Space Programs for Positioning, Navigation and Timing (PNT)



International Conference on Localization and GNSS,
October 6-8, 2026, Rome

Stefano Binda – ESA NAVISP

PNT: is a Strategic Sector – Opportunity for European Growth

Satellite navigation is the largest downstream space market

50 000 jobs in European GNSS downstream market

Europe as a strong international partner

4+ billion Galileo users worldwide / EGNOS fully integrated in aviation

Strategic enabler for European autonomy and resilience (Dual Use)

Supporting European competitiveness in a strategic sector



Positioning, Navigation and Timing is everywhere around us.
Already 10% of EU's GDP relies on GNSSs and it's set to grow.

PNT Resilience: Call for Action

European Security & Resilience

Security Priorities

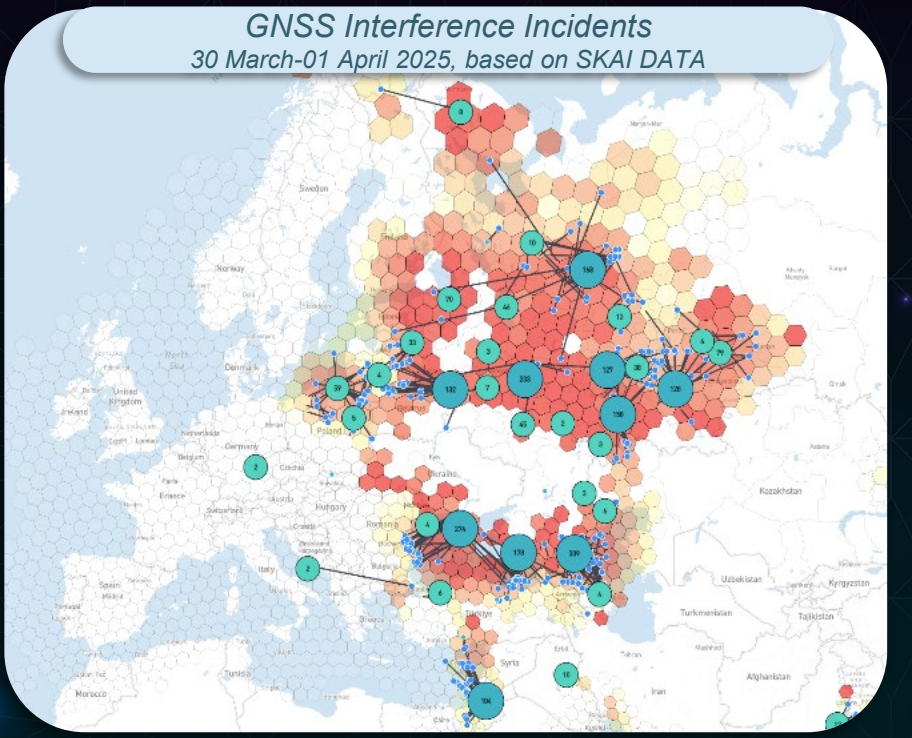
- Nations increasing defence budgets & military modernization
- Critical role of secure communication, surveillance, and navigation in defense operations
- Raising vulnerabilities in Global Satellite Navigation Systems

Critical Infrastructure

- Dependence: Power grids, financial systems, telecom, transportation
- Recent Study estimates weekly losses of UK economy of over £7.64 billion with GNSS outage
- National Resilience Strategies: Alternative PNT solutions, multi-source navigation, quantum-based timing,…

Overcoming Jamming & Spoofing

Robust & Alternative PNT techniques



Europe's Largest Space Infrastructure

GALILEO

34	50+	4 B+
Satellites in Orbit	*Ground stations*	*Users*

Space Segment

- 30 operational satellites (FOC) + 4 in-orbit spares
- 14 Launches under ESA authority
- 12 G2G Satellites Development progressing rapidly

Ground Segment

- Worldwide Deployment
- Cyber security monitoring capabilities
- Navigation data refresh rate lower than 100 min
- 2 GCC, 2GSMC, 20+ TT&C Uplink Stations, 20+ GSS

PRS as Strategic Capability

- PRS is Galileo's regulated service, strategically critical capability for ensuring the long-term resilience, security and autonomy of Europe's PNT infrastructure
- Galileo's credibility as a sovereign European GNSS relies on PRS reliability

EGNOS

3	50+	1000+
GEO Satellites	*Ground Stations*	*Landing procedures*

Space Segment

- Inmarsat 3-F2 (AOR-E), Inmarsat 4-F2 (EMEA), and Astra 5B (GEO-E)
- SBAS differential corrections & integrity messages
- EGNOS V3 in development

