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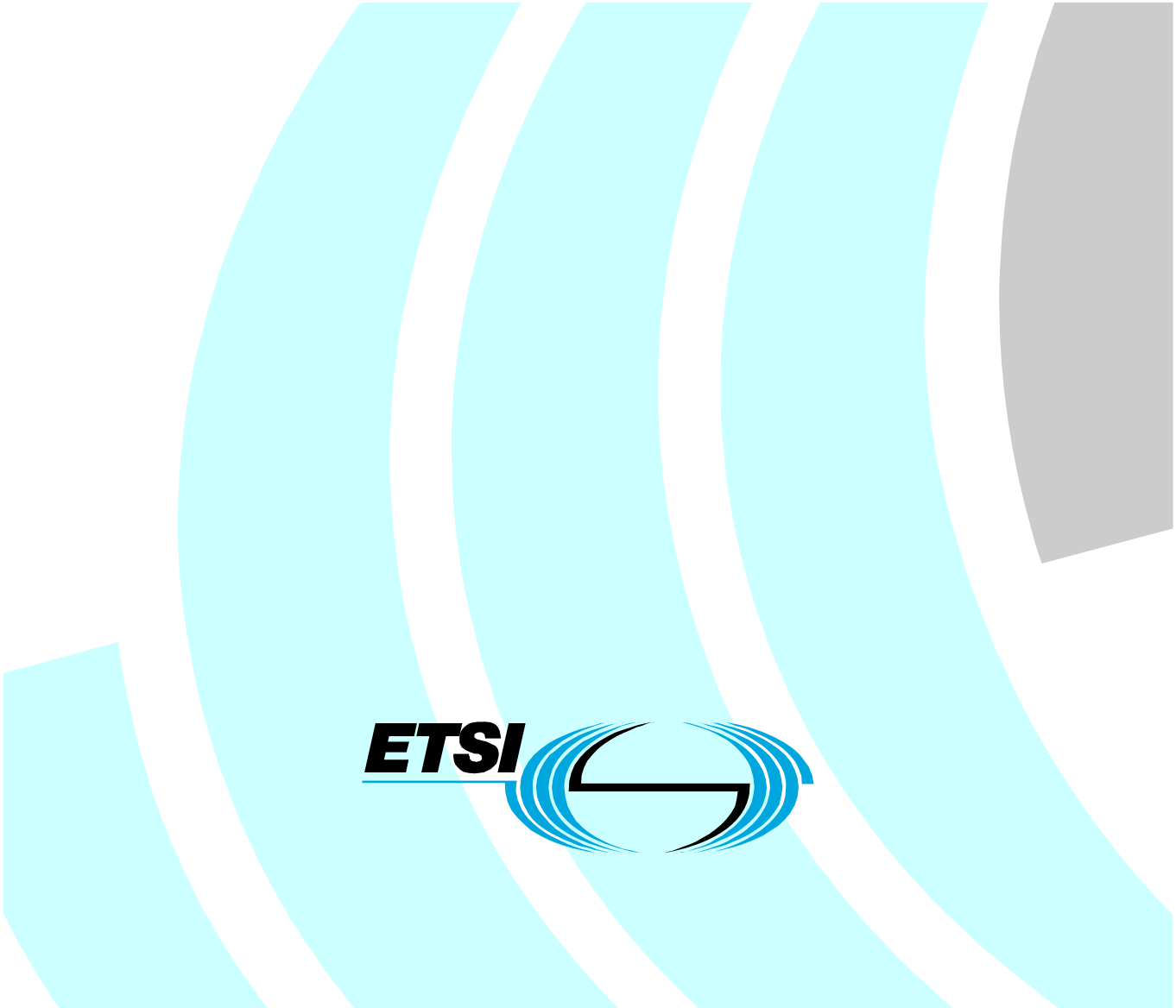
Technical Specification

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



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ETSI

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

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

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Terrestrial Trunked Radio (TETRA).

The present document is part 18, sub-part 2 of a multi-part deliverable covering the Voice plus Data (V+D), as identified below:

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

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

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

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

EN 300 392-5: "Peripheral Equipment Interface (PEI)";

EN 300 392-7: "Security";

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

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

EN 300 392-11: "Supplementary services stage 2";

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

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

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

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

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

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

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

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

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

NOTE: Part 10, sub-part 15 (Transfer of control), part 13 (SDL) and part 14 (PICS) of this multi-part deliverable are of status "historical" and are not maintained.

1 Scope

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

- allowing information to be passed to a location determining entity;
- allowing a location determining entity to request assistance information.

The information passed to the location determining entity, 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.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

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

For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.

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

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ICD-GPS-200: "Navstar GPS Space Segment / Navigation User Interfaces".

[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)".

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area**.** For non-specific references, the latest version of the referenced document (including any amendments) applies.

Not applicable.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 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: the data that is passed from satellites to the location determining entity and supports said location determination, for example by defining satellite positioning

NOTE: For GPS assistance this data is defined by ICD-GPS-200 [1].

