 850

Adjustment = -1 if Rough RTD - Expected OTD =< -850

Adjustment = 0 if -400 =< Rough RTD - Expected OTD =< 400

Range: 0 - 51

Usable range of Multiframe Offset value is 0 - 50. The Multiframe Offset value 51 shall not be encoded by the transmitting entity and shall be treated by the receiving entity as 0.

**Time Slot Scheme**

The Time Slot Scheme field indicates the type of transmission scheme the particular BTS is using. If the MS measures BTSs signals from time slots other than 0 or 4, and it is informed about the burst length schemes used by BTSs, then it can compensate for the possible error. (This is necessary if the MS averages bursts from different time slots, and the BTS uses varying lengths of bursts.) This field is mandatory.

'0' = all time slots are 156,25 bits long;

'1' = time slots 0 and 4 are 157 bits long and other time slots are 156 bits long.

**Rough RTD**

This field indicates the RTD value between this BTS and the reference BTS. The used resolution is 1 bit. This RTD value is the RTD value of TS0s (i.e. the difference in starting of TS0), not only the RTD between starts of bursts. The RTD is defined as TBTS - TRef, where TBTS is the time of the start of TS0 in the BTS in question, and TRef is the time of the start of the TS0 in the reference BTS. This field is mandatory.

Range: 0 - 1250

Usable range of Rough RTD value is 0 - 1249. The RoughRTD value 1250 shall not be encoded by the transmitting entity and shall be treated by the receiving entity as 0.

**Expected OTD**

This field indicates the OTD value that MS is expected to measure between this BTS and reference BTS in its current estimated location. SMLC can estimate MS's location roughly e.g. based on serving BTS coordinates, TA, and possibly some other information. The used resolution is 1 bits. This OTD value is the OTD value of TS0s (i.e. the difference in starting of TS0), not only the OTD between starts of bursts. The OTD is defined as TBTS - TRef, where TBTS is the time of the start of TS0 in the BTS in question, and TRef is the time of the start of the TS0 in the reference BTS. This element is Release 98 extension and it is an optional element included in Release98-Ext IE. SMLC shall send this element to MS supporting MS Assisted or MS Based E-OTD.

Range: 0 - 1250

Usable range of Expected OTD value is 0 - 1249. The Expected OTD value 1250 shall not be encoded by the transmitting entity and shall be treated by the receiving entity as 0.

**Uncertainty Of Expected OTD**

This field indicates the uncertainty in Expected OTD value. The uncertainty is related to SMLC's estimation of MS's location. The uncertainty defines following search window for MS, that it can use to speed up the OTD measurements:

Expected OTD - Uncertainty < measured OTD < Expected OTD + Uncertainty.

This element is Release 98 extension and it is an optional element included in Release98-Ext IE. SMLC shall send this element to MS supporting MS Assisted or MS Based E-OTD.

Range is 0 - 7 with following encoding:

'0' 0 < uncertainty <= 2 bit;

'1' 2 < uncertainty <= 4 bit;

'2' 4 < uncertainty <= 8 bit;

'3' 8 < uncertainty <= 12 bit;

'4' 12 < uncertainty <= 16 bit;

'5' 16 < uncertainty <= 22 bit;

'6' 22 < uncertainty <= 30 bit;

'7' uncertainty > 30 bit.

NOTE: If uncertainty in MS's location is x bits, uncertainty in Expected OTD is 2\*x (in the worst case). When the uncertainty is given with value '7' no upper bound exist for the uncertainty.

The following fields tell the coordinates of neighbor BTSs that are used for E-OTD measurements, and also fine RTD values. This information allows the MS to calculate its own location. These fields (Fine RTD, Relative north, Relative east and Relative altitude) are optional. All of Fine RTD, Relative north, and Relative east fields must be present, if some of them is included.

**Fine RTD**

This field indicates the fine RTD value between this BTS and reference BTS. It provides the 1/256 bit duration resolution to the value expressed in the corresponding Rough RTD field. This RTD value is the RTD value of TS0s (i.e. the difference in starting of TS0), not only the RTD between starts of bursts. The RTD is defined as TBTS - TRef, where TBTS is the time of the start of TS0 in the BTS in question, and TRef is the time of the start of the TS0 in the reference BTS. This field is optional.

Range: 0 - 255

**Relative North**

This field indicates the distance of the neighbor BTS from the reference BTS in north- (negative values mean south) direction. This field is optional. The units are 0,03 seconds. The used reference ellipsoid is WGS 84 ellipsoid.

Range: -200000…200000

**Relative East**

This field indicates the distance of the neighbor BTS from the reference BTS in east (negative values mean west) direction. This field is optional. The units are 0,03 seconds. The used reference ellipsoid is WGS 84 ellipsoid.

Range: -200000 … 200000

**Relative Altitude**

This field indicates the altitude of the neighbor BTS relative to the reference BTS in meters. This field is optional.

Range: -4000 .. 4000 meters

#### A.2.2.4a GPS Time Assistance Measurement Request element

This component does not have any information contents. If this component is present, the MS is requested to return GPS time assistance measurements.

#### A.2.2.4b GPS Reference Time Uncertainty element

This element provides the accuracy of the relation GPS and GSM time in the Reference Time field in GPS Assistance Data IE. If GPS TOW is the given GPS time, then the true GPS time, corresponding to the provided GSM time as observed at the MS location, lies in the interval (GPS TOW - GPS Reference Time Uncertainty, GPS TOW + GPS Reference Time Uncertainty). An entity that supports this element shall always include it when appropriate. This means that when the element is expected but is not received, lack of support at the sender can be assumed and some implementation dependent default interpretation can then be applied.

The uncertainty *r*, expressed in microseconds, is mapped to a number K, with the following formula:

*r* = C\*(((1+x)K)-1)

with C = 0,0022 and x = 0,18. With 0 £ K £ 127, a suitably useful range between 0 and 3 second is achieved for the uncertainty, while still being able to code down to values as small as 0,3 nanoseconds. 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.

Table A.1a: Example values for the GPS Reference Time Uncertainty Parameter Format

|  |  |
| --- | --- |
| **Value of K** | **Value of uncertainty** |
| 0 | 0 nanoseconds |
| 1 | 0,396 nanoseconds |
| 2 | 0,863 nanoseconds |
| - | - |
| 50 | 8,64 microseconds |
| - | - |
| 127 | ≥ 2,96 seconds |

#### A.2.2.4c Velocity Request element

If this element is present, the MS is requested to return a velocity estimate along with the location estimate. Requesting velocity does not guarantee its delivery, if conditions support its availability and it is requested it will be provided.

#### A.2.2.4d GANSS Carrier-Phase Measurement Request Element

This component does not have any information contents. If this component is present, the MS is requested to return carrier phase measurements in the GANSS Measurement Information IE.

#### A.2.2.4e GANSS TOD - GSM Time Association Request Element

This component does not have any information contents. If this component is present, the MS is requested to return GANSS TOD - GSM time association measurements. Only either GPS Timing Assistance Measurement Request Element or GANSS TOD - GSM Time Association Measurement Request should be present in Measure Position Request.

#### A.2.2.4f Required Response Time

This element indicates the maximum response time that shall be allowed for the positioning request in the MS. When this element is received, the MS shall send an RRLP Measure Position Response before the required response time has elapsed.

When this element is received, the MS shall ignore the Response Time field in the Positioning Instructions element.

The Required Response Time has a value from 1 to 128 seconds.

#### A.2.2.4g GANSS Multi-frequency Measurement Request Element

This component does not have any information contents.

If this component is present, the MS is requested to return measurements performed on multiple GANSS signal types if the MS supports this capability. If this component is not present, the MS shall report only one signal type for each GANSS.

If SMLC has indicated supported signal types in Positioning Capability Request, the MS shall only report signals that are supported by SMLC.

#### A.2.2.5 Extended Reference IE

This element is mandatory in any RRLP Measure Position Request component, any RRLP Assistance Data component, any RRLP Positioning Capability Request component and any RRLP Positioning Capability response component.

NOTE: For reasons of backward compatibility, the IE is not defined for a Release 4 or earlier SMLC and would be ignored, when received, by a Release 4 or earlier MS. Additionally, other requirements associated with this IE would not be supported by a Release 4 or earlier MS or SMLC.

The Extended Reference IE contains the following elements:

SMLC code: an integer in the range 0-63 distinguishing any SMLC from other neighbour SMLCs in the same Routing Area. Each SMLC is assigned a specific SMLC ID value. The values assigned to neighbour SMLCs in the same Routing Area between which inter-NSE cell change is possible should be different.

Transaction ID: an integer in the range 0-262143 distinguishing different RRLP transactions in different MSs currently being served by the same SMLC. An SMLC shall assign a different transaction ID to each currently open RRLP transaction for positioning and assistance data delivery among all target MSs. When any RRLP transaction for any MS is completed in the SMLC (e.g. the MS has sent a correctly formatted RRLP Measure Position Response or Assistance Data Ack.) or if the transaction is aborted (e.g. SMLC timeout on an RRLP response), the associated transaction ID value shall become free and may be later assigned to a new RRLP transaction by the SMLC. When any transaction ID value becomes free, an SMLC should attempt to wait for at least 128 seconds (the maximum defined RRLP response time from an MS) before reassigning the same value.

## A.3 Measure Position Response

### A.3.1 General

The Measure Position Response is a RRLP component from the MS to the network. It is the response to the Measure Position Request. It contains the following elements. One of the five elements containing measurement data or location estimate (*E-OTD Measurement Information*, *Location Information*, *GPS Measurement Information, GANSS Measurement Information or GANSS Location Information)* or *Location Information Error element* must be included.

Table A.2: Measure Position Response component content

|  |  |  |
| --- | --- | --- |
| Element | Type/Reference | Presence |
| Multiple Sets | Multiple Sets 3.2.1 | O |
| Reference BTS Identity | Reference BTS Identity 3.2.2 | O |
| E-OTD Measurement Information | E-OTD Measurement Information 3.2.3 | O |
| Location Information | Location Information 3.2.4 | O |
| GPS Measurement Information | GPS Measurement Information 3.2.5 | O |
| Location Information Error | Location Information Error 3.2.6 | C |
| GPS Time Assistance Measurements | GPS Time Assistance Measurements 3.2.6a | O |
| Velocity Estimate | Velocity Estimate 3.2.6b | O |
| Extended Reference | Extended Reference 3.2.7 | C |
| Uplink RRLP Pseudo Segmentation Indication | Uplink RRLP Pseudo Segmentation Indication 3.2.8 | C |
| GANSS Location Information | GANSS Location Information 3.2.9 | O |
| GANSS Measurement Information | GANSS Measurement Information 3.2.10 | O |

### A.3.2 Elements

#### A.3.2.1 Multiple Sets Element

This element indicates how many E-OTD Measurement Informationsets, GPS Measurement Information sets or GANSS Measurement Information sets, and Reference BTS Identities are included to this element. This element is optional. If this element is absent, a single measurement set is included.

**Number of E-OTD/GPS/GANSS Measurement Information Sets**

This field indicates the number of *Number of E-OTD/GPS/GANSS Measurement Information* sets included to this component. This field is mandatory. If two or more types of measurement elements are present, then there are the equal number of them, and each pair has the same reference BTS.

Range: 2 - 3

**Number of Reference BTS**

This field indicates the number of reference BTSs used in this component. This field is mandatory.

Range: 1-3

**Reference BTS relation to Measurement Elements**

This field indicates how the reference BTSs listed in this element relate to measurement sets later in this component. This field is conditional and included only if Number of E-OTD/GPS/GANSS Measurement Information Sets is '3' and Number of Reference BTSs is '2'.

'0' = First reference BTS is related to first and second E-OTD/GPS/GANSS Measurement Information Sets, and second reference BTS is related to third E-OTD/GPS Measurement Information Sets.

'1' = First reference BTS is related to first and third E-OTD/GPS/GANSS Measurement Information Sets, and second reference BTS is related to second E-OTD/GPS/GANSS Measurement Information Sets.

'2' = First reference BTS is related to first E-OTD/GPS/GANSS Measurement Information Sets, and second reference BTS is related to second and third E-OTD/GPS/GANSS Measurement Information Sets.

If this field is not included, the relation between reference BTS and Number of E-OTD/GPS/GANSS Measurement Information Sets is as follows:

- if there are three sets and three reference BTSs -> First reference BTS relates to first set, second reference BTS relates to second set, and third reference BTS relates to third set;

- if there are two sets and two reference BTS -> First reference BTS relates to first set, and second reference BTS relates to second set;

- if there is only one reference BTS and 1-3 sets -> this reference BTS relates to all sets.

#### A.3.2.2 Reference BTS Identity Element

This element identifies the reference BTS(s). This element is conditional to the number of reference BTSs. It is mandatory, if there is more than one reference BTS, and optional otherwise. If this element is not included, the Reference BTS, used in other elements, is the current serving BTS of MS. If this element is included, the BTSs defined here are used as Reference BTSs in all other elements.

*The following fields are repeated for the number of reference BTSs included in the Number of Reference BTS field.*

**CellIdType**

This field indicates is the identity method of the Reference BTS. This field is mandatory within this element.

'0' = Cell identity is told using BSIC and BCCH carrier.

'1' = Cell identity is told using CI, and the LAC is the same as the current serving BTS.

'2' = Cell identity is told using an index referring to the BTS listed in the Measure Position Request component (the indicated reference BTS is 1)

'3' = Cell identity is told using an index referring to the BTS listed in the BCCH allocation list (System Information Neighbor Lists) of the serving BTS. This type of reference identity shall not be used by the MS unless it has received the "E-OTD Measurement Assistance Data for System Information List Element" from the SMLC for this cell.

'4' = Cell identity is told using CI, and the LAC.

**Reference LAC**

This field indicates the Location Area Code of the reference BTS. The purpose of the Location Area Code is to identify a location area. This field is conditional, and included, if CellIDType field is '4'.

Range: 0 - 65535

**Reference CI**

This field indicates the Cell Identity value of the reference BTS. The purpose of the Cell Identity value is to identify a cell within a location area. This field is conditional, and included, if CellIDType field is '1' or '4'.

Range: 0 - 65535

**Reference BCCH Carrier**

This field indicates the absolute RF channel number of the BCCH of the reference base station. BCCH carrier field is conditional and is included only if CellIdType is set '0'.

Range: 0 - 1023

**Reference BSIC**

This field indicates the BSIC (Base Station Identity Code of the base station).

BSIC field is conditional and is included only if CellIdType is set '0' or '3'.

Range: 0 - 63

**Request Index**

This field indicates an index identifying the reference BTS by referring to the BTSs listed in the Measure Position Request component (the indicated reference BTS in the Measure Position Request component has the index value 1, and possible next BTS '2', and so on )

This field is conditional and included only if CellIdType is set to '2'.

Range: 1-16

**System Info Index**

This field indicates an index identifying the reference BTS by referring to the BCCH allocation list (System Information Neighbor List) of the serving BTS .

This field is conditional and included only if CellIdType is set to '3'.

Range: 1-32

#### A.3.2.3 E-OTD Measurement Information Element

The purpose of the E-OTD Measurement Information element is to provide OTD measurements of signals sent from the reference and neighbor based stations. The length of this element depends on the number of neighbor cells for which OTD measurements have been collected. This element is optional in the Measure Position Response component. It is included in the Measure Position Response component, if the network has requested the mobile to perform the MS assisted E-OTD method. BTSs which cannot be measured or whose measurements are excessively inaccurate need not be reported. The MS may include measurements for other BTSs not given in the assistance data by the SMLC.

The E-OTD and 51 multiframe offset values are reported relative to the reference BTS as defined in the previous sub-clauses.

The following fields are repeated for each measurement set.

**Reference Frame Number**

This field indicates the frame number of the last measured burst from the reference BTS modulo 42432. This information can be used as a time stamp for the measurements. This field is mandatory.

Range: 0 - 42431

**Reference Time Slot**

Reference Time Slot indicates the time slot modulo 4 relative to which the MS reports the reference BTS measurements. This field is mandatory.

Range: 0 to 3

NOTE 1: If MS does not know timeslot scheme, the MS reports the used timeslot. MS can only report results based on one time slot (N) or two time slots (N and N+4). If the MS knows the timeslot scheme, it can make measurements from several timeslots and reports that the used timeslot is zero (and makes correction).

**Reference Quality**

Reference Quality field includes the standard deviation of the TOA measurements from the reference BTS with respect to TRef(where TRef is the time of arrival of signal from the reference BTS used to calculate the OTD values). This field is optional. The Reference Quality field can be used to evaluate the reliability of E-OTD measurements in the SMLC and in weighting of the E-OTD values in the location calculation.

Following linear 5 bit encoding is used:

'00000' 0 - (R\*1-1) meters;

'00001' R\*1 - (R\*2-1) meters;

'00010' R\*2 - (R\*3-1) meters;

…

'11111' R\*31 meters or more.

where R is the resolution defined by Std Resolution field. For example, if R=20 meters, corresponding values are 0 - 19 meters, 20 - 39 meters, 40 - 59 meters, …, 620+ meters.

**Number of Measurements**

Number of Measurements for the Reference Quality field is used together with Reference Quality to define quality of the reference base site TOA. The field indicates how many measurements have been used in the MS to define the standard deviation of the measurements. Following 3 bit encoding is used:

'000': 2-4;

'001': 5-9;

'010': 10-14;

'011': 15-24;

'100': 25-34;

'101': 35-44;

'110': 45-54;

'111': 55 or more.

This field is optional.

**Std Resolution**

Std Resolution field includes the resolution used in Reference Quality field and Std of EOTD Measurements field.Encoding on 2 bits as follows:

'00' 10 meters;

'01' 20 meters;

'10' 30 meters;

'11' Reserved.

This field is mandatory.

**TA** **Correction**

This field indicates the estimate of the time difference between the moment that the MS uses to adjust itsinternal timing for reception and transmission (e.g. corresponding to maximum energy) and the estimate of the reception of the first arriving component from the serving BTS. This value can be used as a correction by the SMLC to the Timing Advance (TA) value when the distance between the MS and the serving BTS is estimated based on TA.

The value *TACor* in this field corresponds to the TA Correction in bit periods as follows:

- TA Correction in bit periods = *TACor*/64 -8.

TA Correction has the resolution of 1/64 bit period, and the range - 8 … +7 bit periods. Negative TA Correction in bits indicates that the first signal component from the serving BTS is estimated to arrive before the moment used for communication. This field is optional.

Range: 0-960

**Number of Measured Neighbors**

This field indicates the number of different neighbor BTSs. This field is mandatory.

Range: 0 - 10

NOTE 2: If the MS can not measure any neighbor BTSs, then this value is set to '0'.

*The following fields are repeated for the number of BTSs included in the Number of Measured Neighbors field.*

**Neighbor Identity Present**

The presence of this field is conditional, it shall not be present in the first set. It is mandatory for the other sets. This field indicates whether the identity information (i.e. CellIDType and possibly Neighbor CI / Neighbor BCCH Carrier / Neighbor BSIC / Neighbor Multiframe Offset / Request Index /System Info Index fields) concerning a certain BTS is present or whether the BTS identity is given as reference to the first measurement set.

'0' Identity information not included, and identity of this BTS is same as the identity of BTS in first set with same sequence number.

'1' Identity information is included.

**CellIdType**

This field indicates is the identity method of the cell. This field is conditional, and included if Neighbor Identity Present is '1'**.** If CellIdType field is not present, the following fields can not be present either: Neighbor CI, Neighbor BCCH Carrier, Neighbor BSIC, Neighbor Multiframe Offset, Request Index,System Info Index.

'0' = Cell identity is told using BSIC and BCCH carrier.

'1' = Cell identity is told using CI, and the LAC is the same as the current serving BTS.

'2' = Cell identity is told using 51 Multiframe offset and BCCH carrier.

'3' = Cell identity is told using an index referring to the BTS listed in the Measure Position Request component (the indicated reference BTS is 1).

'4' = Cell identity is told using an index referring to the BTS listed in the BCCH allocation list (System Information Neighbor Lists) of the serving BTS. This type of neighbor identity shall not be used by the MS unless it has received the "E-OTD Measurement Assistance Data for System Information List Element" from the SMLC for this cell.

'5' = Cell identity is told using CI and the LAC.

NOTE: The MS can decide which of these methods to use. The CellIdType '3' and '4' are preferred.

**Neighbor LAC**

This field indicates the Location Area Code of the neighbor BTS. The purpose of the Location Area Code is to identify a location area. This field is conditional, and included, if CellIDType field is '5'.

Range: 0 - 65535

**Neighbor CI**

This field indicates the Cell Identity of the particular neighbor cell. The purpose of the Cell Identity value is to identify a cell within a location area.

Neighbor CI field is conditional and is included only if CellIdType is set '1' or '5' and the CI value of the given cell is available.

Range: 0 - 65535

**Neighbor BCCH Carrier**

This field indicates the absolute RF channel number of the BCCH of the neighbor base station. BCCH carrier field is conditional and is included only if CellIdType is set '0' or '2'.

Range: 0 - 1023

**Neighbor BSIC**

This field indicates the BSIC (Base Station Identity Code of the base station).

BSIC field is conditional and is included only if CellIdType is set '0' or '4'.

Range: 0 - 63

**Neighbor Multiframe Offset**

This field indicates the frame difference between the start of the 51 multiframes frames arriving from this BTS and the reference BTS. The multiframe offset is defined as TBTS - TRef, where TBTS is the time of the start of the 51 multiframe in the BTS in question, and TRef is the time of the start of the 51 multiframe in the reference BTS. This field is conditional and included only if CellIdType is set to '2'.

Range: 0 - 51

**Request Index**

This field indicates an index identifying the reference BTS by referring to the BTSs listed in the Measure Position Request component (the indicated reference BTS in the Measure Position Request component has the index value 1, and possible next BTS '2', and so on).

This field is conditional and included only if CellIdType is set to '3'.

Range: 1-16

**System Info Index**

This field indicates an index identifying the reference BTS by referring to the BCCH allocation list (System Information Neighbor List) of the serving BTS.

This field is conditional and included only if CellIdType is set to '4'.

Range: 1-32

**Neighbor Time Slot**

Neighbor Time Slot indicates the time slot modulo 4 relative to which the MS reports the neighbor BTS measurements. This field is mandatory.

Range: 0 to 3

NOTE 3: If the MS does not know the timeslot scheme, the MS reports the used timeslot. MS can only report a result based on one time slot (N) or two time slots (N and N+4).If the MS knows the timeslot scheme, the MS can make measurements from several timeslots and reports that the used timeslot is zero (and makes correction).

**Number of EOTD Measurements**

Number of Measurements field is used together with Std of EOTD Measurements field to define quality of a reported EOTD measurement. The field indicates how many EOTD measurements have been used in the MS to define the standard deviation of these measurements. Following 3 bit encoding is used.

'000': 2-4;

'001': 5-9;

'010': 10-14;

'011': 15-24;

'100': 25-34;

'101': 35-44;

'110': 45-54;

'111': 55 or more.

This field is mandatory.

**Std of EOTD Measurements**

Std of EOTD Measurements field includes standard deviation ofEOTD measurements. This field is mandatory. It can be used to evaluate the reliability of EOTD measurements in the SMLC and in weighting of the OTD values in location calculation.

Following linear 5 bit encoding is used:

'00000' 0 - (R\*1-1) meters;

'00001' R\*1 - (R\*2-1) meters;

'00010' R\*2 - (R\*3-1) meters;

…

'11111' R\*31 meters or more.

where R is the resolution defined by Std Resolution field. For example, if R=20 meters, corresponding values are 0 - 19 meters, 20 - 39 meters, 40 - 59 meters, …, 620+ meters.

**OTD**

This field indicates the measured OTD value between the receptions of signals from the reference and the neighbor BTS. The OTD is defined as TNbor - TRef (modulo burst length) where TNbor is the time of arrival of signal from the neighbor BTS, and TRef is the time of arrival of signal from the reference BTS. The reporting resolution of the OTD value is 1/256 bit. This field is mandatory.

Range: 0 - 39999

#### A.3.2.3a E-OTD Measurement Extended Information Element

The purpose of the E-OTD Measurement Ext Information element is to provide OTD measurements of signals sent from the reference and neighbour base stations. The length of this element depends on the number of neighbour cells for which OTD measurements have been collected. This element is optional in the Measure Position Response component. It is included in the Measure Position Response component, if E-OTD measurements didn't fit in the E-OTD Measurement Information Element.

The E-OTD and 51 multiframe offset values are reported relative to the reference BTS as defined in the previous sub-clauses.

The following fields are valid only for the first set of measurements

**Number of Measured Neighbors**

This field indicates the number of different neighbor BTSs. This field is mandatory.

Range: 0 - 5

NOTE: If the MS can not measure any neighbor BTSs, then this value is set to '0'.

*The following fields are repeated for the number of BTSs included in the Number of Measured Neighbors field. They are defined in the previous sub-clause :*

- CellIdType,

- Neighbor LAC,

- Neighbor CI,

- Neighbor BCCH Carrier,

- Neighbor BSIC,

- Neighbor Multiframe Offset,

- Request Index,

- System Info Index,

- Neighbor Time Slot,

- Number of EOTD Measurements,

- Std of EOTD Measurements,

- OTD

#### A.3.2.4 Location Information Element

The purpose of Location Information element is to provide the location estimate from the MS to the network, if the MS is capable of determining its own position. Optionally, the element may contain the velocity parameters computed by the MS.

This element is optional. This element contains the following fields.

**Reference Frame**

This field specifies the reference BTS Reference Frame number during which the location estimate was measured. The time of the Reference Frame boundary is as observed by the MS, ie without Timing Advance compensation. This field is mandatory. However, if the Reference Frame number is within (42432..65535), the value of this field shall be ignored and in that case the MS should provide GPS TOW if available.

Table A.3: Reference Frame field contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Units |
| Reference Frame | 16 | --- | 0 - 65535 | frames |

Note that expected values for Reference Frame are in range 0 - 42431.

**GPS TOW**

This field specifies the GPS TOW for which the location estimate is valid , rounded down to the nearest millisecond unit. This field is optional but shall be included if GPS Time Assistance Measurements are included. If GPS Time Assistance Measurements are included in the RRLP Measure Position Response, the MS shall align GPS System time (as defined by the GPS TOW and the GPS TOW Subms fields) with the reported GSM frame boundary observed by the MS at that time.

Table A.4: GPS TOW field contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Units |
| GPS TOW | 24 | 1 ms | 0 - 14399999 | ms |

The 24 bits of GPS TOW are the least significant bits. The most significant bits shall be derived by the Serving Mobile Location Center to unambiguously derive the GPS TOW.

**Fix Type**

This field contains an indication as to the type of measurements performed by the MS: 2D or 3D. This field is mandatory.

'0' = 2D fix.

'1' = 3D fix.

**Position Estimate**

This field contains the calculated position estimate in the format defined in 3GPP TS 23.032. The allowed shapes are:

- ellipsoid Point;

- ellipsoid point with uncertainty circle;

- ellipsoid point with uncertainty ellipse;

- ellipsoid point with altitude and uncertainty ellipsoid.

#### A.3.2.5 GPS Measurement Information Element

The purpose of the GPSMeasurement Information element is to provide GPS measurement information from the MS to the SMLC. This information includes the measurements of code phase and Doppler, which enables the network-based GPS method where position is computed in the SMLC. The proposed contents are shown in table A.5, and the individual fields are described subsequently. See also Figure A.1 for an illustration of the relation between some of the fields.



Figure A.1. Exemplary definitions of GPS measurement information fields.

This element is included in the Measure Position Response component if the network has requested the mobile to perform mobile-assisted location measurements using a GPS location method.

Following fields are repeated a number of times told in Number of E-OTD/GPS Measurement *Sets* field if Multiple Sets element is included. If Multiple Sets element is not included, the default value for sets is one (i.e. the following fields are present only once).

Table A.5: GPS Measurement Information element content

|  |  |  |
| --- | --- | --- |
| Element fields | Presence | Occurrences |
| Reference Frame | O | 1 |
| GPS TOW | M | 1 |
| # of Satellites (*N\_SAT*) | M | 1 |
| Measurement Parameters | M | *N\_SAT* |

The following paragraphs describe the content of each information field of this element.

**Reference Frame**

This field is optional.

Table A.6: Reference Frame field contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Units |
| Reference Frame | 16 | --- | 0 - 65535 | frames |

Note that expected values for Reference Frame are in range 0 - 42431. If Reference Frame and GPS Time Assistance Measurements both are included in the RRLP Measure Position Response, the code phase measurements shall be aligned with the reported GSM frame boundary observed by the MS at that time, as indicated in Figure A.1. The time of the Reference Frame boundary is as observed by the MS, ie without Timing Advance compensation.

**GPS TOW**

This field specifies the GPS TOW for which the location estimate is valid, rounded down to the nearest millisecond unit.This field is mandatory.

Table A.7: GPS TOW field contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Units |
| GPS TOW | 24 | 1 ms | 0 - 14399999 | ms |

The 24 bits of GPS TOW are the least significant bits. The most significant bits shall be derived by the Serving Mobile Location Center to unambiguously derive the GPS TOW.

NOTE: The GPS Reference Time Uncertainty, if present, indicates the accuracy of GPSTOW, as described in sub-clause A.3.2.6.a.

**# of Satellites (*N\_SAT*)**

**Number of Measurements**

This field specifies the number of measurements for which measurements satellites are provided in the component. This value represents the number of satellites that were measured by the MS. This value of *N\_SAT* determines the length of the payload portion of the component. Typical range for *N\_SAT* is four to a maximum of 12. This field is mandatory and occurs once per set.

Table A.7a: # of Satellites field contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Units |
| N\_SAT | 4 | --- | 1 - 16 | --- |

**Measurement Parameters**

This field contains information about the measurements of code phase and Doppler, which enables the network-based method where position is computed in the SMLC. This field is mandatory and occurs *N\_SAT* times per message.

Table A.8: Measurement Parameters field contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Units |
| Satellite ID | 6 | --- | 0 - 63 | --- |
| C/No | 6 | 1 | 0 - 63 | dB-Hz |
| Doppler | 16 | 0,2 | 6553,6 | Hz |
| Whole Chips | 10 | 1 | 0 - 1022 | chips |
| Fractional Chips | 11 | 2-10 | 0 - (1-2-10) | chips |
| Multipath Indicator | 2 | see Table A.9 | TBD | --- |
| Pseudorange RMS Error | 6 | 3 bit mantissa  3 bit exp | 0,5 - 112 | m |

**Satellite ID**

This field identifies the particular satellite for which the measurement data is valid. This values 0 - 63 represent satellite PRNs 1 - 64, respectively.

**C/N0**

This field contains the estimate of the carrier-to-noise ratio of the received signal from the particular satellite used in the measurement. It is given in whole dBs and has a range of 0 to 63. Typical levels observed by MS-based GPS units will be in the range of 20 dB to 50 dB.

**Doppler**

This field contains the Doppler measured by the MS for the particular satellite signal. This information can be used to compute the 3-D velocity of the MS. The Doppler range is sufficient to cover the potential range of values measured by the MS.