Ground Segment

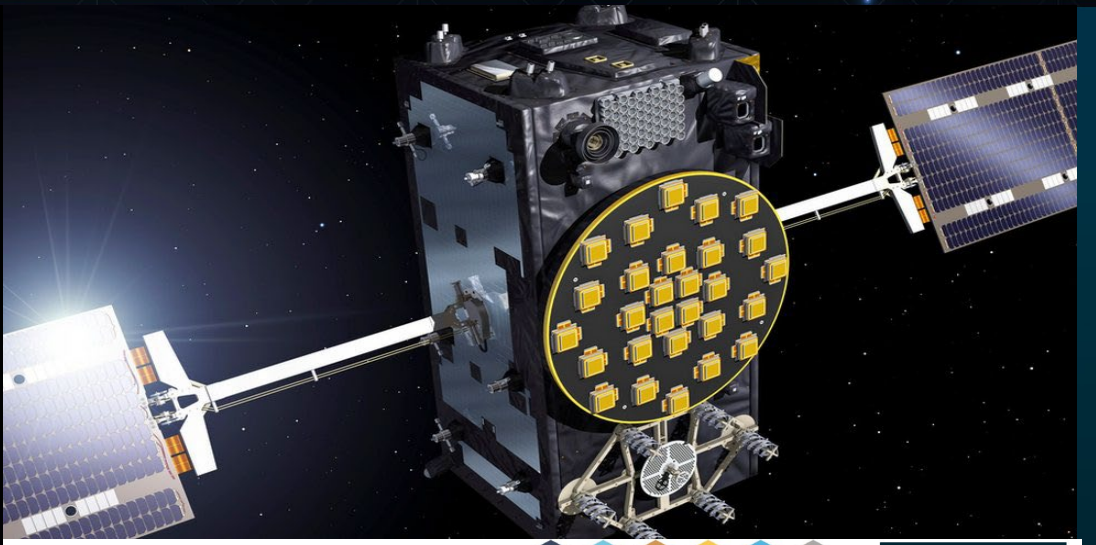
- 2 EGNOS Mission Control Centers
- 40+ RIMS
- 6+ NLES

Safety of life

- Aviation Safety-of-Life service (SoL) — ICAO SARPS compliant
- ESA manages the safety architecture, integrity monitoring, and certification basis underpinning EGNOS Safety-of-Life performance

GALILEO System Under Operations





Galileo Services

GALILEO

Galileo Services have been delivered worldwide **since December 2016**

Open Service (OS)	Public Regulated Service (PRS) – Governmental Service	Search and Rescue Service (SAR)	High Accuracy Service (HAS)	Navigation Message Authentication (OSNMA)	Testing phase Emergency Warning Satellite Service (EWSS)
Freely accessible service for positioning and timing Key component of mass-market applications	Encrypted service designed for greater robustness and higher availability and service continuity	Locates people in distress and acknowledges that the distress signal has been received	Delivers high accuracy services, freely accessible, leveraging on the OS	Delivers authentication of the navigation parameters decoded by Galileo receivers	Supports and complements the civil protection services and the resilience of its infrastructures








EGNOS



EGNOS V3 adds Galileo and Dual Frequency and other features

ESA responsible for V3 design, implementation and deployment

Celeste: Preparing LEO-PNT capabilities for Europe



Back-up PNT

Augmenting Galileo/EGNOS

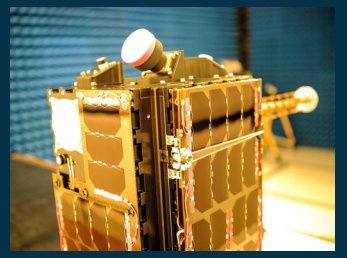
New Services
Public safety, 6G NTN, 2-way, IoT, Indoor

- ❑ Additional signals in L-band (augmentation)
- ❑ Distance to Earth – signal power
- ❑ Geometry diversity and dynamics
- ❑ Frequency diversity – standalone backup.
- ❑ Two-way links – in support to authentication

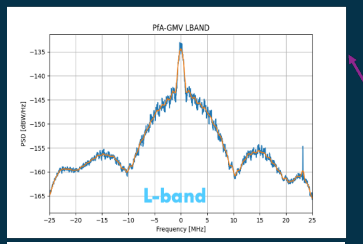
ESA UNCLASSIFIED – Releasable to the Public

