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EUROPEAN GNSS (GALILEO) SERVICES

HIGH ACCURACY SERVICE (HAS)

QUARTERLY PERFORMANCE REPORT

JULY – SEPTEMBER 2023

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- *the Galileo High Accuracy Service, Service Definition Document available here: https://www.gsc-europa.eu/sites/default/files/sites/all/files/Galileo-HAS-SDD_v1.0.pdf*

the content of this report provides the characterisation of the Galileo Open Service and High Accuracy Service performance during the reported period using the various means and tools available at the EUSPA, and is deemed correct. Notwithstanding, the EUSPA and the European Union do not assume any responsibility or liability derived from the accuracy of the data contained therein to the extent permitted by the applicable law.

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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1 INTRODUCTION

This document is the High Accuracy Service (HAS) Public Performance Report for the period of **July**, **August** and **September 2023**.

Starting from January 24th 2023, the EU declared the availability of the HAS Initial Service provision. A new edition of this document is generated every quarter to report the relevant performance metrics throughout the covered period.

HAS is accompanied by associated Interface Control Documents, necessary for the users to access and handle its data, which are both disseminated via SIS ([HAS SIS-ICD]) and via Internet ([HAS IDD-ICD]).

The commitment towards user domain about HAS performance is defined through the Minimum Performance Levels (MPLs) and associated target values reported in the HAS Service Definition Document ([HAS-SDD]).

This document reports on the following performance parameters, with respect to their Minimum Performance Levels (MPLs) declared in the [HAS-SDD]:

- ◊ Accuracy of delivered HAS corrections, both via SIS and via IDD;
- ◊ Availability of HAS corrections, both when disseminated via SIS and via IDD;
- ◊ Coverage in the HAS service area;
- ◊ Timely publication of NAGUs for the HAS.

The evaluation of the timely publication of other NAGUs[1], metrics and MPLs related to the Galileo Open Service is reported in the [OS QPR], namely the Quarterly Performance Report for Open Service of the corresponding period.

This document comprises the following sections:

Section 1: introduces this report, including the status of the Galileo constellation over the quarterly reporting period.

Section 2: provides an executive summary describing main statistics about the achieved HAS performance. Details are reported in the following chapters.

Section 3: provides details about the achieved performances by the HAS in terms of: accuracy, availability of corrections, service coverage and timely publications of NAGUs for the HAS.

Section 4: lists all the cited reference documents.

Section 5: provides the definition of terms, acronyms and abbreviations used in the document.

[1] NAGUs are issued publicly by the European GNSS Service Centre (GSC)

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Table 1 provides the status of the Galileo constellation for which the performance data has been measured over the reporting period.

Table 1: Galileo reported constellation information

Satellite		orbital slot	status
ID	PRN		
GSAT0101	E11	B05	usable
GSAT0102	E12	B06	usable
GSAT0103	E19	C04	usable
GSAT0201	E18	non-nominal	not usable since 2021-02-18. This was notified with NAGU 2021008, and the reason is clarified by Galileo Service Notice #05 (SNGU 2021001, [SvNOTE #5])
GSAT0202	E14	non-nominal	not usable since 2021-02-18, as it is the case of GSAT0201
GSAT0203	E26	B08	usable
GSAT0205	E24	A08	usable, unless for a short maintenance pre-announced by NAGU 2023042 already issued in July
GSAT0206	E30	A05	usable
GSAT0207	E07	C06	usable
GSAT0208	E08	C07	usable, unless for a short maintenance pre-announced by NAGU 2023050 issued in September
GSAT0209	E09	C02	usable
GSAT0210	E01	A02	Not usable since 30/04/2023 @ 00:52 UTC (ref.: NAGU 2023032), was declared not any longer part of the active constellation until further notice since 05/09/2023 @ 00:00 (ref.: NAGU 2023048).
GSAT0211	E02	A06	usable, unless for short maintenances pre-announced by NAGU 2023042 already issued in July
GSAT0212	E03	C08	usable, unless for a short maintenance pre-announced by NAGU 2023050 issued in September
GSAT0213	E04	C03	usable, unless for short maintenances pre-announced by NAGU 2023042 already issued in July
GSAT0214	E05	C01	usable
GSAT0215	E21	A03	usable
GSAT0216	E25	A07	usable, unless during a planned outage, being declared unavailable from 08/08/2023 @ 02:00 to 13/08/2023 @ 08:26 UTC (ref.: NAGUs 2023045, 2023046).
GSAT0217	E27	A04	usable
GSAT0218	E31	A01	usable, unless for a planned outage started in June, ending 01/07/2023 @ 11:10 UTC (ref.: NAGUs 2023036, 2023039)
GSAT0219	E36	B04	usable, unless for a short maintenance pre-announced by NAGU 2023050 issued in September
GSAT0220	E13	B01	usable, unless for a short maintenance pre-announced by NAGU 2023050 issued in September
GSAT0221	E15	B02	usable
GSAT0222	E33	B07	usable, unless for a prolonged outage, being declared unavailable from 04/07/2023 @ 06:10 to 23/07/2023 @ 00:01 UTC (ref.: NAGUs 2023038, 2023040, 2023041).
GSAT0223	E34	B03	usable

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Satellite		orbital slot	status
ID	PRN		
GSAT0224	E10	B15	usable, however to be considered as auxiliary vehicle

For the most up-to-date information about the Galileo Constellation, please refer to the information published by the European GNSS Service Centre (GSC) on its website:

Table 2: Galileo Service Centre main information web pages for Galileo status

Constellation Status Information
https://www.gsc-europa.eu/system-service-status/constellation-information
Reference Constellation Orbital and Technical Parameters
https://www.gsc-europa.eu/system-service-status/orbital-and-technical-parameters
Incident Reporting (Galileo Incidents Report Form)
https://www.gsc-europa.eu/helpdesk → "Report a Galileo Incident"
Interactive support to users (Galileo Help Desk)
https://www.gsc-europa.eu/helpdesk → "Raise your questions"

The Galileo Helpdesk at GSC allows close interaction with users, both to support the exploitation of Galileo services and to collect relevant information on signal performance as observed by the users. The GSC is also responsible for providing the Notice Advisory to Galileo Users (NAGU) messages.

Regarding **GSAT0224** (**E10**), it should be noted that this space vehicle is considered as an "auxiliary" satellite and it is not located in a nominal orbit slot. It is a requirement that it shall not degrade the overall system performance, therefore, the accuracy of HAS corrections is also evaluated for this satellite.

In the case of GPS, users can consult the constellation status published at USCG web portal, as per Table 3.

Table 3: Information web pages for GPS status

Constellation Status Information
https://www.navcen.uscg.gov/gps-constellation
NANU (Notice Advisory to Navstar Users)
https://www.navcen.uscg.gov/archives

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2 EXECUTIVE SUMMARY

During the quarterly reporting period under consideration, the measured HAS performance figures were in line with the Minimum Performance Level (MPL) targets specified in the [HAS-SDD]. Table 4 summarises the compliance with MPLs as dashboards, using the colour coding defined in Table 5.

