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TECHNICAL SPECIFICATION

Terrestrial Trunked Radio (TETRA);
Voice plus Data (V+D) and Direct Mode Operation (DMO);
Part 18: Air interface optimized applications;
Sub-part 4: Net Assist Protocol 2 (NAP2)

Reference

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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee TETRA and Critical Communications Evolution (TCCE).

The present document is part 18, sub-part 4 of a multi-part deliverable covering the Voice plus Data (V+D), as identified below:

ETSI EN 300 392-1: "General network design";

ETSI EN 300 392-2: "Air Interface (AI)";

ETSI EN 300 392-3: "Interworking at the Inter-System Interface (ISI)";

ETSI ETS 300 392-4: "Gateways basic operation";

ETSI TS 100 392-5: "Peripheral Equipment Interface (PEI)";

ETSI TS 100 392-7: "Security";

ETSI EN 300 392-9: "General requirements for supplementary services";

ETSI EN 300 392-10: "Supplementary services stage 1";

ETSI TS 100 392-11: "Supplementary services stage 2";

ETSI EN 300 392-12: "Supplementary services stage 3";

ETSI ETS 300 392-13: "SDL model of the Air Interface (AI)";

ETSI ETS 300 392-14: "Protocol Implementation Conformance Statement (PICS) proforma specification";

ETSI TS 100 392-15: "TETRA frequency bands, duplex spacings and channel numbering";

ETSI TS 100 392-16: "Network Performance Metrics";

ETSI TR 100 392-17: "TETRA V+D and DMO specifications";

ETSI TS 100 392-18: "Air interface optimized applications":

Sub-part 1: "Location Information Protocol (LIP)";

Sub-part 2: "Net Assist Protocol (NAP)";

Sub-part 3: "Direct mode Over The Air Management protocol (DOTAM)";

Sub-part 4: "Net Assist Protocol 2 (NAP2)";

Sub-part 5: "SDS Based Supplementary Service Management (SBSSM)".

NOTE 1: Part 3, sub-parts 6 and 7 (Speech format implementation), part 4, sub-part 3 (Data networks gateway), part 10, sub-part 15 (Transfer of control), part 13 (SDL) and part 14 (PICS) of this multi-part deliverable are in status "historical" and are not maintained.

NOTE 2: Some parts are also published as Technical Specifications such as ETSI TS 100 392-2 and those may be the latest version of the document.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document defines Net Assist Protocol 2 that is optimized for TETRA air interface. It defines services:

- allowing information to be passed to a location determining entity also called MS (Mobile Station);
- allowing a location determining entity to request assistance information to an assistance server.

The information passed to the location determining entity by the assistance server, when relevant, reflects the content and format of the equivalent information (navigation data) which passes from satellites to the location determining entity.

The protocol is capable of supporting more than one position determining technology. Presently it covers multiple GNSS, and is extensible to all network positioning methods.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] IS-GPS-200H (September 2013): "Navstar GPS Space Segment/Navigation User Interfaces".

NOTE: Available at: http://www.gps.gov/technical/icwg/#is-gps-200.

[2] ETSI EN 300 392-1: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 1: General network design".

[3] ETSI EN 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".

[4] ETSI TS 100 392-18-1: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D) and Direct Mode Operation (DMO); Part 18: Air interface optimized applications; Sub-part 1: Location Information Protocol (LIP)".

[5] IS-GPS-705B (September 21, 2011): "Navstar GPS Space Segment/User Segment L5 Interfaces".

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

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

[8] European GNSS: "Galileo OS SIS ICD (Open Service Signal-in-Space Interface Control Document)", Issue 1.1 September 2010, Galileo Joint Undertaking.

NOTE Available at: http://ec.europa.eu/enterprise/policies/satnav/galileo/open-service/index_en.htm.

[9] Russian Institute of Space Device Engineering: "Global Navigation Satellite System GLONASS, Interface Control Document", Version 5.1, 2008.

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

NOTE Available at: http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/library/documents/media/waas/2892bC2a.pdf.

[11] RTCM 10402.3 (August 20, 2001): "RTCM Recommended Standards for Differential GNSS Service (v.2.3)".

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

[13] Recommendation ITU-T X.681: "Information technology - Abstract Syntax Notation One, (ASN.1): Information object specification".

[14] Recommendation ITU-T X.690: "Information technology - ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)".

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

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TS 136 355 (V10.4.0): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP) (3GPP TS 36.355 version 10.4.0 Release 10)".

[i.2] LPP Extensions Specification, Open Mobile Alliance OMA-TS-LPPe-V1-0-20110929-C.

[i.3] ETSI TS 144 031 (V10.0.0): "Digital cellular telecommunications system (Phase 2+); Location Services (LCS); Mobile Station (MS) - Serving Mobile Location Centre (SMLC) Radio Resource LCS Protocol (RRLP) (3GPP TS 44.031 version 10.0.0 Release 10)".

[i.4] ETSI TS 100 392-18-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D) and Direct Mode Operation (DMO); Part 18: Air interface optimized applications; Sub-part 2: Net Assist Protocol (NAP)".

[i.5] ETSI TS 143 059 (V10.0.0): "Digital cellular telecommunications system (Phase 2+); Functional stage 2 description of Location Services (LCS) in GERAN (3GPP TS 43.059 version 10.0.0 Release 10)".

[i.6] ETSI TS 123 032 (V10.0.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Universal Geographical Area Description (GAD) (3GPP TS 23.032 version 10.0.0 Release 10)".

[i.7] ETSI TS 100 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".

[i.8] ETSI TR 102 300-5: " Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Designers' guide; Part 5: Guidance on numbering and addressing".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ETSI EN 300 392-2 [3] and the following apply:

assistance server: entity that maintains location assistance information and sends location assistance information to its clients

navigation data: data that is passed from satellites to the location determining entity and supports location determination, for example by defining satellite positioning

NOTE: For GPS assistance this data is defined by ICD-GPS-200H [1], IS-GPS-705 [5], IS-GPS-800 [6], for QZSS, it is defined in IS-QZSS, [7], for Galileo in OS SIS ICD [8], and for GLONASS in GLONASS ICD [9].

TETRA domain: all entities that are addressed using TETRA defined addresses and understand the binary format of Net Assist Protocol

3.2 Abbreviations

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

ACK ACKnowledgement
AGNSS Assisted Global Navigation Satellite System
A-GNSS Assisted- Global Navigation Satellite System
AI Air Interface
ASN.1 Abstract Syntax Notation 1
BIPM Bureau International des Poids et Mesures
BS Base Station
BTS Base Tranceiver Station
C Conditional
CA Conventional Access
CGI Cell Global Identification
CMCE Circuit Mode Control Entity
CNAV Civil Navigation
CRL Communications Research Laboratory
DGNSS GNSS Differential Corrections
DMO Direct Mode Operation
DN Day Number
ECEF Earth Centred Earth Fixed (coordinate system)
ECI Earth Centered Inertial (coordinate system)
EGNOS European Geostationary Navigation Overlay Service
EOP Earth Orientation Parameters
EPDU Extended Protocol Data Unit
FDMA Frequency Division Multiple Access
FE Functional Entity
FEC Forward Error Correction
GAGAN GPS Aided Geo Augmented Navigation
GEO Geostationary
GLONASS GLObal'naya NAvigatsionnaya Sputnikovaya Sistema

NOTE: English: Global Navigation Satellite System.

GNSS Global Navigation Satellite System
GPS Global Positioning System
GSSI Group Short Subscriber Identity
HOW Handover Word
ICD Interface Control Document
IE Information Element
IGS International GNSS Service

IOD	Issue of Data
IODC	Issue of Data Clock
IRNSS	Indian Regional Navigation Satellite System
ISI	Inter System Interface
ITU-T	International Telecommunications Union - Telecommunication
LA	Location Area
LIP	Location Information Protocol
LOC	LOCation group (at OMA)
LPP	LTE Positioning Protocol
LSB	Least Significant Bit
M	Mandatory
MN	Multiframe Number
MNI	Mobile Network Identity
MO-LR	Mobile Originated Location Request
MS	Mobile Station
MSAS	MTSAT Satellite Augmentation System
MTSAT	Multifunctional Transport Satellites
MSB	Most Significant Bit
NAP	Net Assist Protocol
NAV	Navigation
OMA	Open Mobile Alliance
PDU	Protocol Data Unit
PEI	Peripheral Equipment Interface
PICS	Protocol Implementation Conformance Statement
PLMN	Public Land Mobile Network
PRC	Pseudo-Range Correction
PRN	Pseudo Random Noise
QZSS	Quasi-Zenith Satellite System
QZST	Quasi-Zenith Satellite Time
RRC	Range-Rate Correction
SAP	Service Access Point
SBAS	Space Based Augmentation System
SDL	Specification and Description Language
SDS	Short Data Service
SDS-TL	Short Data Service - Transport Layer
SFN	Single Frequency Network
SNDCP	SubNetwork Dependent Convergence Protocol
SNDCP SAP	SubNetwork Dependent Convergence Protocol Service Access Point
SSI	Short Subscriber Identity
SV	Space Vehicle
SV-ID	Satellite Vehicle Identifier
TBD	To Be Defined
TCP	Transmission Control Protocol
TLM	Telemetry
TOD	Time Of Day
TOW	Time Of Week
UDP	User Datagram Protocol
UDRE	User Differential Range Error
URA	User Range Accuracy
USNO	U.S. Naval Observatory
UTC	Universal Coordinated Time
WAAS	Wide Area Augmentation System
WGS-84	World Geodetic System 1984

4 Net Assist Protocol

4.1 General

The Net Assist Protocol (NAP) is a TETRA air interface optimized application layer protocol that can utilize various transport mechanisms.

The net assist protocol may use SDS-TL service at SDS-TL SAP, refer to ETSI EN 300 392-2 [3], clauses 29.1.1 to 29.5.12 in the case of TETRA MS, though it does not use SDS-TL transport mechanisms to ensure delivery. The same protocol can use packet data at SNDCP SAP as defined in ETSI EN 300 392-2 [3], clause 28 in the case of TETRA MS.

The net assist protocol defines an extendable protocol that can provide net assist information, initially in a GNSS technology based location determination scenario. Resource optimization is achieved by ensuring data is transported in its most compact form as binary data and not in an expanded human readable form. Because of the volume of data and because of the number of satellites it should be noted that some messages have a length which exceeds 500 bits and multiple messages (one for each satellite) may need to be sent.

The net assist protocol can be used in various system configurations including:

- MS to assistance server communication (request for assistance information).
- Assistance server to MS communication (transmission of assistance information).
- MS to MS communication (request for and transmission of assistance information).

NOTE: Although NAP2 supports direct MS to individual MS communication; the use of it is discouraged as the optimized air interface usage may be compromised. One possibility to maintain air interface optimization is the use of a group address as the destination address.

4.2 Location information protocol system architecture

Physical entities identified for the purpose of the present document are:

- Mobile Station (MS) and location accessory requiring net assist information. It is referred as the "T*arget Device*" of location.
- Assistance server inside the TETRA domain with available net assist information (which may have been sourced outside the TETRA domain and passed to it using a suitable protocol which is outside the scope of the present document). It is also called a *"Location Server*".

How the assistance server acquires its net assist information and how it decides when to make that information available are outside the scope of the present document.

Similarly, how the MS determines when and what assistance information is required is outside the scope of the present document.

The assistance information exchange contains scenarios:

- MS determines the type of assistance that it would like and makes a request to the assistance server for information.
- Assistance server to MS, where the assistance server has net assist information, and the assistance server distributes the information to MS.
- MS to MS net assist information exchange without any action in any other entities.

For the purposes of the present document, the TETRA domain consists of entities that are addressable using TETRA addressing and understand the net assist protocol NAP in the binary format of the protocol.

For the purposes of the present document protocol Functional Entities (FE) are used in some clauses instead of physical entities:

FE1: MS requiring net assist information.

FE2: Assistance server.

Figure 4.2.1 defines a typical scenario for the net assist protocol usage.

In figure 4.2.1 the MS FE1 requests assistance information from the assistance server FE2.

In figure 4.2.1 the assistance server FE2 acts as the distribution point for assistance information to one or more MSs FE1 requiring and able to accept assistance information.

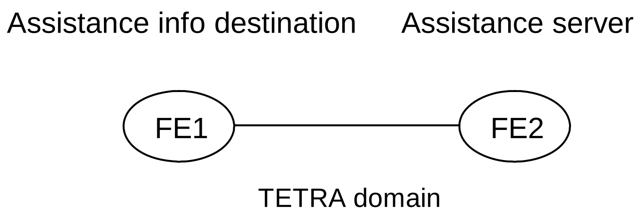

Figure 4.2.1: Simple system with assistance server in TETRA domain

4.3 Net assist protocol service description

4.3.1 General on services

The majority of the location information protocol (ETSI TS 100 392-18-1 [4]) is independent of position determination technology. Assistance data, delivered via the TETRA network, can improve the performance of some GNSS receivers, particularly when they are in areas of poor GNSS satellite signal reception, such that they cannot reliably receive navigation data from the satellites themselves. Additional information is made available in the form of time and location (with uncertainty) assistance data. This release support all known Global Navigation Satellite System (GNSS) covering GPS as well as other constellations such as GLONASS, GALILEO, BEIDOU as well as satellite based augmented systems (EGNOS, WAAS, MSAS) and regional navigation systems (IRNSS, QZSS). Support of various GNSS allow better position determination in polar region, sub-tropical regions, or difficult environment where only a few satellites are visible , and more service availability, accuracy and integrity. The structure of the assistance is consistent with the AGNSS data in the LPP [i.1] from 3GPP, established for the 4th generation of Public Mobile Land Network (PLMN), and it semantic and usage is based on the relevant ICD for each supported constellation.

4.3.2 Services available at the NAP-SAP

FE2 may support network assistance delivery to FE1s, typically using group addressing. For the case that network assistance is delivered to an individual FE1, FE2 may ask for and receive an acknowledgement.

FE1 may support requesting network assistance from FE2. FE2 may respond by delivering network assistance as above.

4.3.3 Service primitives at the NAP-SAP

Service primitives at the NAP-SAP define service access. This service primitive definition assumes that the entity using these service primitives gets all trigger invocations by other means and those are outside the scope of the present document.

NAP-Net assist provide request: this primitive is used to send network assistance data.

NAP-Net assist provide indication: this primitive is used to receive network assistance data.

NAP-Net assist provide response: this primitive is used to acknowledge network assistance data.

NAP-Net assist provide confirmation: this primitive is used to receive network assistance data acknowledgements.

NAP-Net assist demand request: this primitive is used to request (demand) network assistance.

NAP-Net assist demand indication: this primitive is used to receive requests (demands) for network assistance.

NAP-Net assist reject response: this primitive is used to reject the network assistance request.

NAP-Net assist reject confirmation: this primitive is used to receive a network assistance rejection.

4.3.4 Service primitive parameters at the NAP-SAP

As the present document does not define a physical access to the NAP-SAP, the description of the conceptual service primitives is minimized and the service primitive parameters are implied by the information elements in the PDUs.

4.3.5 State description

The net assist protocol uses a single state at the FE that does not link request and response together. At that state NAP sends and receives all the service primitives and PDUs. If it is important for an application to get e.g. response to a specific request or receive an acknowledgement before proceeding, then the application should use a suitable state machine or other means to make that possible.

5 Net assist protocol description

5.1 Description of information elements

5.1.1 General on network assistance information elements

The forms of GNSS network assistance supported are defined by Net assist type grouped in common assistance (which are provided once for all constellations) and generic assistance data that are provided for satellites of a given constellation, and in some case, one signal broadcasted by this constellation, in a generic format. ReferenceTime, ReferenceLocation, Ionosphere model and EarthOrientationParameters are defined in a common model, whereas Almanac data, Almanac reference week, Ephemeris and clock data, Real-time integrity, UTC correction data, Differential Corrections, Data Bit Assistance, Acquisition Assistance and AuxiliaryInformation are all defined in the same model as generic data model with respect to the respective ICD for the constellation (e.g. ICD-GPS-200H [1] for GPS).

It is clarified that for security reasons (detecting spoofing of assistance data):

- The SwMI shall only accept transmissions to the AGNSS GSSI from an authorized MS.
- The MS should reject received AGNSS data that is not coherent with its previously stored assistance data (e.g. coherency test between almanac and ephemeris) or is not coherent with the navigation message received from the GNSS satellites. These coherency tests are in fact integrity tests and it is encouraged having several integrity tests performed on received AGNSS data before processing it.