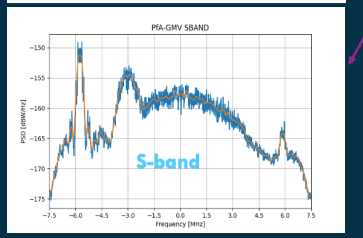
Celeste In-Orbit Demonstrator in 2026







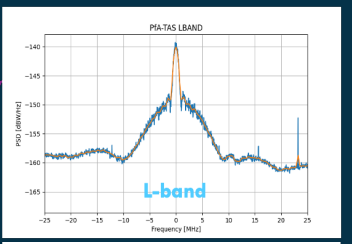


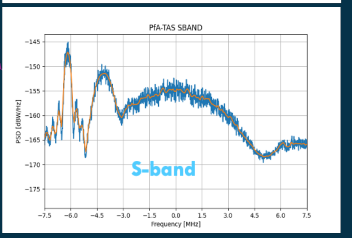


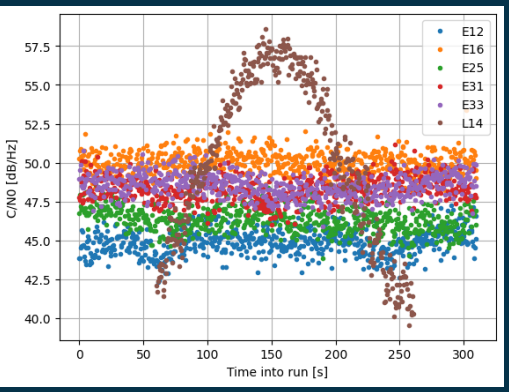
ESTEC laboratory – 3m Dish with L- and S-band feed

