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EUROPEAN GNSS (GALILEO) INITIAL SERVICES

OPEN SERVICE

QUARTERLY PERFORMANCE REPORT

JULY - SEPTEMBER 2017

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1 INTRODUCTION

This document is the *Galileo Initial Open Service (IS OS) Public Performance Report* for the period of July, August and September 2017. Following the declaration of Initial Services in December 2016, a new edition is published after each quarter, in order to provide the public with information about the Galileo Open Service measured performance statistics.

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

- ◇ Galileo Initial Open Service Ranging Performance;
- ◇ Galileo UTC Dissemination and GGTO Determination Performance;
- ◇ Galileo Positioning Performance;
- ◇ Timely Publication of Notice Advisory to Galileo Users (NAGUs)¹.

The document comprises the following sections:

Section 1: Provides an introduction to this report, including the status of the Galileo constellation over the quarterly reporting period.

Section 2: Provides an executive summary describing the achieved performance. Details are reported in the following chapters

Section 3: The Initial Open Service Ranging Performance comprises three subsections: “Availability of the Galileo SF/DF Ranging Service”, “Per-slot Availability of HEALTHY Signal in Space” and “Galileo Signal in Space Ranging Accuracy”.

Section 4: The “UTC Dissemination and GGTO Determination Performance” is presented in two subsections: the “Availability of the Galileo Time Correlation Parameters” and the “Accuracy of Galileo Time Correlation Parameters”. Performance is evaluated for the Universal Time Coordinated (UTC) Time & Frequency Dissemination service and the GST-GPS Time Offset (GGTO) Determination.

Section 5: The “Galileo Positioning Performance” is illustrated in three subsections: “Availability of Global Horizontal Dilution of precision (HDOP)”, “Availability of Galileo Horizontal Positioning” and “Galileo measured Positioning Performance”.

Section 6: The “Timely Publication of Notice Advisory to Galileo Users (NAGUs)” is analysed.

Section 7: The cited reference documents are listed.

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

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

Satellite Code	SV ID (PRN)	CCSDS ID [hex]	Orbital Slot	Status
GSAT-0101	11	3A5	B05	Available
GSAT-0102	12	3A6	B06	Available
GSAT-0103	19	3A7	C04	Available
GSAT-0203	26	263	B08	Available
GSAT-0204	22	264	B03	Available
GSAT-0205	24	265	A08	Available
GSAT-0206	30	266	A05	Available
GSAT-0208	8	268	C07	Available
GSAT-0209	9	269	C02	Available
GSAT-0210	1	26A	A02	Available
GSAT-0211	2	26B	A06	Available
GSAT-0207	7	267	C06	Available
GSAT-0212	3	26C	C08	Available, since 01/08/2017 @ 16:03 ²
GSAT-0213	4	26D	C03	Available, since 09/08/2017 @ 18:58 ³
GSAT-0214	5	26E	C01	Available

Table 1: Galileo Reported Constellation Information

Satellites GSAT-0212 (E03) and GSAT-0213 (E04), which have been declared available since August 2017, are considered in the performance computations to characterise Ranging Accuracy and “per Slot” SIS Availability starting from the month of September 2017.

However, both satellites contributed since the time they were declared available for Navigation services to the “volume” availability performance indicators, such as those related to: ranging capability in the service area; geographic obtainability of HDOP ≤ 5 ; possibility of achieving a positioning solution with DOP ≤ 6 and HPE ≤ 10 [m].

² Ref.: NAGU [2017029](#)

³ Ref.: NAGU [2017033](#)

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:

GNSS Service Centre Web Resources	
Constellation Status Information	https://www.gsc-europa.eu/system-status/Constellation-Information
Reference Constellation Orbital and Technical Parameters	https://www.gsc-europa.eu/system-status/orbital-and-technical-parameters
Incident Reporting (Galileo Incidents Report Form)	https://www.gsc-europa.eu/helpdesk/galileo-incident-report-form
Interactive support to users (Galileo Help Desk)	https://www.gsc-europa.eu/contact-us/helpdesk

Table 2: Galileo status information

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 timely Notice Advisory to Galileo Users (NAGU) messages, as detailed in Section 6.

2 EXECUTIVE SUMMARY

During this third quarterly reporting period after declaration of Initial Services, the measured Galileo Initial Open Service performance figures generally exceed the Minimum Performance Level (MPL) targets specified in the [OS-SDD] with significant margins. The following dashboards summarize the compliance with MPLs, using the colour coding defined in the legend below:





OS MPLs		Target Value	Jul-17	Aug-17	Sep-17
OS SIS Ranging Service	Accuracy, Any Satellite	E1/E5a user	≤ 7m [95%]		
		E1/E5b user	≤ 7m [95%]		
		E1 user	≤ 7m [95%]		
		E5a user	≤ 7m [95%]		
		E5b user	≤ 7m [95%]		

Table 3: MPL Fulfilment Status Dashboard (1/2)

GSAT-0101	GSAT-0102	GSAT-0103	GSAT-0210	GSAT-0214
GSAT-0203	GSAT-0204	GSAT-0205	GSAT-0211	GSAT-0212 ⁴
GSAT-0206	GSAT-0208	GSAT-0209	GSAT-0207	GSAT-0213 ⁴

Allocation of Satellites in dashboard above

Legend

	MPL measurement not available (e.g.: if satellite was not yet declared available)
	Target Value for MPL is fulfilled
	Target Value for MPL is NOT fulfilled (less than 10% away from the Target)
	Target Value for MPL is NOT fulfilled (more than 10% away from the Target)

⁴ Space vehicles GSAT-0212 (E03) and GSAT-0213 (E04) added to reporting period since September, 2017.

OS MPLs			Target Value	Jul-17	Aug-17	Sep-17	
SIS Ranging	Accuracy, Over All Satellites ⁴	E1/E5a user		≤ 2m [95%]			
		E1/E5b user					
		E1 user					
		E5a user					
		E5b user					
	Availability ⁴	Per-slot	E1/E5a		≥ 87%		
			E1/E5b				
			E1				
			E5a				
			E5b				
	Ranging Service	SF / DF Worst Case @ WUL		≥ 87%			
Timing	Accuracy	UTC Time Dissemination		≤ 30ns [95%]			
		UTC Frequency Dissemination		< 3E-13 [95%]			
		GGTO Determination		≤ 20ns [95%]			
	Availability	UTC Determination Service		≥ 87%			
		GGTO Determination Service		≥ 80%			
User Interface	NAGU	Planned Timeliness		≥ 1 day			
		Unplanned Timeliness		≤ 3 days			

Table 4: MPL Fulfilment Status Dashboard (2/2)

After the successful simultaneous launch on November 17th, 2016, the four Galileo satellites placed into orbit (GSAT-0207, -0212, -0213, -0214) are now inserted within the active constellation and providing Navigation Services. As the latest additions, GSAT-0212 (E03) and GSAT-0213 (E04) were declared available in August 2017.

Availability of the Galileo Ranging Service at the Worst User Location (WUL) had stable monthly values of **100%**, which is significantly above expectations, where the MPL is **87%**. The “per-slot” **Availability of a Healthy Signal**, with average monthly values better than **98%**, is also significantly better than the MPL of **87%**.

The **Signal in Space Ranging Accuracy** shows a 95th percentile monthly accuracy better than **0.76 [m]** for individual space vehicles (“Any Satellite”) on Single Frequency observables.⁵ For Dual Frequency signal combinations⁶, the figure is better than **0.5 [m]**. Compliance with the [OS-SDD] MPL is achieved, with the threshold fixed to **7 [m]**.

The average Ranging Accuracy at constellation level (over “All Satellites”) provides figures “per signal” that are better than **0.56 [m]** for Single Frequency signal combinations and **0.4 [m]** for Dual Frequency signal combinations. The specified [OS-SDD] MPL threshold of **2 [m]** is therefore achieved.

The **Availability of the Galileo UTC Time Determination Service** is comfortably achieved, with monthly values of **100%** exceeding the [OS-SDD] MPL target of **87%**.

The **Availability of GGTO Determination** was **100%** in July and August, and **96.86%** in September. Annually normalised figures are obtained with a moving average applied since the Declaration of Initial Services. The measured values are well above the [OS-SDD] MPL target of **80%**.

Excellent values are achieved for **UTC Time Dissemination Service Accuracy** (≤ 9.3 [ns]), **UTC Frequency Dissemination Service Accuracy** (normalized offset better than 5.73×10^{-14}) and the **GGTO Determination Accuracy** (≤ 7.2 [ns]), all computed by accumulating samples over the previous 12 months⁷. The [OS-SDD] MPL targets, which are respectively **30 [ns]**, 3×10^{-13} and **20 [ns]**, are all met.

The **Availability of HDOP ≤ 5** is at least **85.69%**, while the Availability of a **Galileo Horizontal Positioning** better than 10 [m] with **PDOP ≤ 5** is at least **92.24%**. These figures are in line with the deployment status of the Galileo constellation during the reporting period (13 operational satellites in July, 15 since the beginning of August) and with the expected minimum threshold for Initial Services, defined in the [OS-SDD] as **50%** in both cases. These availabilities are constantly improving with the constellation completion towards the final operational capability. During the reporting period, the availability of the HDOP ≤ 5 and Horizontal Positioning better than 10 [m] with PDOP ≤ 5 reached **100%** in some parts of the service area.

⁵ Ranging measurements on the OS signals referred to as E1, E5a, E5b.

⁶ Ranging measurements on OS signal combinations E1/E5a, E1/E5b.

⁷ Monthly figures related to time scales result from processing measurements accumulated since an initial time that is prior to the declaration of Galileo Initial Services.

Availability figures are complemented with “Galileo-only” measured 3D positioning performance attainable when $PDOP \leq 6$. The 95th percentile of **Horizontal and Vertical 3D Positioning Errors** (HPE and VPE, correspondingly) did not exceed **4.55 [m]** and **9.16 [m]** respectively during the reporting period, as measured by experimental reference receivers. In line with the [OS-SDD], no MPL is presently applicable to HPE and VPE values.

Regarding **Publication of NAGUs**, [OS-SDD] MPLs are met during the whole period for both Planned and Unplanned events. The target of at least **24** hours before the start of a scheduled event is always achieved, as well as not more than **72** hours after an unscheduled one. Additional details about NAGU timeliness are presented in § 6 .

As already mentioned, further performance improvements are expected with the on-going Galileo System deployment, also in terms of system robustness and continuity of delivered services.

3 INITIAL OPEN SERVICE RANGING PERFORMANCE

In this section of the report the following performance figures for the Galileo Initial Open Service are provided:

- ◇ Availability of the Galileo SF/DF Ranging Service.
- ◇ Per-slot Availability of HEALTHY Signal in Space.
- ◇ Galileo Signal in Space Ranging Accuracy.

