



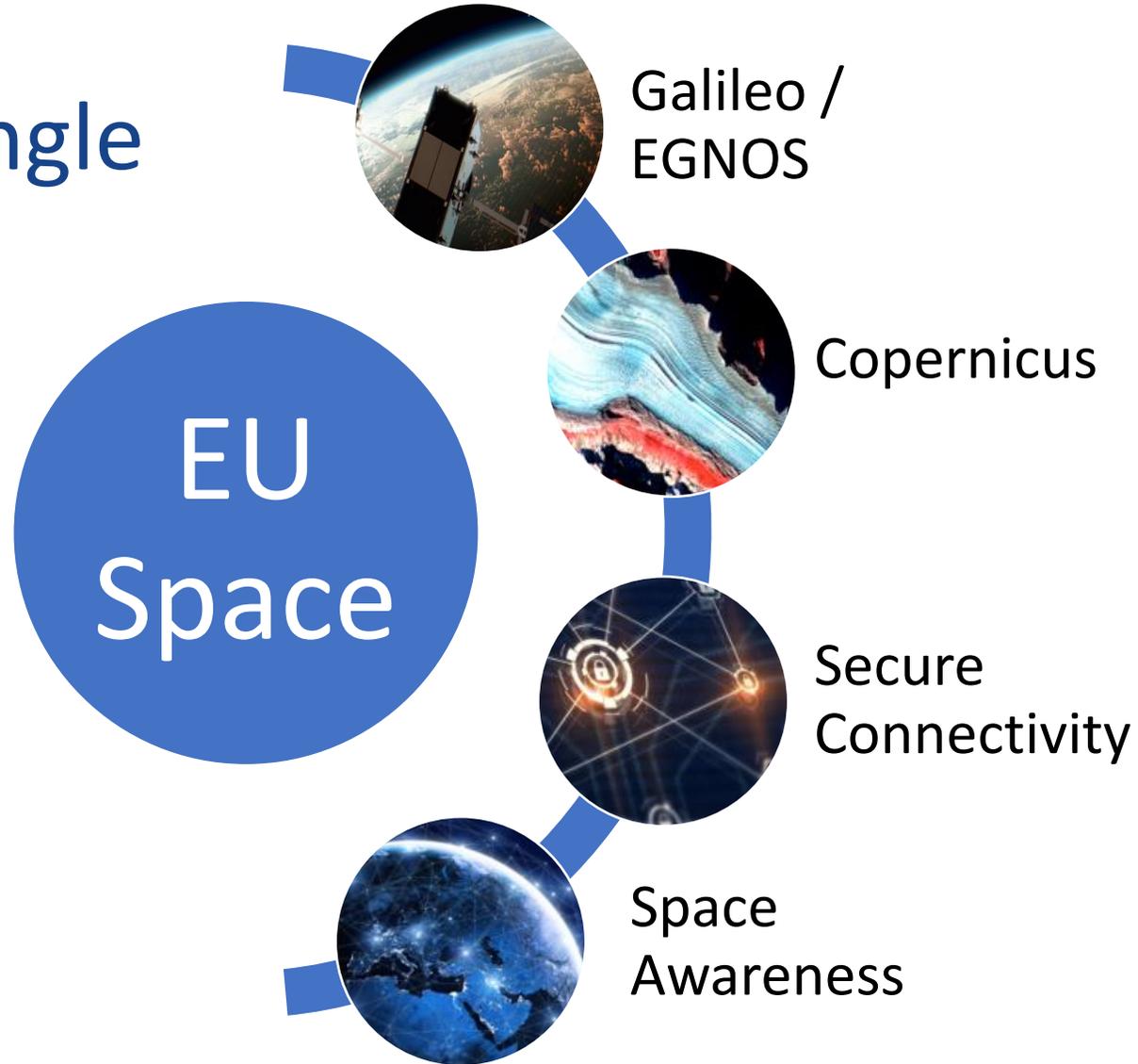
EU SPACE

ICG 2021 GALILEO Status Update

European Commission and
European Space Agency

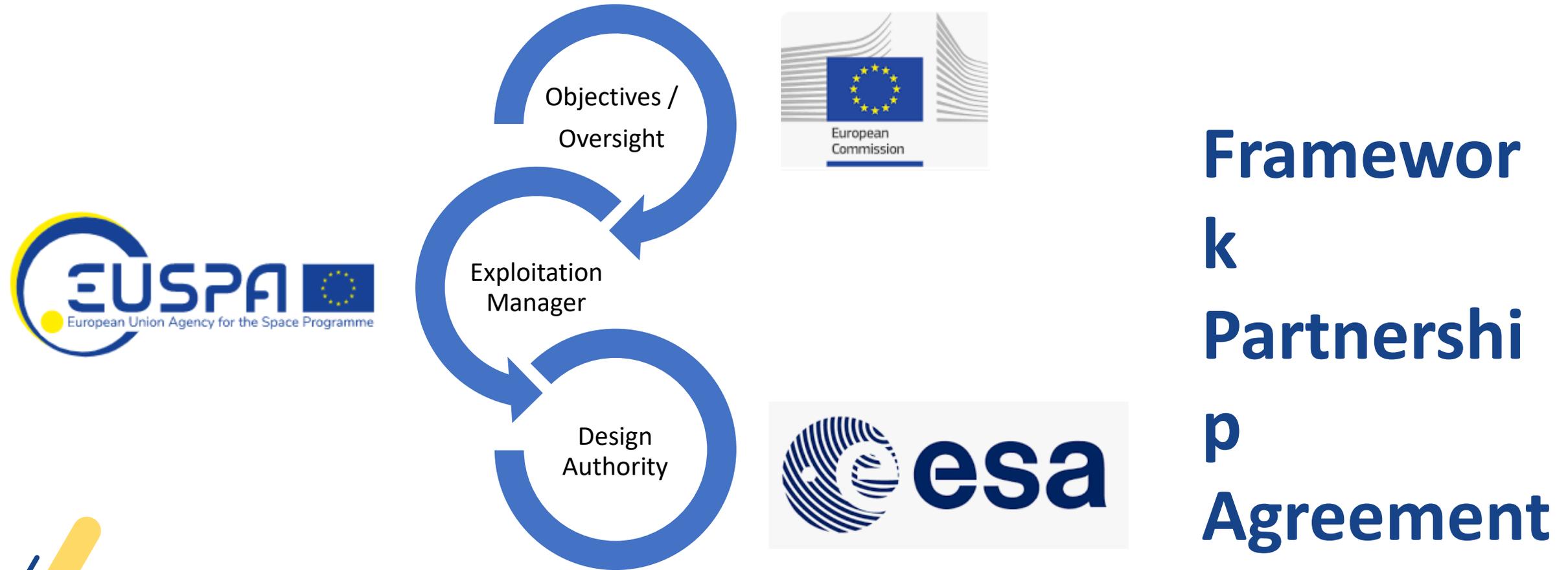
A Broader Angle

New integrated EU Space Programme established by the new Space Regulation covering the period up to 2027