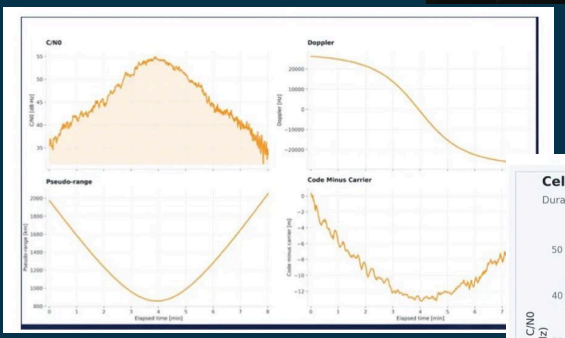


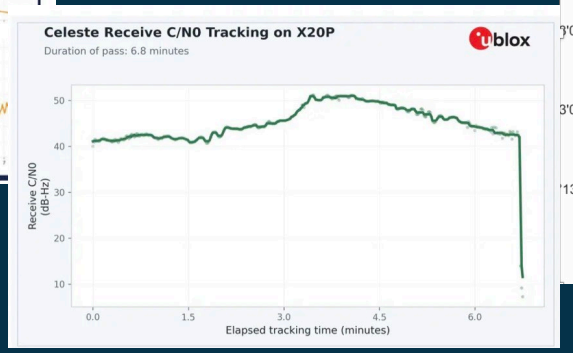


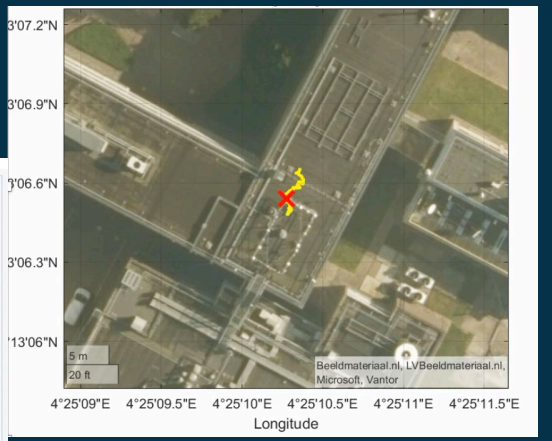


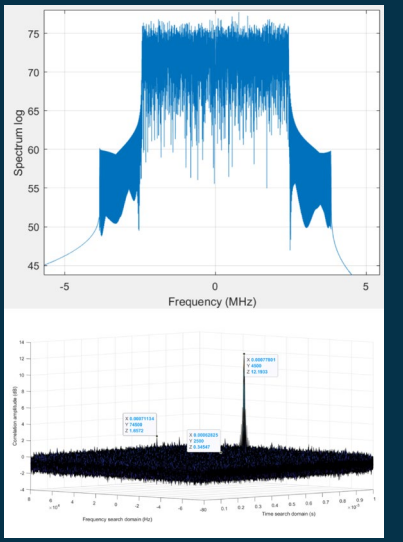










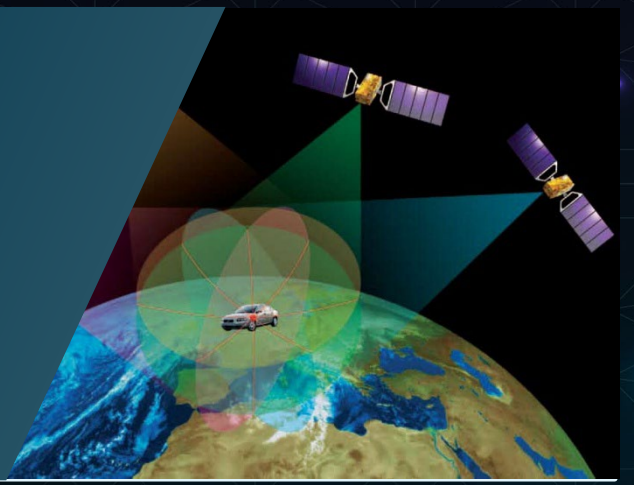




navisp Advancing commercial PNT

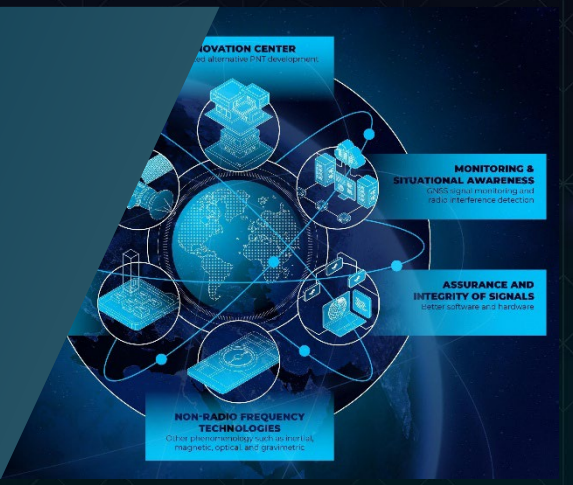
Commercial PNT Missions / Payloads

- Demonstrators
- Hosted payloads
- PNT-enhanced space operations



Downstream / user segment products

- GNSS receivers / components
- Alternative PNT
- Protect, Toughen, Augment



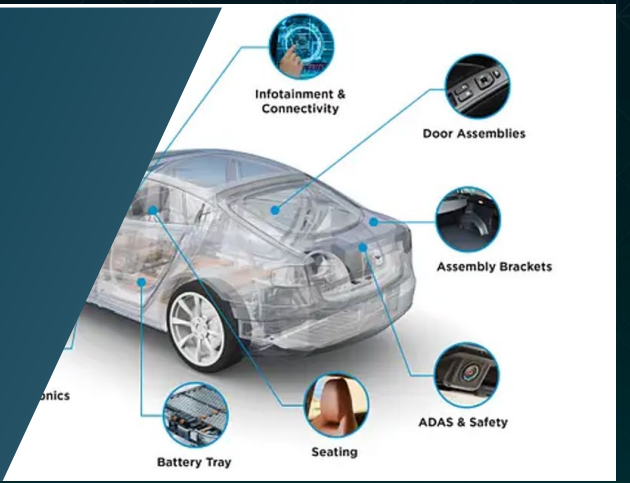
Value – added products / services

- Commercial services
- Timing technologies
- Dual-use



Partnerships

- R&D risk mitigation
- Coordinated actions across value chain
- Ecosystem support



navisp is structured on 3 Elements...



Element 1:
Innovation

Develop novel PNT-related systems and technologies along the entire value chain.

Pave the way for future products and services



Element 2:
Competitiveness

- Improve European industry's capabilities in the global market for PNT technologies and services (products and services)



