



TECHNICAL SPECIFICATION

**Satellite Earth Stations and Systems (SES);
GNSS based location systems;
Part 4: Requirements for location data exchange protocols**

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The present document is part 4 of a multi-part deliverable covering GNSS-based Location Systems (GBLS), as identified in part 1 [1].

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).

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Introduction

The increasing expansion of location-based applications aims to satisfy more and more complex and diversified user requirements: this is highlighted for example by the widespread adoption of multi-functional smart-phones or by the ever wider adoption of tracking devices (e.g. in transport), etc. This requirement for new and innovative location-based applications is generating a requirement for increasingly complex location systems.

The wide spectrum of location-based applications identified in ETSI TR 103 183 [i.1] calls for a new and broader concept for location systems, taking into account solutions in which GNSS technologies are complemented with other technologies to improve robustness and performance. The notion of *GNSS-based location systems* is introduced and defined in the present document.

Additional clauses and information related to the implementation in *GNSS-based location systems* of the various differential GNSS technologies, namely D-GNSS, RTK and PPP are also included in order to facilitate the use of this set of standards by manufacturers and service providers.

1 Scope

This multi-part deliverable addresses integrated GNSS based location systems (GBLS) that combine Global Navigation Satellite Systems (GNSS), with other navigation technologies, as well as with telecommunication networks in order to deliver location-based services to users. As a consequence the present document is not applicable to GNSS only receivers.

This multi-part deliverable proposes a list of functional and performance requirements and related test procedures. For each performance requirement, different classes are defined allowing the benchmark of different GBLS addressing the same applications.

The present document defines the requirements for data elements that may need to be exchanged within the GBLS and externally to applications using the GBLS.

The present document also specifies data exchange models for these data elements which may form the basis of protocols (or for modification of protocols) and which may be used for the exchange of location-related data within complex GBLS, as well as between the GBLS and external applications.

The present document defines the procedures and messages associated with these data exchange models.

The GBLS data exchange models are defined to be independent of their underlying transport mechanisms. Nevertheless, on certain GBLS interfaces, transport protocols are recommended.

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 referenced document (including any amendments) applies.

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

- [1] ETSI TS 103 246-1: "Satellite Earth Stations and Systems (SES); GNSS based location systems; Part 1: Functional requirements".
- [2] ETSI TS 103 246-2: "Satellite Earth Stations and Systems (SES); GNSS based location systems; Part 2: Reference Architecture".
- [3] ETSI TS 103 246-3: "Satellite Earth Stations and Systems (SES); GNSS based location systems; Part 3: Performance requirements".
- [4] OMA-TS-MLP-V3.1: "Mobile Location Protocol".
- [5] OMA-TS-LPPE-V2.0: "LPP Extensions Specification".
- [6] ETSI TS 136 355: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP) (3GPP TS 36.355)".
- [7] RTCM 10402.3: "Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service".
- [8] RTCM 10403.2: "Differential GNSS (Global Navigation Satellite Systems) Services".

2.2 Informative references

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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 TR 103 183: "Satellite Earth Stations and Systems (SES); Global Navigation Satellite Systems (GNSS) based applications and standardisation needs".
- [i.2] OMA-TS-ULP-V3: "User Plane Location Protocol".
- [i.3] OMA-AD-LOCSIP-V1: "Location in SIP/IP core Architecture".
- [i.4] ETSI ES 201 915: "Open Service Access (OSA); Application Programming Interface (API)".
- [i.5] 3GPP2 C.S0022-B: "Position Determination Service for cdma2000 Spread Spectrum Systems".
- [i.6] ETSI TS 125 331: "Universal Mobile Telecommunications System (UMTS); Radio Resource Control (RRC); Protocol specification (3GPP TS 25.331)".
- [i.7] ETSI TS 144 031: "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)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ETSI TS 103 246-1 [1] apply.