Table 4: HAS MPL fulfilment status dashboard

		2023		
HAS MPLs	**target**	**July**	**August**	**September**
accuracy of HAS corrections, in m				
orbit				
Galileo	≤ 0.20	■■	■■	■■
GPS	≤ 0.33	■■	■■	■■
clock				
Galileo	≤ 0.12	■■	■■	■■
GPS	≤ 0.15	■■	■■	■■
code bias				
Galileo	≤ 0.50			
E1-C		■■	■■	■■
E5-Q		■■	■■	■■
E7-Q		■■	■■	■■
E6-C		■■	■■	■■
GPS	≤ 0.50			
L1 C/A		■■	■■	■■
L2 CL		■■	■■	■■
availability of HAS corrections, in %				
Galileo only (≥ 5 corrected satellites)	≥ 87	■■	■■	■■
Galileo and GPS (≥ 8 corrected satellites)	≥ 95	■■	■■	■■
service coverage, in %				
availability of corrections	100	■■	■■	■■
NAGU timeliness				
planned, in days	≥ 2	■		
unplanned, in days	≤ 1.25		■	■

■■ SiS Dissemination | IDD Dissemination

Table 5: legend of HAS MPLs verification dashboard

legend colour	interpretation
none	MPL measurement is not available
■	target value for MPL is fulfilled
■	target value for MPL is not fulfilled (less than 10% away from the target value)
■	target value for MPL is not fulfilled (more than 10% away from the target value)

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2.1 SUMMARY NOTES ABOUT HIGH ACCURACY SERVICE

Any MPLs and supplementary metrics provided in this report for the High Accuracy Service (HAS) are computed for each month of the covered time period, as per the [HAS-SDD] in force.

Concerning the **accuracy** of HAS corrections over the reporting period:

- in July, both in the case of dissemination via SIS and IDD:
  - **orbit corrections** accuracy was **0.16** m for Galileo and **0.31** m for GPS;
  - **clock corrections** accuracy (converted to units of length) was **0.07** m for Galileo and **0.10** m for GPS;
  - **code biases** accuracy was ≤ **0.19** m for Galileo and ≤ **0.21** m for GPS.
- In August, both in the case of dissemination via SIS and IDD:
  - **orbit corrections** accuracy was **0.17** m for Galileo and **0.15** m for GPS;
  - **clock corrections** accuracy (converted to units of length) was **0.06** m for Galileo and **0.09** m for GPS;
  - **code biases** accuracy was ≤ **0.20** m for Galileo and ≤ **0.20** m for GPS.
- In September, both in the case of dissemination via SIS and IDD:
  - **orbit corrections** accuracy was **0.15** m for Galileo and ≤ **0.19** m for GPS;
  - **clock corrections** accuracy (converted to units of length) was **0.06** m for Galileo and ≤ **0.10** m for GPS;
  - **code biases** accuracy was ≤ **0.23** m for Galileo and ≤ **0.20** m for GPS.

The **availability** of HAS corrections is evaluated by volume simulation over the entire service area. Additionally, it is also checked at a number of monitoring sites within the service area.

- Concerning the volume analysis based on consolidated recorded data, the availability of corrections at the worst user location of the HAS service area, both in case of SIS and IDD dissemination, was:
  - in July, ≥ **92.31**% for Galileo only corrections and ≥ **98.78**% for Galileo and GPS corrections;
  - in August, ≥ **92.21**% for Galileo only corrections and ≥ **97.41**% for Galileo and GPS corrections;
  - in September, ≥ **90.19**% for Galileo only corrections and ≥ **98.58**% for Galileo and GPS corrections.
- Concerning the evaluation at monitoring sites using recorded data in all evaluated stations, both for SIS and IDD dissemination, the availability of corrections was:
  - in July, ≥ **92.13**% for Galileo only corrections and ≥ **98.81**% for Galileo and GPS corrections;
  - in August, ≥ **94.42**% for Galileo only corrections and ≥ **98.47**% for Galileo and GPS corrections;
  - in September, ≥ **95.37**% for Galileo only corrections and ≥ **98.93**% for Galileo and GPS corrections.

Service coverage was **100**% of the HAS service area each of the three months.

HAS-specific NAGUs **have been released** during the reporting period, as reported in section 3.4. We remind that the timeliness of NAGUs which are not HAS-specific is evaluated in the [OS QPR].

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3 GALILEO HIGH ACCURACY SERVICE METRICS

Galileo High Accuracy Service (HAS), Initial Service provision was launched on January 24th, 2023, as declared by Galileo [SvNOTE #13].

As per HAS roadmap, with such announcement the EU stated the official transition from previous testing stage to the Initial Service delivery, heading towards the Full Service planned to be achieved in the near future.

In the current Service provision scheme, HAS delivers corrections to the broadcast orbit ephemeris, clock model, as well as code bias estimates. Such corrections are rendered available through Galileo E6-B SIS and via IDD, for both Galileo and GPS, allowing users of both systems to attain an accuracy never achieved before using only the information disseminated by each of the two GNSSs.

This section gives a view of the trend for HAS relevant metrics in the July–September 2023 period.

3.1 ACCURACY OF THE HAS CORRECTIONS

The first relevant set of metrics consists of the accuracy of the HAS corrections[2].

HAS provides corrections to the corresponding satellite orbit and clock offset information which is broadcast in the navigation messages.

The HAS orbit corrections accuracy is evaluated as the 95th percentile of the 3D error of the refined satellite orbits w.r.t. reference products over each month.

Similarly, the HAS clock corrections accuracy is evaluated as the 95th percentile of the residual errors of the refined satellite clock offsets w.r.t. reference products over each month.

Finally, the HAS code biases are intended to replace the broadcast information (BGD/TGD) provided in the navigation messages. The related accuracy is evaluated as 95th percentile over each month; given that the HAS information for code biases is "observable specific", the accuracy evaluation is also as such, being provided separately for Galileo E1-C, E5-Q, E7-Q, E6-C and for GPS L1C, L2C.

Thus:

- the monthly evolution of the accuracy of the HAS orbit corrections, clock corrections and code biases for Galileo are shown in Figure 1, Figure 3 and Figure 5, respectively;
- the monthly evolution of the accuracy of the HAS orbit corrections, clock corrections and code biases for GPS are shown in Figure 2, Figure 4 and Figure 6, respectively.

