SLOVENSKI STANDARD
oSIST prEN 16605:2024

01-maj-2024

Vesolje - Časovni sprejemnik Galileo - Funkcionalne in izvedbene zahteve ter s tem povezani preskusi

Space - Galileo Timing Receiver - Functional and Performance Requirements and associated Tests

Raumfahrt - Galileo Timing Receiver - Funktions- und Leistungsanforderungen und zugehörige Tests

Espace - Récepteur de signaux Galileo pour référence temps - Exigences fonctionnelles et de performances, et essais associés

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ICS:

33.070.40	Satelit	Satellite
49.140	Vesoljski sistemi in operacije	Space systems and operations

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 16605

March 2024

ICS

English version

Space - Galileo Timing Receiver - Functional and Performance Requirements and associated Tests

Raumfahrt - Galileo Timing Receiver - Funktions- und Leistungsanforderungen und zugehörige Tests

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/CLC/JTC 5.

If this draft becomes a European Standard, CEN and CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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European foreword

This document (prEN 16605:2024) has been prepared by Technical Committee CEN/CLC/JTC 5 “Space”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

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Introduction

The timing capabilities, which are inherent to all GNSS, constitute a paramount benefit allowing the timing solutions of excellent performance worldwide. Those capabilities have the particularity to be exploited by sectors which are strategic for the functioning of the modern society. These are the critical infrastructures such as Telecommunications, Energy and Finance. While timing represents in itself a small market compared to others if only timing receivers are taken into account, it is an enabler of critical infrastructures, and thus important for the entire European economy and society. In addition to those strategic sectors, timing is also used in a wide variety of applications including metrology, remote sensing and atmosphere research.

The importance of the timing capability has been considered by the European Commission substantial enough to give it the category of a proper Service in itself as part of the Galileo Service portfolio. This has been formalized at the level of an EU Regulation [66].

The Service definition undoubtedly starts by taking into account the needs of its intended users and be flexible to accommodate their evolutions. To that end, stakeholder's consultations and interactions with the user community took place and led to the identification of the need to increase robustness and trust in the timing products. This aspect has then been incorporated as a key feature for the Galileo Timing Service.

With the Service characteristics and associated performance targets defined, the implementation of the Service provision implies putting together all the necessary elements to be able to meet those targets and to ensure that they are maintained over the Service lifetime.

When all is ready, a formal Service declaration informs the users that they can, from then on, rely on it to develop their own applications.

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The Galileo Timing Service concept relies on two fundamental pillars:

— dissemination of information dedicated at timing users, packaged in a Timing Service Message as part of the Galileo Signal in Space,

— standard for Galileo timing receivers, to ensure that the information provided is adequately processed as intended and the implementation of local barriers enhancing robustness.

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The intent of this standard is to define Requirements and Tests for Galileo timing receivers as part of the Galileo Timing Service. The target users for the standard are all Galileo Timing users, with special focus on critical infrastructures and critical applications. The standard takes into account the specificities of the Galileo Timing Service. This is fundamental in order to ensure the end-to-end performance of the Galileo Timing Service for those users who make use of a receiver developed according to the standard. The Galileo Timing Service covers needs and requirements of timing and synchronization for most users, and it is driven by the critical infrastructure sectors of Energy, Telecom and Finance. The Galileo Timing Service foresees to support various service monitoring levels accordingly, which is reflected in the standard.

Finally, it is worth recalling that although GNSS receivers are already being used in timing applications – in particular GPS since it was the first operational GNSS System – there is no associated standard. This will be then a first, with full support from European Commission, which gives testimony of how serious the Timing Service is taken into account at EU level.

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1 Scope

This document defines the functional and performance requirements and associated tests for Galileo timing receivers. The approach for this document is that of a performance based, meaning that no specific algorithm implementation is required. Instead, performance requirements are defined together with a corresponding test suite for verification.

The subject of this document is the Galileo chipset. Other sensors and/or additional processing that a higher synchronization Unit can implement on top of the Galileo chipset are not the subject of this document.