3.2 Abbreviations

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

| | |
|--------|--|
| 3GPP | 3 rd Generation Partnership Project |
| API | Application Programming Interface |
| ASN | Abstract Syntax Notation |
| BFN | Beam Forming Network |
| CL | Confidence Level |
| CNR | Carrier-to-Noise Ratio |
| DGNSS | Differential GNSS |
| D-GNSS | Differential GNSS |
| DoA | Direction of Arrival |
| DTD | Document Type Definition |
| ECID | Enhanced Cell ID |
| EMI | ElectroMagnetic Interference |
| EOTD | Enhanced Observed Time Difference |
| EPDD | External Protocol for Differential Data |
| EPDU | Extension Protocol Data Unit |
| E-SMLC | Enhanced Mobile Location Centre |
| FFS | For Further Study |
| FKP | Flächen Korrektur Parameter (German) |
| GBLS | GNSS Based Location System |
| GGTO | GPS-Galileo Time Offset |

| | |
|--------|--|
| GNSS | Global Navigation Satellite Systems |
| GPS | Global Positioning System |
| GSM | Global System for Mobile Communications |
| HTTP | HyperText Transfer Protocol |
| HTTPS | HTTP Secure |
| IE | Information Element |
| IMSI | International Mobile Station Identifier |
| INS | Inertial Navigation Sensor |
| LCS | Location Services |
| LOCSIP | LOCation in SIP |
| LPP | LTE Positioning Protocol |
| LPPe | LTE Positioning Protocol Extensions |
| LSEP | Location System External Protocol |
| LSIP | Location System Internal Protocol |
| LTE | Long-Term Evolution |
| MAC | Master Auxiliary Corrections |
| MLP | Mobile Location Protocol |
| MLS | Mobile Location System |
| MS | Mobile Station |
| MSID | Mobile Station Identifier |
| NRTK | Network RTK |
| OMA | Open Mobile Alliance |
| OTDOA | Observed Time Difference of Arrival |
| PPP | Precise Point Positioning |
| PVT | Position Velocity Time |
| QoS | Quality of Service |
| RF | Radio Frequency |
| RRC | Radio Resource Control |
| RRLP | Radio Resource Location services (LCS) Protocol |
| RT | Real-Time |
| RTCM | Radio Technical Commission for Maritime Services |
| RTK | Real Time Kinematic |
| SET | SUPL Enabled Terminal |
| SIP | Session Initiation Protocol |
| SLP | Server Location Provider |
| SMLC | Serving Mobile Location Centre |
| SOAP | Simple Object Access Protocol |
| SRN | Short Range Node |
| SSL | Secure Socket Layer |
| TCP/IP | Transmission Control Protocol over Internet Protocol |
| TLS | Transport Layer Security |
| UE | User Equipment |
| ULP | User-plane Location Protocol |
| UMTS | Universal Mobile Telecommunications System |
| UTC | Coordinated Universal Time |
| UTRA | UMTS Terrestrial Radio Access |
| WLAN | Wireless Local Area Network |
| XML | Extensible Markup Language |

4 Data Exchange Requirements

4.1 Context

The GBLS data that shall or may be exchanged is defined in ETSI TS 103 246-2 [2] in general terms for two main mandatory cases and one optional case:

- 1) externally to applications using the GBLS (mandatory);

- 2) externally to external DGNSS service provider (optional, required when external DGNSS services are used as defined in ETSI TS 103 246-2 [2]);
- 3) internally between modules of the GBLS (mandatory).

When the DGNSS service provision is an internal service, the GNSS differential data will be included in the data exchanges of the type "internally between modules of the GBLS".

The specific requirements for this data are defined further in clauses 5, 6 and 7.

In addition, data exchange models are defined herein as a basis for protocols that may be used to transfer the GBLS data.

Figure 4.1 shows these defined protocol models and their relevant interfaces applied to the GNSS-based Location System (GBLS) and its functional entities as defined in ETSI TS 103 246-2 [2], within an end-to-end system.

NOTE: Throughout the present document, the word "protocol" is used for brevity, when defining a GBLS "data exchange model". The specifications herein are of data exchange models that may form the basis of protocols.