3.1 AVAILABILITY OF THE GALILEO SF/DF RANGING SERVICE

The Availability of the Galileo SF/DF Ranging Service is computed at any user location as the percentage of time that the user is provided with at least one HEALTHY⁸ Galileo Open Service (OS) Signal in Space (SiS).

The following figure shows the monthly availabilities of the Galileo Single Frequency (SF) and Dual Frequency (DF) Ranging Services at the Worst User Location (WUL). WUL is selected among the nodes of an equally spaced geographic grid, within the Navigation Service coverage area.

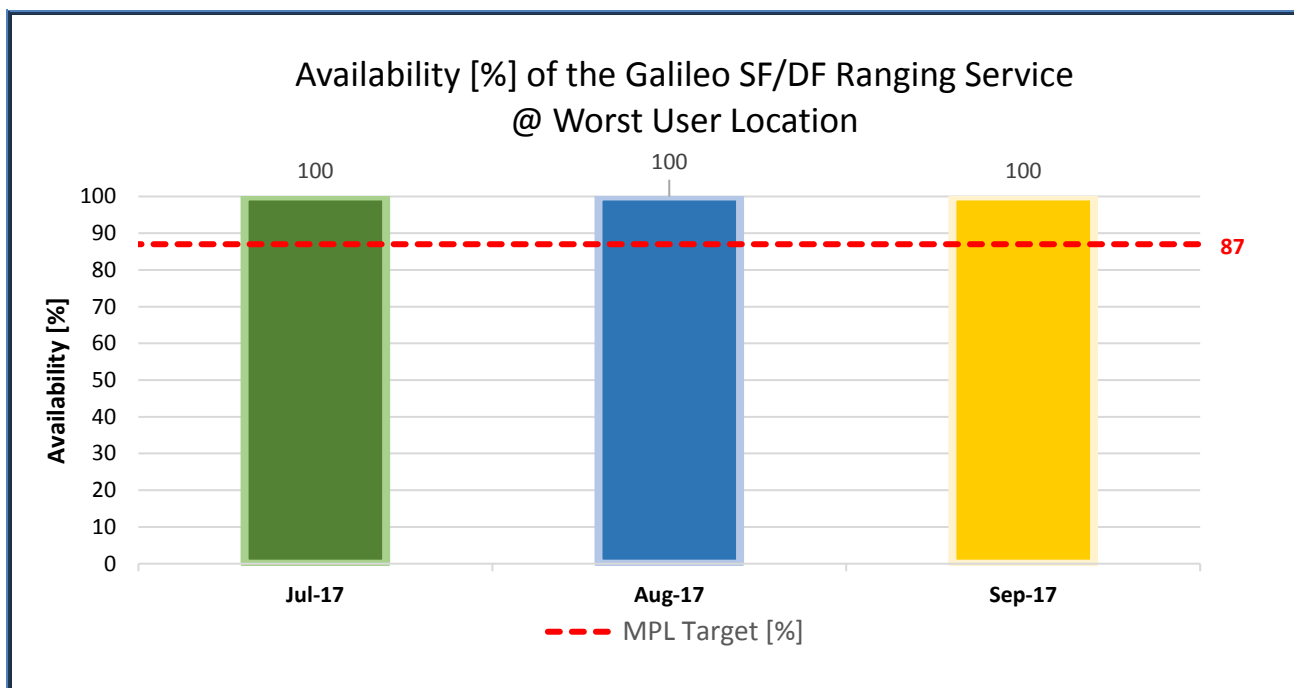


Figure 1: Monthly Availability of the Galileo SF/DF Ranging Service

⁸ HEALTHY Galileo Open Signal in Space is defined in [OS-SDD].

The availability of the Galileo Single Frequency and Dual Frequency Ranging Service is **100%** over the whole reporting period. This significantly exceeds the Minimum Performance Level from [OS-SDD], which is specified as **87%**⁹.

3.2 PER-SLOT AVAILABILITY OF HEALTHY SIGNAL IN SPACE

The “Availability of HEALTHY Signal in Space” is defined, for each Galileo operational satellite, as the percentage of time that the specific satellite broadcasts HEALTHY⁸ Galileo Open Service Signals in Space.

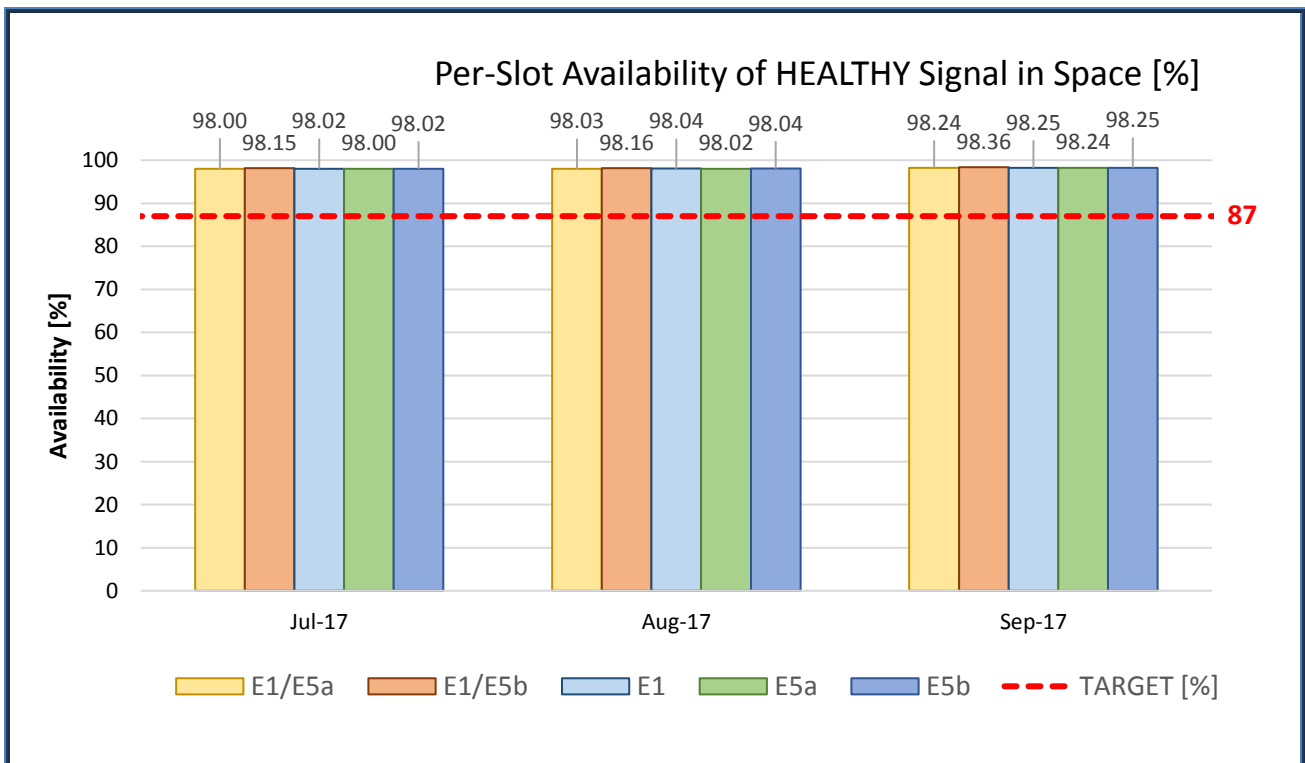


Figure 2: “Per-Slot” availability of HEALTHY Signal in Space for the reporting period

Figure 2 provides the Signal in Space “per slot” availability of Galileo HEALTHY Signals in Space, averaged over the entire constellation during the reporting period.¹⁰ The worst-case among the Single Frequency/Dual Frequency RF signals and signal combinations is considered, per each space vehicle, and for each month.

⁹ Ref.: [OS-SDD], §3.5.2 (Table 15) and §3.5.3 (Table 16)

¹⁰ The [OS-SDD] foresees an “annual normalisation”, which is implemented with an incremental averaging process, accumulating data after the declaration of Initial Services in December 2016

The [OS-SDD] Minimum Performance Level (MPL) specifies **87%** ¹¹ as the target value for the annually normalised constellation average. With a moving average implemented starting from January 2017, the monthly figures of better than **98%** are in line with the target annual figure.

3.3 GALILEO SIGNAL IN SPACE RANGING ACCURACY

The Galileo Signal In Space Error (SISE) vector provides the instantaneous difference between the Galileo satellite position/clock offset as obtained from the broadcast Navigation message, and the “true” satellite position/clock offset. The true orbit path and clock performance are precisely reconstructed using sophisticated tools. When projecting SISE to the user location, the obtained scalar value is also named Ranging Accuracy and represents the ranging error affecting a user receiver. The following figures show the 95th percentile of the monthly global average of the instantaneous Ranging Accuracy, achieved for each Galileo operational satellite and Single Frequency/Dual Frequency combinations. Projection of SISE is implemented at the nodes of a virtual grid, representing all user locations within the Navigation Service coverage area. Any signals carrying Navigation message information with Ageing of Time of Ephemeris beyond the validity period of 4 hours are filtered out, as per [OS-SDD] and explained in §5.3.

As shown in the following Figure 3 and Figure 4, the 95% metric applied to Galileo Signal in Space Ranging Accuracy “for any space vehicle”, over all satellites and frequency combinations, is:

- better than **0.46** [m] (Dual Frequency) and **0.66** [m] (Single Frequency) for individual space vehicles in July;
- better than **0.50** [m] (Dual Frequency) and **0.63** [m] (Single Frequency) for individual space vehicles in August;
- better than **0.50** [m] (Dual Frequency) and **0.76** [m] (Single Frequency) for individual space vehicles in September.