Partners Working Together

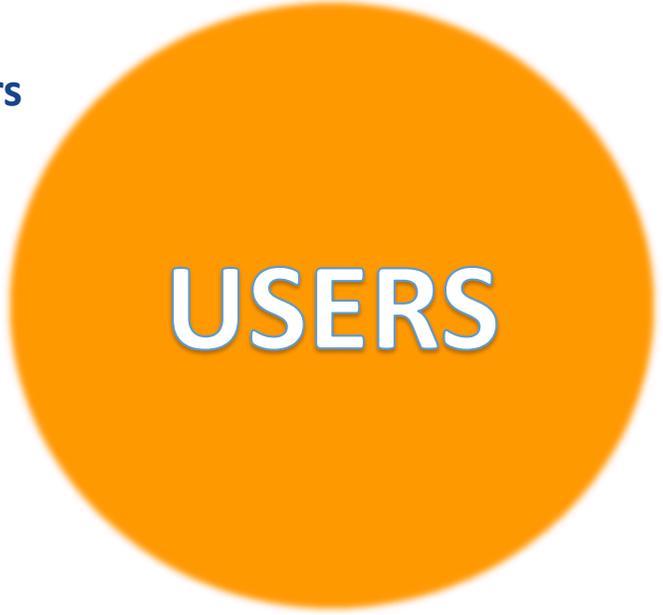


Users at the Heart

User Consultation Forum
Bilateral Agreements with manufacturers
Public Consultation on new features

Prototype Receiver developments
"Fundamental Elements" programme

Performance Monitoring and Reporting
Galileo Reference Centre



USERS

Improved Service Notifications:

- Revisited NAGUs
- Service Notices
- Notification to registered users

Galileo Service Centre

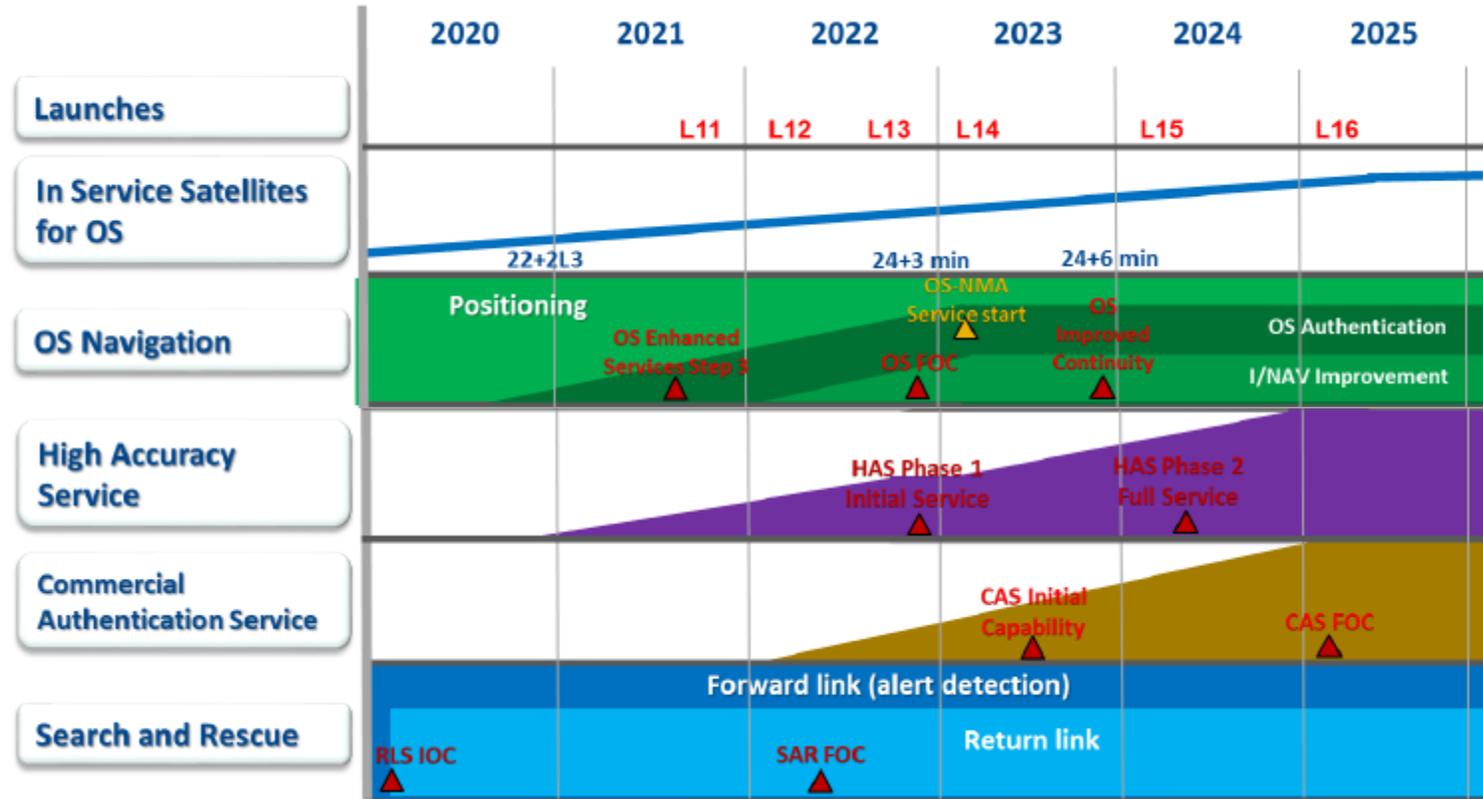
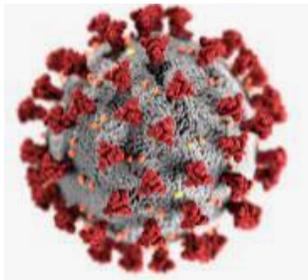
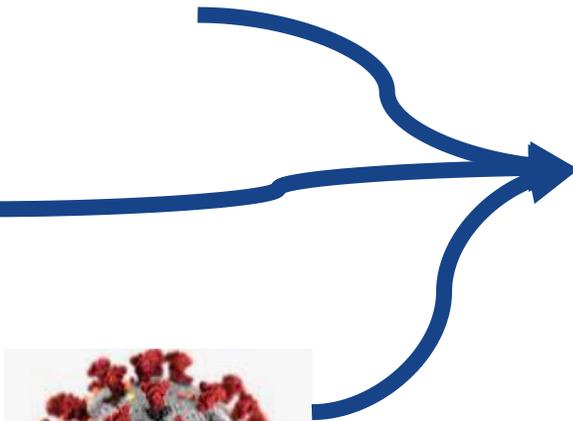
- Help Desk
- Training
- Support to start-ups