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:

BS	Base Station
C	Conditional
DMO	Direct Mode Operation
FE	Functional Entity
GPS	Global Positioning System
LA	Location Area
LIP	Location Information Protocol
M	Mandatory
MNI	Mobile Network Identity
MS	Mobile Station
NAP	Net Assist Protocol
O	Optional
PDU	Protocol Data Unit
SAP	Service Access Point
SDS	Short Data Service
SDS-TL	Short Data Service - Transport Layer
SNDCP SAP	SubNetwork Dependent Convergence Protocol Service Access Point
SV	Space Vehicle
TMO	Trunked Mode Operation
UTC	Universal Coordinated Time
WGS84	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 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 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 GPS 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 NAP 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.
- 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).

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 that it would like assistance 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 4.1 defines a typical scenario for the net assist protocol usage.

In figure 4.1 the MS FE1 requests assistance information from the assistance server FE2.

In figure 4.1 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.

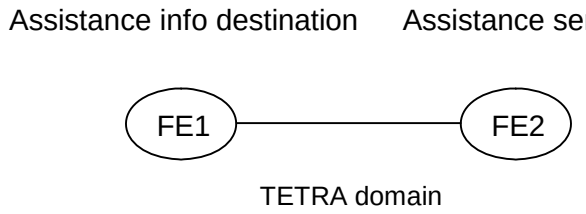

Figure 4.1: Simple system with assistance server in TETRA domain

4.3 Net assist protocol service description

4.3.1 General on services

The majority of the location information protocol (TS 100 392-18-1 [4]) is independent of position determination technology. However, the technology currently used is frequently GPS and in this case a net assistance delivery service is defined. Assistance data, delivered via the TETRA network, can improve the performance of some GPS receivers, particularly when they are in areas of poor GPS 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. Future position determination technology (e.g. Galileo) may benefit from similar assistance under similar scenarios.

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, refer to clause 6.3.

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 GPS network assistance supported are defined by Net assist type, see 6.3.27. Almanac data, Almanac reference week, Ephemeris and clock data, GPS time and Ionosphere and UTC correction data are all defined with respect to ICD-GPS-200 [1].

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. 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 MS receiving network assistance

MS may receive network assistance as presented in figure 5.1. 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.

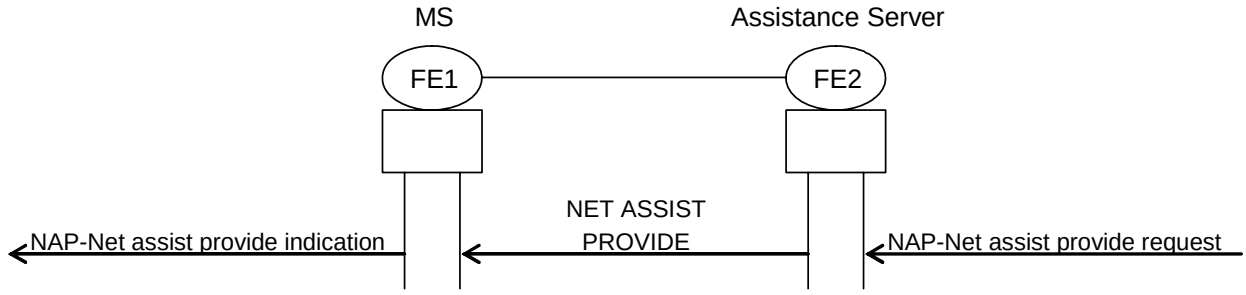

Figure 5.1: MS receiving network assistance data

5.2.3 MS receiving network assistance and sending response

MS may receive network assistance and send acknowledgement to it as presented in figure 5.2. 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.

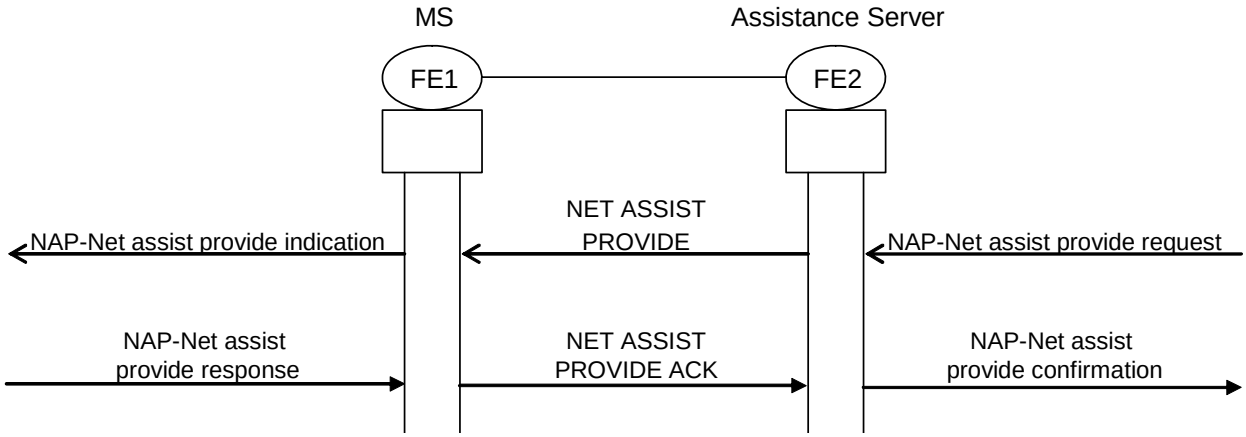

Figure 5.2: MS receiving network assistance data and sending response

5.2.4 MS requesting network assistance

MS may request network assistance as presented in figure 5.3. FE2 will typically respond by distributing the network assistance as in clauses 5.2.2 or 5.2.3.