[2] Ref.: [HAS-SDD], §3.2.2, Table 6; all values are expressed in engineering units of metres

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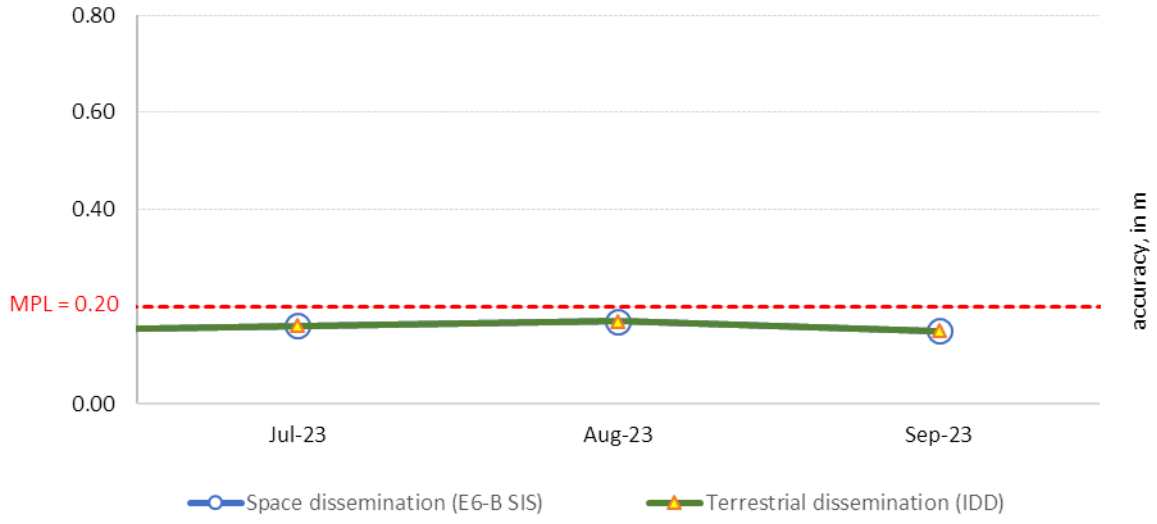

Figure 1: Galileo HAS – accuracy of the Galileo orbit corrections

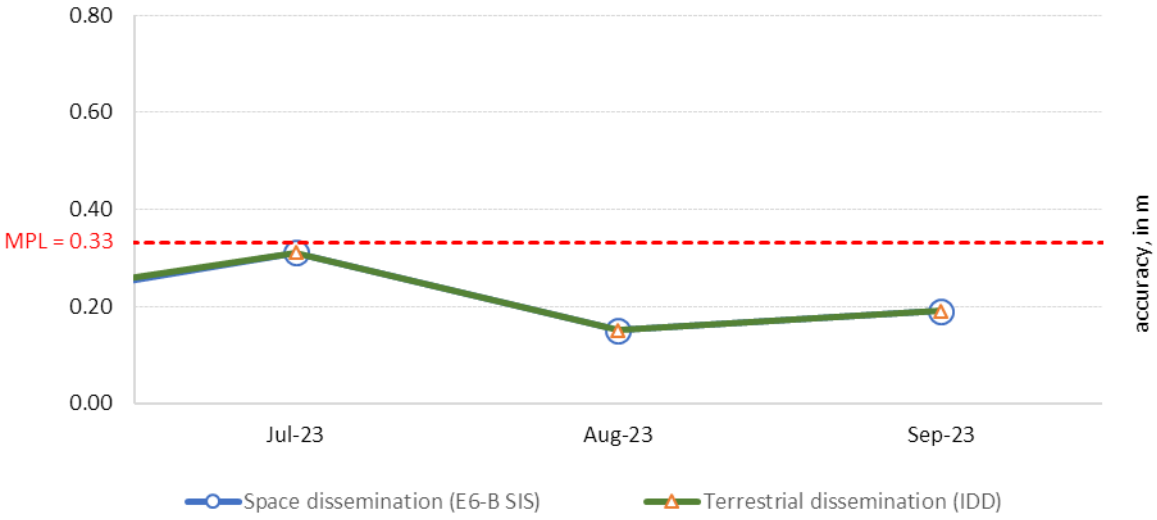

Figure 2: Galileo HAS – accuracy of the GPS orbit corrections

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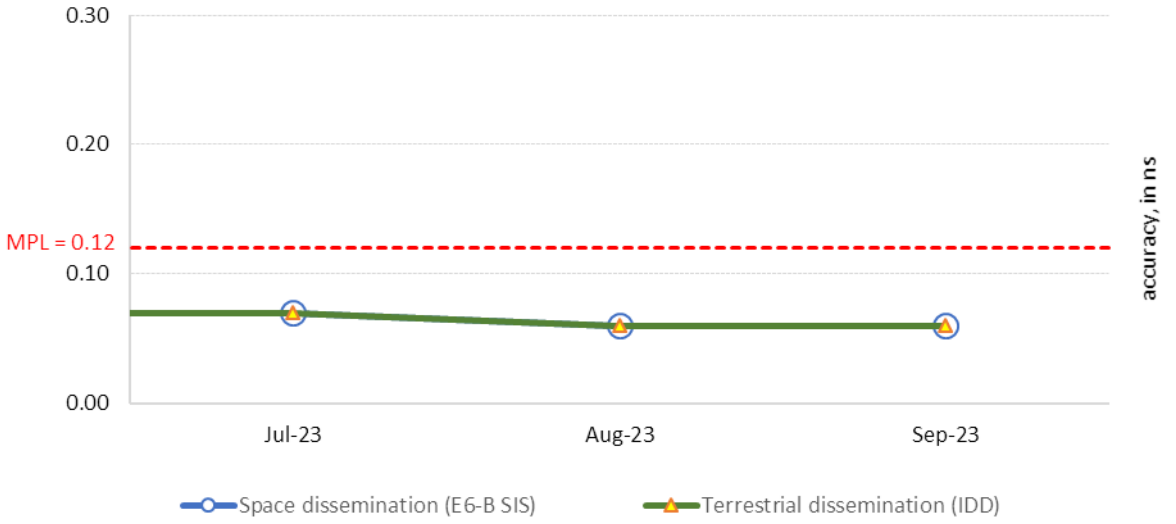