Testing Laboratory for new features
EC's Joint Research Centre

Time for a New Plan



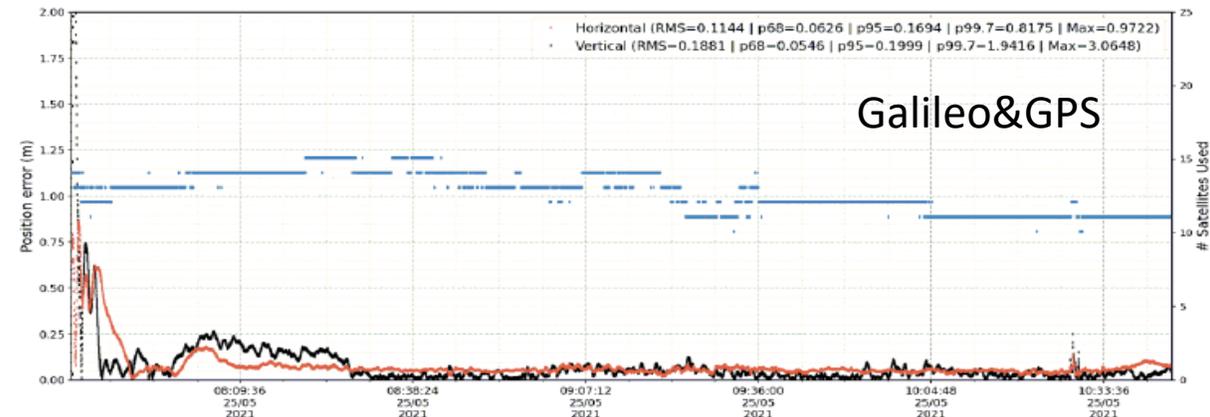
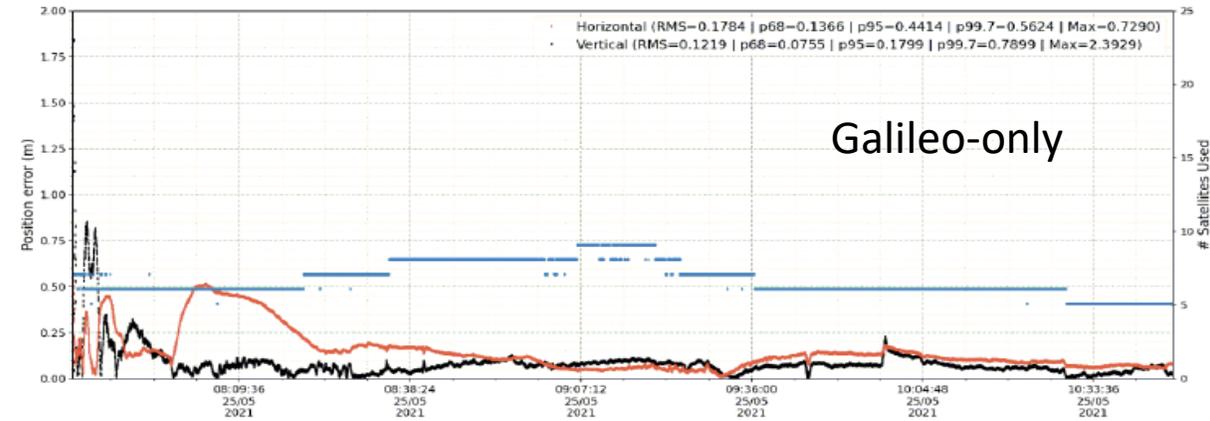
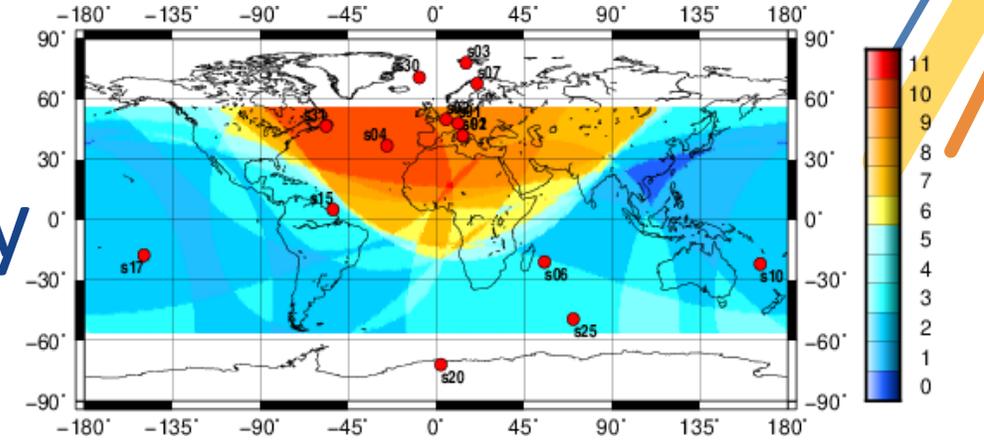
July 2019



Galileo HAS... even better accuracy

Configuration	Orbital Error components [cm], RMS			Total orbital error [cm]*	clock error [ns], RMS
	Radial	Along	Cross		
GPS L1-L2	3.2	9.9	4.9	6.6	0.26
Galileo E1-E5b	3.2	6.9	5.1	5.3	0.15

- Preliminary results from HAS Phase 0 (demonstration phase).
 - September 2020, 14 stations (only!).
 - 15-min orbit prediction, 3-day arcs.
- Main difference wrt standard ODTs:
 - Continuous clock estimation
 - IAR for ODTs satellite-station measurements
- User receiver PPP results promising.



