EU SPACE

Galileo HAS status

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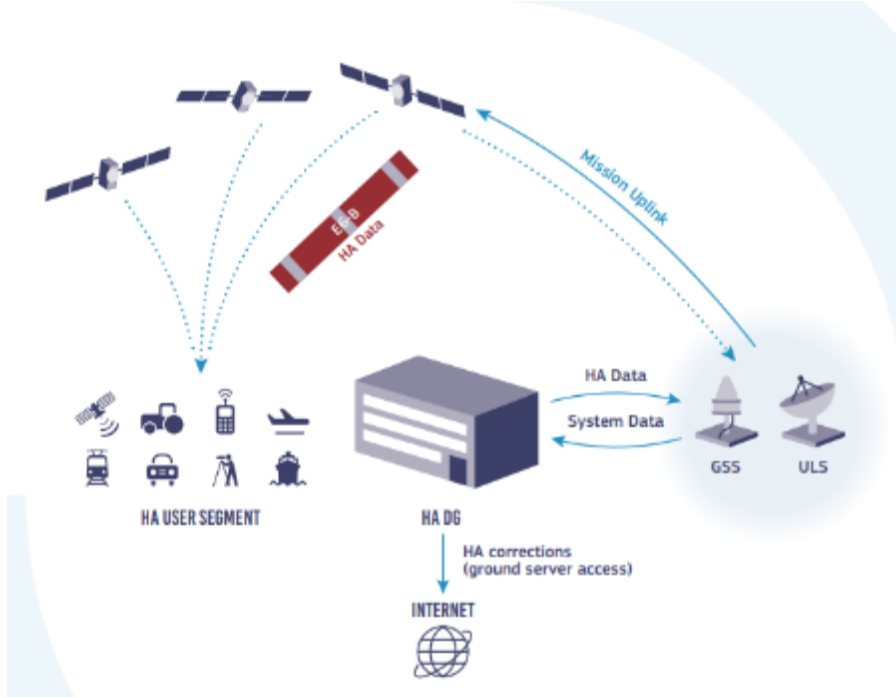
What is Galileo HAS

- Galileo HAS provides precise corrections for Galileo/GPS satellite orbit, clock and signal biases
- Galileo HAS corrections distributed via
  - Galileo satellites, E6-B signal (1278.75 MHz)
  - Internet
- Typical user accuracy in the decimetre level (after convergence), with Precise Point Positioning (PPP) receivers
- (Almost) global coverage and free