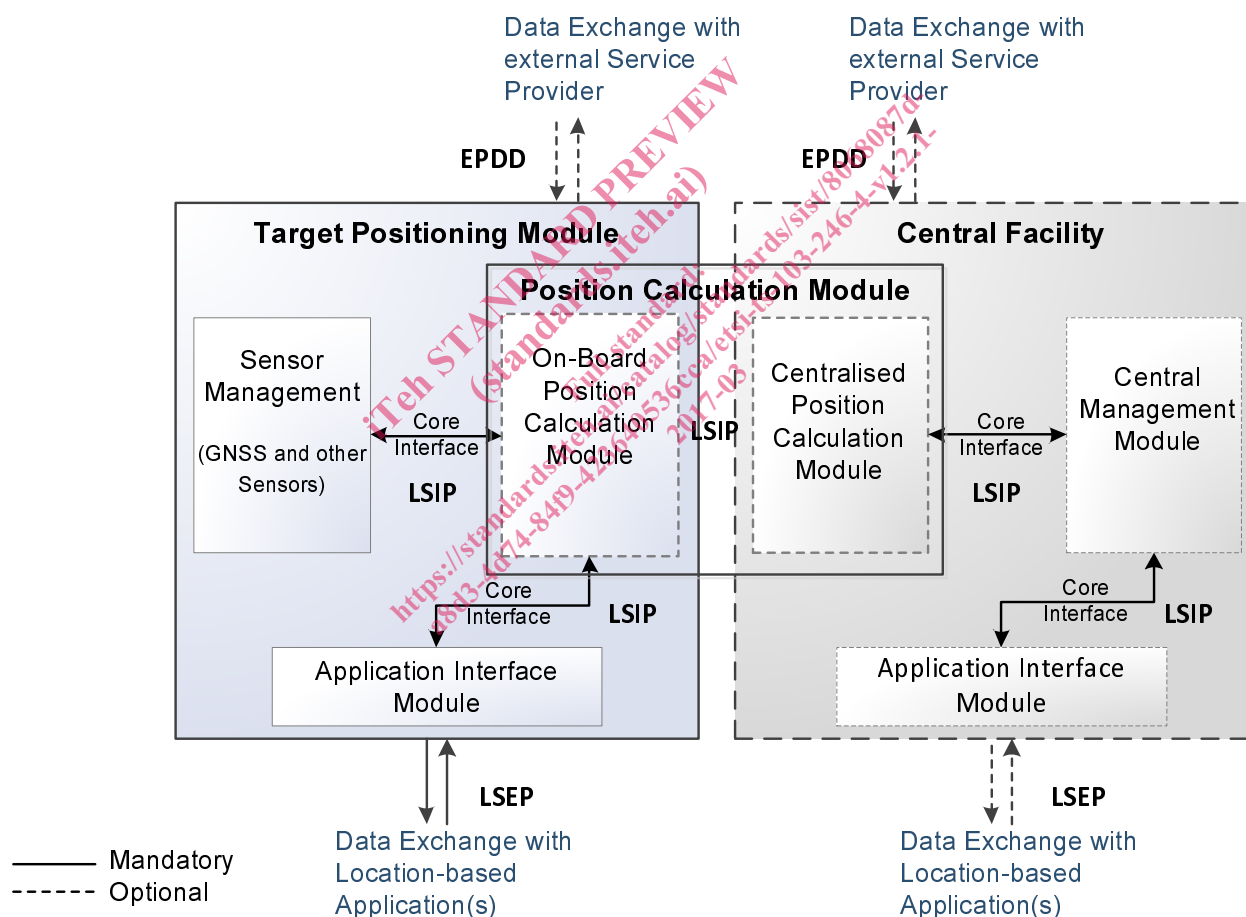


Figure 4.1: Use of LSEP and LSIP in the GBLS architecture

The protocols defined are:

- **LSEP** (Location System External Protocol): between the GBLS and an external application (requesting entity).
- **LSIP** (Location System Internal Protocol): between internal components of the GBLS.
- **EPDD** (External Protocol for Differential Data) as an optional protocol for differential GNSS data exchanged with external Differential Service provider.

The two first protocols shall transfer the location-related data defined in ETSI TS 103 246-2 [2].

The third protocol is reserved for differential GNSS data transfer, if required, and therefore remains an option.

