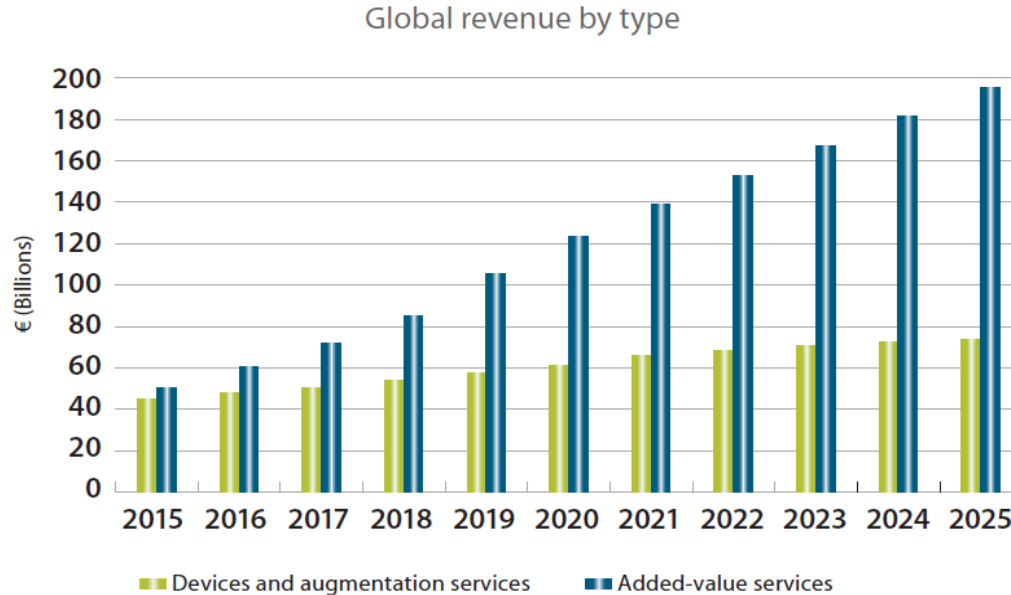


The NAVISP Programme

P.Mancini Ph.D.

NAVISP Programme Manager

ESA UNCLASSIFIED - For Official Use



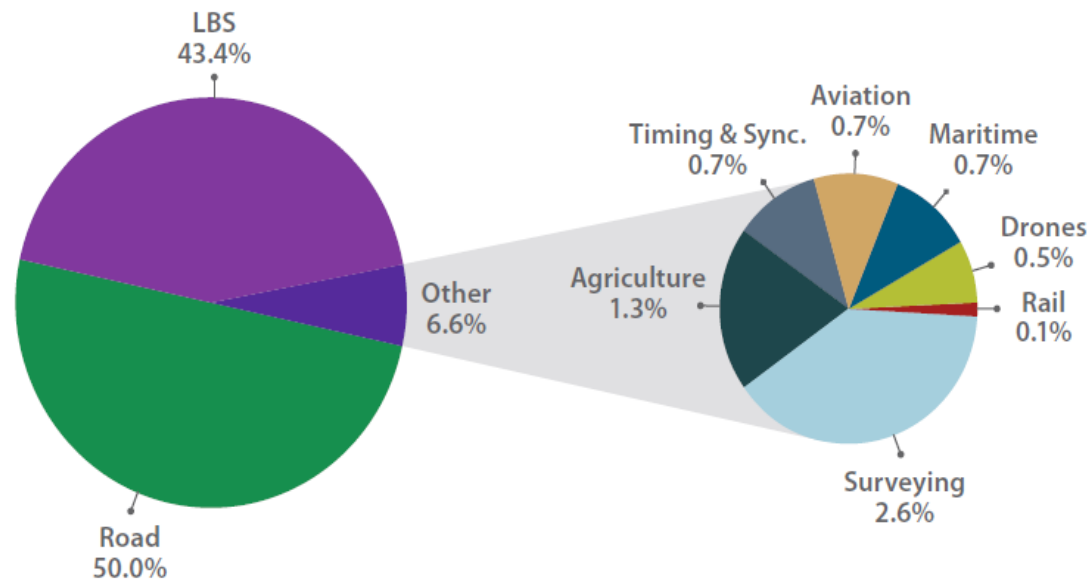
- About 10% of the European economy (GDP) relies on satellite navigation services
- €60 billion revenues in Europe thanks to Galileo and EGNOS by 2027