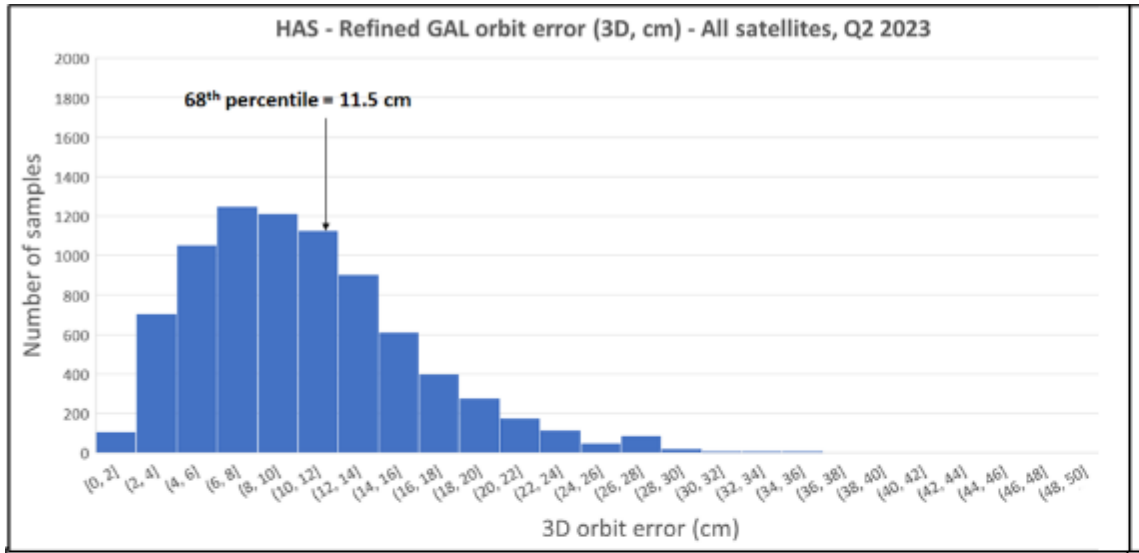


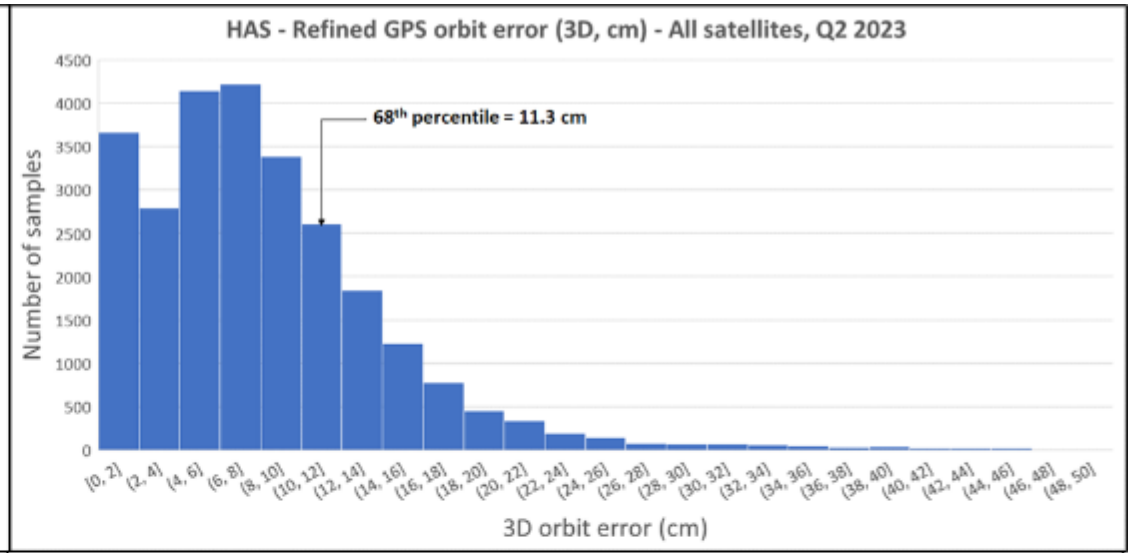
Galileo HAS performance

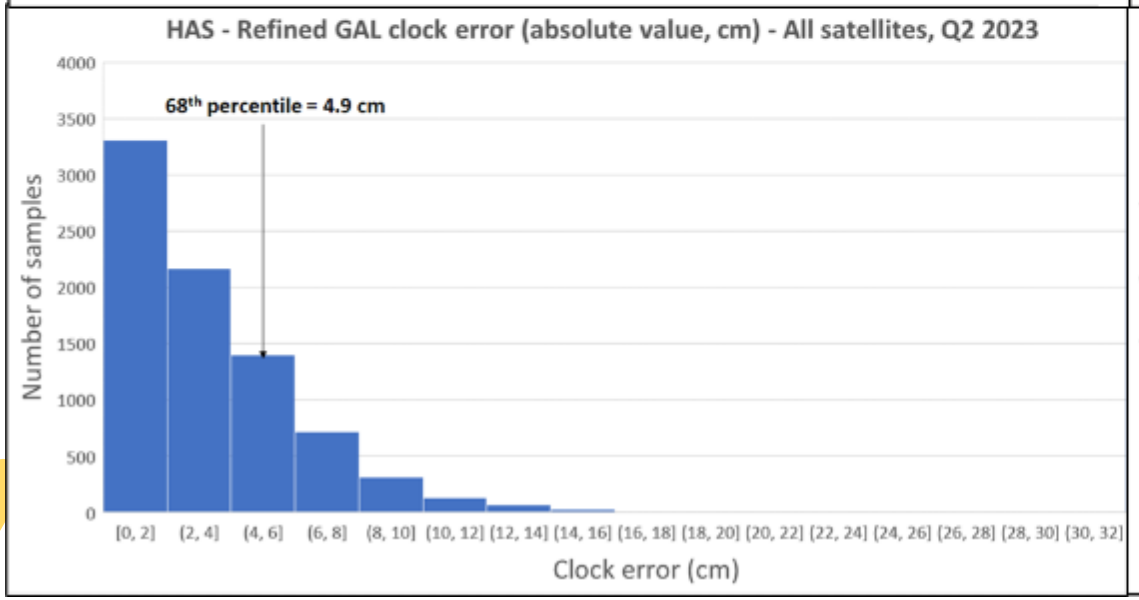
HAS	SERVICE LEVEL 1	SERVICE LEVEL 2
COVERAGE	Global	European Coverage Area (ECA)
TYPE OF CORRECTIONS	PPP - Orbit, clock, biases (code and phase)	PPP - Orbit, clock, biases (code and phase) incl. atmospheric corrections
CORRECTIONS DISSEMINATION	SIS (Galileo E6-B) and IDD (Ntrip)	SIS (Galileo E6-B) and IDD (Ntrip)