Element 3:
Support Member States initiatives

Support European National Programmes along the whole value chain

navisp

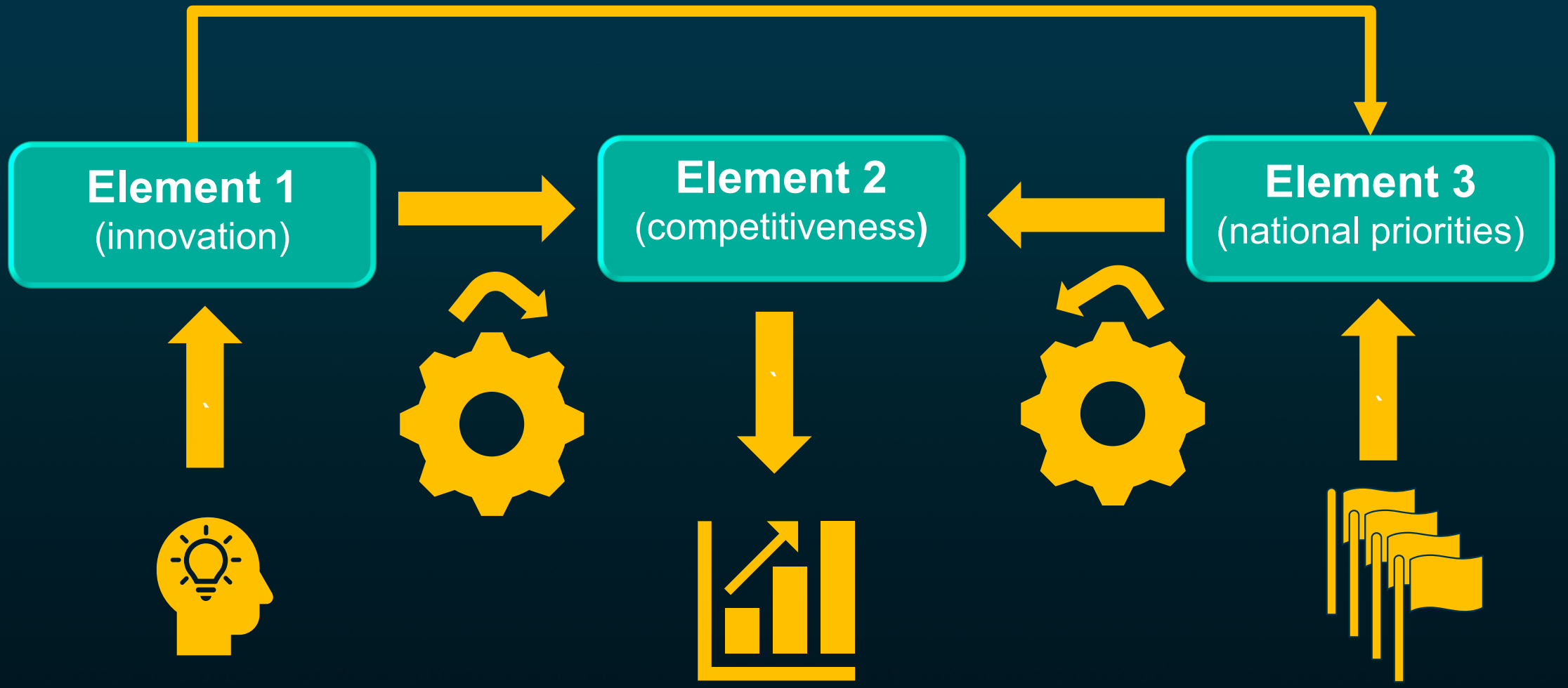
ESA DRIVEN
BASED ON YEARLY WORKPLAN
FULLY FUNDED

INDUSTRY DRIVEN
BASED ON CALL FOR PROPOSALS
CO-FUNDED

INSTITUTIONALLY DRIVEN
BASED ON CALL FOR PROPOSALS
FULLY FUNDED

IPR - Deliverables

…that work in synergy



Innovation in PNT

Enabling PNT Innovations across the value chain



Feasibility / Viability analysis of new groundbreaking PNT concepts

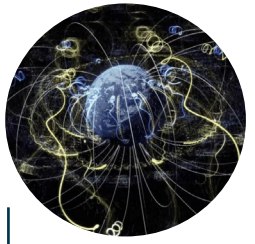
Formulation & implementation of PNT technology strategies & roadmaps

- ESA Driven
- Yearly Workplan
- Fully funded

navisp Element 1 “firsts” in PNT



LEO-PNT Studies
2018



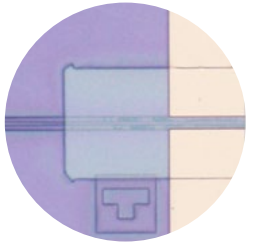
Quantum Sensor
2019



GNSS Lunar
2020



Photonics for PNT receivers
2022



Lithium Niobate Photonic IC
2024

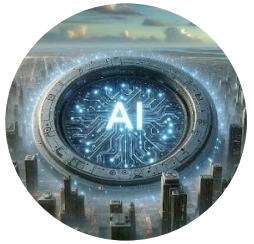


High-accuracy Formation Flying
2025

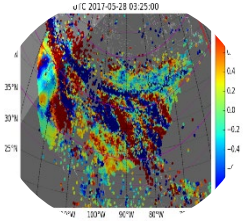
High-Altitude Pseudo-Satellites for PNT
2018