How to prevent an MS listening to broadcast data associated to a GSSI to which the MS is not attached is an issue out of the scope of the present document.

Which assistance type and for which constellation is either specified by the MS requesting network assistance, or by configuration in the network for the set of GNSS enabled MS. There is a trade-off between the required bandwidth and the benefits provided by the assistance on a given constellation.

5.2 Information flows

5.2.1 General on information flows

The information flows in clauses 5.2.2 to 5.2.5 present typical implementations of net assist protocol services. The service primitives are defined in clause 4.3.3. The information flows use the PDU names as defined in clause 6.2 or descriptive names, if no PDU is defined in the present protocol.

The location determining entity within the FE1, or the user of the device, may decide that location determination would benefit from network assistance information. The present document identifies how the request may be handled by the protocol but the decision processes involved in generating that request are not covered by the present document and are not presented in the information flow charts.

5.2.2 Transport layer requirements

The usage of assistance is expected to be as soon as delivered to the MS for each satellite. NAP2 requires reliable, in sequence delivery of NAP2 messages from the underlying transport layers in the network, which is either short message or data packet of TETRA.

This clause describes the transport capabilities that are available within NAP2, independently of that transport layer. 1st the segmentation at protocol layer is defined that allow usage by the receiver of partial data during the transmission. The FE1 implementing NAP2 for the control plane using SDS-TL service at SDS-TL SAP may rely on the reliability of this transport, which shall ensure all three of duplicate detection, acknowledgement, and retransmission. In case this is NOT granted in the message transport layer, the reuse of the transport procedures specified below (based on LPP [i.1]) is recommended. This reliable transport functionality is not used in a user-plane solution using packet data at SNDCP SAP, as the functionality is then ensured by TCP.

The following requirements in clauses 5.2.3, 5.2.4, 5.2.5 and 5.2.6 for NAP2 reliable transport apply only when the capability is supported.

NOTE: Clause 5.2.3 is based on the [i.3], whereas clauses 5.2.4, 5.2.5 and 5.2.6 are based on [i.1].

5.2.3 Pseudo-segmentation

Delivery of components over a limited-size transport as SDS may be supported by the FE2 in the NAP2 level using an optional pseudo-segmentation by sending several shorter messages instead of one long message. Any assistance data that is successfully delivered to an MS 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 [i.5]), shall be retained by the MS. In case of client-server transaction, the assistance server need not to resent the segments previously acknowledged by the MS when positioning or delivery of assistance data is again re-attempted.

If the amount of data that needs to be sent is larger than the maximum PDU size for the underlying transport (refer to ETSI TS 100 392-2 [i.5], clause 14.7.2 for the maximum size of the PDU), the NAP2 pseudo-segmentation shall be used. The NAP2 pseudo-segmentation is the use of several NAP2 components (one in each NAP2 message) to deliver a large amount of information. For FE2 to FE1 messages, the Assistance Data component is the one that is sent several times in order to deliver the information.

The other way to implementing this mechanism is that the FE2 may send NAP2 components that are larger than the transport maximum PDU size. In this case lower level segmentation will be used.

Under NAP2, segmentation of large messages can be implemented in two ways: control plane (SDS) and pseudo-segmentation, user plane (TCP/IP) and lower level segmentation.

An assistance server or a MS may support one or both of these approaches. For interoperability, it is recommended that MS and assistance server support both approaches.

Pseudo-segmented data delivered via SDS can be sent to a specific MS (on-demand) or to a group of MS (broadcast).

It is recommended that the broadcast is implemented via group-addressing and is used for assistance data sent periodically to all MS attached to a specific group. It is recommended, that no message acknowledge is implemented for broadcast.

If some assistance data is found missing by a MS, the MS may perform a request for assistance data (on-demand) for the data missing or out-dated. The reception of the assistance data may be acknowledged by the MS.

For broadcast, it is recommended that the assistance server generates one or several messages that each fit within the maximum PDU size.

To do so, the assistance server could fill separate SDS-TL frame with the assistance data for several satellites, padding the remaining bits of the SDS-TL frame.

There are at least two possibilities for broadcasting the assistance data: a general broadcast (to all MS within the TETRA network) and a partial broadcast (to a group of MS that have requested registration to this group).

However the general broadcast is used as the distribution address for CMCE calls, it may also be used by the SwMI for sending broadcast signalling messages. Therefore the use of a partial broadcast shall be encouraged.

As the Assistance GNSS data are assumed to be a free service (e.g. data available at IGS) and as an MS will be interested only by assistance data related to relevant constellations (e.g. the constellations that can be tracked by the MS receiver), it is recommended to have a partial broadcast of assistance data for each GNSS constellation.

ETSI EN 300 392-1 [2], clause 7, states that "Partial user broadcast shall be obtained by combining different MNI and SSI."

- The Mobile Network Identity (MNI) is an identity that uniquely identifies the network (24 bits).
- The Group SSI (GSSI: Group Short Subscriber Identity: 24 bits), the GSSI is allocated by the network operator.

The pre-allocated addresses (AGNSS group address, AGNSS uplink request address) for the AGNSS service are defined in ETSI TR 102 300-5 [i.8i.8i.8i.8i.8i.8]. The constellation type shall be defined as the first element in the (SDS) PDU.

It is recommended that the definition of the GNSS assistance data for each partial broadcast group is performed according to the categories of the assistance data being broadcasted: common data, generic data from a specific constellation.

After the MS first start-up, it is recommended that the MS requests an attachment to the partial broadcast groups providing assistance GNSS data of interest (those constellations that the user equipment can track) and keeps this attachment in memory. This attachment can remain permanent: it is not recommended that the MS cancel such attachment. In this way, after each start-up, the MS will automatically receive the partial broadcast of interest.

When the assistance server FE2 employs pseudo-segmentation to send a NAP2 Assistance Data message, the FE2 shall send one or more NAP2 Assistance Data components followed by a final NAP2 Assistance Data component. The FE2 shall indicate in all but the final component 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 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, the MS shall assume that pseudo-segmentation is complete. The MS may then employ the rules defined in next clause (duplicate) to verify if the new message is a repeated duplicate of a previous message.

5.2.4 NAP2 duplicate detection

A sender shall include a sequence number in all NAP2 messages sent for a particular location session. The sequence number shall be distinct for different NAP2 messages sent in the same direction in the same location session (e.g. may start at zero in the first NAP2 message and increase monotonically in each succeeding NAP2 message). Sequence numbers used in the uplink and downlink are independent (e.g. can be the same).

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

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

NOTE: For NAP2 control plane use, a target device can be aware of a location session from information provided at the control plane level for downlink transport of an NAP2 message.

5.2.5 NAP2 Acknowledgement

5.2.5.1 General

Each NAP2 message may carry an acknowledgement request and/or an acknowledgement indicator. A NAP2 message including an acknowledgement request (i.e. that include the IE *ackRequested* set to TRUE) shall also include a sequence number. Upon reception of an NAP2 message which includes the IE *ackRequested* set to TRUE, a receiver returns an NAP2 message with an acknowledgement response (i.e. that includes the *ackIndicator* IE set to the same sequence number of the message being acknowledged). An acknowledgement response may contain no NAP2 message body (in which case only the sequence number being acknowledged is significant); alternatively, the acknowledgement may be sent in an NAP2 message along with an NAP2 message body. An acknowledgement is returned for each received NAP2 message that requested an acknowledgement including any duplicate(s). Once a sender receives an acknowledgement for an NAP2 message, and provided any included sequence number is matching, it is permitted to send the next NAP2 message. No message reordering is needed at the receiver since this stop-and-wait method of sending ensures that messages normally arrive in the correct order.

When an NAP2 message is transported via a control plane MO-LR request, the message does not request an acknowledgement.

5.2.5.2 Procedure related to acknowledgement

Figure 5.2.5.2.1 shows the procedure related to acknowledgement.

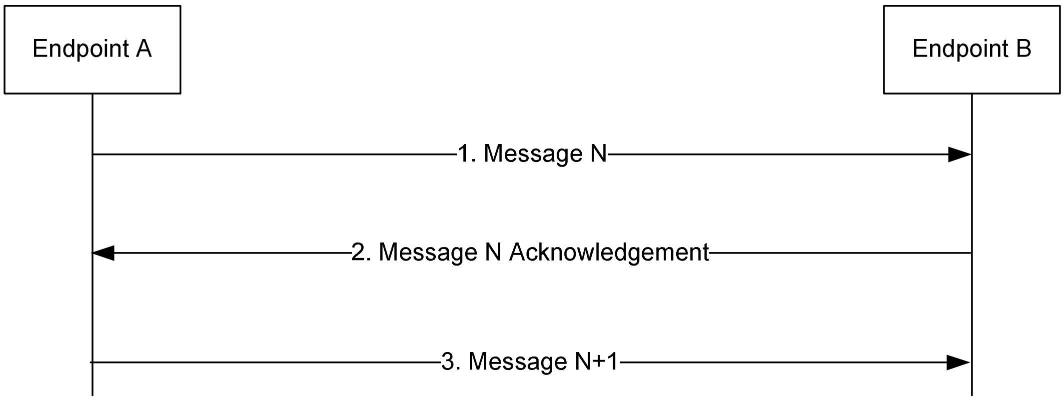

Figure 5.2.5.2.1: NAP2 Acknowledgement procedure

1) Endpoint A sends an NAP2 message *N* to Endpoint B which includes the IE *ackRequested* set to TRUE and a sequence number.

2) If NAP2 message *N* is received and Endpoint B is able to decode the *ackRequested* value and sequence number, Endpoint B shall return an acknowledgement for message *N*. The acknowledgement shall contain the IE *ackIndicator* set to the same sequence number as that in message *N*.

3) When the acknowledgement for NAP2 message *N* is received and provided the included *ackIndicator* IE matches the sequence number sent in message *N*, Endpoint A sends the next NAP2 message *N+1* to Endpoint B when this message is available.

5.2.6 NAP2 retransmission

5.2.6.1 General

This capability builds on the acknowledgement and duplicate detection capabilities. When an NAP2 message which requires acknowledgement is sent and not acknowledged, it is resent by the sender following a timeout period up to three times. If still unacknowledged after that, the sender aborts all NAP2 activity for the associated session. The timeout period is determined by the sender implementation but shall not be less than a minimum value of 250 ms.

5.2.6.2 Procedure related to Retransmission

Figure 5.2.6.2.1 shows the procedure related to retransmission when combined with acknowledgement and duplicate detection.

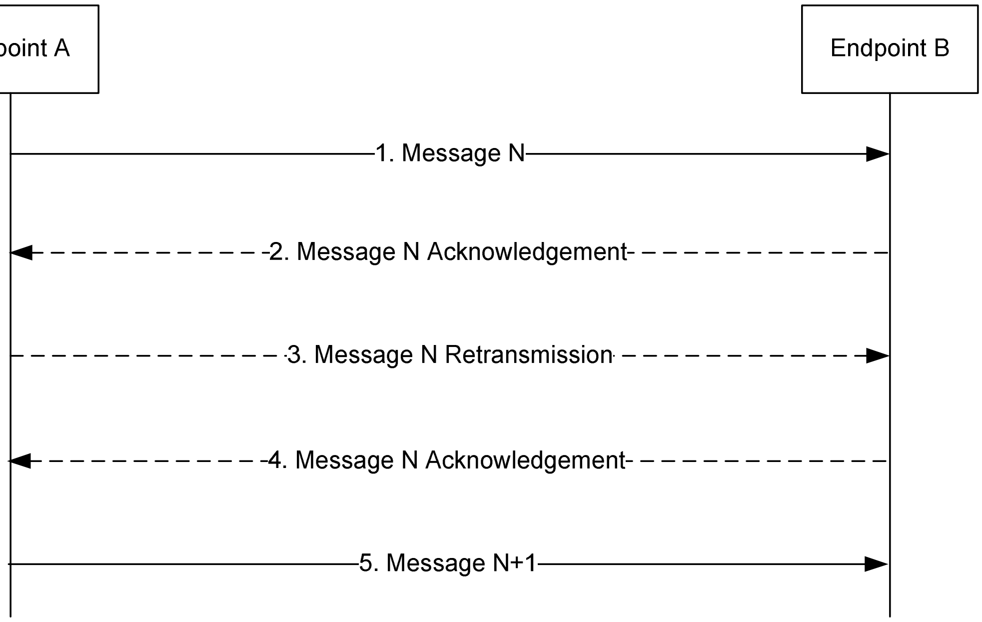

Figure 5.2.6.2.1: NAP2 Retransmission procedure

1) Endpoint A sends an NAP2 message *N* to Endpoint B for a particular location session and includes a request for acknowledgement along with a sequence number.

2) If NAP2 message *N* is received and Endpoint B is able to decode the *ackRequested* value and sequence number (regardless of whether the message body can be correctly decoded), Endpoint B shall return an acknowledgement for message *N*. If the acknowledgement is received by Endpoint A (such that the acknowledged message can be identified and sequence numbers are matching), Endpoint A skips steps 3 and 4.

3) If the acknowledgement in step 2 is not received after a timeout period, Endpoint A shall retransmit NAP2 message *N* and shall include the same sequence number as in step 1.

4) If NAP2 message *N* in step 3 is received and Endpoint B is able to decode the *ackRequested* value and sequence number (regardless of whether the message body can be correctly decoded and whether or not the message is considered a duplicate), Endpoint B shall return an acknowledgement. Steps 3 may be repeated one or more times if the acknowledgement in step 4 is not received after a timeout period by Endpoint A. If the acknowledgement in step 4 is still not received after sending three retransmissions, Endpoint A shall abort all procedures and activity associated with NAP2 support for the particular location session.

5) Once an acknowledgement in step 2 or step 4 is received, Endpoint A sends the next NAP2 message *N+1* for the location session to Endpoint B when this message is available.

5.2.7 MS receiving network assistance

MS may receive network assistance as presented in figure 5.2.7.1. NAP entity stores the parameters for further usage. Typically FE2 will broadcast assistance to a group of MSs. Assistance to an individual MS is allowed.

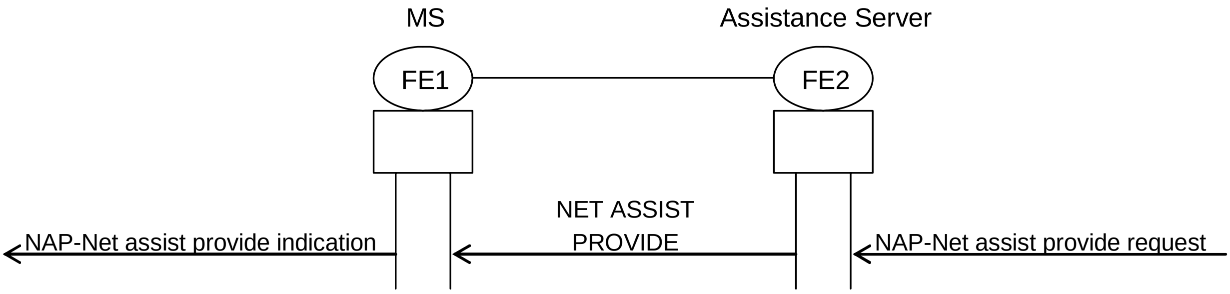

Figure 5.2.7.1: MS receiving network assistance data

5.2.8 MS receiving network assistance and sending response

MS may receive network assistance and send acknowledgement to it as presented in figure 5.2.8.1. NAP entity stores the parameters for further usage. Responses should only be requested from an individually addressed MS. The MS shall only send an acknowledgement if it receives a NET ASSIST PROVIDE PDU that contains an acknowledgement request and the PDU is individually addressed to the MS.

