EU SPACE

Galileo Programme Status

UNOOSA GNSS Workshop

05 December 2022

Vienna

European Commission (EC)
European Space Agency (ESA)
European Union Agency for the Space Programme (EUSPA)

EU SPACE

esa

EU Statement on the War in Ukraine:

Russia's unprovoked and unjustified military aggression against Ukraine grossly violates international law and the principles of the UN Charter. It undermines European and global security and stability.

Thousands of innocent men women and children have been killed and more than 13 million people have been displaced.

Russia should cease its military aggression and withdraw all forces and military equipment from the entire territory of Ukraine immediately and unconditionally.

Russia is also called to fully respect Ukraine's territorial integrity, sovereignty and independence within its internationally recognised borders.

@2022

- Roadmap to Open Service Full Operational Capability
- Two additional launches required (L12/L13) to ensure one spare satellite per plane, initially planned using Soyuz
- Consolidation of launch plan on-going with Arianespace based on development plan for the Ariane 6-2 Launcher

- Service availability already 98-99%
- New ground segment deployed
- New satellite software to bring INAV message improvements (faster acquisition and data robustness)
- Improvements do not depend on completion of the constellation
- Target Q1 2023 for New OS Service Definition Document including extended operation mode, faster incident notification and other improvements

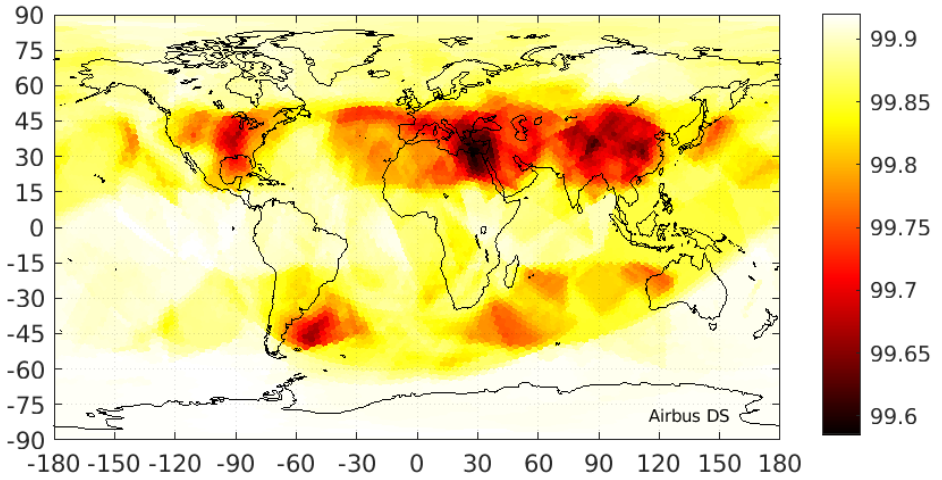
OSNMA

- **Long awaited GNSS feature becoming a reality !**
- OSNMA SIS ICD and receiver guidelines for Public Observation ready since Nov’21
- OSNMA stably transmitted worldwide in E1B for almost one year
- Initial Service declaration foreseen for first half of 2023
- First OSNMA receivers in the market available

OSNMA-transmitting satellites

	1 sat. over 30°	1 sat. over 20°	2 sat. over 10°	4 sat. over 5°
Jun. 2022	96.7 %	99.5 %	98.8 %	96.0 %
May 2022	98.4 %	99.5 %	98.3 %	80.9%
Apr. 2022	98.5 %	99.2 %	98.6 %	83.3 %
Mar. 2022	97.4 %	98.7 %	97.3 %	79.0 %
Feb. 2022	98.9 %	99.7 %	99.1 %	85.9 %
Jan. 2022	99.0 %	99.4 %	98.1 %	82.2 %
Dec. 2021	98.9 %	99.4 %	98.7 %	83.4 %
Nov. 2021	97.4 %	97.8 %	97.3 %	80.7 %