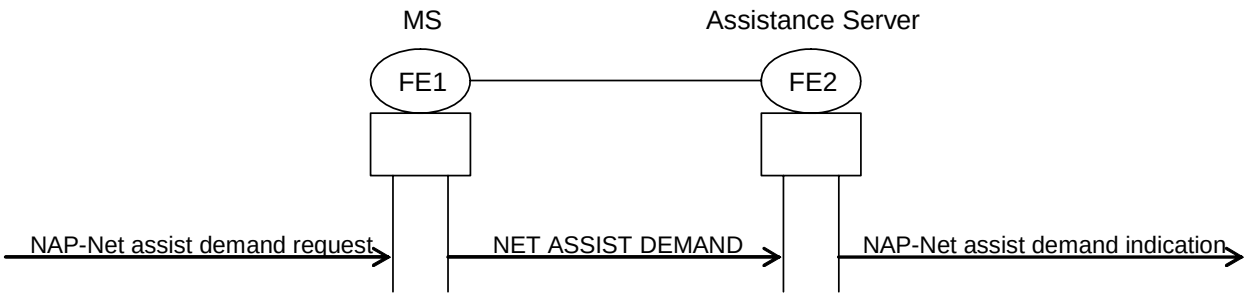

Figure 5.3: MS requesting network assistance data

5.2.5 MS requesting network assistance and receiving a reject

MS may request network assistance requests as presented in figure 5.4. FE2 may respond with a rejection of the request (including reason and retry information).

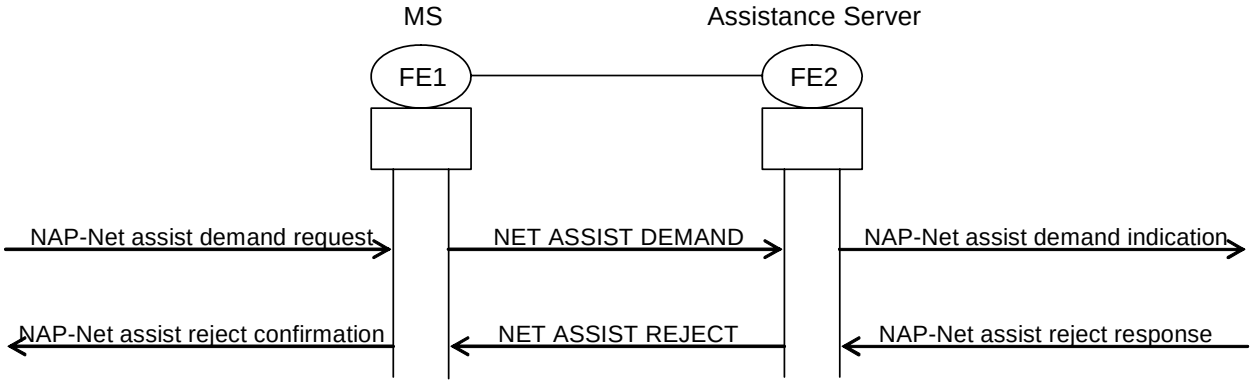

Figure 5.4: MS requesting network assistance data and receiving rejection

5.2.6 Allocation of entities

In the flow charts in figures 5.1 to 5.4, "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 5.1 to 5.4, 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 in any other way in its present circumstances i.e. the MS should only request data it cannot acquire and should use network time when available.

The MS should determine all data required and then make a single request. No new requests shall be initiated until data has been provided or the request has timed out (three minutes).

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.

The assistance service provider should only request an acknowledgement, if the NET ASSIST PROVIDE PDU is individually addressed. 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 Net assist type information element the Net assist type it is acknowledging 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) 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.

5.3.5 GPS Ephemeris assistance

Ephemeris navigation data defines the precise (high accuracy) 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 GPS 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.

5.3.6 GPS Almanac assistance

Almanac navigation data defines the reduced precision orbital parameters of all satellites and is transmitted by every satellite. As described in clause 5.3.5 a GPS receiver may not be able to receive this data. Additionally the data it does have may be out of date.

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 GPS Almanac reference week extended and the GPS 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.

5.3.7 GPS Ionosphere and UTC correction assistance

Ionosphere and UTC correction navigation data defines the current ionosphere compensation parameters and GPS / 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 GPS Ionosphere and UTC correction data information element.

5.3.8 GPS Time assistance

GPS time is available from any GPS satellite. As described in clause 5.3.5 a GPS 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 GPS 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. Due to indeterminate delays in the delivery system, other sources may be more applicable.

5.3.9 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 because it has moved since last acquiring a location fix, because it has not been able to retain a previous location fix or because it is considered too old to be of use. 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 on coding requirements

The net assist protocol sets strict requirements on the PDU encoding so that the maximum amount of information can be fitted into minimum sized messages.

The location information protocol (TS 100 392-18-1 [4]) uses many optional information elements in its PDUs and may require additional new ones in the future. The TETRA air interface protocol optional information elements encoding is optimized for a limited number of optional information elements (type 2) that are known at the design time of the protocol. Additional new information elements can be added later (type 3 or type 4), but the overhead for each new information element is quite large. As a result a new type of optional information elements was designed for the location information protocol (TS 100 392-18-1 [4]) called type 5. Type 5 information elements are similarly used in the definitions in the present document. The use of that type removes use of type 2 and so no O-bit or M-bit is used in the PDU encoding. Refer to TS 100 392-18-1 [4] and clause 6.4.