Figure 3: Galileo HAS – accuracy of the Galileo clock corrections

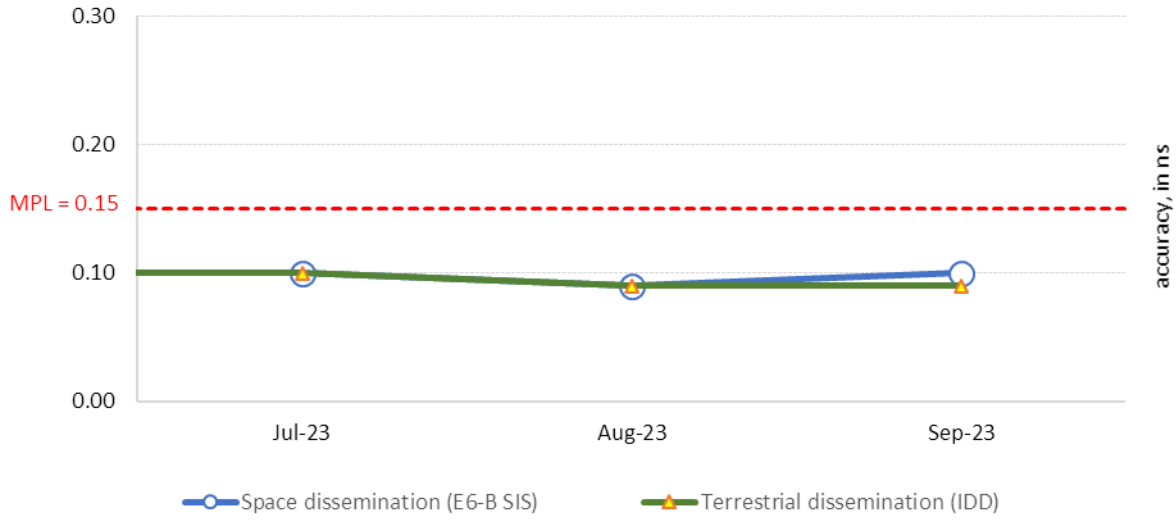

Figure 4: Galileo HAS – accuracy of the GPS clock corrections

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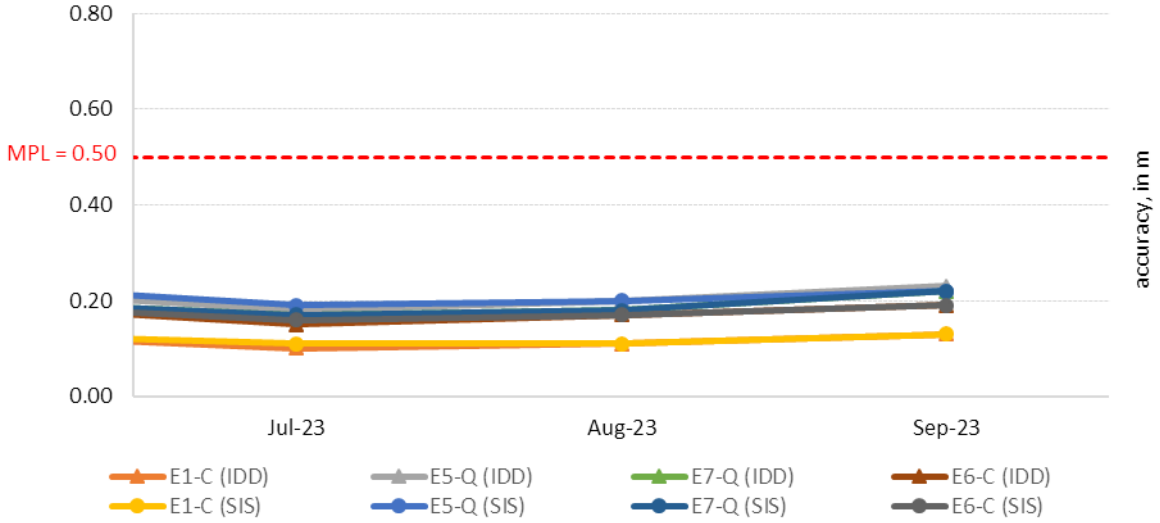

Figure 5: Galileo HAS – accuracy of the Galileo code biases

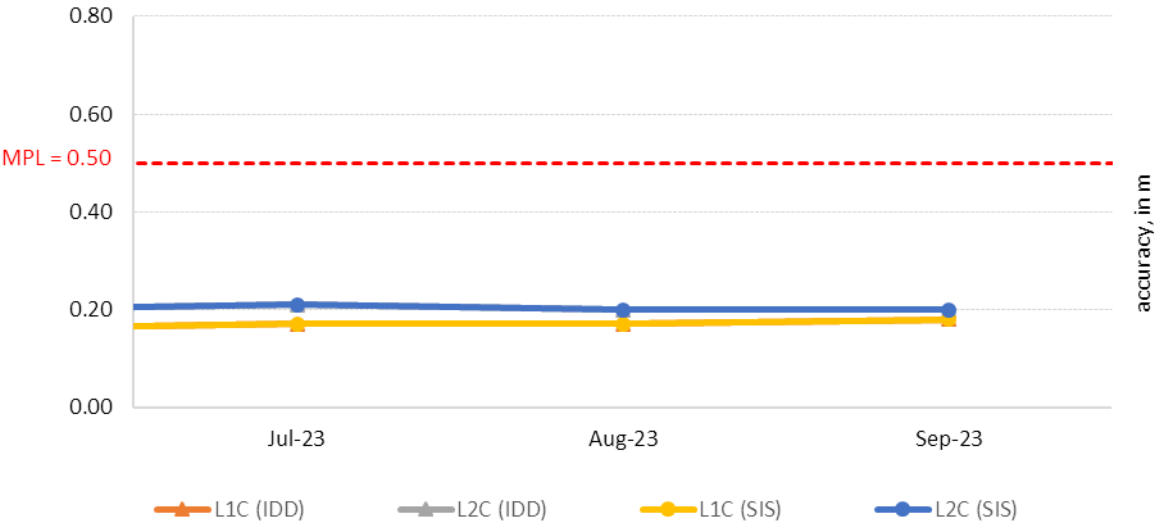

Figure 6: Galileo HAS – accuracy of the GPS code biases

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3.2 AVAILABILITY OF THE HAS CORRECTIONS

The availability of HAS corrections in a given location is defined as the percentage of time in which valid HAS corrections for a minimum number of satellites in view are effectively disseminated to the location in question.

The [HAS-SDD] prescribes [3] two different evaluation conditions for the availability of HAS corrections:

- availability of at least 5 corrected Galileo satellites in view
- availability of at least 8 Galileo and/or GPS satellites in view.

Moreover, the MPL is defined for attaining value from the Worst User Location (WUL) of the HAS service area. Due to the limited number of monitoring sites w.r.t. the extension of the service area, MPLs are evaluated based on volume simulation on a dense grid of virtual nodes. Results are also presented based on data collected at the real sites. In both cases, the characterisation is performed based on a worst user location basis.

The following figures show the monthly evolution of the availability of HAS corrections during the evaluation period. In particular:

- Figure 7 and Figure 9 show the evolution of the availability of HAS corrections at WUL for at least 5 Galileo satellites evaluated by volume simulation and at receiver sites, respectively;
- Figure 8 and Figure 10 show the evolution of the availability of HAS corrections at WUL for at least 8 satellites evaluated by volume simulation and at receiver sites, respectively.

[3] Ref.: [HAS-SDD], §3.2.4, Table 7

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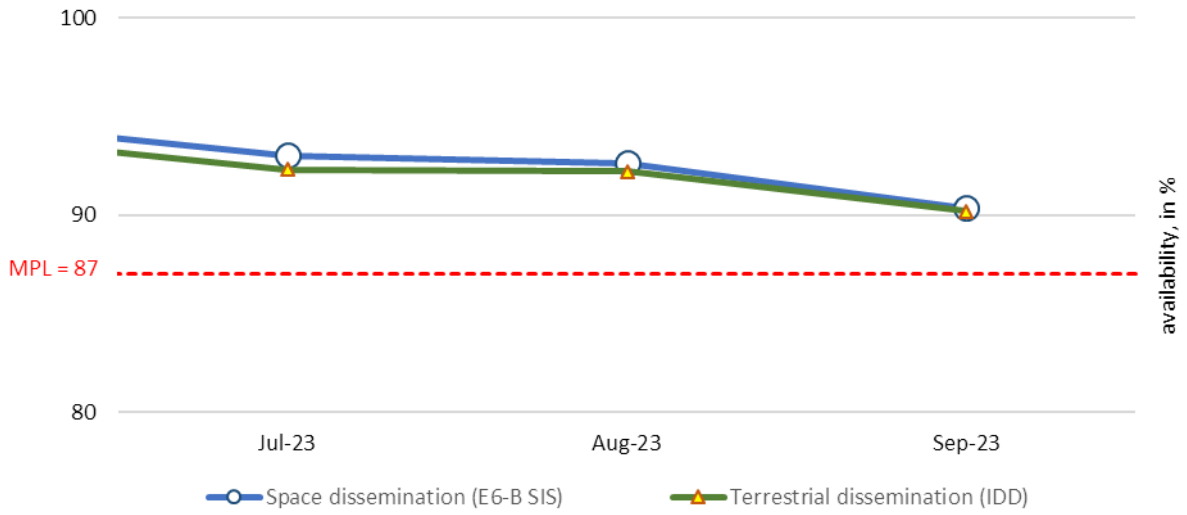