AI Studies applied to PNT
2019



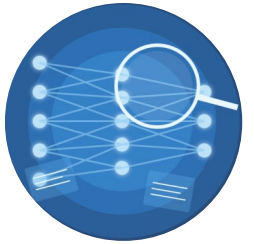
Crowdsourced ionosphere mapping app
2021



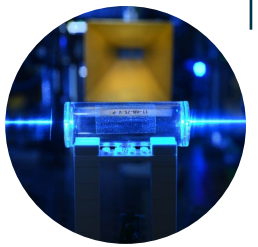
Miniaturised eLoran antenna
2022



Verifiable AI for PNT
2024



Quantum PNT receiver
2025



navisp Element 1 ITTs schedule

ID	Name	2026 J	F	M	A	M	J	J	A	S	O	N	D
EL1-117	Resilience Techniques and Algorithms for GNSS Space Receivers in Interference, Jamming and Spoofing Conditions										ITT		
EL1-118	On demand PNT services during crisis										ITT		
EL1-119	Dual Polarization Arrays for compact resilient GNSS Receivers											ITT	
EL1-120	Resilient PNT Critical National Infrastructure validation test bench						ITT						
EL1-125	Receiver Architectures and Beam Scheduling Strategies for Fused-PNT Concept											ITT	
EL1-130	Robust GNSS Tracker for Sensitive Applications							ITT					
EL1-131	Chip Scale Optical Atomic Clock for PNT applications							ITT					
EL1-132	Development and Validation of Flexible eLoran/GNSS signal simulator									ITT			
EL1-133	Resilient PNT by a combined GNSS/eLoran/INS approach for U space applications										ITT		
EL1-134	All-weather Laser Time and Ranging Links for Optical PNT Systems										ITT		

- EL1-118: Close date xx/11/26
- EL1-120: Close date 02/11/26
- EL1-130: Close date 15/10/26
- EL1-131: Close date 09/10/26
- EL1-132: Close date 18/11/26

Element 1 Workplan 2027 under finalization with more than 20 new activities



Competitiveness in PNT

Boost European Capabilities in global PNT market

R&D industrial risk mitigation for commercially related PNT product development

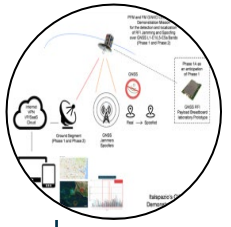
Accelerating industrial return on investment

- Industry driven
- Standard call
- Co-funded

Supporting European PNT Industry with Element 2



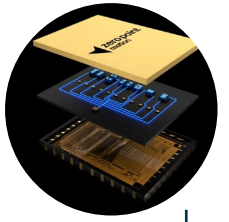
GNSS CRPA
2019



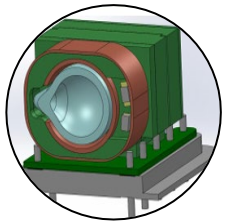
GNSS ISR (GINKO)
2021



Relative GNSS Navigation & Situational Awareness
2023



Photonics IMU
2024



Space Clock Optimization for PNT in LEO (MIRA)
2025



GNSS threat detection
2026

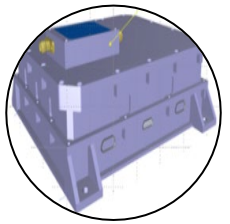
Digital Tachograph with OSNMA
2018



Digital Modem for TWSTFT
2020



GNSS New Space Receiver (MARCONI)
2021



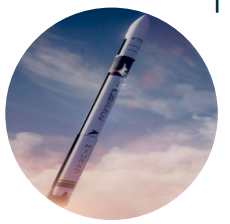
DORT - Dynamic Optical Ranging & Timing
2024



Flexible PNT Simulation (Stella NextGen)
2025



Hybrid PNT for Microlauncher (HALCON)
2025



Multi-resilient PNT chip
2025



navisp impact on the PNT ecosystem

Knowledge

- 370 OP received
- 247 Committed projects
- 123 Completed projects
- 115 ESA TO involved

Capital

- 234 M Investment in projects
- 88 M Industrial investment
- 71 Projects led by newcomers to ESA

