navisp

ESA ENGAGEMENT WITH PNT SECTORS

NAVISP Programme Phase 3

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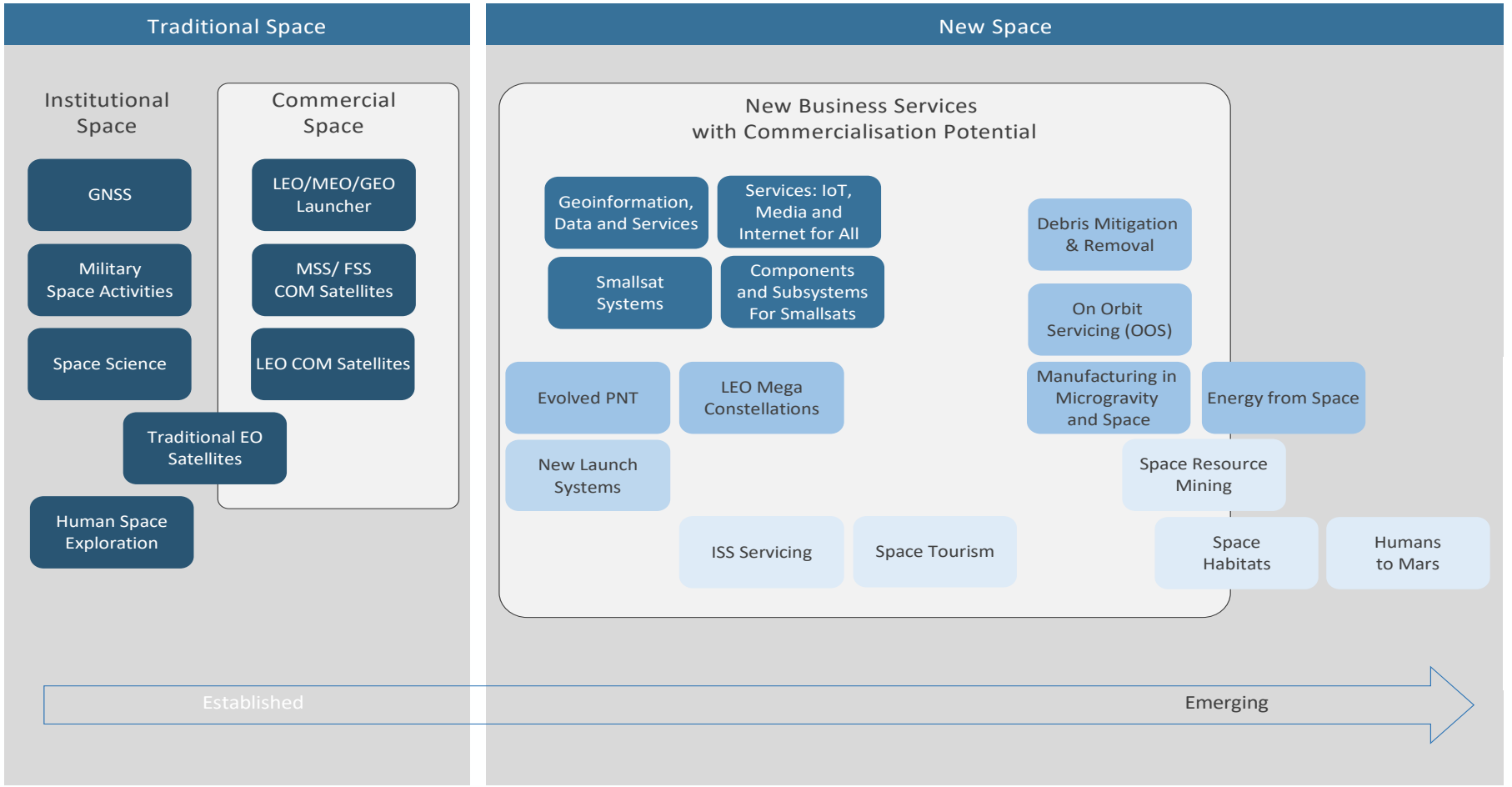
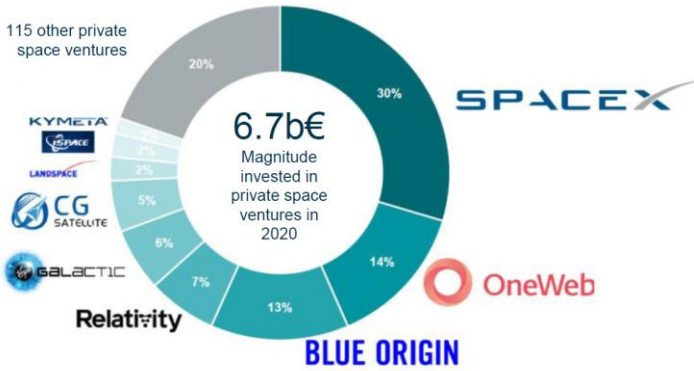
16/6/2022

NewSpace Trends



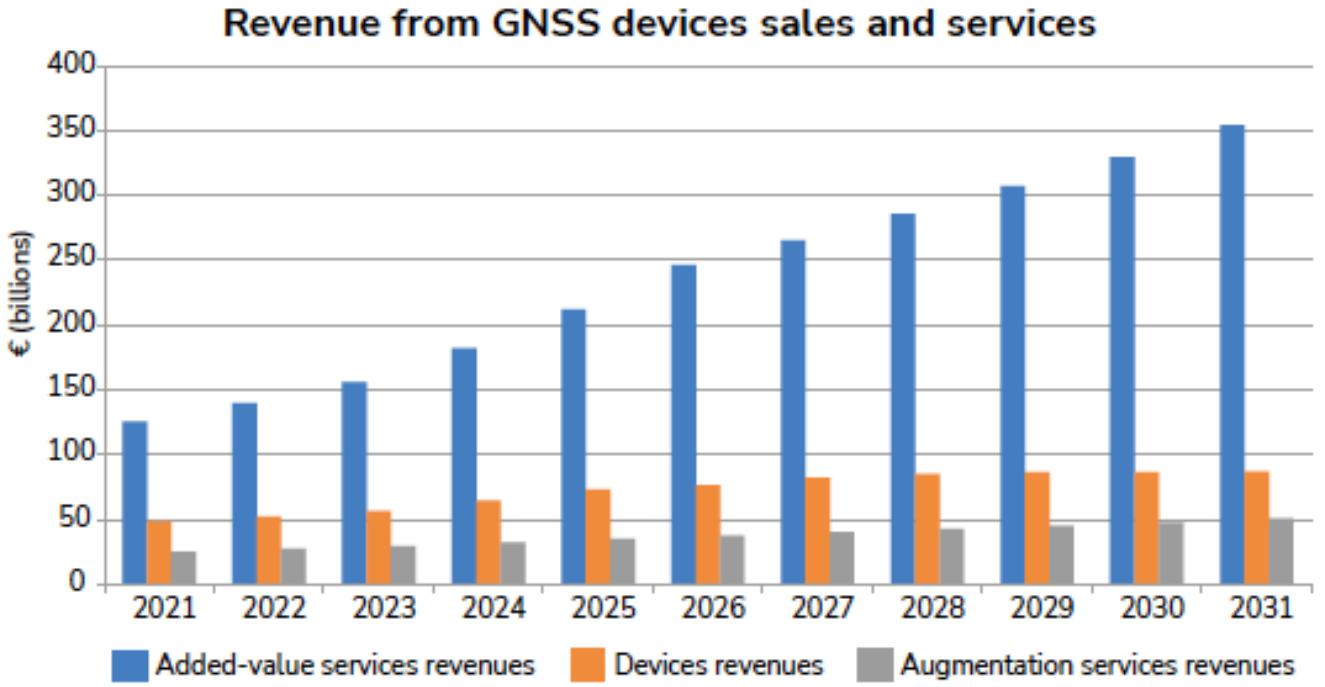
Space continues to attract private investment worldwide. Investors provided a new record of €6.7 billions to private space ventures in 2020, an increase of 30% compared to 2019