Figure 7: Galileo HAS – availability of the corrections for Galileo only modes at the worst (virtual) user location in the HAS service area

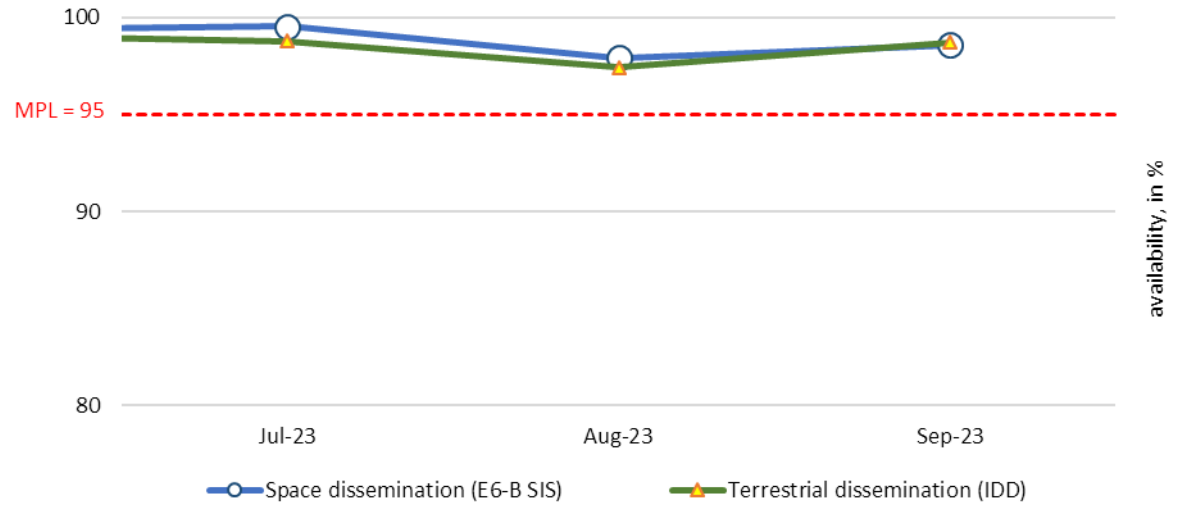

Figure 8: Galileo HAS – availability of the corrections for Galileo + GPS modes at the worst (virtual) user location in the HAS service area

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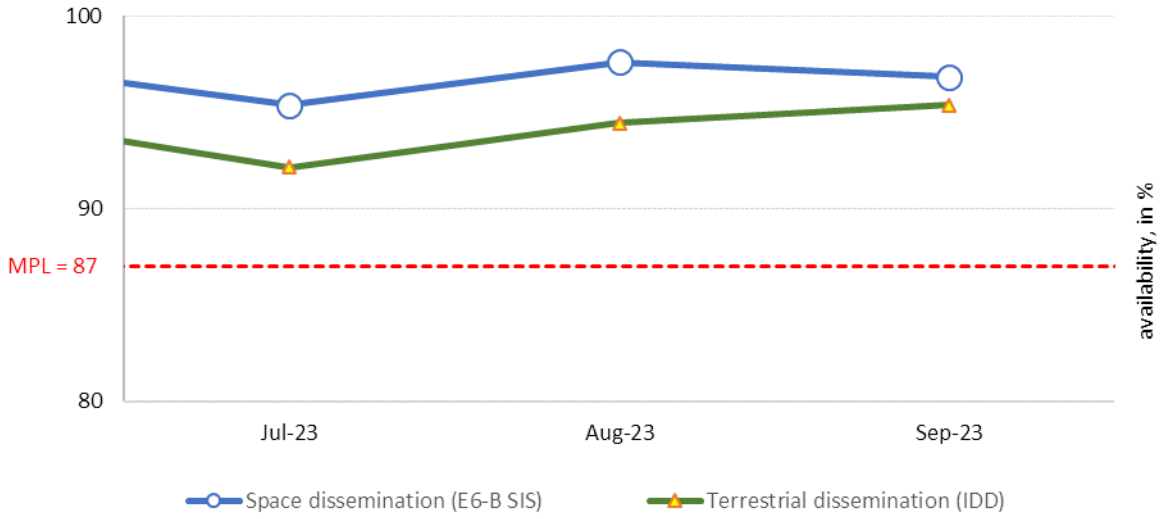

Figure 9: Galileo HAS – availability of the corrections for Galileo only modes at the worst monitoring site

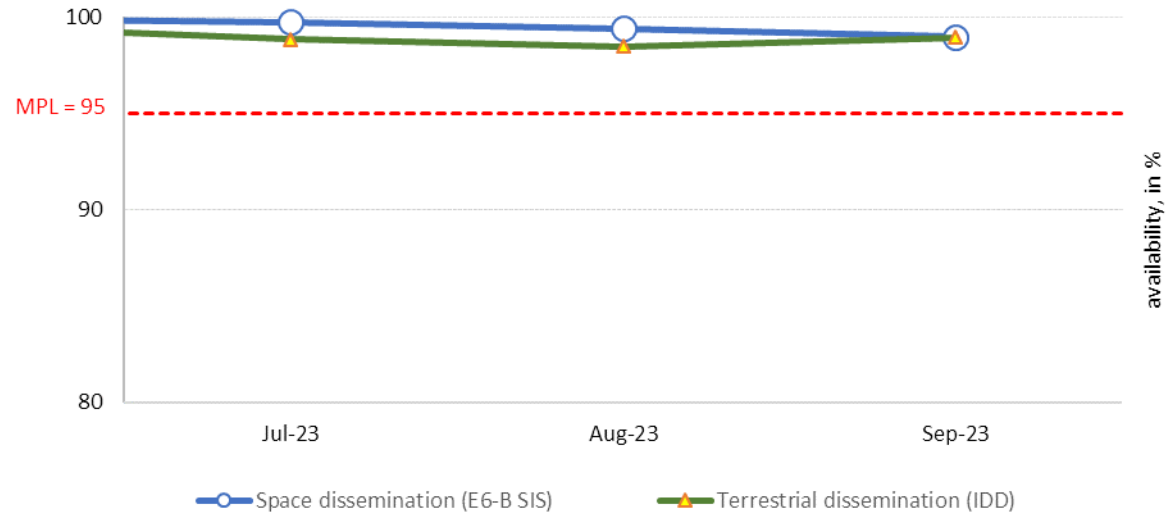

Figure 10: Galileo HAS – availability of the corrections for Galileo + GPS modes at the worst (real) monitoring site

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3.3 COVERAGE OF THE HAS SERVICE

The MPL evaluating the coverage of the HAS is defined as the percentage of the HAS service area in which the availability of HAS corrections equals or exceeds the committed MPLs.