¹¹ Ref.: [OS-SDD], §3.5.1 (Table 14)

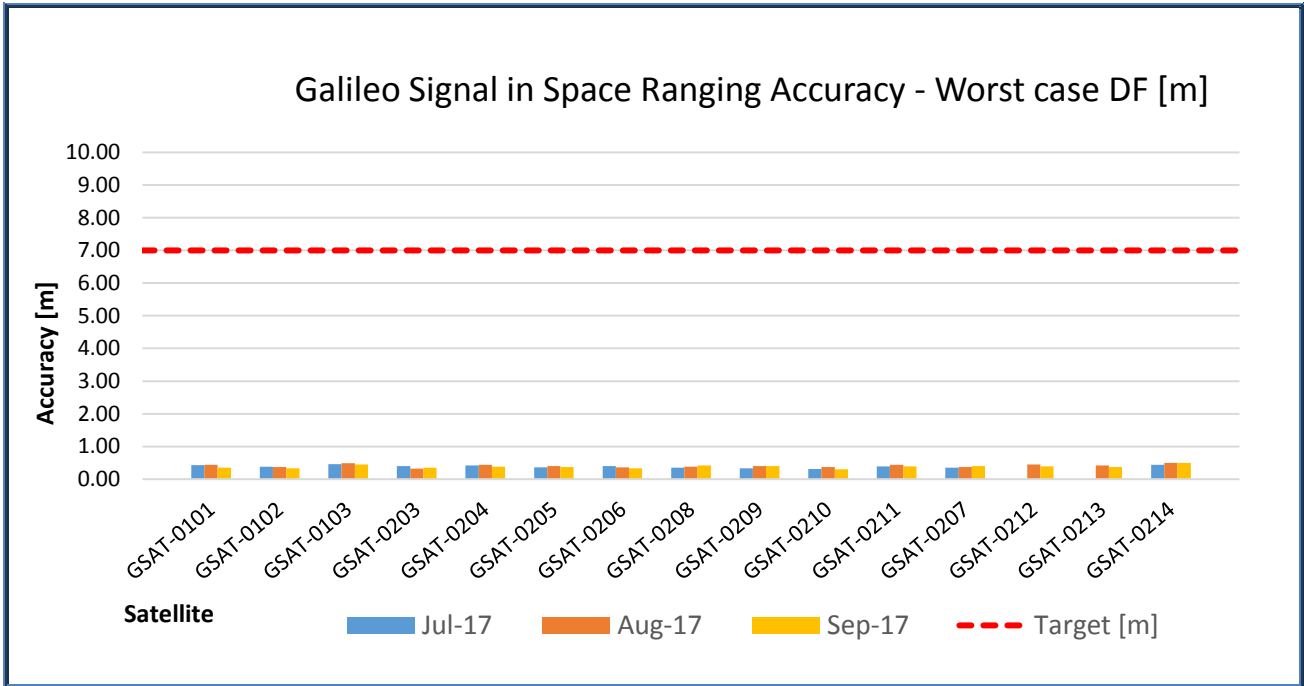


Figure 3: Monthly Galileo SIS Ranging Accuracy (95th percentile) “for any satellite”, measured during reporting period for worst-case, Dual-Frequency (DF)

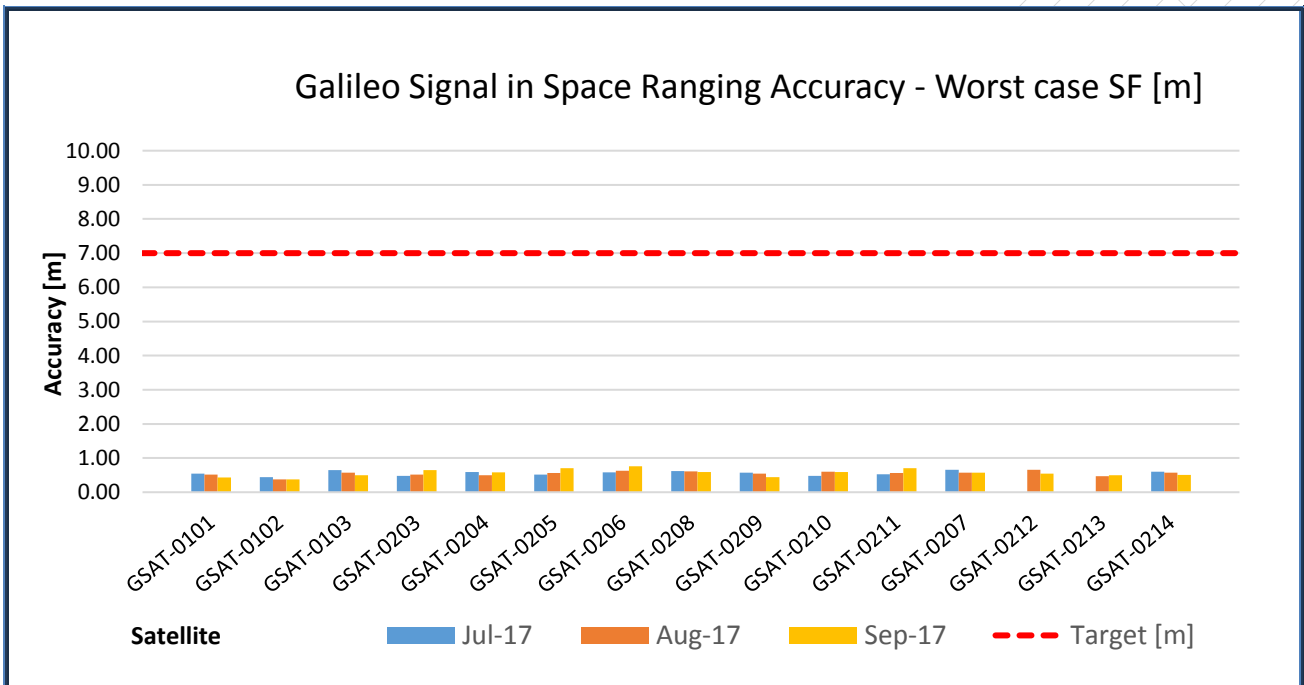


Figure 4: Monthly Galileo SIS Ranging Accuracy (95th percentile) “for any satellite”, measured during reporting period for worst-case, Single-Frequency (SF)

Compliance with [OS-SDD] MPL is always achieved, a maximum threshold of 7 [m]¹² being specified for the monthly performance of each individual satellite.

Figure 5 depicts the average “over all satellites” (constellation mean). Again, the [OS-SDD] MPL target of 2 [m] is met by the Constellation average value.

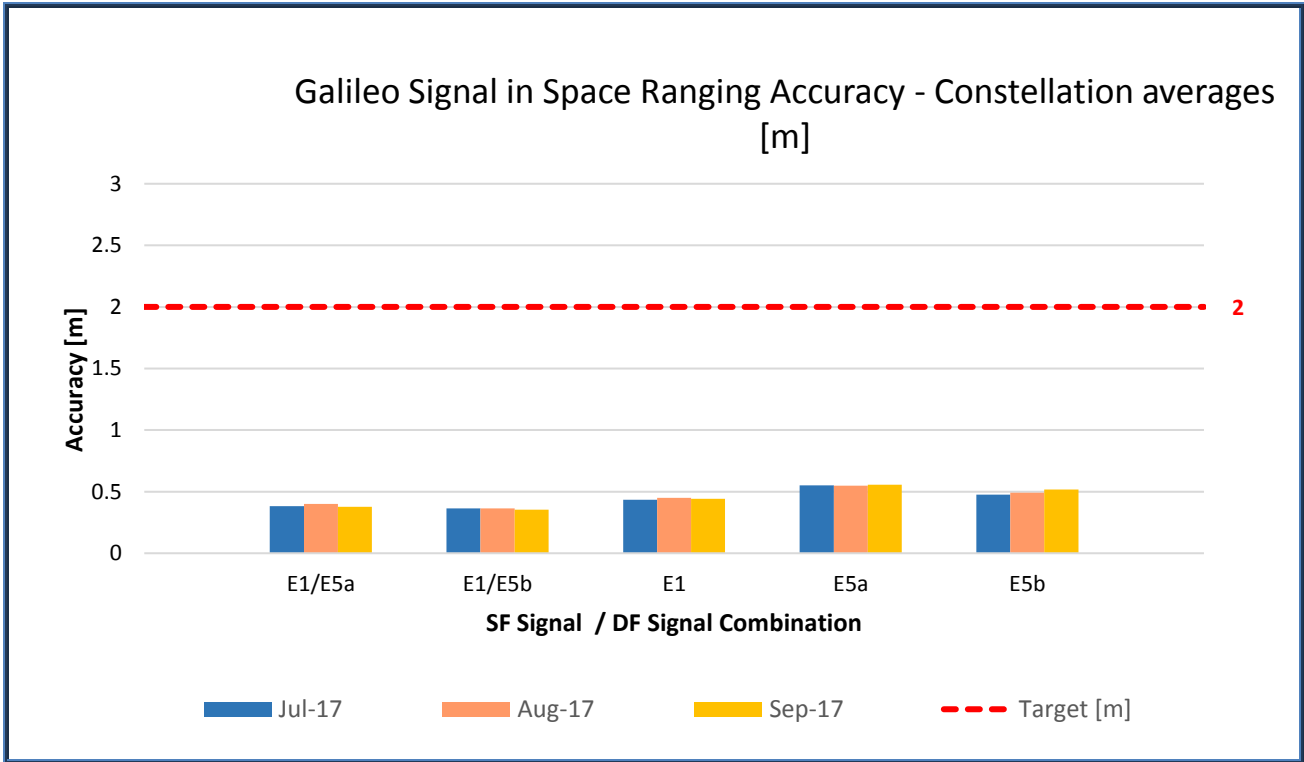


Figure 5: Monthly Galileo SIS Ranging Accuracy (95th percentile) “over all satellites” (constellation average), measured during the reporting period

¹² Ref.: [OS-SDD], §3.4.1 (Table 9)

4 UTC DISSEMINATION AND GGTO DETERMINATION PERFORMANCE

In this section of the report the following performance figures are provided:

- ◇ Availability of the Galileo Time Correlation Parameters;
- ◇ Accuracy of Galileo Time Correlation Parameters.

4.1 AVAILABILITY OF THE GALILEO TIME CORRELATION PARAMETERS

The *Availability of the Galileo Universal Time Coordinated (UTC) Time Determination Service* is defined as the percentage of time that the system provides at least one HEALTHY⁸ ranging/timing Signal in Space above a minimum elevation angle of 5 degrees. Figure 6 provides the Worst User Location (WUL) Availability of the UTC Determination service, computed for a virtual grid of user positions over the service coverage area. This availability was **100%** over the reporting period.