In clauses 6.2 and 6.3 PDU encoding and information element encoding tables use the following key:

- Length: length of the element in bits.
- Type: element type (type 1 or type 5) as defined above.

- C/O/M: conditional/optional/mandatory information in the PDU.
- Value: value of the information element.
- Remark: comment.

6.2 Net assist protocol PDU description tables

6.2.1 NET ASSIST DEMAND PDU

The NET ASSIST DEMAND PDU is used to request network assistance and it shall be encoded as presented in table 6.1.

Table 6.1: NET ASSIST DEMAND PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	4	1	M	2	Net assist demand
Number of Net assist types	4	1	M		
Net assist type	4	1	C		Repeatable. See note 1
LA	10	5	O		See note 2
MNI	24	5	O		See note 3
NOTE 1: Shall be repeated "Number of Net assist types" times. NOTE 2: Optional approximate indication of MS location. NOTE 3: Optional support of the note 2 information.					

6.2.2 NET ASSIST PROVIDE PDU

The NET ASSIST PROVIDE PDU is used to deliver network assistance data and it shall be encoded as presented in table 6.2.

Table 6.2: NET ASSIST PROVIDE PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	4	1	M	0	Net assist provide.
Acknowledgement request	1	1	M		
Number of Net assist types	4	1	M		
Net assist type	4	1	C		Repeatable, see note 1.
Satellite id	6	1	C		See note 2.
GPS Ephemeris and clock data	576	1	C		See note 3.
GPS Almanac reference week extended	13	1	C		See note 4.
GPS Almanac data	192	1	C		See note 4.
GPS Ionosphere and UTC correction data	192	1	C		See note 5.
GPS time estimate	32	1	C		See note 6.
Location data	Variable	1	C		See note 7.
Net assist group address	24	1	C		See note 8.
NOTE 1: This information element and information elements conditional on it shall be repeated "Number of Net assist types" times. NOTE 2: This information element shall be present if Net assist type is "GPS Ephemeris and clock data" or "GPS Almanac data". (It is not strictly necessary for GPS Almanac data because GPS Almanac data contains SV-ID but helps with matching responses to requests). NOTE 3: This information element shall be present if Net assist type is "GPS Ephemeris and clock data". NOTE 4: This information element shall be present if Net assist type is "GPS Almanac data". NOTE 5: This information element shall be present if Net assist type is "GPS Ionosphere and UTC correction data". NOTE 6: This information element shall be present if Net assist type is "GPS Time estimate". NOTE 7: This information element shall be present if Net assist type is "Location estimate". NOTE 8: This information element shall be present if Net assist type is "Net assist group address".					

6.2.3 NET ASSIST PROVIDE ACK PDU

The NET ASSIST PROVIDE ACK PDU is the response to NET ASSIST PROVIDE PDU, if requested, and it shall be encoded as presented in table 6.3.

Table 6.3: NET ASSIST PROVIDE ACK PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	4	1	M	1	Net assist provide ack.
Number of Net assist types	4	1	M		
Result code	3	1	C		Repeatable. See notes 1 and 2.
Net assist type	4	1	C		Repeatable, see note 2.
Satellite id	6	1	C		See note 3.
NOTE 1: Result code for the Net assist type acknowledged. NOTE 2: These information elements shall be repeated as a set "Number of Net assist types" times. NOTE 3: This information element shall be present with the Net assist type information element, if the Net assist type is "GPS Ephemeris and clock data" or "GPS Almanac data".					

6.2.4 NET ASSIST REJECT PDU

The NET ASSIST REJECT PDU is used to reject a request for network assistance and it shall be encoded as presented in table 6.4.

Table 6.4: NET ASSIST REJECT PDU contents

Information element	Length	Type	C/O/M	Value	Remark
PDU type	4	1	M	3	Net assist reject
Reject retry interval	3	1	M		
Number of net assist types	4	1	M		
Reject code	4	1	C		Repeatable. See notes 1 and 2
Net assist type	4	1	C		Repeatable. See note 2
NOTE 1: Reject code for the Net assist type rejected. NOTE 2: These information elements shall be repeated as a set "Number of Net assist types" times.					

6.3 Net assist protocol PDU information elements

6.3.1 Acknowledgement request

The acknowledgement request information element shall be encoded as defined in table 6.5. The coding is the same as in TS 100 392-18-1 [4].

Table 6.5: Acknowledgement request information element contents

Information element	Length	Value	Remark
Acknowledgement request	1	0	No acknowledgement requested
		1	Acknowledgement requested

6.3.2 Angle

The coding is the same as in TS 100 392-18-1 [4]. The angle information element shall be encoded as defined by formula:

- Angle = K × 360 / 256; where
- K = information element value.

Some values are presented without rounding in table 6.6. Angle shall be measured in degrees (in 0 to 360 scale) clockwise from north.