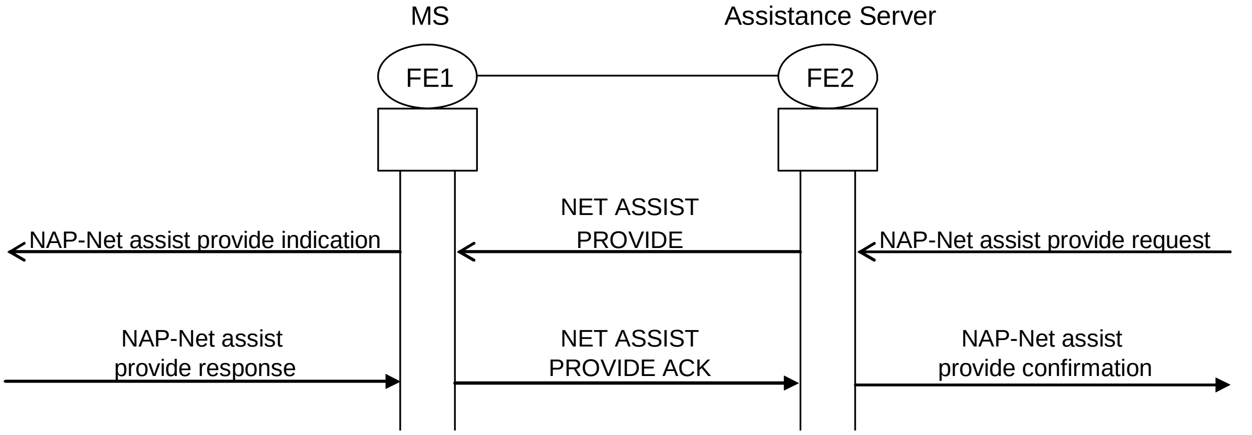

Figure 5.2.8.1: MS receiving network assistance data and sending response

5.2.9 MS requesting network assistance

MS may request network assistance as presented in figure 5.2.9.1. FE2 will typically respond by distributing the network assistance as in clause 5.2.7.

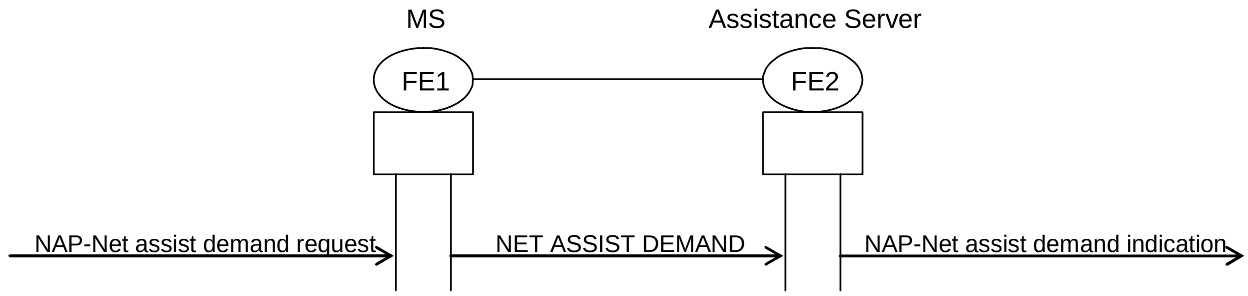

Figure 5.2.9.1: MS requesting network assistance data

5.2.10 MS requesting network assistance and receiving a reject

MS may request network assistance requests as presented in figure 5.2.10.1. FE2 may respond with a rejection of the request (including reason and retry information).

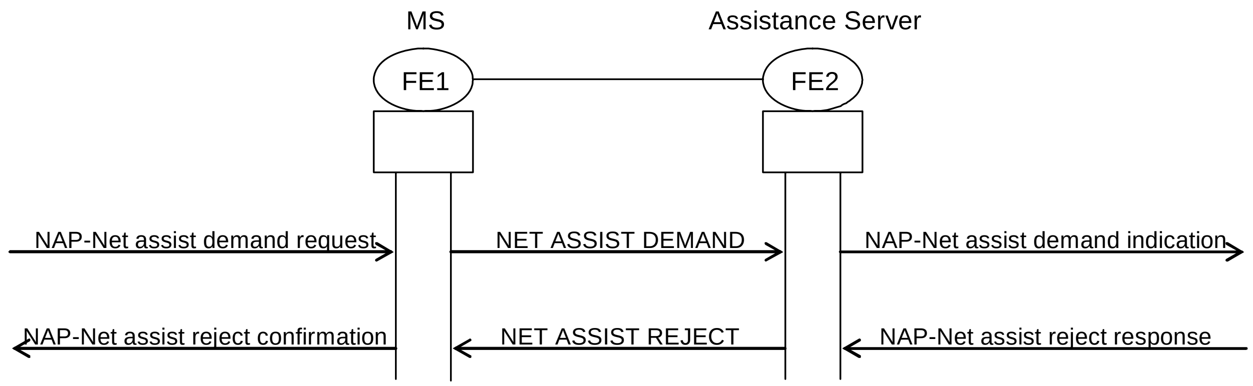

Figure 5.2.10.1: MS requesting network assistance data and receiving rejection

5.2.11 Allocation of entities

In the flow charts in figures 5.2.7.1 to 5.2.10.1, "MS" was used as a physical allocation to FE1 and "Assistance Server" was used as a physical allocation to FE2.

In systems extending to the domain outside the TETRA domain the roles of information entities are in principle the same as in figures 5.2.7.1 to 5.2.10.1, but the information flows to and from the external entities may use other PDUs than shown in the information flows.

5.3 Procedures

5.3.1 General on procedures

It is expected that the MS will only request information that it cannot obtain efficiently in any other way in its present circumstances and should use network time when available.

The MS should determine all data required immediately (e.g. precise time, ephemerid, ..) within a single request. No new requests shall be initiated until data has been provided or the request has timed out (three minutes).

The MS could then later issue a second request for data with a longer time validity period such as almanac for all satellites and also for precise time, ephemerid on satellite about to enter the visibility zone except if these data are available via broadcast.

It is expected that the Net Assist Server, or other receiving entity, should only return information for satellites that the requesting entity will (potentially) have in view and that can be track by the MS (the MS may not have the capability to track all the GNSS constellations).

The assistance service provider should only request an acknowledgement, if the NET ASSIST PROVIDE PDU is individually addressed, therefore no NET ASSIST PROVIDE NOT ACK PDU is needed nor it is defined for the broadcast AGNSS. The MS shall only send an acknowledgement using NET ASSIST PROVIDE ACK PDU, if it receives a NET ASSIST PROVIDE PDU that contains an acknowledgement request, and the PDU is individually addressed to the MS. MS shall indicate in the NET ASSIST PROVIDE ACK PDU a Sequence Number for matching responses to requests in the net assist server.

5.3.2 Service availability

Net assist service availability may be determined by sending a NET ASSIST DEMAND PDU. The MS may retry three times with an interval between retries no less than three minutes. Non receipt of any NET ASSIST PROVIDE or NET ASSIST REJECT PDU may indicate that a Net Assist Server is not available on this network and that the MS shall not retry until next power-up or upon detecting an unsolicited NET ASSIST PROVIDE PDU addressed to the MS (whether individually, group or broadcast addressed) or upon migration to another network.

5.3.3 Rejection of request for assistance

A request for net assist data may be rejected. The requesting MS will be informed of this rejection together with a reason and when it may next request assistance. MS shall not send another NET ASSIST DEMAND PDU until instance as defined in the Reject retry interval or MS has moved to another network.

5.3.4 Routing net assistance to specific terminal groups

In order to support the ability for a net assist server to direct net assist data to specific groups of terminals, an identity (Net assist group address defined by (MNI + GSSI) may be:

- requested by an MS using a NET ASSIST DEMAND PDU;
- assigned to an MS using a NET ASSIST PROVIDE PDU.

Any MS with a non zero Net assist group address:

- shall listen, without requiring over the air attachment, on that address in addition to its other group addresses;
- shall when receiving signalling addressed to the Net assist group address, accept and process only Net assist PDUs.

The Net assist group address shall be remembered through power cycles.

A Net assist group address is valid on the network on which it was provided. The MS shall request a new Net assist group address on migration.

5.4 GNSS assistance types

5.4.0 General

The clause 5.4 describes the usage of assistance data element delivered via NAP2 to the MS.

The types of assistance data element are described in the present clause 5.4, including the three types added by NAP2 versus NAP.

Table 5.4.1: Fields in the GNSS Assistance Data element

Parameter	NAP	NAP2	Common/Generic	Repetition
Reference Time	X	X	C	Yes
Reference Location	X	X	C	No
Ionospheric Model	X	X	C	No
EarthOrientationParameters		X	C	No
time model	X	X	G	No
DGNSS Corrections	X	X	G	Yes
Navigation Model	X	X	G	Yes
Real-Time Integrity	X	X	G	Yes
DataBitAssistance		X	G	Yes
Acquisition Assistance	X	X	G	Yes
Almanac	X	X	G	Yes
UTC Model	X	X	G	No
AuxiliaryInformation		X	G	Yes

When NAP2 pseudo-segmentation is used, the column "Repetition" in table 5.4.1 indicates which parameters may be provided per satellite in more than one NAP2 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 NAP2 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 constellations and the maximum number of satellites defined in the model above (16 constellation and 64 satellites in each) for which data can be included for any parameter in one NAP2 segment shall apply also when counted over all NAP2 segments. The constellation type shall be defined as the first element in the (SDS) PDU.

For all the fields containing additional information dependent on the DGNSS ID, the following rule is applicable. If such assistance type that is satellite dependent (i.e. any of DGNSS Corrections, DGNSS Navigation Model, Real-Time Integrity DGNSS Data Bit Assistance, or DGNSS Auxiliary Information IEs) is provided together with other satellite dependent DGNSS assistance data and NAP2 pseudo-segmentation is used, this assistance Information should be provided for the same satellites and in the same NAP2 segment as the other satellite dependent DGNSS assistance data.

NOTE: For Almanac these fields are always provided for all satellites. (It may be useful to restrict it to satellites about to enter visibility of the area and to send several such almanac updates per day).

This release of the protocol does not include such assistance as extended Ephemeris, altitudeAssistance, solarRadiation, continuous carrier phase, dcbsForAllSVs, navModelDegradationModel, navModel coordinate Based, WideAreaIono, LocalTroposphere, that are defined by OMA in the LPPe protocol [i.2] and could optionnaly be applied on the User Plane (data service) over TETRA, in combination with the types defined in NAP2.

5.4.1 GNSS Ephemeris assistance

Ephemeris navigation data defines the precise (high accuracy) short time period orbital parameters of one satellite and is transmitted by that satellite. The ephemeris also includes satellite clock correction data. A location determining entity may not be able to receive this data from a satellite either because it has not yet found the satellite or because the received signal strength is insufficient for it to demodulate the navigation data.

An assistance server supporting ephemeris assistance could gather this information for all satellites that are in view in the geographically served area and may send that information to MSs using The GNSS Ephemeris and clock data information element. Because of the short lived nature of this data (hours), it may be that the data would be broadcast every hour.

An MS receiving ephemeris for a satellite might simply pass it on to its location determining entity or might only pass it on when it knows its location determining entity does not have up to date ephemeris data for the satellite.

5.4.2 GNSS Almanac assistance

Almanac navigation data defines the reduced precision long time period orbital parameters of all satellites and is transmitted by every satellite. As described in clause 5.4.1 a GNSS receiver may not be able to receive this data. Additionally the almanac data it does have in memory may be out of date or the memory may have been erased.

An assistance server supporting almanac assistance could gather this information for all satellites (both in view and not in view) and may send that information to MSs using the GNSS Almanac reference week extended and the GNSS Almanac data information elements. Because of the longer lived nature of this data (months), it may be that the data would be retained by location determining entities and would only be transmitted on demand.

An MS receiving almanac for a satellite might simply pass it on to its location determining entity or might only pass it on when it knows its location determining entity does not have up to date almanac data for the satellite.

The note provided in clause 4.1 is reminded here: Although NAP2 supports direct MS to individual MS communication; the use of it is discouraged as the optimized air interface usage may be compromised. One possibility to maintain air interface optimization is the use of a group address as the destination address.

5.4.3 GNSS Ionosphere and UTC correction assistance

Ionosphere and UTC correction navigation data defines the current ionosphere compensation parameters and GNSS/UTC time conversions.

The data may improve the accuracy of derived location information and an assistance server may gather it and then distribute it using the GNSS Ionosphere and UTC correction data information element.

5.4.4 GNSS Time assistance

GNSS time is available from any GNSS satellite. As described in clause 5.4.1 a GNSS receiver may not be able to receive this data. Additionally the data it does have may be incorrect or not internally stored, for example the clock time may have been lost due to a battery problem.

An assistance server supporting time assistance could hold and make this information available to MSs using the GNSS time estimate information element, either by regular broadcast or on demand.

A location determining entity receiving time assistance may benefit by better determining satellite positioning for example.

5.4.5 Location assistance

It may be beneficial to the location determining entity to be given an approximate location of the requesting MS to the assistance server. This information may enable the assistance server to determine which satellites should be in view from which a location information improvement may be made.

An assistance server supporting location assistance could be made aware of locations within its geographical area. The location supplied to the entity might be related to the area covered by the assistance server or might be the location of the BS that the MS is currently using. When requested the appropriate location may be sent to the requesting MS using the Location data information element.

An MS may require location assistance if it has moved since last acquiring a location fix, or it has not been able to retain a previous location fix or its information is considered no more valid. When requesting location assistance MS shall use a Net assist type information element with "Location estimate". MS may also add LA and, if needed, MNI information elements to indicate its location as defined by the air interface protocol. Other locations may be more applicable in other scenarios.

6 Net assist protocol coding requirements

6.1 General

The Net Assist Protocol has been designed to set strict requirements on the PDU encoding so that the maximum amount of information can be fitted into minimum sized messages.

NAP protocol uses a constant length binary encoding of data, see ETSI TS 100 392-18-2 [i.4]. In NAP2 the data is presented in an ASN.1 model and the PDU then contains the binary encoding of this model; see Recommendation ITU-T X.680 [12], Recommendation ITU-T X.681 [13], Recommendation ITU-T X.690 [14]. Both on the control plane (SDS) and the User Plane (Data Service), the encoding is BASIC-PER, unaligned encoding Recommendation ITU-T X.691 [15]. The resulting messages also fit into SDS messages. The contents of each LPP message is specified in clause 6.2 using ASN.1 to specify the message syntax and using tables when needed to provide further detailed information about the information elements specified in the message syntax.

The ASN.1 in clause 6.2 (and all of its clauses) uses the same format and coding conventions as described in [11].

Transfer syntax for LPP messages is derived from their ASN.1 definitions by use of Basic Packed Encoding Rules (BASIC-PER), Unaligned Variant, as specified in Recommendation ITU-T X.691 [15]. The encoded LPP message always contains a multiple of 8 bits.

The need for information elements to be present in a message or an abstract type, i.e. the ASN.1 fields that are specified as OPTIONAL in the abstract notation (ASN.1), is specified by means of comment text tags attached to the OPTIONAL statement in the abstract syntax. The meaning of each tag is specified in table 6.1.1. These tags are used in the downlink (server to target) direction only.

Table 6.1.1: Meaning of abbreviations used to specify the need for information elements to be present

Abbreviation	Meaning
Cond conditionTag	Conditionally present An information element for which the need is specified by means of conditions. For each conditionTag, the need is specified in a tabular form following the ASN.1 segment. In case, according to the conditions, a field is not present, the target takes no action and where applicable shall continue to use the existing value (and/or the associated functionality) unless explicitly stated otherwise in the description of the field itself.
Need OP	Optionally present An information element that is optional to signal. For downlink messages, the target is not required to take any special action on absence of the IE beyond what is specified in the procedural text or the field description table following the ASN.1 segment. The target behaviour on absence should be captured either in the procedural text or in the field description.
Need ON	Optionally present, No action An information element that is optional to signal. If the message is received by the target, and in case the information element is absent, the target takes no action and where applicable shall continue to use the existing value (and/or the associated functionality).
Need OR	Optionally present, Release An information element that is optional to signal. If the message is received by the target, and in case the information element is absent, the target shall discontinue/ stop using/ delete any existing value (and/ or the associated functionality).

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

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

6.2 Net assist protocol PDU definitions

6.2.1 Net assist protocol description tables

6.2.1.0 General

The clauses 6.2.1 to 6.2.7 describe the ASN.1 model for the GNSS Assistance Data that is the definition of the payload in all NAP2 messages. Table 6.2.1.1 links service primitives and PDUs together.