GSA

Cumulative Revenue 2015-2025 by market segment

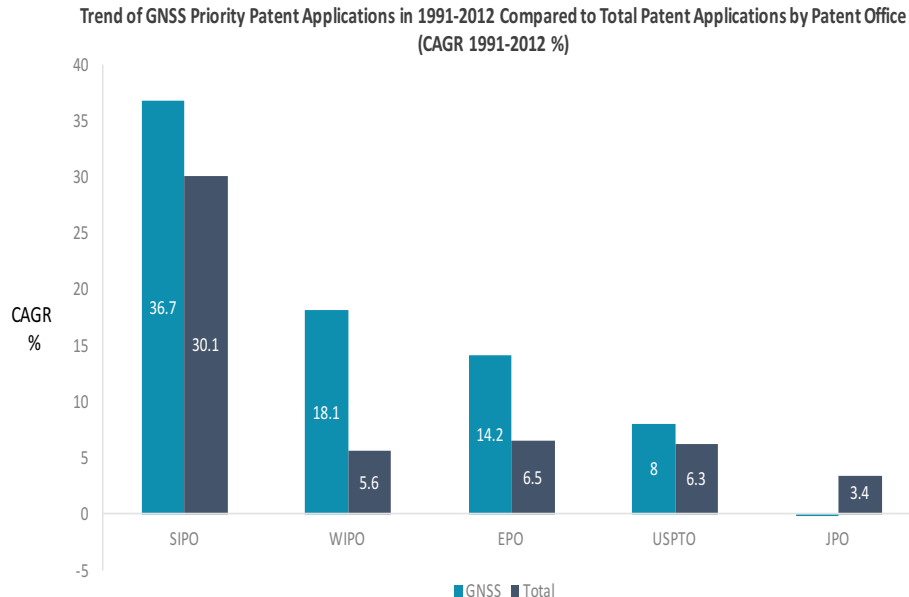


Cumulative Revenue 2015-2025 by segment



GSA

GNSS patent share



Note: USPTO= US Patent Trademark Office, JPO= Japan Patent Office, SIPO= State Intellectual Property Office of the People's Republic of China, WIPO= World Intellectual Property Organization, EPO= European Patent Office. Source: EC, STP Analysis,

China is running at an incredible fast rate showing a GNSS deposited patents CAGR of 37% in the 1991-2012 period, while US patents are growing at 8% CAGR and Japanese ones are actually stagnating. Europe, besides the current lower absolute values, shows a 14% CAGR. Besides Japan, all GNSS patent applications are growing at a higher pace than the total patent applications growth rate

NAVISP Programme: Main motivations



- Foster innovation & competitiveness of the European PNT sector
- Leveraging on ESA knowledge of GNSS Systems
- Contributing to the Space 4.0 ESA Strategy – Open to non-space Industry

To leverage these upcoming opportunities, the European PNT sector will need to:

- Develop cutting-edge technologies & effective products & solutions
- Maintain & increase competitiveness of the research and industrial sectors to keep them at par with existing and emerging solutions worldwide



- **Improve industrial innovation** and competitiveness at all industrial levels and all industrial sizes, and driving growth and jobs
- **Flexibility for MS** to target investments to support national objectives, under MS control
- Enables ESA MS to invest in developing industrial capacity, e.g. qualify **new entrants for the market**
- Uses best practice in terms of **responsiveness and fast contracting procedures**
- Open for **non-space industry** to capture **the full spectrum of PNT innovation and commercialisation**
- Designed to **avoid any duplication** with work funded by the EU under H2020 or Fundamental Elements