The coverage of the HAS service was 100% in each month of the July–September 2023 reporting period.

The HAS service area in the Initial Service delivery phase is shown in Figure 11.

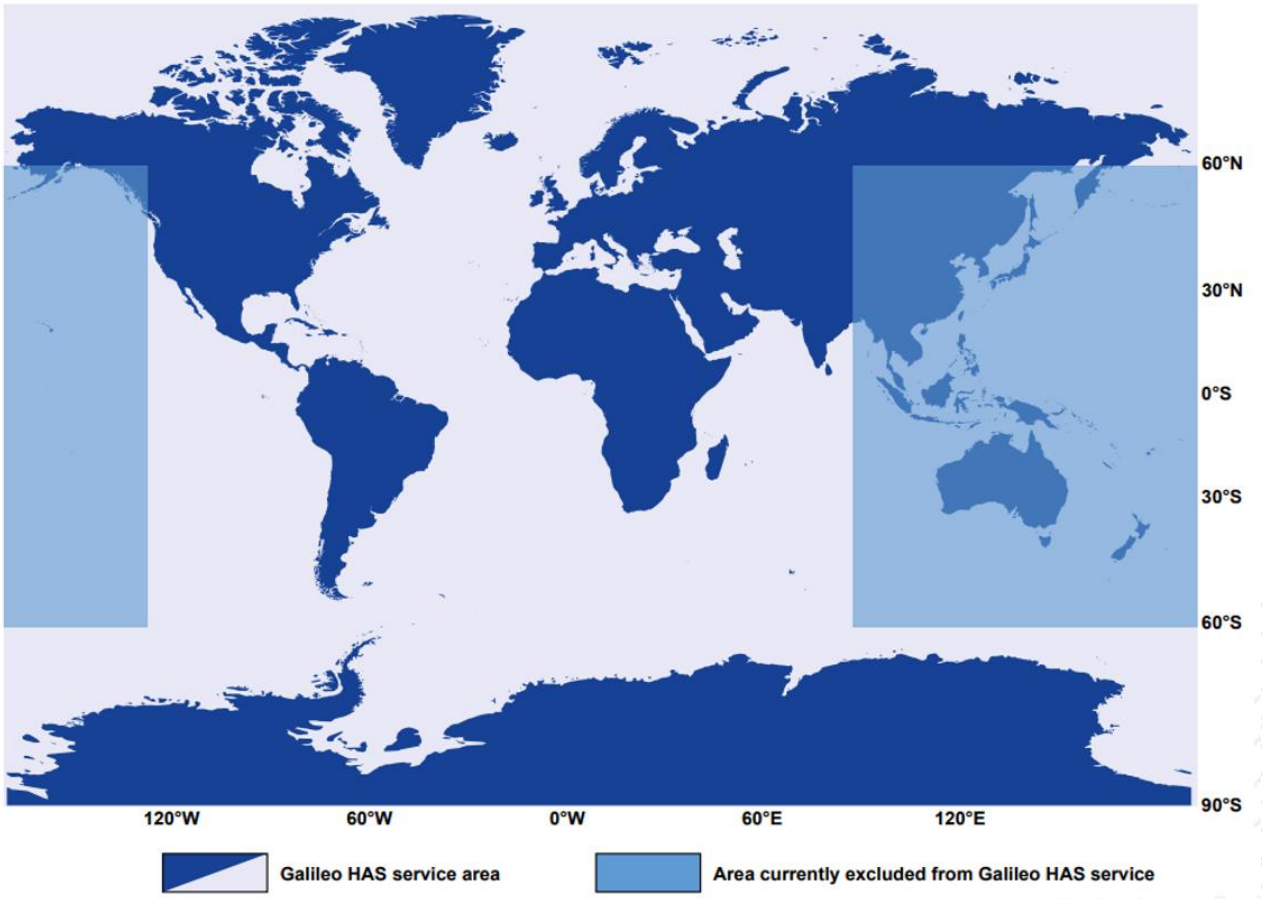

Figure 11: Galileo HAS – Service coverage area in the Initial Service delivery

Target availability for HAS Corrections is 87% in the case of Galileo only users, while 95% for Galileo and GPS ones.

Figure 12 provides volume simulation results for HAS corrections availability in the case of Galileo only users. Values below each image indicate minimum and average values achieved both in the Service Area and for all simulated virtual nodes (grid map including nodes outside the service area).

Figure 13 delivers similar information in the case of users combining Galileo and GPS observables and processing HAS corrections for both GNSS.

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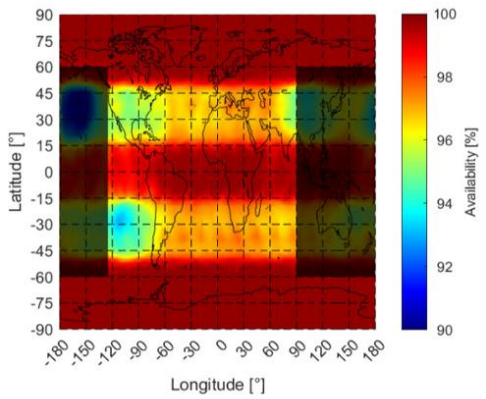
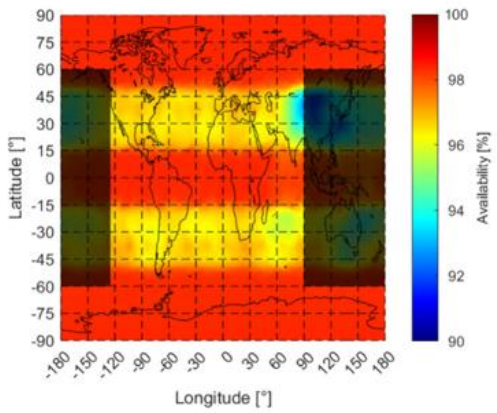
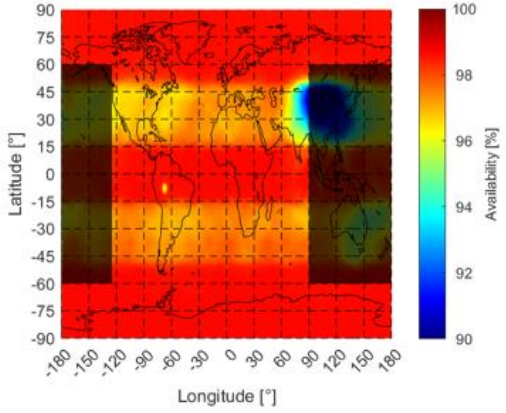
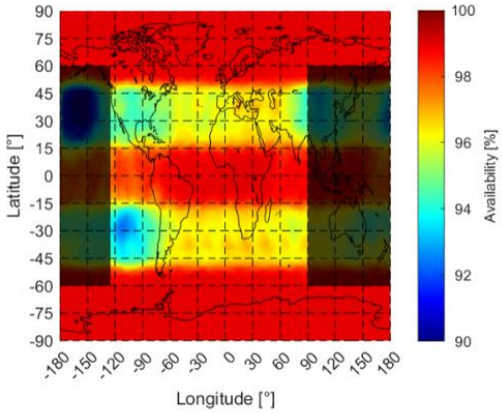
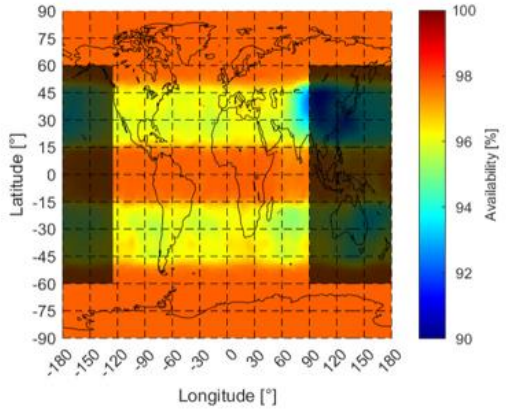
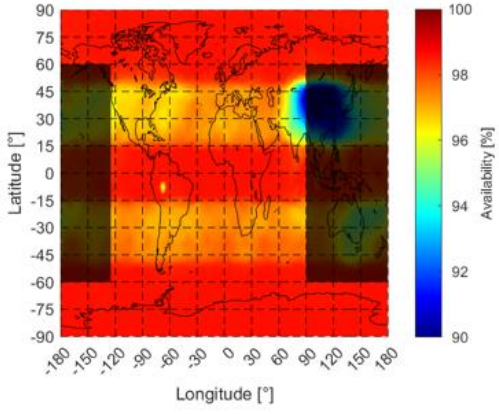
	July 2023	August 2023	September 2023
Dissemination via SIS	 Grid map: min=90.57%, mean=97.73% Service area: min=93.02%, mean=98.17%	 Grid map: min=91.77%, mean=97.05% Service area: min=92.65%, mean=97.43%	 Grid map: min=88.84%, mean=97.50% Service area: min=90.37%, mean=97.91%
Dissemination via IDD	 Grid map: min=89.91%, mean=96.98% Service area: min=92.31%, mean=97.42%	 Grid map: min=91.26%, mean=96.52% Service area: min=92.21%, mean=96.92%	 Grid map: min=88.71%, mean=97.43% Service area: min=90.19%, mean=97.85%