This document covers the following aspects related to Galileo timing receivers:

— GNSS constellations and frequencies processed: Galileo Dual-Frequency. Other modes are optional, as explained below;

— time scales, including Galileo System Time and Universal Time Coordinate;

— Services Levels, this document covers the 2 levels of Service for GST and for UTC to be provided by Galileo Time Service in the first place. The document also anticipates a third Service Level to be provided in the future, for which an update of the document will be needed;

— user dynamics: fixed users, defined as static users with precise knowledge of the antenna position, is the baseline mode;

— processing of Timing Service Message disseminated by the Galileo System;

— local timing integrity barriers: As a minimum, Time Receiver Autonomous Integrity Monitoring processing (T-RAIM);

— robustness to interferences;

— Galileo Open Service Navigation Message Authentication processing;

— robustness to multipath.

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This document does not cover the processing of GPS constellation but this does not preclude Manufacturers to implement GPS processing within the Galileo timing receivers, even if not addressed in this document. The use of other GNSS constellations is not forbidden by this document but the requirements and tests are defined considering Galileo-only, including those related to the integrity of the timing solution.

Single-Frequency modes are not covered by this document. This does not preclude manufacturers to implement single-frequency modes within the Galileo timing receivers, even if not addressed in this document, as a back-up of the nominal Dual-Frequency mode, and reversion mechanisms. It is important to remark that the integrity of the timing solution is only specified for Galileo Dual-Frequency mode.

The Galileo timing receivers addresses only users operating in static conditions. Moving users are not considered as part of this document.

On top of the functional requirements, performance requirements are defined in this document in terms of different key performance indicators such as:

— accuracy, availability and integrity requirements;

— local barriers, T-RAIM performances.

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This document also provides the verification matrix and defines the test suite to verify the most fundamental requirements of the Galileo timing receivers.

Finally, this document provides a section dedicated to guidelines for the installation and maintenance of the Galileo timing receivers. This is a comprehensive section, including provisions for the antenna, cabling and receiver installation, as well as the calibration of time delays.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and acronyms

3.1 Acronyms

Acronyms used in this document and needing a definition are included in the following table:

Table 1 — Acronyms

Acronym	Full expression
ADC	Analog-to-Digital Converter
ARAIM	Advanced Receiver Autonomous Integrity Monitoring
BIPM	Bureau International des Poids et Mesures
C/N0	Carrier to Noise ratio
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CGGTTS	Common GNSS Generic Time Transfer Standard
CW	Continuous Wave
DF	Dual Frequency
DO	Disciplined Oscillator
DOP	Dilution Of Precision
EC	European Commission
ECEF	Earth Centered Earth Fixed
EGALITE	EGNOS and Galileo Timing Service Extension and Consolidation
EGNOS	European Geostationary Navigation Overlay Service
EN	European Standard
ESA	European Space Agency
ETSI	European Telecommunications Standards Institute
FOC	Full Operational Capability
FTA	Fault Tree Analysis
GGTO	GPS-Galileo Time Offset
GMS	Galileo Mission Segment

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Acronym	Full expression
GNSS	Global Navigation Satellite System
GNSST	GNSS Time
GPS	Global Positioning System
GPST	GPS Time
GSS	Galileo Sensor Stations
GST	Galileo System Time
G1G	Galileo First Generation
G2G	Galileo Second Generation
HW	Hardware
IBPL	Isotropy Based Protection Levels
ICD	Interface Control Document
IOD	Issue Of Data
IODUTC	Issue Of Data Universal Time Coordinate
ITRF	International Terrestrial Reference System
ITU	International Telecommunication Union
JRC	Joint Research Center
KPI	Key Performance Indicator
LNA	Low Noise Amplifier
LOS	Line Of Sight
MJD	Modified Julian Day
MOPS	Minimum Operational Performance Standard
MTE	Maximum Tolerable Error
NLOS	Nonline Of Sight
NMA	Navigation Message Authentication
NMEA	National Marine Electronics Association
NTP	Network Time Protocol
OCXO	Oven-Controlled Crystal Oscillator
OS	Open Service
PDOP	Position Dilution Of Precision
PHM	Passive Hydrogen Masers
PMR	Professional Mobile Radio
PMU	Phasor Measurement Unit
PPP	Precise Point Positioning
PPS	Pulse Per Second