**Whole Chips**

This field contains the whole value of the code-phase measurement made by the MS for the particular satellite signal at the time of measurement, in units of 1 GPS chip in the range from 0 to 1022 chips, where increasing binary values of the field signify increasing measured pseudoranges. The code phase measurement is divided into two fields, "Whole Chips" and "Fractional Chips".

**Fractional Chips**

This field contains the fractional value of the code-phase measurement made by the MS for the particular satellite signal at the time of measurement. The resolution of the fractional portion is approximately 0,3 m.

NOTE: The actual ASN.1 coding of this field reserves 11 bits for legacy compatibility. Only the 10 least significant bits are actually required to code the values (0..1023)

**Multipath Indicator**

This field contains the Multipath Indicator value. This parameter is specified according to the representation described in table A.9.

Table A.9: Multipath Indicator values and associated indications

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

Range: 0 - 3

**Pseudorange RMS Error**

This field contains a Pseudorange RMS Error value.

Range: 0,5 m to 112 m

NOTE: This parameter is specified according to a floating-point representation as described in Table A.10.

Table A.10: Pseudorange RMS Error 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 |

#### A.3.2.6 Location Information Error Element

The purpose of Location Information Error element is to provide the indication of error and the reason for it, when the MS can not perform the required location or the network can not determine the position estimate. The element may also indicate what further assistance data may be needed by the target MS to produce a successful location estimate or location measurements. This element is optional. This element has the following fields.

**Error Reason**

This field indicates the reason for error. This field is mandatory.

'0': Undefined error.

'1': There were not enough BTSs to be received when performing mobile based E-OTD.

'2': There were not enough GPS satellites to be received, when performing GPS location.

'3': E-OTD location calculation assistance data missing.

'4': E-OTD assistance data missing.

'5': GPS location calculation assistance data missing.

'6': GPS assistance data missing.

'7': Requested method not supported.

'8': Location request not processed.

'9': Reference BTS for GPS is not the serving BTS.

'10': Reference BTS for E-OTD is not the serving BTS.

'11': There were not enough GANSS satellites received, when performing GANSS location.

'12': GANSS assistance data missing.

'13': Reference BTS for GANSS is not the serving BTS.

**Additional Assistance Data**

This field is optional. Its presence indicates that the target MS will retain assistance data already sent by the SMLC. The SMLC may send further assistance data for any new location attempt but need not resend previous assistance data. The field may contain the following:

|  |  |
| --- | --- |
| GPS Assistance Data: | Necessary additional GPS assistance data (structure and encoding as for the GPS Assistance Data IE in 3GPP TS 49.031 excluding the IEI and length octets) |
| GANSS Assistance Data: | Necessary additional GANSS assistance data (structure and encoding as for the GANSS Assistance Data IE in 3GPP TS 49.031 excluding the IEI and length octets) |

#### A.3.2.6a GPS Time Assistance Measurements Element

This IE contains measurements that are used to define an accurate relation between GSM and GPS time or to provide additional GPS TOW information for MS Assisted A-GPS. The contents are shown in Table A.10a, and the individual fields are described subsequently.

Table A.10a: GPS Time Assistance Measurements Information element content

|  |  |
| --- | --- |
| Element fields | Presence |
| Reference Frame MSB | O |
| GPS TOW Subms | O |
| Delta TOW | O |
| GPS Reference Time Uncertainty | O |

**Reference Frame MSB**

This field shall be included when GPS-GSM time association is provided for either MS Based A-GPS or MS Assisted A-GPS. It indicates the Most Significant Bits (MSBs) of the frame number of the reference BTS corresponding to the GPS measurement or location estimate. Starting from the complete GSM frame number denoted FN, the MS calculates Reference Frame MSB as

Reference Frame MSB = floor(FN/42432)

The complete GSM frame number FN can then be reconstructed in the SMLC by combining the fields Reference Frame with Reference Frame MSB in the following way

FN = Reference Frame MSB\*42432+Reference Frame

Range: 0-63

**GPS TOW Subms**

This field is only applicable for MS-Based A-GPS. This field indicates in units of 100ns the submillisecond part of the GPS time of measurement. This field together with the GPS TOW field in the Location Information Element provides a more accurate time stamp of the location estimate for MS based AGPS Expressed in units of microseconds. The precise GPS time of measurements in milliseconds is thus equal to

GPS TOW + 0,0001\*GPS TOW Subms

The estimation of precise GPS time of measurement using AGPS is vulnerable to millisecond ambiguities. Therefore the MS shall only report this field when it is confident that any millisecond ambiguities have been avoided.

Range: 0-9999

**Delta TOW**

This field is only applicable for MS-Assisted A-GPS. This field specifies the difference in milliseconds between the GPS TOW reported in the GPS Measurement Information Element and the millisecond part of the SV time tsv\_1 of the first SV in the list reported from the MS. Figure A.1 shows an example of Delta TOW calculation. The Delta TOW is defined as Delta TOW = GPS TOW - fix(tsv\_1)

where fix() denotes rounding to the nearest integer towards zero. The estimation of tsv\_1 which forms the basis for the calculation of Delta TOW is vulnerable to millisecond ambiguities. Therefore the MS shall only report this field when it is confident that the correct millisecond event has been recovered.

Range: 0-127

**GPS Reference Time Uncertainty**

This element is optional. It provides the accuracy of the relation GPS and GSM time in the Location Information or GPS Measurement Information Element when GPS-GSM time association is provided. For MS Assisted A-GPS when GPS-GSM time association is not provided, even if GPS Time Assistance Measurement Request is not included in the Measure Position Request, this element can be included to provide the accuracy of the reported GPS TOW. The interval, range and treatment is as described in sub-clause 2.2.4b.

#### A.3.2.6b Velocity Estimate Element

This field contains the calculated velocity estimate in the format defined in 3GPP TS 23.032. The allowed encodings are:

- Horizontal Velocity

- Horizontal with Vertical Velocity

- Horizontal Velocity with uncertainty

- Horizontal with Vertical Velocity and uncertainty

#### A.3.2.7 Extended Reference IE

This IE shall be included in any Measure Position Response if and only if an Extended Reference IE was received in the corresponding previous Measure Position Request message.

NOTE: For reasons of backward compatibility, a Release 4 or earlier MS will not include this IE.

The Extended Reference IE contains the following elements.

SMLC code: an integer in the range 0-63. The value returned by a target MS in a Measure Position Response shall equal the value received from the SMLC in the earlier Measure Position Request.

Transaction ID: an integer in the range 0-262143 distinguishing different RRLP transactions in different MSs currently being served by the same SMLC. The value returned by a target MS in a Measure Position Response shall equal the value received from the SMLC in the earlier Measure Position Request.

When an MS employs pseudo-segmentation to return an RRLP response, the same Extended Reference IE shall be included in each RRLP Measure Position Response component.

#### A.3.2.8 Uplink RRLP Pseudo Segmentation Indication

This element is included by the MS when up-link RRLP pseudo-segmentation is used. In the first segment, 'first of many' is indicated and in the second 'second of many' is indicated. It is not included when up-link pseudo-segmentation is not used.

#### A.3.2.9 GANSS Location Information Element

The purpose of GANSS Location Information element is to provide the GANSS location estimate from the MS to the SMLC, if the MS is capable of determining its own position. Optionally, the element may contain Reference Frame element for including accurate relation between the cellular frame and GANSS Time of Day (TOD) for the serving cell if requested by the SMLC.

If GANSS Positioning Method was included in a Measure Position Request component, this field shall be used to report the location estimate from the MS to the network.

The time reference of GANSS TOD in GANSS Location Information Element can be any GNSS specific system time. The time reference is indicated by GANSS\_TIME\_ID.

The contents of GANSS Location Information are shown in Table A.10.1, and the individual fields are described subsequently.

Table A.10.1: GANSS Location Information Element Content

|  |  |
| --- | --- |
| Element fields | Presence |
| Reference Frame | O (note 1) |
| GANSS TOD | O (note 1) |
| GANSS TOD Frac | O |
| GANSS TOD Uncertainty | O |
| GANSS\_TIME\_ID | O (note 2) |
| Fix Type | M |
| Position Data | M |
| Stationary Indication | O |
| Location Estimate | M |
| NOTE 1: Either Reference Frame or GANSS Reference Time shall always be included.  NOTE 2. Absence of this field means Galileo | |

**Reference Frame**

This element contains Reference FN and Reference FN MSB fields. Reference FN field specifies the reference BTS reference frame number during which the location estimate was measured. The time of the reference frame boundary is as observed by the MS, i.e. without Timing Advance compensation.

Note that expected values for Reference FN are in range 0 - 42431.

Reference FN MSB field specifies the Most Significant Bits (MSB) of the frame number of the reference BTS corresponding to the GANSS Measurement Information or Location Estimate. Starting from the complete GSM frame number denoted FN, the MS calculates Reference FN MSB as

Reference FN MSB = floor(FN/42432)

The complete GSM frame number FN can then be reconstructed in the SMLC by combining the fields Reference Frame with Reference FN MSB in the following way

FN = Reference FN MSB\*42432+Reference FN

Range: 0-63

Table A.10.2: Reference Frame field contents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Unit | Incl. |
| Reference FN | 16 | --- | 0 - 65535 | frame | M |
| Reference FN MSB | 6 | --- | 0 - 63 | frame | O |

**GANSS TOD**

This field specifies the time for which the location estimate is valid, rounded down to the nearest integer millisecond. This field is optional but shall be included if GANSS TOD - GSM time association is included in which case the MS shall align GANSS TOD with the reported GSM frame boundary observed by the MS at that time. The time reference of GANSS TOD is indicated by GANSS\_TIME\_ID.

Table A.10.3: GANSS TOD contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Unit |
| GANSS TOD | 22 | 1 | 0 - 3599999 | ms |

The 22 bits of GANSS TOD are the least significant bits. The most significant bits shall be derived by the SMLC to unambiguously derive the GANSS TOD.

**GANSS TOD Frac**

This field is the submillisecond part of the GANSS time of day. This field together with the GANSS TOD field provides a more accurate time stamp of the Location Estimate having resolution of ~61 ns. This field is optional but shall be included if GANSS TOD - GSM time association is included.

Table A.10.4: GANSS TOD Frac contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Unit |
| GANSS\_TOD\_Frac | 14 | 2-14 | 0 - (1-2-14) | ms |

.

**GANSS TOD Uncertainty**

This parameter provides the accuracy of the relation between GANSS TOD and GSM time if GANSS TOD- GSM time association is provided. When GANSS TOD-GSM time association is not provided, this element can be included to provide the accuracy of the reported GANSS TOD.

The uncertainty *r*, expressed in microseconds, is mapped to a number K, with the following formula:

*r* = C\*(((1+x)K)-1)

with C = 0,0022 and x = 0,18. With 0 £ K £ 127, a suitably useful range between 0 and 3 second is achieved for the uncertainty, while still being able to code down to values as small as 0,3 nanoseconds. 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.

Table A.10.5: Example values for the GANSS TOD Uncertainty Parameter Format

|  |  |
| --- | --- |
| **Value of K** | **Value of uncertainty** |
| 0 | 0 nanoseconds |
| 1 | 0,396 nanoseconds |
| 2 | 0,863 nanoseconds |
| - | - |
| 50 | 8,64 microseconds |
| - | - |
| 127 | ≥ 2,96 seconds |

**GANSS\_TIME\_ID**

This field indicates which GNSS has been used as the time reference for GANSS Location Information. This field is optional and absence of this field means that Galileo system time is used as time reference.

Table A.10.6: GANSS\_TIME\_ID

|  |  |
| --- | --- |
| GANSS\_TIME\_ID | Indication |
| GPS | 0 |
| QZSS | 1 |
| GLONASS | 2 |
| BDS | 3 |
| Reserved for future use | 4-7 |

**Fix Type**

This field contains an indication as to the type of measurements performed by the MS: 2D or 3D. This field is mandatory.

'0' = 2D fix.

'1' = 3D fix.

**Position Data**

This element provides a list of positioning methods and satellite systems used to calculate the Position Estimate. Each bit of this bitmap is of type Boolean, where TRUE ('1') means the particular positioning method or signal(s) from a satellite system has been used.

'bit 0': E-OTD;

'bit 1' GPS;

'bit 2': Galileo;

'bit 3': SBAS;

'bit 4': Modernized GPS;

'bit 5': QZSS;

'bit 6': GLONASS;

'bit 7': BDS;

'bit 8-15': Reserved.

**Stationary Indication**

This field indicates whether the MS is stationary (horizontal and vertical speeds less than the resolution of the Velocity Estimate parameters as defined in 3GPP TS 23.032).

If Velocity Estimate is requested and the MS is stationary, then the Stationary Indication is set to '1' and Velocity Estimate may not be included in Measure Position Response Element.

**Position Estimate**

This field contains the calculated position estimate in the format defined in 3GPP TS 23.032. The allowed shapes are:

- ellipsoid Point;

- ellipsoid point with uncertainty circle;

- ellipsoid point with uncertainty ellipse;

- ellipsoid point with altitude and uncertainty ellipsoid.

As defined in 3GPP TS 23.032, the position estimate is provided in WGS-84 reference system.

#### A.3.2.10 GANSS Measurement Information Element

The purpose of the GANSSMeasurement Information element is to provide GANSS measurement information from the MS to the SMLC and GANSS TOD - GSM time association if requested by the SMLC. This information includes the measurements of code phase, Doppler, C/No and optionally accumulated carrier phase, also called accumulated deltarange (ADR), which enable the network-based GANSS method where position is computed in the SMLC. The contents are shown in table A.10.7, and the individual fields are described subsequently. See also Figure A.1a for an illustration of the relation between some of the fields.



Figure A.1a. Exemplary definitions of GANSS measurement information fields.

GANSSMeasurement Information element is included in the Measure Position Response component if the network has requested the mobile to perform mobile-assisted location measurements using GANSS Positioning Method. GANSSMeasurement Information element will also optionally include carrier phase measurements if SMLC has requested the MS to perform carrier phase measurements.

The following fields are repeated the number of times indicated in Number of E-OTD/GPS/GANSS Measurement Sets field if Multiple Sets element is included. If Multiple Sets element is not included, the default value for sets is one (i.e. the following fields are present only once).

Table A.10.7: GANSS Measurement Information element content

|  |  |  |
| --- | --- | --- |
| Element fields | Presence | Occurrences |
| Reference Frame | O | 1 |
| GANSS TOD | O (note 1) | 1 |
| DeltaTOD | O | 1 |
| GANSS TOD Uncertainty | O | 1 |
| GANSS Generic Measurement Information | M | N\_GANSS |
| NOTE 1: If GPS Measurement Information element is not included in a Measure Position Response component, this field shall be present. | | |

The following paragraphs describe the content of each information field of this element.

**Reference Frame**

These fields are shown in Table A.10.8 and are optional, but shall be included when GANSS TOD- GSM time association is provided.

Note that expected values for Reference FN are in range 0 - 42431. The time of the reference frame boundary is as observed by the MS, ie without Timing Advance compensation.

Reference FN MSB field indicates the Most Significant Bits (MSB) of the frame number of the reference BTS corresponding to the GANSS Measurement Information.

Starting from the complete GSM frame number denoted FN, the MS calculates Reference FN MSB as

Reference FN MSB = floor(FN/42432)

The complete GSM frame number FN can then be reconstructed in the SMLC by combining the fields Reference Frame with Reference FN MSB in the following way

FN = Reference FN MSB\*42432+Reference FN

Table A.10.8: Reference Frame field contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Unit |
| Reference FN | 16 | --- | 0 - 65535 | frame |
| Reference FN MSB | 6 | --- | 0 - 63 | frame |

**GANSS TOD**

This field specifies the GANSS TOD for which the GANSS Measurement Parameters in GANSS Generic Measurement Information Element are valid. This field shall be included when GANSS TOD-GSM time association is provided or if GPS Measurement Information element is not present in a Measure Position Response component. If GPS Measurement Information element is present in a Measure Position Response component, and GANSS TOD field is absent in the GANSS Measurement Information element, the GPS TOW included in the GPS Measurement Information element specifies the reference time for which the GANSS Measurement Parameters are valid.

The 22 bits of GANSS TOD are the least significant bits. The most significant bits shall be derived by the Serving Mobile Location Centre to unambiguously derive the GANSS TOD.

The value for GANSS TOD is derived from the GNSS specific system time of the GNSS reported first in the GANSS Measurement IE rounded down to the nearest millisecond unit.

Table A.10.9: GANSS TOD field contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Units |
| GANSS TOD | 22 | 1 ms | 0 - 3599999 | ms |

**DeltaTOD**

This field specifies the difference in milliseconds between GANSS TOD reported in the GANSS Measurement Information Element and the millisecond part of the SV time tsv\_1 of the first SV in the list reported from the MS. The DeltaTOD is defined as

DeltaTOD = GANSS TOD - fix(tsv\_1)

where fix() denotes rounding to the nearest integer towards zero.

Range: 0-127

**GANSS TOD Uncertainty**

This element provides the accuracy of the relation GANSS TOD -GSM time when GANSS TOD-GSM time association is provided. When GANSS TOD-GSM time association is not provided, even if GANSS TOD - GSM Time Association Measurement Request is not included in the Measure Position Request, this element can be included to provide the accuracy of the reported GANSS TOD.

If GANSS TOD is the given GNSS time, then the true GNSS time, corresponding to the provided GSM time as observed at the MS location, lies in the interval (GANSS TOD – GANSS TOD Uncertainty, GANSS TOD + GANSS TOD Uncertainty).

The uncertainty *r*, expressed in microseconds, is mapped to a number K, with the following formula:

*r* = C\*(((1+x)K)-1)

with C = 0,0022 and x = 0,18. With 0 £ K £ 127, a suitably useful range between 0 and 3 second is achieved for the uncertainty, while still being able to code down to values as small as 0,3 nanoseconds. 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 GANSS TOD Uncertainty value are shown in Table A.10.10.

Table A.10.10: Example values for the GANSS TOD-GSM Time Uncertainty Parameter Format

|  |  |
| --- | --- |
| **Value of K** | **Value of uncertainty** |
| 0 | 0 nanoseconds |
| 1 | 0,396 nanoseconds |
| 2 | 0,863 nanoseconds |
| - | - |
| 50 | 8,64 microseconds |
| - | - |
| 127 | ≥ 2,96 seconds |

**N\_GANSS, Number of GANSS Generic Measurement Information Elements**

N\_GANSS specifies the number of GANSS Generic Measurement Information Element occurrences in GANSS Measurement Information element, one occurrence for each reported GANSS. The range is from 1 to 8.

#### A.3.2.10.1 GANSS Generic Measurement Information Element

Table A.10.11: GANSS Generic Measurement Information

|  |  |  |
| --- | --- | --- |
| **Element fields** | **Presence** | **Occurrences** |
| GANSS ID | O (note 1) | 1 |
| GANSS Generic Measurement Element | M | N\_SGN\_TYPE |
| Note 1: Absence of this field means Galileo. | | |

**GANSS ID**

GANSS ID field identifies the GNSS constellation on which GANSS Measurement Parameters were measured according to Table A.40.

Range: 0 – 7

**N\_SGN\_TYPE, Number of GANSS Generic Measurement Elements**

N\_SGN\_TYPE specifies the number of GANSS Generic Measurement Element occurrences in GANSS Generic Measurement Information element. The range for N\_SGN\_TYPE is from 1 to 8.

Table A.10.12: GANSS Generic Measurement Element contents

|  |  |  |
| --- | --- | --- |
| **Element fields** | **Presence** | **Occurrences** |
| GANSS Signal ID | M | 1 |
| GANSS Code Phase Ambiguity | O | 1 |
| GANSS Measurement Parameters | M | N\_SGN |

This element contains measurement information for one GNSS signal type indicated by GANSS Signal ID.

**GANSS Signal ID**

GANSS Signal ID field identifies the signal on which GANSS Measurement Parameters were measured. The supported signals are listed in Table A.59.

Range: 0 - 7

**GANSS Code Phase Ambiguity**

The GANSS Code Phase Ambiguity field gives the ambiguity of the code phase measurement. It is given in ms and is an integer between 0 and 127.

The Total Code Phase for a satellite k (Satk) is given modulo this GANSS Code Phase Ambiguity and is reconstructed with :

Code\_Phase\_Tot(Satk) = Code\_Phase (Satk)+ Integer Code Phase(Satk) + n \* Code Phase Ambiguity, n= 0,1,2,...

If there is no code phase ambiguity, the GANSS Code Phase Ambiguity shall be set to 0.

The field is optional. If GANSS Code Phase Ambiguity is absent, the default value is 0.

***N\_SGN*, Number of Signal Measurements**

*N\_SGN* specifies the number of GANSS Measurement Parameters element occurrence in GANSS Generic Measurement Information element. Typical range for *N\_SGN* is 4 to a maximum of 16.

**GANSS Measurement Parameters**

This field contains information about the measurements of code phase and Doppler, which enables the network-based method where position is computed in the SMLC. This field is mandatory and occurs *N\_SGN* times in GANSS Generic Measurement Information element.

Table A.10.13: GANSS Measurement Parameters field contents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # of Bits | Resolution | Range | Units | Incl. |
| Signal Quality Parameters | | | | | |
| SV ID | 6 | --- | - | --- | M |
| C/No | 6 | 1 | 0 - 63 | dB-Hz | M |
| Multipath Indicator | 2 | --- | See Table A.9 | --- | M |
| Carrier Quality Indication | 2 | --- | --- | --- | O(1) |
| Code Phase Measurements | | | | | |
| Code Phase | 21 | 2-21 | 0 - (1-2-21) | ms | M |
| Integer Code Phase | 7 | 1 | 0 - 127 | ms | O |
| Code Phase RMS Error | 6 | 3 bit mantissa  3 bit exp | 0,5 - 112 | m | M |
| Doppler Frequency Measurements | | | | | |
| Doppler | 16 | 0,04 | 1310,7 | m/s | O |
| ADR | 25 | 2-10 | 0 - 32767,5 | m | O(1) |
| NOTE 1: All of these fields shall be present together, or none of them shall be present. | | | | | |

**SV ID**

The SV ID is an index number for a satellite within a satellite system. The SV ID value range starts from 0 for each satellite system. The interpretation of SV ID for each GANSS is defined in Table A.10.14.

Table A.10.14: Interpretation of SV ID

|  |  |  |
| --- | --- | --- |
| System | Value of SV ID | Interpretation of SV ID |
| Galileo | '0' – '35'  '36' – '63' | Code No. 1 to 36  Reserved |
| Modernized 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 |
| BDS | '0' – '36'  '37' – '63' | Satellite ranging code number signal No.1 to 37 [18]  Reserved |

**C/N0**

This field contains the estimate of the carrier-to-noise ratio of the received signal from the particular satellite. It is given in whole dB-Hz and has a range of 0 to 63. Typical levels observed by GNSS receivers will be in the range of 16 dB-Hz to 50 dB-Hz.

**Carrier Quality Indication**

This field indicates the quality of a carrier phase measurement as a bit field. The LSB indicates the data polarity, that is. if the data from a specific satellite is received inverted, this is indicated by setting the LSB value to '1'. In the case the data is not inverted, the LSB is set to '0'. The MSB indicates if accumulation of the carrier phase has been continuous, that is, without cycle slips since the previous measurement report. If the carrier phase accumulation has been continuous, the MSB value is set to '1X'. Otherwise, the MSB is set to '0X'.

This field is optional and shall be included only when carrier phase measurements are requested.

Table A.10.16: Carrier Phase Quality Indication values and associated indications

|  |  |
| --- | --- |
| Bit | Polarity Indication |
| '0' | Data Direct |
| '1' | Data Inverted |
| '0X' | Carrier phase not continuous |
| '1X' | Carrier phase continuous |
| X = do not care | |

**Code Phase**

This field contains the whole and fractional value of the code-phase measurement made by the MS 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 (e.g. Galileo L1 OS measurement is divided by 1023,0 chip/ms).

**Integer Code Phase**

This field indicates the integer millisecond part of the code phase that is expressed modulo the GANSS Code PhaseAmbiguity.

The value of the ambiguity is given in the GANSS Ambiguity field of the GANSS Generic Measurement Information element.

The Integer code phase is optional. The default value is 0.

**Code Phase RMS Error**

This field contains Code Phase RMS Error value. This parameter has the same range as described in Table A.10.

**Doppler**

This field contains the Doppler measured by the MS for the particular satellite signal. This information can be used to compute the 3-D velocity of the MS.

The Doppler range is sufficient to cover the potential range of values measured by the MS. Doppler measurements are converted into unit of m/s by multiplying the Doppler measurement in Hz by the *nominal* wavelength of the measured signal.

**ADR**

This field contains the ADR measurement measured by the MS for the particular satellite signal. This information can be used to compute the 3-D velocity or high-accuracy position of the MS. ADR measurements are converted into units of m by multiplying the ADR measurement by the *nominal* wavelength of the measured signal.

This field is optional and shall be included only when carrier phase measurements are requested.

## A.4 Assistance Data

### A.4.1 General

The Assistance Data is a RRLP component from the network to the MS. It is used by the network to provide assistance data to enable MS-based E-OTD or MS-based Assisted GPS capabilities in the MS and may be used to help support MS-assisted E-OTD and MS-assisted Assisted GPS. It contains the following elements.

Table A.11: Assistance Data component content

|  |  |  |
| --- | --- | --- |
| Element | Type/Reference | Presence |
| E-OTD Reference BTS for Assistance Data | E-OTD Reference BTS for Assistance Data 2.2.3 | C |
| E-OTD Measurement Assistance Data | E-OTD Measurement Assistance Data 2.2.4 | C |
| E-OTD Measurement Assistance Data for System Information List | E-OTD Measurement Assistance Data for System Information List 2.2.5 | C |
| GPS Assistance Data | GPS Assistance Data 4.2.4 | C |
| Additional GPS Assistance Data | Additional GPS Assistance Data 4.2.4c | O |
| GPS Time Assistance Measurement Request | GPS Time Assistance Measurement Request 4.2.4a | O |
| GPS Reference Time Uncertainty | GPS Reference Time Uncertainty 4.2.4b | O |
| More Assistance Data To Be Sent | More Assistance Data To Be Sent 4.2.5 | C |
| Extended Reference | Extended Reference 2.2.5 | C |
| GANSS Assistance Data | GANSS Assistance Data 4.2.6 | C |
| GANSS Carrier-Phase Measurement Request | GANSS Carrier-Phase Measurement Request 4.2.7 | O |
| GANSS TOD - GSM Time Association Request | GANSS TOD - GSM Time Association Request 4.2.8 | O |

### A.4.2 Elements

#### A.4.2.1 E-OTD Reference BTS for Assistance Data Element

This element is conditional. It is as described in sub-clause 2.2.3. If the network can provide assistance data, and data for E-OTD has been requested, this element is included.

#### A.4.2.2 E-OTD Measurement Assistance Data Element

This element is conditional. It is as described in sub-clause 2.2.4. If the network can provide assistance data, and data for E-OTD has been requested, this element is included.

#### A.4.2.3 E-OTD Measurement Assistance Data for System Information List Element

This element is conditional. It is as described in sub-clause 2.2.5. If the network can provide assistance data, and data for E-OTD has been requested, this element is included.

#### A.4.2.4 GPS Assistance Data Element

The GPS Assistance Data element contains a single GPS assistance message that supports both MS-assisted and MS-based GPS methods. This element can contain one or more of the fields listed in table A.12 below, which support both MS-assisted and MS-based GPS methods. As table A.12 shows, all fields are optional.

Note that certain types of GPS Assistance data may be derived, wholly or partially, from other types of GPS Assistance data.

In addition, an Integrity Monitor (IM) shall detect unhealthy (e.g., failed/failing) satellites and also shall inform users of measurement quality in DGPS modes when satellites are healthy. Excessively large pseudo range errors, as evidenced by the magnitude of the corresponding DGPS correction, shall be used to detect failed satellites. Unhealthy satellites should be detected within 10 seconds of the occurrence of the satellite failure. When unhealthy (e.g., failed/failing) satellites are detected, the assistance and/or DGPS correction data shall not be supplied for these satellites. When the error in the IM computed position is excessive for solutions based upon healthy satellites only, DGPS users shall be informed of measurement quality through the supplied UDRE values. After bad satellites have been indicated in the Real Time Integrity field, if the satellites return to healthy condition for some period of time, the indications for them shall be removed from this field.

Table A.12: Fields in the GPS Assistance Data element

|  |  |  |
| --- | --- | --- |
| Parameter | Presence | Repetition |
| Reference Time | O | Yes |
| Reference Location | O | No |
| DGPS Corrections | O | Yes |
| Navigation Model | O | Yes |
| Ionospheric Model | O | No |
| UTC Model | O | No |
| Almanac | O | Yes |
| Acquisition Assistance | O | Yes |
| Real-Time Integrity | O | Yes |

When RRLP pseudo-segmentation is used, Table A.12 indicates which parameters may be repeated in more than one RRLP segment in order to provide data for multiple satellites. When any such parameter appears in more than one segment, the following rules shall apply.

1. There shall be no repetition of data for the same satellite.

2. Optional and conditional elements in the parameter not associated with a particular satellite shall each appear in at most one RRLP segment.

3. Any mandatory element not associated with a particular satellite shall assume consistent values in the case of an element related to current GPS time and the same value otherwise.

4. The maximum number of satellites defined in sub-clause 5.1 for which data can be included for any parameter in one RRLP segment shall apply also when counted over all RRLP segments.

**Reference** **Time**

These fields specify the relationship between GPS time and air-interface timing of the BTS transmission in the reference cell. These fields occur once per message; some are mandatory and some are conditional, as shown in table A.14. Note that Reference Time may also be present within the Acquisition Assistance parameter. In such a case, the SMLC shall ensure consistency.

Table A.14: Reference Time (Fields occurring once per message)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| GPS Week | 10 | 1 | 0 - 1023 | weeks | M |
| GPS TOW | 23 | 0,08 | 0-604799,92 | sec | M |
| BCCH Carrier | 10 | 1 | 0 - 1023 | --- | O (note 1) |
| BSIC | 6 | 1 | 0 - 63 | --- | O (note 1) |
| FNm | 21 | 1 | 0 - (221-1) | frames | O (note 1) |
| TN | 3 | 1 | 0 - 7 | timeslots | O (note 1) |
| BN | 8 | 1 | 0 - 156 | bits | O (note 1) |
| GPS TOW Assist | 24\*N\_SAT | --- | ---- | --- | O |
| NOTE 1: All of these fields shall be present together, or none of them shall be present. | | | | | |

**GPS Week**

This field specifies the GPS week number of the assistance being provided. GPS Week eliminates one-week ambiguities from the time of the GPS assistance. This field is mandatory.

NOTE: The number of 1024 week cycles since the GPS zero time-point is provided in the GPS Reference Time Extension in Table A.29u.