The Protocol definitions in clauses 4.2.1 to 4.2.4 address the following aspects:

- 1) protocol procedures;
- 4) message definitions from a semantic point of view i.e. the information they shall contain, and how this information is structured;
- 5) information elements within messages and a set of relationships between them.

The definitions do not cover:

- Message syntax. Thus no encoding scheme or data representation is given.
- Underlying transport mechanisms for the messages.

4.2 Protocol Choice and Compatibility

4.2.1 LSEP (MLP)

LSEP is based on the procedures, messages and elements of OMA MLP [4]. Annex A provides a rationale for this choice.

MLP is intended for a Mobile Location Service (MLS) Client (e.g. a GBLS external application) to obtain the related data of a location target (e.g. mobile terminal, GBLS Positioning Module, etc.) from a Location Server (e.g. the GBLS).

MLP is defined at the application layer of the protocol stack. Its messages are defined in XML and it is intended to be transported over HTTP or other protocols (e.g. SOAP). For security reasons Secure Socket Layer (SSL) or Transport Layer Security (TLS) cryptographic protocols can be used to carry HTTP (or HTTPS).

4.2.2 LSIP (LPPe)

4.2.2.1 General

LSIP is defined as an extension to LPP and relies also on the procedures, messages and elements of LPPe [5]. Annex A provides a rationale for this choice.

As LPPe is also defined as an extension to, and relies on the main elements of, LPP [6] then LSIP is in effect based on both of these protocols.

LPPe is intended to provide transactions for location-related data in a client-server model, and specifically between a SET and SLP ("target" and "server" in LPPe). However LPPe allows many of its messages to be transacted in reversed mode also.

In the GBLS, LSIP is defined for interfaces between all internal functional blocks. clause A.3 describes implementation options.

LSIP as defined herein defines the global set of necessary location-related data required for the overall functioning of the GBLS as defined in ETSI TS 103 246-2 [2].

In addition, when the GBLS requires to internally implement a differential GNSS service (either a local service with one reference station or a network of service), some specific differential data encapsulated in the LSIP should be considered.

4.2.2.2 LSIP Data Exchange Requirements

A summary of additional data for LSIP (i.e. not included in LPPe) requiring to be transferred over the GBLS interfaces defined in ETSI TS 103 246-2 [2] is shown in table 4.1 (defined for each type of LSIP procedure: Location information exchange and Assistance data exchange).

Table 4.1: Extension data for LSIP procedures

| Interface | Location information exchange | Assistance or differential data exchange |
|---------------------|--|---|
| | LSIP-Specific data | LSIP-Specific data |
| 1 (GNSS) | observables (Pseudo-range, Accumulated Doppler Range), RF samples, + error on PVT and observables. | A-GNSS assistance data (models (nav, GGTO, UTC), RT integ, diff corr, data bit assist, acq assist, almanac, aux. info). |
| 2 (Telco) | N/A. | N/A. |
| 3 (INS) | Gyro/accelerometer measurements + error estimates. | N/A. |
| 4 (Magnetometer) | Magnetic field + error estimates. | Temperature (for calibration). |
| 5 (odometer) | speed, distance, + error estimates. | Wheel diameter. |
| 6 (BFN) | Body orientation, jammer characteristics: number, power, direction of arrival (DoA). | N/A. |
| 7 (map) | FFS. | N/A. |
| 8 | location information consistent with "location-related data" defined in LSEP: <ul style="list-style-type: none"> • Position (horizontal, vertical), velocity (linear/angular) acceleration (linear/angular), heading. • QoS estimation (estimated accuracy of the above params). • Integrity and Authentication parameters. | N/A. |
| 9 | All location data identified on I/F 10. | All assistance data from Assistance Server D-GNSS differential data according to the D-GNSS method. |
| 10 | All location-related data above from sensor interfaces (1 to 6), and dedicated to central processing (in centralized position calculation module). Additionally, any "processed" location information from the On-Board position calculation Module, and needing to be forwarded to the Central Facility. | All location data present on interfaces 1 to 8. D-GNSS differential data according to the D-GNSS method and architecture. |

For memory, the architecture level 3 with the corresponding interfaces in ETSI TS 103 246-2 [2] is described as follow.