SUPPORTED CONSTELLATIONS & FREQUENCIES	Galileo E1/E5a/E5b/E6/E5 AltBOC GPS L1/L5/L2C	Galileo E1/E5a/E5b/E6/E5 GPS L1/L5/L2C
HORIZONTAL ACCURACY 95%	<20 cm	<20cm
VERTICAL ACCURACY 95%	<40cm	<40cm
CONVERGENCE TIME	<300 s	<100 s
USER HELPDESK	24/7	24/7

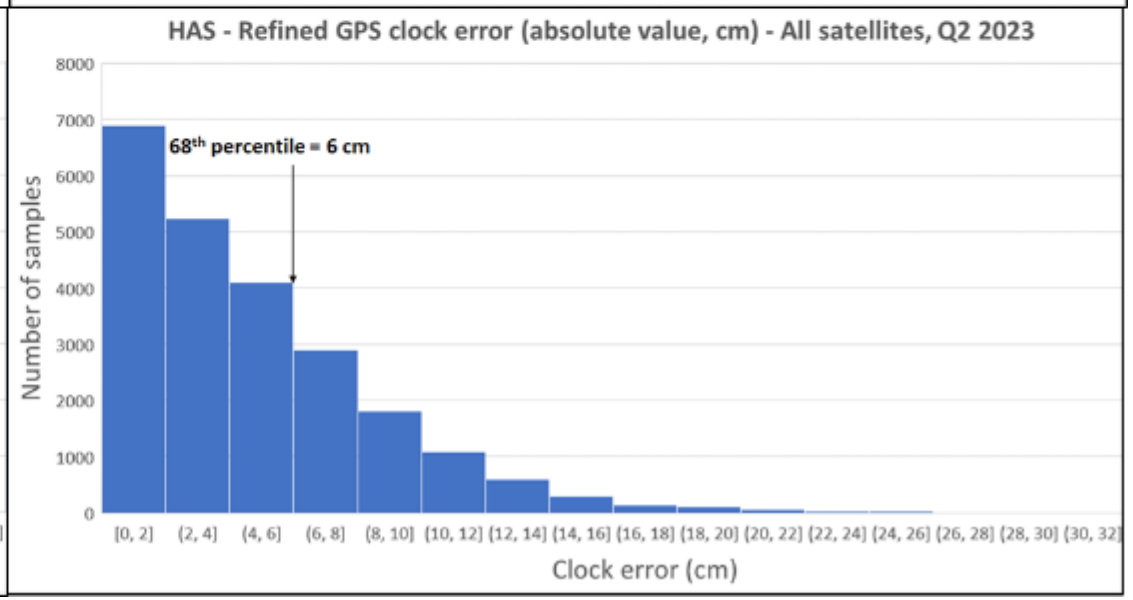
https://www.gsc-europa.eu/electronic-library/programme-reference-documents#ACCURACY