**GPS** **TOW**

The GPS TOW (time-of-week) is a mandatory field and is specified with 80 msec resolution. When GSM Time Present is "1", GPS TOW and BCCH/BSIC/FNm/TN/BN IEs provide a valid relationship between GPS and GSM time, as seen at the approximate location of the MS, ie the propagation delay from BTS to MS shall be compensated for by the SMLC. Depending on implementation, the relation between GPS and GSM time may have varying accuracy. Therefore, the uncertainty of the timing relation may be provided in the optional field GPS Reference Time Uncertainty. If the propagation delay from BTS to MS is not accurately known, the SMLC shall use the best available approximation of the propagation delay and take the corresponding delay uncertainty into account in the calculation of the field GPS Reference Time Uncertainty. When GSM Time Present is "0", GPS TOW is an estimate of current GPS time of week at time of reception of the RRLP segment containing this data by the MS. The SMLC should achieve an accuracy of +/- 3 seconds for this estimate including allowing for the transmission delay between SMLC and MS of the RRLP segment containing GPS TOW. Note that the MS should further compensate GPS TOW for the time between the reception of the segment containing GPS TOW and the time when the GPS TOW field is used.

**BCCH Carrier/BSIC/FNm/TN/BN**

These fields specify the state of the GSM frame number, timeslot number, and bit number, respectively, of the reference BTS with the specified BCCH carrier and BSIC at the time that correspond to GPS TOW. The SMLC shall use the current serving BTS as the reference BTS. The frame number field is given modulo 221, i.e., the MSB of the GSM frame number is truncated. The MS shall interpret FNm as the most recent of the two possible frame numbers that FNm could represent. The target MS has the option of rejecting a GPS position request or GPS assistance data if the reference BTS is not the serving BTS.

**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 MS to know the entire 1,2-second (60-bit) pattern of TLM and HOW that is transmitted at the start of each six-second subframe by the particular GPS satellite. This field contains information for each of N\_SAT satellites, and optional. The individual fields for each satellite in the message are shown in table A.15a.

Table A.15a: GPS TOW Assist (Fields occurring N\_SAT times per message)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| SatID | 6 | --- | 0 - 63 | --- | M |
| TLM Message | 14 | --- | 0 - 16383 | Bit field | M |
| Anti-Spoof | 1 | 1 | 0 -1 | Bit field | M |
| Alert | 1 | 1 | 0 - 1 | Bit field | M |
| TLM Reserved | 2 | --- | 0 - 3 | Bit field | M |

**SatID**

This field identifies the satellite for which the corrections are applicable. The values ranging from 0 to 63 represent satellite PRNs ranging from 1 to 64, respectively.

**TLM Message**

This field contains a 14-bit value representing the Telemetry Message (TLM) being broadcast by the GPS satellite identified by the particular SatID, with the MSB occurring first in the satellite transmission.

**Anti-Spoof/Alert**

These fields contain the Anti-Spoof and Alert flags that are being broadcast by the GPS satellite identified by SatID.

**TLM Reserved**

These fields contain the two reserved bits in the TLM Word being broadcast by the GPS satellite identified by SatID, with the MSB occurring first in the satellite transmission.

**Reference** **Location**

The Reference Location field contains a 3-D location (with uncertainty) specified as per 3GPP TS 23.032. The purpose of this field is to provide the MS with a priori knowledge of its location in order to improve GPS receiver performance. The allowed shape is 3-D location with uncertainty (ellipsoid point with altitude and uncertainty ellipsoid).

**DGPS Corrections**

These fields specify the DGPS corrections to be used by the MS. All fields are mandatory when DGPS Corrections are present in the GPS Assistance Data.

Table A.15: DGPS Corrections

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| The following fields occur once per message | | | | | |
| GPS TOW | 20 | 1 | 0 - 604799 | sec | M |
| Status/Health | 3 | 1 | 0-7 | --- | M |
| N\_SAT | 4 | 1 | 1-16 | --- | M |
| The following fields occur once per satellite (N\_SAT times) | | | | | |
| SatID | 6 | --- | 0 - 63 | --- | M |
| IODE | 8 | --- | 0 - 255 | --- | M |
| UDRE | 2 | --- | 0 - 3 | --- | M |
| PRC | 12 | 0,32 | 655,04 | meters | M |
| RRC | 8 | 0,032 | 4,064 | meters/sec | M |
| Delta PRC2 | 8 | --- | --- | --- | M |
| Delta RRC2 | 4 | --- | --- | --- | M |
| Delta PRC3 | 8 | --- | --- | --- | M |
| Delta RRC3 | 4 | --- | --- | --- | M |

**GPS TOW**

This field indicates the baseline time for which the corrections are valid.

**Status/Health**

This field indicates the status of the differential corrections contained in the broadcast message. The values of this field and their respective meanings are shown below in table A.16.

Table A.16: Values of Status/Health IE

|  |  |
| --- | --- |
| Code | 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 |

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 message. 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 DGPS network) is currently not being monitored. The value "111" indicates that the corrections provided by the source are invalid, as judged by the source. In the later case, the message shall contain no corrections for individual satellites. Any MS that receives DGPS Corrections in a GPS Assistance Data IE shall contain the appropriate logic to properly interpret this condition and look for the next IE.

**N\_SAT**

This field indicates the number of satellites for which differential corrections are available. Corrections for up to 16 satellites.

**SatID**

This field identifies the satellite for which the corrections are applicable. The values ranging from 0 to 63 represent satellite PRNs ranging from 1 to 64, respectively.

**IODE**

This IE is the sequence number for the ephemeris for the particular satellite. The MS can use this IE to determine if new ephemeris is used for calculating the corrections that are provided in the broadcast message. This eight-bit IE identifies a particular set of ephemeris data for a GPS satellite and may occupy the numerical range of [0, 255]. The transmitted IODE value will be different from any value transmitted by the GPS satellite during the preceding six hours. For more information about this field can be found from RTCM-SC104.

**User Differential Range Error** **(UDRE)**

This field provides an estimate of the uncertainty (1-) in the corrections for the particular satellite. The value in this field shall be multiplied by the UDRE Scale Factor in the common Corrections Status/Health field to determine the final UDRE estimate for the particular satellite. The meanings of the values for this field are described in table A.18.

Table A.18: Values of UDRE IE

|  |  |
| --- | --- |
| 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 |

Each UDRE value shall be adjusted based on the operation of an Integrity Monitor (IM) function which exists at the network (SMLC, GPS server, or reference GPS receiver itself). Positioning errors derived at the IM which are excessive relative to DGPS expected accuracy levels shall be used to scale the UDRE values to produce consistency.

**Pseudo-Range Correction** **(PRC)**

This field indicates the correction to the pseudorange for the particular satellite at the GPS Reference Time, *t*0. The value of this field is given in meters (m) and the resolution is 0,32, as shown in table A.15 above. The method of calculating this field is described in [9].

If the SMLC has received a request for GPS assistance data from an MS which included a request for the navigation models and DGPS (i.e., bit D and E are set to one in 'Requested GPS Assistance Data, see 3GPP TS 49.031), the SMLC shall determine, for each satellite, if the navigation model stored by the MS is still suitable for use with DGPS corrections (also see navigation model update conditions right before Table A.19) and if so and if DGPS corrections are supported the SMLC should send DGPS corrections without including the navigation model.

The IODE value sent for a satellite shall always be the IODE value that corresponds to the navigation model for which the pseudo-range corrections are applicable.

The pseudo-range correction shall correspond to the available navigation model (the one already stored in and identified by the MS or the one included in the same procedure as the pseudo-range correction). The MS shall only use the PRC value when the IODE value received matches its available navigation model.

**Pseudo-Range Rate Correction** **(RRC)**

This field indicates the rate-of-change of the pseudorange correction for the particular satellite, using the satellite ephemeris identified by the IODE IE. The value of this field is given in meters per second (m/sec) and the resolution is 0,032, as shown in table A.15 above. For some time *t*1 > *t*0, the corrections for IODE are estimated by

PRC(*t*1, IODE) = PRC(*t*0, IODE) + RRC(*t*0, IODE)(*t*1 - *t*0) ,

and the MS uses this to correct the pseudorange it measures at *t*1, PRm(*t*1, IODE), by

PR(*t*1, IODE) = PRm(*t*1, IODE) + PRC(*t*1, IODE) .

The SMLC shall always send the RRC value that corresponds to the PRC value that it sends (see above for details). The MS shall only use the RRC value when the IODE value received matches its available navigation model.

**Delta Pseudo-Range Correction 2 (Delta PRC2)**

This IE is not used. The sender shall set it to zero and the receiver shall ignore it.

**Delta Pseudo-Range Rate Correction 2 (Delta RRC2)**

This IE is not used. The sender shall set it to zero and the receiver shall ignore it.

**Delta Pseudo-Range Correction 3 (Delta PRC3)**

This IE is not used. The sender shall set it to zero and the receiver shall ignore it.

**Delta Pseudo-Range Rate Correction 3 (Delta RRC3)**

This IE is not used. The sender shall set it to zero and the receiver shall ignore it.

**Navigation** **Model**

This set of fields contains information required to manage the transfer of precise navigation data to the GPS-capable MS. In response to a request from an MS for GPS assistance data, the SMLC shall determine whether to send the navigation model for a particular satellite to an MS based upon factors like the T-Toe limit specified by the MS and any request from the MS for DGPS (also see above). This information includes control bit fields as well as satellite ephemeris and clock corrections. The individual fields are given in Table A.19 below, and the conditions for their presence is discussed below.

Table A.19: Navigation Model (per-satellite fields - (1) = Positive range only)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| Navigation Model Flow Control (once per message) | | | | |
| Num\_Sats\_Total | 4(1) | 1 | --- | M |
| Satellite and Format Identification (once per satellite) | | | | |
| SatID | 6(1) | --- | --- | M |
| Satellite Status | 2 | --- | Boolean | M |
| Satellite Navigation Model and Associated Bits (once per satellite) | | | | |
| C/A or P on L2 | 2 | --- | Boolean | C |
| URA Index | 4 | --- | Boolean | C |
| SV Health | 6 | --- | Boolean | C |
| IODC | 10(1) | --- | --- | C |
| L2 P Data Flag | 1 | --- | Boolean | C |
| SF 1 Reserved | 87 | --- | --- | C |
| TGD | 8 | 2-31 | sec | C |
| toc | 16(1) | 24 | sec | C |
| af2 | 8 | 2-55 | sec/sec2 | C |
| af1 | 16 | 2-43 | sec/sec | C |
| af0 | 22 | 2-31 | sec | C |
| Crs | 16 | 2-5 | meters | C |
| n | 16 | 2-43 | semi-circles/sec | C |
| M0 | 32 | 2-31 | semi-circles | C |
| Cuc | 16 | 2-29 | radians | C |
| e | 32(1) | 2-33 | --- | C |
| Cus | 16 | 2-29 | radians | C |
| (A)1/2 | 32(1) | 2-19 | meters1/2 | C |
| toe | 16(1) | 24 | sec | C |
| Fit Interval Flag | 1 | --- | Boolean | C |
| AODO | 5 | 900 | sec | C |
| Cic | 16 | 2-29 | radians | C |
| OMEGA0 | 32 | 2-31 | semi-circles | C |
| Cis | 16 | 2-29 | radians | C |
| i0 | 32 | 2-31 | semi-circles | C |
| Crc | 16 | 2-5 | meters | C |
|  | 32 | 2-31 | semi-circles | C |
| OMEGAdot | 24 | 2-43 | semi-circles/sec | C |
| Idot | 14 | 2-43 | semi-circles/sec | C |

**Num\_Sats\_Total**

This field specifies the number of satellites that are included in the provided Navigation Model. A range of 1-16 is available. This field is mandatory when the Navigation Model field is included in the message.

**SatID**

This field identifies the satellite for which the assistance is applicable. This value is the same as the PRN number provided in the navigation message transmitted by the particular satellite. The range is 0 to 63, with 0-31 indicating GPS satellites 1-32, respectively, and 32-63 indicating satellites in future augmentation systems (e.g., WAAS or EGNOS). This field is mandatory for each included satellite.

**Satellite** **Status**

This field is a two-bit value that indicates the status of the Navigation Model for the particular satellite specified by SatID. This field is mandatory for each included satellite. The MS shall interpret the combinations of the two bits as follows.

Table A.20: Satellite Status (per-satellite field)

|  |  |  |
| --- | --- | --- |
| MSB | LSB | Interpretation |
| 0 | 0 | New satellite, new Navigation Model |
| 0 | 1 | Existing satellite, same Navigation Model |
| 1 | 0 | Existing satellite, new Navigation Model |
| 1 | 1 | Reserved |

This Satellite Navigation Model and associated bit fields include the parameters that accurately model the orbit and clock state of the particular satellite. For the particular satellite, these fields are conditional based on the value of Satellite Status for that satellite. The fields are absent when Satellite Status is "01", and present for all other values. The format for the ephemeris, clock corrections, and associate bits are specified in ICD-GPS-200.

**Ionospheric** **Model**

The Ionospheric Model contains fields needed to model the propagation delays of the GPS signals through the ionosphere. The information elements in this field are shown in table A.21. Proper use of these fields allows a single‑frequency GPS receiver to remove approximately 50 % of the ionospheric delay from the range measurements. The Ionospheric Model is valid for the entire constellation and changes slowly relative to the Navigation Model. All of the fields must be included when Ionospheric Model is present.

Table A.21: Ionospheric Model (occurs once per message, when present)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| 0 | 8 | 2-30 | seconds | C |
| 1 | 8 | 2-27 | sec/semi-circle | C |
| 2 | 8 | 2-24 | sec/(semi-circle)2 | C |
| 3 | 8 | 2-24 | sec/(semi-circle)3 | C |
| 0 | 8 | 211 | seconds | C |
| 1 | 8 | 214 | sec/semi-circle | C |
| 2 | 8 | 216 | sec/(semi-circle)2 | C |
| 3 | 8 | 216 | sec/(semi-circle)3 | C |

**UTC** **Model**

The UTC Model field contains a set of parameters needed to relate GPS time to Universal Time Coordinate (UTC). All of the fields in the UTC Model are mandatory when the field is present.

Table A.22: UTC Model (occurs once per message,  
when present per-satellite fields - (1) = Positive range only)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| A1 | 24 | 2-50 | sec/sec | C |
| A0 | 32 | 2-30 | seconds | C |
| tot(1) | 8 | 212 | seconds | C |
| WNt(1) | 8 | 1 | weeks | C |
| tLS | 8 | 1 | seconds | C |
| WNLSF(1) | 8 | 1 | weeks | C |
| DN | 8 | 1 | days | C |
| tLSF | 8 | 1 | seconds | C |

**Almanac**

These fields specify the coarse, long-term model of the satellite positions and clocks. These fields are given in table A.23. With one exception (i), these parameters are a subset of the ephemeris and clock correction parameters in the Navigation Model, although with reduced resolution and accuracy. The almanac model is useful for receiver tasks that require coarse accuracy, such as determining satellite visibility. The model is valid for up to one year, typically. Since it is a long-term model, the field should be provided for all satellites in the GPS constellation. If almanac is not provided for the full GPS constellation, the SMLC shall set the Complete Almanac Provided field in Table A.29w to FALSE. All fields in the Almanac are mandatory when the Almanac is present. The fields toa and WNa specify the GPS time-of-week and week number, respectively, that are the reference points for the Almanac parameters.

The Almanac also is useful as an acquisition aid for network-based GPS methods. Given a recent Almanac (< 3‑4 weeks old), the MS only needs Reference Time and Reference Location information to quickly acquire the signals and return measurements to the network.

The Almanac also contains information about the health of that satellite as described in ICD-GPS-200. If this Alamanc has been captured from the satellite signal, the SV Health field represents the predicted satellite health at the time the GPS control segment uploaded the Almanac to the satellite. According to ICD-GPS-200, this health information may differ from the SV Health field in the Navigation Model (table A.19) due to different upload times.

The parameters Num\_Sats\_Total and SatID shall be interpreted in the same manner as described under table A19.

Table A.23: Almanac (per-satellite fields - (1) = Positive range only)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| The following fields occur once per message | | | | |
| Num\_Sats\_Total | 6(1) | 1 | --- | M |
| WNa | 8(1) | 1 | weeks | M |
| The following fields occur once per satellite | | | | |
| SatID | 6(1) | --- | --- | M |
| e(1) | 16 | 2-21 | dimensionless | M |
| toa(1) | 8 | 212 | sec | M |
| i | 16 | 2-19 | semi-circles | M |
| OMEGADOT | 16 | 2-38 | semi-circles/sec | M |
| SV Health | 8 | --- | Boolean | M |
| A1/2(1) | 24 | 2-11 | meters1/2 | M |
| OMEGA0 | 24 | 2-23 | semi-circles | M |
|  | 24 | 2-23 | semi-circles | M |
| M0 | 24 | 2-23 | semi-circles | M |
| af0 | 11 | 2-20 | seconds | M |
| af1 | 11 | 2-38 | sec/sec | M |

**Acquisition** **Assistance**

The Acquisition Assistance field of the GPS Assistance Data Information Element contains parameters that enable fast acquisition of the GPS signals in network-based GPS positioning. Essentially, these parameters describe the range and derivatives from respective satellites to the Reference Location at the Reference Time. Table A.24 illustrates the assistance data occurring once per message and table A.25 illustrates the assistance data occurring per number of satellites for which acquisition assistance is being provided. Figure A.2 illustrates the relation between some of the fields.

This field is optional. The field would probably appear when the Method Type field of the Positioning Instructions IE is set to 0 (MS-Assisted) and the Positioning Methods field of the Position Instructions IE is set to 1 (GPS) or 2 (GPS or E-OTD).

Table A.24: GPS Acquisition Assist - Parameters appearing once per message

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | Range | Bits | Resolution | Incl. | Notes |
| Number of Satellites | | 0 - 15 | 4 |  | M |  |
| Reference Time | GPS TOW | 0 -604799,92 sec | 23 | 0,08 sec | M |  |
| BCCH Carrier | 0 - 1023 | 10 |  | O1 |  |
| BSIC | 0 - 63 | 6 |  | O1 |  |
| Frame # | 0 - 2097151 | 21 |  | O1 |  |
| Timeslots # | 0 - 7 | 3 |  | O1 |  |
| Bit # | 0 - 156 | 8 |  | O1 |  |
| NOTE: All of these field shall be present together, or none of them shall be present. | | | | | | |

Table A.25: GPS Acquisition Assist - Parameters appearing [number of satellites] times per message

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Range | Bits | Resolution | Incl. | Notes |
| SVID/PRNID | 1 - 64 (0 - 63 ) | 6 |  | M |  |
| Doppler (0th order term) | -5120 Hz to 5117,5 Hz | 12 | 2,5 Hz | M |  |
| Doppler (1st order term) | -1,0 - 0,5 Hz/sec. | 6 | 1/42 Hz/sec. | O1 |  |
| Doppler Uncertainty | 12.5 Hz - 200 Hz  [2-n(200) Hz, n = 0 - 4] | 3 |  | O1,3 |  |
| Code Phase | 0 - 1022 chips | 10 | 1 chip | M |  |
| Integer Code Phase | 0-19 | 5 | 1 C/A period | M |  |
| GPS Bit number | 0 - 3 | 2 |  | M |  |
| Code Phase Search Window | 1 - 192 chips | 4 |  | M |  |
| Azimuth | 0 - 348,75 deg | 5 | 11,25 deg | O2 |  |
| Elevation | 0 - 78,75 deg | 3 | 11,25 deg | O2 |  |
| NOTE 1: Both of these fields shall be present together, or none of them shall be present.  NOTE 2: Both of these fields shall be present together, or none of them shall be present.  NOTE 3: If Doppler Uncertainty Extension (Table A.29x) is present, Doppler Uncertainty shall be set to value 0 (200 Hz). | | | | | |



Figure A.2. Exemplary calculations of Acquisition Assistance fields.

This field indicates whether or not angle information is present in this message. The MS shall interpret a value of "1" to mean that angle (Azimuth and Elevation) information is present, and "0" to mean that it is not provided. This field is mandatory.

**Number of** **Satellites**

This field contains the number of satellites identified in this information element. This field is mandatory.

Range: 0 - 15

**Reference** **Time**

The Reference Time field of the GPS Acquisition Assistance Data IE specifies the relationship between GPS time and air-interface timing of the BTS transmission in the reference cell.

**GPS** **TOW** subfield specifies the GPS TOW for which the location estimate is valid. When the parameters BCCH Carrier/BSIC/Frame #/Timeslots #/Bit # are present, together with GPSTOW they provide a valid relationship between GPS and GSM time, as seen at the approximate location of the MS, ie the propagation delay from BTS to MS shall be compensated for by the SMLC. Depending on implementation, the relation between GPS and GSM time may have varying accuracy. The uncertainty of the timing relation may be provided in the optional field GPS Reference Time Uncertainty. If the propagation delay from BTS to MS is not accurately known, the SMLC shall use the best available approximation of the propagation delay and take the corresponding delay uncertainty into account in the calculation of the field GPS Reference Time Uncertainty. GPS TOW is mandatory when the GPS Acquisition Assistance Data Information Element is included. When the GSM time parameters are not present the GPS TOW is an estimate of current GPS time of week at time of reception of the RRLP segment containing the GPS TOW by the MS. The SMLC should achieve an accuracy of +/- 3 seconds for this estimate including allowing for the transmission delay between SMLC and MS of the RRLP segment containing GPS TOW. Note that the MS should further compensate GPS TOW for the time between the reception of the segment containing GPS TOW and the time when the GPS TOW field is used.

Range: 0 - 604799,92 sec

The **BCCH Carrier** # and **BSIC** subfields specify the reference cell for which GSM timing is provided. These subfields are optional when the GPS Acquisition Assistance Data Information Element is included. If included, the SMLC shall set the reference cell to the current serving cell. A target MS has the option of rejecting a GPS position request or GPS assistance data if the reference cell is not the serving cell.

The **Frame #** subfield specifies the GSM frame number of the BTS transmissions for the reference cell that occur at the given GPS TOW. This subfield is optional when the GPS Acquisition Assistance Data Information Element is included.

Range: 0 - 2097151

The **Timeslots #** subfield specifies the GSM timeslot of the BTS transmissions for the reference cell that occur at the given GPS TOW. This subfield is optional when the GPS Acquisition Assistance Data Information Element is included.

Range: 0 - 7

The **Bit #** subfield specifies the GSM and bit number of the BTS transmissions for the reference cell that occur at the given GPS TOW. This subfield is optional when the GPS Acquisition Assistance Data Information Element is included.

Range: 0 - 156

**SVID/PRNID**

This field identifies the particular satellite for which the measurement data is supplied. This value is the same as the PRN number provided in the navigation message transmitted by the particular satellite.

The range is 0 to 63, where SVID = PRNID - 1

**Doppler (0th order term)**

This field contains the Doppler (0th order term) value. A positive value defines the increase in satellite signal frequency due to velocity towards the MS. A negative value defines the decrease in satellite signal frequency due to velocity away from the MS. This field is mandatory.

Range: 5120 Hz to 5117,5 Hz

**Doppler (1st order term**)

This field contains the Doppler (1st order term) value. A positive value defines the rate of increase in satellite signal frequency due to acceleration towards the MS. A negative value defines the rate of decrease in satellite signal frequency due to acceleration away from the MS. This field is optional.

Range: -1,0 Hz to 0,5 Hz / s

**Doppler** **Uncertainty**

This field contains the Doppler uncertainty value. It is defined such that the Doppler experienced by a stationary MS is in the range "Doppler  Doppler Uncertainty" to "Doppler  Doppler Uncertainty". This field is optional. If Doppler Uncertainty (together with Doppler 1st order term) is omitted, the terminal shall interpret Doppler Uncertainty as greater than +/-200 Hz. If the Doppler Uncertainty Extension (Table A.29x) field is present, the MS that supports the Doppler Uncertainty Extension shall ignore this field.

Permitted Values: 12,5 Hz, 25 Hz, 50 Hz, 100 Hz, 200 Hz as encoded by an integer n in the range 0-4 according to the formula in Table A.25

**Code Phase**

This field contains code phase, in units of 1 GPS chip, in the range from 0 to 1022 GPS chips, where increasing binary values of the field signify increasing predicted pseudoranges, as seen by a receiver at the Reference Location at the time GPS TOW. The Reference Location would typically be an apriori estimate of the MS location. This field is mandatory.

Range: 0-1022 chips

**Integer** **Code** **Phase**

This field contains integer code phase, i.e. the number of the code periods that have elapsed since the latest GPS bit boundary, in units of C/A code period, as seen by a receiver at the Reference Location at the time GPS TOW. This field is mandatory.

Range: 0-19

**GPS Bit Number**

This field contains GPS bit number (expressed modulo 4) currently being transmitted at the time GPS TOW, as seen by a receiver at the Reference Location. This field is mandatory.

Range: 0-3

**Code Phase** **Search** **Window**

This field contains the code phase search window. The code phase search window accounts for the uncertainty in the estimated MS location but not any uncertainty in GPS TOW. 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". This field is mandatory.

Range: 0-15 (i.e. 1-512 chips according to following table)

Table A.26: Code Phase Search Window Parameter Format

|  |  |
| --- | --- |
| CODE\_PHASE\_WIN | Code Phase Search Window (GPS chips) |
| '0000' | 512 |
| '0001' | 1 |
| '0010' | 2 |
| '0011' | 3 |
| '0100' | 4 |
| '0101' | 6 |
| '0110' | 8 |
| '0111' | 12 |
| '1000' | 16 |
| '1001' | 24 |
| '1010' | 32 |
| '1011' | 48 |
| '1100' | 64 |
| '1101' | 96 |
| '1110' | 128 |
| '1111' | 192 |

**Azimuth**

This field together with the Azimuth LSB included in Acquisition Assistance Extension in Table A.29v contains the azimuth angle. An angle of x degrees means the satellite azimuth a is in the range (x  a < x+0,703125) degrees. This field is optional.

Range: 0 – 359,296875 degrees.

**Elevation**

This field together with the Elevation LSB included in Acquisition Assistance Extension in Table A.29v contains the elevation angle. An angle of y degrees means the satellite elevation e is in the range (y  e < y+0,703125) degrees except for y = 89,296875 where the range is extended to include 90 degrees. This field is optional.

Range: 0 – 89,296875 degrees

**Real-Time Integrity**

The Real-Time Integrity field of the GPS Assistance Data Information Element contains parameters that describe the real-time status of the L1C/A signal in GPS constellation. Primarily intended for non-differential applications, the real-time integrity of the satellite constellation is of importance as there is no differential correction data by which the mobile can determine the soundness of each satellite signal. The Real-Time GPS Satellite Integrity data communicates the health of the L1C/A signal to the mobile in real-time. The format is shown in table A.29. The SMLC shall always transmit the Real Time Integrity field with the current list of satellites with unhealthy L1C/A signal, for any A-GPS positioning attempt and whenever A-GPS assistance data is sent. The same applies for GANSS positioning attempt and assistance data when modernized GPS is involved. If the number of bad satellites (NBS) is zero, then the Real Time Integrity field shall be omitted. When the Extended Reference IE is included in the RRLP Measure Position Request message or in the RRLP Assistance Data message, then the MS shall interpret the absence of a Real Time Integrity field in the assistance data provided by the SMLC to mean that NBS is zero. If the Extended Reference IE is not present, this interpretation applies when the assistance data is provided by the SMLC following a previous request of the MS for Real Time Integrity data.

Table A.29: Real-Time Integrity - Parameters appearing NBS times

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| Bad\_SVID | 6 | 1 | 0-63 | --- | C |

**NBS (Number of Bad Satellites)**

The NBS value indicates the number of satellite ID's that follow. The user should not use the L1C/A signal of those satellites at this time in a fix. This NBS value is determined from the Bad\_SVID list.

**Bad\_SVID**

This six bit field appears NBS times, and indicates the SVID of satellites which L1C/A signal should not be used for fix by the user at this time. The values ranging from 0 to 63 represent satellite PRNs ranging from 1 to 64, respectively.

#### A.4.2.4a GPS Time Assistance Measurement Request Element

This element is optional and controls if the MS should return GPS time assistance measurements or not to the SMLC. The inclusion of this parameter implies use of measure Position Request The description is found in sub-chapter 2.2.4a.

#### A.4.2.4b GPS Reference Time Uncertainty Element

This element is conditional and provides the accuracy of the relation GPS and GSM time in the Acquisition Assistance in GPS Assistance Data Element. The interval, range and treatment is as described in sub-clause 2.2.4b.

#### A.4.2.4c Additional GPS Assistance Data

The Additional GPS Assistance Data Element contains additional GPS assistance data which are not included in the GPS Assistance Data Element. This element can contain one or more of the fields listed in Table A.29a below.

Table A.29a: Fields in the Additional GPS Assistance Data element

|  |  |  |
| --- | --- | --- |
| Parameter | Presence | Repetition |
| GPS Ephemeris Extension | O | Yes |
| GPS Ephemeris Extension Check | O | Yes |
| DGPS Corrections Validity Period | O | Yes |
| GPS Reference Time Extension | O | No |
| GPS Acquisition Assistance Extension | O | Yes |
| GPS Almanac Extension | O | No |
| GPS Acquisition Assistance Extension-R12 | O | Yes |

When RRLP pseudo-segmentation is used, Table A.29a indicates which parameters may be repeated in more than one RRLP segment in order to provide data for multiple satellites. When any such parameter appears in more than one segment, the following rules shall apply.

1. There shall be no repetition of the same data for the same satellite, even though there might be multiple realizations of the IEs for the same satellite. For example, GPS Ephemeris Extension may occur multiple times for the same satellite, but with different data content.

2. Optional and conditional elements in the parameter not associated with a particular satellite shall each appear in at most one RRLP segment.

3. Any mandatory element not associated with a particular satellite shall assume consistent values in the case of an element related to current GPS time and the same value otherwise.

4. The maximum number of satellites defined in sub-clause 5.1 for which data can be included for any parameter in one RRLP segment shall apply also when counted over all RRLP segments.

**GPS Ephemeris Extension**

The GPS Ephemeris extension contains parameters designed to extend the time of applicability of the Ephemeris terms by the continuous addition of the delta ephemeris terms to the respective terms of the referenced ephemeris.

This message can provide extension information for every satellite for many days into the future; doing so may create a large message, thus care must be taken to consider the transport bandwidth. The SMLC can limit the duration of the extension to decrease the message size. For example if the extension duration is limited to twelve hours the payload will be approximately 2,000 octets, for a typical 27 satellite constellation.

Table A.29.b: GPS Ephemeris Extension

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| gpsEphemerisHeader | See Table A.29.c | | --- | O |
| gpsReferenceSet | See Table A.29.e | | --- | O |
| ephemerisDeltaMatrix | List of GPSEphemerisDeltaEpochs | | | O |

Table A.29.c: GPS Ephemeris Header

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| GPS Ephemeris Extension (Once per message) | | | | |
| timeOfEstimation | See Table A.29.d | | --- | M |
| validityPeriod | 3 | 1 | Hours | M |
| ephemerisExtensionDuration | 9 | 1 | Hours | M |

**Time of Estimation**

The GPS Time at Estimation provides the GPS time at which the ephemeris extensions were created.