Steady Growth in GNSS market

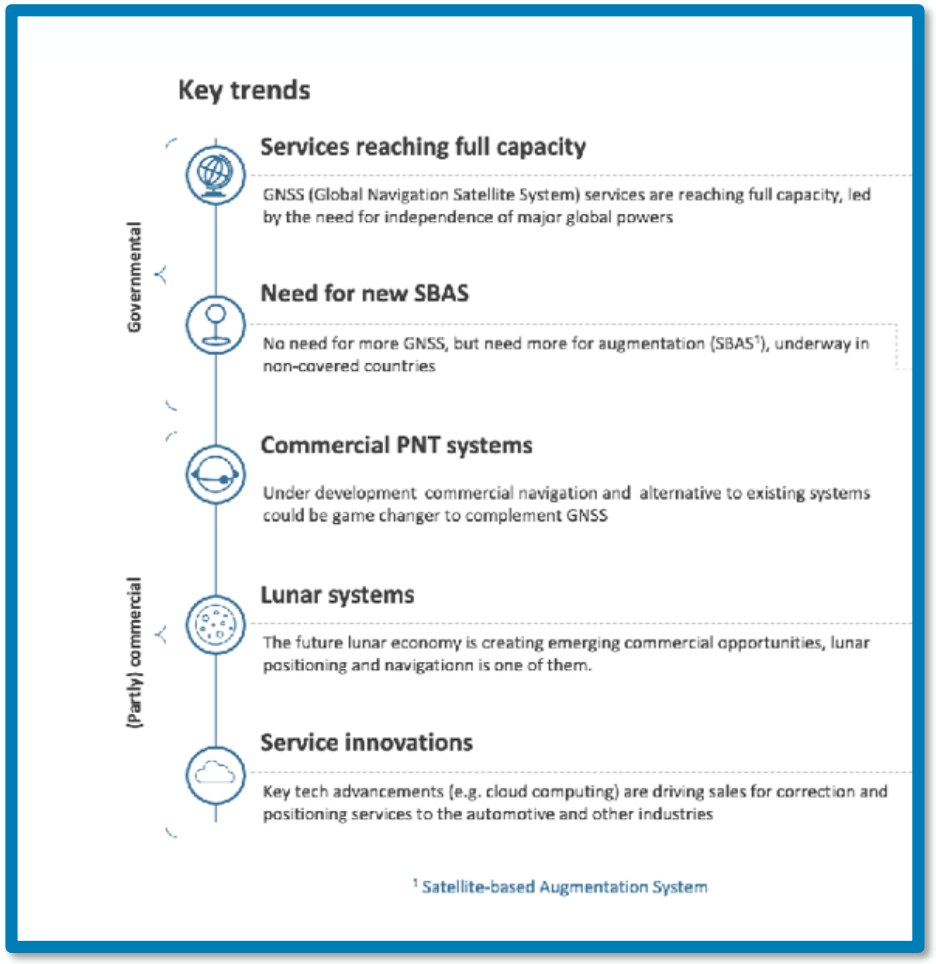
Navigation is the newest and already the biggest of the space application markets

- From 6.5 billion receiver units as an installed base in 2021 to 10.6 billion receiver units installed base in 2031
- Global annual market revenues in 2031: 87 B€(devices) and 405 B€ (services and augmentations)
- CAGR of 9.2% between 2021 and 2031
- Road and Consumer solutions dominate all other market segments in terms of cumulative revenue



Source: EUSPA Market Report 2022

Key trends in GNSS/ PNT systems



Key players

Satelles
- Satellite Time and Location (STL) system only alternative PNT solution at **TRL 9** by leveraging the Iridium constellation
- Raised $26 Mn in Series C funding in 2019

GEESPACE
- Dedicated LEO PNT services for **autonomous vehicles**
- $320+ Mn in funding, two in-orbit demonstrators launched

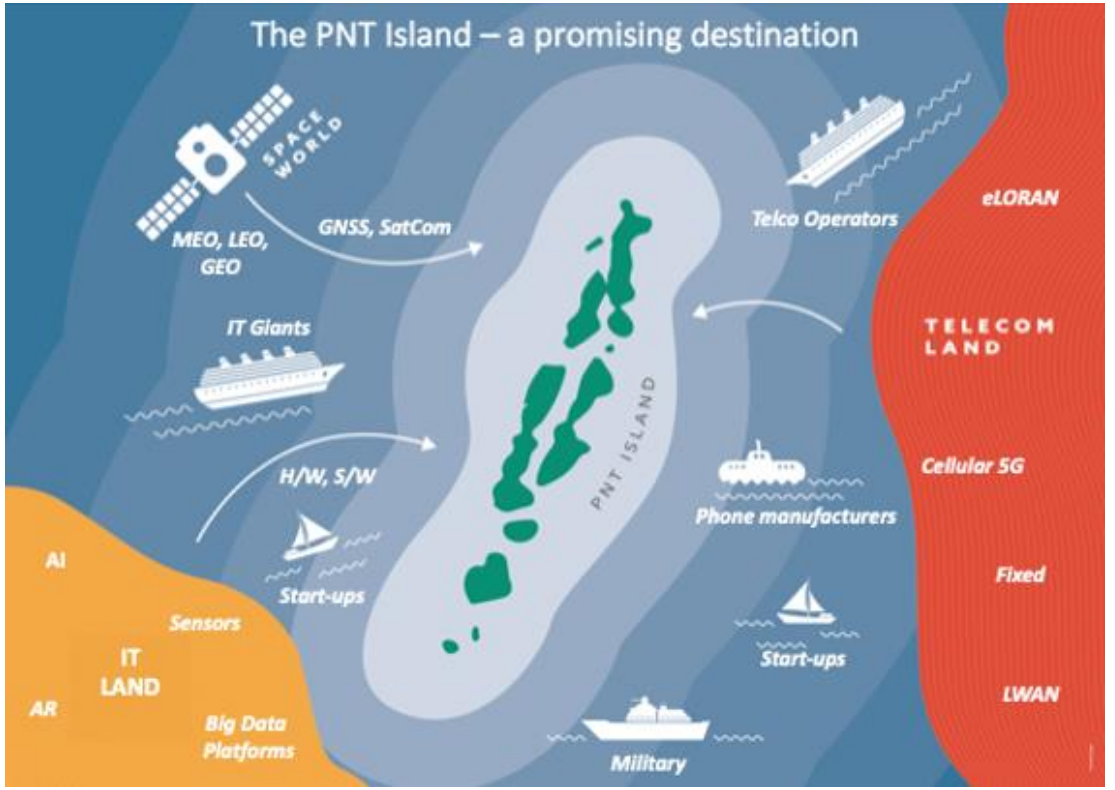
xona space systems
- Targeting **safety-critical operation** with tenfold increase in accuracy
- Funding of ~$1 Mn in pre-seed round led by 1517

OneWeb
- Complementing GPS signal

Researchers external to SpaceX triangulated the signals from six Starlink satellites to fix a location on Earth with less than eight meters of accuracy.

Different Stakeholders exposed to very diversified technologies

- Developing innovative products/services will require expertise in several fields, which rarely exists at a single organization.
- The PNT island is being addressed by different actors coming not only from the space sector but also from the telecom and the IT world.



Future PNT systems/applications will be the result of the combination of:

- Information and communication technologies (IoT)
- PNT applications
- Telecommunications services (5G/6G)
- Space sector / New Space actors (GNSS, LEO constellations, etc.)

What is Ubiquitous Positioning?