Galileo HAS performance – product accuracy



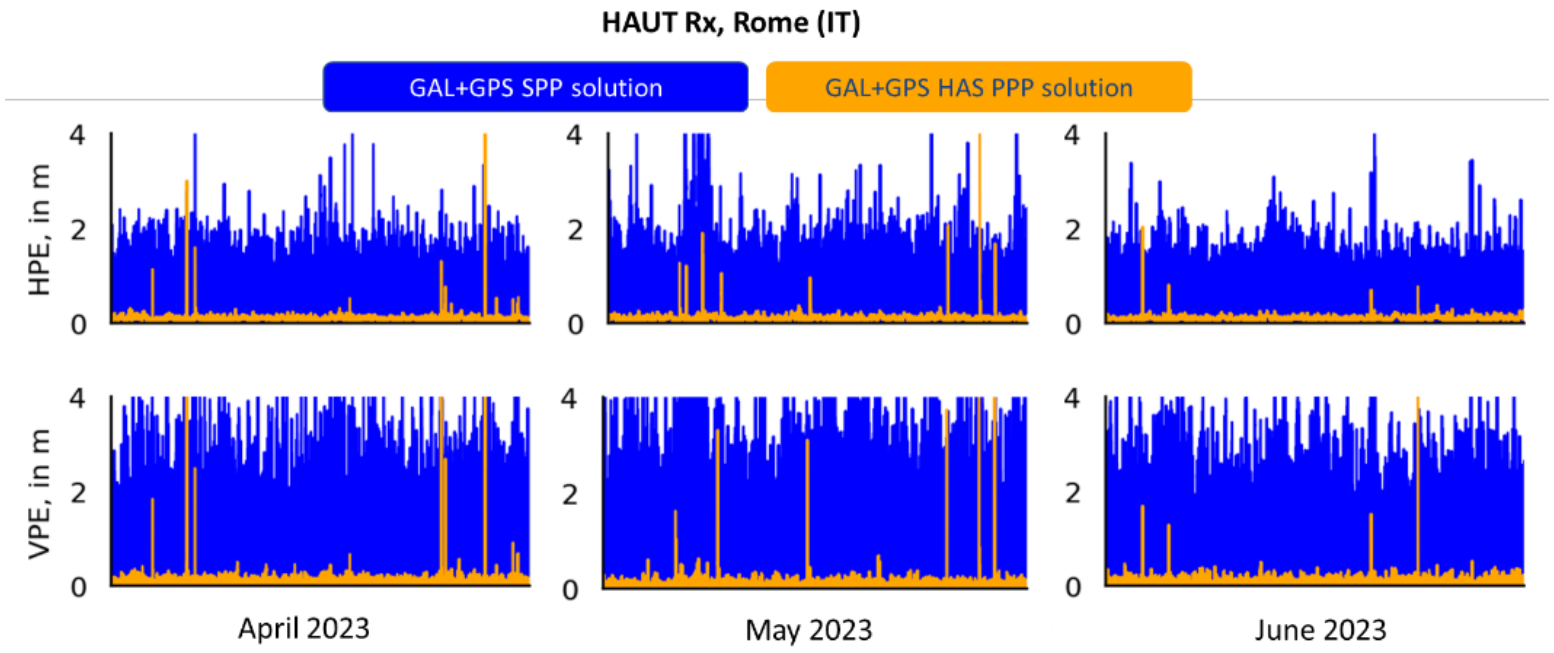


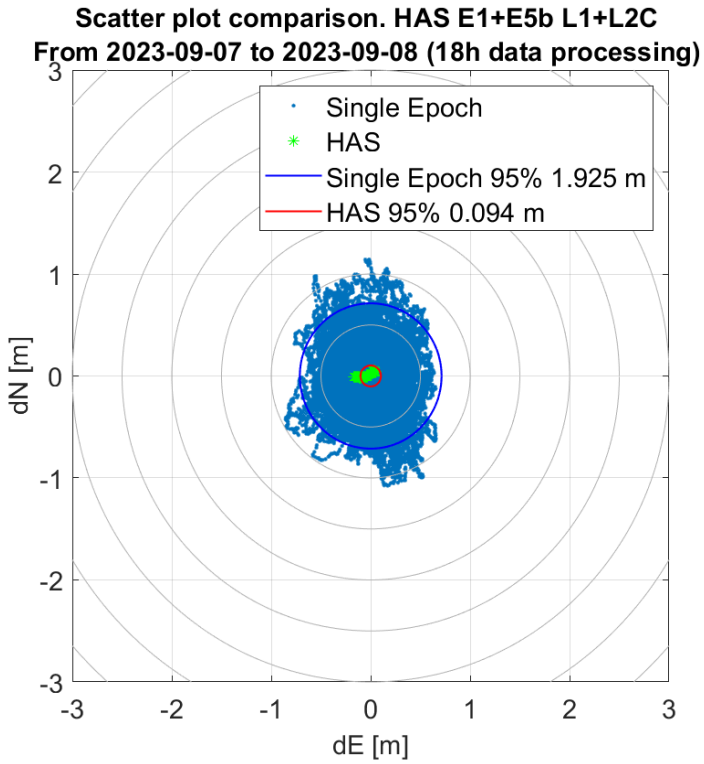




http://www.gsc-europa.eu/electronic-library/performance-reports/galileo-high-accuracy-service-has