Table A.29.d: Time of Estimation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| GPS Week of Estimation | 10 | 1 | Week | M |
| GPS TOW of Estimation | 20 | 1 | Seconds | M |

**GPS Week of Estimation**

This field specifies the week of the time that the estimation was determined.

Range: 0 - 1023 weeks

**GPS TOW of Estimation**

Integer number of GPS TOW seconds within the current week of the time that the estimation was determined.

Range: 0 - 604800 s.

**Validity Period**

The validityPeriod indicates the validity period of the GPS Reference Set. It also indicates the default validity period of each individual delta ephemeris packet in the case that the individual validityPeriod is not present in the GPS Delta Epoch Header (see Table A.29.j). It is the length of time that the GPS Reference Set is intended to last and, if applicable, it is the length of time that the ephemeris constructed by application of the delta is intended to last.

Range: 1 – 8 hours.

**Ephemeris Extension Duration**

The Ephemeris Extension duration indicates the total block of time measured in units of hours that the extended ephemeris covers.

Range: 1 – 512 hours.

The gpsEphemeris header is mandatory only once in the delivery of the GPS Ephemeris Extension message.

**GPS Reference Set**

Table A.29.e: GPS Reference Set

|  |  |  |
| --- | --- | --- |
| Parameter | Presence | Note |
| GPS Reference Orbit | M | See Table A.29.f |

The GPS Reference Set is a list of GPS Reference Orbits, one for each healthy satellite vehicle at the time of construction.

**GPSReference Orbit**

Table A.29.f: GPS Reference Orbit

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| svID | 5 | 1 | --- | M |
| gpsOrbitModel | See Table A.29.g | | -- | M |
| gpsClockModel | See Table A.29.h | | -- | M |

**SvID**

The satellite vehicle ID identifying to which satellite the following orbital and clock model apply

**GPSOrbitModel**

This field is a structure that contains the Reference Nav Model satellite orbit information upon which all subsequent delta information will be applied to create the next ephemeris for use in navigation.

Table A.29.g: Reference Nav Model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| keplerToe | 16 | 24 | seconds | M |
| keplerW | 32 | 2-31 | hours | M |
| keplerDeltaN | 16 | 2-43 | semi-circles/sec | M |
| keplerM0 | 32 | 2-31 | semi-circles | M |
| keplerOmegaDot | 27 | 2-43 | semi-circles/sec | M |
| keplerE | 32 | 2-33 | --- | M |
| keplerIDot | 14 | 2-43 | semi-circles/sec | M |
| keplerAPowerHalf | 32 | 2-19 | Meters1/2 | M |
| keplerIO | 32 | 2-31 | semi-circles | M |
| kelerOmega0 | 32 | 2-31 | semi-circles | M |
| keplerCrs | 16 | 2-5 | meters | M |
| keplerCis | 16 | 2-29 | radians | M |
| keplerCus | 16 | 2-29 | radians | M |
| keplerCrc | 16 | 2-5 | meters | M |
| keplerCic | 16 | 2-29 | radians | M |
| KeplerCuc | 16 | 2-29 | radians | M |

**GPSClockModel**

This field is a structure that contains the satellite clock model upon which all subsequent clock information will be applied to create the next clock model for use in navigation.

**GPS Clock Model**

Table A.29.h: GPS Clock Model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| aF2 | 8 | 2-55 | seconds/seconds2 | M |
| aF1 | 16 | 2-43 | seconds/seconds | M |
| aF0 | 22 | 2-31 | seconds | M |
| tgd | 8 | 2-31 | seconds | M |

**GPS Ephemeris Delta Matrix**

GPS Ephemeris Delta Matrix is a list of GPS Ephemeris Delta Epochs. Each epoch is indicated by a unique seqNum. Each epoch corresponds to a specific update interval and contains a delta epoch header and ephemeris delta elements for all PRNs for that epoch.

**GPS Ephemeris Delta Epoch**

Table A.29.i: GPS Ephemeris Delta Epoch

|  |  |  |
| --- | --- | --- |
| Parameter | Note | Incl. |
| gpsDeltaEpochHeader | See Table A.29.j | O |
| gpsDeltaElementList | List of GPS Ephemeris Delta Elements | M |

**GPS Delta Epoch Header**

Table A.29.j: GPS Delta Epoch Header

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| validityPeriod | 3 | 1 | Hours | O |
| ephemerisDeltaSizes | See Table A.29.k | | | O |
| ephemerisDeltaScales | See Table A.29.l | | | O |

**Validity Period**

The validityPeriod indicates the validity period of each individual delta ephemeris packet. It is the length of time that the ephemeris constructed by application of the delta is intended to last. If not present then the default validityPeriod in the GPS Ephemeris Header IE applies (see Table A.29.c).

Range: 1 – 8 hours.

**Ephemeris Delta Sizes**

This field is a structure that indicates the bit sizes for all the fields in the GPS Ephemeris Delta structure.

Table A.29.k: GPS Ephemeris Delta Sizes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| bitSize\_delta\_ | 5 | 1 | --- | M |
| bitSize\_delta\_n | 4 | 1 | --- | M |
| bitSize\_delta\_M0 | 5 | 1 | --- | M |
| bitSize\_delta\_OMEGAdot | 5 | 1 | --- | M |
| bitSize\_delta\_e | 5 | 1 | --- | M |
| bitSize\_delta\_Idot | 4 | 1 | --- | M |
| bitSize\_delta\_sqrtA | 5 | 1 | --- | M |
| bitSize\_delta\_i0 | 5 | 1 | --- | M |
| bitSize\_delta\_OMEGA0 | 5 | 1 | --- | M |
| bitSize\_delta\_Crs | 4 | 1 | --- | M |
| bitSize\_delta\_Cis | 4 | 1 | --- | M |
| bitSize\_delta\_Cus | 4 | 1 | --- | M |
| bitSize\_delta\_Crc | 4 | 1 | --- | M |
| bitSize\_delta\_Cic | 4 | 1 | --- | M |
| bitSize\_delta\_Cuc | 4 | 1 | --- | M |
| bitSize\_delta\_tgd | 4 | 1 | --- | M |

**Ephemeris Delta Scales**

This field is a structure that indicates the scale factor modifiers for all the fields in the GPS Ephemeris Delta structure.

Table A.29.l: GPS Ephemeris Delta Scales

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| scale\_delta\_ | 5 | 1 | --- | M |
| scale\_delta\_n | 5 | 1 | --- | M |
| scale\_delta\_M0 | 5 | 1 | --- | M |
| scale\_delta\_OMEGAdot | 5 | 1 | --- | M |
| scale\_delta\_e | 5 | 1 | --- | M |
| scale\_delta\_Idot | 5 | 1 | --- | M |
| scale\_delta\_sqrtA | 5 | 1 | --- | M |
| scale\_delta\_i0 | 5 | 1 | --- | M |
| scale\_delta\_OMEGA0 | 5 | 1 | --- | M |
| scale\_delta\_Crs | 5 | 1 | --- | M |
| scale\_delta\_Cis | 5 | 1 | --- | M |
| scale\_delta\_Cus | 5 | 1 | --- | M |
| scale\_delta\_Crc | 5 | 1 | --- | M |
| scale\_delta\_Cic | 5 | 1 | --- | M |
| scale\_delta\_Cuc | 5 | 1 | --- | M |
| scale\_delta\_tgd | 5 | 1 | --- | M |

**GPS Delta Element List**

GPS Delta Element List is a list of GPS Ephemeris Delta Elements

**GPS Ephemeris Delta Element**

Each GPS Ephemeris Delta Element is encoded as an octet string of up to 47 octets. Each element is uniquely identified by the pair (seqNum, sv\_ID) and it is defined as a structure as shown in table A.29.m. The MS should parse the octet string according to the fields specified in table A.29.m. Each element in table A.29.m but for seqNum and sv\_ID should be treated as a signed integer. The actual number of octets is determined by the size of the bit fields in the GPS\_Ephemeris\_Delta\_Sizes table (table A.29.k). Each set of up to 47 octets represents a single extension for a single satellite vehicle. Each element encodes the satellite vehicle ID and the sequence number. The sequence number specifies the order in which the individual ephemeris extension elements are assembled as time marches forward to create the next ephemeris. The sequence number is the same for all satellite vehicle IDs for a particular update period.

Table A.29.m: GPS Ephemeris Delta Element

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Default # Bits | Scale Factor | Default Scale | Units | Incl. |
| sequenceNum | 7 |  | 1 | 1 | --- | M |
| svID | 5 |  | 1 | 1 | --- | M |
| delta\_ | 1..32 (1) | 21 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | semi-circles | M |
| delta\_n | 1..16 (1) | 12 | 2-16\*2-43 .. 215\*2-43 (2) | 2-43 | semi-circles/sec | M |
| delta\_M0 | 1..32 (1) | 21 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | semi-circles | M |
| delta\_OMEGAdot | 1..24 (1) | 13 | 2-16\*2-43 .. 215\*2-43 (2) | 2-43 | semi-circles/sec | M |
| delta\_e | 1..32 (1) | 18 | 2-16\*2-33 .. 215\*2-33 (2) | 2-33 | --- | M |
| delta\_Idot | 1..14 (1) | 11 | 2-16\*2-43 .. 215\*2-43 (2) | 2-43 | semi-circles/sec | M |
| delta\_sqrtA | 1..32 (1) | 14 | 2-16\*2-19 .. 215\*2-19 (2) | 2-19 | meters1/2 | M |
| delta\_i0 | 1..32 (1) | 14 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | semi-circles | M |
| delta\_OMEGA0 | 1..32 (1) | 14 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | semi-circles | M |
| delta\_Crs | 1..16 (1) | 12 | 2-16\*2-5 .. 215\*2-5 (2) | 2-5 | meters | M |
| delta\_Cis | 1..16 (1) | 11 | 2-16\*2-29 .. 215\*2-29 (2) | 2-29 | radians | M |
| delta\_Cus | 1..16 (1) | 12 | 2-16\*2-29 .. 215\*2-29 (2) | 2-29 | radians | M |
| delta\_Crc | 1..16 (1) | 12 | 2-16\*2-5 .. 215\*2-5 (2) | 2-5 | meters | M |
| delta\_Cic | 1..16 (1) | 11 | 2-16\*2-29 .. 215\*2-29 (2) | 2-29 | radians | M |
| delta\_Cuc | 1..16 (1) | 12 | 2-16\*2-29 .. 215\*2-29 (2) | 2-29 | radians | M |
| delta\_tgd | 1..16 (1) | 2 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | seconds | M |

(1) The number of bits of each signed integer field is variable and it is indicated once for all numEphemerisDeltas by the structure ephemerisDeltasSizes. When the ephemerisDeltaSizes field is not present, the values found in the columns "Default # Bits" shall be used.

(2) The scale factor of each parameter is variable around the default scale factor. The variation for each field is indicated once for all numEphemerisDeltas by the structure ephemerisDeltasScales. For example, if the scale factor modifier for delta\_omega has a value of 4, the scale factor for delta\_omega is 24 \* 2-31. When the ephemerisDeltaScales is not used, the values found in the column "Default Scale" shall be used.

**sequenceNum**

This field indicates the order of the Ephemeris delta terms. The ephemeris constructed for use in satellite positioning is built by adding the delta terms to the referenced GPS\_Navigation Model in the order dictated by this sequence number. The sequence number shall remain the same for each svID in an epoch of Ephemeris Deltas corresponding to a particular update interval.

**svID**

This field identifies the satellite ID within a particular sequenceNum or epoch.

These fields, with the exception of sequenceNum and svID, specify the deltas to be added to the existing Ephemeris to create a new Ephemeris suite that is extended from its predecessor by the time provided in the "validityPeriod" parameter. To compute the time of ephemeris for the newly constructed ephemeris, validityPeriod is added to the preceding toe. The ephemeris time of clock (toc) is set equal to the toe.

For each of the other ephemeris terms the corresponding delta ephemeris term is added in order to create the updated ephemeris. The terms delta\_M0, delta\_i0, and delta\_OMEGA0 of the delta ephemeris must be extrapolated prior to the addition of the delta terms as follows:

Where is the WGS 84 value of the earth's gravitational constant for GPS user and is equal to 3,986005 \* 1014 m3/sec2, and A(i) is the semi-major axis associated with this satellite's update. The extrapolation of delta\_M0, uses the prior set's sqrtA term to compute A(i) as the square of sqrtA(i).

delta\_OMEGA0(i+1) = delta\_OMEGA0(i) + delta\_OMEGAdot(i) \* dt

i0 (i+1) = i0(i) + Idot(i) \* dt

Where dt is equal to the validity period \* 3600. The terms af0, and af1 from the GPS clock model must be extrapolated as follows:

af0(i+1) = af0(i) + af1(i)\* dt + af2\*dt2

af1(i+1) = af1(i) + 2 \* af2(i) \* d**t**

af2(i+1) = af2(i)

Where af0, af1, and af2 are the clock model terms as shown in table A.29.c

dt is equal to the validity period represented in seconds (validityPeriod \* 3600)

The following demonstrates the application of the ephemeris extension technique. Assume the validityPeriod = 5, representing: (5+1) hours = 6 hours, and the GPS Navigation model for a particular satellite, identified by the reference IOD has a toe = 0 seconds.

The toe for sequenceNumber 1 is computed by adding the validityPeriod to the initial toe of 0 as 0 + 6 hours = 0 + 21600 seconds. The new ephemeris is constructed by adding the delta ephemeris terms from set 1 to the reference ephemeris creating the new ephemeris, which will be used for the next six hours. For the five terms listed above (delta\_M0, delta\_i0, delta\_OMEGA0, af0, and af1) the extrapolation described must occur prior to the addition of the delta term.

The next ephemeris computation will occur by adding the validityPeriod to the current toe of 21600 as: 21600 + 6 hours = 21600 + 21600 = 43200. The ephemeris delta terms from set two are added to the ephemeris resulting from the prior addition to create the next ephemeris. This is done for each satellite vehicle ID.

**GPS Ephemeris Extension check**

The GPS Ephemeris Extension check provides information about non foreseen events that occurred during the period starting at the gpsBeginTime to the current time. An event is signified through a bit string . Each bits refers to one PRN. If a bit is set to one, this means that the ephemeris extension is no longer valid for this specific PRN. In order to indicate planned future manuvers an end time is provided. The SMLC can indicate that a future event is planned between the current time and the end time of this ephemeris extension.

Table A.29.n: Ephemeris Extension check

|  |  |  |
| --- | --- | --- |
| Parameter | Presence | Note |
| gpsBeginTime | M | See Table A.29o |
| gpsEndTime | M | See Table A.29p |
| gpsSatEventsInfo | M | See Table A.29q |

**GPS Begin Time**

The GPS begin time corresponds to the GPS Week and GPS Seconds of Estimation of the ephemeris extensions block.

Table A.29.o: GPS Begin Time

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| GPS Week | 10 | 1 | Weeks | M |
| GPS TOW | 20 | 1 | Seconds | M |

**GPS End Time**

The GPS end time represents the final time the Ephemeris extension is valid.

Table A.29.p: GPS End Time

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| GPS Week | 10 | 1 | Weeks | M |
| GPS TOW | 20 | 1 | Seconds | M |

**GPS Sat Event Information**

This IE is designed to indicate events that have or may occur between the gpsBeginTime and the gpsEndTime.

Table A.29.q: GPS Sat Event Information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| EventOccurred | 32 | - | - | M |
| FutureEventNoted | 32 | - | - | M |

**EventOccurred**

If a bit is is clear in the eventOccured field it indicates that a satellite maneuver has not occurred since the ganssBeginTime nor is a maneuver planned for the next sixty minutes.

**FutureEventNoted**

If a bit is set in the futureEventNoted field it indicates that a maneuver is planned during the time period between current time plus sixty minutes and gpsEndTime

**DGPS Corrections Validity Period**

This element is an extension to the DGPS Corrections IE and provides the validity period of the differential corrections for each satellite included in the DGPS Corrections IE (see Table A.15). This element may only be included if the DGPS Corrections IE is included in the GPS Assistance Data element.

Table A.29r: DGPS Corrections Validity Period

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| N\_SAT | 4 | 1 | 1-16 | --- | M |
| The following fields occur once per satellite (N\_SAT times) | | | | | |
| SatID | 6 | --- | 0-63 | -- | M |
| UDRE Growth Rate | 3 | --- | 0-7 | --- | M |
| Time of Validity for UDRE Growth Rate | 3 | --- | 0-7 | --- | M |

**N\_SAT**

This field indicates the number of satellites for which differential corrections validity period is available. This field shall be set to the same value as the N\_SAT parameter in the DGPS Corrections element in Table A.15.

**SatID**

This field identifies the satellite for which the corrections validity period is applicable. The values ranging from 0 to 63 represent satellite PRNs ranging from 1 to 64, respectively. The UDRE Growth Rate and Time of Validity for UDRE Growth Rate IEs shall be included for the same satellite IDs as the differential corrections in Table A.15 are provided.

**UDRE Growth Rate**

This field provides an estimate of the growth rate of uncertainty (1-) in the corrections for the particular satellite identified by SatID. The estimated UDRE at time value specified in the "Time of Validity for UDRE Growth Rate" *t1* is calculated as follows:

UDRE(*t0*+*t1*) = UDRE(*t0*)  UDRE Growth Rate

where *t0* is the DGPS Reference Time GPS TOW for which the corrections in Table A.15 are valid, *t1* is the "Time of Validity for UDRE Growth Rate" field as shown in Table A.29t, UDRE(*t0*) is the User Differential Range Error field as provided in Table A.15, and "UDRE Growth Rate" field is the factor as shown in Table A.29s.

Table A.29s: Values of UDRE Growth Rate IE

|  |  |
| --- | --- |
| Value | Indication |
| 000 | 1,5 |
| 001 | 2 |
| 010 | 4 |
| 011 | 6 |
| 100 | 8 |
| 101 | 10 |
| 110 | 12 |
| 111 | 16 |

**Time of Validity for UDRE Growth Rate**

This field specifies the time when the "UDRE Growth Rate" field applies. The meaning of the values for this field is described in Table A.29t.

Table A.29t: Time of Validity for UDRE Growth Rate IE

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

**GPS Reference Time Extension**

This element is an extension to the Reference Time IE and is shown in Table A.29u. If Reference Time is provided by the SMLC, the GPS Reference Time Extension shall also be provided.

NOTE: For reasons of backward compatibility, this IE is not defined for a Release 9 or earlier SMLC and would be ignored, when received, by a Release 9 or earlier MS. This means that when the element is expected but is not received, the SMLC is Release 9 or earlier.

Table A.29u: Reference Time Extension

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| GPS Week Cycle Number | 3 | 1 | 0 - 7 | 1024 weeks | M |

**GPS Week Cycle Number**

This field provides the number of 1024 GPS week cycles occurred since the GPS zero time-point (midnight of the night of January 5, 1980/morning of January 6, 1980). The first 1024 GPS weeks since the zero time-point is GPS Week Cycle Number 0.

**GPS Acquisition Assistance Extension**

This element is an extension to the Acquisition Assistance IE and is shown in Table A.29v. If Acquisition Assistance is provided by the SMLC, the GPS Acquisition Assistance Extension shall also be provided.

NOTE: For reasons of backward compatibility, this IE is not defined for a Release 9 or earlier SMLC and would be ignored, when received, by a Release 9 or earlier MS. This means that when the element is expected but is not received, the SMLC is Release 9 or earlier.

Table A.29v: Acquisition Assistance Extension

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| N\_SAT | 4 | 1 | 0-15 | --- | M |
| The following fields occur once per satellite (N\_SAT times) | | | | | |
| SatID | 6 | --- | 0-63 | -- | M |
| Azimuth LSB | 4 | 0,703125 | 0-10,546875 | degrees | M |
| Elevation LSB | 4 | 0,703125 | 0-10,546875 | degrees | M |

**N\_SAT**

This field indicates the number of satellites for which Acquisition Assistance is provided. This field shall be set to the same value as the Number of Satellites parameter in theAcquisition Assist element in Table A.24.

**SatID**

This field identifies the satellite for which the Acquisition Assistance is provided. This field shall be set to the same value as the SVID/PRN field in Table A.25.

**Azimuth LSB**

This field specifies the 4 least significant bits of the satellite azimuth angle. The 5 most significant bits are provided in the Azimuth field in Table A.25. The full satellite azimuth is constructed as "Azimuth"  11,25 + "Azimuth LSB"  0,703125 degrees.

**Elevation LSB**

This field specifies the 4 least significant bits of the satellite elevation angle. The 5 most significant bits are provided in the Elevation field in Table A.25. The full satellite elevation is constructed as "Elevation"  11,25 + "Elevation LSB"  0,703125 degrees.

**GPS Almanac Extension**

This element is an extension to the Almanac IE and and is shown in Table A.29w. If Almanac is provided by the SMLC, the Almanac Extension shall also be provided.

NOTE: For reasons of backward compatibility, this IE is not defined for a Release 9 or earlier SMLC and would be ignored, when received, by a Release 9 or earlier MS. This means that when the element is expected but is not received, the SMLC is Release 9 or earlier.

Table A.29w: Almanac Extension

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| Complete Almanac Provided | 1 | --- | --- | Boolean | M |

**Complete Almanac Provided**

This field indicates whether the SMLC provided Almanac for the full GPS constellation or not. TRUE means complete GPS almanac is provided.

**GPS Acquisition Assistance Extension-R12**

This element is an extension to the Acquisition Assistance IE and is shown in Table A.29x. The SMLC should include this field only if supported by the MS.

Table A.29x: Acquisition Assistance Extension-R12

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| Confidence | 7 | 1 | 0-100 | percent | O |
| N\_SAT | 4 | 1 | 0-15 | --- | O |
| The following fields occur once per satellite (N\_SAT times) | | | | | |
| SatID | 6 | --- | 0-63 | -- | M |
| Doppler Uncertainty Extension | 3 | --- | 300, 400, 500, 600, 'No Information' | Hz | M |

**Confidence**

This field specifies the confidence level of the reference location area or volume used to calculate the GPS Acquisition Assistance parameters (search windows). A high percentage value (e.g., 98% or more) indicates to the MS that the provided search windows are reliable. The SMLC should include this field to indicate the confidence level of the provided information.

Range: 0 – 100

**N\_SAT**

This field indicates the number of satellites for which GPS Acquisition Assistance Extension-R12 is provided.

**SatID**

This field identifies the satellite for which the GPS Acquisition Assistance Extension-R12 is provided.

**Doppler Uncertainty Extension**

If this field is present, the MS that supports this field shall ignore the Doppler Uncertainty (Table A.25) field. This field specifies additional Doppler uncertainty values. It is defined such that the Doppler experienced by a stationary MS is in the range [Doppler-Doppler Uncertainty Extension] to [Doppler+Doppler Uncertainty Extension].

Enumerated values define 300 Hz, 400 Hz, 500 Hz, 600 Hz, and "No Information".

#### A.4.2.5 More Assistance Data To Be Sent Element

#### A.4.2.5 More Assistance Data To Be Sent Element

This element is set by the SMLC to indicate to the MS if more Assistance Data components or a the final RRLP Measure Position Request component will be sent in the current procedure in order to deliver the entire set of assistance data.

#### A.4.2.6 GANSS Assistance Data

The GANSS Assistance Data consists of two or more data elements depending on the number of GNSS constellations included in the GANSS Assistance Data. GANSS Assistance Data elements are of two different types: GANSS Common Assistance Data and GANSS Generic Assistance Data. GANSS Common Assistance Data element is included at most only once and it contains Information Elements that can be used with any GNSS constellation. GANSS Generic Assistance data element can be included multiple times depending on the number of GNSS constellations supported in the GANSS Assistance Data. One GANSS Generic Assistance Data element contains Information Elements dedicated only for one specific GNSS constellation at a time. If two or more constellations are supported, GANSS Generic Assistance Data is given for each constellation separately.

The fields in GANSS Assistance Data are listed in Table A.30 below. As table A.30 shows, all fields are optional.

Table A.30: Fields in the GANSS Assistance Data element

|  |  |  |
| --- | --- | --- |
| Element | Presence | Repetition |
| GANSS Common Assistance Data | O | No |
| GANSS Generic Assistance Data | O | Yes |

When RRLP pseudo-segmentation is used, Tables A.30, A.31 and A.39 indicate which elements may be repeated in more than one RRLP segment in order to provide data for multiple constellations, satellites or signals. When any such element – with the exception of the GANSS ID and SBAS ID element – appears in more than one segment, the following rules shall apply.

1. There shall be no repetition of the same data for the same constellation, satellite or signal even though there might be multiple realizations of the IEs for the same constellation, satellite or signal. For example, DGANSS corrections may occur multiple times for the same satellite.

2. Optional and conditional fields in the element not associated with a particular satellite or signal shall each appear in at most one RRLP segment.

3. Any mandatory field not associated with a particular satellite or signal shall assume consistent values in the case of a field related to current reference time and the same value otherwise.

4. The maximum number of constellations, satellites or signals defined in sub-clause 5.1 for which data can be included for any parameter in one RRLP segment shall apply also when counted over all RRLP segments.

#### A.4.2.6.1 GANSS Common Assistance Data

GANSS Common Assistance Data element contains GNSS constellation independent information elements that can be applied on any specific GNSS or on a combination of GNSS. GANSS Common Assistance Data fields are included in GANSS Assistance Data only once. This element can contain one or more of the fields listed in table A.31 below. As Table A.31 shows, all fields are optional.

Table A.31: GANSS Common Assistance Data content

|  |  |  |
| --- | --- | --- |
| Element | Presence | Repetition |
| GANSS Reference Time | O | No |
| GANSS Reference Location | O | No |
| GANSS Ionospheric Model | O | No |
| GANSS Additional Ionospheric Model | O | No |
| GANSS Earth Orientation Parameters | O | No |
| GANSS Reference Time Extension | O | No |

**GANSS Reference** **Time**

This field specifies the GANSS Time Of Day (TOD) with uncertainty and relationship between GANSS Reference Time and air-interface timing of the BTS transmission in the reference cell. These fields occur once per message; some are mandatory and some are optional, as shown in Table A.33.

When GANSS TOD -GSM Time association is present, GANSS TOD and BCCH/BSIC/FNm/TN/BN IEs provide a valid relationship between GANSS TOD and GSM time, as seen at the approximate location of the MS, i.e. the propagation delay from BTS to MS shall be compensated for by the SMLC. Depending on implementation, the relation between GANSS TOD and GSM time may have varying accuracy. Therefore, the uncertainty of the timing relation is provided in GANSS TOD Uncertainty. If the propagation delay from BTS to MS is not accurately known, the SMLC shall use the best available approximation of the propagation delay and take the corresponding delay uncertainty into account in the calculation of the field GANSS TOD Uncertainty. When GANSS TOD -GSM Time association is not present, GANSS TOD is an estimate of current GANSS TOD at time of reception of the RRLP segment containing this data by the MS. The SMLC should achieve an accuracy of +/- 3 seconds for this estimate including allowing for the transmission delay between SMLC and MS of the RRLP segment containing GANSS TOD. Note that the MS should further compensate GANSS TOD for the time between the reception of the segment containing GANSS TOD and the time when the GANSS TOD field is used.

Table A.33: GANSS Reference Time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| GANSS Reference Time Information (once per message) | | | | | |
| GANSS Day | 13 | 1 | 0 - 8191 | day | M |
| GANSS TOD | 17 | 1 | 0 - 86399 | sec | M |
| GANSS TOD Uncertainty | 7 | - | 0…127 | - | O |
| GANSS\_TIME\_ID | 3 | --- | --- | --- | O (note 3) |
| GANSS TOD - GSM Time Association (once per message) | | | | | |
| BCCH Carrier | 10 | 1 | 0 - 1023 | --- | O (note 1) |
| BSIC | 6 | 1 | 0 - 63 | --- | O (note 1) |
| FNm | 21 | 1 | 0 - (221-1) | frames | O (note 1) |
| TN | 3 | 1 | 0 - 7 | timeslots | O (note 1) |
| BN | 8 | 1 | 0 - 156 | bits | O (note 1) |
| FN1 | 7 | 2-30 | -5,9605e-8 - +5,8673e-8 | sec/sec | O (note 2) |
| NOTE 1: All of these fields shall be present together, or none of them shall be present. | | | | | |
| NOTE 2: This field can be optionally included if GANSS TOD - GSM Time association is present. | | | | | |
| NOTE 3. Absence of this field means Galileo system time. | | | | | |

**GANSS Day**

This field specifies the sequential number of days (with day count starting at 0) from the origin of the GNSS system time indicated by GANSS\_TIME\_ID modulo 8192 days (about 22 years). The GNSS system time origin is defined in Table A.34 for each GANSS.

NOTE: The number of 8192 day cycles since the GANSS zero time-point is provided in the GANSS Reference Time Extension in Table A.35c.

**GANSS TOD**

Integer number of GANSS TOD seconds within the current day.

Range: 0 - 86399 s.

**GANSS TOD Uncertainty**

GANSS TOD uncertainty value as described in 3.2.9. This field is optional.

**GANSS\_TIME\_ID**

This field specifies the GNSS system time used in GANSS Reference Time. The SMLC shall set the GANSS\_TIME\_ID only to system times for corresponding GANSSs supported by the MS.

Table A.34: GANSS\_TIME\_ID

|  |  |  |
| --- | --- | --- |
| GANSS\_TIME\_ID | Indication | GNSS System Time Origin |
| Galileo System Time | (default) | 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 |
| GPS System Time | 0 | January 6, 1980; 00:00:00 UTC(USNO) |
| QZSS System Time | 1 | January 6, 1980; 00:00:00 UTC(USNO) |
| GLONASS System Time | 2 | 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 [17] |
| BDS | 3 | January 1, 2006 00:00:00 UTC (NTSC) |
| Reserved for future use | 4 - 7 | – |

**BCCH Carrier/BSIC/FNm/TN/BN/FN1**

These fields specify the state of the GSM frame number, respectively, of the reference BTS with the specified BCCH carrier and BSIC at the time that correspond to GANSS TOD. Also, the drift rate of the frame timing, FN1, with respect to the GANSS TOD is optionally given. The SMLC shall use the current serving BTS as the reference BTS. The target MS has the option of rejecting a GANSS position request or GANSS assistance data if the reference BTS is not the serving BTS. If FNm field is present in the assistance, cellular time parameters FNm/TN/BN shall be aligned with the integer GANSS TOD second given in GANSS TOD field.

**GANSS Reference** **Location**

The Reference Location field contains a 3-D location (with uncertainty) specified as per 3GPP TS 23.032. The purpose of this field is to provide the MS with a priori knowledge of its location in order to improve GNSS receiver performance. The allowed shape is 3-D location with uncertainty (ellipsoid point with altitude and uncertainty ellipsoid). As defined in 3GPP TS 23.032, the GANSS Reference Location is provided in WGS-84 reference system.

NOTE: If GPS Assistance Data component is present as well, the SMLC should include the Reference Location either in the GPS Assistance Data or GANSS Common Assistance Data element.