Ecosystem

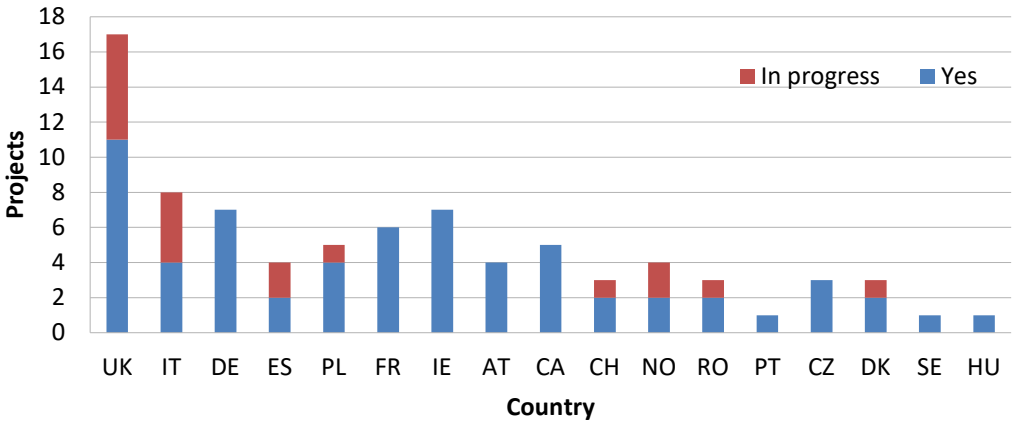
- 296 Industrial Entities
- 179 SME
- 19 Market owners involved

Customer

- 64 Products in the market
- 28 Standalone products
- 36 Upgraded products

Source: NAVISP Element 2 Data

Projects leading to commercial products



Space Programmes / Missions:

- OpSTAR
- VDES-R
- FreeGNSS
- GINKO
- WISDOM
- SAFIR-PNT

Element 2 – How to Apply – Cooperative Agreement!