Figure 12: Galileo HAS – Availability of corrections for “Galileo only” users

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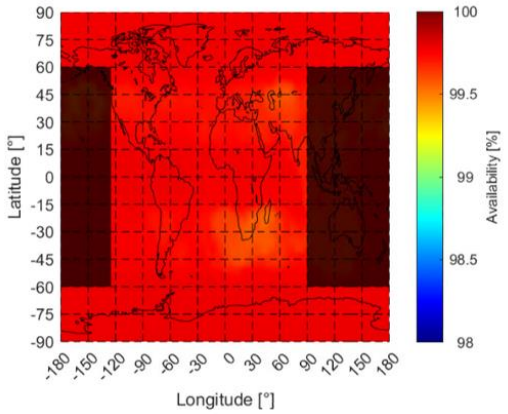
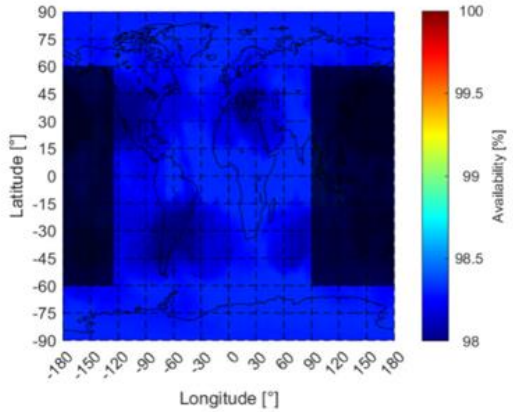
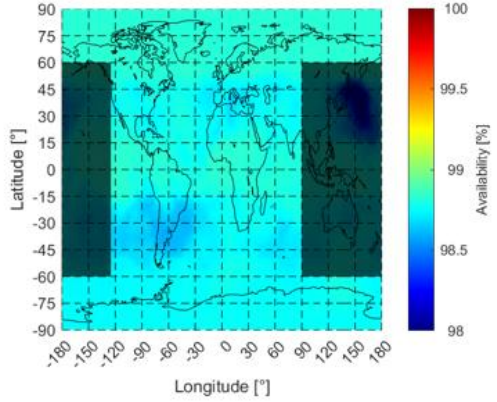
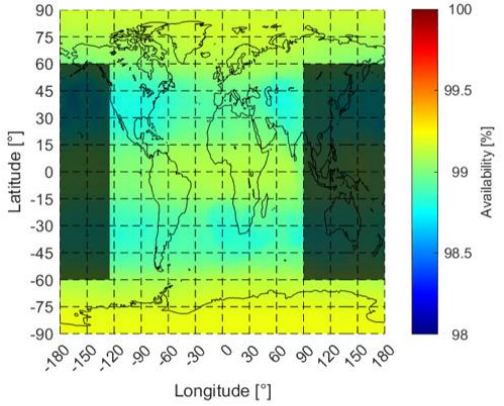
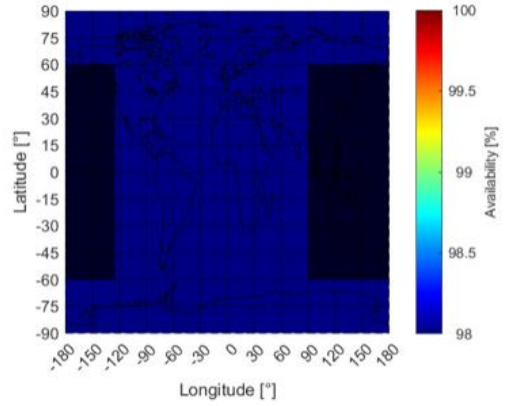
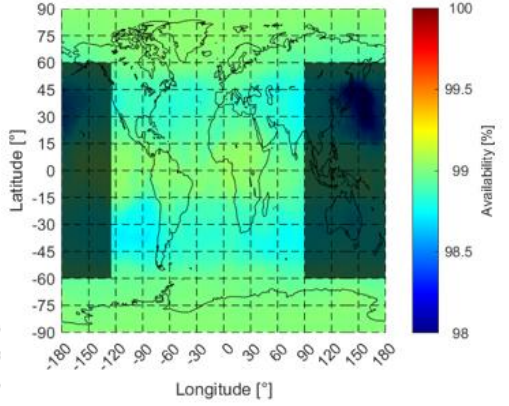
	July 2023	August 2023	September 2023
Dissemination via SIS	 Grid map: min=99.53%, mean=99.73% Service area: min=99.53%, mean=99.73%	 Grid map: min=97.09%, mean=98.17% Service area: min=97.92%, mean=98.23%	 Grid map: min=98.06%, mean=98.74% Service area: min=98.58%, mean=98.76%
Dissemination via IDD	 Grid map: min=98.63%, mean=98.96% Service area: min=98.78%, mean=98.99%	 Grid map: min=96.50%, mean=97.69% Service area: min=97.41%, mean=97.76%	 Grid map: min=98.00%, mean=98.87% Service area: min=98.70%, mean=98.91%

Figure 13: Galileo HAS – Availability of corrections for “Galileo + GPS” users

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3.4 TIMELY PUBLICATION OF HAS RELATED NOTICE ADVISORY TO GALILEO USERS (NAGU)

The European GNSS Service Centre (GSC) is responsible for timely publication of Notice Advisory to Galileo Users (NAGU) messages on its web pages:

Table 6: Galileo Service Centre web pages for Notice Advisory to Galileo Users (NAGUs)

active NAGUs
https://www.gsc-europa.eu/system-status/user-notifications
archived NAGUs
https://www.gsc-europa.eu/system-status/user-notifications-archived

According to the [OS-SDD] in force, NAGUs related to planned events need to be published at least **48** hours [4] before the start of the event. For unplanned events, the [OS-SDD]specifies a delay of up to **30** hours [4] from the detection of the unplanned event until a corresponding NAGU is issued.