**GANSS Ionospheric** **Model**

GANSS Ionospheric Model contains parameters to model the propagation delay of the GNSS signals through the ionosphere. The information elements in this field are shown in Table A.35. Proper use of these fields as defined in [11] allows a single‑frequency GNSS receiver to remove the ionospheric delay from the pseudorange measurements.

Table A.35: GANSS Ionospheric Model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| GANSS Ionosphere Model Parameters | | | | |
| ai0 | 11 | 2-2 | Solar Flux Units | M |
| ai1 | 11 | 2-8 | Solar Flux Units/degree | M |
| ai2 | 14 | 2-15 | Solar Flux Units/degree2 | M |
| GANSS Ionosphere Regional Storm Flags | | | | |
| Storm Flag 1 | 1 | --- | --- | O (note 1) |
| Storm Flag 2 | 1 | --- | --- | O (note 1) |
| Storm Flag 3 | 1 | --- | --- | O (note 1) |
| Storm Flag 4 | 1 | --- | --- | O (note 1) |
| Storm Flag 5 | 1 | --- | --- | O (note 1) |
| NOTE 1: All of these fields shall be present together, or none of them shall be present. | | | | |

**GANSS Ionosphere Parameters**

The ionosphere model parameters are used to estimate the ionospheric distortions on pseudoranges as described in [11] section 5.1.6.

**GANSS Ionosphere Regional Storm Flags**

These fields specify the Ionosphere disturbance flags (1,…,5) for five different regions as described in [11] section 5.1.6. If the ionosphere disturbance flag for a region is not present the target device shall treat the ionosphere disturbance condition as unknown.

**GANSS Additional Ionospheric** **Model**

The GANSS Additional Ionospheric Model contains parameters to model the propagation delays of the GANSS signals through the ionosphere. The information elements in this field are shown in table A.35.a.

When Data ID 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 [16]. When Data ID has the value '00' it indicates the parameters are applicable worldwide [16]. All other values for Data ID are reserved. When Data ID 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 [18].

Table A.35.a: GANSS Additional Ionospheric Model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| Data ID | 2 | -- | See text | M |
| 0 | 8 | 2-30 | seconds | M |
| 1 | 8 | 2-27 | sec/semi-circle | M |
| 2 | 8 | 2-24 | sec/(semi-circle)2 | M |
| 3 | 8 | 2-24 | sec/(semi-circle)3 | M |
| 0 | 8 | 211 | seconds | M |
| 1 | 8 | 214 | sec/semi-circle | M |
| 2 | 8 | 216 | sec/(semi-circle)2 | M |
| 3 | 8 | 216 | sec/(semi-circle)3 | M |

**GANSS Earth Orientation Parameters**

The GANSS Earth Orientation Parameters provides parameters to construct the ECEF and ECI coordinate transformation as defined in [12] and are shown in Table A.35.b. GANSS Earth Orientation Parameters indicate the relationship between the Earth's rotational axis and WGS-84 reference system.

Table A.35.b: GANSS Earth Orientation Paramaters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| tEOP | 16 | 24 | seconds | M |
| PM\_X | 21 | 2-20 | arc-seconds | M |
| PM\_X\_dot | 15 | 2-21 | arc-seconds/day | M |
| PM\_Y | 21 | 2-20 | arc-seconds | M |
| PM\_Y\_dot | 15 | 2-21 | arc-seconds/day | M |
| UT1 | 31 | 2-24 | seconds | M |
| UT1\_dot | 19 | 2-25 | seconds/day | M |

**GANSS Reference Time Extension**

This element is an extension to the GANSS Reference Time IE and is shown in Table A.35c. If GANSS Reference Time is provided by the SMLC, the GANSS Reference Time Extension shall also be provided.

NOTE: For reasons of backward compatibility, this IE is not defined for a Release 9 or earlier SMLC and would be ignored, when received, by a Release 9 or earlier MS. This means that when the element is expected but is not received, the SMLC is Release 9 or earlier.

Table A.35c: GANSS Reference Time Extension

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| GANSS Day Cycle Number | 3 | 1 | 0 - 7 | 8192 days | M |

**GANSS Day Cycle Number**

This field provides the number of 8192 day cycles occurred since the GANSS zero time-point defined in Table A.34. The first 8192 GANSS days since the zero time-point is GANSS Day Cycle Number 0.

#### A.4.2.6.2 GANSS Generic Assistance Data

GANSS Generic Assistance data elements contain Information Elements that are applied on one specific GNSS at a time indicated by GANSS\_ID. The format of the IE's remains the same regardless of the GANSS; only the values of the parameters and inclusion of certain optional fields will vary.

GANSS Generic Assistance Data is repeated for each GNSS included in GANSS Assistance Data. GANSS Generic Assistance Data can contain one or more of the elements listed in Table A.39 below. As Table A.39 shows, all fields are optional.

Table A.39: GANSS Generic Assistance Data content

|  |  |  |
| --- | --- | --- |
| Element | Presence | Repetition |
| GANSS ID | O (note 1) | Yes |
| GANSS Time Model | O | Yes |
| DGANSS Corrections | O | Yes |
| GANSS Navigation Model | O | Yes |
| GANSS Real-Time Integrity | O | Yes |
| GANSS Data Bit Assistance | O | Yes |
| GANSS Reference Measurement Information | O | Yes |
| GANSS Almanac Model | O | Yes |
| GANSS UTC Model | O | Yes |
| GANSS Ephemeris Extension | O | Yes |
| GANSS Ephemeris Ext Check | O | Yes |
| SBAS ID | O | Yes |
| GANSS Additional UTC Model | O | Yes |
| GANSS Auxiliary Information | O | Yes |
| DGANSS Corrections Validity Period | O | Yes |
| GANSS Time Model Extension | O | Yes |
| GANSS Reference Measurement Extension | O | Yes |
| GANSS Almanac Model Extension | O | Yes |
| GANSS Almanac Model Extension-R12 | O | Yes |
| GANSS Reference Measurement Extension-R12 | O | Yes |
| DBDS Corrections | O (note 2) | Yes |
| BDS Grid Model | O (note 2) | Yes |
| NOTE 1: Absence of this field means Galileo.  NOTE 2: The field may be present if the GANSS ID = BDS; otherwise it is not present. | | |

**GANSS\_ID**

This field indicates the GNSS for which the following assistance data IE's in GANSS Generic Assistance Data element are dedicated. The supported GANSS are listed in Table A.40. Absence of this field indicates Galileo. If GANSS ID indicates SBAS, the SBAS ID shall be included to indicate the specific SBAS addressed.

Range: 0 - 7

Table A.40: GANSS\_ID

|  |  |
| --- | --- |
| GANSS\_ID | Indication |
| SBAS | 0 |
| Modernized GPS | 1 |
| QZSS | 2 |
| GLONASS | 3 |
| BDS | 4 |
| Reserved for future use | 5-7 |

**GANSS Time Model**

This field specifies a model to relate GNSS system time to a selected time reference. GNSS Time Offset ID (GNSS\_TO\_ID) identifies the GNSS for which the relation is provided.

The SMLC may send multiple GANSS Time Models (up to 7) for a specific GNSS depending on the number of the allowed satellite systems in GANSS Positioning Method. For example, the SMLC may send two GANSS Time Models for Galileo to give the relations between Galileo and two GNSS system times.

NOTE: The integer number of seconds of the GNSS-GNSS Time Offset is provided in the GANSS Time Model Extension in Table A.55.22.

Table A.41: GANSS Time Model

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| GANSS Time Model Reference Time | 16 | 24 | 0 - 604784 | s | M |
| TA0 | 32 | 2-35 |  | sec | M |
| TA1 | 24 | 2-51 |  | sec/sec | O (NOTE) |
| TA2 | 7 | 2-68 |  | sec/sec2 | O (NOTE) |
| GNSS\_TO\_ID | 3 | --- | --- | --- | M |
| Week Number | 13 | 1 | 0 - 8191 | week | O |
| NOTE: The fields indicated by "NOTE" should not be included if GPS Reference Time is provided in the assistance data. | | | | | |

**GANSS Time Model Reference Time**

This field specifies the reference time of week for GANSS Time Model and it is given in GNSS specific system time.

Range: 0 604784 seconds

**TA0/TA1/TA2**

These fields specify the GANSS Time Model for a specific GNSS system by constant and first and second order terms of polynomial. The first and second order terms are optional.

**GNSS\_TO\_ID**

This field specifies GNSS Time Offset ID. GANSS Time Model contains parameters to convert GNSS System Time from the system indicated by GANSS\_ID to GNSS System Time indicated by GNSS\_TO\_ID. The conversion is defined in [12,13,14]. The SMLC should include a GANSS Time Model for the same GANSS\_ID as the GANSS\_TIME\_ID in GANSS Reference Time. If the SMLC does not include a GANSS Time Model for the same GANSS\_ID as the GANSS\_TIME\_ID in GANSS Reference Time or if GANSS Reference Time is not included the MS assumes TA1 and TA2 are equal to zero.

Table A.42: GNSS\_TO\_ID

|  |  |
| --- | --- |
| GNSS\_TO\_ID | Indication |
| GPS | 0 |
| GALILEO | 1 |
| QZSS | 2 |
| GLONASS | 3 |
| BDS | 4 |
| Reserved for future use | 5-7 |

**Week Number**

This field specifies the reference week of GANSS Time Model given in GNSS specific system time. This field is optional.

NOTE: The time relationship between the system time indicated by GANSS\_ID and system time indicated by GNSS\_TO\_ID is given by the following equation [12,13,14]:   
  
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 GANSS\_ID.  
WN is the week number of the GNSS system time indicated GANSS\_ID corresponding to the tE.   
tGGTO is the system time of week for the time model data in the GNSS time indicated by  
 GANSS\_IDand given by the GANSS Time Model Reference Time field.  
WNGGTO is the week number for the time model data in the GNSS time indicated by GANSS\_ID corresponding to the tGGTO and given by the Week Number 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 GANSS Time Model, the MS assumes A1GGTO and A2GGTO are equal to zero.

The GNSS system times in the GANSS Time Model 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 (GANSS Day/GANSS TOD) 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.

**DGANSS Corrections**

These fields specify the DGANSS corrections to be used by the MS.

Table A.43: DGANSS Corrections

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| The following fields occur once per message | | | | | |
| DGANSS Reference Time | 7 | 30 | 0 - 3570 | seconds | M |
| N\_SGN\_TYPE | 2 | 1 | 1 - 3 | --- | M |
| The following fields occur once per GANSS signal type (N\_SGN\_TYPE times) | | | | | |
| GANSS\_Signal\_ID | 3 | --- | --- | --- | M |
| Status/Health | 3 | 1 | 0 - 7 | --- | M |
| N\_SAT | 4 | 1 | 1 - 16 | --- | M |
| The following fields occur once per satellite (N\_SAT times) | | | | | |
| SV\_ID | 6 | --- | 0…63 | --- | M |
| IOD | 10 | --- | --- | --- | M |
| UDRE | 2 | --- | 0 - 3 | --- | M |
| PRC | 12 | 0,32 | 655,04 | meters | M |
| RRC | 8 | 0,032 | 4,064 | meters/sec | M |

**DGANSS Reference Time**

This field indicates the baseline time for which the DGANSS corrections are valid as modulo 3600 s. DGANSS Reference Time is given in GNSS system time.

Range: 0 - 3600 s

**N\_SGN\_TYPE**

This field indicates the number of GNSS signal types included in DGANSS Corrections IE.

Range: 1 - 3

**GANSS\_Signal\_ID**

DGANSS corrections are provided per GNSS signal type identified by GANSS\_Signal\_ID. The supported signals are listed in Table A.59.

**Status/Health**

This field indicates the status of the differential corrections contained in the broadcast message. The values of this field and their respective meanings are shown below in Table A.44.

Table A.44: Values of Status/Health IE

|  |  |
| --- | --- |
| Code | 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 |

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 message. 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 DGANSS network) is currently not being monitored. The value "111" indicates that the corrections provided by the source are invalid, as judged by the source. In the later case, the message shall contain no corrections for individual satellites. Any MS that receives DGANSS Corrections in a GANSS Assistance Data IE shall contain the appropriate logic to properly interpret this condition and look for the next IE.

**N\_SAT**

This field indicates the number of satellites (per specified GANSS\_Signal\_ID) for which differential corrections areincluded in this element.

Range: 1 - 16

**SV\_ID**

The SV ID is an index number for a satellite. The interpretation of SV ID is defined in Table A.10.14.

**Issue Of Data**

Issue of Data field contains the identity for the GANSS Navigation Model, as defined in Table A.48.2 (i.e., excluding the IOD\_MSB, if applicable for the particular GANSS or signal).

**User Differential Range Error** **(UDRE)**

This field provides an estimate of the uncertainty (1-) in the corrections for the particular satellite. The value in this field shall be multiplied by the UDRE Scale Factor in the common Corrections Status/Health field to determine the final UDRE estimate for the particular satellite. The meanings of the values for this field are described in Table A.45.

Table A.45: Values of UDRE IE

|  |  |
| --- | --- |
| 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 |

Each UDRE value shall be adjusted based on the operation of an Integrity Monitor (IM) function which exists at the network (SMLC, GPS server, or reference GPS receiver itself). Positioning errors derived at the IM which are excessive relative to DGPS expected accuracy levels shall be used to scale the UDRE values to produce consistency.

**Pseudo-Range Correction** **(PRC)**

This field indicates the correction to the pseudorange for the particular satellite at DGANSS Reference Time, *t*0. The value of this field is given in meters (m) and the resolution is 0,32, as shown in Table A.43 above. The method of calculating this field is described in [9].

If the SMLC has received a request for GANSS assistance data from an MS which included a request for the navigation models and DGANSS (i.e., bit J and M are set to one in 'Requested GANSS Assistance Data, see 3GPP TS 49.031), the SMLC shall determine, for each satellite, if the navigation model stored by the MS is still suitable for use with DGANSS corrections (also see navigation model update conditions right before Table A.46) and if so and if DGANSS corrections are supported the SMLC should send DGANSS corrections without including the 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 pseudo-range correction shall correspond to the available navigation model (the one already stored in and identified by the MS or the one included in the same procedure as the pseudo-range correction). The MS shall only use the PRC 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 GANSS ID indicates GLONASS).

**Pseudo-Range Rate Correction** **(RRC)**

This field indicates the rate-of-change of the pseudorange correction for the particular satellite, using the satellite ephemeris and clock corrections identified by the IOD IE. The value of this field is given in meters per second (m/sec) and the resolution is 0,032, as shown in table A.43 above. For some time *t*1 > *t*0, the corrections for IOD are estimated by

PRC(*t*1, IOD) = PRC(*t*0, IOD) + RRC(*t*0, IOD)(*t*1 - *t*0) ,

and the MS uses this to correct the pseudorange it measures at *t*1, PRm(*t*1, IOD), by

PR(*t*1, IOD) = PRm(*t*1, IOD) + PRC(*t*1, IOD) .

The SMLC shall always send the RRC value that corresponds to the PRC value that it sends (see above for details). The MS shall only use the RRC value when the IOD value received matches its available navigation model.

**GANSS Navigation** **Model**

This set of fields contains information required to manage the transfer of precise navigation data to the GANSS-capable MS. In response to a request from a MS for GANSS Assistance Data, the SMLC shall determine whether to send the navigation model for a particular satellite to an MS based upon factors like the T-Toe limit specified by the MS and any request from the MS for DGANSS (also see above). This information includes control bit fields as well as satellite ephemeris and clock corrections and clock and orbit accuracy models. GANSS Orbit Model can be given in Keplerian parameters or as state vector in Earth-Centered Earth-Fixed coordinates, dependent on the GANSS-ID and the MS capabilities. The meaning of these parameters is defined in relevant ICDs of the particular GANSS and GNSS specific interpretations apply. For example, Modernized GPS and QZSS use the same model parameters but some parameters have a different interpretation [16].

GANSS Navigation Model element can contain data up to at most 32 satellites. The individual fields are given in Table A.46 and the conditions for their presence is discussed below.

Table A.46: GANSS Navigation Model contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| Navigation Model Flow Control (once per message) | | | | |
| Num\_Sat | 5 | 1 | --- | M |
| Non-Broadcast Indication | 1 | --- | --- | M |
| The following fields occur once per satellite (Num\_Sat times) | | | | |
| SV ID | 6 | --- | --- | M |
| SV Health | 5 | --- | --- | M |
| IOD | 10 | --- | --- | M |
| GANSS Clock Model | See Table A.49.1 | --- | --- | M |
| GANSS Orbit Model | See Table A.49.2 | --- | --- | M |
| SV Health\_MSB | 1 | --- | --- | O |
| IOD\_MSB | 1 | --- | --- | O |
| SV Health Extension | 4 | -- | -- | O |

**Num\_Sat**

This field specifies the number of satellites that are included in the provided GANSS Navigation Model element. A range of 1-32 is available. This field is mandatory when the GANSS Navigation Model field is included in the GANSS Assistance Data message.

**Non-Broadcast Indication**

This field indicates if the GANSS Navigation Model Elements are not derived from satellite broadcast data or are given in a format not native to the GANSS.

Table A.47: Values of Non-Broadcast Indication Flag

|  |  |
| --- | --- |
| Value | Non-Broadcast Indication |
| 0 | GANSS Navigation Data elements corresponding with broadcasted data |
| 1 | GANSS Navigation Data element not derived from satellite broadcast |

**SV\_ID**

The field specifies the SV/Slot ID for which the GANSS Navigation Model Elements is given. The interpretation of SV ID is defined in Table A.10.14.

Range: 0 - 63

**SV Health and SV Health\_MSB**

This parameter gives information about the satellite's current health. The health values are GNSS system specific. The SV Health bits have the encoding as in Table A.48.1 for a particular GANSS. The SV Health\_MSB may be present for some GANSS or signals as defined in Table A.48.1. If SV Health\_MSB is present, the total SV Health information is created by appending the SV Health field to the SV Health\_MSB field.

Table A.48.1: Interpretation SV Health Bits

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| GANSS | SV Health\_MSB | SV Health Bit String(5) | | | | |
| Bit 1 (MSB) | Bit 2 | Bit 3 | Bit 4 | Bit 5 (LSB) |
| Galileo  [11, section 5.1.9.3] | ---(1) | E5a Data Validity Status | E5b Data Validity Status | E1-B Data Validity Status | E5a Signal Health Status | |
| Modernized GPS(2) | ---(1) | L1C Health  [14] | L1 Health [12,13] | L2 Health  [12,13] | L5 Health [12,13] | '0'  (reserved) |
| SBAS(3) | ---(1) | Ranging On (0), Off(1) | Corrections On (0), Off (1) | Integrity On (0), Off(1) | '0'  (reserved) | '0'  (reserved) |
| QZSS  QZS-L1(4) | MSB of SV Health [16] | 5 LSBs of SV Health [16] | | | | |
| QZSS  QZS-L1C/L2C/L5(5) | ---(1) | L1C Health  [16] | L1 Health  [16] | L2 Health  [16] | L5 Health  [16] | '0'  (reserved) |
| GLONASS | ---(1) | Bn (MSB)  [17, page 23] | FT  [17, Table 4.4] | | | |
| BDS | ---(1) | B1I Health (SatH1) [18] | '0'  (reserved) | | | |
| Note 1: The SV Health\_MSB field shall not be present in GANSS Navigation Model for these GANSS or GANSS signals.  Note 2: 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: SV Health in case of GANSS ID indicates SBAS includes the 5 LSBs of the Health included in GEO Almanac Message Parameters (Type 17) [15].  Note 4: If GANSS ID indicates 'QZSS', and GANSS Orbit Model-2 is included, this interpretation of SV Health applies.  Note 5: If GANSS ID indicates 'QZSS', and GANSS Orbit Model-3 is included, this interpretation of SV Health applies. | | | | | | |

**SV Health Extension**

This parameter gives additional information about the satellite's current health. The health values are GNSS system specific. The SV Health Extension bits have the encoding as in Table A.48.1a for a particular GANSS.

Table A.48.1a: Interpretation SV Health Extension Bits

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GANSS | SV Health Extension Bit String(4) | | | | |
| Bit 1 (MSB) | Bit 2 | Bit 3 | | Bit 4 (LSB) |
| Galileo [11, section 5.1.9.3] | E5b Signal Health Status | | | E1-B Signal Health Status | |

**Issue Of Data**

Issue of Data field contains the identity for GANSS Navigation Model. The IOD\_MSB may be present for some GANSS or signals as defined in Table A.48.2a. If IOD\_MSB is present, the total IOD information is constructed as defined in Table A.48.2a.

In the case of broadcasted Galileo ephemeris, the IOD contains the IODnav as described in [11].

In case of broadcasted Modernized GPS ephemeris, the IOD contains the 11-bit parameter toe as defined in [12, Table 30-I] [14, Table 3.5-1] and is constructed using IOD and IOD\_MSB fields.

In case of broadcasted SBAS ephemeris, the IOD contains the 8 bits Issue of Data as defined in [15] Message Type 9.

In case of broadcasted QZSS QZS-L1 ephemeris, the IOD contains the IODC as described in [16].

In case of broadcasted QZSS QZS-L1C/L2C/L5 ephemeris, the IOD contains the 11-bit parameter toe as defined in [16] and is constructed using IOD and IOD\_MSB fields.

In case of broadcasted GLONASS ephemeris, the IOD contains the parameter tb as defined in [17].

In case of broadcasted BDS ephemeris, the IOD contains the 11 MSB bits of toe as defined in [18].

Table A.48.2: Interpretation of Issue Of Data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GANSS | Parameter | # Bits | Scale Factor | Range | Units |
| Galileo | IODnav | 10 | -- | 0-1023 | -- |
| Modernized GPS(1) | LSBs of toe | 10 | 300 | 0-306900 | seconds |
| SBAS | IOD | 8 | -- | 0-255 | -- |
| QZSS – QZS-L1(2) | IODC | 10 | -- | 0-1023 | -- |
| QZSS – QZS-L1C/L2C/L5(1)(3) | LSBs of toe | 10 | 300 | 0-306900 | seconds |
| GLONASS | tb | 7 | 15 | 15-1425 | minutes |
| BDS(4) | bit 2 (MSB) to bit 11 (MSB) of toe | 10 | 512 | 0-524288 | seconds |
| Note 1: The MSB of toe is provided in IOD\_MSB field.  Note 2: If GANSS ID indicates 'QZSS', and GANSS Clock and Orbit Model-2 are included, this interpretation of IOD applies.  Note 3: If GANSS ID indicates 'QZSS', and GANSS Clock and Orbit Model-3 are included, this interpretation of IOD applies .  Note 4: If GANSS ID indicates 'BDS', the bit 2 (MSB) to bit 11 (MSB) are provided in IOD field and the bit 1 (MSB) is provided in IOD\_MSB field. | | | | | |

Table A.48.2a: Interpretation of IOD\_MSB

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| GANSS(1) | IOD\_MSB | Scale Factor | Units | Comment |
| Modernized GPS | MSB of toe | 307200 | seconds | The full toe is constructed as "MSB of toe" x 307200 + "LSBs of toe" x 300  (Effective range of full toe is 0-604500 seconds) |
| QZSS – QZS-L1C/L2C/L5 | MSB of toe | 307200 | seconds | The full toe is constructed as "MSB of toe" x 307200 + "LSBs of toe" x 300  (Effective range of full toe is 0-604500 seconds) |
| BDS | Bit 1 (MSB) of toe | 524288 | seconds | The full IOD is constructed as " IOD\_MSB " x 524288+ "IOD" x 512  (Effective range of IOD is 0-604672 seconds) |
| Note 1: The IOD\_MSB field shall not be present in GANSS Navigation Model for GANSS or GANSS signals not defined in this Table. | | | | |

**GANSS Clock Model**

GANSS clock model (Model-1) contains one or two clock model elements. If included, Clock Model-1 shall be included once or twice depending on the MS capability.

If the MS is supporting multiple Galileo signals, the SMLC shall include both F/Nav and I/Nav clock models in GANSS Clock Model IE if the SMLC assumes the MS to perform Location Information calculation using multiple signals. The MS capabilities to support multiple GNSS frequencies are indicated in the Positioning Capability Response element (clause A.8). Otherwise, SMLC shall include only the model suitable for the GNSS.

Table A.49.1: GANSS Clock Model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| One of the following models can be included: | | | | |
| Model-1: | | | | |
| Satellite Clock Model (Galileo [11]) | | | | |
| toc | 14(u) | 60 | sec | C(1) |
| af2 | 6 | **2**-59 | sec/sec2 | C(1) |
| af1 | 21 | 2-46 | sec/sec | C(1) |
| af0 | 31 | 2-34 | sec | C(1) |
| TGD (BGD) | 10 | 2-32 | sec | O(1) |
| Model ID | 1 | --- | --- | O |
| Model-2: | | | | |
| NAV Clock Model | | | | |
| toc | 16 | 24 | seconds | C(1) |
| af2 | 8 | 2-55 | sec/sec2 | C(1) |
| af1 | 16 | 2-43 | sec/sec | C(1) |
| af0 | 22 | 2-31 | seconds | C(1) |
| TGD | 8 | 2-31 | seconds | C(1) |
| Model-3: | | | | |
| CNAV/CNAV-2 Clock Model | | | | |
| toc | 11 | 300 | seconds | C(1) |
| top | 11 | 300 | seconds | C(1) |
| URAoc Index | 5 | --- | --- | C(1) |
| URAoc1 Index | 3 | --- | --- | C(1) |
| URAoc2 Index | 3 | --- | --- | C(1) |
| af2-n | 10 | 2-60 | sec/sec2 | C(1) |
| af1-n | 20 | 2-48 | sec/sec | C(1) |
| af0-n | 26 | 2-35 | seconds | C(1) |
| TGD | 13 | 2-35 | seconds | C(1) |
| ISCL1CP | 13 | 2-35 | seconds | O(2) |
| ISCL1CD | 13 | 2-35 | seconds | O(2) |
| ISCL1C/A | 13 | 2-35 | seconds | O(3) |
| ISCL2C | 13 | 2-35 | seconds | O(3) |
| ISCL5I5 | 13 | 2-35 | seconds | O(4) |
| ISCL5Q5 | 13 | 2-35 | seconds | O(4) |
| Model-4: | | | | |
| GLONASS Satellite Clock Model | | | | |
| n(tb) | 22 | 2-30 | seconds | C(1) |
| n(tb) | 11 | 2-40 | --- | C(1) |
| n | 5 | 2-30 | seconds | O |
| Model-5: | | | | |
| SBAS Satellite Clock Model | | | | |
| t0 | 13 | 16 | seconds | C(1) |
| aGfo | 12 | 2-31 | seconds | C(1) |
| aGf1 | 8 | 2-40 | Seconds/sec | C(1) |
| Model-6: | | | | |
| BDS Satellite Clock Model | | | | |
| AODC | 5 | --- | --- | C(1) |
| toc | 17 | 23 | seconds | C(1) |
| a0 | 24 | 2-33 | sec/sec | C(1) |
| a1 | 22 | 2-50 | sec/sec2 | C(1) |
| a2 | 11 | 2-66 | seconds | C(1) |
| TGD | 10 | 10-10 | seconds | C(1) |
| NOTE 1: All of these fields shall be present together, or none of them shall be present.  NOTE 2: Both of these fields shall be present together, or none of them shall be present.  NOTE 3: Both of these fields shall be present together, or none of them shall be present.  NOTE 4: Both of these fields shall be present together, or none of them shall be present. | | | | |

**Model ID**

This field specifies the identity of the clock model according to Table A.49.1a. This field is optional.

Table A.49.1a: Galileo Clock Model Identity

|  |  |
| --- | --- |
| Value | Identity |
| 0 | I/Nav |
| 1 | F/Nav |

**GANSS Orbit Model**

GANSS Orbit Model IE contains the following presentation: Satellite Navigation Model Using Keplerian Parameters or Satellite Navigation Model Using Earth-Centered, Earth-fixed Parameters as described in Table A.49.2.