New technology

More GNSS satellites

More GNSS signals

Communications

WiFi / RFID

UWB, Sparse Band

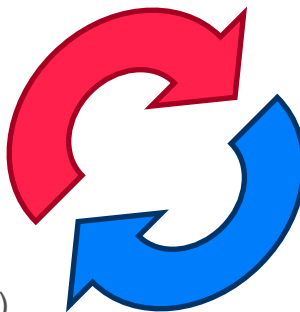
Digital broadcasting

Pseudolites, Locatalites

Smaller, cheaper inertial sensors

Digital mapping (outdoor & indoor)

More processing power



Drives new applications

New applications

Seamless indoor-outdoor personal navigation

Intelligent Transport Systems

Rail signalling & control

Precision aircraft landing

Ships in harbours

Location-dependent billing

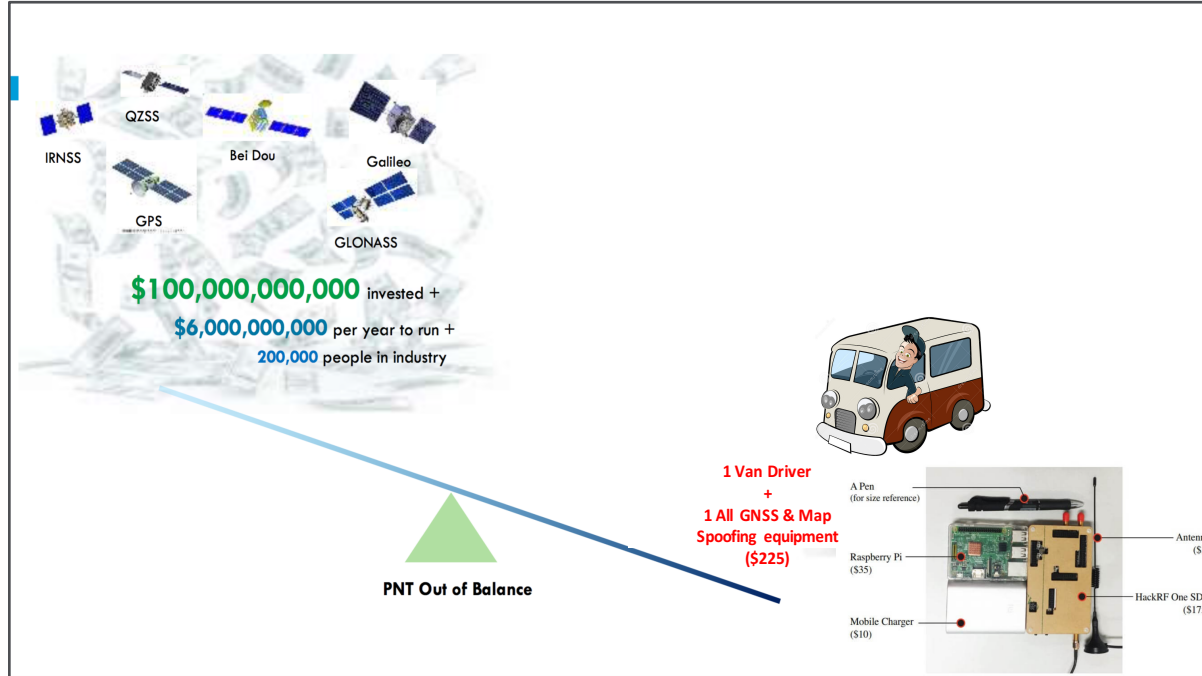
Virtual security fences

Tracking people/animals/assets

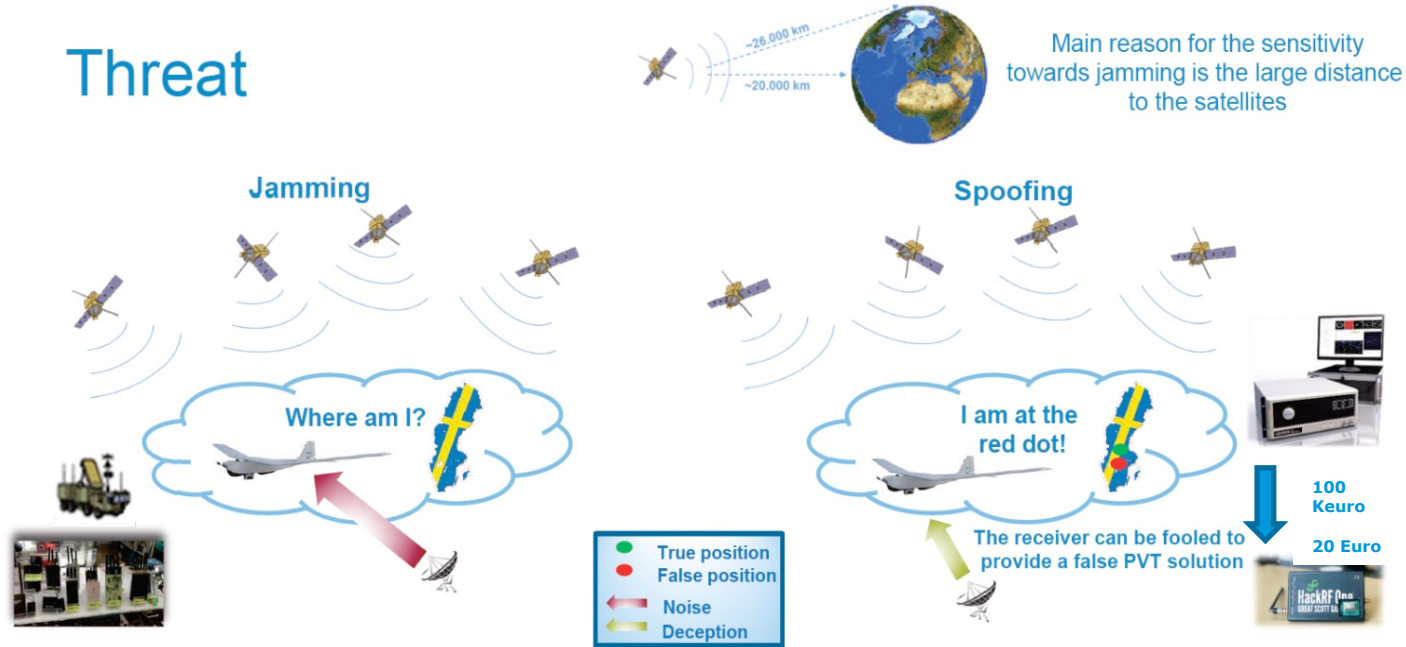
Social inclusion

Creates new challenges

PNT unbalance...