*: 1D mean RMS; Reference: CNES products from IGS; Source: AALECS & MAGICGNSS, GMV

Galileo HAS... moved forward



MILESTONE

User Consultation Platform

- The User Consultation Platform (UCP) is a forum for interaction between users of position, navigation and time solutions and the organisations and institutions dealing, directly and indirectly, with Galileo and EGNOS. The platform serves as a key tool for gathering user requirements and validating the Galileo HAS target performance
- The UCP 2020 will be held during European Space Week on 7-11 December 2020 (<https://www.eu-spaceweek.eu/>)

Call for Expression of Interest

- Participating in the HAS SiS ICD public consultation
- Expressing interest in participating in ad-hoc HAS SiS testing campaigns
- Providing feedback on specific HAS user requirements

HAS PO Testing

HAS SiS ICD Publication

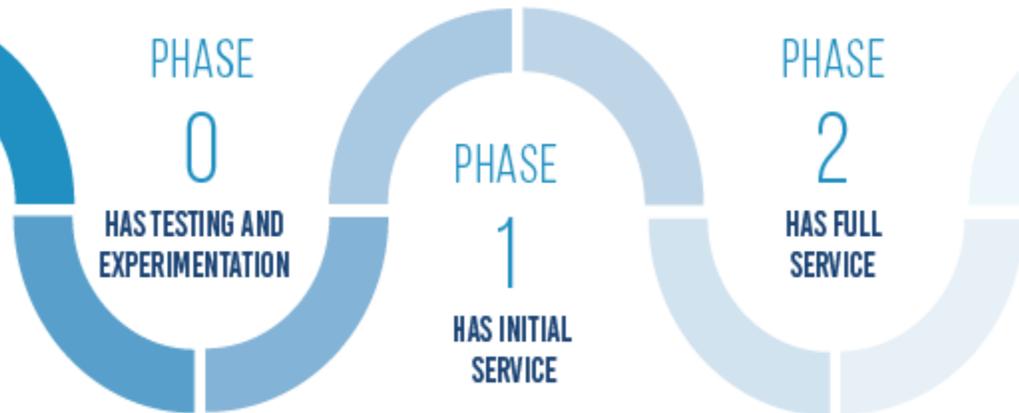
- Following the finalisation of the testing phase, the first version of the HAS message specification document is planned to be published

HAS Initial Service Declaration

- After the necessary service validation activities, the HA Service will be declared available and the HA Service Definition Document will be published

HAS Full Service Operational Capability

2020
2021
2021
2021
2022
> 2024



Validate dissemination capabilities

HAS SiS tests and experimentation

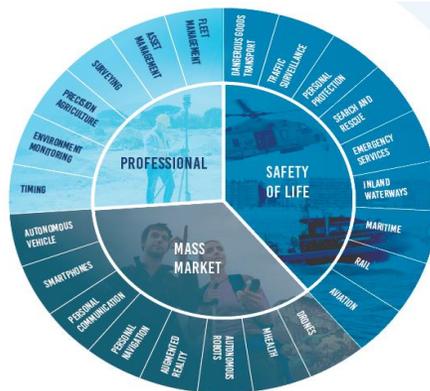
Leverage lessons learned for following phases

Use Galileo system data only (GSS)

Relaxed performance targets

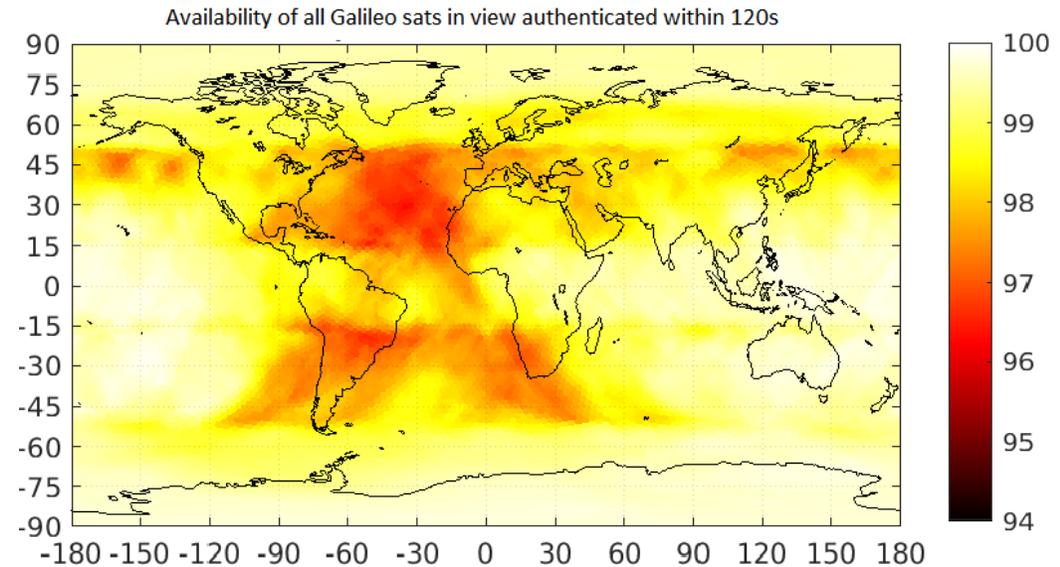
Improved design / infrastructure

Additional data (stations) to improve the performance



It's a matter of Trust

- OSNMA **over-the-air testing** since November 2020 without affecting standard OS users. Different OSNMA configurations and processes (key renewal, revocation, etc.) have been successfully tested.
 - ✓ Worldwide dissemination with up to 20 connected satellites and “cross-authentication” concept
 - ✓ No degradation of OS PVT accuracy
 - ✓ Availability of authentic PVT equivalent to standard OS for users with synchronisation requirements better or equal to 30 seconds (works for receiver with time reference up to 5-min error)
- Next steps: OSNMA ICD/guidelines/keys publication and start of “Public Observation Phase”
- Commercial Authentication Service (including signal authentication) assisted concept consolidated and under prototyping



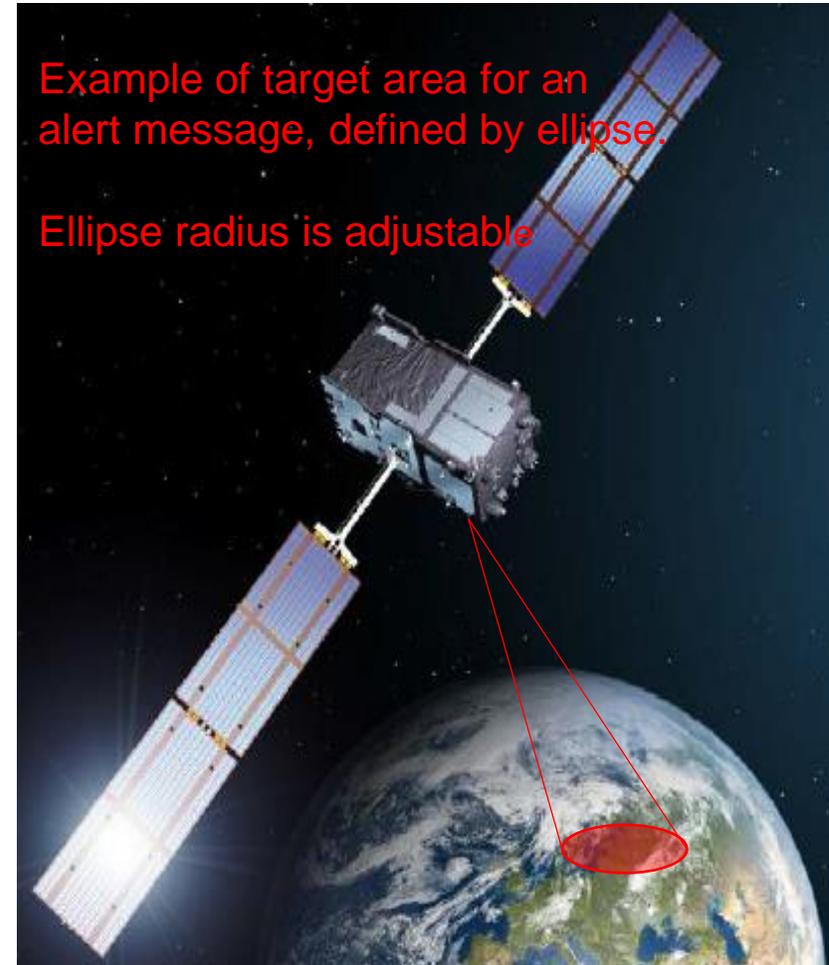
...stay tuned!