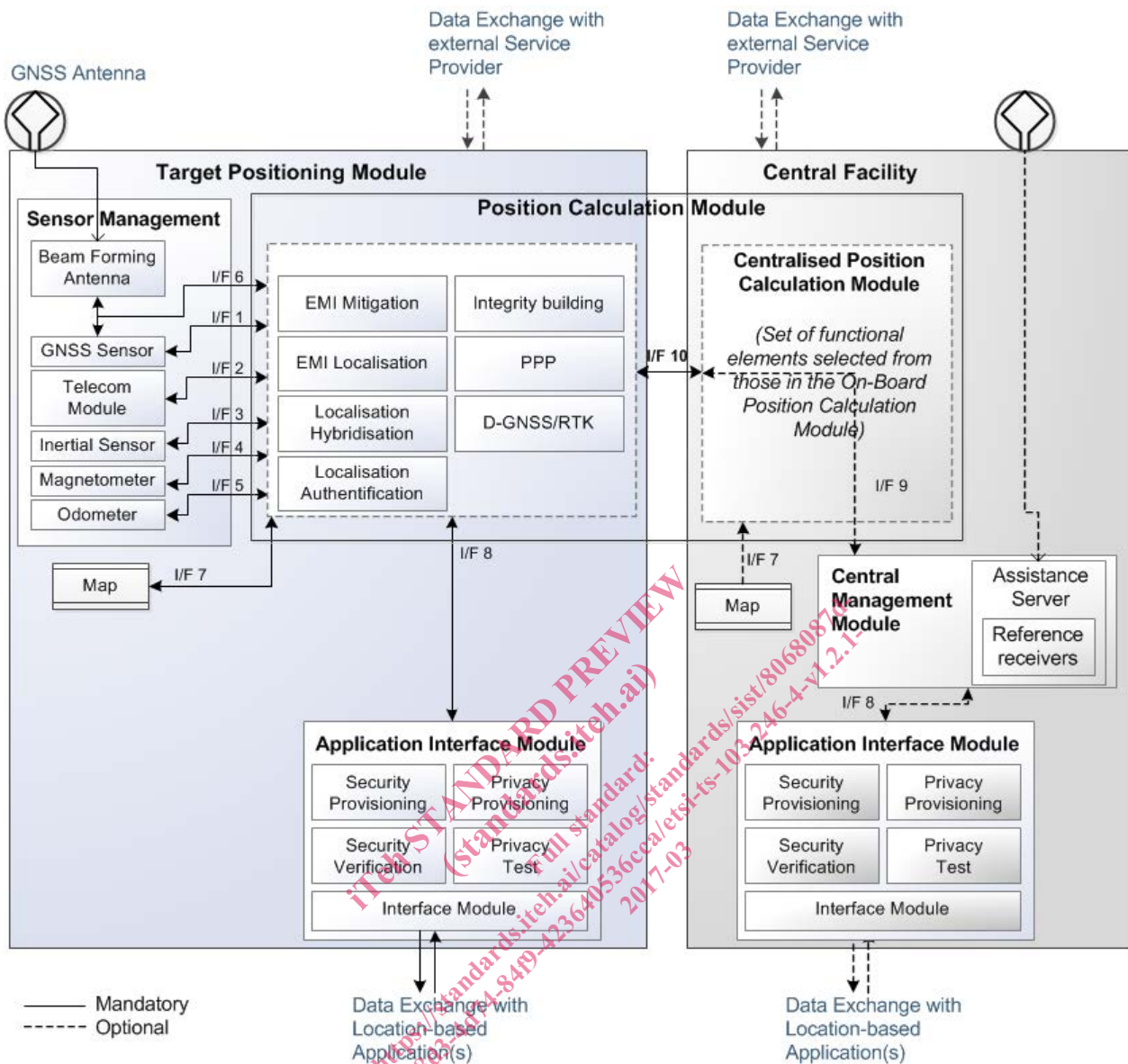


Figure 4.2: GBLS detailed architecture

Table 4.2 shows the data to be made available for GBLS external interface (i.e. for an application) and which should therefore be consistent with LSEP data elements. The relevant source protocols and the LSIP extension IEs are also shown.