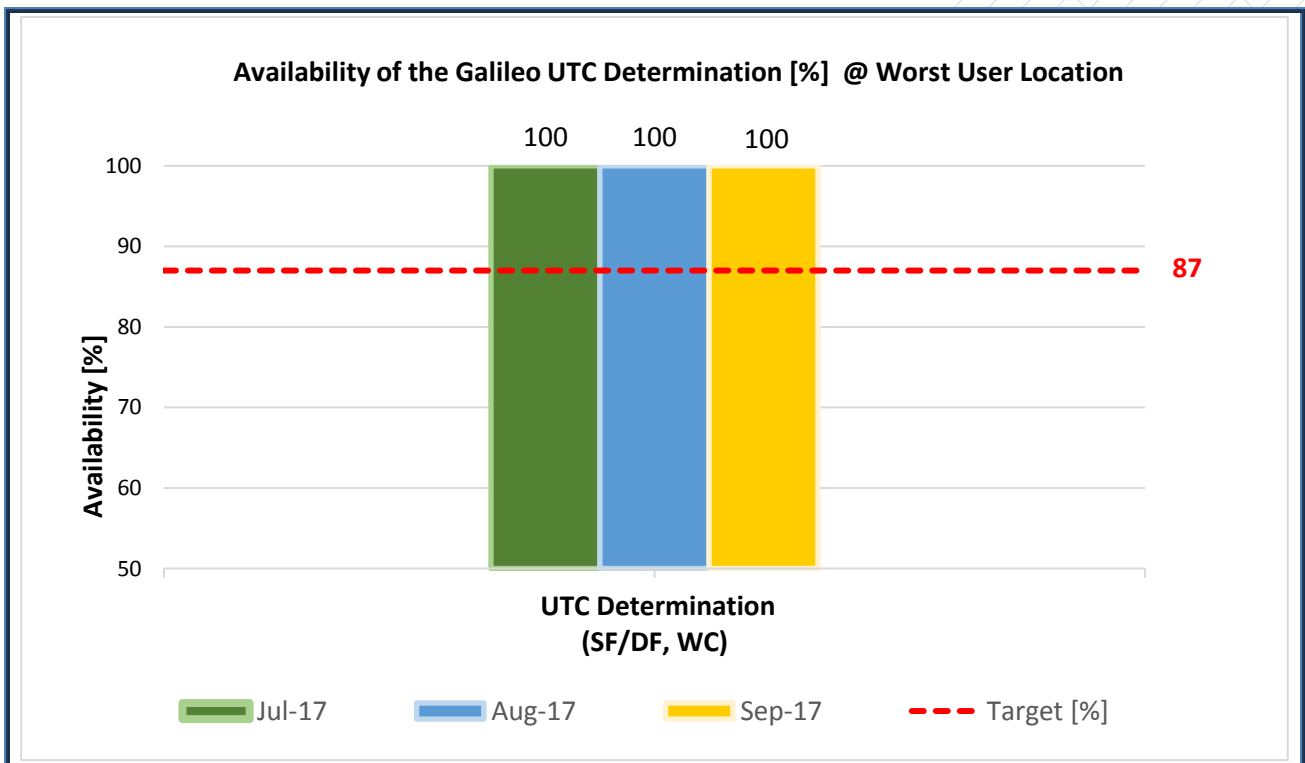


Figure 6: Monthly availability of the UTC Determination Service during the reporting period

The *Availability of Galileo to GPS Time Offset (GGTO) Determination* is the percentage of time that the system provides at least one non-dummy GGTO¹³ set of coefficients within the Navigation message, acquiring SiS from a space vehicle seen above a minimum elevation angle of 5 degrees. Figure 7 gives the availability of the GGTO Determination for Worst User Location (WUL), computed for a virtual grid of user positions over the service coverage area.

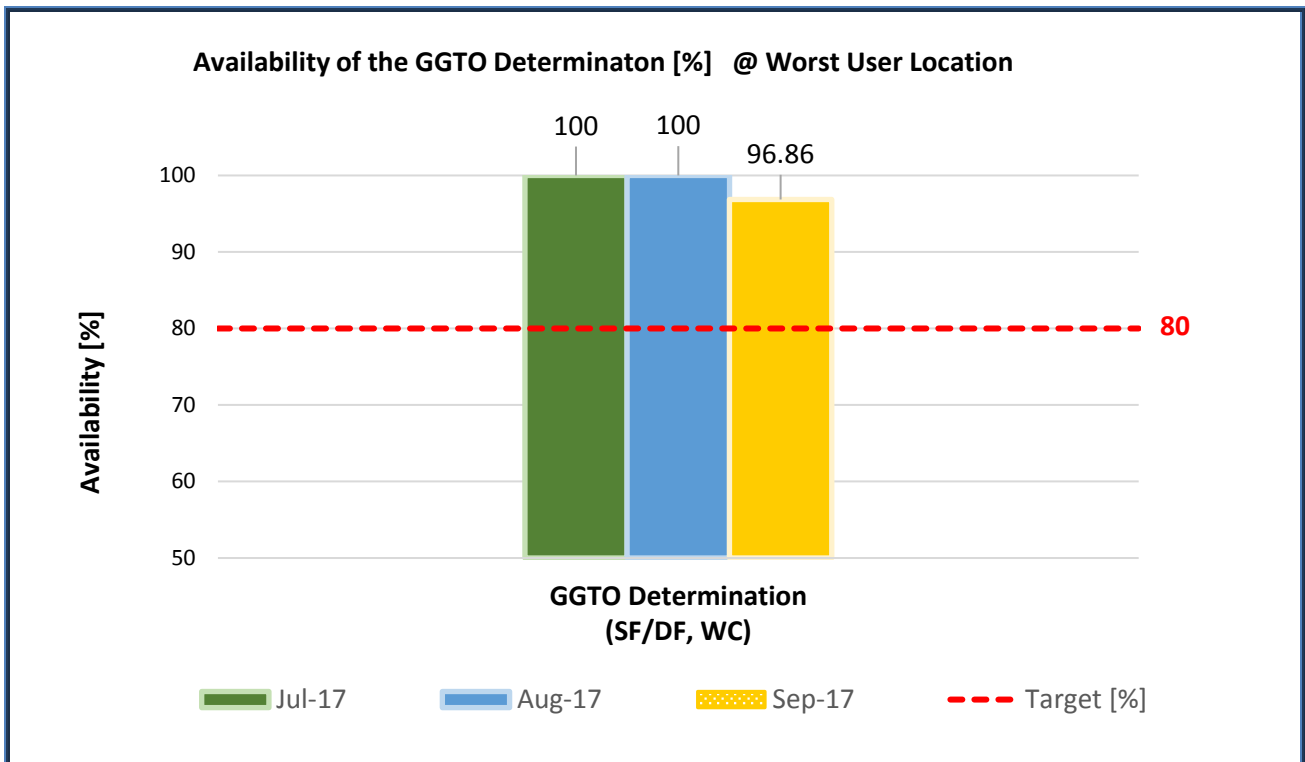


Figure 7: Evolution of the annually normalised availability of the GGTO Determination, during the reporting period

The monthly availability of the Galileo UTC Determination Service always reached **100%**.

The Galileo user GGTO Determination capability was **100%** in July and August, while it was **96.86%** in September. The reason for a slight drop of the availability figure in September is related to the release of “dummy” coefficients on September 15th @ 13:51 up to the day after @ 14:55 (ref.: NAGUs [2017038](#) and [2017039](#)).

However, the MPL of **87%**¹⁴ specified by [OS-SDD] is fully achieved.

¹³ “Dummy” GGTO is defined in [OS-SDD] and in Galileo SiS ICD in terms of “all 1’s” appearing in the GGTO parameters binary slot(s) carried by the Navigation message.

¹⁴ Ref.: [OS-SDD], §3.5.4 (Table 17) and §3.6.1.2 (Table 19)

4.2 ACCURACY OF GALILEO TIME CORRELATION PARAMETERS

The Galileo Signal in Space *Universal Time Coordinated (UTC) Time Dissemination Accuracy* and the Galileo Signal in Space *Universal Time Coordinated (UTC) Frequency Dissemination Accuracy* are computed as the daily average error of the normalized time and frequency offset relative to UTC for a user equipped with a Standard Timing / Calibration Laboratory Receiver. ¹⁵

The *Galileo to GPS Time Offset (GGTO) Determination Accuracy* is computed as the daily average of the difference between the GST-GPS Time Offset computed using the Galileo navigation message and the true GST-GPS Time Offset.

Figure 8 shows the 95th percentile of the daily average of the UTC Dissemination Accuracy, observed and normalised over a period of 12 months.

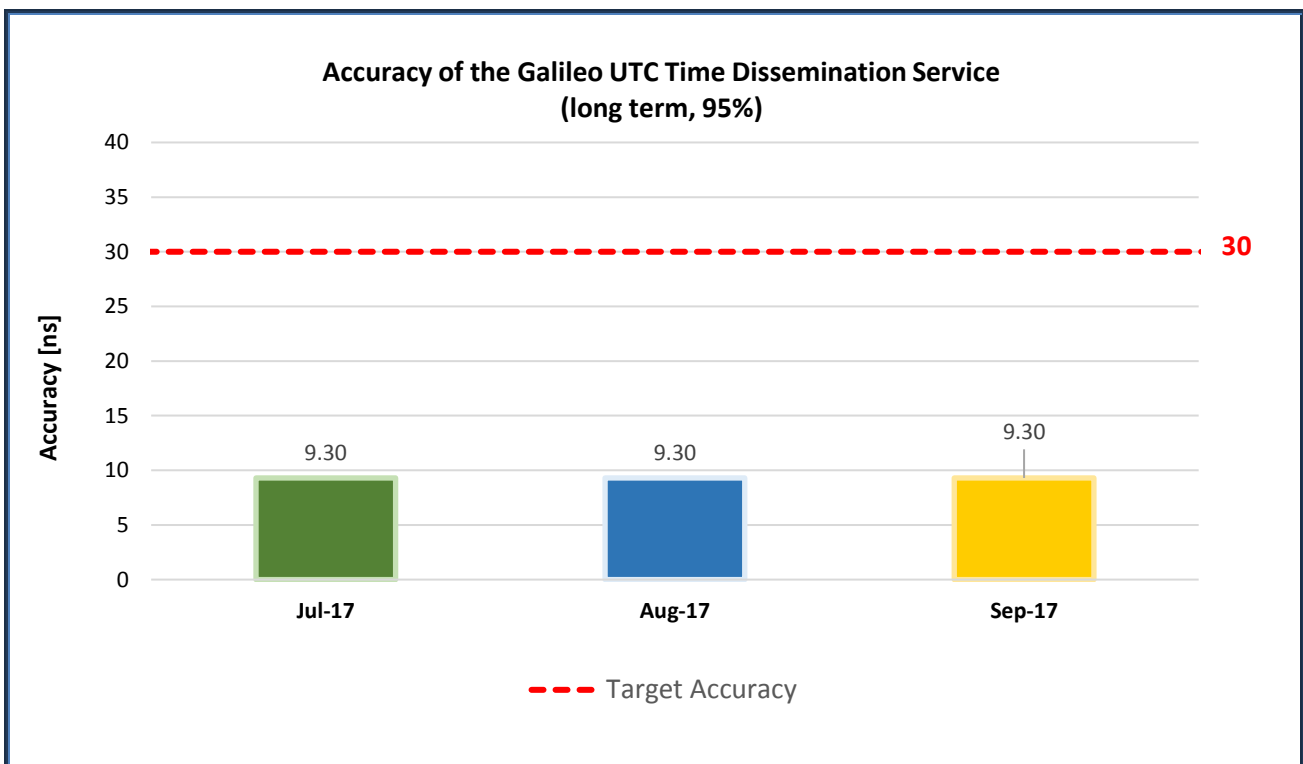


Figure 8: 95th Long-term 95% percentile of UTC Time Dissemination Accuracy

Figure 9 shows the 95th percentile of the daily average of the GGTO Determination Accuracy, normalised annually.