Multi-sensor, low-cost and robust positioning

- Based on single or multiple users
- Different types of platforms and sensors
- Autonomous or cooperative navigation

Seamless transition

- Different sensors
- Different platforms
- Different algorithms
- When transitioning between different environments
  - *Plug-and-play* concept

Continuous positioning across all environments

- Open areas, partially obstructed, indoor

Courtesy of Prof Terry Moore, University of Nottingham

Ubiquitous Positioning: The Challenges

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

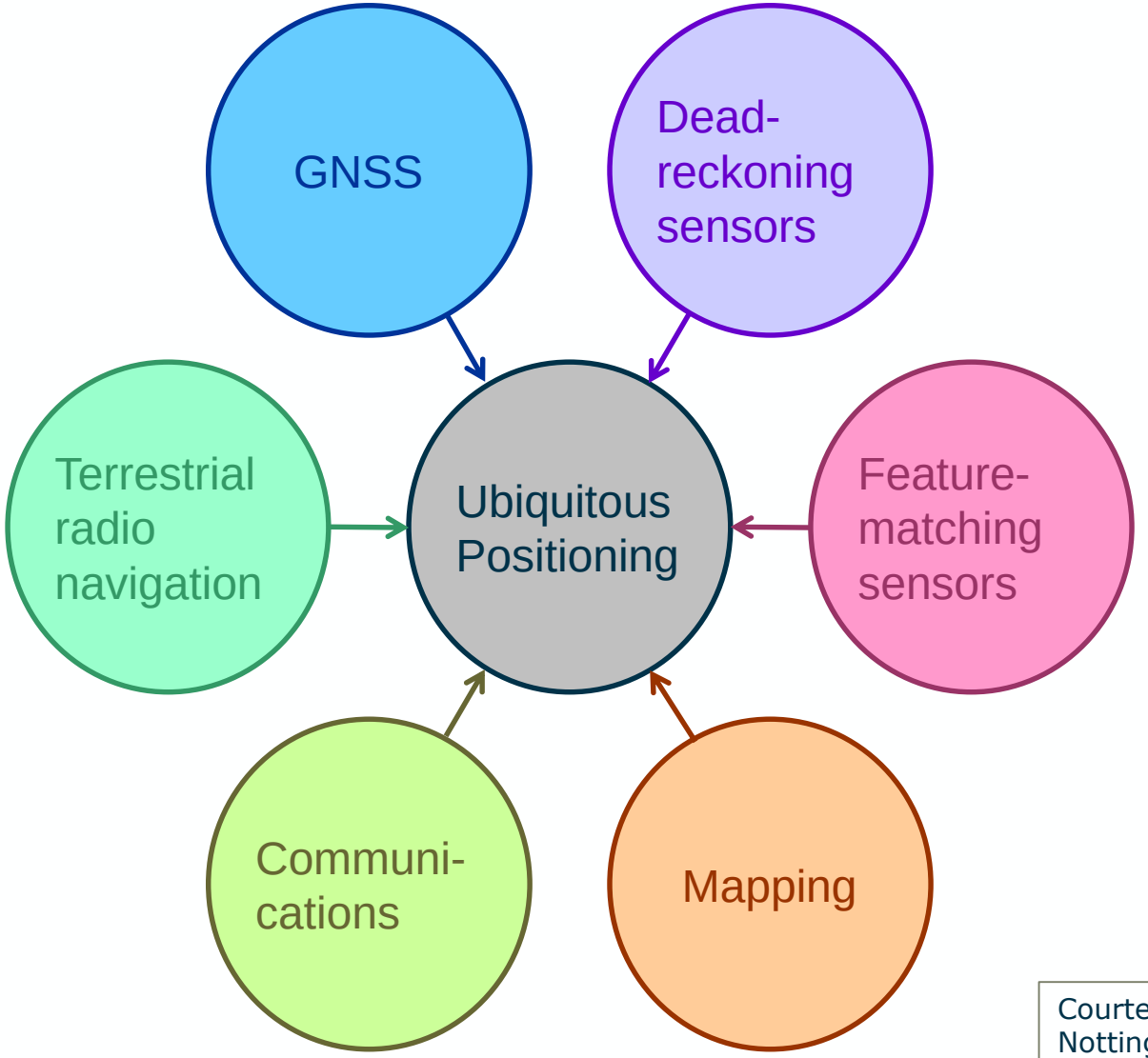
Tracking people/animals/assets

Social inclusion

Creates new challenges

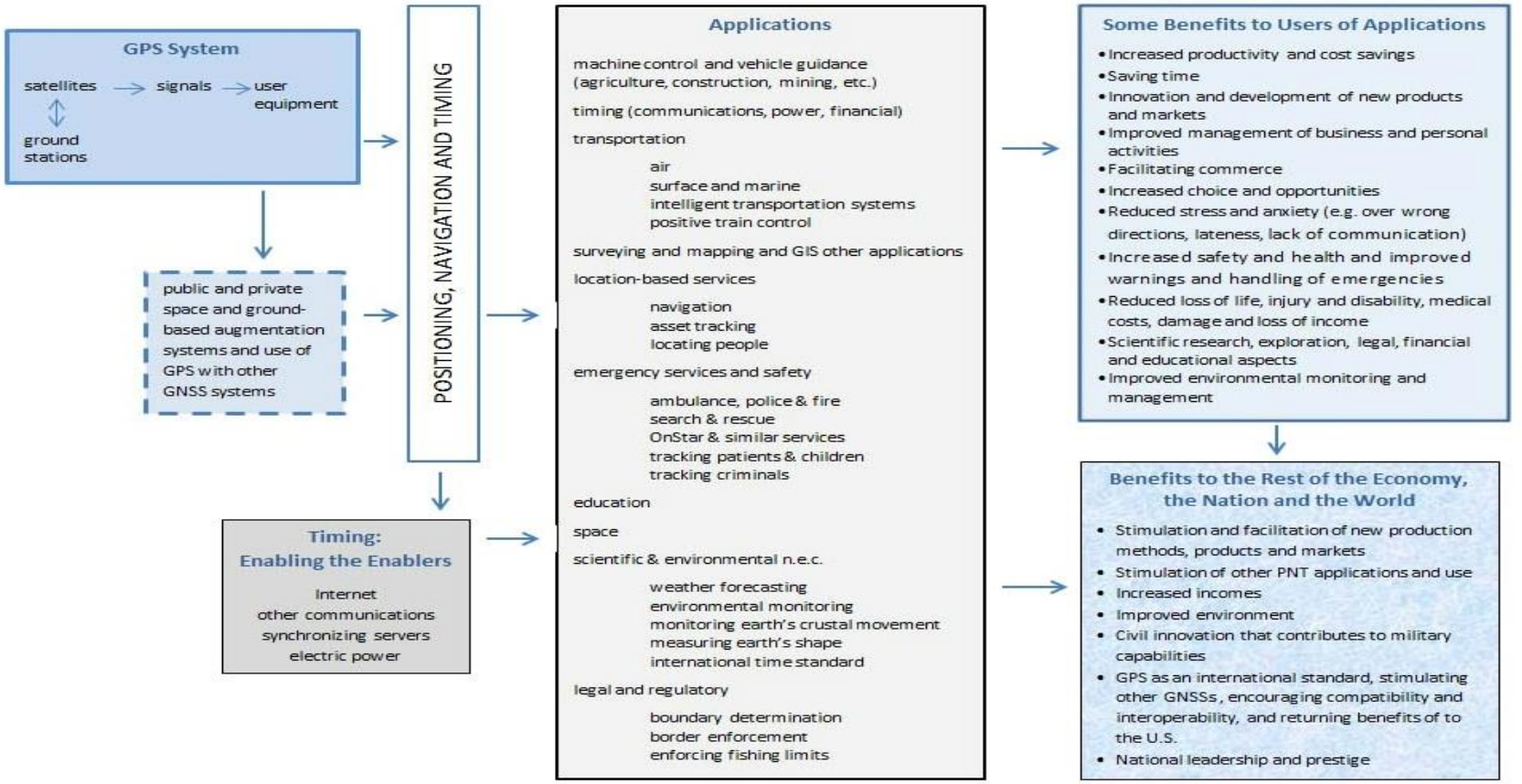
Courtesy of Prof Terry Moore, University of Nottingham and Dr Paul Groves, UCL