Galileo HAS performance – user accuracy

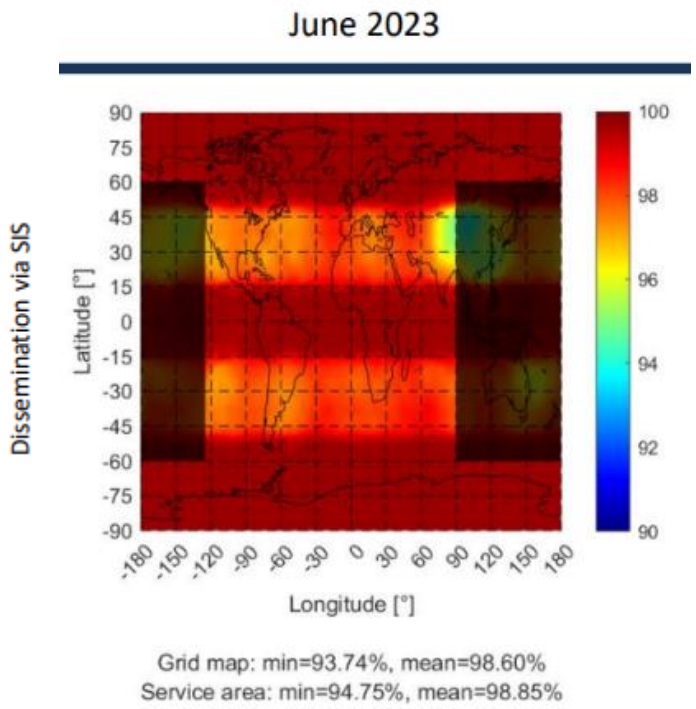




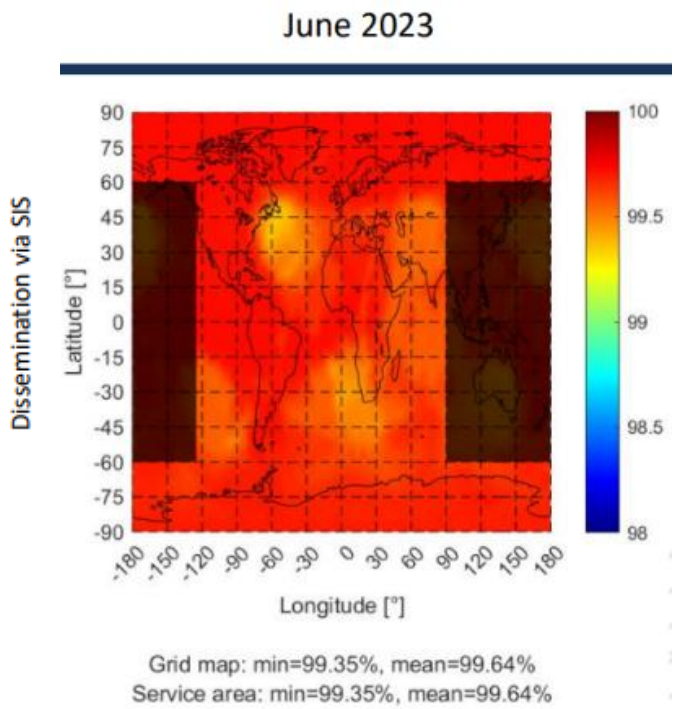
Source: EUSPA/JRC

Galileo HAS performance – availability

- availability of at least 5 corrected Galileo satellites in view



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



HAS Performance – PPP Accuracy worldwide

	Errors RMS (cm)			Errors P95 (cm)	
Europe & Africa	North	East	Height	Horizontal	Vertical
SPTR	4.5	6.6	13.8	19.5	26.5
ROBU	5.7	6.6	14.0	17.3	26.8
SWOJ	6.5	6.1	14.6	13.5	28.3
NAWI	4.0	5.3	14.4	18.1	25.3
America	North	East	Height	Horizontal	Vertical
USNA	6.0	8.3	17.5	19.8	32.9
CABU	6.1	9.0	21.9	21.4	38.1
CHSA	8.8	13.7	24.0	26.5	36.1
FRTA	9.1	9.7	24.2	27.0	40.7