Table 6.6: Angle information element contents

Information element	Length	Value	Direction in degrees	Remark
Angle	8	0	0	
		1	1,40625	
		2	2,8125	
		etc.	etc.	
		16	22,5	
		etc.	etc.	
		32	45	
		etc.	etc.	
		64	90	
		etc.	etc.	
		127	178,59375	
		128	180	
		etc.	etc.	
		192	270	
		etc.	etc.	
		255	358,59375	

6.3.3 Confidence level

Confidence level information element shall indicate the probability that the actual location is inside the indicated uncertainty area. It shall be coded as presented in table 6.7. The coding is the same as in TS 100 392-18-1 [4].

Table 6.7: Confidence level information element contents

Information element	Length	Value	Remark
Confidence level	3	0	50 %
		1	68 %
		2	80 %
		3	90 %
		4	95 %
		5	99 %
		6	99,9 %
		7	Confidence level not known

6.3.4 GPS Almanac data

The GPS almanac data information element shall be 192 bits containing the GPS almanac data for one satellite. For maximum openness, the GPS almanac data shall be in the same form as in the navigation data transmitted by GPS satellites, as defined by ICD-GPS-200 [1], but without the parity bits.

In the GPS navigation data, the GPS almanac data for a satellite is in words 3 to 10 of one of subframe 5 pages 1 to 24, or subframe 4 pages 2 to 5 or pages 7 to 10. The almanac data information element shall contain these eight words but for each of the 30 bit words, the 6 parity bits shall be removed, leaving 24 bits. With eight such 24 bit words, the total is 192 bits.

6.3.5 GPS Almanac reference week extended

The GPS Almanac reference week extended shall be 13 bits, containing integer weeks since the start of GPS week 0, defined to be midnight on 5th January / morning of 6th January 1980, to which almanac reference time (t_{oa}) is referenced see [1]. GPS Almanac reference time is a parameter in GPS Almanac data. Note that this definition means that the 13 bit value will overflow in year 2137.

6.3.6 GPS Ephemeris and clock data

The GPS ephemeris and clock data information element shall be 576 bits, containing the GPS ephemeris and clock data for one satellite. For maximum openness the GPS ephemeris and clock data shall be in the same form as in the navigation data transmitted by GPS satellites, as defined by ICD-GPS-200 [1], but without the parity bits.

In the GPS navigation data, the GPS ephemeris and clock data for a satellite is in word 3 to word 10 of subframes 1, 2 and 3. The ephemeris and clock data information element shall contain these 3 x 8 words in subframe order, but for each of the 30 bit words, the 6 parity bits shall be removed, leaving 24 bits. With 3 x 8 such 24 bit words, the total is 576 bits.

6.3.7 GPS Ionosphere and UTC correction data

The GPS ionosphere and UTC correction data information element shall be 192 bits containing the GPS ionosphere and UTC correction data. For maximum openness the GPS ionosphere and UTC correction data shall be in the same form as in the navigation data transmitted by GPS satellites, as defined by ICD-GPS-200 [1], but without the parity bits.

In the GPS navigation data, the GPS ionosphere and UTC correction data is in word 3 to word 10 of subframe 4 page 18. The ionosphere and UTC correction data information element shall contain these eight words but for each of the 30 bit words, the 6 parity bits shall be removed, leaving 24 bits. With eight such 24 bit words, the total is 192 bits.

6.3.8 GPS time estimate

The GPS time shall be 32 bits, containing integer seconds since the start of GPS week 0, defined to be midnight on 5th January / morning of 6th January 1980, see [1]. Note that this definition means that the 32 bit value will overflow in year 2116.

When used for GPS time estimate assistance, GPS time estimate shall be the current GPS time as accurately as possible, given the constraints of the delivery mechanism.

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.

6.3.9 Half of major axis

The coding is the same as in TS 100 392-18-1 [4].

Half of major axis value shall indicate half of the total length of the major axis of the ellipse shape. For coding purposes half of the major axis value shall be used in the shapes. Half of major axis shall be encoded as defined for the Horizontal position uncertainty in clause 6.3.11. The value of the major axis shall be larger or equal to the value of the minor axis.

NOTE: The use of the half of the major and minor axis in the ellipse shapes results in the same numerical value for the major and minor axis presentation in the PDU as for the horizontal position accuracy in the circle shape in the case of circular ellipse.

6.3.10 Half of minor axis

The coding is the same as in TS 100 392-18-1 [4].

Half of minor axis value shall indicate half of the total length of the minor axis of the ellipse shape. For coding purposes half of the minor axis value shall be used in the shapes. Half of minor axis shall be encoded as defined for the Horizontal position uncertainty in clause 6.3.11.

6.3.11 Horizontal position uncertainty

The horizontal position uncertainty information elements shall be encoded as defined in table 6.8. The coding is the same as in TS 100 392-18-1 [4]. The horizontal position uncertainty part is defined by equation:

- Horizontal position uncertainty = $A \times (1 + x)^{(K + B)} + C$, where:
- A = 2;
- x = 0,2;
- K = information element value;
- B = 5;
- C = -4.