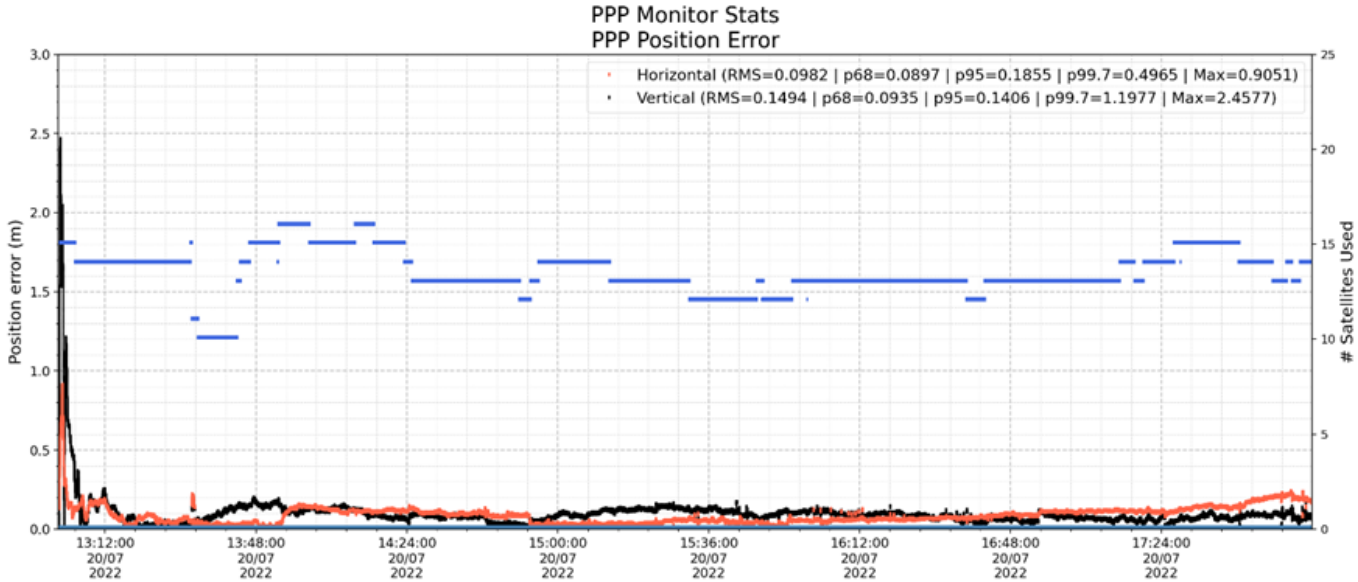
Results in EU; NB: less than 4 sats allow OSNMA PVT; source: JRC



High Accuracy Service

- HAS SIS ICD available since May ‘22
- Since July ‘22, HAS signal also available worldwide with orbit and clock corrections and biases for Galileo (E1, E5a/b, E6) and GPS (L1C/A, L2C)
- **Still in validation phase, but very high performance already!**
- Initial Service declaration foreseen for end ’22, including an internet-based correction distribution service

NEW
GALILEO
HAS SIS ICD
PUBLISHED



Initial HAS Galileo+GPS, 2f iono-free, float, open sky, static. Based on MagicPPP/PAULA project

Search and Rescue

– Service performing extremely well
  - ***forward link*** (since Dec 2016)
  - ***return link*** (since Jan 2021)

– EU Coverage with 3 MEOLUT

– Extension to Indian Ocean with 4th MEOLUT in Q1 2023 (Reunion Island)

New features coming:

- EUROCAE approved **remote beacon activation** from 2023
- Quicker rescues enabled via **distress beacon position sharing**
- **Two-way communication** possible using return link feature

Emergency Warning Service

- On-demand broadcast (L1 band) of alerts and guidance to population at risk
- Alert activation decided by national civil protection
- Public demonstration phase Q1 2023 to Q3 2023
- Service declaration 2024

Galileo
Emergency
Warning
Service

Advantage of Galileo EWS:

- Reaches population at large scale in ~ 1 minute
- No specific equipment needed. Simply a user terminal with Galileo chipset in it
- Available also when terrestrial alert systems are down (collapsed or saturated)

COMMON STANDARD NOW AGREED WITH JAPAN AND OTHERS ARE INTERESTED

Other Services coming

- Advanced timing service
- Space Service Volume
- ARAIM for safety of life application
- Contribution to ionosphere prediction

Support to Users

Performance monitoring and reporting

- Galileo Reference Centre

Service notice, NAGUs, Helpdesk, training, support to startups

- Galileo Service Centre

Market development & User Consultation EUSPA

Testing lab for new features

- Joint Research Centre

Receiver developments

- Fundamental elements programme
- Bilateral agreements with manufacturers

G2G and Beyond

- Legal basis and requirements baseline in place
- Budget available
- Fast Track towards Galileo 2nd Generation
- R&D activity in parallel to maintain security of supply and study emerging concepts for GNSS (LEO-PNT)

From R&D….

…to launch and exploitation !