Asia	North	East	Height	Horizontal	Vertical
INKO	5.8	8.7	21.8	19.1	35.7
TATA	8.6	15.9	27.0	33.1	52.2

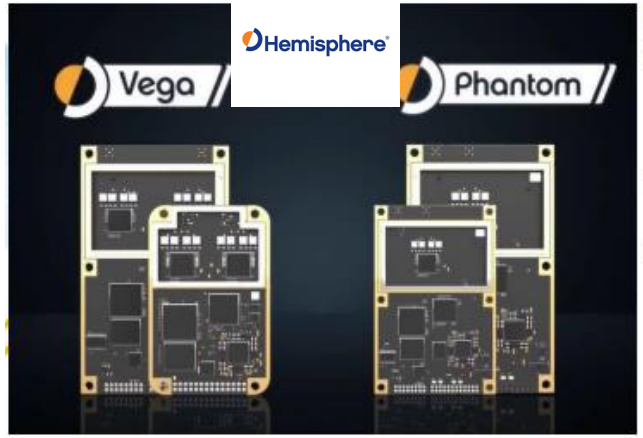
Source: GMV. Results from 31/8-5/9/22.

Typical HAS products over 24h, 10-11/Oct/2023

Source: EUSPA

Galileo HAS adoption: some examples

The Arrow Gold+™ is the first GNSS receiver in the GIS market to support the new Galileo High-Accuracy Initial Service, providing free out-of-the-box 20 centimeter accuracy anywhere in the world.

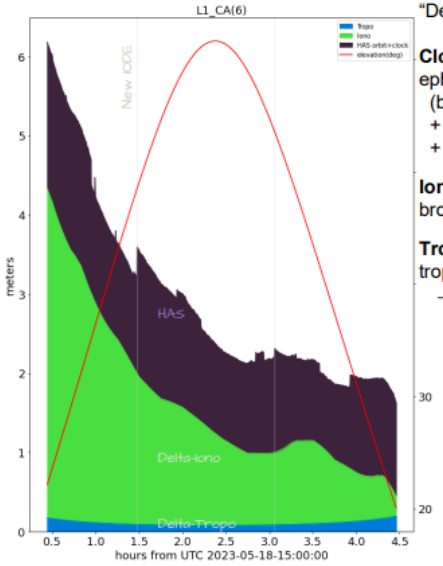


Hemisphere and HAS

- Phantom and Vega platforms include E6BC signal capability
- Beta released in February 2023
- Full release in July 2023 with firmware version 6.1.1