Table 6.8: Horizontal position uncertainty information element contents

Information element	Length	Type	C/O/M	Value	Remark
Horizontal position uncertainty	6	1	M	0	Less than 1 m
				1	Less than 2 m
				2	Less than 3,2 m
				etc.	etc.
				10	Less than 27 m
				etc.	etc.
				20	Less than 187 m
				etc.	etc.
				30	Less than 1,18 km
				etc.	etc.
				40	Less than 7,31 km
				etc.	etc.
				50	Less than 45,3 km
				etc.	etc.
				60	Less than 280 km
				61	Less than 337 km
				62	Less than 404 km
				63	Best effort

6.3.12 LA

The LA information element shall be encoded as presented in table 6.9.

Table 6.9: LA information element contents

Information sub-element	Length	C/O/M	Remark
LA	10	M	See EN 300 392-1 [2], clause 7

6.3.13 Latitude

The coding is the same as in TS 100 392-18-1 [4].

Latitude information element shall indicate latitude of the location point in units of $180/2^{24}$ degrees in range -90 degrees to $+(90 - 180 / 2^{24})$ degrees using two's complement presentation. Negative values shall be south of equator and positive values shall be north of equator.

6.3.14 Location altitude

The location altitude information element shall be encoded as presented in table 6.10. The coding is the same as in TS 100 392-18-1 [4].

NOTE 1: The reference level of the location altitude is defined by the Location altitude type information element.

NOTE 2: The 75 m resolution is selected to match with civil aviation flight levels.

Table 6.10: Location altitude information element contents

Information element	Length	Value	Remark	Remark
Location altitude type	1	0	Altitude above WGS84 ellipsoid, see note 1	
		1	User defined altitude reference, see note 2	
Altitude	11	0	Reserved	
		1	-200 m	
		2	-199 m	Step 1 m
		etc.	etc.	
		1 201	1 000 m	
		1 202	1 002 m	Step 2 m
		etc.	etc.	
		1 926	2 450 m	
		1 927	2 525 m	Step 75 m
		etc.	etc.	
		2 045	11 375 m	
		2 046	11 450 m	
		2 047	11 525 m or more	
NOTE 1: Altitude is the height above WGS84 reference system. In order to get actual altitude above sea level application need to make adjustment based on the longitude and latitude. NOTE 2: User defined altitude may be an altitude determined on a map, flight height or any other means. It is assumed that the involved applications know the meaning of the user defined altitude reference.				

6.3.15 Location altitude uncertainty

The location altitude uncertainty information element shall be encoded as presented in table 6.11. The coding is the same as in TS 100 392-18-1 [4].

Table 6.11: Location altitude uncertainty information element contents

Information element	Length	Value	Height	Remark
Location altitude uncertainty	3	0	Less than 1 m	
		1	Less than 2 m	
		2	Less than 5 m	
		3	Less than 15 m	
		4	Less than 50 m	
		5	Less than 150 m	
		6	Less than 300 m	
		7	Best effort or not supported	

6.3.16 Location circle

The location circle information element shall be encoded as presented in table 6.12. The coding is the same as in TS 100 392-18-1 [4].

Table 6.12: Location circle information element contents

Information element	Length	Type	C/O/M	Remark
Longitude	25	1	M	
Latitude	24	1	M	
Horizontal position uncertainty	6	1	M	
NOTE: The total size of this information element is 55.				

6.3.17 Location circle with altitude

The location circle with altitude information element shall be encoded as presented in table 6.13. The coding is the same as in TS 100 392-18-1 [4].

Table 6.13: Location circle with altitude information element contents

Information element	Length	Type	C/O/M	Remark
Longitude	25	1	M	
Latitude	24	1	M	
Horizontal position uncertainty	6	1	M	
Location altitude	12	1	M	
NOTE: The total size of this information element is 67.				

6.3.18 Location circle with altitude and uncertainty

The location circle with altitude and uncertainty information element shall be encoded as defined in table 6.14. The coding is the same as in TS 100 392-18-1 [4].

Table 6.14: Location circle with altitude and uncertainty information element contents

Information element	Length	Type	C/O/M	Remark
Longitude	25	1	M	
Latitude	24	1	M	
Horizontal position uncertainty	6	1	M	
Location altitude	12	1	M	
Location altitude uncertainty	3	1	M	
NOTE: The total size of this information element is 70.				

6.3.19 Location data

The location data information element shall be encoded as presented in table 6.15. The coding is based on the equivalent definition in TS 100 392-18-1 [4].

Table 6.15: Location data information element contents

Information element	Length	Type	C/O/M	Remark
Location shape	4	1	M	
Location circle	55		C	See note
Location ellipse	72		C	See note
Location circle with altitude	67		C	See note
Location ellipse with altitude	84		C	See note
Location circle with altitude and uncertainty	70		C	See note
Location ellipse with altitude and uncertainty	87		C	See note
NOTE: Presence of this information element is conditional on the location shape information element.				

6.3.20 Location ellipse

The location ellipse information element shall be encoded as presented in table 6.16. The coding is the same as in TS 100 392-18-1 [4].

Table 6.16: Location ellipse information element contents

Information element	Length	Type	C/O/M	Remark
Longitude	25	1	M	
Latitude	24	1	M	
Half of the major axis	6	1	M	
Half of the minor axis	6	1	M	
Angle, see note 1	8	1	M	
Confidence level	3	1	M	
NOTE 1: Angle should be in range 0 to 180 degrees (in 360 degrees scale). NOTE 2: The total size of this information element is 72.				