Resiliency Above All

- GNSS applications are ubiquitous and need additional resilience
  - Resiliency of GNSS (signals modulation/power, authentication, receivers, antenna, ..)
  - Interference / Spoofing detection capability (on ground, inside receiver, through space)

- LEO PNT --> target new missions and exploit synergies with the EU's new IRIS^2 global secure connectivity system
- Alt PNT --> Testing and Demo Day at Joint Research Centre
- New version of European Radio Navigation Plan
- Regulatory actions in Europe and at ITU

Galileo Constellation Status:

Navigation (23 in service)
Search and Rescue (25 in service)

28 satellites in orbit

3 not usable

1 spare

1 unavailable

2 no SAR (by design)

GSAT 104 (Spare, NAVANT failure), relocation from C05 to C14 completed on 12/05/2021

GSAT 204 (Spare, SAR off), relocation from B03 to B14 completed on 06/05/2021 (NAGU 2017045)

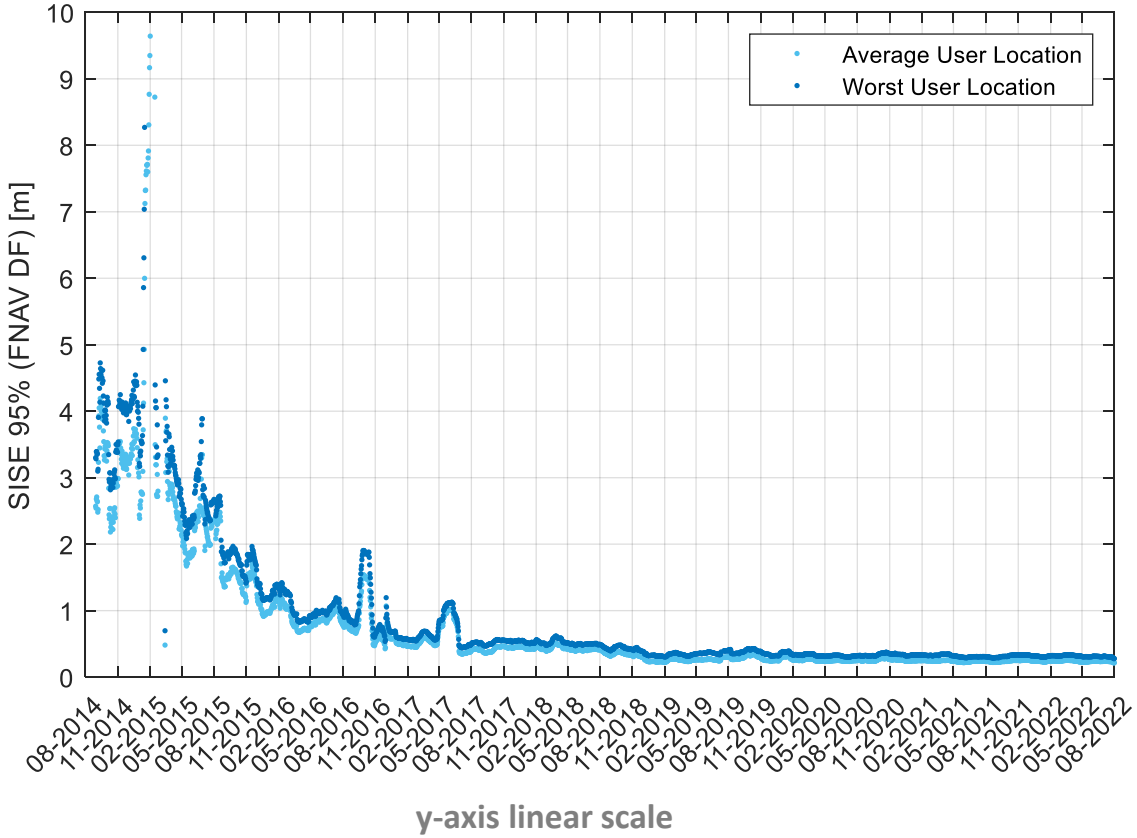
GSAT 201/202 (set to unhealthy)

GSAT 210 currently **Not Usable** ((DVS=WWG), NAGU2022035)