Key elements of ubiquitous PNT



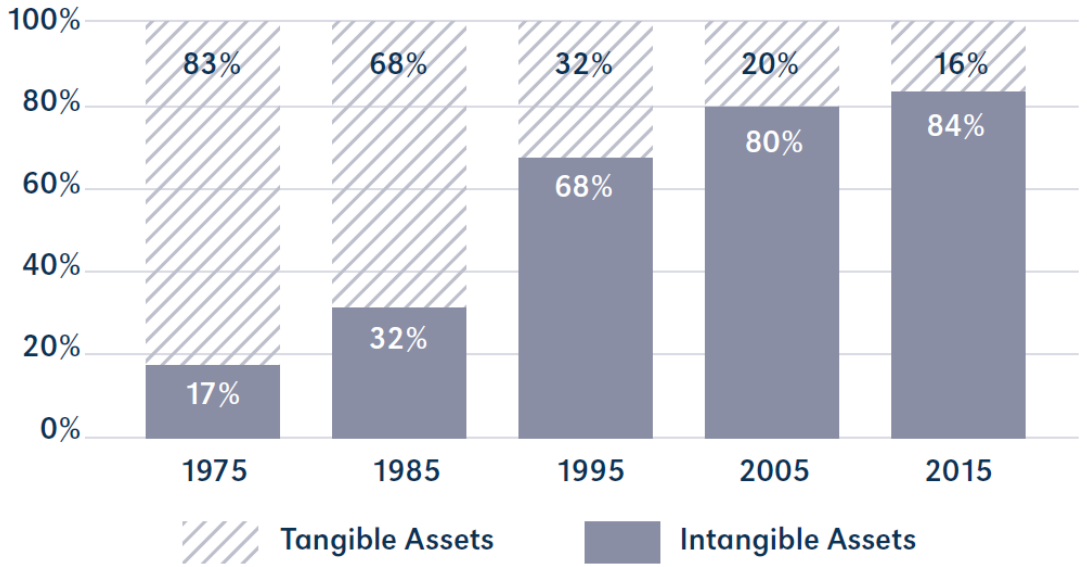
Courtesy of Prof Terry Moore, University of Nottingham and Dr Paul Groves, UCL

GPS Value chain for the US

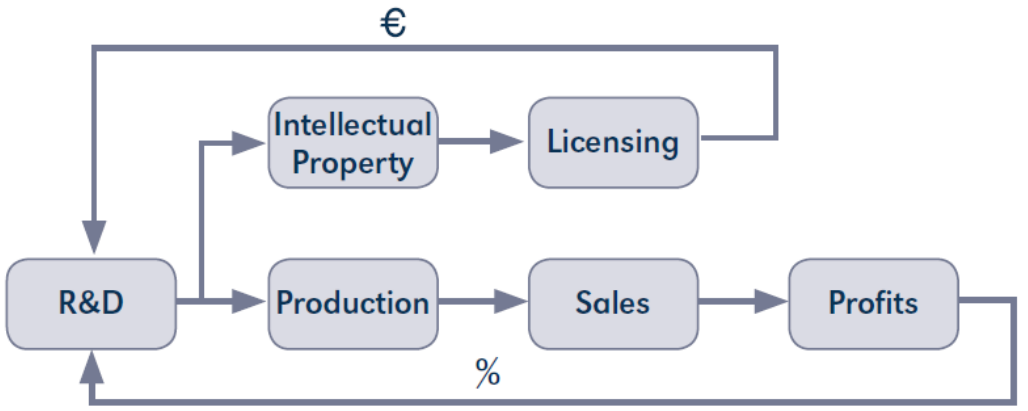


THE ECONOMIC VALUE OF GPS: PRELIMINARY ASSESSMENT
National Space-Based Positioning, June 11, 2015, Irv Leveson

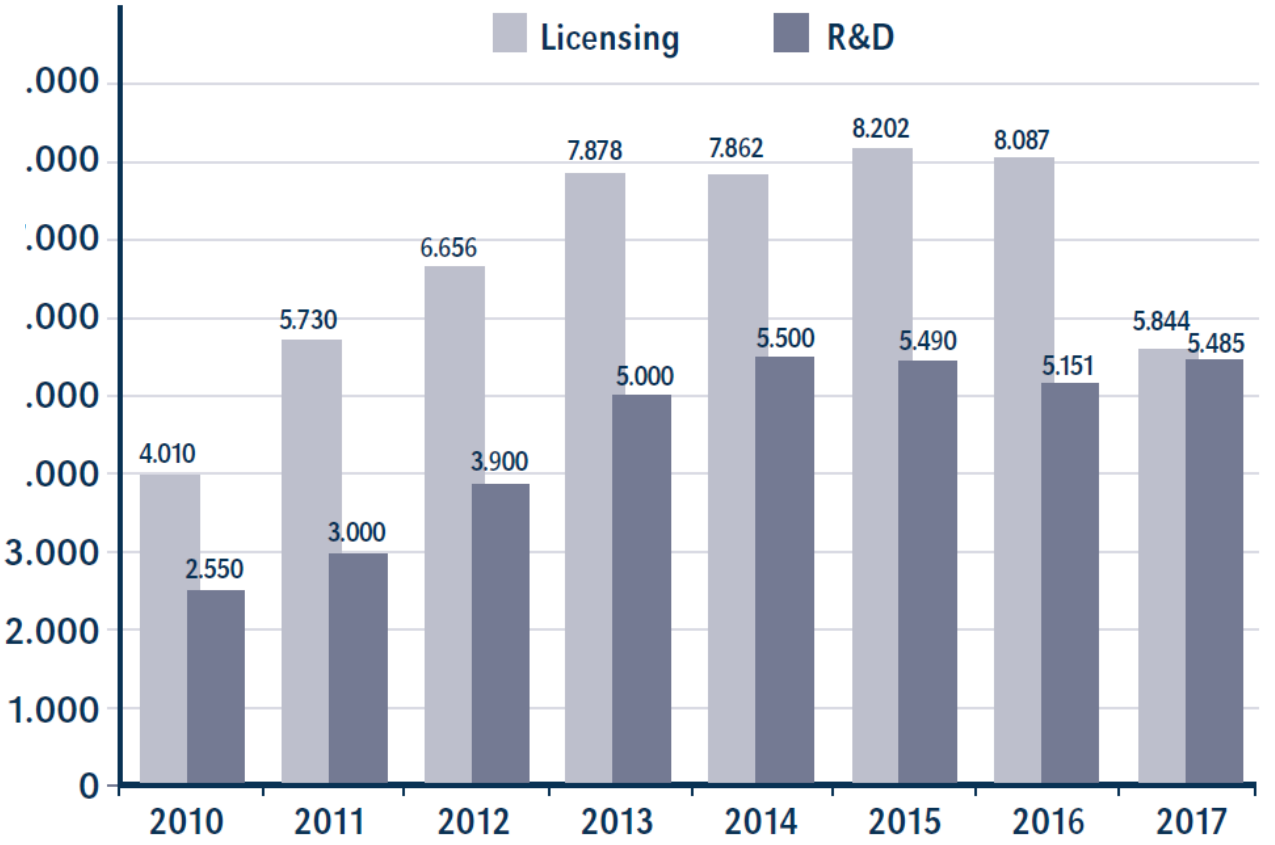
Companies Financing R&D Expenditure with Licensing Revenue: protect your IPRs