6.3.21 Location ellipse with altitude

The location ellipse with altitude element shall be encoded as presented in table 6.17. The coding is the same as in TS 100 392-18-1 [4].

Table 6.17: Location ellipse with altitude and uncertainty information element contents

Information element	Length	Type	C/O/M	Remark
Longitude	25	1	M	
Latitude	24	1	M	
Half of the major axis	6	1	M	
Half of the minor axis	6	1	M	
Angle, see note 1	8	1	M	
Location altitude	12	1	M	
Confidence level	3	1	M	
NOTE 1: Angle should be in range 0 to 180 degrees (in 360 degrees scale). NOTE 2: The total size of this information element is 84.				

6.3.22 Location ellipse with altitude and uncertainty

The location ellipse with altitude and uncertainty information element shall be encoded as presented in table 6.18. The coding is the same as in TS 100 392-18-1 [4].

NOTE: The confidence level is the confidence level of the horizontal position uncertainty.

Table 6.18: Location ellipse with altitude and uncertainty information element contents

Information element	Length	Type	C/O/M	Remark
Longitude	25	1	M	
Latitude	24	1	M	
Half of the major axis	6	1	M	
Half of the minor axis	6	1	M	
Angle, see note 1	8	1	M	
Location altitude	12	1	M	
Location altitude uncertainty	3	1	M	
Confidence level	3	1	M	
NOTE 1: Angle should be in range 0 to 180 degrees (in 360 degrees scale). NOTE 2: The total size of this information element is 87.				

6.3.23 Location shape

Location shape information element shall be encoded as presented in table 6.19. The coding is based on the equivalent definition in TS 100 392-18-1 [4].

Table 6.19: Location shape information element contents

Information element	Length	Value	Remark
Location shape	4	0	Reserved
		1	Reserved
		2	Location circle
		3	Location ellipse
		4	Reserved
		5	Location circle with altitude
		6	Location ellipse with altitude
		7	Location circle with altitude and altitude uncertainty
		8	Location ellipse with altitude and altitude uncertainty
		9	Reserved
		10	Reserved
		11	Reserved
		12	Reserved
		13	Reserved
		14	Reserved
		15	Location shape extension, see note
NOTE: For this value the Location shape information element shall be followed by the Location shape extension information element of 4 bits. The Location shape extension is outside the scope of the present document.			

6.3.24 Longitude

The coding is the same as in TS 100 392-18-1 [4].

Longitude information element shall indicate longitude of the location point in steps of $360/2^{25}$ degrees in range -180 degrees to $+(180 - 360/2^{25})$ degrees using two's complement presentation. Negative values shall be west of zero meridian and positive values shall be east of zero meridian.

6.3.25 MNI

The MNI information element shall be encoded as presented in table 6.20.

Table 6.20: MNI information element contents

Information sub-element	Length	C/O/M	Remark
Country Code	10	M	See EN 300 392-1 [2], clause 7
Network Code	14	M	See EN 300 392-1 [2], clause 7

6.3.26 Net assist group address

The Net assist group address information element shall indicate a Group Short Subscriber Identity address as defined in table 6.21. The coding is the same as in TS 100 392-18-1 [4].

Table 6.21: Net assist group address information element contents

Information element	Length	Value	Remark
Net assist group address	24		See EN 300 392-1 [2], clause 7

6.3.27 Net assist type

The net assist type information element shall be encoded as defined in table 6.22.

Table 6.22: Net assist type information element contents

Information element	Length	Value	Remark
Net assist type	4	0000_2	GPS Ephemeris and clock data
		0001_2	GPS Almanac data
		0010_2	GPS Ionosphere and UTC correction data
		0011_2	GPS Time estimate
		0100_2	Location estimate
		0101_2	Net assist group address
		0110_2	All assist types
		0111_2	Reserved
		1000_2	Reserved
		1001_2	Reserved
		1010_2	Reserved
		1011_2	Reserved
		1100_2	Reserved
		1101_2	Reserved
		1110_2	Reserved
		1111_2	Reserved

6.3.28 Number of net assist types

The Number of net assist types information element shall be encoded as defined in table 6.23.

Table 6.23: Number of Net assist types information element contents

Information element	Length	Value	Remark
Number of net assist types	4	0000_2	Reserved
		0001_2	1 type of Net assist
		0010_2	2 types of Net assist
		0011_2	3 types of Net assist
		0100_2	4 types of Net assist
		0101_2	5 types of Net assist
		0110_2	6 types of Net assist
		0111_2	Reserved
		1000_2	Reserved
		1001_2	Reserved
		1010_2	Reserved
		1011_2	Reserved
		1100_2	Reserved
		1101_2	Reserved
		1110_2	Reserved
		1111_2	Reserved

6.3.29 PDU type

The PDU type information element shall be encoded as defined in table 6.24.

Table 6.24: PDU type information element contents

Information element	Length	Value	Remark
PDU type	4	0000_2	Net assist provide
		0001_2	Net assist provide ack
		0010_2	Net assist demand
		0011_2	Net assist reject
		0100_2	Reserved
		0101_2	Reserved
		0110_2	Reserved
		0111_2	Reserved
		1000_2	Reserved
		1001_2	Reserved
		1010_2	Reserved
		1011_2	Reserved
		1100_2	Reserved
		1101_2	Reserved
		1110_2	Reserved
		1111_2	Reserved

6.3.30 Reject code

The Reject code information element shall be encoded as defined in table 6.25.