Table 6.2.1.1: NAP2 primitives and PDUs usage

Primitive	Direction	Usage	ASN.1 type	PDU
NAP-Net assist provide request	FE1 ← FE2	send network assistance data.	*ProvideAssistanceData*	NET ASSIST PROVIDE
NAP-Net assist provide response	FE1 → FE2	acknowledge network assistance data	*Acknowledgment* (Not required above TCP, but on UDP or SDS).	NET ASSIST PROVIDE ACK
NAP-Net assist demand request	FE1 → FE2	request (demand) network assistance	*RequestAssistanceData*	NET ASSIST DEMAND
NAP-Net assist reject response	FE1 ← FE2	reject the network assistance request	*Abort*	NET ASSIST REJECT
NAP-Net assist provide response	FE1 → FE2	acknowledge network assistance data not received or received with error	*Not acknowledge (Not required above TCP, but on UDP or SDS).*	NET ASSIST PROVIDE NOT ACK

NOTE: The clauses 6.2.1.3 to 6.2.7.8 are corresponding very closely to the clause 6.5.2 and part of clause 6.4.2 in LPP [i.1], with minor compatible adaptations for specificities of TETRA and the new *InformationElements* in clauses 6.2.4 to 6.2.8.

The use of positioning measurement is another option added in NAP2. It does NOT include network positioning methods, capability information or location reports (that are covered in LIP [4]).

The PDU type information element and the transport reliability shall be encoded as defined in clauses 6.2.2 to 6.2.8.

6.2.1.1 LPP-PDU-Definitions

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

```
-- ASN1START

/* This model is defined for the Network Assistance Protocol over TETRA Network, defined in ETSI
TETRA WG3.
It is primarily based on 3GPP LPP
All additions to the subset of LPP are prefixed with NAP- in order to clearly mark them in the ASN1
model.
non relevant network related items are replaced with place holders named holderX */


NAP2-PDU-Definitions {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
tetra (22) modules (1) nap2 (1) version1 (1) nap-PDU-Definitions (1) }
-- OID registration needed for a NAP id

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- ASN1STOP
```

6.2.1.2 NAP-Message

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

```
-- ASN1START

-- Specific TETRA definitions to be revised

NAP-Message ::= SEQUENCE { -- similar to LPP
    transactionID           NAP-TransactionID   OPTIONAL,   -- Need ON
    endTransaction          BOOLEAN,
    sequenceNumber          SequenceNumber      OPTIONAL,   -- Need ON
    acknowledgment          NAP-Acknowledgment  OPTIONAL,   -- Need ON
    nap-MessageBody         NAP-MessageBody     OPTIONAL    -- Need ON
}

SequenceNumber ::= INTEGER (0..255)

NAP-Acknowledgment ::= SEQUENCE {  -- NET ASSIST PROVIDE ACK
    ackRequested    BOOLEAN,                             -- same LPP
    ackIndicator    SequenceNumber          OPTIONAL,    -- same LPP
    resultCode      NAP-ResultCode          OPTIONAL,   -- specific NAP
    netAssistType   NAP-AssistType          OPTIONAL,   -- specific NAP
}

-- ASN1STOP
```

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

6.2.1.3 LPP-MessageBody

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

```
-- ASN1START
NAP-MessageBody ::= CHOICE {  -- subset of LPP
    c1                      CHOICE {
        spare15 NULL, spare14 NULL,
        requestAssistanceData       RequestAssistanceData,
        provideAssistanceData       ProvideAssistanceData,
        spare11 NULL, spare10 NULL,
        abort                       Abort,
        error                       Error,
        spare7 NULL, spare6 NULL, spare5 NULL, spare4 NULL,
        spare3 NULL, spare2 NULL, spare1 NULL, spare0 NULL
    },
    messageClassExtension   SEQUENCE {}
}

-- ASN1STOP
```

6.2.1.4 NAP-TransactionID

The NAP-TransactionID identifies a particular NAP transaction and the initiator of the transaction.

```
-- ASN1START


NAP-TransactionID ::= SEQUENCE {
    initiator               Initiator,
    transactionNumber       TransactionNumber,
    ...
}

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

TransactionNumber ::= INTEGER (0..255)
-- end messages

-- ASN1STOP
```

NOTE 1: The NET ASSIST PROVIDE ACK PDU is of type acknowledgment defined as a flag and a sequence number, and 3 IE specific of NAP2.

NOTE 2: The NET ASSIST REJECT PDU is of type error.

6.2.2 Common IEs

6.2.2.0 General principle

Common IEs comprise IEs that were applicable in the LPP to more than one positioning method.

6.2.2.1 Abort

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

```
-- ASN1START

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

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

-- ASN1STOP
```

6.2.2.2 Error

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

```
-- ASN1START

Error ::= CHOICE {
    error-r9                    Error-r9-IEs,
    criticalExtensionsFuture    SEQUENCE {}
}

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

-- ASN1STOP
```

6.2.2.3 CommonIEsRequestAssistanceData

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

```
-- ASN1START

CommonIEsRequestAssistanceData ::= SEQUENCE {
    servingHolder1      NULL        OPTIONAL,   -- LPP compatibility
    ...
}

-- ASN1STOP
```

6.2.2.4 CommonIEsProvideAssistanceData

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

```
-- ASN1START

CommonIEsProvideAssistanceData ::= SEQUENCE {
    ...
}

-- ASN1STOP
```

6.2.2.5 CommonIEsAbort

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

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.2.6 CommonIEsError

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

```
-- ASN1START

CommonIEsError ::= SEQUENCE {
    errorCause      ENUMERATED {
        undefined,
        napMessageHeaderError,
        napMessageBodyError,
        epduError,
        incorrectDataValue,
    ...
    }
}

-- ASN1STOP
```

***CommonIEsError* field descriptions**
errorCause This IE defines the cause for an error. '*napMessageHeaderError*', '*napMessageBodyError*' and '*epduError*' is used if a receiver is able to detect a coding error in the NAP header (i.e. in the common fields), LPP message body or in an EPDU, respectively.

6.2.2.7 RequestAssistanceData

The *RequestAssistanceData* message body in a NAP message is used by the target device to request assistance data from the location server.

```
-- ASN1START

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

RequestAssistanceData-r9-IEs ::= SEQUENCE {
    commonIEsRequestAssistanceData      CommonIEsRequestAssistanceData      OPTIONAL,   -- Need ON
    a-gnss-RequestAssistanceData        A-GNSS-RequestAssistanceData        OPTIONAL,   -- Need ON
    holder1                             NULL                                OPTIONAL,   -- Need ON
    epdu-RequestAssistanceData          EPDU-Sequence                       OPTIONAL,   -- Need ON
    ...
}

-- ASN1STOP
```

6.2.2.8 ProvideAssistanceData

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

```
-- ASN1START

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

ProvideAssistanceData-r9-IEs ::= SEQUENCE {
    commonIEsProvideAssistanceData      CommonIEsProvideAssistanceData      OPTIONAL,   -- Need ON
    a-gnss-ProvideAssistanceData        A-GNSS-ProvideAssistanceData        OPTIONAL,   -- Need ON
    holder1                             NULL                                OPTIONAL,   -- Need ON
    epdu-Provide-Assistance-Data        EPDU-Sequence                       OPTIONAL,   -- Need ON
    netAssistGroupAddress               NetAssistGroupAddress               OPTIONAL,   -- Need ON
    ...
}

-- ASN1STOP
```

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

6.2.2.9 A-GNSS-ProvideAssistanceData

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.2.10 GNSS-CommonAssistData

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.2.11 GNSS-GenericAssistData

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

```
-- ASN1START

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

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

-- ASN1STOP
```

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

6.2.3 GNSS Assistance Data Elements

6.2.3.1 GNSS-ReferenceTime

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

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

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

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

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

```
-- ASN1START

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

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

-- ASN1STOP
```

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

***GNSS-ReferenceTime* field descriptions**
gnss-SystemTime This field provides the specific GNSS system time.
networkTime This field specifies the cellular network time at the epoch corresponding to gnss-SystemTime.
referenceTimeUnc This field provides the accuracy of the relation between gnssSystemTime and networkTime time if IE networkTime is provided. When IE networkTime is not provided, this field can be included to provide the accuracy of the provided gnssSystemTime. If GNSS TOD is the given GNSS time, then the true GNSS time, corresponding to the provided network time as observed at the target device location, lies in the interval: [GNSS TOD - referenceTimeUnc, GNSS TOD + referenceTimeUnc]. The uncertainty r, expressed in microseconds, is mapped to a number K, with the following formula: $r = C \times (((1 + x)^K) - 1)$ with C = 0.5 and x = 0,14. To encode any higher value of uncertainty than that corresponding in the above formula to K = 127, the same value, K = 127, shall also be used. The uncertainty is then coded on 7 bits, as the binary encoding of K. Example values for the referenceTimeUnc Format: see table 6.2.3.1.1.
bsAlign This flag, if present, indicates that the transmission timings of all cells sharing, depending on the Radio Access Technology, the same carrier frequency and Tracking Area/Location Area/Routing Area as the cell indicated, are frame aligned. This information allows the target device to derive the GNSS – cellular time relation for any of these cells based on the timing relation information provided in GNSS-ReferenceTime. The flag should be set consistently in all these cells. This flag does not guarantee single frequency networks (SFN) alignment.

Table 6.2.3.1.1: Examples of K to uncertainty relation

Value of K	Value of uncertainty
0	0 nanoseconds
1	70 nanoseconds
2	149,8 nanoseconds
10	6,37 microseconds
50	349,6 microseconds
75	9,26 milliseconds
127	≥ 8,43 seconds

6.2.3.2 GNSS-SystemTime

```
-- ASN1START

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

-- ASN1STOP
```

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

***GNSS-SystemTime* field descriptions**
gnss-TimeID This field specifies the GNSS for which the GNSS-SystemTime is provided.
gnss-DayNumber This field specifies the sequential number of days from the origin of the GNSS System Time as follows: GPS, QZSS, SBAS – Days from January 6th 1980 00:00:00 UTC(USNO); Galileo – TBD; GLONASS – Days from January 1st 1996.
gnss-TimeOfDay This field specifies the integer number of seconds from the GNSS day change.
gnss-TimeOfDayFrac-msec This field specifies the fractional part of the gnssTimeOfDay field in 1 milliseconds resolution. The total GNSS TOD is gnss-TimeOfDay + gnssTimeOfDayFrac msec.
notificationOfLeapSecond This field specifies the notification of forthcoming leap second correction, as defined by parameter KP in [9], table 4.7.
gps-TOW-Assist This field contains several fields in the Telemetry (TLM) Word and Handover Word (HOW) that are currently being broadcast by the respective GPS satellites. Combining this information with GPS TOW enables the target device to know the entire 1,2 second (60-bit) pattern of TLM and HOW that is transmitted at the start of each six-second NAV subframe by the particular GPS satellite.

6.2.3.3 GPS-TOW-Assist

```
-- ASN1START

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

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

-- ASN1STOP
```

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

6.2.3.4 NetworkTime

```
-- ASN1START

NetworkTime ::= SEQUENCE {
    secondsFromFrameStructureStart              INTEGER(0..12533),
    fractionalSecondsFromFrameStructureStart    INTEGER(0..3999999),
    frameDrift                                  INTEGER (-64..63)   OPTIONAL,   -- Cond GNSSsynch
    cellID      CHOICE {
                holder1     NULL,
                holder2     NULL,
                holder3     NULL,
                tETRA       SEQUENCE {
                            -- physical parameter TBD for synchronisation to the TETRA carrier
                            cellGlobalIdTETRA   NAP-CellGlobalIdTETRA   OPTIONAL,   -- Need ON
                            ...
                            },
                ...
                } OPTIONAL,
    ...
}

-- ASN1STOP
```

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

***NetworkTime* field descriptions**
secondsFromFrameStructureStart This field specifies the number of seconds from the beginning of the longest frame structure in the corresponding air interface.
fractionalSecondsFromFrameStructureStart This field specifies the fractional part of the secondsFromFrameStructureStart in 250 ns resolution. The total time since the particular frame structure start is secondsFromFrameStructureStart + fractionalSecondsFromFrameStructureStart.
frameDrift This field specifies the drift rate of the GNSS-network time relation with scale factor 2^{-30} seconds/second, in the range from -5,9605 x 10^{-8} to +5,8673^{-8} seconds/second.
cellID This field specifies the cell for which the GNSS–network time relation is provided.
Arfcn This field (absolute radio frequency channel number), identifies specific radio channels in a cellular mobile radio system in is a numbering system for the cells. This is a physical parameters for TETRA bcchCarrier, used to specify the GNSS-network time relation.
cellGlobalIdTETRA This field specifies the Cell Global Identification (CGI), the globally unique identity of a cell in TETRA, of the reference base station for the GNSS-network time relation.

6.2.3.5 GNSS-ReferenceLocation

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.3.6 EllipsoidPointWithAltitudeAndUncertaintyEllipsoid

The IE *EllipsoidPointWithAltitudeAndUncertaintyEllipsoid* is used to describe a geographic shape as defined in [i.6].

```
-- ASN1START

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

-- ASN1STOP
```

6.2.3.7 GNSS-IonosphericModel

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.3.8 KlobucharModelParameter

```
-- ASN1START

KlobucharModelParameter ::= SEQUENCE {
    dataID          BIT STRING (SIZE (2)),
    alfa0           INTEGER (-128..127),
    alfa1           INTEGER (-128..127),
    alfa2           INTEGER (-128..127),
    alfa3           INTEGER (-128..127),
    beta0           INTEGER (-128..127),
    beta1           INTEGER (-128..127),
    beta2           INTEGER (-128..127),
    beta3           INTEGER (-128..127),
    ...
}

-- ASN1STOP
```

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

6.2.3.9 NeQuickModelParameter

```
-- ASN1START

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

-- ASN1STOP
```

***NeQuickModelParameter* field descriptions**
ai0, ai1, ai2 These fields are used to estimate the ionospheric distortions on pseudoranges as described in [8] on page 71.
ionoStormFlag1, ionoStormFlag2, ionoStormFlag3, ionoStormFlag4, ionoStormFlag5 These fields specify the ionosphere storm flags (1,…,5) for five different regions as described in [8] on page 71. If the ionosphere storm flag for a region is not present the target device shall treat the ionosphere storm condition as unknown.

6.2.3.10 GNSS-EarthOrientationParameters

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

```
-- ASN1START

GNSS-EarthOrientationParameters ::= SEQUENCE {
    teop                INTEGER (0..65535),
    pmX                 INTEGER (-1048576..1048575),
    pmXdot              INTEGER (-16384..16383),
    pmY                 INTEGER (-1048576..1048575),
    pmYdot              INTEGER (-16384..16383),
    deltaUT1            INTEGER (-1073741824..1073741823),
    deltaUT1dot         INTEGER (-262144..262143),
    ...
}

-- ASN1STOP
```

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

6.2.3.11 GNSS-TimeModelList

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

```
-- ASN1START

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

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

-- ASN1STOP
```

***GNSS-TimeModelElement* field descriptions**
gnss-TimeModelRefTime This field specifies the reference time of week for *GNSS-TimeModelElement* and it is given in GNSS specific system time. Scale factor 2^4 seconds.
tA0 This field specifies the bias coefficient of the *GNSS-TimeModelElement*. Scale factor 2^{-35} seconds.
tA1 This field specifies the drift coefficient of the *GNSS-TimeModelElement.* Scale factor of 2^{-51} seconds/second.
tA2 This field specifies the drift rate correction coefficient of the *GNSS-TimeModelElement.* Scale factor of 2^{-68} seconds/second^2.
gnss-TO-ID This field specifies the GNSS system time of the GNSS for which the *GNSS-TimeModelElement* is applicable. *GNSS-TimeModelElement* contains parameters to convert GNSS system time from the system indicated by *GNSS-ID* to GNSS system time indicated by *gnss-TO-ID*. The conversion is defined in [4],[5] and [6]. See table 6.2.3.11.1.
weekNumber This field specifies the reference week of the *GNSS-TimeModelElement* given in GNSS specific system time. Scale factor 1 week.
deltaT This field specifies the integer number of seconds of the GNSS-GNSS time offset provided in the *GNSS-TimeModelElement.* Scale factor 1 second.