¹⁵ Note that the final UTC Determination Accuracy experienced by the user will also be affected by ranging errors, on top of the reported UTC Dissemination Accuracy

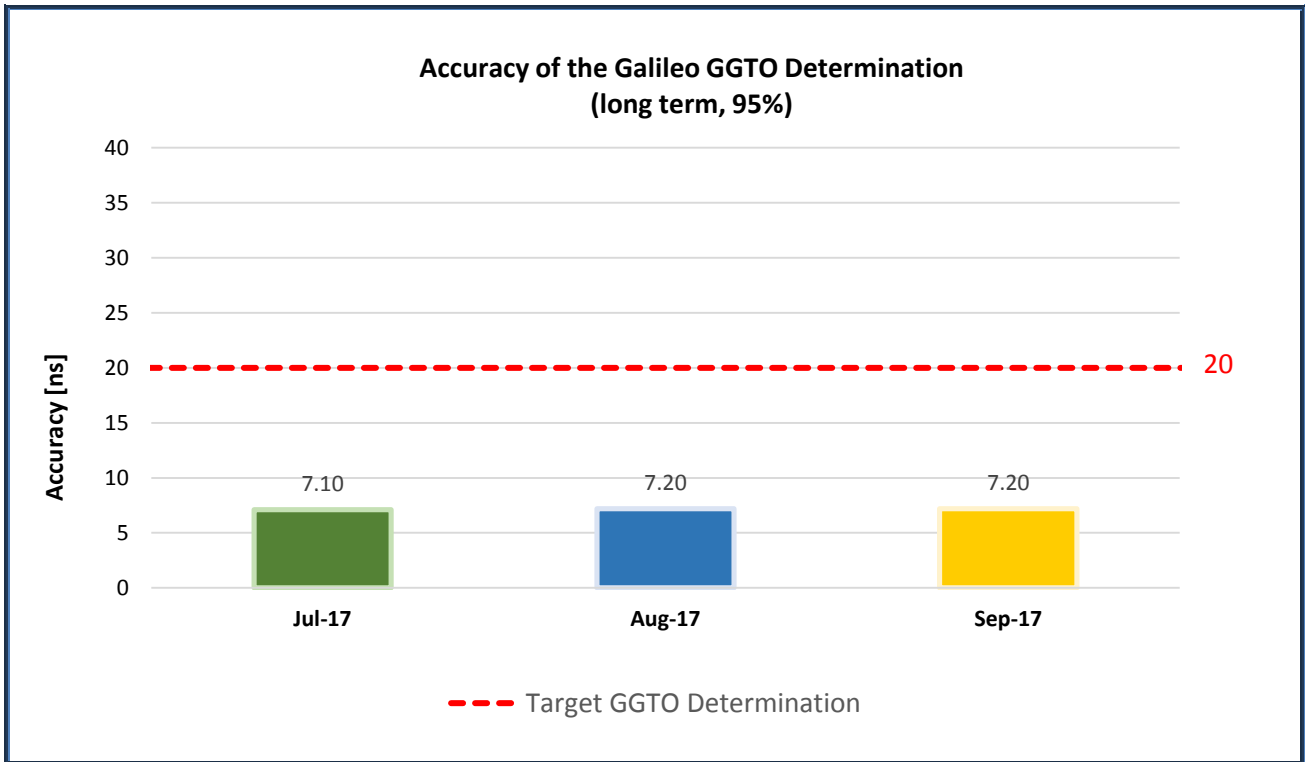


Figure 9: Long-term 95th percentile of GGTO Determination Accuracy

Figure 10 shows the 95th percentile of the UTC Frequency Dissemination Accuracy, computed accumulating measurement data over the past 12 months¹⁶.

As seen in Figure 8 and Figure 9, the long term 95th percentile of UTC (Time) Dissemination Accuracy is always around **9.3** [ns] and the GGTO Determination Accuracy is better than **7.2** [ns]. These figures are both well within the [OS-SDD] Minimum Performance Level specifications of **30** [ns] and **20** [ns], respectively¹⁷.

Regarding UTC Frequency Dissemination accuracy, Figure 10 shows that the measured 95th percentile value is always around **5.73E-14**, which is well within the [OS-SDD] MPL normalised annual ceiling of **3.0E-13**¹⁸.

¹⁶ Monthly figures result from a processing that includes measurements accumulated since an initial time which is antecedent to the declaration of Galileo Initial Services

¹⁷ Ref.: [OS-SDD], §3.4.3 (Table 12) and §3.6.1.2 (Table 18)

¹⁸ Ref.: [OS-SDD], §3.4.4 (Table 13)

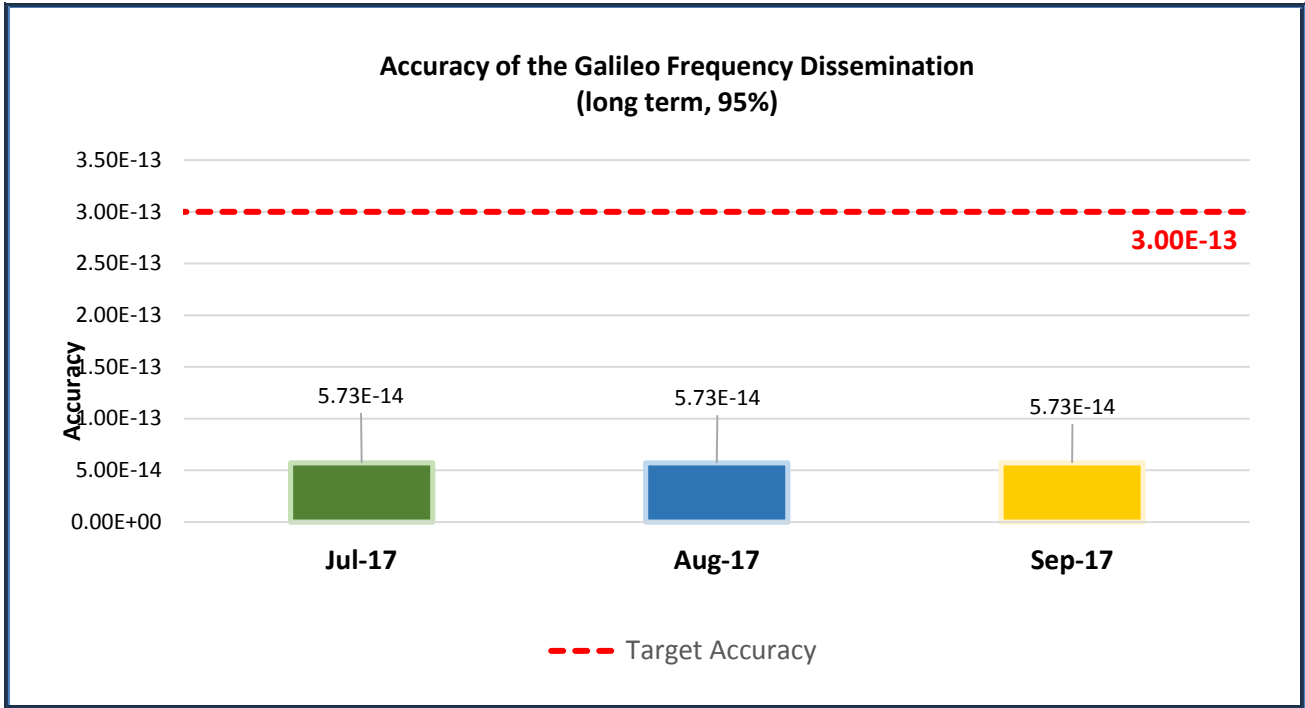


Figure 10: Long-term 95th percentile of UTC Frequency Dissemination Accuracy

5 GALILEO POSITIONING PERFORMANCE

In this section of the report the following performance figures are provided:

- ◇ Availability of Global Horizontal Dilution of precision (HDOP);
- ◇ Availability of Galileo Horizontal Positioning;
- ◇ Galileo measured Positioning Performance.

No specific MPLs are currently defined for Galileo stand-alone positioning performance. Nevertheless, the target expectation is an availability of at least 50%¹⁹.

5.1 AVAILABILITY OF GLOBAL HORIZONTAL DILUTION OF PRECISION (HDOP)

The *Availability of Global Horizontal Dilution of precision* (HDOP) is defined as the percentage of time that at least 3 Galileo satellites transmitting HEALTHY Galileo Open Service Signal in Space, above a minimum elevation angle of 5 degrees and satisfying a condition of HDOP below 5, are in view from the user locations.

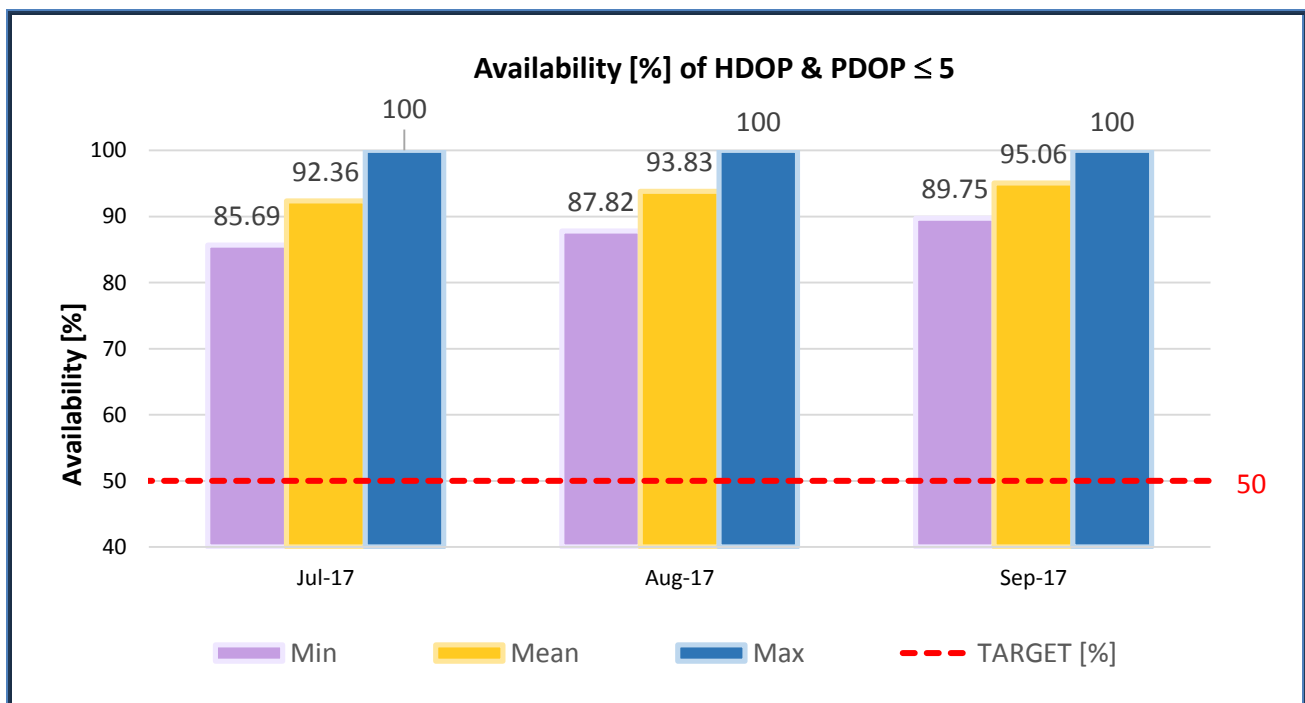


Figure 11: Availability of HDOP ≤ 5

¹⁹ Ref.: [OS-SDD], §C.7.1 (Table 25) and §C.7.2 (Table 26)

Figure 11 above shows the monthly HDOP average availability computed for a grid of user locations within the service coverage area. The progressive improvement of the availability figures over the observation period can be clearly seen. The probability of achieving a standalone Galileo 2D positioning solution with favourable DOP, thus with good accuracy, is now quite high over the whole world.