World Facing Crises ...2021 and beyond



The Galileo Emergency Warning Service...

- Global coverage
- No 'mobile' connection required - Resilience to ground destruction
- Uses existing Open Service signal spare capacity
- Multi-hazard (tornadoes, earthquakes, nuclear disaster or industrial disaster, terrorist attacks, ...)
- On-demand broadcast of an alert message + associated guidance by Local Civil Protection Authorities
- Complementary to existing systems
- Reach out population in a timely manner (2-3 minutes), whatever the size of the area
- Geo-location information encoded in the message to target only the relevant population
- Synergies with Copernicus Emergency Management Service and its other system capabilities
- An interoperable solution studied in cooperation with Japan and India



SAR ...The Return

- **Remote Activation of Beacons**

- ✓ *Under “MRD” formalisation*
- ✓ *EUROCAE standard approved*

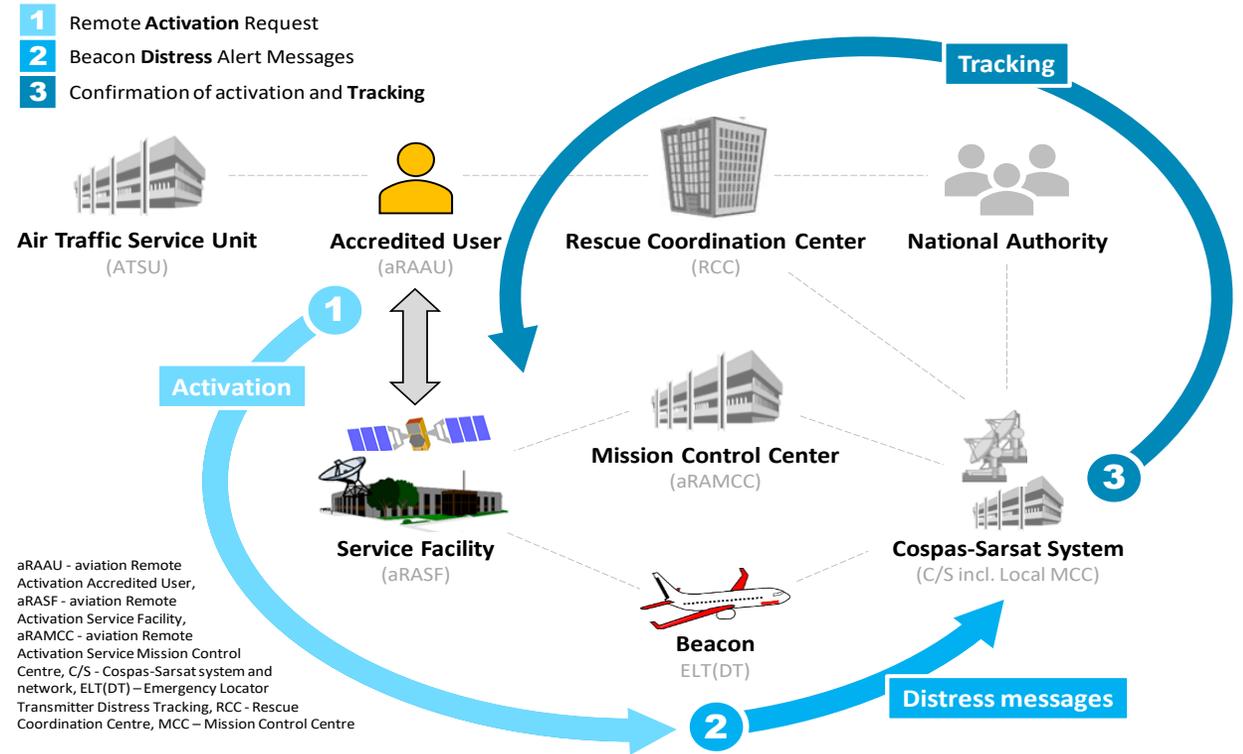
- RCC (or airline) can contact Galileo to remotely activate a beacon via the RLM of Galileo
- Use cases: **Aviation**: aircraft disappearance, Un-responsive crew; **Maritime**: overdue vessel

- **Two-way (distress) communication**

- Enabled by the long Return Link Message; based on predefined Q&A helping the rescue mission

- **Distress Position Sharing**

- RCC can contact Galileo to share the position of a beacon user in distress with other nearby users



Fast...but not Furious !

G2G Service Portfolio and High Level Mission Objectives adopted

- Advanced Timing Services
- Space Service Volume
- ARAIM – coming back to serving SoL
- Emergency Warning Services
- Search And Rescue – Innovative services
- Ionosphere Prediction Service
- Signals Evolution – increased performance at user level (reduced power consumption, TTFF, accuracy authentication, etc.)
- SAR 2nd Generation Beacons
- PRS evolutions



Far and Beyond



Horizon Europe
THE NEXT EU RESEARCH & INNOVATION PROGRAMME (2021 – 2027)

The image shows the Horizon Europe logo and a collection of research-related icons including a lightbulb, a person, a microscope, a rocket, and a gear.