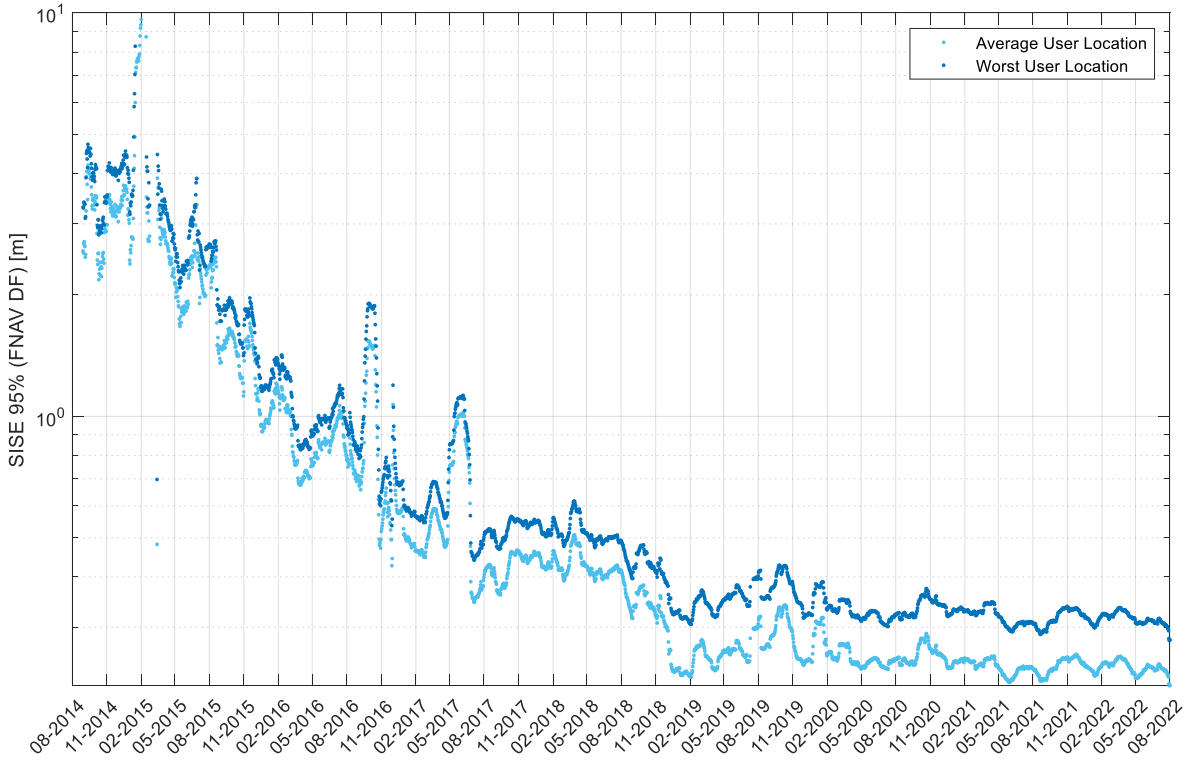
L11 slots on Plane B: B03, B15

GSAT223/224 entered into Service on 29 August

As-observed Ranging Performance
STABLE



y-axis linear scale

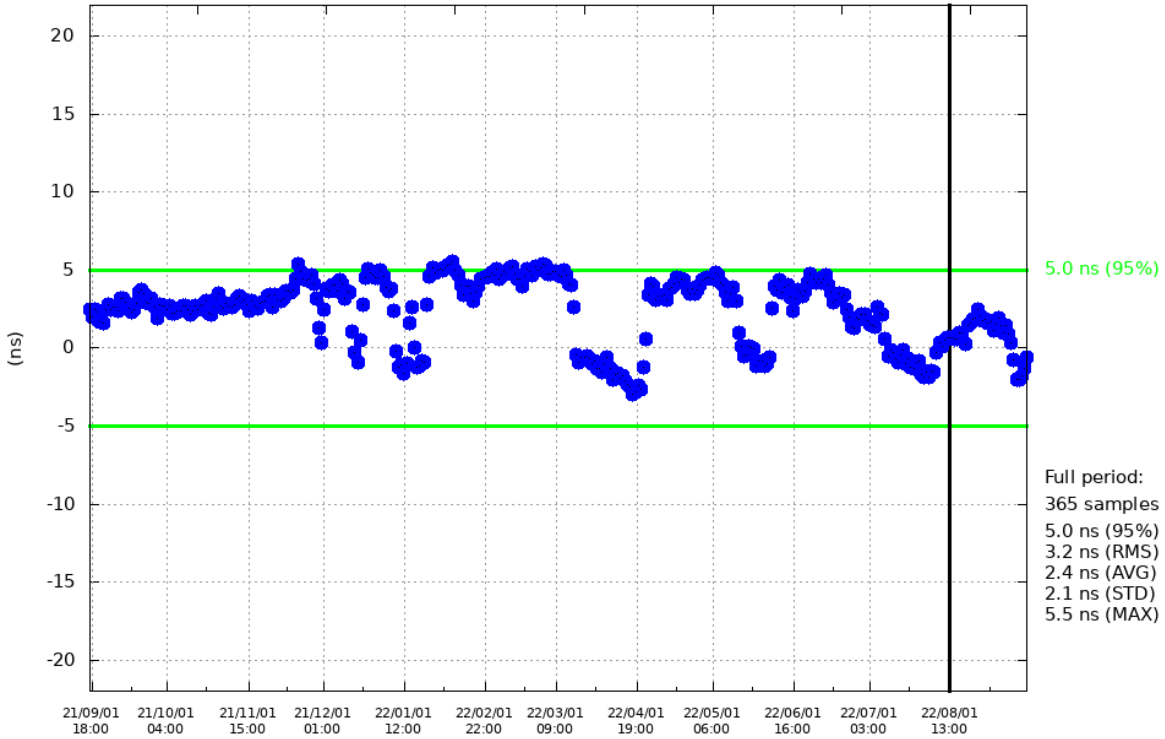


y-axis log scale

- **Very stable Signal In Space Ranging Error (SISE) trend → 0.22m (95%)** all satellites, in July (FNAV)