Table A.49.2: GANSS Orbit Model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| **One of the following models can be included:** | | | | |
| **Model-1:** | | | | |
| Satellite Navigation Model Using Keplerian Parameters | | | | |
| toe | 14(u) | 60 | sec | C |
|  | 32 | 2-31 | semi-circles | C |
| n | 16 | 2-43 | semi-circles/sec | C |
| M0 | 32 | 2-31 | semi-circles | C |
| OMEGAdot | 24 | 2-43 | semi-circles/sec | C |
| e | 32(u) | 2-33 | --- | C |
| Idot | 14 | 2-43 | semi-circles/sec | C |
| sqrtA | 32(u) | 2-19 | meters1/2 | C |
| i0 | 32 | 2-31 | semi-circles | C |
| OMEGA0 | 32 | 2-31 | semi-circles | C |
| Crs | 16 | 2-5 | meters | C |
| Cis | 16 | 2-29 | radians | C |
| Cus | 16 | 2-29 | radians | C |
| Crc | 16 | 2-5 | meters | C |
| Cic | 16 | 2-29 | radians | C |
| Cuc | 16 | 2-29 | radians | C |
| **Model-2:** | | | | |
| Satellite Navigation Model Using NAV Keplerian Parameters | | | | |
| URA Index | 4 | -- | -- | C |
| Fit Interval Flag | 1 | -- | Boolean | C |
| toe | 16 | 24 | sec | C |
|  | 32 | 2-31 | semi-circles | C |
| n | 16 | 2-43 | semi-circles/sec | C |
| M0 | 32 | 2-31 | semi-circles | C |
| OMEGAdot | 24 | 2-43 | semi-circles/sec | C |
| e | 32(u) | 2-33 | --- | C |
| Idot | 14 | 2-43 | semi-circles/sec | C |
| sqrtA | 32(u) | 2-19 | meters1/2 | C |
| i0 | 32 | 2-31 | semi-circles | C |
| OMEGA0 | 32 | 2-31 | semi-circles | C |
| Crs | 16 | 2-5 | meters | C |
| Cis | 16 | 2-29 | radians | C |
| Cus | 16 | 2-29 | radians | C |
| Crc | 16 | 2-5 | meters | C |
| Cic | 16 | 2-29 | radians | C |
| Cuc | 16 | 2-29 | radians | C |
| **Model-3:** | | | | |
| Satellite Navigation Model Using CNAV/CNAV-2 Keplerian Parameters | | | | |
| top | 11 | 300 | seconds | C |
| URAoe Index | 5 | --- | --- | C |
| A | 26 | 2-9 | meters | C |
| A\_dot | 25 | 2-21 | meters/sec | C |
| n0 | 17 | 2-44 | semi-circles/sec | C |
| n0\_dot | 23 | 2-57 | semi-circles/sec2 | C |
| M0-n | 33 | 2-32 | semi-circles | C |
| en | 33 | 2-34 | --- | C |
| n | 33 | 2-32 | semi-circles | C |
| 0-n | 33 | 2-32 | semi-circles | C |
| \_dot | 17 | 2-44 | semi-circles/sec | C |
| io-n | 33 | 2-32 | semi-circles | C |
| i0-n\_dot | 15 | 2-44 | semi-circles/sec | C |
| Cis-n | 16 | 2-30 | radians | C |
| Cic-n | 16 | 2-30 | radians | C |
| Crs-n | 24 | 2-8 | meters | C |
| Crc-n | 24 | 2-8 | meters | C |
| Cus-n | 21 | 2-30 | radians | C |
| Cuc-n | 21 | 2-30 | radians | C |
| **Model-4:** | | | | |
| Satellite Navigation Model Using GLONASS Earth-Centered, Earth-fixed Parameters | | | | |
| En | 5(u) | 1 | days | C |
| P1 | 2(u) | -- | --- | C |
| P2 | 1(u) | 1 | --- | C |
| M | 2(u) | 1 | --- | O |
|  | 27 | 2-11 | kilometers | C |
|  | 24 | 2-20 | kilometres/second | C |
|  | 5 | 2-30 | kilometres/second2 | C |
|  | 27 | 2-11 | kilometers | C |
|  | 24 | 2-20 | kilometres/second | C |
|  | 5 | 2-30 | kilometres/second2 | C |
|  | 27 | 2-11 | kilometers | C |
|  | 24 | 2-20 | kilometres/second | C |
|  | 5 | 2-30 | kilometres/second2 | C |
| **Model-5:** | | | | |
| Satellite Navigation Model Using SBAS Earth-Centered, Earth-fixed Parameters | | | | |
| t0 | 13 | 16 | seconds | O(1) |
| Accuracy | 4 | -- | -- | C |
| XG | 30 | 0,08 | meters | C |
| YG | 30 | 0,08 | meters | C |
| ZG | 25 | 0,4 | meters | C |
| XG Rate‑of‑Change | 17 | 0,000625 | meters/sec | C |
| YG Rate‑of‑Change | 17 | 0,000625 | meters/sec | C |
| ZG Rate‑of‑Change | 18 | 0,004 | meters/sec | C |
| XG Acceleration | 10 | 0,0000125 | meters/sec2 | C |
| YG Acceleration | 10 | 0,0000125 | meters/sec2 | C |
| ZG Acceleration | 10 | 0,0000625 | meters/sec2 | C |
| **Model-6:** | | | | |
| Satellite Navigation Model Using BDS Keplerian Parameters | | | | |
| AODE | 5 | -- | -- | C |
| URA Index | 4 | -- | -- | C |
| toe | 17 | 23 | seconds | C |
| A1/2 | 32 | 2-19 | meters1/2 | C |
| e | 32 | 2-33 | -- | C |
|  | 32 | 2-31 | semi-circles | C |
| n | 16 | 2-43 | semi-circles/sec | C |
| M0 | 32 | 2-31 | semi-circles | C |
| 0 | 32 | 2-31 | semi-circles | C |
| \_dot | 24 | 2-43 | semi-circles/sec | C |
| i0 | 32 | 2-31 | semi-circles | C |
| Idot | 14 | 2-43 | semi-circles/sec | C |
| Cuc | 18 | 2-31 | radians | C |
| Cus | 18 | 2-31 | radians | C |
| Crc | 18 | 2-6 | meters | C |
| Crs | 18 | 2-6 | meters | C |
| Cic | 18 | 2-31 | radians | C |
| Cis | 18 | 2-31 | radians | C |
| Note 1: If GANSS Clock Model-5 is not included, this field shall be present. | | | | |
| NOTE u: unsigned parameter | | | | |

**GANSS Real-Time Integrity**

Integrity Monitor (IM) shall detect unhealthy (e.g., failed/failing) satellite signals and also shall inform users of measurement quality in DGANSS modes when satellite signals are healthy. Excessively large pseudo range errors, as evidenced by the magnitude of the corresponding DGANSS correction, shall be used to detect failed satellite signals. Unhealthy satellite signals should be detected within 10 seconds of the occurrence of the satellite signal failure. When unhealthy (e.g., failed/failing) satellite signals are detected, the assistance and/or DGANSS correction data shall not be supplied for these satellite signals. When the error in the IM computed position is excessive for solutions based upon healthy satellite signals only, DGANSS users shall be informed of measurement quality through the supplied UDRE values. After bad satellite signals have been indicated in the Real Time Integrity field, if the satellite signals return to healthy condition for some period of time, the indications for them shall be removed from this field.

GANSS Real-Time Integrity field of the GANSS Assistance Data Information Element contains parameters that describe the real-time status of the GANSS constellations. Primarily intended for non-differential applications, the real-time integrity of the satellite constellation is of importance as there is no differential correction data by which the mobile can determine the soundness of each satellite signal. GANSS Real-Time Integrity data communicates the health of the GNSS signals to the mobile in real-time. The format is shown in Table A.50. The SMLC shall always transmit the GANSS Real Time Integrity field with the current list of unhealthy signals, for any GANSS positioning attempt and whenever GANSS Assistance Data is sent. If the number of bad signals (NBS) is zero, then the GANSS Real Time Integrity field shall be omitted.

Table A.50: GANSS Real-Time Integrity

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| The following fields occur once per SV with bad signal (NBS times) | | | | | |
| Bad\_GNSS\_SV\_ID | 6 | 1 | --- | --- | M |
| Bad\_GNSS\_Signal\_ID | 8 | 1 | --- | --- | O |

**NBS (Number of satellites with bad signal)**

The NBS value indicates the number of satellites with bad signal.

**Bad\_GNSS\_SV\_ID**

This field specifies the SV ID of the satellite with bad signal or signals. The interpretation of SV ID is defined in Table A.10.14.

**Bad\_GNSS\_Signal\_ID**

This field identifies the bad signal of a satellite. Absence of this field means that all signals on the specific SV are bad. The interpretation of Bad\_GNSS\_Signal\_ID is listed in Table A.59. If the satellite in question belongs to the modernized GPS constellation and has some healthy signals but bad L1C/A signal, Bad\_GNSS\_Signal\_ID shall be present but may have all the bits set to '0'. Status of L1C/A signal shall be indicated with Real-Time Integrity IE in GPS Assistance Data Element.

**GANSS Data Bit Assistance**

This element provides data bit assistance data for specific satellite signals for data wipe-off. The data bits included in the assistance data depends on the GANSS and its signal.

Table A.51: GANSS Data Bit Assistance

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Bits** | **Resolution** | **Range** | **Incl.** |
| GANSS TOD | 6 | 1 | 0 – 59 | M |
| The following fields occur once per satellite (N\_SAT times) | | | | |
| SV ID | 6 | 1 | --- | M |
| The following fields occur once per signal (N\_SGN times) | | | | |
| GANSS\_Signal\_ID | 3 | 1 | 0 - 7 | M |
| N\_BIT | 10 | 1 | 1 – 1024 | M |
| Data Bits | N\_BIT | --- | --- | M |

**GANSS TOD**

This field indicates the reference time of the first bit of the data in GANSS Data Bit Assistance in integer seconds in GNSS specific system time.

Data Bit Reference Time is given as modulo 60 s from GANSS TOD.

**N\_SAT**

This field specifies the number of satellites in GANSS Data Bit Assistance element.

**SV\_ID**

The field specifies the SV for which the GANSS Data Bit Assistance is given. The interpretation of SV ID is defined in Table A.10.14.

Range: 0 – 63

**N\_SGN**

This field specifies the number of signals for which GANSS Data Bit Assistance is provided.

Range: 1 – 8

**GANSS\_Signal\_ID**

This field specifies the GANSS signal type of the GANSS Data Bit Assistance as listed in Table A.59.

**N\_BIT**

This field indicates the number of bits (or symbols) included in the IE.

**Data Bits**

Data bits are contained in GNSS system and data type specific format.

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 Modernized GPS L1C, it contains the encoded and interleaved modulation symbols as defined in [14] section 3.2.3.1.

In case of Modernized GPS L2C, it contains either the NAV data modulation bits, the FEC encoded NAV data modulation symbols, or the FEC encoded CNAV data modulation symbols, dependent on the current signal configuration of this satellite as defined in [12, Table 3-III].

In case of Modernized GPS L5, it contains the FEC encoded CNAV data modulation symbols as defined in [13].

In case of SBAS, it contains the FEC encoded data modulation symbols as defined in [15].

In case of QZSS QZS-L1, it contains the NAV data modulation bits as defined in [16] section 5.2. In case of QZSS QZS-L1C, it contains the encoded and interleaved modulation symbols as defined in [16] section 5.3. In case of QZSS QZS-L2C, it contains the encoded modulation symbols as defined in [16] section 5.5. In case of QZSS QZS-L5, it contains the encoded modulation symbols as defined in [16] section 5.6.

In case of GLONASS, it contains the 100 sps differentially Manchester encoded modulation symbols as defined in [17] section 3.3.2.2.

In case of BDS, it contains the encoded and interleaved modulation symbols as defined in [18] section 5.1.3.

**GANSS Reference Measurement Information**

This field provides reference code and Doppler measurement information of visible satellites of a GANSS constellation. The information can be used as acquisition assistance to improve the sensitivity of the receiver.

These parameters describe the range and optionally the derivatives from respective satellites to the GANSS Reference Location at the GANSS Reference Time. The code phase and Doppler fields are aligned with the time provided in GANSS Reference Time. Figure A.4a illustrates the relation between some of the fields with respect to the GANSS TOD.

If GPS Acquisition Assistance is included the Reference Time included in the GPS Acquisition Assistance is also valid for the GANSS Reference Measurement fields and the parameters are referenced to GPS TOW. Figure A.4b illustrates the relation between some of the fields with respect to GPS TOW.

The parameters are given in units of ms and m/s which makes it possible to convert the values to any nominal frequency and chipping and code rate.

Table A.52: GANSS Reference Measurement Information Contents

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Range | Bits | Resolution | Incl. |
| GANSS\_Signal\_ID | 0 - 7 | 3 | --- | M |
| The following fields occur once per satellite (**Num\_Sat** times) | | | | |
| SV\_ID | 0 - 63 | 6 |  | M |
| Doppler (0th order term) | -1024 m/s to 1023,5 m/s | 12 | 0,5 m/s | M |
| Doppler (1st order term) | -0,2 - 0,1 m/s2. | 6 | 1/210 m/s2. | O(1) |
| Doppler Uncertainty | 2,5 m/s - 40 m/s  [2-n(40) m/s, n = 0 - 4] | 3 | --- | O(1,3) |
| Code Phase | 0 - (1-2-10) ms | 10 | 2-10 ms | M |
| Integer Code Phase | 0 - 127 ms | 7 | 1 ms | M |
| Code Phase Search Window | See Table A.53 | 5 | --- | M |
| Azimuth | 0 - 348,75 deg | 5 | 11,25 deg | O(2) |
| Elevation | 0 - 78,75 deg | 3 | 11,25 deg | O(2) |
| Code Phase\_1023 | boolean | 1 | --- | O |
| NOTE 1,2: All of these fields shall be present together, or none of them shall be present.  NOTE 3: If Doppler Uncertainty Extension (Table A.55.25) is present, Doppler Uncertainty shall be set to value 0 (40 m/s). | | | | |



Figure A.4a. Exemplary calculations of some GANSS Reference Measurement fields with respect to GANSS TOD.



Figure A.4b. Exemplary calculations of some GANSS Reference Measurement fields with respect to GPS TOW.

**GANSS\_Signal\_ID**

This field specifies the GNSS signal type. The supported signals are listed in Table A.59.

**Num\_Sat**

This field specifies the number of satellites in GANSS Reference Measurement Information element.

**SV\_ID**

This field specifies the SV for which the GANSS Reference Measurement Assistance is given. The interpretation of SV ID is defined in Table A.10.14.

Range: 0 – 63

**Doppler (0th order term)**

This field contains the Doppler (0th order term) value. A positive value in Doppler defines the increase in satellite signal frequency due to velocity towards the MS. A negative value in Doppler defines the decrease in satellite signal frequency due to velocity away from the MS.

Doppler is given in unit of m/s by multiplying the Doppler value in Hz by the *nominal* wavelength of the assisted signal.

This field is mandatory.

**Doppler (1st order term**)

This field contains the Doppler (1st order term) value. A positive value defines the rate of increase in satellite signal frequency due to acceleration towards the MS. A negative value defines the rate of decrease in satellite signal frequency due to acceleration away from the MS.

Doppler (1st order term) is given in unit of m/s by multiplying the Doppler value in Hz by the *nominal* wavelength of the assisted signal.

This field is optional.

**Doppler** **Uncertainty**

This field contains the Doppler uncertainty value. It is defined such that the Doppler experienced by a stationary MS is in the range "Doppler  Doppler Uncertainty" to "Doppler  Doppler Uncertainty". This field is optional. If Doppler Uncertainty (together with Doppler 1st order term) is omitted, the terminal shall interpret Doppler Uncertainty as greater than +/-40 m/s. If the Doppler Uncertainty Extension (Table A.55.25) field is present, the MS that supports the Doppler Uncertainty Extension shall ignore this field.

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.

Permitted 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 the formula in Table A.52.

**Code Phase**

This field together with the Code Phase\_1023 field contains code phase, in units of milliseconds, 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 GANSS Reference Time. The Reference Location would typically be an apriori estimate of the MS location. This field is mandatory.

Range: 0 - (1-2-10) ms

NOTE: The value (1-2-10) ms is encoded using the Code Phase\_1023 field.

**Integer Code Phase**

This field contains integer code phase (expressed modulo 128 ms). The satellite integer milliseconds code phase currently being transmitted at the GANSS Reference Time, as seen by a receiver at the Reference Location is calculated as reference time (GANSS TOD or GPS TOW, expressed in milliseconds) minus (Integer\_Code\_Phase + (n×128 ms)), as shown in Figure A.4a/b, with n = …-2,-1,0,1,2…. This field is mandatory.

Range: 0-127 ms

**Code Phase** **Search** **Window**

This field contains the code phase search window. The code phase search window accounts for the uncertainty in the estimated MS location but not any uncertainty in GANSS 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 milliseconds. This field is mandatory.

Range: 0-31 (i.e. 0,002 - 2,000 ms according to following table)

Table A.53: Code Phase Search Window Parameter Format

|  |  |
| --- | --- |
| CODE\_PHASE\_SEARCH\_WINDOW | 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 |

**Azimuth**

This field together with the Azimuth LSB included in GANSS Reference Measurement Extension in Table A.55.23contains the azimuth angle. An angle of x degrees means the satellite azimuth a is in the range (x  a < x+0,703125) degrees. This field is optional.

Range: 0 - 359,296875 degrees.

**Elevation**

This field together with the Elevation LSB included in GANSS Reference Measurement Extension in Table A.55.23 contains the elevation angle. An angle of y degrees means the satellite elevation e is in the range (y  e < y+0,703125) degrees except for y = 89,296875 where the range is extended to include 90 degrees. This field is optional.

Range: 0 - 89,296875 degrees

**Code Phase\_1023**

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 Code Phase field is 1022. If this field is set to FALSE, the code phase is the value provided in the Code Phase field in the range from 0 to (1 - 2×2-10) ms. If this field is not present and the Code Phase field has the value 1022, the MS may assume that the code phase is between (1 - 2×2-10) and (1 - 2-10) ms.

**GANSS Almanac Model**

These fields specify the coarse, long-term model of the satellite positions and clocks. These fields are given in Table A.54. The meaning of these parameters is defined in relevant ICDs of the particular GANSS and GNSS specific interpretations apply. For example, Modernized GPS and QZSS use the same model parameters but some parameters have a different interpretation [16].

GANSS Almanac Model is useful for receiver tasks that require coarse accuracy, such as determining satellite visibility. The model is valid for up to few weeks, typically. Since it is a long-term model, the field should be provided for all satellites in the GNSS constellation. If almanac is not provided for the full GNSS constellation, the SMLC shall set the Complete Almanac Provided field in Table A.55.24 to FALSE.

Table A.54: GANSS Almanac Model (per-satellite fields - (1) = Positive range only)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| The following fields occur once per message | | | | |
| Num\_Sats\_Total | 6 | 1 | --- | M |
| Week Number | 8 | 1 | weeks | M |
| Toa | 8 | 212 if GANSS-ID is not Galileo.  600 if GANSS-ID is Galileo | s | O |
| IODa | 2 | --- | --- | O |
| **One of the following models can be included:** | | | | |
| **Model-1:** | | | | |
| This model occurs once per satellite (**Num\_Sats\_Total** times) | | | | |
| GANSS Almanac Model Using Keplerian Parameters | | | | |
| SV\_ID | 6 | --- | --- | M |
| e | 11 | 2-16 | dimensionless | M |
| i | 11 | 2-14 | semi-circles | M |
| OMEGADOT | 11 | 2-33 | semi-circles/sec | M |
| SV Status INAV | 4 | --- | dimensionless | M |
| SV Status FNAV | 2 | --- | dimensionless | O |
| delta\_A1/2 | 13 | 2-9 | meters1/2 | M |
| OMEGA0 | 16 | 2-15 | semi-circles | M |
|  | 16 | 2-15 | semi-circles | M |
| M0 | 16 | 2-15 | semi-circles | M |
| af0 | 16 | 2-19 | seconds | M |
| af1 | 13 | 2-38 | sec/sec | M |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Model-2:** | | | | | | This model occurs once per satellite (**Num\_Sats\_Total** times) | | | | | | GANSS Almanac Model Using NAV Keplerian Parameters | | | | | | SV\_ID | 6 | --- | --- | M | | e | 16 | 2-21 | dimensionless | M | | i | 16 | 2-19 | semi-circles | M | | OMEGADOT | 16 | 2-38 | semi-circles/sec | M | | SV Health | 8 | --- | Boolean | M | | A1/2 | 24 | 2-11 | meters1/2 | M | | OMEGA0 | 24 | 2-23 | semi-circles | M | |  | 24 | 2-23 | semi-circles | M | | M0 | 24 | 2-23 | semi-circles | M | | af0 | 11 | 2-20 | seconds | M | | af1 | 11 | 2-38 | sec/sec | M | | **Model-3:** | | | | | | This model occurs once per satellite (**Num\_Sats\_Total** times) | | | | | | GANSS Almanac Model Using Reduced Keplerian Parameters | | | | | | SV\_ID | 6 | --- | --- | M | | A | 8 | 2+9 | meters | M | | 0 | 7 | 2-6 | semi-cicles | M | | 0 | 7 | 2-6 | semi-circles | M | | L1 Health | 1 | --- | --- | M | | L2 Health | 1 | --- | --- | M | | L5 Health | 1 | --- | --- | M | | | | | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Model-4:** | | | | | | This model occurs once per satellite (**Num\_Sats\_Total** times) | | | | | | GANSS Almanac Model Using Midi Keplerian Parameters | | | | | | SV\_ID | 6 | --- | --- | M | | e | 11 | 2-16 | --- | M | | i | 11 | 2-14 | semi-circles | M | | \_dot | 11 | 2-33 | semi-circles/sec | M | | sqrtA | 17 | 2-4 | meters1/2 | M | | 0 | 16 | 2-15 | semi-circles | M | |  | 16 | 2-15 | semi-circles | M | | M0 | 16 | 2-15 | semi-circles | M | | afo | 11 | 2-20 | seconds | M | | af1 | 10 | 2-37 | sec/sec | M | | L1 Health | 1 | --- | --- | M | | L2 Health | 1 | --- | --- | M | | L5 Health | 1 | --- | --- | M | | | | | |
| **Model-5:** | | | | |
| This model occurs once per satellite (**Num\_Sats\_Total** times) | | | | |
| GANSS Almanac Model Using GLONASS Keplerian Parameters | | | | |
| NA | 11 | 1 | days | M |
| nA | 5 | 1 | --- | M |
| HnA | 5 | 1 | --- | M |
| nA | 21 | 2-20 | semi-circles | M |
| tnA | 21 | 2-5 | seconds | M |
| inA | 18 | 2-20 | semi-circles | M |
| TnA | 22 | 2-9 | seconds/orbit period | M |
| T\_DOTnA | 7 | 2-14 | seconds/orbit period2 | M |
| nA | 15 | 2-20 | --- | M |
| nA | 16 | 2-15 | semi-circles | M |
| nA | 10 | 2-18 | seconds | M |
| CnA | 1 | 1 | --- | M |
| MnA | 2 | 1 | --- | O |
| **Model-6:** | | | | |
| This model occurs once per satellite (**Num\_Sats\_Total** times) | | | | |
| GANSS Almanac Model Using SBAS ECEF Parameters | | | | |
| Data ID | 2 | 1 | -- | M |
| SV\_ID | 6 | -- | -- | M |
| Health | 8 | -- | -- | M |
| XG | 15 | 2600 | meters | M |
| YG | 15 | 2600 | meters | M |
| ZG | 9 | 26000 | meters | M |
| XG Rate-of-Change | 3 | 10 | meters/sec | M |
| YG Rate-of-Change | 3 | 10 | meters/sec | M |
| ZG Rate-of-Change | 4 | 40,96 | meters/sec | M |
| t0 | 11 | 64 | seconds | M |
| **Model-7:** | | | | |
| This model occurs once per satellite (**Num\_Sats\_Total** times) | | | | |
| GANSS Almanac Model Using BDS Keplerian Parameters | | | | |
| SV\_ID |  | -- |  | M |
| toa | 8 | 212 | seconds | O(note 2) |
| A1/2 | 24 | 2-11 | meters1/2 | M |
| e | 17 | 2-21 | -- | M |
|  | 24 | 2-23 | semi-circles | M |
| M0 | 24 | 2-23 | semi-circles | M |
| 0 | 24 | 2-23 | semi-circles | M |
| \_dot | 17 | 2-38 | semi-circles/sec | M |
| i | 16 | 2-19 | semi-circles | M |
| a0 | 11 | 2-20 | seconds | M |
| a1 | 11 | 2-38 | sec/sec | M |
| Hea | 9 | -- | -- | O (note 3) |
| NOTE 2: 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 GANSSAlmanacModel  NOTE 3: This IE is mandatory present if the IE "SV ID" is between 0 and 29 and not needed otherwise. | | | | |

**Num\_Sats\_Total**

This field specifies the total number of satellites in GANSS Almanac Model.

Range: 1 - 36

**Week Number**

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. If Toa is not included in GANSS Almanac Model, the MS shall ignore the Week Number.

Range: 0 - 255

NOTE: In case of Galileo, the almanac reference week number WNa natively contains only the 2 LSB's [11, section 5.1.10].

**Toa**

This field specifies the Almanac Reference Time common to all satellites in GANSS Almanac Model Using Keplerian Parameters given in GNSS specific system time.

Range: 0 - 255

In case of GNSS-ID does not indicate Galileo, the scale factor is 212 seconds. In case of GNSS-ID does indicate Galileo, the scale factor is 600 seconds.

NOTE: Range extension of Toa may be present in the GANSS Almanac Model Extension-R12 element (Table A.55.25), if GANSS-ID indicates Galileo.

**IODa**

This field specifies the Issue-Of-Data common to all satellites in GANSS Almanac Model using Keplerian Parameters.

Range: 0 - 3

NOTE: Range extension of IODa may be present in the GANSS Almanac Model Extension-R12 element (Table A.55.25), if GANSS-ID indicates Galileo.

**SV\_ID**

This field identifies the satellite for which the GANSS Almanac Model is given. The interpretation of SV ID is defined in Table A.10.14.

Range: 0 - 63

**SV Status INAV**

This field contains the I/NAV health status bits [11, section 5.1.10].

**SV Status FNAV**

This field contains the F/NAV health status bits [11, section 5.1.10]. If the MS is supporting multiple Galileo signals, the SMLC shall include this field.

**GANSS UTC Model**

The GANSS UTC Model field contains a set of parameters needed to relate GNSS system time to Universal Time Coordinate (UTC). All of the fields in the GANSS UTC Model are mandatory when the field is present. The UTC time standard, UTC(k), is GNSS specific. E.g., if GANSS ID indicates QZSS, GANSS UTC Model field contains a set of parameters needed to relate QZST to UTC(NICT).

Table A.55: GANSS UTC Model (Model-1)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| A1 | 24 | 2-50 | sec/sec | C |
| A0 | 32 | 2-30 | seconds | C |
| tot | 8 | 212 | seconds | C |
| WNt | 8 | 1 | weeks | C |
| tLS | 8 | 1 | seconds | C |
| WNLSF | 8 | 1 | weeks | C |
| DN | 8 | 1 | days | C |
| tLSF | 8 | 1 | seconds | C |

**GANSS Ephemeris Extension**

The GANSS Ephemeris extension contains parameters designed to extend the time of applicability of the Ephemeris terms by the continuous addition of the delta ephemeris terms to the respective terms of the referenced ephemeris.

This message can provide extension information for every satellite for many days into the future; doing so may create a large message, thus care must be taken to consider the transport bandwidth. The SMLC can limit the duration of the extension to decrease the message size. For example if the extension duration is limited to twelve hours the payload will be approximately 2,000 octets, for a typical 27 satellite constellation.

Table A.55.2: GANSS Ephemeris Extension

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| ganssEphemerisHeader | See Table A.55.3 | | --- | O |
| ganssReferenceSet | See Table A.55.5 | | --- | O |
| ganssEphemerisDeltaMatrix | List of GANSSEphemerisDeltaEpochs | | | O |

Table A.55.3: GANSS Ephemeris Header

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| GANSS Ephemeris Extension (Once per message) | | | | |
| timeAtEstimation | See Table A.55.4 | | --- | M |
| validityPeriod | 3 | 1 | Hours | M |
| ephemerisExtensionDuration | 9 | 1 | Hours | M |

**Time at Estimation**

The Time at Estimation provides the GANSS time at which the ephemeris extensions were created.

Table A.55.4: Time at Estimation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| GANSS Day of Estimation | 13 | 1 | Day | M |
| GANSS TOD of Estimation | 17 | 1 | Seconds | M |

**GANSS Day of Estimation**

This field specifies the sequential number of days (with day count starting at 0) from the origin of the GNSS system time indicated by GANSS\_TIME\_ID modulo 8192 days (about 22 years) of the time that the estimation was determined. The GNSS system time origin is defined in Table A.34 for each GANSS.

Range: 0 - 8191 days

**GANSS TOD of Estimation**

Integer number of GANSS TOD seconds within the current day of the time that the estimation was determined.

Range: 0 - 86399 s.

**Validity Period**

The validityPeriod indicates the validity period of the GANSS Reference Set. It also indicates the default validity period of each individual delta ephemeris packet in the case that the individual validityPeriod is not present in the GANSS Delta Epoch Header (see Table A.55.8). It is the length of time that the GANSS Reference Set is intended to last and, if applicable, it is the length of time that the ephemeris constructed by application of the delta is intended to last.

Range: 1 – 8 hours.

**Ephemeris Extension Duration**

The Ephemeris Extension duration indicates the total block of time measured in units of hours that the extended ephemeris covers.

Range: 1 - 512 Hours.

The ganssEphemeris header is mandatory only once in the delivery of the GANSS Ephemeris Extension message

**GANSS Reference Set**

Table A.55.5: GANSS Reference Set

|  |  |  |
| --- | --- | --- |
| Parameter | Presence | Note |
| GANSS Reference Orbit | M | See Table A.55.6 |

**GANSS Reference Orbit**

Table A.55.6: GANSS Reference Orbit

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| svID | 6 | 1 | --- | M |
| ganssOrbitModel | See Table A.29.g | | -- | M |
| ganssClockModel | See Table A.49.1 | | -- | M |

**SvID**

The satellite vehicle ID identifying to which satellite the following orbital and clock model apply. The interpretation of SV ID is defined in Table A.10.14.

**GANSS OrbitModel**

This field is a structure that contains the Reference Nav Model (see Table A.29.g) satellite orbit information upon which all subsequent delta information will be applied to create the next ephemeris for use in navigation.

**GANSS ClockModel**

This field is a structure that contains the satellite clock model upon which all subsequent clock information will be applied to create the next clock model for use in navigation.

**GANSA Ephemeris Delta Matrix**

GANSS Ephemeris Delta Matrix is a list of GANSS Ephemeris Delta Epochs. Each epoch is indicated by a unique seqNum. Each epoch corresponds to a specific update interval and contains a delta epoch header and ephemeris delta elements for all PRNs for that epoch.

**GANSS Ephemeris Delta Epoch**

Table A.55.7: GANSS Ephemeris Delta Epoch

|  |  |  |
| --- | --- | --- |
| Parameter | Note | Incl. |
| ganssDeltaEpochHeader | See Table A.55.8 | O |
| ganssDeltaElementList | List of GANSS Ephemeris Delta Elements | M |

**GANSS Delta Epoch Header**

Table A.55.8: GANSS Delta Epoch Header

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| validityPeriod | 3 | 1 | Hours | O |
| ephemerisDeltaSizes | See Table A.55.9 | | | O |
| ephemerisDeltaScales | See Table A.55.10 | | | O |

**Validity Period**

The validityPeriod indicates the validity period of each individual delta ephemeris packet. It is the length of time that the ephemeris constructed by application of the delta is intended to last. If not present then the default validityPeriod in the GANSS Ephemeris Header IE applies (see Table A.55.3).

Range: 1 – 8 hours.

**Ephemeris Delta Sizes**

This field is a structure that indicates the bit sizes for all the fields in the GANSS Ephemeris Delta structure

Table A.55.9: GANSS Ephemeris Delta Sizes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| bitSize\_delta\_ | 5 | 1 | --- | M |
| bitSize\_delta\_n | 4 | 1 | --- | M |
| bitSize\_delta\_M0 | 5 | 1 | --- | M |
| bitSize\_delta\_OMEGAdot | 5 | 1 | --- | M |
| bitSize\_delta\_e | 5 | 1 | --- | M |
| bitSize\_delta\_Idot | 4 | 1 | --- | M |
| bitSize\_delta\_sqrtA | 5 | 1 | --- | M |
| bitSize\_delta\_i0 | 5 | 1 | --- | M |
| bitSize\_delta\_OMEGA0 | 5 | 1 | --- | M |
| bitSize\_delta\_Crs | 4 | 1 | --- | M |
| bitSize\_delta\_Cis | 4 | 1 | --- | M |
| bitSize\_delta\_Cus | 4 | 1 | --- | M |
| bitSize\_delta\_Crc | 4 | 1 | --- | M |
| bitSize\_delta\_Cic | 4 | 1 | --- | M |
| bitSize\_delta\_Cuc | 4 | 1 | --- | M |
| bitSize\_delta\_tgd1 | 4 | 1 | --- | M |
| bitSize\_delta\_tgd2 | 4 | 1 | --- | M |

**Ephemeris Delta Scales**

This field is a structure that indicates the scale factor modifiers for all the fields in the GANSS Ephemeris Delta structure.