Source: Ocean Tomo, Intangible asset market value study, 2017

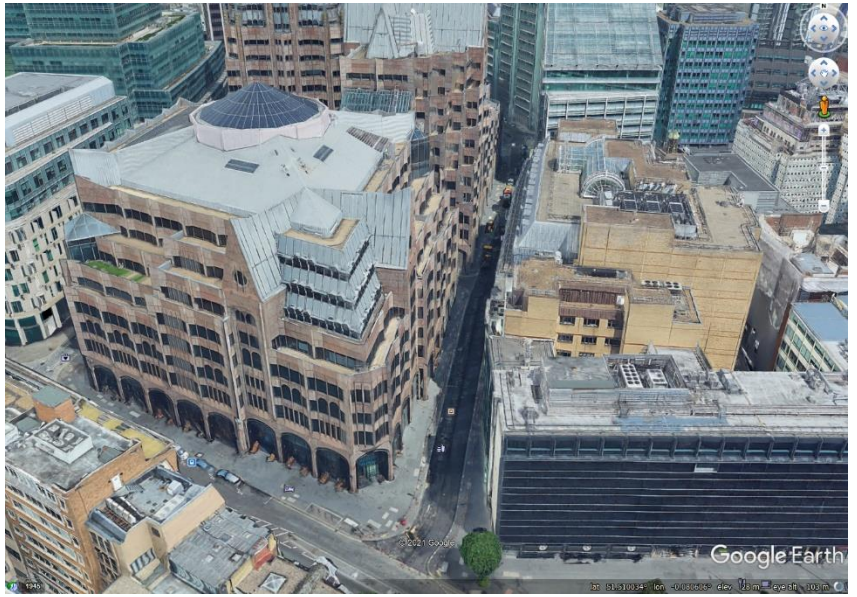


The Qualcomm Case



Source: Annual Report (USD million)

Conventional GNSS in Dense Urban Areas



City of London
RMS position error: 16m
Maximum position error: 60m

Canary Wharf, London
RMS position error: 85m
Maximum position error: 500m

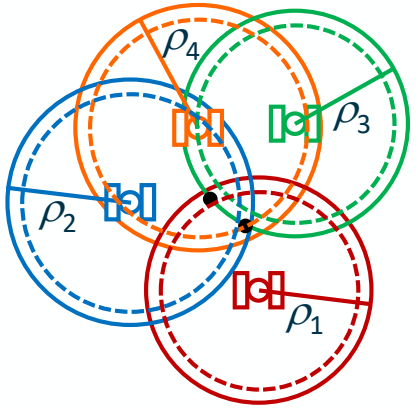
Conventional positioning algorithms assume a direct path from each satellite to the receive antenna

GNSS Signals are blocked, reflected and diffracted by buildings

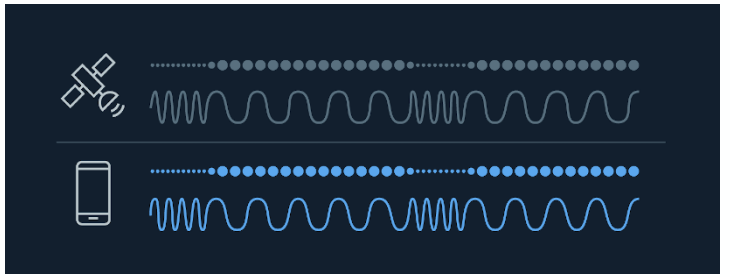
P. Groves UCL

Improving GNSS in Dense Urban Areas

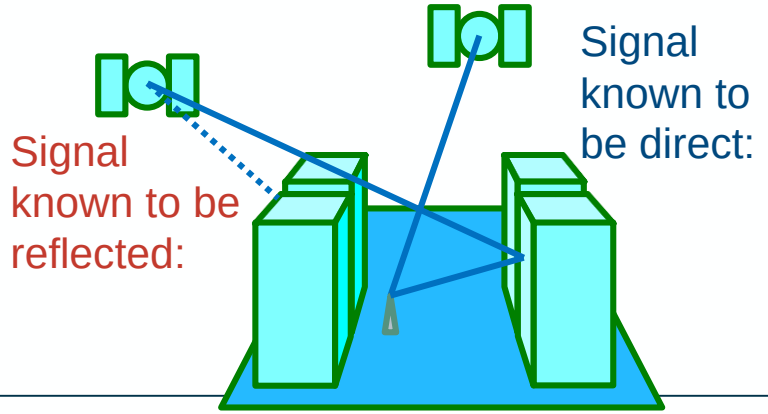
1. Optimize Everything in Conventional GNSS Positioning