Table 6.2.3.11.1: gnss-TO-ID to Indication relation

Value of gnss-TO-ID	Indication
1	GPS
2	Galileo
3	QZSS
4	GLONASS
5 to 15	reserved

6.2.3.12 GNSS-DifferentialCorrections

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

```
-- ASN1START

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

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

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

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

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

-- ASN1STOP
```

***GNSS-DifferentialCorrections* field descriptions**
dgnss-RefTime This field specifies the time for which the DGNSS corrections are valid, modulo 1 hour. *dgnss-RefTime* is given in GNSS specific system time. Scale factor 1 second.
dgnss-SgnTypeList This list includes differential correction data for different GNSS signal types, identified by *GNSS-SignalID*.
gnss-StatusHealth This field specifies the status of the differential corrections. The values of this field and their respective meanings are defined as in table 6.2.3.12.1 *gnss-StatusHealth Value to Indication relation.* The first six values in this field indicate valid differential corrections. When using the values described below, the "UDRE Scale Factor" value is applied to the UDRE values contained in the element. The purpose is to indicate an estimate in the amount of error in the corrections. The value "110" indicates that the source of the differential corrections (e.g. reference station or external DGNSS network) is currently not being monitored. The value "111" indicates that the corrections provided by the source are invalid, as judged by the source.
dgnss-SatList This list includes differential correction data for different GNSS satellites, identified by *SV-ID*.
iod This field specifies the Issue of Data field which contains the identity for the *GNSS-NavigationModel.*
udre This field provides an estimate of the uncertainty (1 - σ) in the corrections for the particular satellite. The value in this field shall be multiplied by the UDRE Scale Factor in the *gnss-StatusHealth* field to determine the final UDRE estimate for the particular satellite. The meanings of the values for this field are shown in the table 6.2.3.12.2 *udre Value* to Indication relation.

***GNSS-DifferentialCorrections* field descriptions**
pseudoRangeCor This field specifies the correction to the pseudorange for the particular satellite at *dgnss-RefTime*, t_0. The value of this field is given in meters and the scale factor is 0,32 meters in the range of ±655,04 meters. The method of calculating this field is described in [11]. If the location server has received a request for GNSS assistance data from a target device which included a request for the GNSS Navigation Model and DGNSS, the location server shall determine, for each satellite, if the navigation model stored by the target device is still suitable for use with DGNSS corrections and if so and if DGNSS corrections are supported the location server should send DGNSS corrections without including the GNSS Navigation Model. The *iod* value sent for a satellite shall always be the IOD value that corresponds to the navigation model for which the pseudo-range corrections are applicable. The target device shall only use the *pseudoRangeCor* value when the IOD value received matches its available navigation model. Pseudo-range corrections are provided with respect to GNSS specific geodetic datum (e.g. PZ-90.02 if *GNSS-ID* indicates GLONASS). Scale factor 0,32 meters.
rangeRateCor This field specifies the rate-of-change of the pseudorange correction for the particular satellite, using the satellite ephemeris and clock corrections identified by the *iod* field. The value of this field is given in meters per second and the resolution is 0,032 meters/second in the range of ±4,064 meters/second. For some time $t_1 > t_0$, the corrections for *iod* are estimated by: $PRC(t_1, IOD) = PRC(t_0, IOD) + RRC(t_0, IOD) \times \cdot(t_1 - t_0)$, and the target device uses this to correct the pseudorange it measures at t_1, $PR_m(t_1, IOD)$, by: $PR(t_1, IOD) = PR_m(t_1, IOD) + PRC(t_1, IOD)$. The location server shall always send the RRC value that corresponds to the PRC value that it sends. The target device shall only use the RRC value when the *iod* value received matches its available navigation model. Scale factor 0,032 meters/second.
udreGrowthRate This field provides an estimate of the growth rate of uncertainty (1 - σ) in the corrections for the particular satellite identified by *SV-ID*. The estimated UDRE at time value specified in the *udreValidityTime* t_1 is calculated as follows: $UDRE(t_0 + t_1) = UDRE(t_0) \times udreGrowthRate$, where t_0 is the DGNSS Reference Time *dgnss-RefTime* for which the corrections are valid, t_1 is the *udreValidityTime* field, $UDRE(t_0)$ is the value of the *udre* field, and *udreGrowthRate* field is the factor as shown in the table 6.2.3.12.3 Value of *udreGrowthRate* to Indication relation.
udreValidityTime This field specifies the time when the *udreGrowthRate* field applies and is included if *udreGrowthRate* is included. The meaning of the values for this field is as shown in the table 6.2.3.12.4 Value of *udreValidityTime* to Indication relation.

Table 6.2.3.12.1: *gnss-StatusHealth* Value to Indication relation

gnss-StatusHealth Value	Indication
000	UDRE Scale Factor = 1,0
001	UDRE Scale Factor = 0,75
010	UDRE Scale Factor = 0,5
011	UDRE Scale Factor = 0,3
100	UDRE Scale Factor = 0,2
101	UDRE Scale Factor = 0,1
110	Reference Station Transmission Not Monitored
111	Data is invalid - disregard

Table 6.2.3.12.2: *udre Value* to Indication relation

udre Value	Indication
00	UDRE ≤ 1,0 m
01	1,0 m < UDRE ≤ 4,0 m
10	4,0 m < UDRE ≤ 8,0 m
11	8,0 m < UDRE

Table 6.2.3.12.3: Value of *udreGrowthRate* to Indication relation

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

Table 6.2.3.12.4: Value of *udreValidityTime* to Indication relation

Value of udreValidityTime	Indication [seconds]
000	20
001	40
010	80
011	160
100	320
101	640
110	1 280
111	2 560

6.2.3.13 GNSS-NavigationModel

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

```
-- ASN1START

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

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

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

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

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

-- ASN1STOP
```

***GNSS-NavigationModel* field descriptions**
nonBroadcastIndFlag This field indicates if the *GNSS-NavigationModel* elements are not derived from satellite broadcast data or are given in a format not native to the GNSS. A value of 0 means the *GNSS-NavigationModel* data elements correspond to GNSS satellite broadcasted data; a value of 1 means the *GNSS-NavigationModel* data elements are not derived from satellite broadcast.
gnss-SatelliteList This list provides ephemeris and clock corrections for GNSS satellites indicated by *SV-ID*.
svHealth This field specifies the satellite's current health. The health values are GNSS system specific. The interpretation of *svHealth* depends on the *GNSS-ID* and is as shown in table 6.2.3.13.1 GNSS to svHealth Bit String(8) relation.
iod This field specifies the Issue of Data and contains the identity for GNSS Navigation Model. In case of broadcasted GPS NAV ephemeris, the *iod* contains the IODC as described in [4]. In case of broadcasted Modernized GPS ephemeris, the *iod* contains the 11-bit parameter t_{oe} as defined in [4], table 30-I and [6], table 3.5-1. In case of broadcasted SBAS ephemeris, the *iod* contains the 8 bits Issue of Data as defined in [10] Message Type 9. In case of broadcasted QZSS QZS-L1 ephemeris, the *iod* contains the IODC as described in [7]. In case of broadcasted QZSS QZS-L1C/L2C/L5 ephemeris, the *iod* contains the 11-bit parameter t_{oe} as defined in [7]. In case of broadcasted GLONASS ephemeris, the *iod* contains the parameter t_b as defined in [9]. In the case of broadcasted Galileo ephemeris, the *iod* contains the IOD index as described in [8]. The interpretation of *iod* depends on the *GNSS-ID* and is as shown in table 6.2.3.13.2 GNSS to iod Bit String(11) relation.

Table 6.2.3.13.1: GNSS to svHealth Bit String(8) relation

GNSS	***svHealth* Bit String(8)**							
	Bit 1 (MSB)	**Bit 2**	**Bit 3**	**Bit 4**	**Bit 5**	**Bit 6**	**Bit 7**	**Bit 8 (LSB)**
GPS L1/CA(1)	SV Health [4]						'0' (reserved)	'0' (reserved)
Modernized GPS(2)	L1C Health [6]	L1 Health [4], [5]	L2 Health [4], [5]	L5 Health [4], [5]	'0' (reserved)	'0' (reserved)	'0' (reserved)	'0' (reserved)
SBAS(3)	Ranging On (0),Off(1) [10]	Corrections On(0),Off(1) [10]	Integrity On(0),Off(1) [10]	'0' (reserved)	'0' (reserved)	'0' (reserved)	'0' (reserved)	'0' (reserved)
QZSS(4) QZS-L1	SV Health [7]						'0' (reserved)	'0' (reserved)
QZSS(5) QZS-L1C/L2C/L5	L1C Health [7]	L1 Health [7]	L2 Health [7]	L5 Health [7]	'0' (reserved)	'0' (reserved)	'0' (reserved)	'0' (reserved)
GLONASS	B_n (MSB) [9], page 30	F_T [9], table 4.4				'0' (reserved)	'0' (reserved)	'0' (reserved)
Galileo [8, pages 75-76]	E5a Data Validity Status	E5b Data Validity Status	E1-B Data Validity Status	E5a Signal Health Status See [8], table 67		'0' (reserved)	'0' (reserved)	'0' (reserved)

NOTE 1: If *GNSS-ID* indicates 'gps', and GNSS Orbit Model-2 is included, this interpretation of *svHealth* applies.
NOTE 2: If *GNSS-ID* indicates 'gps', and GNSS Orbit Model-3 is included, this interpretation of *svHealth* applies. If a certain signal is not supported on the satellite indicated by *SV-ID*, the corresponding health bit shall be set to '1' (i.e. signal can not be used).
NOTE 3: *svHealth* in case of *GNSS-ID* indicates 'sbas' includes the 5 LSBs [10] of the Health included in GEO Almanac Message Parameters (Type 17) [10].
NOTE 4: If *GNSS-ID* indicates 'qzss', and GNSS Orbit Model-2 is included, this interpretation of *svHealth* applies.
NOTE 5: If *GNSS-ID* indicates 'qzss', and GNSS Orbit Model-3 is included, this interpretation of *svHealth* applies.

Table 6.2.3.13.2: GNSS to iod Bit String(11) relation

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

6.2.3.14 StandardClockModelList

```
-- ASN1START

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

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

-- ASN1STOP
```

***StandardClockModelList* field descriptions**
standardClockModelList *gnss-ClockModel* Model-1 contains one or two clock model elements depending on the GNSS. If included, clock Model-1 shall be included once or twice depending on the target device capability. If the target device is supporting multiple Galileo signals, the location server shall include both F/Nav and I/Nav clock models in *gnss-ClockModel* if the location server assumes the target device to perform location information calculation using multiple signals.
stanClockToc Parameter t_{oc} defined in [8]. Scale factor 60 seconds.
stanClockAF2 Parameter af_2 defined in [8]. Scale factor 2^{-65} seconds/second^2.
stanClockAF1 Parameter af_1 defined in [8]. Scale factor 2^{-45} seconds/second.
stanClockAF0 Parameter af_0 defined in [8]. Scale factor 2^{-33} seconds.
stanClockTgd Parameter T_{GD} defined in [8]. Scale factor 2^{-32} seconds. This field is required if the target device supports only single frequency Galileo signal.
stanModelID This field specifies the identity of the clock model according to the table 6.2.3.14.1 Value of stanModelID to Identity relation. This field is required if the location server includes both F/Nav and I/Nav Galileo clock models in *gnss-ClockModel.*

Table 6.2.3.14.1: Value of stanModelID to Identity relation

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

6.2.3.15 NAV-ClockModel

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.3.16 CNAV-ClockModel

```
-- ASN1START

CNAV-ClockModel ::= SEQUENCE {
    cnavToc         INTEGER (0..2015),
    cnavTop         INTEGER (0..2015),
    cnavURA0        INTEGER (-16..15),
    cnavURA1        INTEGER (0..7),
    cnavURA2        INTEGER (0..7),
    cnavAf2         INTEGER (-512..511),
    cnavAf1         INTEGER (-524288..524287),
    cnavAf0         INTEGER (-33554432..33554431),
    cnavTgd         INTEGER (-4096..4095),
    cnavISCl1cp     INTEGER (-4096..4095)           OPTIONAL,   -- Need ON
    cnavISCl1cd     INTEGER (-4096..4095)           OPTIONAL,   -- Need ON
    cnavISCl1ca     INTEGER (-4096..4095)           OPTIONAL,   -- Need ON
    cnavISCl2c      INTEGER (-4096..4095)           OPTIONAL,   -- Need ON
    cnavISCl5i5     INTEGER (-4096..4095)           OPTIONAL,   -- Need ON
    cnavISCl5q5     INTEGER (-4096..4095)           OPTIONAL,   -- Need ON
    ...
}

-- ASN1STOP
```

***CNAV-ClockModel* field descriptions**
cnavToc Parameter t_{oc}, clock data reference time of week (seconds) [4], [5], [6] and [7]. Scale factor 300 seconds.
cnavTop Parameter t_{op}, clock data predict time of week (seconds) [4], [5], [6] and [7]. Scale factor 300 seconds
cnavURA0 Parameter URA_{oc} Index, SV clock accuracy index (dimensionless) [4], [5], [6] and [7].
cnavURA1 Parameter URA_{oc1} Index, SV clock accuracy change index (dimensionless) [4], [5], [6] and [7].
cnavURA2 Parameter URA_{oc2} Index, SV clock accuracy change rate index (dimensionless) [4], [5], [6] and [7].
cnavAf2 Parameter $a_{f2\text{-}n}$, SV clock drift rate correction coefficient (sec/sec^2) [4], [5], [6] and [7]. Scale factor 2^{-60} seconds/second^2.
cnavAf1 Parameter $a_{f1\text{-}n}$, SV clock drift correction coefficient (sec/sec) [4], [5], [6] and [7]. Scale factor 2^{-48} seconds/second.
cnavAf0 Parameter $a_{f0\text{-}n}$, SV clock bias correction coefficient (seconds) [4], [5], [6] and [7]. Scale factor 2^{-35} seconds.
cnavTgd Parameter T_{GD}, Group delay correction (seconds) [4], [5], [6] and [7]. Scale factor 2^{-35} seconds.
cnavISCl1cp Parameter ISC_{L1CP}, inter signal group delay correction (seconds) [6] and [7]. Scale factor 2^{-35} seconds. The location server should include this field if the target device is GPS capable and supports the $L1_C$ signal.
cnavISCl1cd Parameter ISC_{L1CD}, inter signal group delay correction (seconds) [6] and [7]. Scale factor 2^{-35} seconds. The location server should include this field if the target device is GPS capable and supports the $L1_C$ signal.
cnavISCl1ca Parameter $ISC_{L1C/A}$, inter signal group delay correction (seconds) [4], [5] and [7]. Scale factor 2^{-35} seconds. The location server should include this field if the target device is GPS capable and supports the $L1_{CA}$ signal.
cnavISCl2c Parameter ISC_{L2C}, inter signal group delay correction (seconds) [4], [5] and [7]. Scale factor 2^{-35} seconds. The location server should include this field if the target device is GPS capable and supports the $L2_C$ signal.
cnavISCl5i5 Parameter ISC_{L5I5}, inter signal group delay correction (seconds) [5] and [7]. Scale factor 2^{-35} seconds. The location server should include this field if the target device is GPS capable and supports the L5 signal.

***CNAV-ClockModel* field descriptions**
cnavISCl5q5 Parameter ISC_{L5Q5}, inter signal group delay correction (seconds) [5] and [7]. Scale factor 2^{-35} seconds. The location server should include this field if the target device is GPS capable and supports the L5 signal.