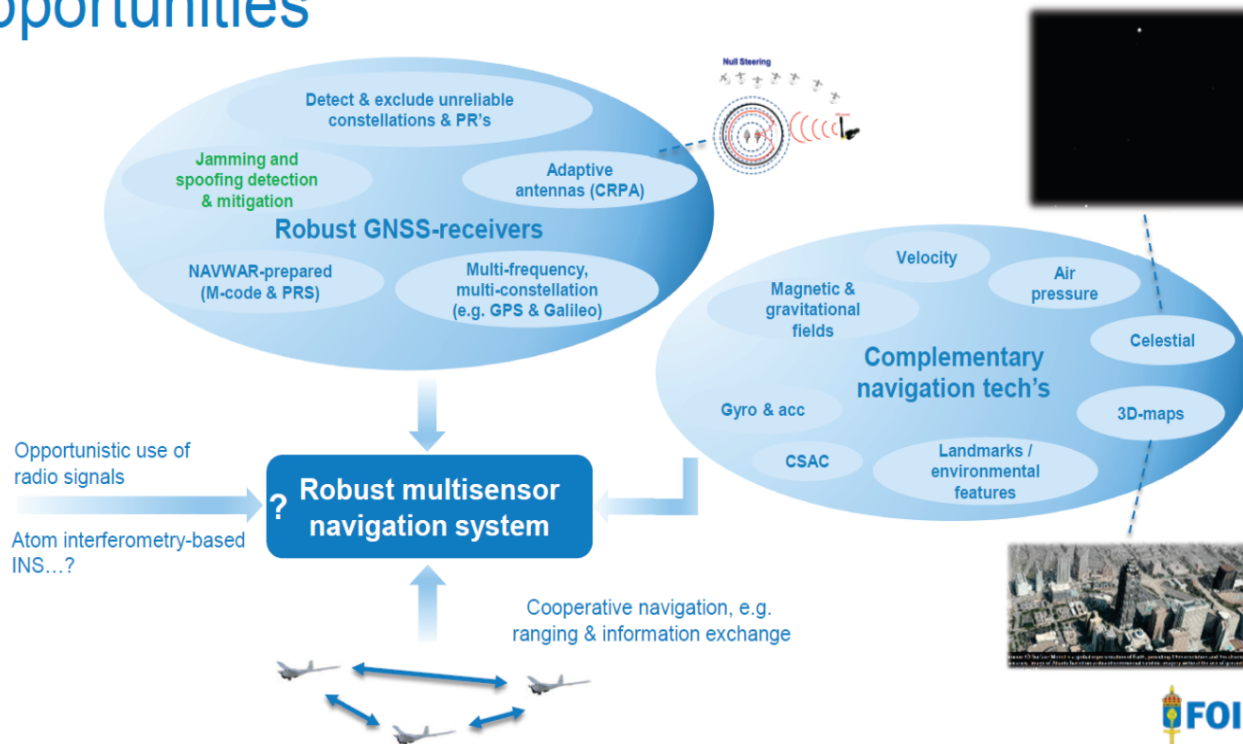


Threat



Critical infrastructures that depends on GNSS for its positioning or timing requirements should be equipped with interference monitoring, detection, and alert service, and should have alternative non-GNSS back-up solution