As One Among Others

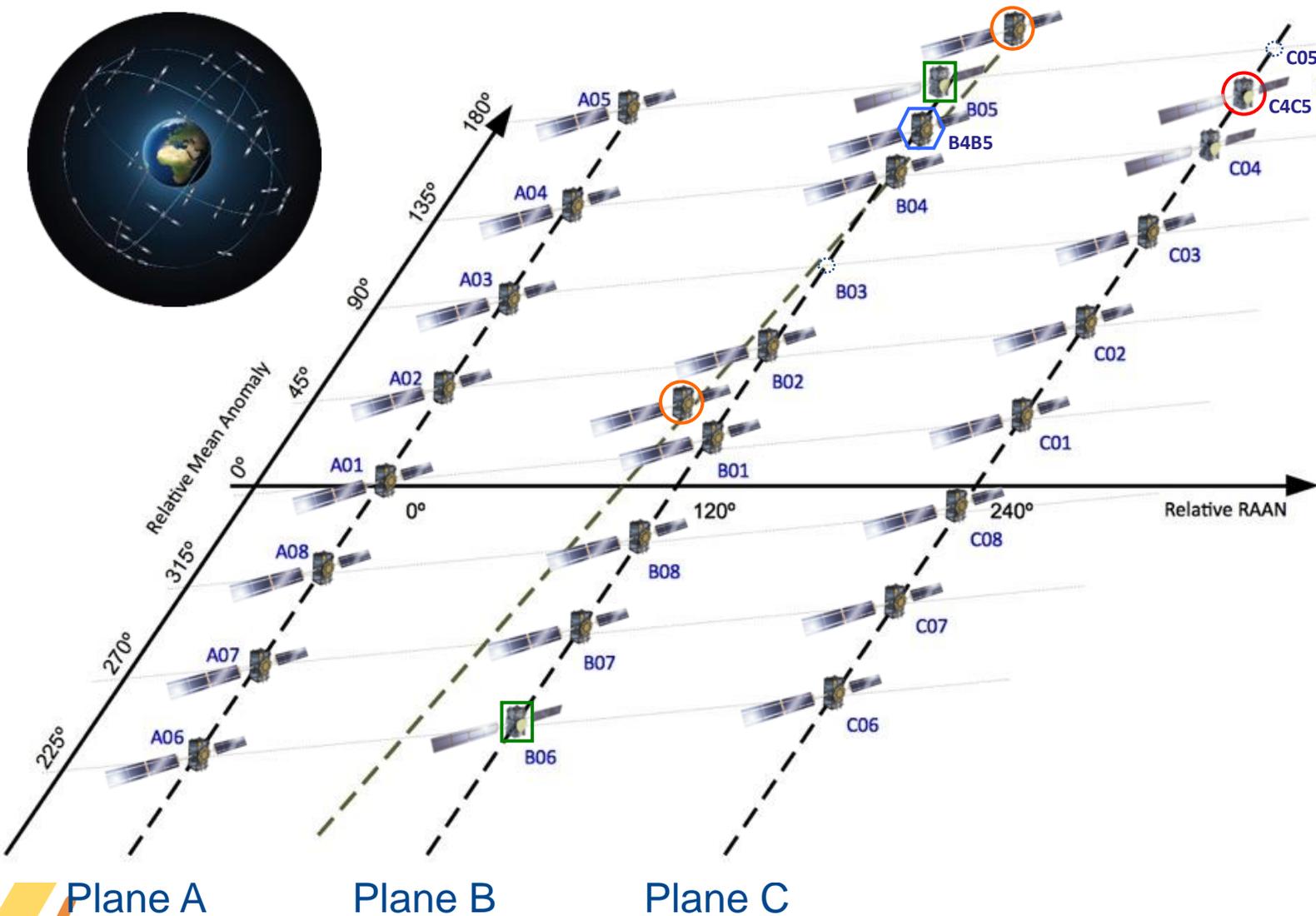
- **Bilateral Cooperation** with other core constellation providers
- Define new services collaboratively
 - SAR / RLS / 2-way COM
 - Emergency Warning Distribution
 - Advanced RAIM for Safety of Life
 - Authentication solutions



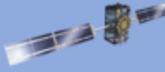
International/multi-lateral

- ITU: Coordinate and defend GNSS Spectrum
- UN-ICG: service provision and performance monitoring
- ICAO: Galileo standards adopted in Nov 2020

Galileo Constellation Status



Navigation (22 in service)
Search and Rescue (24 in service)

-  26 satellites in orbit
-  2 unhealthy (NAV P/L only)
-  1 spare
-  1 unavailable
-  2 no SAR (by design)