5.2 AVAILABILITY OF GALILEO HORIZONTAL POSITIONING

The *Availability of Galileo Horizontal Positioning* is defined as the percentage of time with a horizontal positioning error less than or equal to 10 [m], considering only HEALTHY⁸ Galileo Open Signal in Space from satellites above a minimum elevation angle of 5 degrees and assuming a receiver operating in “altitude hold” mode, with HDOP filtering . Horizontal Positioning assumes that Navigation Equations are to be solved in two dimensions ²⁰.

Figure 12 shows the monthly average availability computed for a grid of user locations within the service coverage area, considering only system level contributions to the positioning error.

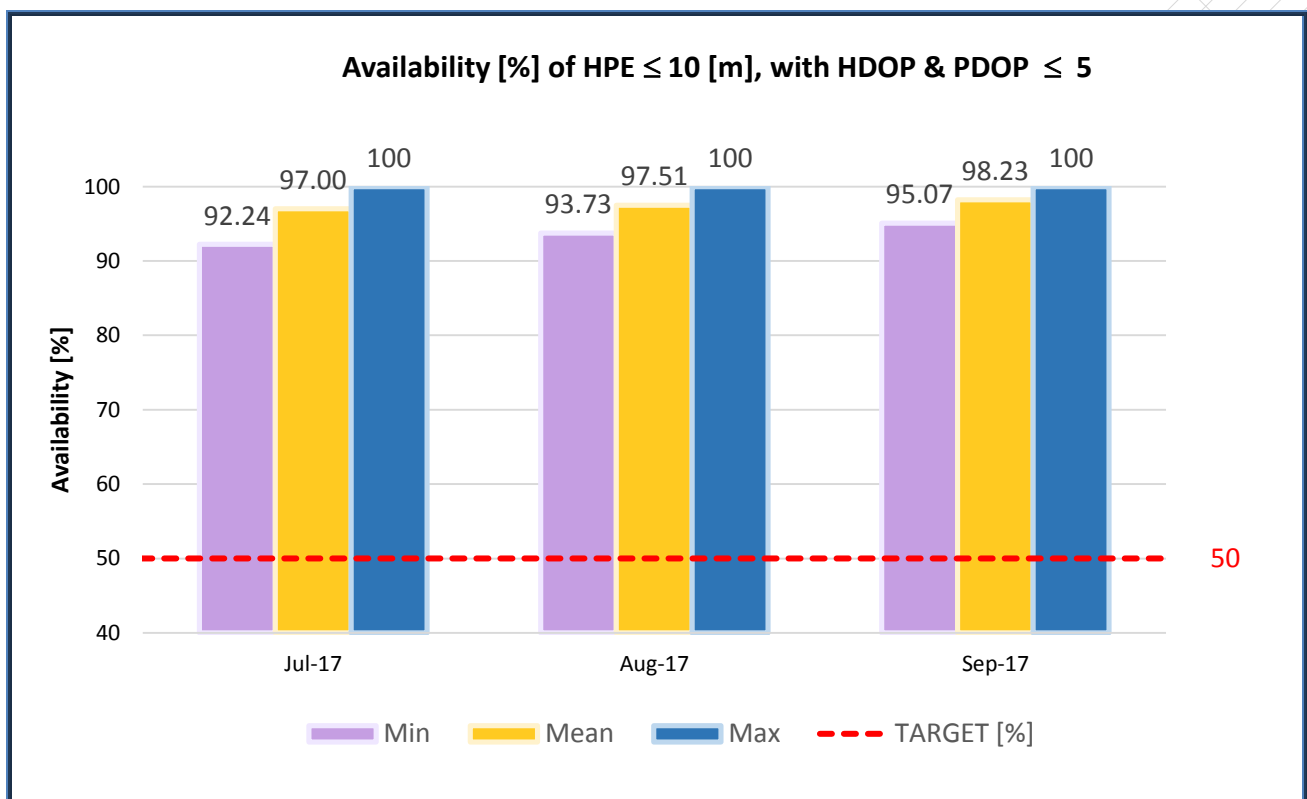


Figure 12: Availability of the Galileo Horizontal Positioning Service with Accuracy ≤ 10 [m]

Again, the figure shows a constant increase of the performance from July to September.

²⁰ E.g.: determining only user latitude and longitude, while the altitude over Earth ellipsoid is provided as input known *a priori*

5.3 GALILEO MEASURED POSITIONING PERFORMANCE

Although the Galileo FOC constellation is not yet complete and hence positioning is not yet declared as a Galileo Service, this section provides Navigation Sensor Error estimates as an indication of Galileo Navigation Positioning performance capabilities.

The following figures show the *Horizontal and Vertical Positioning Accuracy Performance* based on measurements collected over a number of test receivers, solving for user coordinates by following OS-SDD recommendations about SIS health status, "Ageing of toE"²¹ and PDOP ≤ 6. To this aim it is recalled that, according to the [OS-SDD] directions, Navigation message coefficients with an "Ageing of toE" beyond 4 hours have expired validity, so that ranging observables from a corresponding satellite and signal should not be used for positioning and/or time measurement purposes. The horizontal axis is limited on each plot to a maximum error of 20 metres. Each figure reports also the number of samples exceeding a horizontal or vertical error larger than 20 [m].

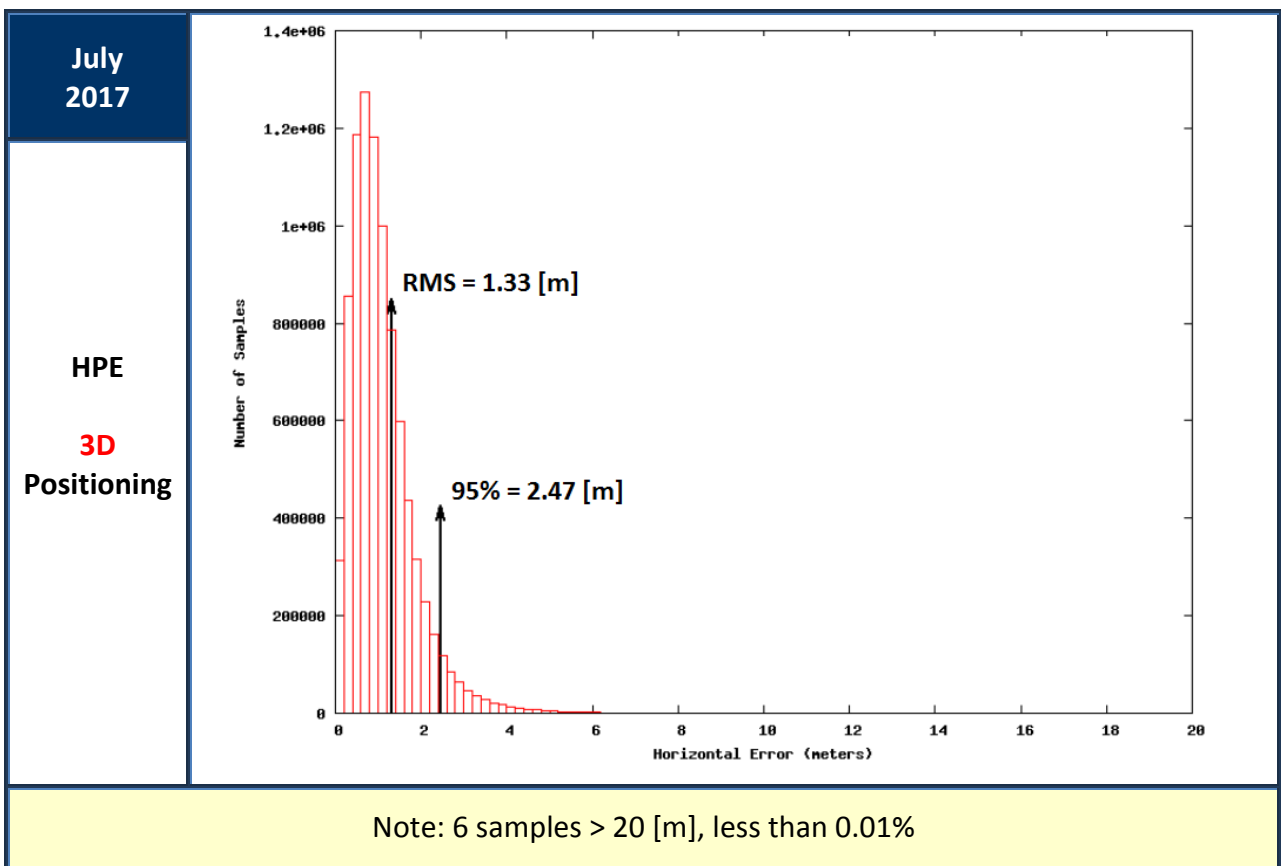


Figure 13: Horizontal Positioning Error (HPE) for "Galileo-only" users (July 2017)

²¹ Parameter "toE" (Time of Ephemeris) is disseminated in the Navigation message, as part of the Ephemeris Set. See [SIS-ICD], section 5.1.1