Table A.55.10: GANSS Ephemeris Delta Scales

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| scale\_delta\_ | 5 | 1 | --- | M |
| scale\_delta\_n | 5 | 1 | --- | M |
| scale\_delta\_M0 | 5 | 1 | --- | M |
| scale\_delta\_OMEGAdot | 5 | 1 | --- | M |
| scale\_delta\_e | 5 | 1 | --- | M |
| scale\_delta\_Idot | 5 | 1 | --- | M |
| scale\_delta\_sqrtA | 5 | 1 | --- | M |
| scale\_delta\_i0 | 5 | 1 | --- | M |
| scale\_delta\_OMEGA0 | 5 | 1 | --- | M |
| scale\_delta\_Crs | 5 | 1 | --- | M |
| scale\_delta\_Cis | 5 | 1 | --- | M |
| scale\_delta\_Cus | 5 | 1 | --- | M |
| scale\_delta\_Crc | 5 | 1 | --- | M |
| scale\_delta\_Cic | 5 | 1 | --- | M |
| scale\_delta\_Cuc | 5 | 1 | --- | M |
| scale\_delta\_tgd1 | 5 | 1 | --- | M |
| scale\_delta\_tgd2 | 5 | 1 | --- | M |

**GANSS Delta Element List**

GANSS Delta Element List is a list of GANSS Ephemeris Delta Elements

**Ephemeris Delta Element**

Each GANSS Ephemeris Delta element is uniquely identified by the pair (seqNum, sv\_ID) and it is defined as a structure as shown in table A.55.11. The MS should parse the octet string according to the fields specified in table A.55.4. Each element in table A.55.4 but for seqNum and sv\_ID should be treated as a signed integer. Each Ephemeris delta is transmitted as an octet string of up to 49 octets. The actual number of octets is determined by the size of the bit fields in the GPS\_Ephemeris\_Delta\_Sizes table (table A.55.9). Each set of up to 49 octets represents a single extension for a single satellite vehicle. Each set encodes the satellite vehicle ID and the sequence number. The sequence number specifies the order in which the individual ephemeris extension elements are assembled as time marches forward to create the next ephemeris. The sequence number is the same for all satellite vehicle IDs for a particular update period.

Table A.55.11: GANSS Ephemeris Delta Element

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Default # Bits | Scale Factor | Default Scale | Units | Incl. |
| sequenceNum | 7 |  | 1 | 1 | --- | M |
| svID | 6 |  | 1 | 1 | --- | M |
| delta\_ | 1..32 (1) | 21 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | semi-circles | M |
| delta\_n | 1..16 (1) | 12 | 2-16\*2-43 .. 215\*2-43 (2) | 2-43 | semi-circles/sec | M |
| delta\_M0 | 1..32 (1) | 21 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | semi-circles | M |
| delta\_OMEGAdot | 1..24 (1) | 13 | 2-16\*2-43 .. 215\*2-43 (2) | 2-43 | semi-circles/sec | M |
| delta\_e | 1..32 (1) | 18 | 2-16\*2-33 .. 215\*2-33 (2) | 2-33 | --- | M |
| delta\_Idot | 1..14 (1) | 11 | 2-16\*2-43 .. 215\*2-43 (2) | 2-43 | semi-circles/sec | M |
| delta\_sqrtA | 1..32 (1) | 14 | 2-16\*2-19 .. 215\*2-19 (2) | 2-19 | meters1/2 | M |
| delta\_i0 | 1..32 (1) | 14 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | semi-circles | M |
| delta\_OMEGA0 | 1..32 (1) | 14 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | semi-circles | M |
| delta\_Crs | 1..16 (1) | 12 | 2-16\*2-5 .. 215\*2-5 (2) | 2-5 | meters | M |
| delta\_Cis | 1..16 (1) | 11 | 2-16\*2-29 .. 215\*2-29 (2) | 2-29 | radians | M |
| delta\_Cus | 1..16 (1) | 12 | 2-16\*2-29 .. 215\*2-29 (2) | 2-29 | radians | M |
| delta\_Crc | 1..16 (1) | 12 | 2-16\*2-5 .. 215\*2-5 (2) | 2-5 | meters | M |
| delta\_Cic | 1..16 (1) | 11 | 2-16\*2-29 .. 215\*2-29 (2) | 2-29 | radians | M |
| delta\_Cuc | 1..16 (1) | 12 | 2-16\*2-29 .. 215\*2-29 (2) | 2-29 | radians | M |
| delta\_tgd1 | 1..16 (1) | 2 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | seconds | M |
| delta\_tgd2 | 1..16 (1) | 2 | 2-16\*2-31 .. 215\*2-31 (2) | 2-31 | seconds | M |

(1) The number of bits of each signed integer field is variable and it is indicated once for all numEphemerisDeltas by the structure ephemerisDeltasSizes. When the ephemerisDeltaSizes field is not present, the values found in the columns "Default # Bits" shall be used.

(2) The scale factor of each parameter is variable around the default scale factor. The variation for each field is indicated once for all numEphemerisDeltas by the structure ephemerisDeltasScales. For example, if the scale factor modifier for delta\_omega has a value of 4, the scale factor for delta\_omega is 24 \* 2-31. When the ephemerisDeltaScales is not used, the values found in the column "Default Scale" shall be used.

**sequenceNum**

This field indicates the order of the Ephemeris delta terms. The ephemeris constructed for use in satellite positioning is built by adding the delta terms to the referenced GANSS\_Navigation Model in the order dictated by this sequence number. The sequence number shall remain the same for each svID in a group of Ephemeris Deltas corresponding to a particular update epoch.

**svID**

This field identifies the satellite ID within a particular sequenceNum.

These fields, with the exception of sequenceNum and svID, specify the deltas to be added to the existing Ephemeris to create a new Ephemeris suite that is extended from its predecessor by the time provided in the "validityPeriod" parameter. To compute the time of ephemeris for the newly constructed ephemeris, validityPeriod is added to the preceding toe. The ephemeris time of clock (toc) is set equal to the toe.

For each of the other ephemeris terms the corresponding delta ephemeris term is added in order to create the updated ephemeris. The terms delta\_M0, delta\_i0, and delta\_OMEGA0 of the delta ephemeris must be extrapolated prior to the addition of the delta terms as follows:

Where is the WGS 84 value of the earth's gravitational constant for GANSS user, and A(i) is the semi-major axis associated with this satellite's update. The extrapolation of delta\_M0, uses the prior set's sqrtA term to compute A(i) .

OMEGA0(i+1)=OMEGA0(i) +deltaOMEGA0(i)+OMEGAdot(i)\*dt

i0 (i+1) = i0(i) + delta\_i0(i)+Idot(i) \* dt

Where dt is equal to validityPeriod\*3600. The terms af0, and af1 from the GANSS clock model must be extrapolated as follows:

af0(i+1) = af0(i) + af1(i)\* dt + af2(i)\*dt2

af1(i+1) = af1(i) + 2 \* af2(i) \* d**t**

af2(i+1) = af2(i)

Where af0, af1, and af2 are the clock model terms as shown in table A.49.1.

The following demonstrates the application of the ephemeris extension technique. Assume the validityPeriod = 5, representing: (5+1)hours = 6 hours, and the GANSS Navigation model for a particular satellite, identified by the reference IOD has a toe = 0 seconds.

The toe for sequenceNumber 1 is computed by adding the validityPeriod to the initial toe of 0 as 0 + 6 hours =0 + 21600 seconds. The new ephemeris is constructed by adding the delta ephemeris terms from set 1 to the reference ephemeris creating the new ephemeris, which will be used for the next six hours. For the five terms listed above (delta\_M0, delta\_i0, delta\_OMEGA0, af0, and af1) the extrapolation described must occur prior to the addition of the delta term. Of course if one of these three delta ephemeris terms was provided in full via the exception table then the extrapolation is unnecessary and the exception term combined with the delta\_ephemeris term is used directly.

The next ephemeris computation will occur by adding the validityPeriod to the current toe of 21600 as: 21600 + 6 hours = 21600 + 21600 = 43200. The ephemeris delta terms from set two are added to the ephemeris resulting from the prior addition to create the next ephemeris. This is done for each satellite vehicle ID listed in the provided satellite list indicated in the ganssSatRef field.

**GANSS Ephemeris Extension check**

The GANSS Ephemeris Extension check provides information about non foreseen events that occurred during the period starting at the ganssBeginTime to the current time. An event is signified through a bit string . Each bits refers to one PRN. If a bit is set to one, this means that the ephemeris extension is no longer valid for this specific PRN. In order to indicate planned future manuvers an end time is provided. The SMLC can indicate that a future event is planned between the current time and the end time of this ephemeris extension.

Table A.55.12: Ephemeris Extension check

|  |  |  |
| --- | --- | --- |
| Parameter | Presence | Note |
| ganssBeginTime | M | See Table A.55.13 |
| ganssEndTime | M | See Table A.55.14 |
| ganssSatEventsInfo | M | See Table A.55.15 |

**GANSS Begin Time**

The GANSS begin time corresponds to the GANSS Day and GANSS Seconds of Estimation of the ephemeris extensions block.

Table A.55.13: GANSS Begin Time

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| GANSS Day | 13 | 1 | Day | M |
| GANSS TOD | 17 | 1 | Seconds | M |

**GANSS End Time**

The GANSS end time represents the final time the Ephemeris extension is valid.

Table A.55.14: GANSS End Time

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| GANSS Day | 13 | 1 | Day | M |
| GANSS TOD | 17 | 1 | Seconds | M |

**GANSS Sat Event Information**

This IE is designed to indicate events that have or may occur between the ganssBeginTime and the ganssEndTime.

Table A.55.15: GANSS Sat Event Information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| EventOccurred | 64 | - | - | M |
| FutureEventNoted | 64 | - | - | M |

**EventOccurred**

**FutureEventNoted**

If a bit is clear in the eventOccured field it indicates that a satellite maneuver has not occurred since the ganssBeginTime nor is a maneuver planned for the next sixty minutes.

If a bit is set in the futureEventNoted field it indicates that a maneuver is planned during the time period between current time plus sixty minutes and ganssEndTime

**SBAS ID**

If GANSS ID indicates SBAS, this field defines the specific SBAS for which the GANSS specific assistance data are provided according to Table A.55.16.

Table A.55.16: SBAS ID

|  |  |
| --- | --- |
| SBAS | Value of SBAS ID |
| WAAS | 0 |
| EGNOS | 1 |
| MSAS | 2 |
| GAGAN | 3 |
| Reserved | 4-7 |

**GANSS Additional UTC Model**

The GANSS Additional UTC Model field contains several sets of parameters needed to relate GNSS system time to Universal Time Coordinate (UTC), as defined in [12, 13, 14, 15, 16, 17]. Only one parameter set can be included in one GANSS Additional UTC Model and which set of parameters to include depends on the GANSS-ID and MS capabilities.

The UTC time standard, UTC(k), is GNSS specific. E.g., if GANSS ID indicates QZSS, GANSS Additional UTC Model field contains a set of parameters needed to relate QZST to UTC(NICT). If GANSS ID indicates Modernized GPS, GANSS Additional UTC Model field contains a set of parameters needed to relate GPS system time to UTC(USNO). If GANSS ID indicates GLONASS, GANSS Additional UTC Model field contains a set of parameters needed to relate GLONASS system time to UTC(RU). If GANSS ID indicates SBAS, GANSS Additional UTC Model field 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 GANSS ID indicates BDS, GANSS Additional UTC Model field contains a set of parameters needed to relate BDS system time to UTC (NTSC).

Table A.55.17: GANSS Additional UTC Model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| **One of the following models can be included:** | | | | |
| **Model-2** (as defined in [12,13,14,16]) | | | | |
| A0-n | 16 | 2-35 | seconds | C(1) |
| A1-n | 13 | 2-51 | sec/sec | C(1) |
| A2-n | 7 | 2-68 | sec/sec2 | C(1) |
| tLS | 8 | 1 | seconds | C(1) |
| tot | 16 | 24 | seconds | C(1) |
| WNot | 13 | 1 | weeks | C(1) |
| WNLSF | 8 | 1 | weeks | C(1) |
| DN | 4 | 1 | days | C(1) |
| tLSF | 8 | 1 | seconds | C(1) |
| **Model-3** (as defined in [17]) | | | | |
| NA | 11 | 1 | days | C(1) |
| c | 32 | 2-31 | seconds | C(1) |
| B1 | 11 | 2-10 | seconds | O(2) |
| B2 | 10 | 2-16 | sec/msd | O(2) |
| KP | 2 | 1 | --- | O |
| **Model-4** (as defined in [15], Message Type 12) | | | | |
| A1WNT | 24 | 2-50 | sec/sec | C(1) |
| A0WNT | 32 | 2-30 | seconds | C(1) |
| tot | 8 | 212 | seconds | C(1) |
| WNt | 8 | 1 | weeks | C(1) |
| tLS | 8 | 1 | seconds | C(1) |
| WNLSF | 8 | 1 | weeks | C(1) |
| DN | 8 | 1 | days | C(1) |
| tLSF | 8 | 1 | seconds | C(1) |
| UTC Standard ID | 3 | 1 | --- | C(1) |
| **Model-5** (as defined in [18]) | | | | |
| A0UTC | 32 | 2-30 | Seconds | C(1) |
| A1UTC | 24 | 2-50 | sec/sec | C(1) |
| tLS | 8 | 1 | Seconds | C(1) |
| WNLSF | 8 | 1 | Weeks | C(1) |
| DN | 8 | 1 | Days | C(1) |
| tLSF | 8 | 1 | Seconds | C(1) |
| Note 1: All of these fields shall be present together, or none of  them shall be present.  Note 2: If the optional elements are included, both elements shall be included. | | | | |

**UTC Standard ID**

If GANSS 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 Table A.55.18 ( [15], Message Type 12).

Table A.55.18: UTC Standard ID

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

**GANSS Auxiliary Information**

This field contains additional information dependent on the GANSS ID and is shown in Table A.55.19. If GANSS Auxiliary Information is provided together with other satellite dependent GANSS assistance data (i.e., any of DGANSS Corrections, GANSS Navigation Model, GANSS Data Bit Assistance, or GANSS Reference Measurement Information IEs) and RRLP pseudo-segmentation is used, the GANSS Auxiliary Information should be provided for the same satellites and in the same RRLP segment as the other satellite dependent GANSS assistance data.

Table A.55.19: GANSS Auxiliary Information Parameter Format

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | Range | Bits | | Resolution | Incl. |
| **One of the following group of elements can be included, dependent on the GANSS ID** | | | | | | |
| The following fields may only be present if GANSS ID indicates Modernized GPS and occur once per satellite (N\_SAT times): | | | | | | |
| SV ID | 0-63 | | 6 | --- | | M |
| Signals Available | Table A.59 | | 8 | --- | | M |
| The following fields may only be present if GANSS ID indicates GLONASS and occur once per satellite (N\_SAT times): | | | | | | |
| SV ID | | 0-63 | 6 | | --- | M |
| Signals Available | | Table A.59 | 8 | | --- | M |
| Channel number | | -7 – 13 | 5 | | --- | M |

**SV\_ID**

This field specifies the SV for which the GANSS Auxiliary Information is given. The interpretation of SV ID is defined in Table A.10.14.

Range: 0 – 63

**Signals Available**

This field indicates the ranging signals supported by the satellite indicated by SV ID. This field is given as a bit string as shown in Table A.59 for a particular GANSS. If a bit is set to '1' it indicates that the satellite identified by SV ID transmits ranging signals according to the signal correspondence in Table A.59. If a bit is set to '0' it indicates that the corresponding signal is not supported on the satellite identified by SV ID.

**Channel number**

This field indicates the GLONASS carrier frequency number of the satellite identified by SV ID, as defined in [17].

**DGANSS Corrections Validity Period**

This element is an extension to the DGANSS Corrections IE and provides the validity period of the differential corrections for each satellite and signal included in the DGANSS Corrections IE (see Table A.43). This element may only be included if the DGANSS Corrections IE is included in the GANSS Generic Assistance Data element.

Table A.55.20: DGANSS Corrections Validity Period

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| N\_SGN\_TYPE | 2 | 1 | 1-3 | --- | M |
| The following fields occur once per GANSS signal type (N\_SGN\_TYPE times) | | | | | |
| GANSS\_Signal\_ID | 3 | --- | --- | --- | M |
| N\_SAT | 4 | 1 | 1-16 | --- | M |
| The following fields occur once per satellite (N\_SAT times) | | | | | |
| SV\_ID | 6 | --- | 0-63 | -- | M |
| UDRE Growth Rate | 3 | --- | 0-7 | --- | M |
| Time of Validity for UDRE Growth Rate | 3 | --- | 0-7 | --- | M |

**N\_SGN\_TYPE**

This field indicates the number of GNSS signal types included in DGANSS Corrections Validity Period IE. This field shall be set to the same value as the N\_SGN\_TYPE parameter in the DGANSS Corrections element in Table A.43.

**GANSS\_Signal\_ID**

DGANSS corrections validity period are provided per GNSS signal type identified by GANSS\_Signal\_ID. The supported signals are listed in Table A.59. This field shall be set to the same value as the GANSS\_Signal\_ID parameter in the DGANSS Corrections element in Table A.43.

**N\_SAT**

This field indicates the number of satellites for which differential corrections validity period is available. This field shall be set to the same value as the N\_SAT parameter in the DGANSS Corrections element in Table A.43.

**SV\_ID**

This field identifies the satellite for which the corrections validity period is applicable. The interpretation of SV ID is defined in Table A.10.14. The UDRE Growth Rate and Time of Validity for UDRE Growth Rate IEs shall be included for the same SV\_IDs as the differential corrections in Table A.43 are provided.

**UDRE Growth Rate**

This field provides an estimate of the growth rate of uncertainty (1-) in the corrections for the particular satellite identified by SV\_ID. The estimated UDRE at time value specified in the "Time of Validity for UDRE Growth Rate" *t1* is calculated as follows:

UDRE(*t0*+*t1*) = UDRE(*t0*)  UDRE Growth Rate

where *t0* is the DGANSS Reference Time for which the corrections in Table A.43 are valid, *t1* is the "Time of Validity for UDRE Growth Rate" field as shown in Table A.55.21, UDRE(*t0*) is the User Differential Range Error field as provided in Table A.43, and "UDRE Growth Rate" field is the factor as shown in Table A.55.21.

Table A.55.21: Values of UDRE Growth Rate IE

|  |  |
| --- | --- |
| Value | Indication |
| 000 | 1,5 |
| 001 | 2 |
| 010 | 4 |
| 011 | 6 |
| 100 | 8 |
| 101 | 10 |
| 110 | 12 |
| 111 | 16 |

**Time of Validity for UDRE Growth Rate**

This field specifies the time when the "UDRE Growth Rate" field applies. The meaning of the values for this field is described in Table A.55.21a.

Table A.55.21a: Time of Validity for UDRE Growth Rate IE

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

**GANSS Time Model Extension**

This element is an extension to the GANSS Time Model IE and is shown in Table A.55.22. If GANSS Time Model is provided by the SMLC, the GANSS Time Model Extension shall also be provided.

NOTE: For reasons of backward compatibility, this IE is not defined for a Release 9 or earlier SMLC and would be ignored, when received, by a Release 9 or earlier MS. This means that when the element is expected but is not received, the SMLC is Release 9 or earlier.

Table A.55.22: GANSS Time Model Extension

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| GNSS\_TO\_ID | 3 | --- | --- | --- | M |
| Delta T | 8 | 1 | -128 - 127 | seconds | M |

**GNSS\_TO\_ID**

This field is the same as defined in Table A.41 and specifies GNSS for which the GANSS Time Model Extension is provided.

**Delta T**

This field specifies the integer seconds of the GNSS-GNSS Time Offset provided in the GANSS Time Model in Table A.41.

**GANSS Reference Measurement Extension**

This element is an extension to the GANSS Reference Measurement Information IE and is shown in Table A.55.23. If GANSS Reference Measurement Information is provided by the SMLC, the GANSS Reference Measurement Extension shall also be provided.

NOTE: For reasons of backward compatibility, this IE is not defined for a Release 9 or earlier SMLC and would be ignored, when received, by a Release 9 or earlier MS. This means that when the element is expected but is not received, the SMLC is Release 9 or earlier.

Table A.55.23: GANSS Reference Measurement Extension

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| Num\_Sat | 4 | 1 | 0-15 | --- | M |
| The following fields occur once per satellite (Num\_Sat times) | | | | | |
| SV\_ID | 6 | --- | 0-63 | -- | M |
| Azimuth LSB | 4 | 0,703125 | 0-10,546875 | degrees | M |
| Elevation LSB | 4 | 0,703125 | 0-10,546875 | degrees | M |

**Num\_Sat**

This field indicates the number of satellites for which GANSS Reference Measurement is provided. This field shall be set to the same value as the Num\_Sat parameter in the GANSS Reference Measurement Information element in Table A.52.

**SV\_ID**

This field identifies the satellite for which the GANSS Reference Measurement is provided. This field shall be set to the same value as the SV\_ID field in Table A.52.

**Azimuth LSB**

This field specifies the 4 least significant bits of the satellite azimuth angle. The 5 most significant bits are provided in the Azimuth field in Table A.52. The full satellite azimuth is constructed as "Azimuth"  11,.25 + "Azimuth LSB"  0,703125 degrees.

**Elevation LSB**

This field specifies the 4 least significant bits of the satellite elevation angle. The 5 most significant bits are provided in the Elevation field in Table A.52. The full satellite elevation is constructed as "Elevation"  11,25 + "Elevation LSB"  0,703125 degrees.

**GANSS Almanac Model Extension**

This element is an extension to the GANSS Almanac Model IE and is shown in Table A.55.24. If GANSS Almanac Model is provided by the SMLC, the GANSS Almanac Model Extension shall also be provided.

NOTE: For reasons of backward compatibility, this IE is not defined for a Release 9 or earlier SMLC and would be ignored, when received, by a Release 9 or earlier MS. This means that when the element is expected but is not received, the SMLC is Release 9 or earlier.

Table A.55.24: GANSS Almanac Model Extension

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| Complete Almanac Provided | 1 | --- | --- | Boolean | M |

**Complete Almanac Provided**

This field indicates whether the SMLC provided Almanac for the full GANSS constellation or not. TRUE means complete GANSS almanac is provided.

**GANSS Almanac Model Extension-R12**

This element is an extension to the GANSS Almanac Model IE and is shown in Table A.55.25. It is used only if GANSS-ID is Galileo in this version of protocol.

Table A.55.25: GANSS Almanac Model Extension-R12

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Units | Incl. |
| Toa-Ext | 10 | 600 | s | O (note 1) |
| IODa-Ext | 4 | -- | -- | O (note 2) |
| NOTE 1: If Toa in GANSS Almanac Model element (Table A.54) is present, this field shall not be present.  NOTE 2: If IODa in GANSS Almanac Model element (Table A.54) is present, this field shall not be present. | | | | |

**Toa-Ext**

This field specifies the Almanac Reference Time common to all satellites in GANSS Almanac Model using Keplerian Parameters given in GNSS specific system time.

Range: 256 - 1023

In case of GNSS-ID does indicate Galileo, the scale factor is 600 seconds.

**IODa-Ext**

This field specifies the Issue-Of-Data common to all satellites in GANSS Almanac Model using Keplerian Parameters.

Range: 4 - 15

**GANSS Reference Measurement Extension-R12**

This element is an extension to the GANSS Reference Measurement Information IE and is shown in Table A.55.25.a. The SMLC should include this field only if supported by the MS.

Table A.55.25.a: GANSS Reference Measurement Extension-R12

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| GANSS\_Signal\_ID | 3 | --- | 0-7 | --- | M |
| Confidence | 7 | 1 | 0-100 | percent | O |
| Num\_Sat | 4 | 1 | 0-15 | --- | O |
| The following fields, if included, occur once per satellite (Num\_Sat times) | | | | | |
| SV\_ID | 6 | --- | 0-63 | -- | M |
| Doppler Uncertainty Extension | 3 | --- | 60, 80, 100, 120, 'No Information' | m/s | M |

**GANSS\_Signal\_ID**

This field specifies the GNSS signal type. The supported signals are listed in Table A.59.

**Confidence**

This field specifies the confidence level of the reference location area or volume used to calculate the GANSS Reference Measurement parameters (search windows). A high percentage value (e.g., 98% or more) indicates to the MS that the provided search windows are reliable. The SMLC should include this field to indicate the confidence level of the provided information.

Range: 0 – 100

**Num\_Sat**

This field indicates the number of satellites for which GANSS Reference Measurement Extension-R12 is provided.

**SV\_ID**

This field identifies the satellite for which the GANSS Reference Measurement Extension-R12 is provided.

**Doppler Uncertainty Extension**

If this field is present, the MS that supports this field shall ignore the Doppler Uncertainty (Table A.52) field. This field specifies additional Doppler uncertainty values. It is defined such that the Doppler experienced by a stationary MS is in the range [Doppler-Doppler Uncertainty Extension] to [Doppler+Doppler Uncertainty Extension]. Doppler Uncertainty Extension is given in unit of m/s by multiplying the Doppler Uncertainty Extension value in Hz by the nominal wavelength of the assisted signal.

Enumerated values define 60 m/s, 80 m/s, 100 m/s, 120 m/s, and "No Information".

**DBDS Corrections**

These fields specify the DBDS corrections to be used by the MS.

Table A.55.25.b: DBDS Corrections

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| The following fields occur once per message | | | | | |
| N\_SGN\_TYPE | 2 | 1 | 1 - 3 | --- | M |
| DBDS Reference Time | 12 | 1 | 0 - 3599 | seconds | M |
| The following fields occur once per GANSS signal type (N\_SGN\_TYPE times) | | | | | |
| N\_SAT | 6 | 1 | 1 - 64 | --- | M |
| DBDS Signal ID | 3 | --- | --- | --- | M |
| The following fields occur once per satellite (N\_SAT times) | | | | | |
| SV\_ID | 6 | --- | 0 - 63 | --- | M |
| UDREI | 4 | --- | 0 - 15 | --- | M |
| RURAI | 4 | --- | 0 - 15 | --- | M |
| Delta T | 13 | 0.1 | -409.5 – 409.5 | meters | M |

**DBDS Reference Time**

This field indicates the baseline time for which the DBDS corrections are valid as modulo 3600 s. DBDS Reference Time is given in BDS system time.

Range: 0 - 3599 s

**DBDS Signal\_ID**

DBDS corrections are provided per BDS signal type identified by BDS Signal\_ID. The supported signals are listed in Table A.59.

**UDREI**

UDRE is used to describe the error of equivalent clock correction in meters. It is indicated by user differential range error index (UDREI). It occupies 4 bits for each satellite within the range of 1~15 and the update rate is 3 seconds. The corresponding relationship between UDRE and UDREI is shown in A.55.26.

Table A.55.26: UDREI definitions

|  |  |
| --- | --- |
| UDREI | UDRE  （meters, 99.9％） |
| 0 | 1 |
| 1 | 1.5 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |
| 5 | 5 |
| 6 | 6 |
| 7 | 8 |
| 8 | 10 |
| 9 | 15 |
| 10 | 20 |
| 11 | 50 |
| 12 | 100 |
| 13 | 150 |
| 14 | Not monitored |
| 15 | Not available |

**RURAI**

Regional User Range Accuracy (RURA) is used to describe the satellite signal pseudo-range error in meters.The satellite signal integrity information is indicated with the Regional User Range Accuracy Index (RURAI). It occupies 4 bits for each satellite so the effective range of RURAI is 0 to 15. See Table A.55.27 for the corresponding relationship between RURAI and RURA.

Table A.55.27: RURAI definitions

|  |  |
| --- | --- |
| RURAI | RURA  （meters, 99.9%） |
| 0 | 0.75 |
| 1 | 1 |
| 2 | 1.25 |
| 3 | 1.75 |
| 4 | 2.25 |
| 5 | 3 |
| 6 | 3.75 |
| 7 | 4.5 |
| 8 | 5.25 |
| 9 | 6 |
| 10 | 7.5 |
| 11 | 15 |
| 12 | 50 |
| 13 | 150 |
| 14 | 300 |
| 15 | > 300.0 |

**Delta\_T**

The BDS differential correction information is expressed in equivalent clock correction (Δt). It occupies 13 bits for each satellite with the unit and scale factor of meter and 0.1 respectively and is expressed with two's complement. The MSB is for the sign bit (+ or –).

**BDS Grid Model**

The BDS Grid Model parameters are used to estimate the ionospheric distortions on pseudoranges as described in [18] on page 76.

Table A.55.28: BDS Grid Model

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | # Bits | Scale Factor | Range | Units | Incl. |
| The following fields occur once per message | | | | | |
| BDS Reference Time | 12 | 1 | 0 - 3599 | seconds | M |
| N\_IGP | 9 | 1 | 1 - 320(1) | - | M |
| The following fields occur once per IGP (N\_IGP times(1)) | | | | | |
| IGP number | 9 | -- | 1…320 | --- | M |
| Vertical Delay | 9 | 0.125 | 0 - 63.625 | meters | M |
| GIVEI | 4 | -- | -- | -- | M |
| NOTE 1: Up to 16 instances are used in this version of the specification. The values 17 to 320 are reserved for future use. | | | | | |

**BDS Reference Time**

This field indicates the baseline time for which the BDS Grid Model are valid as modulo 3600 s. BDS Reference Time is given in BDS system time.

Range: 0 - 3599 s

**IGP number**

This field indicates the ionospheric grid point (IGP) number as defined in [18].

**Vertical Delay**Vertical delay is used to indicate the vertical ionosphere delay on B1I signal at the ith grid point, expressed in scale factor of 0.125 and with unit of meters. The effective range of vertical delay is between 0 to 63.625 meters.

**GIVEI**

The grid ionosphere vertical error (GIVE) describes the delay correction accuracy at ionosphere grid points and is indicated with GIVEI. See Table A.55.29 for the relationship between GIVEI and GIVE.

Table A.55.29: GIVEI definitions

|  |  |
| --- | --- |
| GIVEI | GIVE  (meters, 99.9%) |
| 0 | 0.3 |
| 1 | 0.6 |
| 2 | 0.9 |
| 3 | 1.2 |
| 4 | 1.5 |
| 5 | 1.8 |
| 6 | 2.1 |
| 7 | 2.4 |
| 8 | 2.7 |
| 9 | 3 |
| 10 | 3.6 |
| 11 | 4.5 |
| 12 | 6 |
| 13 | 9 |
| 14 | 15 |
| 15 | 45 |

#### A.4.2.7 GANSS Carrier-Phase Measurement Request Element

This element is optional and controls if the MS should return carrier-phase measurements in GANSS Measurement Information IE or not to the SMLC. The inclusion of this parameter implies use of measure Position Request. The description is found in sub-chapter 2.2.4d.

#### A.4.2.8 GANSS TOD - GSM Time Association Request Element

This element is optional and controls if the MS should return GANSS TOD - GSM Time Association Measurements or not to the SMLC. The inclusion of this parameter implies use of measure Position Request. The description is found in sub-chapter 2.2.4e.

## A.5 Assistance Data Acknowledgement

### A.5.1 General

The MS sends the Assistance Data Acknowledgement component to the SMLC to indicate that it has received the whole Assistance Data component.

## A.6 Protocol Error

### A.6.1 General

This component is used by the receiving entity (SMLC or MS) to indicate to the sending entity, that there is a problem that prevents the receiving entity to receive a complete and understandable component.

This component has the following values:

'0': Undefined;

'1': Missing Component;

'2': Incorrect Data;

'3': Missing Information Element or Component Element;

'4': Message Too Short;

'5': Unknown Reference Number.