Opportunities



Jouni Rantakokko, Deputy Research Director FOI

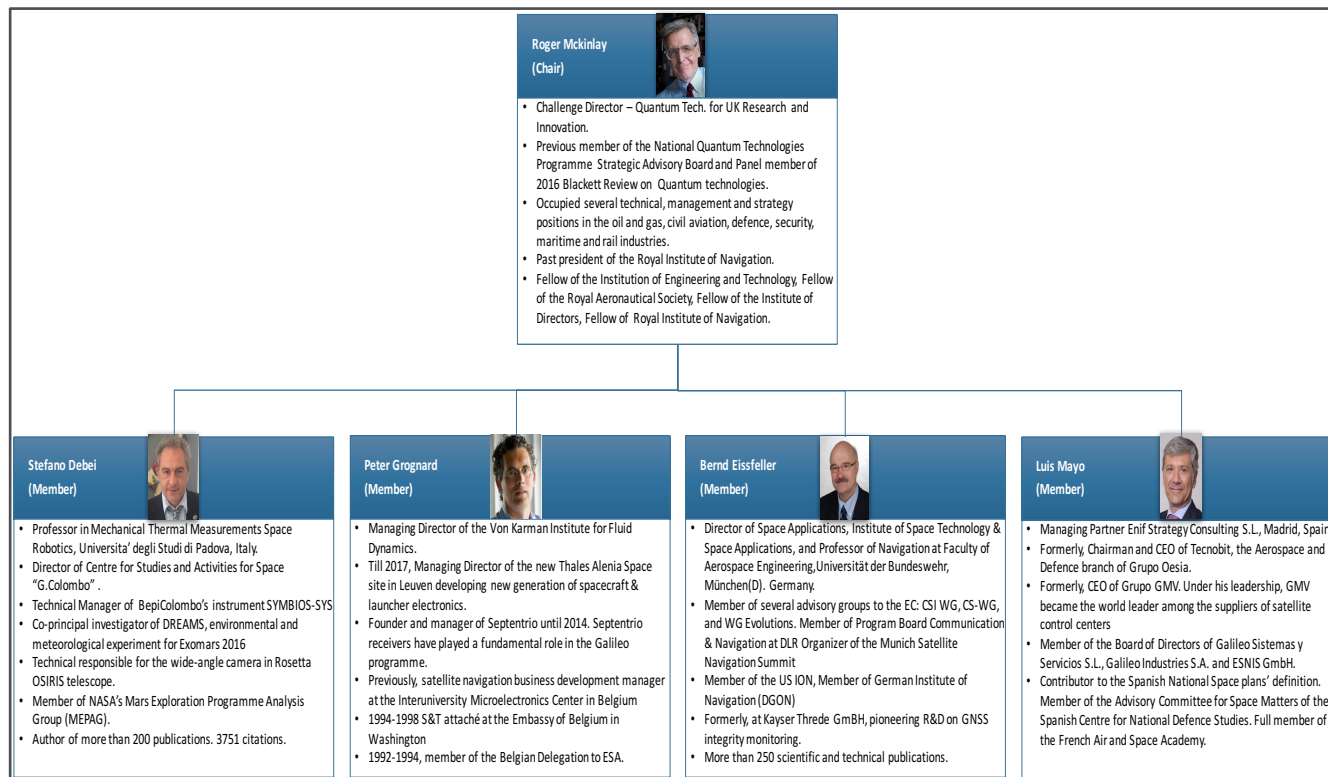
NAVISP motivation to participate



- The Programme is managed with **15% of overhead**
- **IPR remains with the Contractor**
- All information is treated **as commercial sensitive**
- **Transferable product ownership** upon contract completion
- **ESA partnering and facilitating the procurement process and the project execution**

- for Element 1: Workplans 2017/2018 and Addendum/2019 are being implemented for a total of 37 approved activities. The totality of the available budget is engaged
- Element 2 activities have been incubated at a very fast pace together with several Member States and key European PNT stakeholders for a total of 60 activities positively assessed in the pipeline. 70% of the available budget engaged. Nature of actors involved:
 - 61% of the Primes are SME
 - 15 Mixed Public/Private consortia (large/SME/universities and research centres)
 - New actors: 37 among all actors involved (95 Primes and subcos) have never worked with ESA before
- Element 3 has also been rapidly implemented since last year CfP kick off: 10 proposals already submitted resulting in 87% of the budget engaged

- NAVISP aims to foster innovation on the PNT field while supporting industry and member states interests.
 - NAVISP portfolio of activities is quite heterogeneous: mix of ESA-driven, industry-driven initiatives, namely bottom-up in an attempt to capture the broad scope of NAVISP.
 - Is the NAVIPS portfolio complete? Is it meeting the needs of an evolving and highly competitive PNT market?
 - An advisory committee of high-profile experts has been set up to provide an external view to help ESA in answering the above questions.
- NAVAC: **NAV**igation Innovation and Support Programme **A**dvisory **C**ommittee



- NAVISP Element 1:
 - WP2019 and WP2020: Portfolio of activities supported
 - Recommendations for future WPs:
 - Increase of activities portfolio addressing integration of space/non space sensors
 - Strengthen link between use-cases and proposed solutions
 - Acceleration of schedule in Proof-of-Concept projects
 - Cross linking of activities results
- Evaluation of achievements of NAVISP phase I and recommendations for Phase II:
 - Report including key findings and recommendations presented to Member States on September 11th, 2019

**Solicited by the increasing interest of Member States,
ESA prepared a NAVISP Phase II in view of Cmin 2019
doubling the funding request from to 20 to 40 MEuro per
year**