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Acronym	Full expression
PSTN	Public Switched Telephone Network
PVT	Position Velocity and Time
RAIM	Receiver Autonomous Integrity Monitoring
RF	Radio Frequency
RFI	Radio Frequency Interference
RG	Radio Guide
RINEX	Receiver INdependent EXchange
RSS	Root Sum Square
RTCA	Radio Technical Commission for Aeronautics
Rx	Receiver
R&R	Record and Replay
SBAS	Space Based Augmentation System
SDD	Service Definition Document
SDR	Software Defined Radio
SF	Single Frequency
SHS	Signal Health Status
SI	Système International d'unités (International System of Units)
SIS	Signal In Space
SISA	Signal In Space Accuracy
SL	Service Level
SNR	Signal Noise Ratio
SPS	Symbols per second
STARLITE	Preparation Of Standards For Galileo timing receivers
SVID	Space Vehicle Identification
T-ARAIM	Timing ARAIM
T-IBPL	Timing IBPL
T-RAIM	Timing RAIM
TAI	International Atomic Time
TBC	To Be Confirmed
TBD	To Be Defined
TC	Test Case
TDOP	Time Dilution of Precision
TE	Time Error
TESLA	Timed Efficient Stream Loss-tolerant Authentication

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Acronym	Full expression
TGD	Time Group Delay
TIC	Time Interval Counter
TOD	Time Of Day
TOW	Time Of Week
TS	Tender Specifications
TSM	Timing Service Monitoring
TTA	Time To Alert
TTFF	Time To First Fix
TTL	Transistor-Transistor Logic
TTN	Time To Notify
T&S	Time and Synchronization
UART	Universal Asynchronous Receiver-Transmitter
UCP	User Consultation Platform
UI	User Interface
URE	User Range Error
USB	Universal Serial Bus
USRP	Universal Software Radio Peripheral
UTC	Universal Time Coordinate
UTCO	UTC Offset
UV	Ultraviolet
VLBI	Very Long Baseline Interferometry
WG	Working Group
WN	Week Number
WP	Work Package

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3.2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.2.1
accuracy
degree of conformance of the position, velocity and/or time with the true position, velocity and/or time of the GNSS user [1]

3.2.2
availability
percentage of time that the services of the system are usable by the user [2]

3.2.3
back-up mode
operational mode of the synchronization unit hosting the Galileo timing receiver in which some of the functionality and/or input data are not available for the complete performances to be reached, but can still continue operating under certain functional constrains

3.2.4
C/N0
SNR of a modulated signal consisting of the ratio of the power of the transmitted signal in the passband frequency over the power of the noise per unit bandwidth, expressed in dB/Hz

3.2.5
dynamic mode
unitless specification of the position/time error propagation as an effect of the satellite position and pseudorange geometry towards the receiver, considering that solutions calculated using pseudoranges of close satellites have greater uncertainties compared with solutions calculated using distant satellites

3.2.6
DOP
dilution of precision is a term used to specify the position/time error propagation as an effect satellite position and pseudorange geometry towards the receiver. Solutions calculated using pseudoranges of close satellites have greater uncertainties compared with solutions calculated using distanced satellites. DOP is unitless

1 In the case of this document, the focus is placed on the accuracy of an estimated time, it is measured in nanoseconds and is provided as a statistic threshold (e.g. 2-sigma). The concept of accuracy in this document is equivalent to the one in other more general standards such as ISO/IEC Guide 99:2007.

2 Availability is an indication of the ability of the system to provide usable service within the specified coverage area. Signal availability is the percentage of time that navigation/timing signals transmitted from external sources are available for use. It is a function of both the physical characteristics of the environment and the technical capabilities of the transmitter facilities. Availability is usually expressed in a % of time over a specified period.

Availability = (Number_Epochs_Timing_Service_Available / Total_Number_of_Epochs) * 100

For the particular case of the Availability of the Galileo Timing Service, the Availability concept is used for the availability of the Service Levels 1, 2 and 3 instead of signal availability.