GALILEO HAS COVERAGE AT IONGNSS+ 2023

- **Selected presentations:**
  - ***The Galileo High Accuracy Service (HAS): A Pioneer Free-of-Charge Precise Positioning Service***
  - ***Enhancing Global PPP Service Reliability with Hemisphere Atlas® and Galileo HAS: A Dual Redundant Approach***
  - ***PPP Performance Assessment Setup for Galileo High Accuracy Service***
  - ***Galileo High Accuracy Service SDR Implementation***
  - ***Testing the Galileo High Accuracy Service in Different Operational Scenarios***
  - ***Achieving Sub-Decimetre Accuracy with the Galileo High Accuracy Service: Results from GMV's HAS Positioning Engine***
- Alternates:
  - *Performance Assessment of Galileo High Accuracy Service (HAS) with Low-Cost GNSS/IMU Sensors in Urban Driving Environments*
  - *Characterization of Galileo High Accuracy Service (HAS) Corrections and Positioning Performance in Initial Phase*
  - *The Galileo High Accuracy Service: Assessment of the Quality of Corrections and Preliminary PPP Performance*
  - *Assessment of Galileo High Accuracy Service (HAS) using the Galileo High Accuracy Reference Algorithm and User Terminal (HAUT)*



"Delta-Layer Cake"

Clock & orbit: corrections to ephemeris position and clock:
(broadcast error af_0, af_1, af_2,
+ group delay
+ relativistic offset)

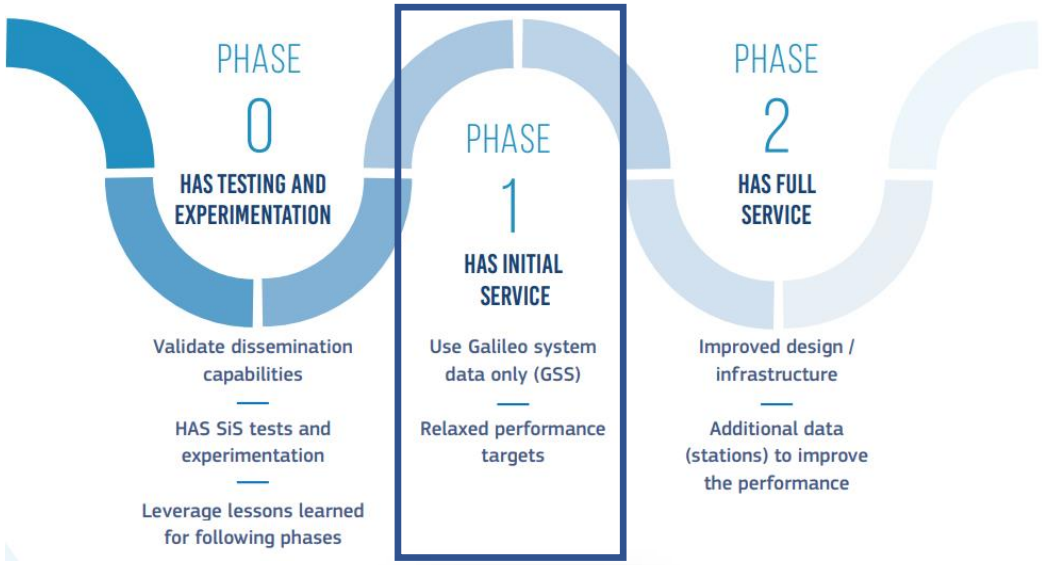
Iono: corrections to broadcast iono model

Tropo: corrections to nominal tropo delay

android

Summary and next steps

- Galileo HAS provides free orbit/clock/bias corrections worldwide for Galileo and GPS through E6B SIS and internet
- Allows dm-level accuracy with PPP algorithms
- In service since Jan’23
- HAS-enabled receivers in the market and many more to come!
- Next steps:
  - UA publication before end of the year, incl. test vectors (Dec’23)
  - Addition of GSS and provision of phase biases
  - Provision of data authentication, error confidence levels, ionospheric corrections over Europe, and better performance over next years (2025/26 timeframe)



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THE FUTURE
gmv
European GNSS Service Center
And many more...

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