2. Deploy Extended Coherent Integration – Supercorrelation



3. Use 3D-Mapping-Aided (3DMA) GNSS Positioning Algorithms

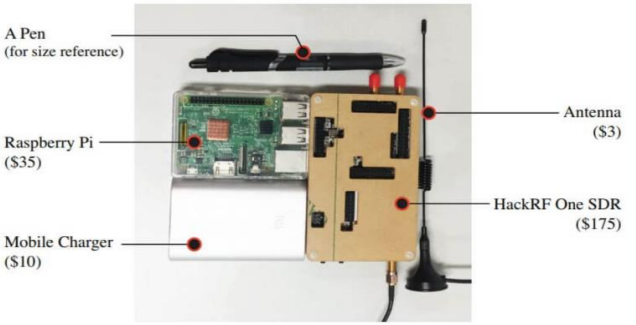


4. Aid GNSS with Imaging Sensors

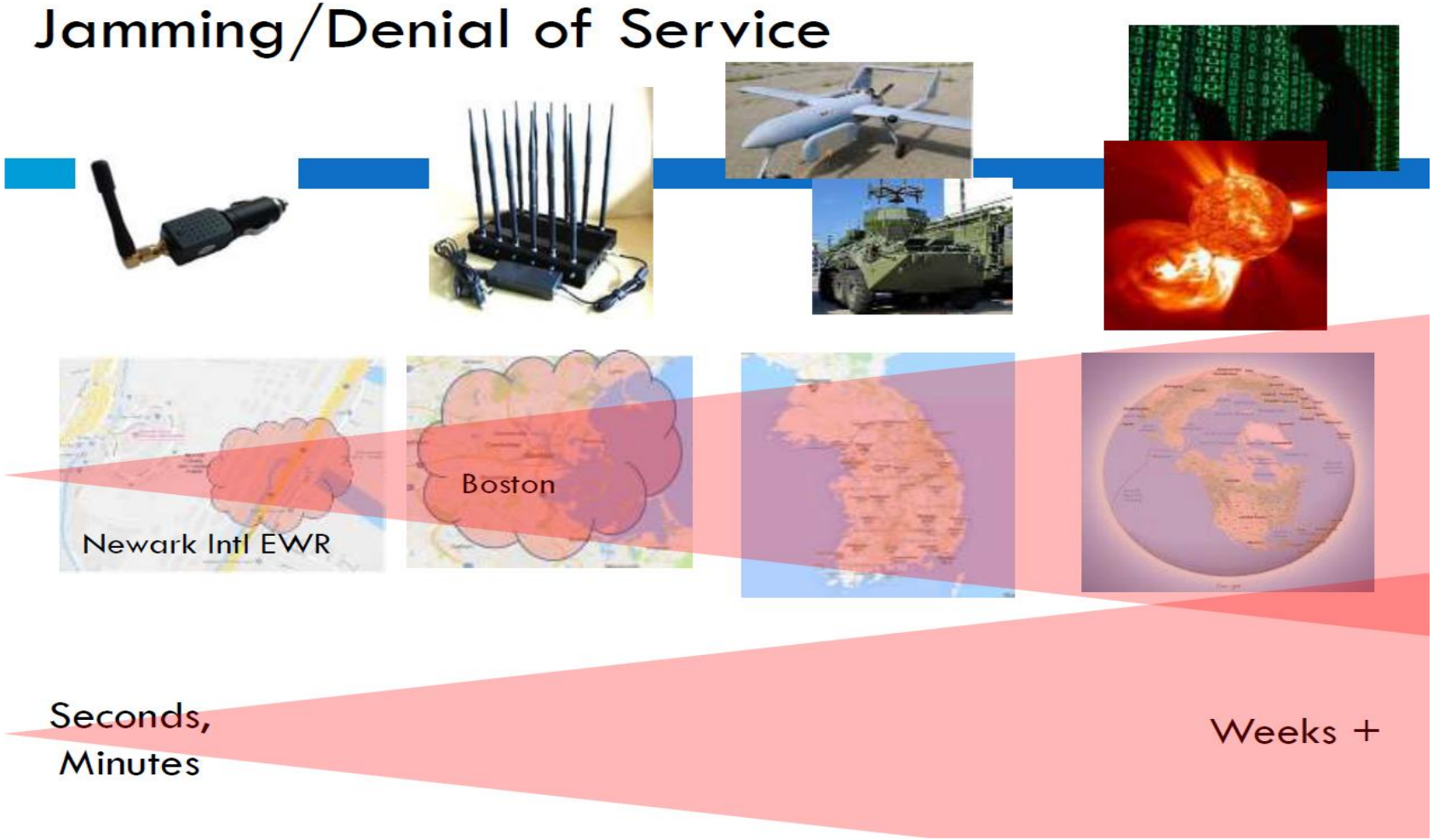
P. Groves UCL

GNSS Unbalance

1 Van Driver
+
1 All GNSS & Map Spoofing equipment
($225)

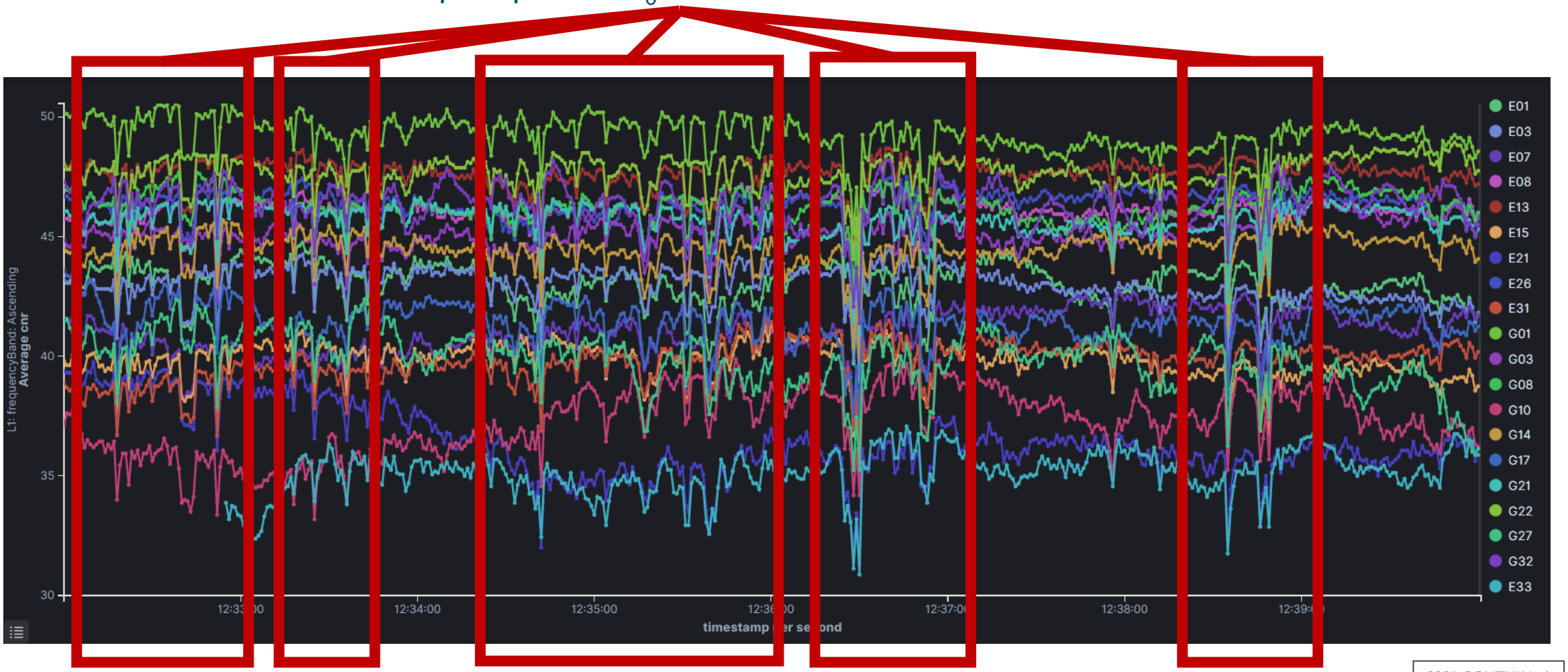


Jamming examples



Jamming is frequent….

Sharp drops in C/N_0 several times a minute



NAVISP, is designed to foster innovation & competitiveness of European industry

To leverage these upcoming opportunities, European GNSS industry will need to:

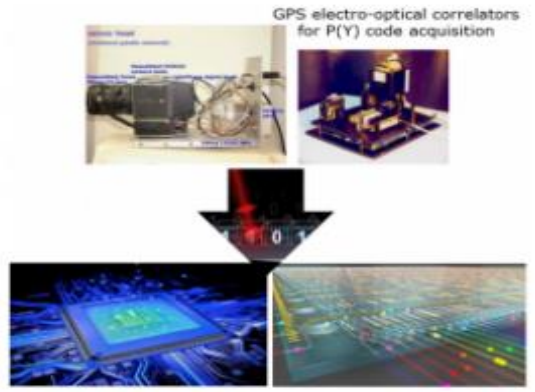
- Develop cutting-edge technologies & effective products & services
- Maintain & increase competitiveness of the manufacturing sector to keep it competitive w.r.t. existing and emerging non-EU solutions
- Support PNT national programmes and relevant institutional activities following ad hoc participant MS's request

- 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;
- Designed to avoid any duplication with work funded by the EU/EUSPA
- Open for non-space industry to capture the full spectrum of PNT innovation and commercialisation

NAVISP: the right tool to support expanding European PNT capabilities

ELEMENT 1

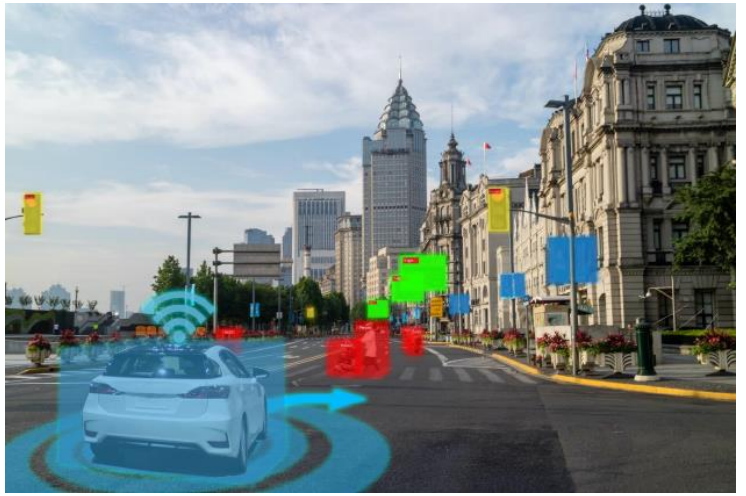
Analyse and develop new PNT systems technologies