6.2.3.17 GLONASS-ClockModel

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.3.18 SBAS-ClockModel

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.3.19 NavModelKeplerianSet

```
-- ASN1START

NavModelKeplerianSet ::= SEQUENCE {
    keplerToe        INTEGER (0 .. 16383),
    keplerW          INTEGER (-2147483648..2147483647),
    keplerDeltaN     INTEGER (-32768..32767),
    keplerM0         INTEGER (-2147483648..2147483647),
    keplerOmegaDot   INTEGER (-8388608.. 8388607),
    keplerE          INTEGER (0..4294967295),
    keplerIDot       INTEGER (-8192..8191),
    keplerAPowerHalf INTEGER (0.. 4294967295),
    keplerI0         INTEGER (-2147483648..2147483647),
    keplerOmega0     INTEGER (-2147483648..2147483647),
    keplerCrs        INTEGER (-32768..32767),
    keplerCis        INTEGER (-32768..32767),
    keplerCus        INTEGER (-32768..32767),
    keplerCrc        INTEGER (-32768..32767),
    keplerCic        INTEGER (-32768..32767),
    keplerCuc        INTEGER (-32768..32767),
    ...
}

-- ASN1STOP
```

***NavModelKeplerianSet* field descriptions**
keplerToe Parameter t_{oe}, time-of-ephemeris in seconds [8]. Scale factor 60 seconds.
keplerW Parameter ω, argument of perigee (semi-circles) [8]. Scale factor 2^{-31} semi-circles.
keplerDeltaN Parameter Δn, mean motion difference from computed value (semi-circles/sec) [8]. Scale factor 2^{-43} semi-circles/second.
keplerM0 Parameter M_0, mean anomaly at reference time (semi-circles) [8]. Scale factor 2^{-31} semi-circles.
keplerOmegaDot Parameter OMEGAdot, longitude of ascending node of orbit plane at weekly epoch (semi-circles/sec) [8]. Scale factor 2^{-43} semi-circles/second.
keplerE Parameter e, eccentricity [8]. Scale factor 2^{-33}.
KeplerIDot Parameter Idot, rate of inclination angle (semi-circles/sec) [8]. Scale factor 2^{-43} semi-circles/second.
keplerAPowerHalf Parameter sqrtA, semi-major Axis in (meters) ^{½} [8]. Scale factor 2^{-19} meters ^{½} .
keplerI0 Parameter i_0, inclination angle at reference time (semi-circles) [8]. Scale factor 2^{-31} semi-circles.
keplerOmega0 Parameter $OMEGA_0$, longitude of ascending node of orbit plane at weekly epoch (semi-circles) [8]. Scale factor 2^{-31} semi-circles.
keplerCrs Parameter C_{rs}, amplitude of the sine harmonic correction term to the orbit radius (meters) [8]. Scale factor 2^{-5} meters.
keplerCis Parameter C_{is}, amplitude of the sine harmonic correction term to the angle of inclination (radians) [8]. Scale factor 2^{-29} radians.
keplerCus Parameter C_{us}, amplitude of the sine harmonic correction term to the argument of latitude (radians) [8]. Scale factor 2^{-29} radians.
keplerCrc Parameter C_{rc}, amplitude of the cosine harmonic correction term to the orbit radius (meters) [8]. Scale factor 2^{-5} meters.

***NavModelKeplerianSet* field descriptions**
keplerCic Parameter C_{ic}, amplitude of the cosine harmonic correction term to the angle of inclination (radians) [8]. Scale factor 2^{-29} radians.
keplerCuc Parameter C_{uc}, amplitude of the cosine harmonic correction term to the argument of latitude (radians) [8]. Scale factor 2^{-29} radians.

6.2.3.20 NavModelNAV-KeplerianSet

```
-- ASN1START

NavModelNAV-KeplerianSet ::= SEQUENCE {
    navURA          INTEGER (0..15),
    navFitFlag      INTEGER (0..1),
    navToe          INTEGER (0..37799),
    navOmega        INTEGER (-2147483648..2147483647),
    navDeltaN       INTEGER (-32768..32767),
    navM0           INTEGER (-2147483648..2147483647),
    navOmegaADot    INTEGER (-8388608..8388607),
    navE            INTEGER (0..4294967295),
    navIDot         INTEGER (-8192..8191),
    navAPowerHalf   INTEGER (0..4294967295),
    navI0           INTEGER (-2147483648..2147483647),
    navOmegaA0      INTEGER (-2147483648..2147483647),
    navCrs          INTEGER (-32768..32767),
    navCis          INTEGER (-32768..32767),
    navCus          INTEGER (-32768..32767),
    navCrc          INTEGER (-32768..32767),
    navCic          INTEGER (-32768..32767),
    navCuc          INTEGER (-32768..32767),
    addNAVparam     SEQUENCE {
        ephemCodeOnL2   INTEGER (0..3),
        ephemL2Pflag    INTEGER (0..1),
        ephemSF1Rsvd    SEQUENCE {
            reserved1       INTEGER (0..8388607),   -- 23-bit field
            reserved2       INTEGER (0..16777215),  -- 24-bit field
            reserved3       INTEGER (0..16777215),  -- 24-bit field
            reserved4       INTEGER (0..65535)      -- 16-bit field
        },
        ephemAODA       INTEGER (0..31)
    }   OPTIONAL,   -- Need ON
    ...
}

-- ASN1STOP
```

***NavModelNAV-KeplerianSet* field descriptions**
navURA Parameter URA Index, SV accuracy (dimensionless) [4] and [7].
navFitFlag Parameter Fit Interval Flag, fit interval indication (dimensionless) [4] and [7].
navToe Parameter t_{oe}, time of ephemeris (seconds) [4] and [7]. Scale factor 2^4 seconds.
navOmega Parameter ω, argument of perigee (semi-circles) [4] and [7]. Scale factor 2^{-31} semi-circles.
navDeltaN Parameter Δn, mean motion difference from computed value (semi-circles/sec) [4] and [7]. Scale factor 2^{-43} semi-circles/second.
navM0 Parameter M_0, mean anomaly at reference time (semi-circles) [4] and [7]. Scale factor 2^{-31} semi-circles.
navOmegaADot Parameter $\dot{\Omega}$, rate of right ascension (semi-circles/sec) [4] and [7]. Scale factor 2^{-43} semi-circles/second.
navE Parameter e, eccentricity (dimensionless) [4] and [7]. Scale factor 2^{-33}.

***NavModelNAV-KeplerianSet* field descriptions**
navIDot Parameter IDOT, rate of inclination angle (semi-circles/sec) [4] and [7]. Scale factor 2^{-43} semi-circles/second.
navAPowerHalf Parameter $\sqrt{A}$, square root of semi-major axis (meters$^{1/2}$) [4] and [7]. Scale factor 2^{-19} meters ½ .
navI0 Parameter i_0, inclination angle at reference time (semi-circles) [4] and [7]. Scale factor 2^{-31} semi-circles.
navOmegaA0 Parameter Ω_0, longitude of ascending node of orbit plane at weekly epoch (semi-circles) [4] and [7]. Scale factor 2^{-31} semi-circles.
navCrs Parameter C_{rs}, amplitude of sine harmonic correction term to the orbit radius (meters) [4] and [7]. Scale factor 2^{-5} meters.
navCis Parameter C_{is}, amplitude of sine harmonic correction term to the angle of inclination (radians) [4] and [7]. Scale factor 2^{-29} radians.
navCus Parameter C_{us}, amplitude of sine harmonic correction term to the argument of latitude (radians) [4] and [7]. Scale factor 2^{-29} radians.
navCrc Parameter C_{rc}, amplitude of cosine harmonic correction term to the orbit radius (meters) [4] and [7]. Scale factor 2^{-5} meters.
navCic Parameter C_{ic}, amplitude of cosine harmonic correction term to the angle of inclination (radians) [4] and [7]. Scale factor 2^{-29} radians.
navCuc Parameter C_{uc}, amplitude of cosine harmonic correction term to the argument of latitude (radians) [4] and [7]. Scale factor 2^{-29} radians. [4]
addNAVparam These fields include data and reserved bits in the GPS NAV message [4] and [13]. These additional navigation parameters, if provided by the location server, allow the target device to perform data wipe-off similar to what is done by the target device with the *GNSS-DataBitAssistance.*

6.2.3.21 NavModelCNAV-KeplerianSet

```
-- ASN1START

NavModelCNAV-KeplerianSet ::= SEQUENCE {
    cnavTop             INTEGER (0..2015),
    cnavURAindex        INTEGER (-16..15),
    cnavDeltaA          INTEGER (-33554432..33554431),
    cnavAdot            INTEGER (-16777216..16777215),
    cnavDeltaNo         INTEGER (-65536..65535),
    cnavDeltaNoDot      INTEGER (-4194304..4194303),
    cnavMo              INTEGER (-4294967296..4294967295),
    cnavE               INTEGER (0..8589934591),
    cnavOmega           INTEGER (-4294967296..4294967295),
    cnavOMEGA0          INTEGER (-4294967296..4294967295),
    cnavDeltaOmegaDot   INTEGER (-65536..65535),
    cnavIo              INTEGER (-4294967296..4294967295),
    cnavIoDot           INTEGER (-16384..16383),
    cnavCis             INTEGER (-32768..32767),
    cnavCic             INTEGER (-32768..32767),
    cnavCrs             INTEGER (-8388608..8388607),
    cnavCrc             INTEGER (-8388608..8388607),
    cnavCus             INTEGER (-1048576..1048575),
    cnavCuc             INTEGER (-1048576..1048575),
    ...
}

-- ASN1STOP
```

***NavModelCNAV-KeplerianSet* field descriptions**
cnavTop Parameter t_{op}, data predict time of week (seconds) [4], [5], [6] and [7]. Scale factor 300 seconds.
cnavURAindex Parameter URA_{oe} Index, SV accuracy (dimensionless) [4], [5], [6] and [7].
cnavDeltaA Parameter ΔA, semi-major axis difference at reference time (meters) [4], [5], [6] and [7]. Scale factor 2^{-9} meters.
cnavAdot Parameter $\dot{A}$, change rate in semi-major axis (meters/sec) [4], [5], [6] and [7]. Scale factor 2^{-21} meters/sec.
cnavDeltaNo Parameter Δn_0, mean motion difference from computed value at reference time (semi-circles/sec) [4], [5], [6] and [7]. Scale factor 2^{-44} semi-circles/second.
cnavDeltaNoDot Parameter $\Delta\dot{n}_0$, rate of mean motion difference from computed value (semi-circles/sec^2) [4], [5], [6] and [7]. Scale factor 2^{-57} semi-circles/second^2.
cnavMo Parameter M_{0-n}, mean anomaly at reference time (semi-circles) [4], [5], [6] and [7]. Scale factor 2^{-32} semi-circles.
cnavE Parameter e_n, eccentricity (dimensionless) [4], [5], [6] and [7]. Scale factor 2^{-34}.
cnavOmega Parameter ω_n, argument of perigee (semi-circles) [4], [5], [6] and [7]. Scale factor 2^{-32} semi-circles.
cnavOMEGA0 Parameter Ω_{0-n}, reference right ascension angle (semi-circles) [4], [5], [6] and [7]. Scale factor 2^{-32} semi-circles.
cnavDeltaOmegaDot Parameter $\Delta\dot{\Omega}$, rate of right ascension difference (semi-circles/sec) [4], [5], [6] and [7]. Scale factor 2^{-44} semi-circles/second.
cnavIo Parameter i_{o-n}, inclination angle at reference time (semi-circles) [4], [5], [6] and [7]. Scale factor 2^{-32} semi-circles.
cnavIoDot Parameter I_{0-n}-DOT, rate of inclination angle (semi-circles/sec) [4], [5], [6] and [7]. Scale factor 2^{-44} semi-circles/second.
cnavCis Parameter C_{is-n}, amplitude of sine harmonic correction term to the angle of inclination (radians) [4], [5], [6] and [7]. Scale factor 2^{-30} radians.
cnavCic Parameter C_{ic-n}, amplitude of cosine harmonic correction term to the angle of inclination (radians) [4], [5], [6] and [7]. Scale factor 2^{-30} radians.
cnavCrs Parameter C_{rs-n}, amplitude of sine harmonic correction term to the orbit radius (meters) [4], [5], [6] and [7]. Scale factor 2^{-8} meters.
cnavCrc Parameter C_{rc-n}, amplitude of cosine harmonic correction term to the orbit radius (meters) [4], [5], [6] and [7]. Scale factor 2^{-8} meters.
cnavCus Parameter C_{us-n}, amplitude of the sine harmonic correction term to the argument of latitude (radians) [4], [5], [6] and [7]. Scale factor 2^{-30} radians.
cnavCuc Parameter C_{uc-n}, amplitude of cosine harmonic correction term to the argument of latitude (radians) [4], [5], [6] and [7]. Scale factor 2^{-30} radians.

6.2.3.22 NavModel-GLONASS-ECEF

```
-- ASN1START

NavModel-GLONASS-ECEF ::= SEQUENCE {
    gloEn               INTEGER (0..31),
    gloP1               BIT STRING (SIZE(2)),
    gloP2               BOOLEAN,
    gloM                INTEGER (0..3),
    gloX                INTEGER (-67108864..67108863),
    gloXdot             INTEGER (-8388608..8388607),
    gloXdotdot          INTEGER (-16..15),
    gloY                INTEGER (-67108864..67108863),
    gloYdot             INTEGER (-8388608..8388607),
    gloYdotdot          INTEGER (-16..15),
    gloZ                INTEGER (-67108864..67108863),
    gloZdot             INTEGER (-8388608..8388607),
    gloZdotdot          INTEGER (-16..15),
    ...
}

-- ASN1STOP
```

***NavModel-GLONASS-ECEF* field descriptions**
gloEn Parameter E_n, age of data (days) [9]. Scale factor 1 days.
gloP1 Parameter P1, time interval between two adjacent values of t_b (minutes) [9].
gloP2 Parameter P2, change of t_b flag (dimensionless) [9].
gloM Parameter M, type of satellite (dimensionless) [9].
gloX Parameter $x_n(t_b)$, x-coordinate of satellite at time t_b (kilometers) [9]. Scale factor 2^{-11} kilometers.
gloXdot Parameter $\dot{x}_n(t_b)$, x-coordinate of satellite velocity at time t_b (kilometers/sec) [9]. Scale factor 2^{-20} kilometers/second.
gloXdotdot Parameter $\ddot{x}_n(t_b)$, x-coordinate of satellite acceleration at time t_b (kilometers/sec^2) [9]. Scale factor 2^{-30} kilometers/second^2.
gloY Parameter $y_n(t_b)$, y-coordinate of satellite at time t_b (kilometers) [9]. Scale factor 2^{-11} kilometers.
gloYdot Parameter $\dot{y}_n(t_b)$, y-coordinate of satellite velocity at time t_b (kilometers/sec) [9]. Scale factor 2^{-20} kilometers/second. [9]
gloYdotdot Parameter $\ddot{y}_n(t_b)$, y-coordinate of satellite acceleration at time t_b (kilometers/sec^2) [9]. Scale factor 2^{-30} kilometers/second^2.
gloZ Parameter $z_n(t_b)$, z-coordinate of satellite at time t_b (kilometers) [9]. Scale factor 2^{-11} kilometers.
gloZdot Parameter $\dot{z}_n(t_b)$, z-coordinate of satellite velocity at time t_b (kilometers/sec) [9]. Scale factor 2^{-20} kilometers/second.
gloZdotdot Parameter $\ddot{z}_n(t_b)$, z-coordinate of satellite acceleration at time t_b (kilometers/sec^2) [9]. Scale factor 2^{-30} kilometers/second^2.

6.2.3.23 NavModel-SBAS-ECEF

```
-- ASN1START
 [9]
NavModel-SBAS-ECEF ::= SEQUENCE {
    sbasTo              INTEGER (0..5399)                   OPTIONAL,   -- Cond ClockModel
    sbasAccuracy        BIT STRING (SIZE(4)),
    sbasXg              INTEGER (-536870912..536870911),
    sbasYg              INTEGER (-536870912..536870911),
    sbasZg              INTEGER (-16777216..16777215),
    sbasXgDot           INTEGER (-65536..65535),
    sbasYgDot           INTEGER (-65536..65535),
    sbasZgDot           INTEGER (-131072..131071),
    sbasXgDotDot        INTEGER (-512..511),
    sbagYgDotDot        INTEGER (-512..511),
    sbasZgDotDot        INTEGER (-512..511),
    ...
}

-- ASN1STOP
```

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

***NavModel-SBAS-ECEF* field descriptions**
sbasTo Parameter t_0, time of applicability (seconds) [10]. Scale factor 16 seconds.
sbasAccuracy Parameter Accuracy, (dimensionless) [10].
sbasXg Parameter X_G, (meters) [10]. Scale factor 0,08 meters.
sbasYg Parameter Y_G, (meters) [10]. Scale factor 0,08 meters.
sbasZg Parameter Z_G, (meters) [10]. Scale factor 0,4 meters.
sbasXgDot Parameter X_G , Rate-of-Change, (meters/sec) [10]. Scale factor 0,000625 meters/second.
sbasYgDot Parameter Y_G , Rate-of-Change, (meters/sec) [10]. Scale factor 0,000625 meters/second.
sbasZgDot Parameter Z_G , Rate-of-Change, (meters/sec) [10]. Scale factor 0,004 meters/second.
sbasXgDotDot Parameter X_G , Acceleration, (meters/sec^2) [10]. Scale factor 0,0000125 meters/second^2.
sbagYgDotDot Parameter Y_G , Acceleration, (meters/sec^2) [10]. Scale factor 0,0000125 meters/second^2.
sbasZgDotDot Parameter Z_G Acceleration, (meters/sec^2) [10]. Scale factor 0,0000625 meters/second^2.