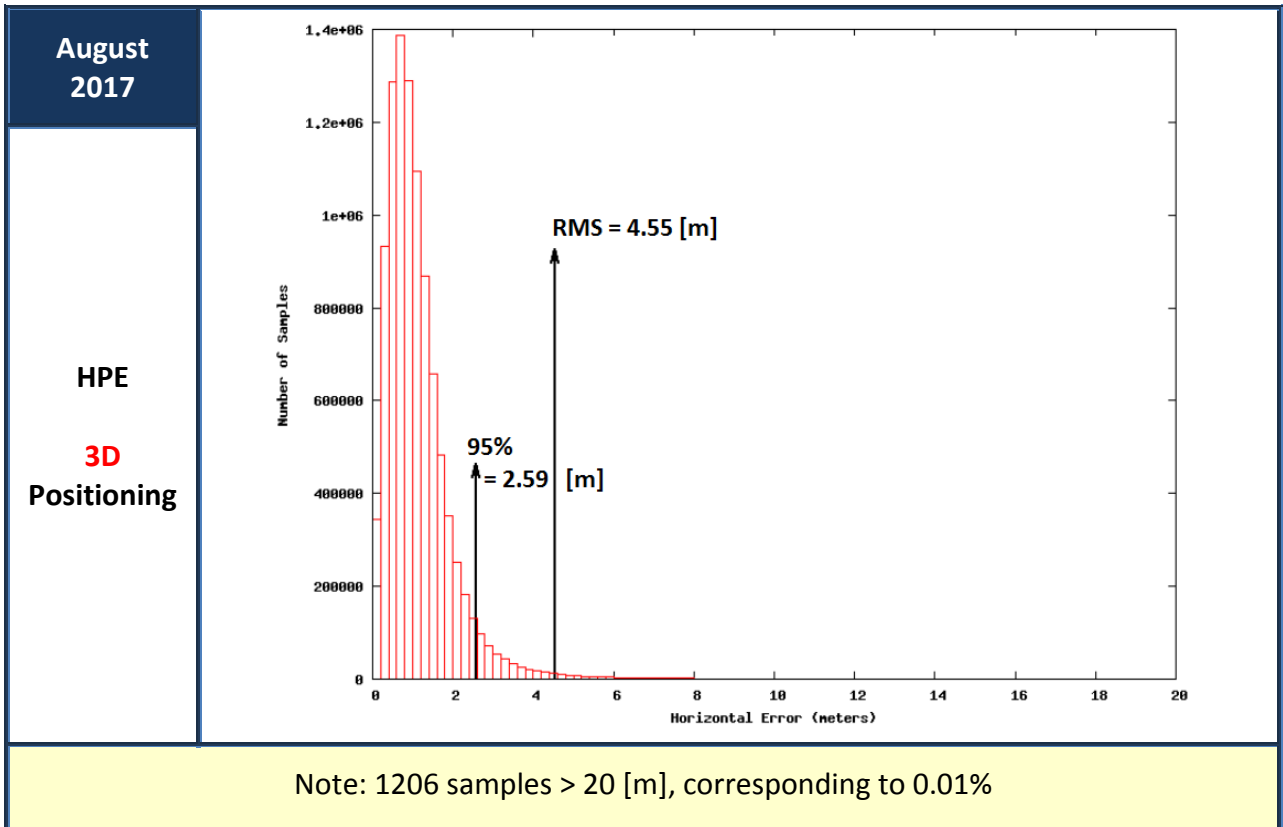


Figure 14: Horizontal Positioning Error (HPE) for “Galileo-only” users (August 2017)

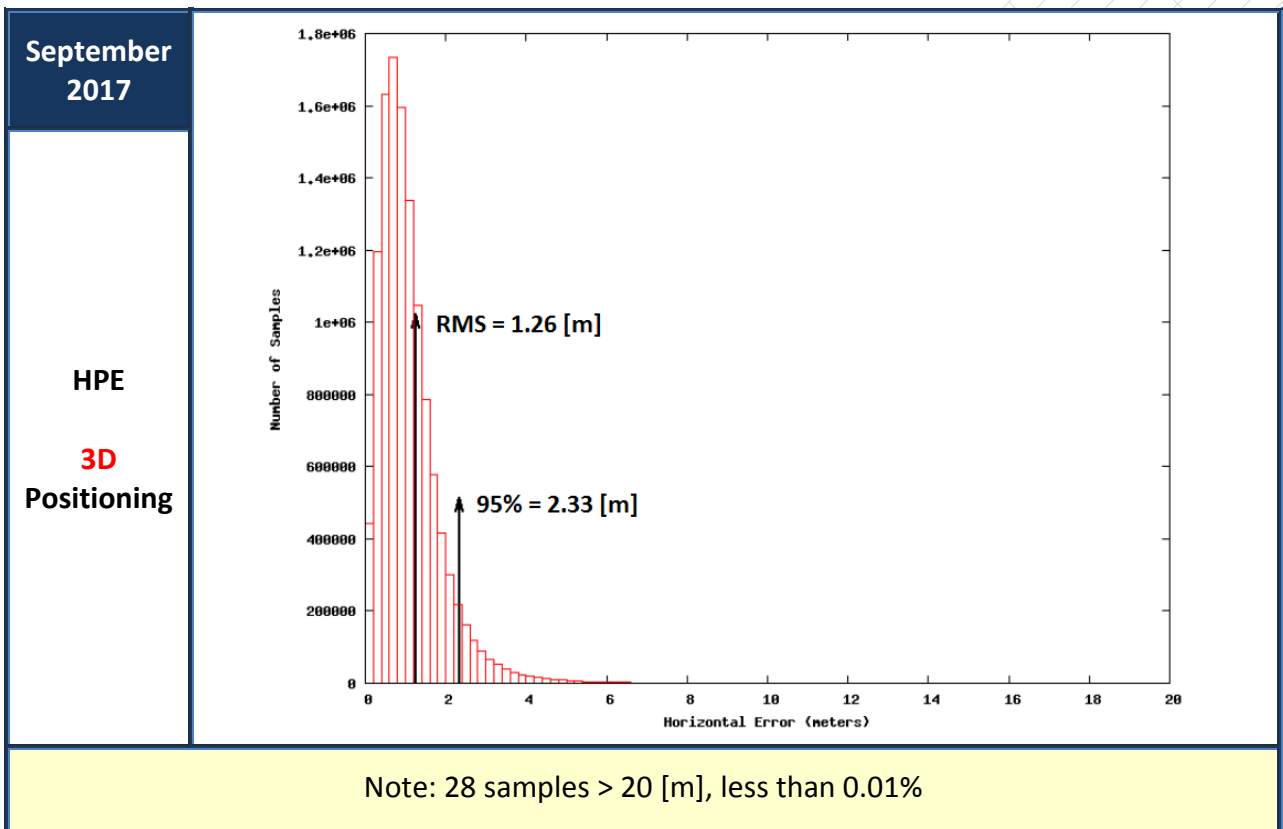


Figure 15: Horizontal Positioning Error (HPE) for “Galileo-only” users (September 2017)

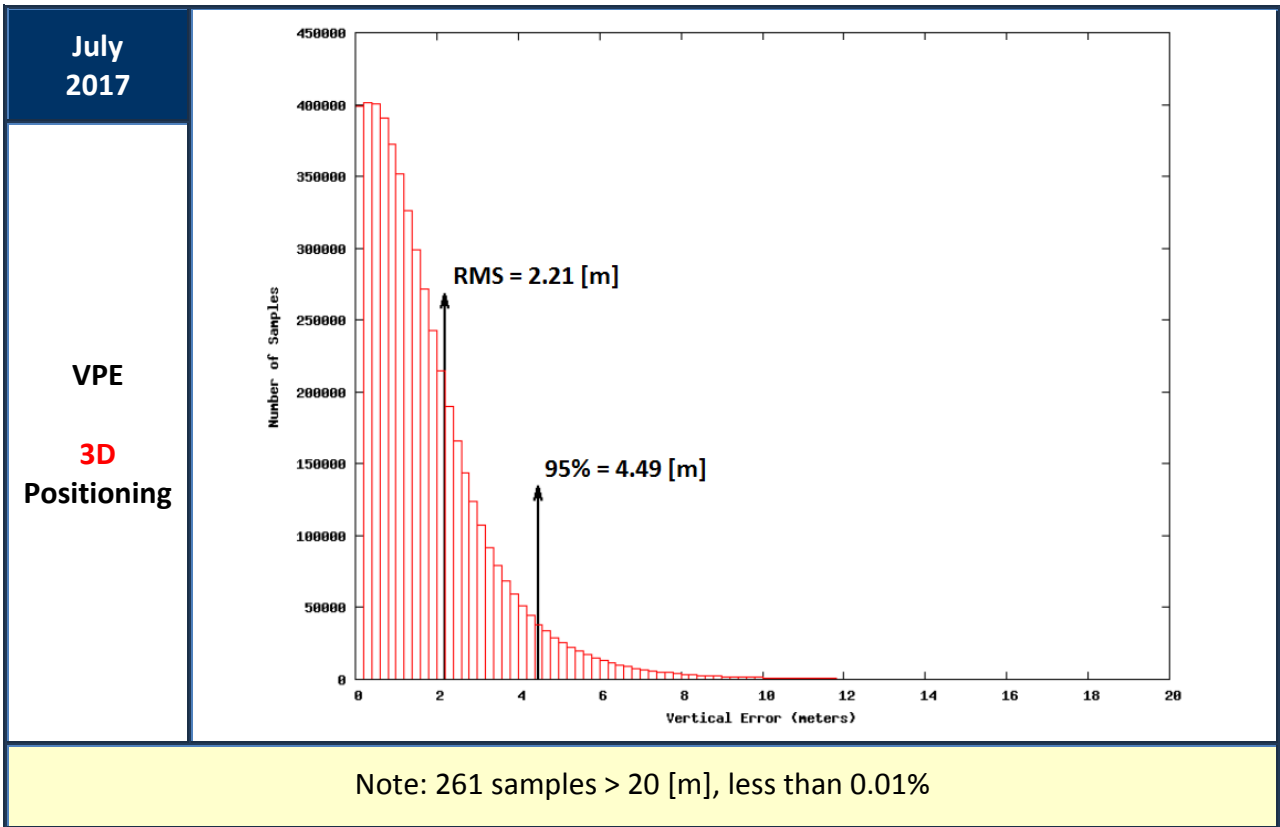


Figure 16: Vertical Positioning Error (VPE) for Galileo only users (July 2017)