Table 6.25: Reject code information element contents

Information element	Length	Value	Remark
Reject code	4	0000_2	Assist data not available
		0001_2	Unauthorized
		0010_2	Not supported
		0011_2	Other reason
		0100_2	Net assist type not supported
		0101_2	Reserved
		0110_2	Reserved
		0111_2	Reserved
		1000_2	Reserved
		1001_2	Reserved
		1010_2	Reserved
		1011_2	Reserved
		1100_2	Reserved
		1101_2	Reserved
		1110_2	Reserved
		1111_2	Reserved

6.3.31 Reject retry interval

The Reject retry information element shall be encoded as defined in table 6.26.

Table 6.26: Result code information element contents

Information element	Length	Value	Remark
Reject retry	3	000_2	Retry after power-up
		001_2	Retry after unsolicited NET ASSIST PROVIDE received, see note 1
		010_2	Retry after timeout, see note 2
		011_2	Reserved
		100_2	Reserved
		101_2	Reserved
		110_2	Reserved
		111_2	Reserved
NOTE 1 The MS is not allowed to retry until it receives a NET ASSIST PROVIDE addressed to the MS. NOTE 2 The timer, of duration three minutes, starts when the NET ASSIST DEMAND is sent.			

6.3.32 Result code

The Result code information element shall be encoded as defined in table 6.27.

Table 6.27: Result code information element contents

Information element	Length	Value	Remark
Result code	3	000_2	Success
		001_2	Not supported
		010_2	Error
		011_2	Reserved
		100_2	Reserved
		101_2	Reserved
		110_2	Reserved
		111_2	Reserved

6.3.33 Satellite id

The satellite id information element shall be 6 bits containing the space vehicle identity.

For GPS related net assist types it will be the space vehicle identity (as defined in ICD-GPS-200 [1]).

6.3.34 Type 5 element identifier

Type 5 element identifier shall define information contents of the information element, in NAP PDUs, as presented in table 6.28.

Table 6.28: Type 5 element identifier information element contents

Information element	Length	Value	Remark
Type 5 element identifier	5	0	Reserved
		1	LA
		2	MNI
		3	Reserved
		4	Reserved
		5	Reserved
		6	Reserved
		7	Reserved
		8	Reserved
		9	Reserved
		10	Reserved
		11	Reserved
		12	Reserved
		13	Reserved
		14	Reserved
		15	Reserved
		16	Reserved
		17	Reserved
		18	Reserved
		19	Reserved
		20	Reserved
		21	Reserved
		22	Reserved
		23	Reserved
		24	Reserved
		25	Reserved
		26	Reserved
		27	Reserved
		28	Reserved
		29	Reserved
		30	Reserved
		31	Extended type 5 information element, see note
NOTE: Extension encoding is outside the scope of the present document. The extended type 5 information element shall be ignored, if the extension is not supported.			

6.4 Type 5 information element description

This clause is the same as the equivalent clause in TS 100 392-18-1 [4].

6.4.1 Type 5 information element definition

Type 5 information element coding modifies PDU encoding principles so that the type 5 information element replaces both type 2 and type 3/4 information elements. In a PDU using type 5 information elements there cannot be any type 2 or type 3/4 information elements and so no O-bit nor M-bit is needed. PDU end is indicated by length information element.

Type 5 information element length can be from 1 bit to 63 bits in one bit steps and from 64 bits to 1 080 bits in 8 bits (octet) steps.

6.4.2 Type 5 element length

The type 5 element length information element shall be encoded as presented in table 6.29.

Table 6.29: Type 5 element length information element contents

Information element	Length	Value	Remark
Type 5 element length	6	000000_2	Type 5 length extension
		000001_2	Element data length is one bit
		000010_2	Element data length is two bits
		etc.	etc.
		111111_2	Element data length is 63 bits

6.4.3 Type 5 element length extension

The type 5 element length extension information element shall be encoded as presented in table 6.30.

Table 6.30: Type 5 element length extension information element contents

Information element	Length	Value	Remark
Type 5 element length extension	7	0000000_2	Reserved
		00000001_2	Element data length is eight octets
		0000010_2	Element data length is nine octets
		etc.	etc.
		1111111_2	Element data length is 135 octets

6.4.4 Type 5 information element

The type 5 information elements shall be encoded as presented in table 6.31.

Table 6.31: Type 5 information element

Information element	Length	Type	C/O/M	Remark
Type 5 element identifier	5	1	M	Shall be unique per SDS-TL Protocol ID
Type 5 element length	6	1	M	
Type 5 element length extension	7		C	Shall be present, if and only if type 5 element length has value "000000"
Extended type 5 information element	See note 1		C	Shall be present, if and only if type 5 element identifier value is "11111"
Element data	variable	1	M	See note 2

NOTE 1: The length of the Extended type 5 information element will be defined in a later version of the present document.

NOTE 2: In the case the type 5 element length extension is used and the length of the actual element data is not octet bounded the element data shall contain fill bits at the end, the fill bits shall have value "1". Fill bit value one allows Binary Coded Decimal presentation of numbers, refer to clause 6.3.11 of TS 100 392-18-1 [4].

History

Document history		
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