6.2.3.24 GNSS-RealTimeIntegrity

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

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

```
-- ASN1START

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

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

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

-- ASN1STOP
```

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

6.2.3.25 GNSS-DataBitAssistance

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

```
-- ASN1START

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

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

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

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

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

-- ASN1STOP
```

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

6.2.3.26 GNSS-AcquisitionAssistance

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

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

Figure 6.2.3.26.1 illustrates the relation between some of the fields, using GPS TOW as exemplary reference.

```
-- ASN1START

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

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

GNSS-AcquisitionAssistElement  ::= SEQUENCE {
    svID                        SV-ID,
    doppler0                    INTEGER (-2048..2047),
    doppler1                    INTEGER (0..63),
    dopplerUncertainty          INTEGER (0..4),
    codePhase                   INTEGER (0..1022),
    intCodePhase                INTEGER (0..127),
    codePhaseSearchWindow       INTEGER (0..31),
    azimuth                     INTEGER (0..511),
    elevation                   INTEGER (0..127),
    ...,
    codePhase1023               BOOLEAN             OPTIONAL    -- Need OP
}

-- ASN1STOP
```

***GNSS-AcquisitionAssistance* field descriptions**
gnss-SignalID This field specifies the GNSS signal for which the acquisition assistance are provided.
gnss-AcquisitionAssistList These fields provide a list of acquisition assistance data for each GNSS satellite.
svID This field specifies the GNSS *SV-ID* of the satellite for which the *GNSS-AcquisitionAssistance* is given.
doppler0 This field specifies the Doppler (0^{th} order term) value. A positive value in Doppler defines the increase in satellite signal frequency due to velocity towards the target device. A negative value in Doppler defines the decrease in satellite signal frequency due to velocity away from the target device. Doppler is given in unit of m/s by multiplying the Doppler value in Hz by the nominal wavelength of the assisted signal. Scale factor 0,5 m/s in the range from -1 024 m/s to +1 023,5 m/s.
doppler1 This field specifies the Doppler (1^{st} order term) value. A positive value defines the rate of increase in satellite signal frequency due to acceleration towards the target device. A negative value defines the rate of decrease in satellite signal frequency due to acceleration away from the target device. Scale factor 1/210 m/s^2 in the range from -0,2 m/s^2 to +0,1 m/s^2.
dopplerUncertainty This field specifies the Doppler uncertainty value. It is defined such that the Doppler experienced by a stationary target device is in the range [Doppler–Doppler Uncertainty] to [Doppler+Doppler Uncertainty]. Doppler Uncertainty is given in unit of m/s by multiplying the Doppler Uncertainty value in Hz by the nominal wavelength of the assisted signal. Defined values: 2,5 m/s, 5 m/s, 10 m/s, 20 m/s, 40 m/s as encoded by an integer *n* in the range 0 to 4 according to: $2^{-n}(40)$ m/s; n = 0 to 4.
codePhase This field together with the codePhase1023 field specifies the code phase, in units of milli-seconds, in the range from 0 to 1 millisecond scaled by the nominal chipping rate of the GNSS signal, where increasing values of the field signify increasing predicted signal code phases, as seen by a receiver at the reference location at the reference time. The reference location would typically be an a priori estimate of the target device location. Scale factor 2^{-10} ms in the range from 0 to ($1 - 2^{-10}$) ms.
intCodePhase This field contains integer code phase (expressed modulo 128 ms) currently being transmitted at the reference time, as seen by a receiver at the reference location. Scale factor 1 ms in the range from 0 to 127 ms.
codePhaseSearchWindow This field contains the code phase search window. The code phase search window accounts for the uncertainty in the estimated target device location but not any uncertainty in reference time. It is defined such that the expected code phase is in the range [Code Phase–Code Phase Search Window] to [Code Phase+Code Phase Search Window] given in units of milliseconds. Range 0 to 31, mapping according to the table 6.2.3.26.1 codePhaseSearchWindow Value to Interpretation Code Phase Search Window [ms] relation.
azimuth This field specifies the azimuth angle. An angle of x degrees means the satellite azimuth a is in the range ($x \le a < x + 0,703125$) degrees. Scale factor 0,703125 degrees.

***GNSS-AcquisitionAssistance* field descriptions**
elevation This field specifies the elevation angle. An angle of y degrees means the satellite elevation e is in the range ($y \le e < y + 0{,}703125$) degrees. Scale factor 0,703125 degrees.
codePhase1023 This field if set to TRUE indicates that the code phase has the value 1 023 × 2^{-10} = (1 - 2^{-10}) ms. This field may only be set to TRUE if the value provided in the codePhase IE is 1 022. If this field is set to FALSE, the code phase is the value provided in the codePhase IE in the range from 0 to (1 – 2 × 2^{-10}) ms. If this field is not present and the codePhase IE has the value 1 022, the target device may assume that the code phase is between (1 – 2 × 2^{-10}) ms and (1 - 2^{-10}) ms.

Table 6.2.3.26.1: codePhaseSearchWindow Value to Interpretation Code Phase Search Window [ms] relation

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

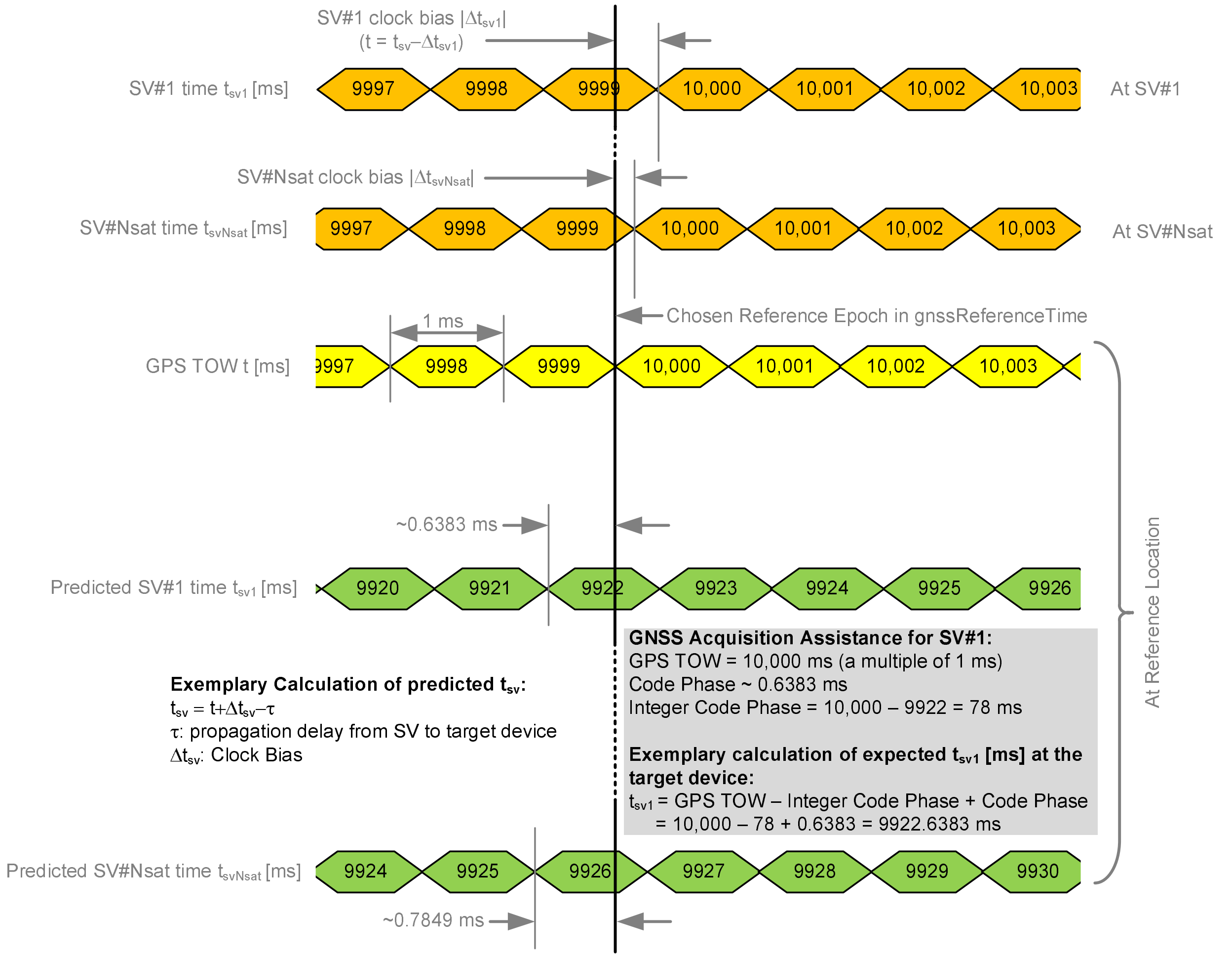

Figure 6.2.3.26.1: Exemplary calculation of some GNSS Acquisition Assistance fields

6.2.3.27 GNSS-Almanac

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

```
-- ASN1START

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

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

GNSS-AlmanacElement ::= CHOICE {
    keplerianAlmanacSet     AlmanacKeplerianSet,        -- Model-1
    keplerianNAV-Almanac    AlmanacNAV-KeplerianSet,    -- Model-2
    keplerianReducedAlmanac AlmanacReducedKeplerianSet, -- Model-3
    keplerianMidiAlmanac    AlmanacMidiAlmanacSet,      -- Model-4
    keplerianGLONASS        AlmanacGLONASS-AlmanacSet,  -- Model-5
    ecef-SBAS-Almanac       AlmanacECEF-SBAS-AlmanacSet,-- Model-6
    ...
}

-- ASN1STOP
```

***GNSS-Almanac* field descriptions**
weekNumber This field specifies the almanac reference week number in GNSS specific system time to which the almanac reference time *toa* is referenced, modulo 256 weeks. This field is required for non-GLONASS GNSS.
toa This field specifies the almanac reference time given in GNSS specific system time, in units of seconds with a scale factor of 2^{12}. This field is required for non-GLONASS GNSS.
ioda This field specifies the issue of data. This field is required for Galileo GNSS.
completeAlmanacProvided If set to TRUE, the *gnss-AlmanacList* contains almanacs for the complete GNSS constellation indicated by *GNSS-ID*.
gnss-AlmanacList This list contains the almanac model for each GNSS satellite in the GNSS constellation.

6.2.3.28 AlmanacKeplerianSet

```
-- ASN1START

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

-- ASN1STOP
```

***AlmanacKeplerianSet* field descriptions**
svID This field identifies the satellite for which the GNSS Almanac Model is given.
kepAlmanacE Parameter e, eccentricity, dimensionless [8]. Scale factor 2^{-16}.
kepAlmanacDeltaI Parameter δi, semi-circles [8]. Scale factor 2^{-14} semi-circles.
kepAlmanacOmegaDot Parameter OMEGADOT, longitude of ascending node of orbit plane at weekly epoch (semi-circles/sec) [8]. Scale factor 2^{-33} semi-circles/seconds.
kepSVHealth Parameter SV Health KP, dimensionless. This field specifies the SV Health status in GNSS almanac model using Keplerian parameters. In Galileo case this field shall contain the I/NAV health status bits [8].
kepAlmanacAPowerHalf Parameter delta $A^{1/2}$, Semi-Major Axis delta $(meters)^{1/2}$ [8]. Scale factor 2^{-9} meters ^{½} .
kepAlmanacOmega0 Parameter $OMEGA_0$, longitude of ascending node of orbit plane at weekly epoch (semi-circles) [8]. Scale factor 2^{-15} semi-circles.
kepAlmanacW Parameter ω, argument of perigee (semi-circles) [8]. Scale factor 2^{-15} semi-circles.
kepAlmanacM0 Parameter M_0, mean anomaly at reference time (semi-circles) [8]. Scale factor 2^{-15} semi-circles.
kepAlmanacAF0 Parameter af_0, seconds [8]. Scale factor 2^{-19} seconds.
kepAlmanacAF1 Parameter af_1, sec/sec [8]. Scale factor 2^{-38} seconds/second.

6.2.3.29 AlmanacNAV-KeplerianSet [8]

```
-- ASN1START

AlmanacNAV-KeplerianSet ::= SEQUENCE {
    svID                    SV-ID,
    navAlmE                 INTEGER (0..65535),
    navAlmDeltaI            INTEGER (-32768..32767),
    navAlmOMEGADOT          INTEGER (-32768..32767),
    navAlmSVHealth          INTEGER (0..255),
    navAlmSqrtA             INTEGER (0..16777215),
    navAlmOMEGAo            INTEGER (-8388608..8388607),
    navAlmOmega             INTEGER (-8388608..8388607),
    navAlmMo                INTEGER (-8388608..8388607),
    navAlmaf0               INTEGER (-1024..1023),
    navAlmaf1               INTEGER (-1024..1023),
    ...
}

-- ASN1STOP
```

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

6.2.3.30 AlmanacReducedKeplerianSet

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.3.31 AlmanacMidiAlmanacSet

```
-- ASN1START

AlmanacMidiAlmanacSet ::= SEQUENCE {
    svID                    SV-ID,
    midiAlmE                INTEGER (0..2047),
    midiAlmDeltaI           INTEGER (-1024..1023),
    midiAlmOmegaDot         INTEGER (-1024..1023),
    midiAlmSqrtA            INTEGER (0..131071),
    midiAlmOmega0           INTEGER (-32768..32767),
    midiAlmOmega            INTEGER (-32768..32767),
    midiAlmMo               INTEGER (-32768..32767),
    midiAlmaf0              INTEGER (-1024..1023),
    midiAlmaf1              INTEGER (-512..511),
    midiAlmL1Health         BOOLEAN,
    midiAlmL2Health         BOOLEAN,
    midiAlmL5Health         BOOLEAN,[4]
    ...
}

-- ASN1STOP
```

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

6.2.3.32 AlmanacGLONASS-AlmanacSet

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.3.33 AlmanacECEF-SBAS-AlmanacSet

```
-- ASN1START

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

-- ASN1STOP
```

***AlmanacECEF-SBAS-AlmanacSet* field descriptions**
sbasAlmDataID Parameter Data ID, dimensionless [10].
svID This field identifies the satellite for which the GNSS Almanac Model is given.
sbasAlmHealth Parameter Health, dimensionless [10].
sbasAlmXg Parameter X_G, meters [10]. Scale factor 2 600 meters.
sbasAlmYg Parameter Y_G, meters [10]. Scale factor 2 600 meters.
sbasAlmZg Parameter Z_G, meters [10]. Scale factor 26 000 meters.
sbasAlmXgdot Parameter X_G Rat-of-Change, meters/sec [10]. Scale factor 10 meters/second.
sbasAlmYgDot Parameter Y_G Rate-of-Change, meters/sec [10]. Scale factor 10 meters/second.
sbasAlmZgDot Parameter Z_G Rate-of-Change, meters/sec [10]. Scale factor 40,96 meters/second.
sbasAlmTo Parameter t_0, seconds [10]. Scale factor 64 meters/seconds.