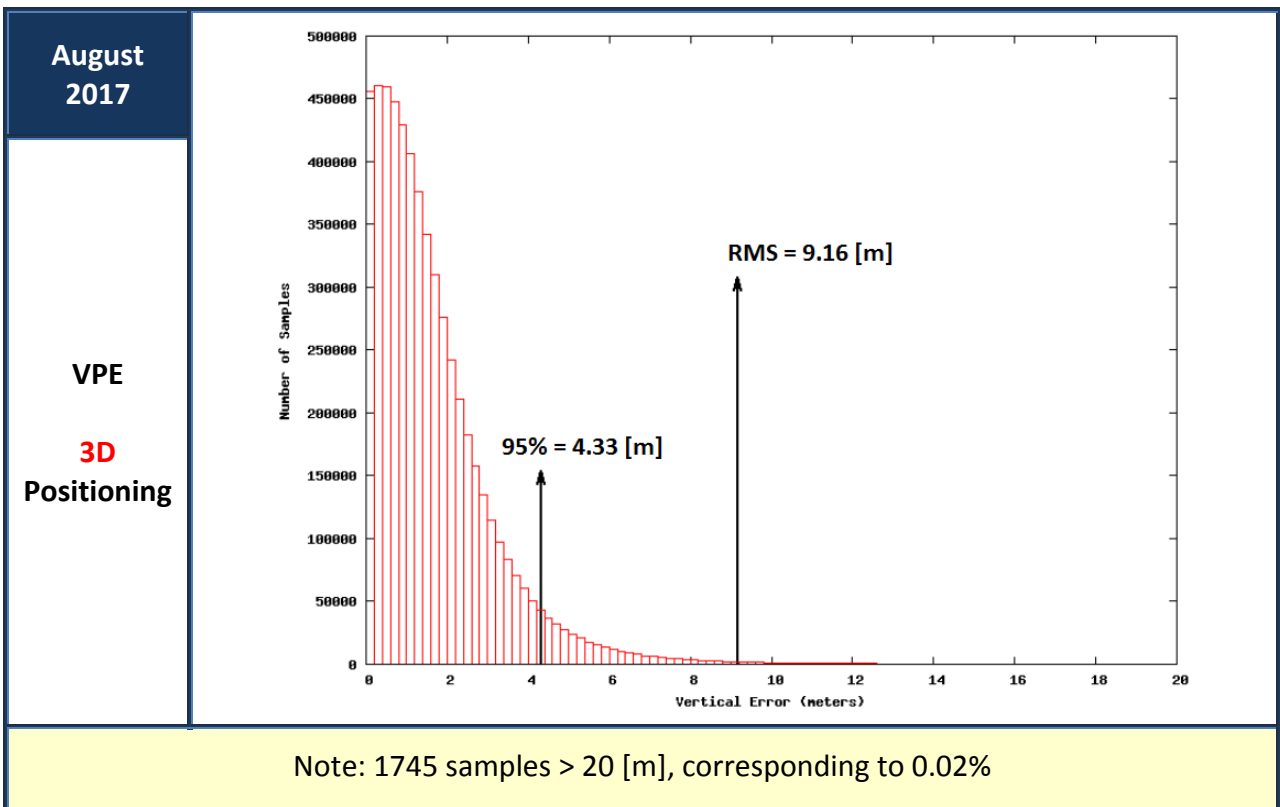


Figure 17: Vertical Positioning Error (VPE) for Galileo only users (August 2017)

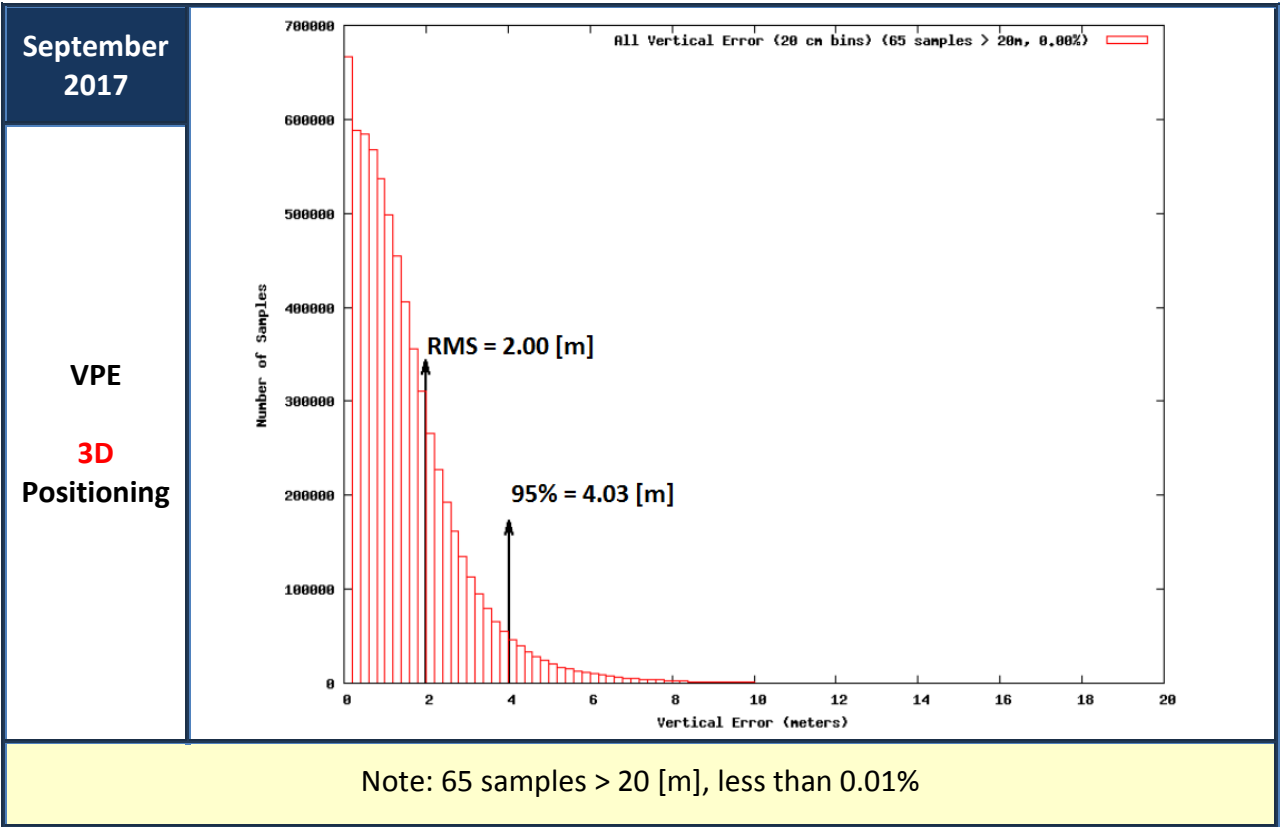


Figure 18: Vertical Positioning Error (VPE) for Galileo only users (September 2017)

6 TIMELY PUBLICATION OF NOTICE ADVISORY TO GALILEO USERS (NAGUS)

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

GNSS Service Centre NAGU Publication Service Web Pages	
NAGUs	https://www.gsc-europa.eu/system-status/user-notifications (Active user Notifications)
Information	https://www.gsc-europa.eu/system-status/user-notifications-archive (Archived user Notifications)

Table 5: GSC main information web pages for Galileo Status

During the reporting period, the **target MPLs for all NAGUs have been met in all cases.**

According to MPLs in the [OS-SDD], NAGUs related to Planned events need to be published at least **24** hours²² before the event starts. In this category, the best performance occurred in July, when the NAGU concerning GSAT-0204 (E22) undergoing clock re-synchronisation (ref.: NAGU [2017028](#)) was published 4.89 days in advance of the event.

For Unplanned events, the [OS-SDD] specifies a delay of up to **72** hours²² from the detection of the unplanned event until a corresponding NAGU is issued.

In the "Unplanned" category, the best performance was in September, with a reaction time of 0.12 days for communicating restart of the broadcast of GGTO coefficients (ref.: NAGU [2017039](#)).

No NAGUs issued in the period refer to unplanned events affecting the Space Segment.

The summary of NAGUs that have been published during the reporting period is as follows:

²² Ref.: [OS-SDD], §3.7.1 (Table 20)

Month	Category	Reason for publishing	Notice Advisory ID	Type
July	PLN_OUTAGE	GSAT-0204 (E22) undergoing clock re-synchronisation and application of relativistic correction from 01/08/2017 @ 13:35 UTC to 03/08/2017 @ 01:45 UTC	2017028	P
August	USABINIT	GSAT-0212 (E03) usable for the first time since 01/08/2017 @ 16:03, as new element of Galileo fleet providing services	2017029	U
	USABLE	GSAT-0204 (E22) usable again as of 03/08/2017@ 03:22 UTC	2017030	U
	PLN_OUTAGE	GSAT-0205 (E24) unavailable from 07/08/2017 @ 06:05 to 09/08/2017@ 15:35 UTC due to application of new clock configuration	2017031	P
	USABLE	GSAT-0205 (E24) usable again as of 09/08/2017 @ 15:08	2017032	U
	USABINIT	GSAT-0213 (E04) usable for the first time since 09/08/2017 @ 18:58, as new element of Galileo fleet providing services	2017033	U
	PLN_OUTAGE	GSAT-0214 (E05) unavailable from 21/08/2017 @ 09:00 to 22/08/2017@ 16:00 UTC due to application of new clock configuration	2017034	P
	USABLE	GSAT-0214 (E05) usable again as of 22/08/2017 @ 15:07	2017035	U
	PLN_OUTAGE	GSAT-0207 (E07) unavailable from 29/08/2017 @ 06:05 to 31/08/2017@ 11:15 UTC due to application of new clock configuration	2017036	P
	USABLE	GSAT-0207 (E07) usable again as of 31/08/2017 @ 10:20	2017037	U
September	GENERAL	Unplanned unavailability of GGTO as of 15/09/2017 13:51	2017038	U
	GENERAL	GGTO broadcast available again since 16/09/2017 14:55	2017039	U

NAGU Type Categorization: "P" = Planned, "U" = Unplanned

Table 6: NAGUs published during Quarter

7 REFERENCES

This section identifies the documents explicitly referenced in this Galileo Initial Open Service Public Performance Report.

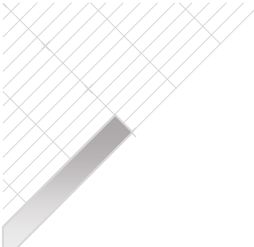
- [SIS-ICD] European GNSS (Galileo) Open Service Signal-In-Space Interface Control Document (OS-SIS-ICD), Issue 1.3, European Union, December 2016
- [IONO] Ionospheric Correction Algorithm for Galileo Single Frequency Users, Issue 1.2, European Union, September 2016
- [OS-SDD] European GNSS (Galileo) Open Service Definition Document (OS-SDD), Issue 1.0, European Union, December 2016.

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

For an exhaustive description about Minimum Performance Levels (MPLs), the reader is referred to the [OS-SDD]. Individual sections of the [OS-SDD] have been referenced throughout this report when referring to MPL target values.

8 LIST OF ACRONYMS

Acronym	Definition
DF	(Galileo OS) Dual Frequency combination (E1/E5a, E1/E5b)
DOP	Dilution of Precision
ECEF	Earth Centred, Earth Fixed frame coordinates
FOC	Full Operational Capability
GSA	European Global Navigation Satellite Systems Agency
GGTO	GST-GPS Time Offset
GMS	Galileo Mission Segment
GPS	Global Positioning System
G/S	Ground Segment
GSC	European GNSS Service Centre
GST	Galileo System Time
HDOP	Horizontal Dilution of Precision
HPE	Horizontal Positioning Error
ICD	Interface Control Document
IS	(Galileo) Initial Services
MPL	Minimum Performance Level
NAGU	Notice Advisory to Galileo Users
OS	(Galileo Navigation) Open Service
PDOP	Position Dilution of Precision
SDD	Service Definition Document
SF	(Galileo OS) Single Frequency (E1, E5a, E5b)
SIS	Signal in Space
SISE	Signal In Space Error vector (4-dimensional)



Acronym	Definition
toE	Time of Ephemeris
UTC	Universal Time Coordinated
VPE	Vertical Positioning Error
WUL	Worst User Location

End of Document