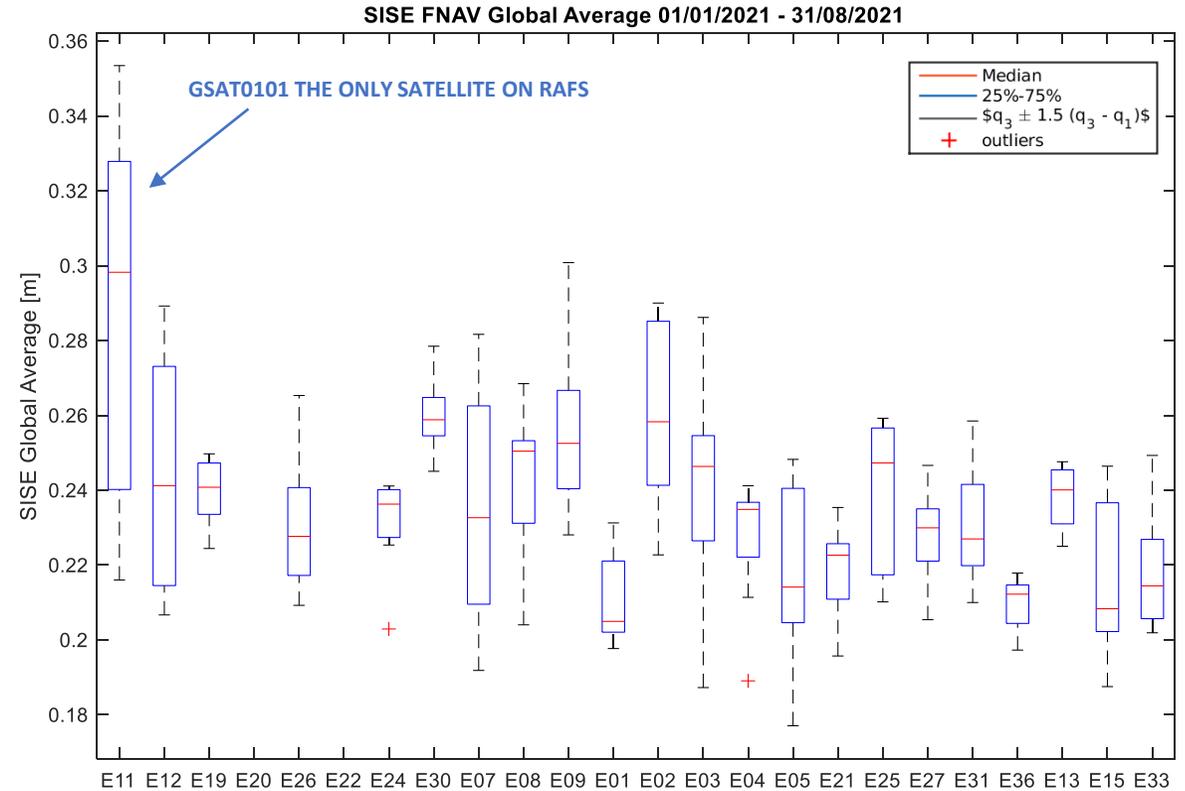
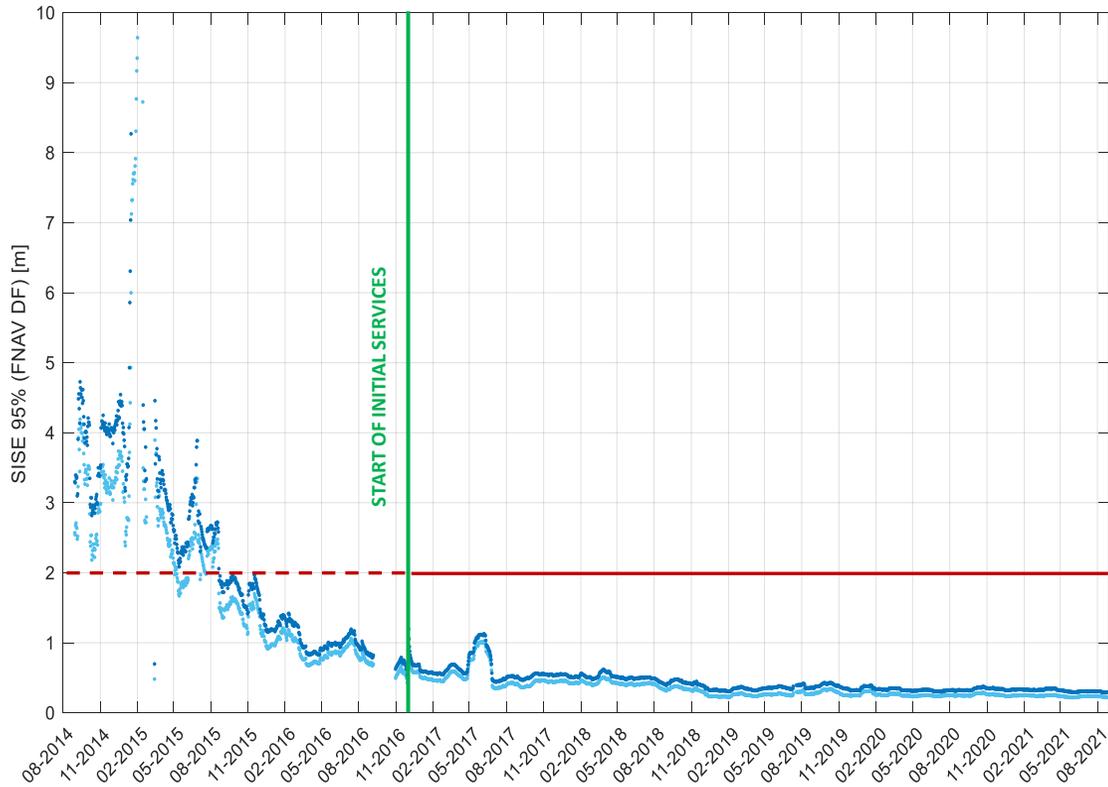
GSAT 104 (Spare, NAVANT failure), relocation from C05 to C4C5 completed on 12/05/2021

GSAT 204 (Spare, SAR operational), relocation from B03 to B4B5 completed on 06/05/2021

GSAT 201/202 (set to unhealthy)

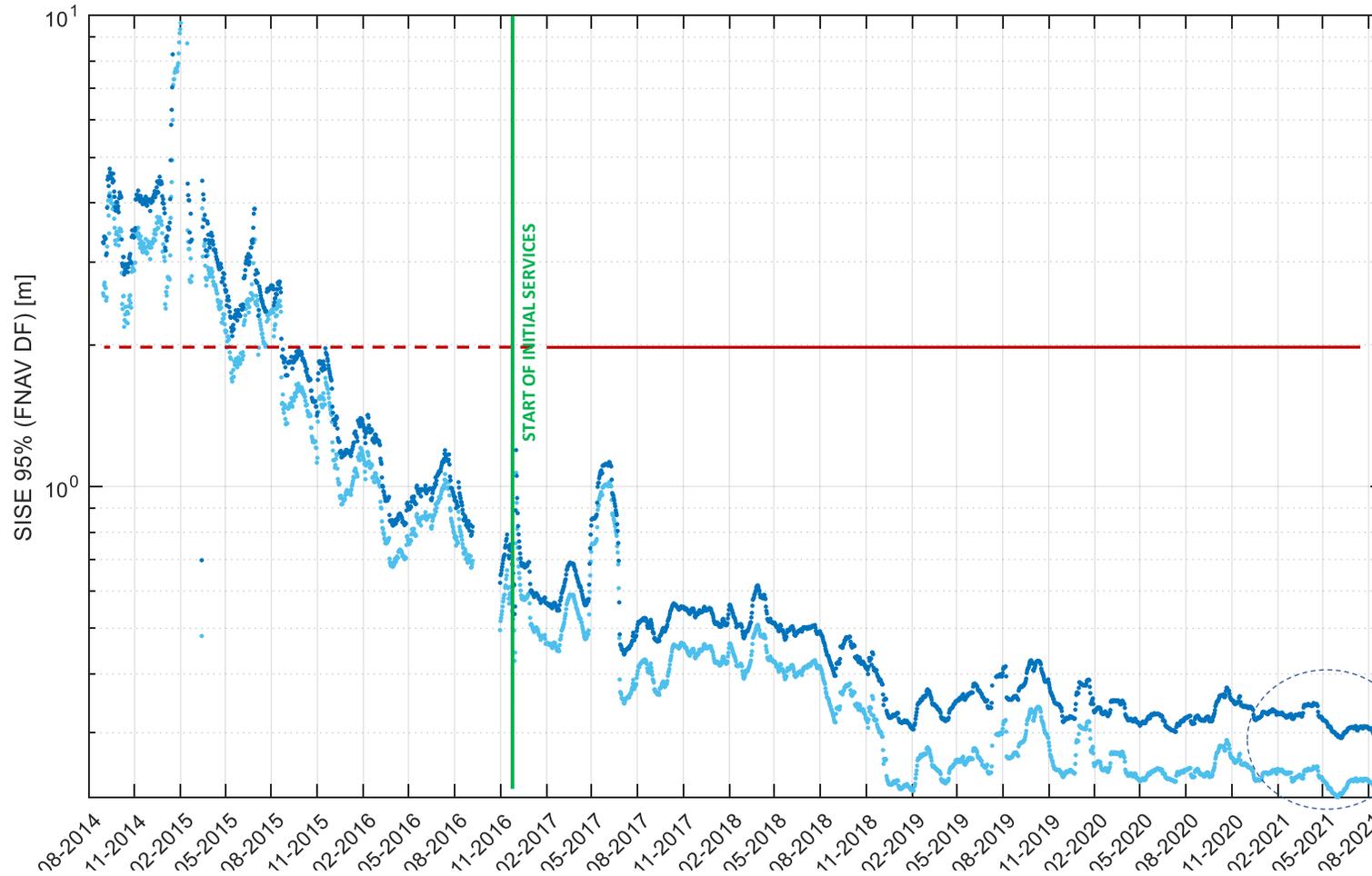
L11 slots in Plane B: B03, B5B6

Stable As-observed Ranging Performance



- Decreasing Ranging Error trend due to increasing number of Satellites and G/S improvements
- **Ranging accuracy (95%) 0.22m** all satellites, in **August 2021** (FNAV)

Ranging Performance (Log scale)



NEW MINIMUM reached since GSS sites consolidated!