### A.6.2 Extended Reference IE

This IE shall be included in any Protocol Error message if and only if an Extended Reference IE was received in the corresponding previous Measure Position Request or Assistance Data message.

NOTE: For reasons of backward compatibility, a Release 4 or earlier MS will not include this IE.

The Extended Reference IE contains the following elements.

SMLC code: an integer in the range 0-63. The value returned by a target MS in a Protocol Error message shall equal the value received from the SMLC in the earlier Measure Position Request or Assistance Data message.

Transaction ID: an integer in the range 0-262143 distinguishing different RRLP transactions in different MSs currently being served by the same SMLC. The value returned by a target MS in a Protocol Error message shall equal the value received from the SMLC in the earlier Measure Position Request or Assistance Data message.

## A.7 Positioning Capability Request

### A.7.1 General

The SMLC sends the Positioning Capability Request component to the MS to request the MS positioning capabilities, types of assistance data supported and any assistance data that may be needed. It contains the following elements.

Table A.56: Positioning Capability Request component content

|  |  |  |
| --- | --- | --- |
| Element | Type/Reference | Presence |
| Extended Reference | Extended Reference 2.2.5 | M |
| GANSS Position Method Parameters | GANSS Position Method Parameters, Table A.58 | O |

## A.8 Positioning Capability Response

### A.8.1 General

The Positioning Capability Response is a RRLP component from the MS to the network. It is the response to the Positioning Capability Request. It contains the following elements.

Table A.57: Positioning Capability Response component content

|  |  |  |
| --- | --- | --- |
| Element | Type/Reference | Presence |
| Extended Reference | Extended Reference 2.2.5 | M |
| Positioning Capabilities | Positioning Capabilities 8.2.1 | M |
| Assistance Data Supported | Assistance Data Supported 8.2.2 | O |
| Assistance Data Needed | Assistance Data Needed 8.2.3 | O |

### A.8.2 Elements

#### A.8.2.1 Positioning Capabilities

This element indicates the positioning methods and other positioning capabilities supported by the MS. The inclusion of this element is mandatory.

The MS may indicate support for non-GANSS position methods and/or GANSS position methods. The MS indicates its support for non-GANSS position methods using a bit string with one bit representing each method, set to one if the method is supported and zero if it is not. The following Non-GANSS Position Methods can be identified:

- MS Assisted E-OTD;

- MS Based E-OTD;

- MS Assisted GPS;

- MS Based GPS;

- Standalone GPS.

The MS indicates its support for GANSS position methods by providing the parameters shown in Table A.58 for each GANSS system supported.

Table A.58: GANSS Position Method Support

|  |
| --- |
| GANSS Position Method Parameters |
| GANSS\_ID |
| GANSS Position Method Types |
| GANSS Signals |
| SBAS ID |

GANSS\_ID

Range: 0 - 7

This field indicates the GANSS. The supported GANSS are defined in sub-clause A.4.2.6.2 (Table A.40). Absence of this field indicates Galileo.

GANSS Position Method Types

For each supported GANSS system, the MS shall and SMLC may indicate which method types are supported. This is represented using a bit string with one bit per method type where a one value indicates support and a zero value no support. The following GANSS Method Types can be identified:

- MS Assisted;

- MS Based;

- Standalone.

GANSS Signals

For each supported GANSS system, the MS shall and SMLC may indicate which signals are supported. This is represented using a bit string with one bit per signal where a one value indicates support and a zero value no support. The individual signals are denoted generically as signal1, signal2 etc. in the ASN.1 in clause 5.l. Table A.59 shows the signal correspondence for each defined GANSS system. Unfilled table entries indicate no assignment and shall either not be included or set to zero if included.

The GANSS Signal Correspondence in Table A.59 is also used when a single signal is addressed (e.g., when reporting GANSS measurements or providing GANSS assistance data). In this case, an Integer value is used to indicate the signal, and the values 0 to 7 correspond to GANSS Signal 1 to 8, respectively.

Table A.59: GANSS Signal Correspondence

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GANSS System | Signal 1 | Signal 2 | Signal 3 | Signal 4 | Signal 5 | Signal 6 | Signal 7 | Signal 8 |
| Galileo | E1 | E5a | E5b | E6 | E5a+E5b |  |  |  |
| Modernized GPS | L1C | L2C | L5 |  |  |  |  |  |
| SBAS | L1 |  |  |  |  |  |  |  |
| QZSS | QZS-L1 | QZS-L1C | QZS-L2C | QZS-L5 |  |  |  |  |
| GLONASS | G1 | G2 | G3 |  |  |  |  |  |
| BDS | B1I |  |  |  |  |  |  |  |

SBAS\_ID

If GANSS ID in Table A.58 indicates support for SBAS, this field shall be present to indicate support of specific SBAS using a bit map with one bit per SBAS where a one value indicates support and a zero value no support.

Table A.59.a: SBAS ID Correspondence

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Bit 0 | Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 |
| WAAS | EGNOS | MSAS | GAGAN | reserved | reserved | reserved | reserved |

The MS shall also indicate whether it supports multiple measurement sets for the MS Assisted position methods listed below. This is represented using a bit string with one bit representing each position method which is set to a one if multiple measurement sets are supported for that method and to a zero if not. The following MS Assisted Position Methods associated with Multiple Measurement Sets can be identified:

- E-OTD;

- GPS;

- GANSS.

#### A.8.2.2 Assistance Data Supported

This element indicates the types of assistance data that the MS supports for GPS and GANSS and is shown in Table A.59.b.

Table A.59.b: Assistance Data Supported

|  |
| --- |
| GANSS Position Method Parameters |
| GPS Assistance Data |
| GANSS Assistance Data |
| GANSS Additional Assistance Data Choices |

GPS Assistance Data

In the case of GPS, support for each of the following types of assistance data can be individually indicated using a bit string in which a one value indicates support and a zero no support. The following GPS Assistance Indications can be identified:

- Almanac;

- UTC model;

- Ionospheric Model;

- Navigation Model;

- DGPS Corrections;

- Reference Location;

- Reference Time;

- Acquisition Assistance;

- Real Time Integrity;

- Ephemeris Extension;

- Ephemeris Extension Check;

- GPS Acquisition Assistance Extension-R12.

- DBDS Corrections

- BDS Grid Model

GANSS Assistance Data

In the case of GANSS, support for each of the following types of common assistance data is indicated using a bit string in which each bit represents one type of assistance data and is set to a one to indicate support and a zero to indicate no support. The following Common GANSS Assistance Indications can be identified:

- GANSS Reference Time;

- GANSS Reference Location;

- GANSS Ionospheric Model;

- GANSS Additional Ionospheric Model;

- GANSS Earth Orientation Parameters.

The MS indicates its support for assistance data specific to each GANSS system by providing the parameters shown in Table A.60 for each GANSS system supported.

Table A.60: GANSS Assistance Support

|  |
| --- |
| GANSS Assistance Parameters |
| GANSS\_ID |
| GANSS Assistance |

GANSS\_ID

Range: 0 - 7

This field indicates the GANSS. The supported GANSS are defined in sub-clause A.4.2.6.2 (Table A.40). Absence of this field indicates Galileo.

GANSS Assistance

Supported GANSS Assistance data is indicated using a bit string in which each bit represents one type of assistance data and is set to a one to indicate support and a zero to indicate no support. The following types of Specific GANSS Assistance Indications can be identified.

- GANSS Real Time Integrity;

- GANSS Differential Corrections;

- GANSS Almanac;

- GANSS Reference Measurement Information;

- GANSS Navigation Model;

- GANSS Time Model GNSS-UTC;

- GANSS Time Model GNSS-GNSS;

- GANSS Data Bit Assistance;

- GANSS Ephemeris Extension;

- GANSS Ephemeris Extension Check;

- GANSS Additional UTC Model;

- GANSS Auxiliary Information;

- GANSS Reference Measurement Extension-R12.

GANSS Additional Assistance Data Choices

For GANSS Assistance Data elements for which multiple choices exist (GANSS Clock Model (Table A.49.1), GANSS Orbit Model (Table A.49.2), GANSS Almanac Model (Table A.54), and GANSS UTC Model/Additional UTC Model (Table A.55/A.55.17)) the MS and SMLC shall support the native formats choice as defined in the relevant ICDs for each GANSS signal. The MS can indicate which additional non-native choice(s) is(are) supported for a particular GANSS using a bit map with one bit per model where a one value indicates support and a zero value no support. Note that native support need not be indicated in this bit map.

Table A.61: GANSS Additional Assistance Data Choices

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | #Bits | Type/Reference | Prsesence |
| **The following fields occur once per GANSS (Num\_GANSS times)** | | | |
| GANSS ID | 3 | Table A.40 | O(1) |
| GANSS Clock Model Choice | 8 | Bit String –Table A.62 | C(2) |
| GANSS Orbit Model Choice | 8 | Bit String –Table A.62 | C(2) |
| GANSS Almanac Model Choice | 8 | Bit String –Table A.62 | C(3) |
| GANSS UTC Model Choice | 8 | Bit String –Table A.62 | C(4) |
| Note 1: Absence of this field indicates Galileo.  Note 2: These elements may only be present if GANSS Navigation Model support is indicated in GANSS Assistance.  Note 3: This element may only be present if GANSS Almanac support is indicated in GANSS Assistance.  Note 4: This element may only be present if GANSS Additional UTC Model support is indicated in GANSS Assistance. | | | |

Table A.62: Bit String of GANSS Additional Assistance Data Choices

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 |
| The individual Models 1-8 are identified in Tables A.49.1, A.49.2, A.54, and A.55/A.55.17.  Non defined Models in Assistance Data Choices shall have the value '0' at the corresponding bit position. | | | | | | | |

#### A.8.2.3 Assistance Data Needed

This element indicates the types of assistance data that the MS may need to obtain a location estimate or positioning measurements. The MS shall use this IE to indicate to the SMLC all the supported assistance data types for which the MS does not have current versions using the assistance data request IEs defined in 3GPP TS 49.031. The SMLC can then decide which subset of these assistance data types if any to download. The IE is encoded using the request for assistance data IEs defined for GPS and GANSS in 3GPP TS 49.031, with the following exceptions:

Requested GPS Assistance Data (clause 10.10 in 3GPP TS 49.031):

- If the MS supports Navigation Model (Bit D), Ephemeris Extension (Bit J), and Ephemeris Extension Check (Bit K), all three bits D, J, and K can be set to value 1 if the MS has no current versions of these assistance data types. If bit D is set to value 1, the coding of octets 5 to 8+2n shall be according to Figure 10.10.2 in clause 10.10 of 3GPP TS 49.031.

Requested GANSS Assistance Data (clause 10.31 in 3GPP TS 49.031):

- If the MS supports Navigation Model (Bit M), Ephemeris Extension (Bit N), and Ephemeris Extension Check (Bit R), all three bits M, N, and R can be set to value 1 if the MS has no current versions of these assistance data types.

- If the MS supports GANSS Ephemeris Extension (Bit N) and the MS has no current version of this assistance data type, bit N shall be set to value 1 but the corresponding extension octets in Figure 10.31.3d of 3GPP TS 49.031 shall be omitted.

- If the MS supports GANSS Data Bit Assistance (Bit Q) and the MS has no current version of this assistance data type, bit Q shall be set to value 1 but the corresponding extension octets in Figure 10.31.3c of 3GPP TS 49.031 shall be omitted.

- If the MS supports GANSS Ephemeris Extension Check (Bit R) and the MS has no current version of this assistance data type, bit R shall be set to value 1 but the corresponding extension octets in Figure 10.31.3e of 3GPP TS 49.031 shall be omitted.

# A.9 Multilateration Timing Advance Request

## A.9.1 General

The Multilateration Timing Advance Request is a RRLP component sent from the SMLC to the MS. The SMLC uses the minimum guaranteed assessment error value of the BTS (i.e. the BTS Reception Accuracy Capability received from the BSC as part of assistance information and MS Sync Accuracy received from SGSN in the PERFORM-LOCATION-REQUEST PDU) when determining the Target-Number-of-Cells to use in the triggering RRLP message and the BTS Reception Accuracy Level reported by that BTS (when the Multilateration Timing Advance procedure is ongoing) to estimate the MS position and the corresponding positioning accuracy (see 3GPP TS 45.010 and 3GPP TS 43.059). This RRLP component contains the following elements.

Table A.9.1: Multilateration Timing Advance Request component content

|  |  |  |
| --- | --- | --- |
| Element | Type/Reference | Presence |
| Target-Number-of-Cells | Target-Number-of-Cells A.9.2.1 | M |
| Requested-MS-Synchronization-Accuracy | Requested-MS-Synchronization-Accuracy A.9.2.2 | M |
| MTA-Method | MTA-Method A.9.2.3 | M |
| Random-ID-Set | MTA-Method A.9.2.4 | M |
| MPM-Timer | MPM-Timer A.9.2.5 | M |
| Serving-Cell | Serving-Cell A.9.2.6 | M |
| Co-Sited-Cells | Co-Sited-Cells A.9.2.7 | O |
| Cell-Set N | Cell Set N A.9.2.8 | M |
| MTA-Security | MTA-Security A.9.2.9 | O |

## A.9.2 Elements

### A.9.2.1 Target-Number-of-Cells Element

This field is a 3 bit integer used to indicate the optimum number of cells a MS is to use when performing the radio access part of the MTA procedure. This field is mandatory, and has the following values:

0 0 0 : 2 cells  
0 0 1 : 3 cells

…

1 1 1 : 9 cells

### A.9.2.2 Requested-MS-Synchronization-Accuracy Element

This field is a 4 bit integer used to indicate the synchronization accuracy the MS should attempt to realize when performing the radio access part of the MTA procedure using the RLC Data Block method or the Extended Access Burst method and is coded as per the value part of the MS Synchronization Accuracy IE defined in 3GPP TS 49.031 [7]. The synchronization accuracy requested by this field shall be ignored when performing the radio access part of the MTA procedure using the Access Burst method.

### A.9.2.3 MTA-Method

This field indicates the MTA method the MS is to use when performing the radio access part of the MTA procedure and allows for indicating the following methods.

RLC Data Block: If this method is indicated then no additional information is included within the MTA-Method information.

Access Burst: If this method is indicated then no additional information is included within the MTA-Method information.

Extended Access Burst: If this method is indicated then the Short BSS ID field is included as part of the MTA-Method information.

These methods require that either PEO or EC-GSM-IoT operation is enabled in the MS. If EC-GSM-IoT operation is enabled but CC1 is not used on the uplink then the MS shall use the RLC Data Block method (if supported). If neither PEO or EC-GSM-IoT operation is enabled the MS shall not perform the commanded MTA procedure.

**Short-BSS-ID**

This parameter identifies the serving BSS within a cluster of BSS areas and is used for the Extended Access Burst method. The Short BSS ID together with a Random ID value identify the target MS for the Multilateration Timing Advance procedure in a unique way in the network.

### A.9.2.4 Random-ID

This parameter is used by a MS when it performs the radio access part of the MTA procedure using the RLC Data Block or Extended Access Burst method. The Random ID value sent by a MS performing the radio access part of the MTA procedure is selected from a set of up to 9 Random ID values provided by the RRLP Multilateration Timing Advance Request message. Each Random ID value provided by the RRLP message can only be used in one cell used by a MS when performing the radio access part of the MTA procedure. After reception by the BSS it is sent to the SMLC along with corresponding MTA timing advance information using a SCCP connection that the Random ID is logically associated with (i.e. when the SMLC first allocates a set of Random ID values for inclusion in a RRLP message they will always be associated with a SCCP connection used by the SMLC for an ongoing MTA procedure). The reception of any one of the allocated Random ID values along with corresponding MTA timing advance information therefore allows the SMLC to validate the timing advance information.

### A.9.2.5 MPM-Timer

This field is a 3 bit integer used to indicate the maximum amount of time the MS can use to perform the radio access part of the MTA procedure and is coded as per the MPM Timer field defined in 3GPP TS 49.031 [7].

### A.9.2.6 Serving-Cell

This field is set to ‘1’ if the SMLC requests the MS to include the serving cell when performing the radio access part of the MTA procedure.

### A.9.2.7 Co-Sited-Cells

This field identifies the set of cells that are co-sited with the serving cell and therefore shall not be used by the MS when performing the radio access part of the MTA procedure.

### A.9.2.8 Cell-Set N

This field provides assistance information for one or more sets of cells wherein information for at least one cell is provided within each Cell Set for which assistance information is provided. When multiple cells are identified for a given Cell Set then each cell in the set is co-sited and the MS shall therefore use at most one cell from the set when performing the radio access part of the MTA procedure. If the ARFCN and BSIC of the serving cell is included for a cell within a Cell Set then the MS shall use that cell when performing the radio access part of the MTA procedure.

**Short-ID**

This parameter identifies the cell specific Short ID value to be sent from the MS to the BSS when the MS performs the radio access part of the MTA procedure in a cell using the Access Burst method. It is part of the MTA related measurement information passed from the BSS to the SMLC and is used by the SMLC to validate the corresponding MTA related measurement information it receives for that cell.

**ARFCN**  
This field is the binary representation of the absolute radio frequency channel number (ARFCN) defined in 3GPP TS 45.005.

**BSIC-Info**

This field identifies the 9 bit BSIC (see 3GPP TS 45.003 and 3GPP TS 45.008) associated with the indicated ARFCN.

**EC-Cell-Information**

When a cell supports EC-GSM-IoT the corresponding EC-RACH-Control-Parameters may be included as part of the assistance information. If excluded for that cell the MS shall default to using the EC-RACH-Control-Parameters provided for any other cell in that set. If EC-RACH-Control-Parameters are not provided for any cell in a set of cells that support EC-GSM-IoT then the MS shall read the EC-BCCH for the cell in that cell set that it chooses to use to perform the Multilateration Timing Advance procedure and thereby acquire the required EC-RACH-Control-Parameters information.

**PEO-Cell-Information**

When a cell supports PEO the corresponding RACH-Control-Parameters may be included as part of the assistance information. If excluded for that cell the MS shall default to using the RACH-Control-Parameters provided for any other cell in that set. If RACH-Control-Parameters are not provided for any cell in a set of cells that support PEO then the MS shall read the BCCH for the cell in that cell set that it chooses to use to perform the Multilateration Timing Advance procedure and thereby acquire the required RACH-Control-Parameters information.

**EC-BS-CC-CHANS**

This field is a 2 bit integer and indicates the number of extended coverage common control channels (EC-CCCHs) supported in the cell (see 3GPP TS 44.018).

**EC-RXLEV-ACCESS-MIN**  
This field is a 6 bit integer and is coded as the binary representation of the minimum received signal level at the MS for which it is permitted to access the system when using the EC-RACH, see 3GPP TS 45.008.

**MS-TXPWR-MAX-CCH**  
This field is coded as the binary representation of the "power control level" in 3GPP TS 45.005 corresponding to the maximum TX power level an MS may use when accessing the system on the (EC-)CCCH. This value shall be used by the Mobile Station according to 3GPP TS 45.008.

**LB-MS-TXPWR-MAX-CCH**  
The LB\_MS\_TXPWR\_MAX\_CCH field is coded as the binary representation of the "power control level" in 3GPP TS 45.005 corresponding to the maximum TX power level an MS may use on all other than DCS 1800 and PCS 1900 frequency bands when accessing the system on the (EC-)CCCH. The use of this field is defined in 3GPP TS 45.008.

**CELL-SELECTION-RLA-MARGIN**  
The CELL\_SELECTION\_RLA\_MARGIN field provides the MS with information whether RLA\_EC and RLA\_GC based measurements may be omitted or not. The use of this field is defined in 3GPP TS 45.008.

**DL-CC-Selection**This field is a BOOLEAN and indicates the method for selecting the downlink coverage class to be used by the MS (see 3GPP TS 44.018). The use of this field is defined in 3GPP TS 45.008.

**BT-Threshold-DL**This field is a 5 bit integer and indicates the signal level threshold below which blind physical layer transmissions are used on EC-CCCH. The use of this field is defined in 3GPP TS 45.008.

**CC2-Range-DL**

**CC3-Range-DL**  
These fields are 5 bit integers and are optionally sent by the network to indicate the signal level range of the indicated downlink coverage classes. The presence of one or both of these fields indicates network support of the associated downlink coverage class. The use of these fields is defined in 3GPP TS 45.008.

**BT-Threshold-UL**  
This field is a 5 bit integer and indicates the signal level threshold below which blind physical layer transmissions are used on EC-RACH. The use of this field is defined in 3GPP TS 45.008.

**CC2-Range-UL  
CC3-Range-UL**  
These fields are 5 bit integers and are optionally sent by the network to indicate the signal level range of the indicated uplink coverage classes. The presence of one or both of the above fields indicates network support of the associated uplink coverage class. The use of these fields is defined in 3GPP TS 45.008.

**CC4-Range-UL**

This field is optionally sent by the network to indicate the signal level range of uplink coverage class 4 and when included it implicitly indicates uplink class 5 is supported. The use of this field is defined in 3GPP TS 45.008.

**BSPWR**  
This field indicates the BTS output power transmitted on FCCH and EC-SCH.The use of this field is defined in 3GPP TS 45.008.

**DL-Signal-Strength-Step-Size**  
This field indicates the step-size in signal level above BT\_Threshold\_DL possible to report by the MS in the EC MULTILATERATION REQUEST message. The use of this field is defined in 3GPP TS 44.018.

**EC-Reduced-PDCH-Allocation**

This field indicates that the number of consecutive PDCHs the network allocates when assigning an EC TBF to a MS indicating Coverage Class CC2, CC3 or CC4 on the uplink or downlink during packet access. The use of this field is defined in 3GPP TS 44.018.

**EC-Max-Retrans**  
This field is a 2 bit integer and indicates the maximum number of retransmissions on EC-RACH. It is encoded as the Max retrans field in the RACH Control Parameters IE defined in 3GPP TS 44.018.

**Sm**  
This field is a 2 bit integer used by a MS to determine the number of multiframes it needs to read on the EC-AGCH in an attempt to find a response matching its last EC-RACH transmission. The use of this field is defined in 3GPP TS 44.018.

**Tm**  
This field is a 2 bit integer used by a MS to determine the number of multiframes on the EC-RACH from which it randomly selects a transmission/retransmission opportunity. The use of this field is defined in 3GPP TS 44.018.

**Access-Timeslots**  
This field is a BOOLEAN and indicates whether random access mapped over two timeslots shall be applied or not (see 3GPP TS 44.018). The use of this field is defined in 3GPP TS 44.018.

**ALPHA**  
This field is an optional 4 bit integer and provides the binary representation of the parameter  for MS output power control in units of 0.1, see 3GPP TS 45.008. For encoding and description of the ALPHA field see the Global Power Control Parameters IE in 3GPP TS 44.060.

**T3168  
T3192  
T3226**

These fields are optional 3 bit integers. The use of these fields is defined in 3GPP TS 44.060.

**T3248**

This field is a 2 bit integer. The use of this field is defined in 3GPP TS 44.060.

**MTA-BITMAP**This field contains a 4 bit bitmap indicating the Multilateration Timing Advance methods supported by a cell. See 3GPP TS 44.018 for a description of the Multilateration Timing Advance methods. Support for each of the methods listed below is provided using a BOOLEAN.

- MTA-RLC-Data-Block-method

- MTA-Access-Burst-method

- MTA-Extended-Access-Burst-method

- MTA-spare

**RXLEV-ACCESS-MIN**This field is a 6 bit integer and is coded as the binary representation of the minimum received signal level at the MS for which it is permitted to access the system when using the RACH, see 3GPP TS 45.008.

**Max-Retrans**  
This field is a 2 bit integer and indicates the maximum number of retransmissions on RACH. The use of this field is defined in 3GPP TS 44.018.

**Tx-integer**  
This field is a 4 bit integer and indicates the number of slots to spread the transmission on RACH. The use of this field is defined in 3GPP TS 44.018.

### A.9.2.9 MTA-Security

This field indicates the method for verifying the integrity of the MTA Access procedure.

MTA Access Security: If this method is indicated the MS generates MTA Signature at the end of MTA Access procedure based on the parameters associated with the successfully completed radio access parts of the MTA procedure using the Integrity protection keys negotiated with SGSN.

BSS Duplication Detection Method: If this method is indicated, MS sends MTA sequence number in each of the MTA Access attempt including the last attempt. BSS verifies the integrity of the access procedure based on detection of duplicate sequence numbers received from the same MS identifier.

# A.10 Multilateration OTD Request

## A.10.1 General

The Multilateration OTD (MOTD) request is an RRLP component from the network to the MS. This message is sent to MS to start MOTD measurements of neighbour base stations based on the given cell list

Table A.63: Multilateration OTD Request content

|  |  |  |
| --- | --- | --- |
| Element | Type/Reference | Presence |
| Target Number of OTD measurements | Target Number of OTD Measurements 10.2.1 | M |
| Required DL Synchronisation Accuracy | Required DL Synchronisation Accuracy 10.2.2 | M |
| Serving Cell Set | Cell Set 10.2.3 | O |
| Neighbouring Cell Set | Cell Sets 10.2.4 | O |

## A.10.2 Elements

### A.10.2.1 Target Number of OTD Measurements

This element indicates the number of OTD measurements required to achieve the estimated positioning accuracy. The MS can complete the OTD measurement procedure once the target number of OTD measurements are completed or if no neighbour cells from further neighbour cell sites can be received and send the Multilalteration OTD response message.

### A.10.2.2 Required DL Synchronisation Accuracy

This element indicates the downlink synchronisation accuracy the MS should try to achieve with serving cell and neighbour cells. MS shall estimate the DL sync accuracy (i.e MS Sync Accuracy (see 3GPP TS 45.010)) on reception of every additional synchronisation burst reception. MS stops further reception and processing of synchronisation bursts if the estimated downlink sync accuracy is better than the required DL synchronisation accuracy or the maximum number of synchronisation iterations is already reached.

### A.10.2.3 Serving Cell Set

This element contains the list of cells which are co-sited with the serving cell. MS shall avoid OTD measurements on the cells from this cell set. Each information element consists of ARFCN and BSIC of the cell as shown in Table A.64.

Table A.64: Cell Set

|  |
| --- |
| MOTD Measurements Parameter |
| ARFCN |
| BSIC |

### A.10.2.4 Neighbour Cell Sets

This information element provides up to 8 cell sets where each neighbour cell set consists of information about co-sited cells of (at least) one neighbour cell site. The co-sited cell information is used by MS while measuring the OTD with the neighbour cells. The MS shall measure the OTD only with the strongest cell per neighbour cell set.

Each Cell set information element indicates the ARFCN and BSIC of the cell (refer to Table A.64).

# A.11 Multilateration OTD Response

## A.11.1 General

The Multilateration OTD (MOTD) Response is a RRLP component from the MS to network. This message is sent by the MS in response to the Multilateration OTD Request message containing the multilateration OTD measurement results.

Table A.65 Multilateration OTD Request content

|  |  |  |
| --- | --- | --- |
| Element | Type/Reference | Presence |
| Serving Cell Downlink synchronisation Accuracy | Serving Cell DL Synch Accuracy. 11.2.1 | M |
| MOTD Measurement Results | MOTD Measurement Results 11.2.2 | O |
| MOTD Receive Level Measurements | MOTD Receive level Measurements 11.2.3 | O |

## A.11.2 Elements

### A.11.2.1 Serving Cell Downlink Synchronisation Accuracy

This element indicates the downlink synchronisation accuracy estimated for the serving cell at MS when it measures the OTD with neighbour cells for Multilateration OTD Response.

### A.11.2.2 MOTD Measurement Results

This element consists of up to 7 OTD Measurement Information elements each containing the OTD measurement results along with the cell related information. OTD Measurement Information is shown in Table A.66.

Table A.66: OTD Measurement Information

|  |
| --- |
| OTD Measurement Information |
| ReportedCell |
| MS Synchronisation Accuracy |
| OTD Measurement Result |

**The MS Synchronisation Accuracy**

This parameter refers to the estimated synchronisation accuracy of the cell for which the OTD measurement with respect to serving cell is measured. MS estimates the synchronisation accuracy based on received downlink synchronisation bursts as specified in 3GPP TS 45.010.

**Reported Cell**

This field indicates whether the reported cell is cell index within the CellSets given on MOTD Measurement Request message or combination of BSIC and ARFCN.

'0' = Reported Cell is given as the index to the cell in the serving Cell Set and Neighbour Cell Sets provided in the MOTD Measurement Request.

'1' = Reported Cell is given as BSIC(9 bit) and ARFCN of the cell.

**CellIdx**

The index of the cell within the Serving Cell Set and Neighbour Cell Sets provided in the MOTD Measurement Request message. The index spans across all the cells of the Serving Cell Set and Neighbour Cell Sets. (For example Index 0 refers to the first cell in the ServingCellSet. If ServingCellSet contains 3 cells, then index 3 refers to the first cell of the first Neighbour Cell Set).

**OTD Measurement Result**

This parameter indicates the observed time difference between the TDMA frame timing of the measured cell and the serving cell. The time difference is reported modulo 125 normal symbol periods in terms of 1/8 normal symbol period granularity. (For example, if the TDMA frame timing of the neighbour cell is observed to be ⅛ normal symbol period earlier than the TDMA frame timing of the serving cell, 8·((1250-⅛) mod 125) = 999 is reported.)

### A.11.2.3 MOTD Receive Level Measurements

This element is included in the MOTD Measurement Response when only one MOTD measurement result can be reported as part of the MOTD Measurement Response. This element consists of Receive Level Information parameters for all neighbour cells that the MS can receive, each consisting of receive level measurement and the cell identity related information. The MOTD Receive Level Measurement Information parameter is shown in Table A.67.

Table A.67: OTD Measurement Information

|  |
| --- |
| OTD Measurement Information |
| ReportedCell |
| Receive Level Measurement |

**Reported Cell**

Refer to subclause A.10.2.2 for definition and encoding of this parameter.

**Receive Level Measurement**

This parameter contains the RXLEV measurement of the reported cell. MS measures and reports this value as specified in 3GPP TS 45.008.

Annex B (informative):  
Change History

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2017-03 |  |  |  |  |  | Release 14 version (frozen at TSG-75) | 14.0.0 |
| 2017-06 | RP-76 | RP-170923 | 0227 | 8 | B | Introduction of Multilateration | 14.1.0 |
| 2017-06 | RP-76 | RP-170923 | 0228 | 3 | B | Introduction of Multilateration OTD | 14.1.0 |
| 2017-09 | RP-77 | RP-171593 | 0230 | - | F | Clarification to GANSS time model | 14.2.0 |
| 2017-12 | RP-78 | RP-172189 | 0231 | - | F | RRLP ASN.1 syntax corrections for Multilateration Positioning and GANSS | 14.3.0 |
| 2018-06 | RP-80 | RP-180822 | 0234 | - | B | Security Enhancement for MTA in network configuration without LLC security | 15.0.0 |
| 2020-07 | RP-88e | - | - | - | - | Upgrade to Rel-16 version without technical change | 16.0.0 |