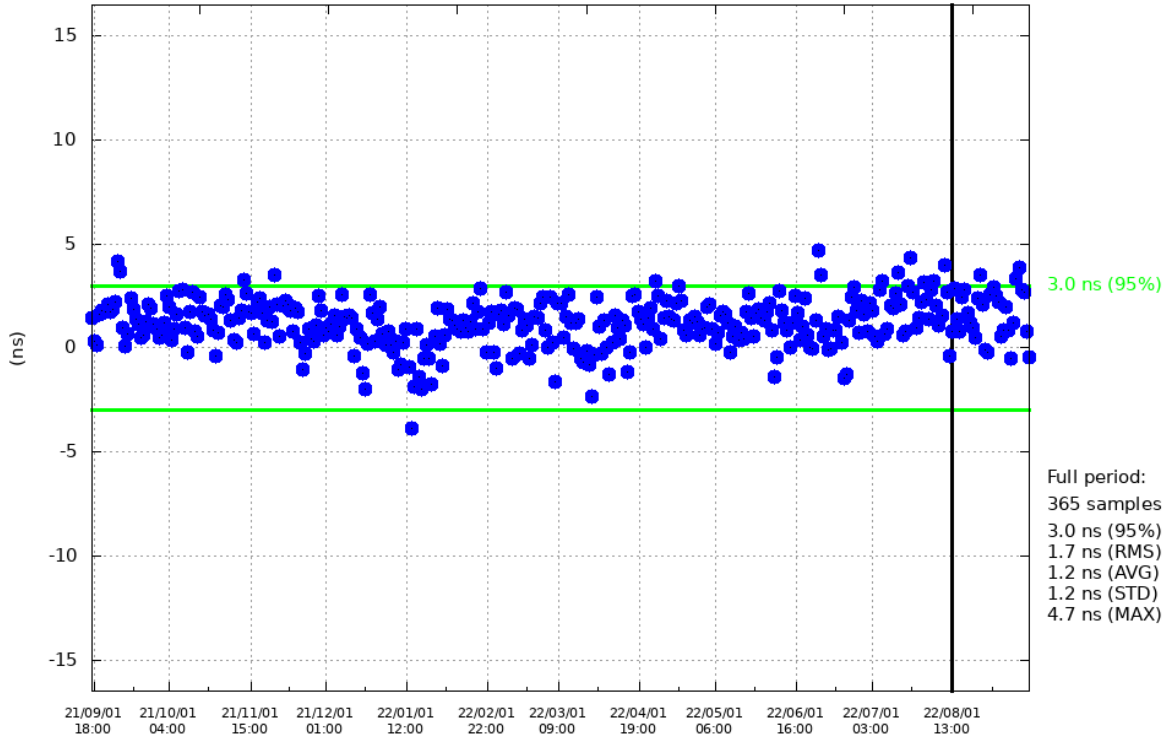
Galileo Timing Accuracy
STABLE

Broadcast UTC offset



5.0ns (95%) < 30ns IS target

GGTO accuracy



3.0ns (95%) < 20ns IS target

- Evaluated with calibrated timing GPS/Galileo receiver operated in UTC(k) laboratory (PTB, INRIM)

Working together as a team