NAVISP PHASE 1 contributions



Participating States	Element 1 (M€) m.e.c	Element 2 (M€) m.e.c	Element 3 (M€) m.e.c
Austria	0.40	1.41	-
Belgium	0.50	-	1.49
Canada	-	2.02	-
Czech Republic	1.01	1.01	0.20
Denmark	0.50	0.50	0.50
Finland	0.55	1.11	0.28
France	2.02	4.03	-
Germany	2.50	2.50	-
Ireland	-	1.01	-
Italy	-	2.52	-
Netherlands	0.50	0.50	-
Norway	0.71	2.02	2.32
Poland	-	1.51	-
Portugal	-	1.01	-
Romania	0.68	0.68	0.68
Spain	-	6.05	-
Sweden	-	0.72	-
Switzerland	0.99	1.53	-
United Kingdom	5.04	20.16	5.04
Total	15.40	50.27	10.51

NAVISP PHASE 2 contributions



NAVISP Phase 2 Contributions	Element 1	Element 2	Element 3	Total
Austria	0	1	0	1
Belgium	0.89	2.5	2.5	5.89
Czech Republic		2	1	3
Denmark	0.25	0.25	0.5	1
Finland	0.4	0.8		1.2
France	1	2		3
Greece	0.9	0		0.9
Germany				0
Hungary	1	1	1	3
Ireland		0.5		0.5
Italy	3	9	3	15
Luxemburg	0		0	0
Netherlands	0.5	0.5		1
Norway	1	2.5	1	4.5
Poland		0.3		0.3
Portugal		1.5		1.5
Romania				0
Spain		5		5
Sweden	0.4			0.4
Switzerland	3	2		5
United Kingdom	6	9	5	20
Canada				0
Slovenia				0
Total	18.34	39.85	14	72.19



Indicative financial profile (in M€, 2019 e.c.)



	2020	2021	2022	2023	2024	2025	POST 25	
Phase 2	3.00	12.00	24.00	21.19	12.00			72.19
Expected short term new contributions		2.00	4.00	1.81				7.81
Total phase 2	3.00	14.00	28.00	23.00	12.00			80.00
Post Phases				9.00	20.00	32.00	59.00	120.00
Total	32.00	32.00	32.00	32.00	32.00	32.00	59.00	277.00

NAVISP Industry Days

Day 1: 22nd January 2020, ESTEC, Erasmus High Bay Area

13:30 - 14:35	Session 1: Introduction
	<i>Welcome</i> Philippe Michel, Head of Navigation Strategy and Programme Department, ESA
	<i>The NAVISP Programme</i> Pierluigi Mancini, Head of NAVISP Programme Office, ESA
	<i>Assessment of NAVISP</i> Rafael Lucas, NAVISP Advisory Committee Secretariat, ESA
	<i>GNSS Market Report</i> Invited Speaker: Flavio Sbardellati, Market Development Department, European GNSS Agency (GSA)
14:35 - 16:25	Session 2: NAVISP Element 1 – “Innovation in Satellite Navigation”
	<i>Introduction</i> Giorgio Solari, Head of NAVISP Element 1 Office, ESA
	<i>Innovation Beyond GNSS</i> Invited Speaker: Diana Furchtgott-Roth, Deputy Assistant Secretary for Research and Technology, U.S. Department of Transportation
	<i><Industry Presentations></i> Integrity Monitoring and Prediction Concept for Autonomous Car Resilience and Safety (IMPACARS), NSL Trusted Radionavigation Via Two-Way Ranging, Space Systems Finland Ltd Weather Monitoring Based on Collaborative Crowdsourcing, Airbus Defence and Space SAS High-Altitude Pseudo-Satellites (HAPS) for PNT, Sonaca S.A
16:25 - 16:45	Coffee Break

16:45 - 18:00

Round Table: "Solutions for Autonomous Road Vehicles"

Chair: Rafael Lucas NAVISP Advisory Committee Secretariat, ESA

Panelists: Michael Baus Project Director, Vehicle Motion and Position Sensor, Chassis Systems Control,
Robert Bosch GmbH

Irma Rodríguez Head of GNSS Algorithms, Products and Services, GMV

Joop Veenis Project lead ESA ESTEC Connected and Automated Shuttles,
Dutch Automated Mobility