6.2.3.34 GNSS-UTC-Model

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

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.3.35 UTC-ModelSet1

```
-- ASN1START

UTC-ModelSet1 ::= SEQUENCE {
    gnss-Utc-A1          INTEGER (-8388608..8388607),
    gnss-Utc-A0          INTEGER (-2147483648..2147483647),
    gnss-Utc-Tot         INTEGER (0..255),
    gnss-Utc-WNt         INTEGER (0..255),
    gnss-Utc-DeltaTls    INTEGER (-128..127),
    gnss-Utc-WNlsf       INTEGER (0..255),
    gnss-Utc-DN          INTEGER (-128..127),
    gnss-Utc-DeltaTlsf   INTEGER (-128..127),
    ...
}

-- ASN1STOP
```

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

6.2.3.36 UTC-ModelSet2

```
-- ASN1START

UTC-ModelSet2 ::= SEQUENCE {
    utcA0                INTEGER (-32768..32767),
    utcA1                INTEGER (-4096..4095),
    utcA2                INTEGER (-64..63),
    utcDeltaTls          INTEGER (-128..127),
    utcTot               INTEGER (0..65535),
    utcWNot              INTEGER (0..8191),
    utcWNlsf             INTEGER (0..255),[7]
    utcDN                BIT STRING (SIZE(4)),
    utcDeltaTlsf         INTEGER (-128..127),
    ...
}

-- ASN1STOP
```

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

6.2.3.37 UTC-ModelSet3

```
-- ASN1START

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

-- ASN1STOP
```

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

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

6.2.3.38 UTC-ModelSet4

```
-- ASN1START

UTC-ModelSet4 ::= SEQUENCE {
    utcA1wnt            INTEGER (-8388608..8388607),
    utcA0wnt            INTEGER (-2147483648..2147483647),[9]
    utcTot              INTEGER (0..255),
    utcWNt              INTEGER (0..255),
    utcDeltaTls         INTEGER (-128..127),
    utcWNlsf            INTEGER (0..255),
    utcDN               INTEGER (-128..127),
    utcDeltaTlsf        INTEGER (-128..127),
    utcStandardID       INTEGER (0..7),
    ...
}

-- ASN1STOP
```

***UTC-ModelSet4* field descriptions**
utcA1wnt Parameter A_{1WNT}, sec/sec ([10], Message Type 12). Scale factor 2^{-50} seconds/second.
utcA0wnt Parameter A_{0WNT}, seconds ([10], Message Type 12). Scale factor 2^{-30} seconds.
utcTot Parameter t_{ot}, seconds ([10], Message Type 12). Scale factor 2^{12} seconds.
utcWNt Parameter WN_t, weeks ([10], Message Type 12). Scale factor 1 week.
utcDeltaTls Parameter Δt_{LS}, seconds ([10], Message Type 12). Scale factor 1 second.
utcWNlsf Parameter WN_{LSF}, weeks ([10], Message Type 12). Scale factor 1 week.
utcDN Parameter DN, days ([10], Message Type 12). Scale factor 1 day.
utcDeltaTlsf Parameter Δt_{LSF}, seconds ([10], Message Type 12). Scale factor 1 second.
utcStandardID If *GNSS-ID* indicates 'sbas', this field indicates the UTC standard used for the SBAS network time indicated by *SBAS-ID* to UTC relation as defined in the table 6.2.3.38.1 Value of UTC Standard ID to UTC Standard relation ([10], Message Type 12).

Table 6.2.3.38.1: Value of UTC Standard ID to UTC Standard relation

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

6.2.3.39 GNSS-AuxiliaryInformation

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

```
-- ASN1START

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

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

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

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

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

-- ASN1STOP
```

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

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

6.2.4 GNSS Assistance Data Request

6.2.4.1 A-GNSS-RequestAssistanceData

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

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.4.2 GNSS-CommonAssistDataReq

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

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.4.3 GNSS-GenericAssistDataReq

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

```
-- ASN1START

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

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

-- ASN1STOP
```

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

6.2.5 GNSS Assistance Data Request Elements

6.2.5.1 GNSS-ReferenceTimeReq

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

```
-- ASN1START

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

-- ASN1STOP
```

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

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

6.2.5.2 GNSS-ReferenceLocationReq

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

```
-- ASN1START

GNSS-ReferenceLocationReq ::=   SEQUENCE {

    ...
}

-- ASN1STOP
```

6.2.5.3 GNSS-IonosphericModelReq

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

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.5.4 GNSS-EarthOrientationParametersReq

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.5.5 GNSS-TimeModelListReq

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

```
-- ASN1START

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

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

-- ASN1STOP
```

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

6.2.5.6 GNSS-DifferentialCorrectionsReq

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

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.5.7 GNSS-NavigationModelReq

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

```
-- ASN1START

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


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

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

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

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


-- ASN1STOP
```

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

***GNSS-NavigationModelReq* field descriptions**
storedNavList This list provides information to the location server about which *GNSS-NavigationModel* data the target device has currently stored for the particular GNSS indicated by *GNSS-ID*.
reqNavList This list provides information to the location server which *GNSS-NavigationModel* data are requested by the target device.
gnss-WeekOrDay If *GNSS-ID* does not indicate 'glonass', this field defines the GNSS Week number of the assistance currently held by the target device. If *GNSS-ID* is set to 'glonass', this field defines the calendar number of day within the four-year interval starting from 1st of January in a leap year, as defined by the parameter N_T in [9] of the assistance currently held by the target device.
gnss-Toe If *GNSS-ID* does not indicate 'glonass', this field defines the GNSS time of ephemeris in hours of the latest ephemeris set contained by the target device. If *GNSS-ID* is set to 'glonass', this field defines the time of ephemeris in units of 15 minutes of the latest ephemeris set contained by the target device (range 0 to 95 representing time values between 0 and 1 425 minutes). In this case, values 96 to 255 shall not be used by the sender.
t-toeLimit If *GNSS-ID* does not indicate 'glonass', this IE defines the ephemeris age tolerance of the target device in units of hours. If *GNSS-ID* is set to 'glonass', this IE defines the ephemeris age tolerance of the target device in units of 30 minutes.

***GNSS-NavigationModelReq* field descriptions**
satListRelatedDataList This list defines the clock and orbit models currently held by the target device for each SV. This field is not included if the target device does not have any stored clock and orbit models for any SV.
svID This field identifies the particular GNSS satellite.
iod This field identifies the issue of data currently held by the target device.
clockModelID, orbitModelID These fields define the clock and orbit model number currently held by the target device. If these fields are absent, the default interpretation of the table 6.2.5.7.1 GNSS-ID to clockModelID & orbitModelID relation applies.
svReqList This field defines the SV for which the navigation model assistance is requested. Each bit position in this BIT STRING represents a *SV-ID*. Bit 1 represents *SV-ID* = 1 and bit 64 represents *SV-ID* = 64. A one-value at a bit position means the navigation model data for the corresponding *SV-ID* is requested, a zero-value means not requested.
clockModelIDPrefList, orbitModelID-PrefList These fields define the Model-IDs of the clock and orbit models that the target device wishes to obtain in the order of preference. The first Model-ID in the list is the most preferred model, the second Model-ID the second most preferred, etc. If these fields are absent, the default interpretation of the table 6.2.5.7.2 GNSS-ID to clockModelID-PrefList & orbitModelIDPrefList relation applies.
addNavparamReq This field specifies whether the location server is requested to include the *addNAVparam* fields in *GNSS-NavigationModel* IE (*NavModel-NAVKeplerianSet* field) or not. TRUE means requested.

Table 6.2.5.7.1: GNSS-ID to clockModelID & orbitModelID relation

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

Table 6.2.5.7.2: GNSS-ID to clockModelID-PrefList & orbitModelID-PrefList relation

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

6.2.5.8 GNSS-RealTimeIntegrityReq

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.5.9 GNSS-DataBitAssistanceReq

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

```
-- ASN1START

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

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

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

-- ASN1STOP
```

***GNSS-DataBitAssistanceReq* field descriptions**
gnss-TOD-Req This field specifies the reference time for the first data bit requested in GNSS specific system time, modulo 1 hour. Scale factor 1 second.
gnss-TOD-FracReq This field specifies the fractional part of *gnss-TOD-Req* in 1 millisecond resolution. Scale factor 1 millisecond.
dataBitInterval This field specifies the time length for which the Data Bit Assistance is requested. The *GNSS-DataBitAssistance* shall be relative to the time interval (*gnss-TOD-Req*, *gnss-TOD-Req* + *dataBitInterval*). The *dataBitInterval r*, expressed in seconds, is mapped to a binary number K with the following formula: $r = 0{,}1 \times 2^{K}$ Value K=15 means that the time interval is not specified.
gnss-SignalType This field specifies the GNSS Signal(s) for which the *GNSS-DataBitAssistance* are requested. A one-value at a bit position means *GNSS-DataBitAssistance* for the specific signal is requested; a zero-value means not requested.
gnss-DataBitsReq This list contains the SV-IDs for which the *GNSS-DataBitAssistance* is requested.

6.2.5.10 GNSS-AcquisitionAssistanceReq

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

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.5.11 GNSS-AlmanacReq

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

```
-- ASN1START

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

-- ASN1STOP
```

***GNSS-AlmanacReq* field descriptions**
modelID This field specifies the Almanac Model ID requested. If this field is absent, the default interpretation as GNSS-ID to modelID relation in table 6.2.5.11.1 applies.

Table 6.2.5.11.1: GNSS-ID to modelID relation

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

6.2.5.12 GNSS-UTC-ModelReq

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

```
-- ASN1START

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

-- ASN1STOP
```

***GNSS-UTC-ModelReq* field descriptions**
modelID This field specifies the *GNSS-UTCModel* set requested. If this field is absent, the default interpretation as GNSS-ID to modelID relation in the table 6.2.5.12.1 applies.

Table 6.2.5.12.1: GNSS-ID to modelID relation

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

6.2.5.13 GNSS-AuxiliaryInformationReq

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.6 GNSS Error Elements

6.2.6.1 A-GNSS-Error

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.6.2 GNSS-LocationServerErrorCauses

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.6.3 GNSS-TargetDeviceErrorCauses

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

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.7 Common GNSS Information Elements

6.2.7.1 GNSS-ID

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.7.2 GNSS-ID-Bitmap

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

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.7.3 GNSS-SignalID

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

```
-- ASN1START

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

-- ASN1STOP
```

***GNSS-SignalID* field descriptions**
gnss-SignalID This field specifies a particular GNSS signal. The interpretation of *gnss-SignalID* depends on the *GNSS-ID* and is as shown in the table 6.2.7.3.1 System to Value & Explanation relation.

Table 6.2.7.3.1: System to Value & Explanation relation

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

6.2.7.4 GNSS-SignalIDs

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

```
-- ASN1START

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

-- ASN1STOP
```

***GNSS-SignalIDs* field descriptions**
gnss-SignalIDs This field specifies one or several GNSS signals using a bit map. A one-value at the bit position means the particular signal is addressed; a zero-value at the particular bit position means the signal is not addressed. The interpretation of the bit map in *gnssSignalIDs* depends on the *GNSS-ID* and is shown in the table 6.2.7.4.1. Unfilled table entries indicate no assignment and shall be set to zero.

Table 6.2.7.4.1: Interpretation of the bit map in *gnssSignalIDs*

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

6.2.7.5 SBAS-ID

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

```
-- ASN1START

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

-- ASN1STOP
```

6.2.7.6 SBAS-IDs

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

```
-- ASN1START

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

-- ASN1STOP
```

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

6.2.7.7 SV-ID

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

```
-- ASN1START

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

-- ASN1STOP
```

***SV-ID* field descriptions**
satellite-id This field specifies a particular satellite within a specific GNSS. The interpretation of *satellite-id* depends on the *GNSS-ID* see table 6.2.7.7.1.

Table 6.2.7.7.1: Interpretation of *satellite-id*

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

NOTE: GPS time does not apply leap seconds and there is a changing time difference between GPS time and UTC. TETRA time broadcast indicates time from the 00:00 hours January the 1st of every year and so it absorbs UTC time leap second at the beginning of the year. The leap seconds at the first of July will not be absorbed.

6.2.7.8 EPDU-Sequence

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

```
-- ASN1START

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

maxEPDU INTEGER ::= 16

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

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

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

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

EPDU-Body ::= OCTET STRING

-- ASN1STOP
```

***EPDU-Sequence* field descriptions**
EPDU-ID This field provides a unique integer ID for the externally defined positioning method. Its value is assigned to the external entity that defines the EPDU. See table 6.2.7.8.1 External PDU Identifier Definition for a list of external PDU identifiers defined in this version of the present document.
EPDU-Name This field provides an optional character encoding which can be used to provide a quasi-unique name for an external PDU – e.g. by containing the name of the defining organization and/or the name of the associated public or proprietary standard for the EPDU.
EPDU-Body The content and encoding of this field are defined externally to LPP.

Table 6.2.7.8.1: External PDU Identifier Definition

EPDU-ID	EPDU Defining entity	Method name	Reference
1	OMA LOC	OMA LPP extensions (LPPe)	[i.2]

6.2.8 TETRA Network related IEs

6.2.8.0 Guiding principle

In the clause 6.2.8 and its all subclauses, the Information Elements (not in LPP [i.1]) are specific to TETRA, as compared to 3GPP networks, and reproduces in the ASN.1 model the information defined in NAP ETSI TS 100 392-18-2 [i.4], which are:

- optional approximate indication of MS location in the NET ASSIST DEMAND PDU, by the LA and MNI
- group addressing for multicast
- acknowledge of the provided data

- global cell Id
- Net assist type
- result code, reject code and retry mode

6.2.8.1 Tetra Local Area and Mobile Network Identifier

```
-- ASN1START

-- begin of specific TETRA
NAP-LA ::= BIT STRING (SIZE (1..10 )) -- See ETSI EN 300 392 1 [2], clause 7

NAP-MNI ::= SEQUENCE {
    countryCode CountryCode,
    networkCode NetworkCode
}

CountryCode ::= BIT STRING (SIZE (1..10 )) -- See ETSI EN 300 392 1 [2], clause 7
NetworkCode ::= BIT STRING (SIZE (1..14 )) -- See ETSI EN 300 392 1 [2], clause 7

-- ASN1STOP
```

6.2.8.2 Net assist group address

The Net assist group address information element shall indicate a Group Short Subscriber Identity address as defined below. The coding is the same as in ETSI TS 100 392-18-1 [4].

```
-- ASN1START

NetAssistGroupAddress ::= BIT STRING (SIZE (1..24)) -- See ETSI EN 300 392 1 [2], clause 7  ...

-- ASN1STOP
```

6.2.8.3 CellGlobalIdTETRA

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

```
-- ASN1START

NAP-CellGlobalIdTETRA ::= SEQUENCE {
    mn-Identity             NAP-MNI,
    locationAreaCode        NAP-LA,
    cellIdentity            BIT STRING (SIZE (16)),
    ...
}
-- ASN1STOP
```

***CellGlobalIdTETRA* field descriptions**
mn-Identity This field identifies the MN of the cell as defined in [10].
cellIdentity This field defines the identity of the cell within the context of the MN as defined in [10] and [12]. The size of the bit string allows for the 16-bit extended TETRA cell ID; in case the cell ID is shorter, the first bits of the string are set to 0.

6.2.8.4 Result code

The Result code information element shall be encoded as defined below.

```
-- ASN1START

NAP-ResultCode ::= ENUMERATED {
    success (0),
    notSupported (1),
    error (2),
    reserved3 (3),
    reserved4 (4),
    reserved5 (5),
    reserved6 (6),
    reserved7 (7)
}

-- ASN1STOP
```

6.2.8.5 Net assist type

The net assist type information element shall be encoded as defined below

```
-- ASN1START

NAP-AssistType  ::= BIT STRING {
    gNSSEphemerisAndClockData (0),
    gNSSAlmanacData (1),
    gNSSIonosphereAndUTCcorrectionData (2),
    gNSSTimeEstimate (3),
    locationEstimate (4),
    netAssistGroupAddress (5),
    allAssistTypes (6),
    reserved7 (7),
    reserved8 (8),
    reserved9 (9),
    reserved10 (10),
    reserved11 (11),
    reserved12 (12),
    reserved13 (13),
    reserved14 (14),
    reserved15 (15)
} (SIZE (1..16))

-- ASN1STOP
```

6.2.8.6 Retry interval

The Reject retry information element is not in LPP [i.1], and are specific to the NAP protocol. These shall specify the modality of retrying a NET ASSIST DEMAND. It shall be encoded as defined below.

```
-- ASN1START

NAP-RejectRetry ::= ENUMERATED {
    retryAfterPower-up (0),
    retryAfterUnsolicitedNET-ASSIST-PROVIDE-received (1), -- The MS is not allowed to retry until it receives a NET ASSIST PROVIDE addressed to the MS.
    retryAfterTimeout (2), -- The timer, of duration three minutes, starts when the NET ASSIST DEMAND is sent.
    reserved3 (3),
    reserved4 (4),
    reserved5 (5),
    reserved6 (6),
    reserved7 (7),
    reserved8 (8),
    reserved9 (9),
    reserved10 (10),
    reserved11 (11),
    reserved12 (12),
    reserved13 (13),
    reserved14 (14),
    reserved15 (15)
}

-- end of specific TETRA

END

-- ASN1STOP
```

Annex A (informative): Change Requests

The present document implements change requests as defined in table A.1.

NOTE: The standards version indicates the baseline version.

Table A.1: Change requests

No	CR vers.	Standard Version	Clauses affected	Title	CR Status
001	10	V1.1.1	1, 3.1, 4.2, 4.3.1, 5.1.1, 5.2.3, 5.3.1, 5.3.4, 5.4, 5.4.1, 5.4.2, 5.4.4, 5.4.5, 6.2.1, 6.2.3.1	Text clarifications, updates and wording, main proposal on the subscription groups	WG3 approved 8.1.2015

History

Document history		
V1.1.1	June 2012	Publication
V1.2.1	July 2015	Publication