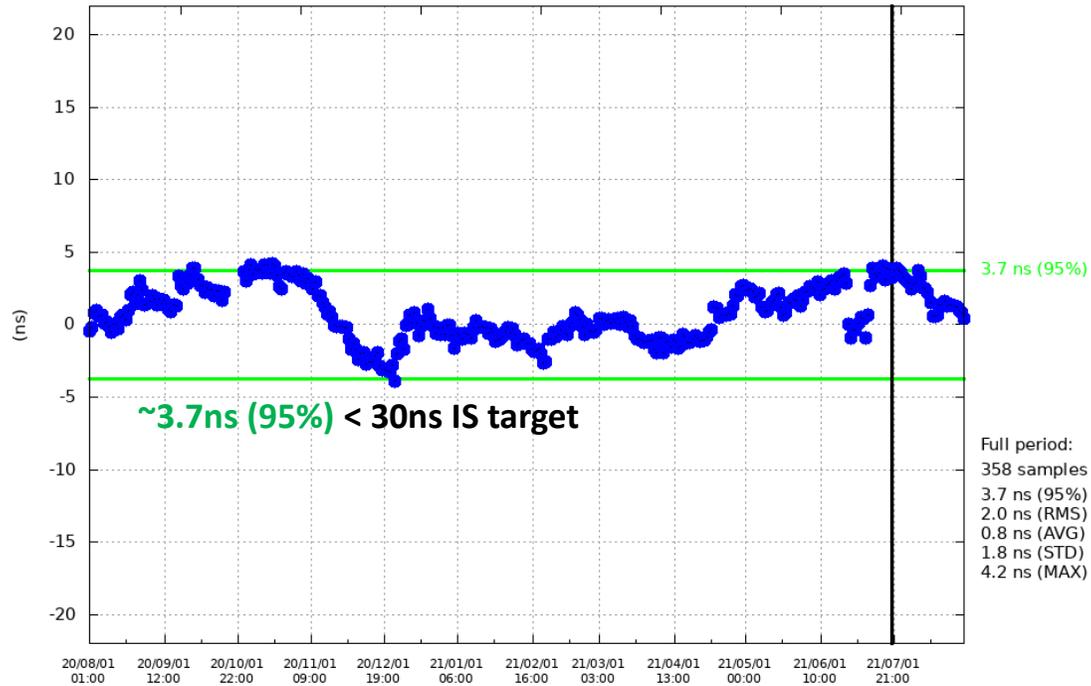
Improved OSPF robustness and GSS data availability

- SISE Constellation Average computed as 30 days moving average
- Decreasing Ranging Error trend due to increasing number of Satellites and G/S improvements
- **Ranging accuracy (95%) 0.22m** all satellites, in **August 2021** (FNAV)

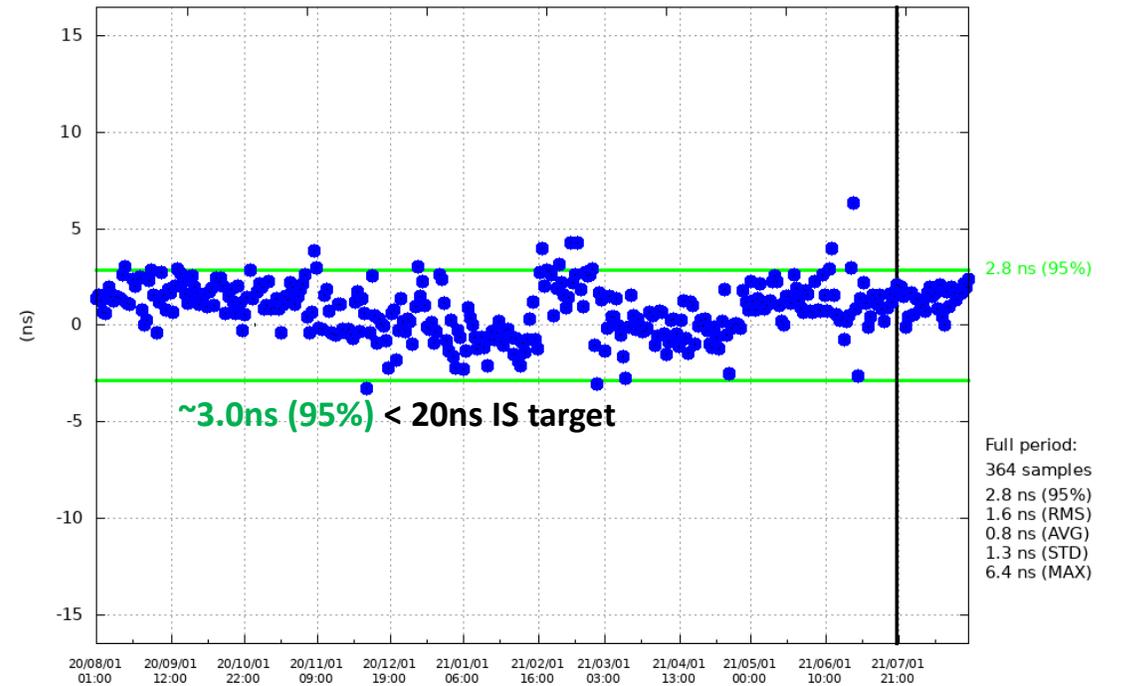
Best Satellite GSAT0214 (PHM-A) **16cm (95%)** in May 2021 | Worst Satellite GSAT0101 (RAFS-A) **40cm (95%)** in Jan 2021

Galileo Timing Availability **STABLE**

Broadcast UTC Offset



GGTO accuracy



- Evaluated with calibrated timing GPS/Galileo receiver operated in UTC(k) laboratory (PTB, INRIM)
- Deployment of new V2B.08.01.00 in all 4 GSS PTFs, including GRCPs
- GSSPTFs delay calibration complete for GRCNs and GRCPs