The summary of NAGUs that have been published during the reporting period is as per the following Table 7; NAGU publication timeliness requirements were met with large margins, as per figures reported in it.

During the quarter, **5** NAGUs have been published. In particular:

- in **July, 1 (one)** NAGU of category “planned” was issued, warning about the forthcoming HAS outage for an operation to be implemented in August.
- in **August, 1 (one)** NAGU of category “unplanned” was issued, dealing with the recovery of HAS provision.
- in **September, 3 (three)** NAGUs of category “unplanned” have been published, each recalling an occurred outage of HAS provision, always lasting for a few hours.

Table 7 provides a summary of published NAGUs during the quarter.

[4] Ref.: [OS-SDD] §3.6.1 (Table 21)

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Table 7 : NAGUs published during the first quarter of 2023

month	NAGU type	reason for publishing	notice advisory ID	NAGU categ.*	timeliness
July					
	GENERAL (HAS PLN_OUTAGE)	Warning about forthcoming unavailability of service provision since 03/08/2023 @ 08:00 UTC	2023043	**P**	Published **5.83** days before the event
August					
	GENERAL (HAS USABLE)	Announcing recovery of service, as of 03/08/2023 @ 10:59 UTC	2023044	**U**	Published **0.25** days after the event
September					
	GENERAL (HAS UNP_SHTRCVR)	Warning about occurred outage of service on 08/09/2023, from 01:15 to 03:10 UTC	2023049	**U**	Published **0.57** days after the event
	GENERAL (HAS UNP_SHTRCVR)	Warning about occurred outage of service on 22/09/2023, from 12:37 to 17:36 UTC	2023051	**U**	Published **0.87** days after the event
	GENERAL (HAS UNP_SHTRCVR)	Warning about occurred outage of service on 24/09/2023, from 11:38 to 14:12 UTC	2023052	**U**	Published **0.36** days after the event

* NAGU categorisation for timeliness evaluation: **P** = planned, **U** = unplanned

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4 REFERENCES

This section identifies the documents explicitly referenced in this Galileo Public Performance Report, or in any case considered of peculiar relevance for HAS users.

[OS SIS-ICD] European GNSS (Galileo) Open Service Signal-In-Space Interface Control Document (OS-SIS-ICD), Issue 2.0, European Union, January 2021.

[IONO] Ionospheric Correction Algorithm for Galileo Single Frequency Users, Issue 1.2, European Union, September 2016.

[OS-SDD] European GNSS (Galileo) Open Service Definition Document (OS-SDD), Issue 1.2, European Union, November 2021.

[SvNOTE #5] Galileo Service Notice #05 - Unavailability of the Galileo Auxiliary satellites GSAT0201 and GSAT0202

[SvNOTE #11] Galileo Service Note #11 - Following the successful Testing activities for the enhanced I/NAV message on GSAT0223 (E34) and GSAT0224 (E10), Galileo users are notified that, until July 2023, the on-board S/W of all FOC satellites need to be upgraded, enabling the improvement.

[SvNOTE #13] Galileo Service Notice #13 - EU announced the delivery of Galileo High Accuracy Service (HAS), open access and free of charge, based on the provision of precise corrections (for orbit, clock, code biases) transmitted by the Galileo E6-B signal in space component. HAS aims to improve the accuracy of respective engineering data transmitted with Navigation messages, allowing users to achieve a Precise Point Positioning (PPP) solution for their coordinates.

[HAS SIS-ICD] European GNSS (Galileo) HAS Signal-In-Space Interface Control Document (HAS SIS-ICD).

[HAS IDD-ICD] European GNSS (Galileo) HAS Internet Data Distribution Interface Control Document (available previa registration).

[HAS-SDD] European GNSS (Galileo) HAS Service Definition Document (HAS-SDD).

[OS QPR] Quarterly Performance Report for Open Service, covering the same period of this document. Please download it from the performance reports section of European GNSS Service Centre.

Previous documents are available to users through the web portal of the European GNSS Service Centre (http://www.gsc-europa.eu/).

Individual sections of the HAS Service Definition Document have been referenced throughout this report when referring to MPL target values and calculation methods.

For an exhaustive description of the Open Service and HAS Minimum Performance Levels (MPLs), the reader is referred respectively to the [OS-SDD] and [HAS-SDD] that are in force.

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5 LIST OF ACRONYMS

Acronym	Definition
AUL	Average User Location
BGD	Bias Group Delay (parameter delivered in the Navigation messages)
DF	(Galileo OS) dual-frequency combination (E1/E5a, E1/E5b, see [OS SIS-ICD])
DOP	Dilution of Precision
ECEF	Earth Centred, Earth Fixed frame coordinates
EUSPA	European Union Agency for the Space Programme
F/NAV	Navigation message provided in the E5a signal [OS SIS-ICD]
FOC	Full Operational Capability
GGTO	GST-GPS Time Offset
GMS	Galileo Mission Segment
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
G/S	Ground Segment
GSC	European GNSS Service Centre
GST	Galileo System Time
HAS	High Accuracy Service
HDOP	Horizontal Dilution of Precision
HPE	Horizontal Positioning Error
ICD	Interface Control Document
IDD	Internet Data Distribution (HAS)
I/NAV	Navigation message provided in the E1-B and E5b signals [OS SIS-ICD]
IS	(Galileo) Initial Services
MPL	Minimum Performance Level
MAC	Message Authentication Code
NAGU	Notice Advisory to Galileo Users
NANU	Notice Advisory to Navstar Users
NAPA	No Accuracy Prediction Available
OLTN	OSNMA Live Test Notification
OS	(Galileo Navigation) Open Service
OSNMA	Galileo Open Service Navigation Message Authentication
PDOP	Position Dilution of Precision

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Acronym	Definition
SBDO	Stand-By Duty Officer
SDD	Service Definition Document
SDM	Service Delivery Manager
SF	(Galileo OS) single-frequency (E1, E5a, E5b)
SIS	Signal in Space
SISA	Signal In Space Accuracy
SISE	Signal In Space Error vector (4-dimensional)
SNGU	Service Notice to Galileo Users
toE	Time of Ephemeris
USCG	United States Coast Guard
UTC	Universal Time Coordinated
VPE	Vertical Positioning Error
WUL	Worst User Location

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End of Document

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