Outline Proposal:
https://ideas.esa.int/

National Delegation support:
https://navisp.esa.int/nationaldelegation/

Full Proposal (requires supplier reg):
https://esastar-publication.sso.esa.int/

Agreement Negotiation and award



Support to Member States

Support European National Programmes across the value chain

- Preparation for public services
- Test-ranges

Understanding PNT resilience and mitigation measures

- Institutionally driven
- Standard call
- Fully funded

Supporting Participating States PNT with Element 3



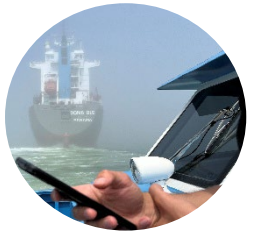
Interference Capture Device
2019



Space-based VDES-R
2020



PNT Automotive Test-Center
2021

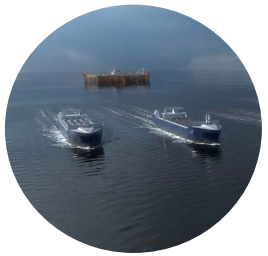


Ground-based VDES-R
2023

TOUCAN

UK TWSTF National Time
2025

Trondheim Maritime Test Area
2019



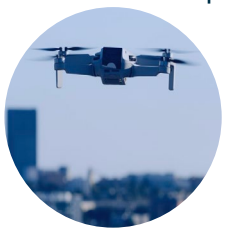
UK eLoran Time Diss.
2021



Drone Cyber Evaluation Facility CYTEF
2022



BE Secure UTM
2024



PL GNSS Mon Network
2025



Grimaldi Innovation Lab
2026

GLIMS

Element 3 – How to Apply

navisp
element 3 – support to member states

4 months



Outline Proposal:
https://ideas.esa.int/



National Delegation support:
https://navisp.esa.int/nationaldelegation/



Full Proposal (requires supplier reg):
https://esastar-publication.sso.esa.int/

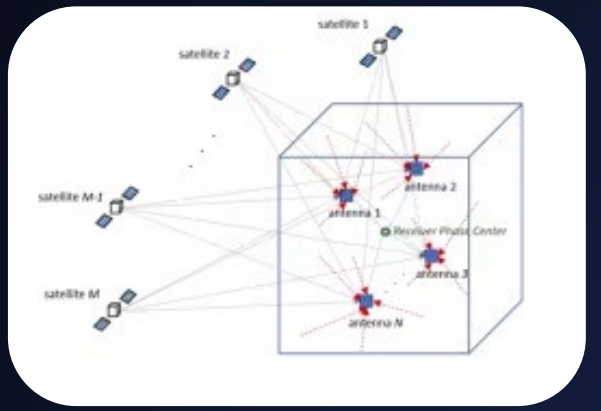


Contract Negotiation and award

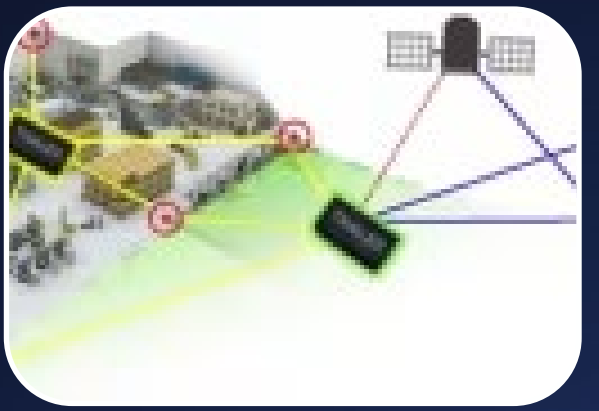
Applications and services-related projects



SPLI – Self-positioning local infrastructure with GNSS, UWB and WiFi RFT



Precise Timing for Indoor Small Cells



GEONAV - Real-time Indoor/Outdoor precise (<1m) tracking



HYPER-5G - HYbrid Positioning Engine Running on 5G and GNSS

danalto

gmv INNOVATING SOLUTIONS

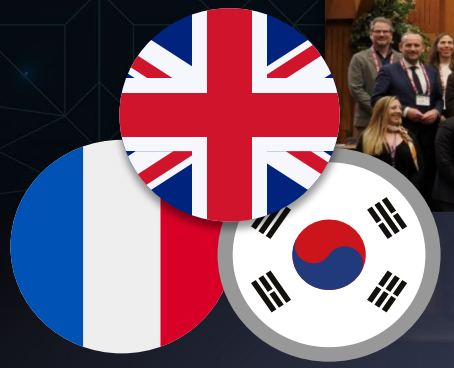
THALES

GReD algoWATT GREEN TECH SOLUTIONS

POLITECNICO MILANO 1863

navisp is supporting efforts to rebuild eLoran





International conference of countries interested in e-Loran at ESA/ESTEC in March'26, under the leadership of the UK PNT Office

Combination of eLoran and signals from space

- eLoran horizontal position accuracy can be < 10 m with differential corrections
- eLoran can be a robust source of absolute time to improve the resilience of space-based PNT solutions

Conclusions

- GNSS, and PNT in general, strategic sector for Europe
- GNSS Multi-layer evolving
- NAVISP supports European Industry in commercial PNT markets and supports National PNT Objectives
- Resilient, ubiquitous, accurate PNT, from space and from ground, instrumental to European growth



How to reach navisp

- **NAVISP events**

https://navisp.esa.int/calendar

- **LinkedIn**

https://linkedin.com/company/navisp-esa/



NID26 High-level Agenda



October 14 - Session 1
14:30 - 16:00

Navigating the Storm
Strategies for PNT Resilience and Threat Mitigation

GNSS jamming and spoofing have surged since 2022, driven by conflicts and cheap hardware. Critical infrastructure, aviation, maritime, energy, finance, relies on GNSS for positioning and timing, yet its signals are extremely weak and easily disrupted. All these factors form the ingredients of a perfect storm.

This session will explore the key strategies being implemented to overcome these challenges in the introduction and deployment of commercial PNT products and services, highlighting practical approaches and emerging opportunities.



October 14 - Session 2
16:30 - 18:00

The Next Maritime PNT
PNT for Ports and Underwater Infrastructure Management

The session will bring port authorities, shipping companies and infrastructure operators together to discuss PNT needs in ports and underwater environments, where resilient positioning and timing are critical for goods handling, safe vessel berthing, and monitoring subsea infrastructure.

These use cases highlight the broad reliance on PNT and the need for robust solutions in complex maritime and near-shore conditions.



October 15 - Session 3
09:30 – 11:00

Unmanned Operations
Challenges of Scaling-up Drone Applications

Drone applications are rapidly moving from pilots to real-world deployment across sectors like transport, ports, and public safety, but scaling remains challenging. It requires not only mature technology, but also strong regulation, reliable PNT, and solutions to security risks like counter-UAS.

This session brings together regulators, authorities, and users to explore current drone use in traffic management, port operations, and safety-critical infrastructure monitoring.



October 15 - Session 4
12:00 – 15:00

eLoran and Indoor
And Complementary PNT Technologies

Enhanced long-range navigation (eLoran) is a high-power terrestrial system for positioning and timing in safety-critical sectors.

The March 2026 ESA/ESTEC conference confirmed its role as a GNSS complement or backup, including in Europe. NAVISP supports ongoing antenna, receiver, and timing developments.

This session will highlight eLoran test results alongside other complementary solutions, such as 5G broadcast positioning and advances in indoor positioning.