ELEMENT 2

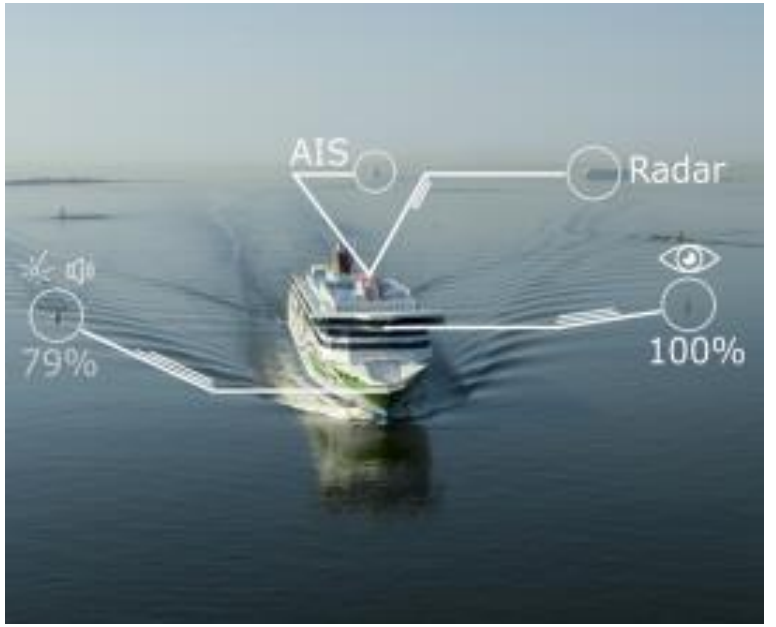
Carry out ad hoc technological developments and pre-operational activities

Support the emergence of innovative PNT services



ELEMENT 3

Support to MS National Programmes along the whole value chain



NAVISP overall status

- **A consolidated programmatic framework**
  - Close to 6 years of operations
  - overall budget 170 M€
  - 230 activities engaged, different costs

- **More than 200 different actors**
  - 62% of the companies belong to other economic sectors
  - 65% of the Prime are SME
  - 55% have never worked with ESA before
  - 26 Consortia with at least 2 different actors types SME/Large Company/University
  - 10 Consortia with members from different countries

- A wide variety of products, at different stage of development

- A wide variety of markets addressed

NAVAC

- Provide recommendations as to which broad areas of interest have the greatest potential for the development of NAVISP activities and how this potential may best be realized.
- Make a preliminary assessment of ideas and proposals made by the Agency on NAVISP Element 1 Workplans, in order to assist NAVISP management in setting priorities.
- Provide ad-hoc advice on the results and value of individual projects.

- **Make an overall assessment of the Programme effectiveness at the end of each phase and make recommendations for the following one.**

NAVAC Composition

Luis Mayo, Chair

Roger Mckinlay, Member

Bernd Eissfeller, Member

Peter Grognard, Member

Didier Faivre, Member

Key NAVAC recommendations for NAVISP Phase 3 (1/2)

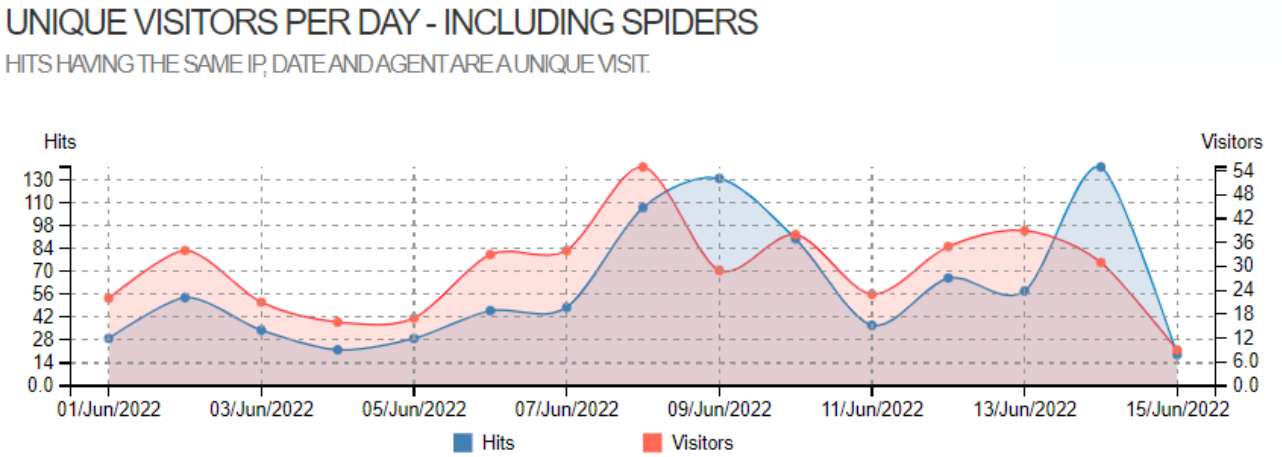
- Thematic calls have demonstrated to be an effective mechanism. We recommend to launch additional thematic calls in areas of choice, e.g. “Inertial Technology in Europe”.
- Devote further efforts to fill the gaps in the European technological base for PNT systems and reduce the dependence on global supply chains (Asia, USA).
- Increase whenever possible the level of funding per activity to improve the effectiveness of the public investment.
- Reinforce outreach actions, by taking joint actions with other public bodies, industry associations or institutions (e.g. ERTICO or EASA).
- Emphasize achieving a higher industrialization level in Element 2 activities.

Key NAVAC recommendations for NAVISP Phase 3 (2/2)

- NAVAC encourages ESA Executive to implement a higher research culture in NAVISP by stretching the scope of activities and increasing the flexibility in adapting project objectives to improved or changing perceptions of market needs.
- Make additional efforts to involve non-space primes in the programme, but not at the expense of non-space SMEs.
- Incorporate mechanisms that allow supporting SME in the protection and exploitation of the IPR generated within the scope of the programme.
- Devise some mechanisms to improve market knowledge and networking support in non-space sectors.
- Persist in the implementation of periodic industry surveys within the Element 2 companies to assess the commercial success of the products supported by NAVISP.

NAVISP Website

- Purpose is to turn visitors into prospects.
- Main means of informing visitors about the objective, aims, achievements and projects of NAVISP.
- Contains information an all three Elements
  - On going and completed projects
  - Opportunities available for bidders.
- Latest NAVISP news is posted about PNT news, success stories and events.
- Informs potential tenderers on how to successfully apply to the programme.