18:00 - 19:00

Networking Cocktail

NAVISP Industry Days

Day 2: 23rd January 2020, ESTEC, Erasmus High Bay Area

09:00 - 11:30

Session 3: NAVISP Element 2 – “Competitiveness in PNT”

Introduction

Alessandra Fiumara, NAVISP Element 2 Manager, ESA

*UAS Navigation Aspects and
Interaction with other Airspace Users*

Invited Speaker: Andreas Lipp, EUROCONTROL

<Industry Presentations>

Crowd-sourced platform for GNSS anomaly identification, isolation and attribution analysis (COLOSSUS), NSL

Space GNSS Receiver, Syderal

Triband antennas for automotive (MISSATO), Taoglas

10:30 - 10:50

Coffee Break

<Industry Presentations>

Robust Remotely Piloted Aircraft System (RPAS) Missions in Arctic Environments, Integrated UAV

Galileo Public Authenticated Server-Based Snapshot Positioning (G-PASSION), Intecs Solutions

SPACEKEYS, Flight Keys

11:30 - 13:00

Session 4: NAVISP Element 3 – “Support to Member States”

Introduction

Rafael Lucas, NAVISP Advisory Committee Secretariat, ESA

Galileo Status

Invited Speaker: Javier Benedicto, Head of Galileo Programme Department, ESA

<Industry Presentations>

Maritime Resilience and Integrity of NAVigation (MARINAV), NLA International

Advanced RFI Detection, Alerting, and Analysis System (ARFIDAAS), SINTEF

Cybersecurity Test & Evaluation Facility for Belgian future space and air transportation system (CyTEF), Belgian Royal Military Academy

GNSS vulnerability & mitigation in Czech Republic, GNSS Center of Excellence

13:00 - 14:30

Lunch Break

14:30 - 16:00

Session 5: Closing Session

NAVAC Recommendations for NAVISP Phase 2

Invited Speaker: Roger McKinlay, NAVISP Advisory Committee Chair

Conclusions and Way Forward

Pierluigi Mancini, Head of NAVISP Programme Office, ESA

Final Remarks

Paul Verhoef, Director of Navigation

16:00

End of Meeting

At the event, several opportunities for rides in the “Orbiter” (ESTEC autonomous shuttle) will be organized during the breaks

Industry Demonstrations

1. **AGORA**, system for the management of crowd and organiser staff leveraging on GNSS positioning in order to improve security and help organizing large public events. *Romanian InSpace Engineering.*
2. **DRACONAV**, industrial version of a secure GNSS module able to detect GNSS signal spoofing, replay and jamming attacks and provide an estimated PVT (Dead Reckoning) when an attack is detected. *FDC.*
3. **Galileo Public Authenticated Server-Based Snapshot Positioning (G-Passion)**, GNSS server-based position authentication service using the Galileo signal. *Intec Solutions.*
4. **GDARS**, advanced GNSS RF-bands record and playback instrument, combining the highest fidelity with first class flexibility and performances. *Saphyrion.*
5. **GIDAS**, scalable and flexible real-time GNSS Interference Detection & Analysis System which can be used as standalone monitoring station for interference detection and can be upgraded to a more complex network of stations which allows interference detection and interferer localization. *TeleConsult Austria.*
6. **High Accuracy Assistance Service (HAAS)**, high-precision, cloud-based corrections service. It contains highly accurate corrections for orbits, clocks, ionospheric and tropospheric delays. *RX Networks.*
7. **NextGen GNSS Antenna**, multi-frequency/multi-constellation GNSS antenna aiming at providing centimetric accuracy and intended initially for use in the driverless car market. *Helix Technologies.*
8. **SPACEKEYS**, RAIM prediction system offering easy integration into any flight planning system as well as introducing new innovative features that will allow an aircraft operator to avoid areas of low GNSS accuracy already during the trajectory creation process. *Flightkeys.*