NAVISP Financial Profile

Two programmatic phases, partially overlapping:

- Phase 1 from 2017 until 2021 (5y)
- Phase 2 from 2020 until 2022 (3y)

Phase	Element	2017	2018	2019	2020	2021	2022	Total
1	1	4.01	4.01	4.01	4.01	4.01	-	20,028
	2	9.86	9.86	9.86	9.86	9.86	-	49,315
	3	2.07	2.07	2.07	2.07	2.07	-	10,372
	Total phase 1	**15.94**	**15.94**	**15.94**	**15.94**	**15.94**	**-**	**79,715**
Phase	**Element**							
2	1				8.04	8.04	8.04	24,109
	2				15.10	15.10	15.10	45,287
	3				**5.31**	**5.31**	**5.31**	**15,939**
	Total phase 2				**28.45**	**28.45**	**28.45**	**85,335**
TOTAL PROGRAMME	**Element**							
	1	4.01	4.01	4.01	12.04	12.04	8.04	44,137
	2	9.86	9.86	9.86	24.96	24.96	15.10	94,602
	3	2.07	2.07	2.07	7.39	7.39	5.31	26,311
	Total programme	**15.94**	**15.94**	**15.94**	**44.39**	**44.39**	**28.45**	**165,050**

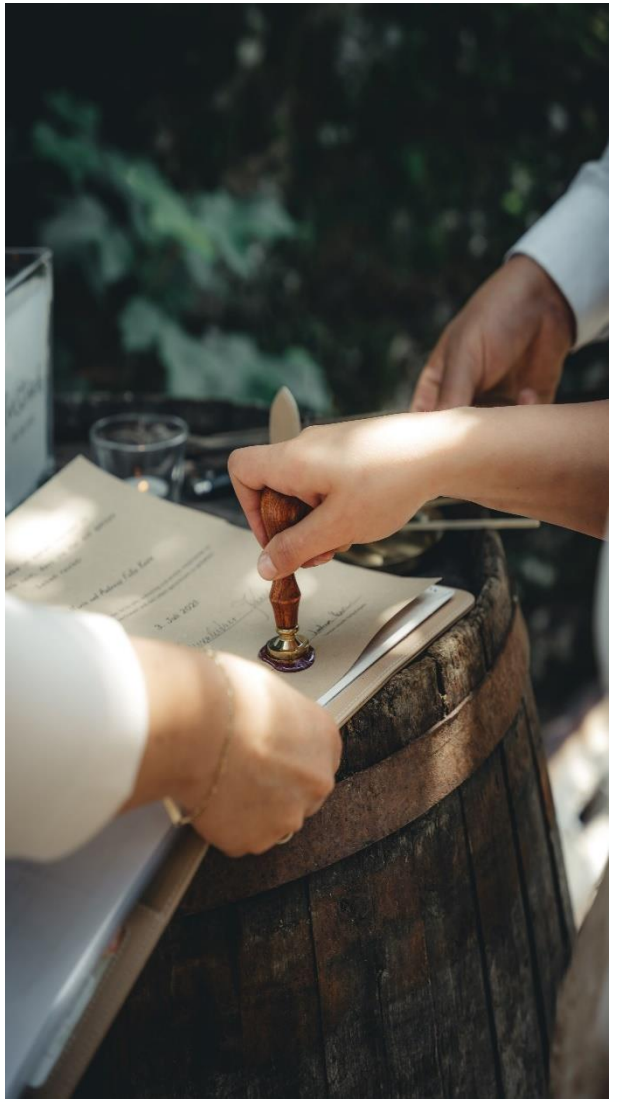
NAVISP Phase 3

For CM 2022 ESA-DNAV proposes a NAVISP Phase 3 targeting a similar budget envelope of 40 MEuro per year (120 MEuro in 3 years), strengthening the ESA dedicated team and internal resources to the programme to feature stronger bonding with strategic industry market owners and ad hoc support to Member States when requested.

The main objective of NAVISP Phase 3 is to continue to facilitate the generation of satellite navigation/PNT innovative propositions with Member States and their industry

NAVISP Strengths

- The programme has leveraged industry investment for over 30 million euro
- The activities undertaken spread along the whole PNT value chain, and score high in technological innovation.
- NAVISP has engaged companies and organizations coming from both space and other sectors.
- NAVISP has helped many SME to break their way into the market, create new jobs and develop new products.
- The Participating Member States has also benefited from NAVISP by improving their national PNT infrastructures and supporting their industry.
- NAVISP can already boast quite a few success stories, and it is fair to expect some more to materialize as more ongoing projects conclude.



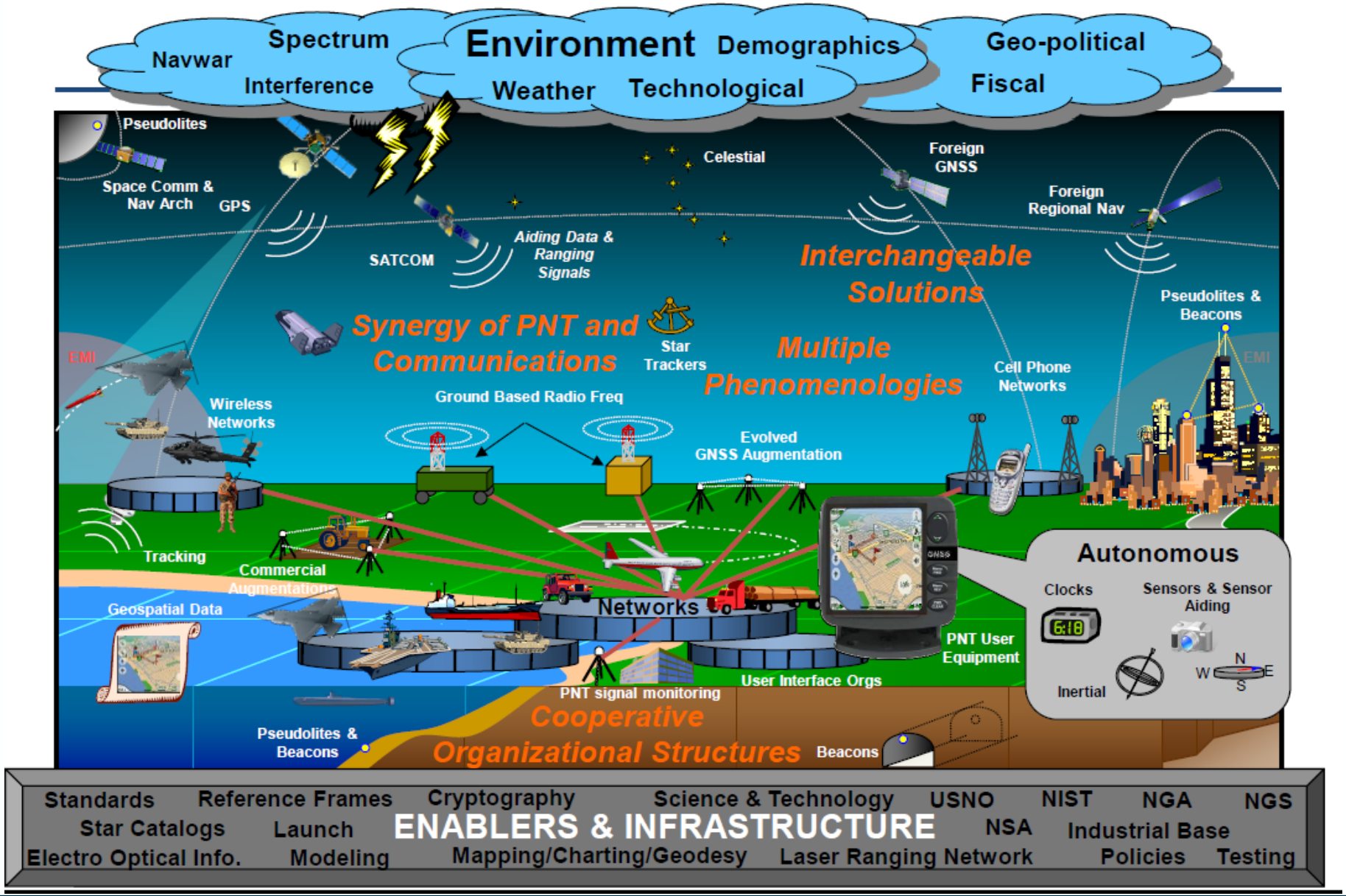
Conclusions

- NAVISP is the ESA programmatic tool envisaged to generate PNT European champions, indeed after its first two Phases key success stories are proving the pertinence of this action

- NAVISP PHASE 3 will call for the same ingredients to enhance the on-going results

- NAVISP programme scope and structure is well suited to support new entrants in the PNT field, i.e. start-ups and SMEs

Future of Positioning, Navigation, and Timing



Karen Van Dyke
U.S. Department of Transportation