

European
Global Navigation
Satellite Systems
Agency

Trendy na rynki pozycjonowania, nawigacji i precyzyjnego czasu



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Politechnika Warszawska

Listopad 2019

The GSA is responsible for market development, operations and security of Galileo and EGNOS



➤ 202 Staff

➤ 21 Nationalities



➤ GSA (Prague)

- Galileo Security Monitoring Centre (GSMC)
St. Germain en Laye, FR
San Martín de la Vega, ES
- European GNSS Service Centre (GSC)
Torrejon, ES
- Galileo Reference Centre
Noordwijk, NL
- EGNOS
Toulouse, Fr
- Liaison Office
Brussels, Be



Can GNSS be user driven?

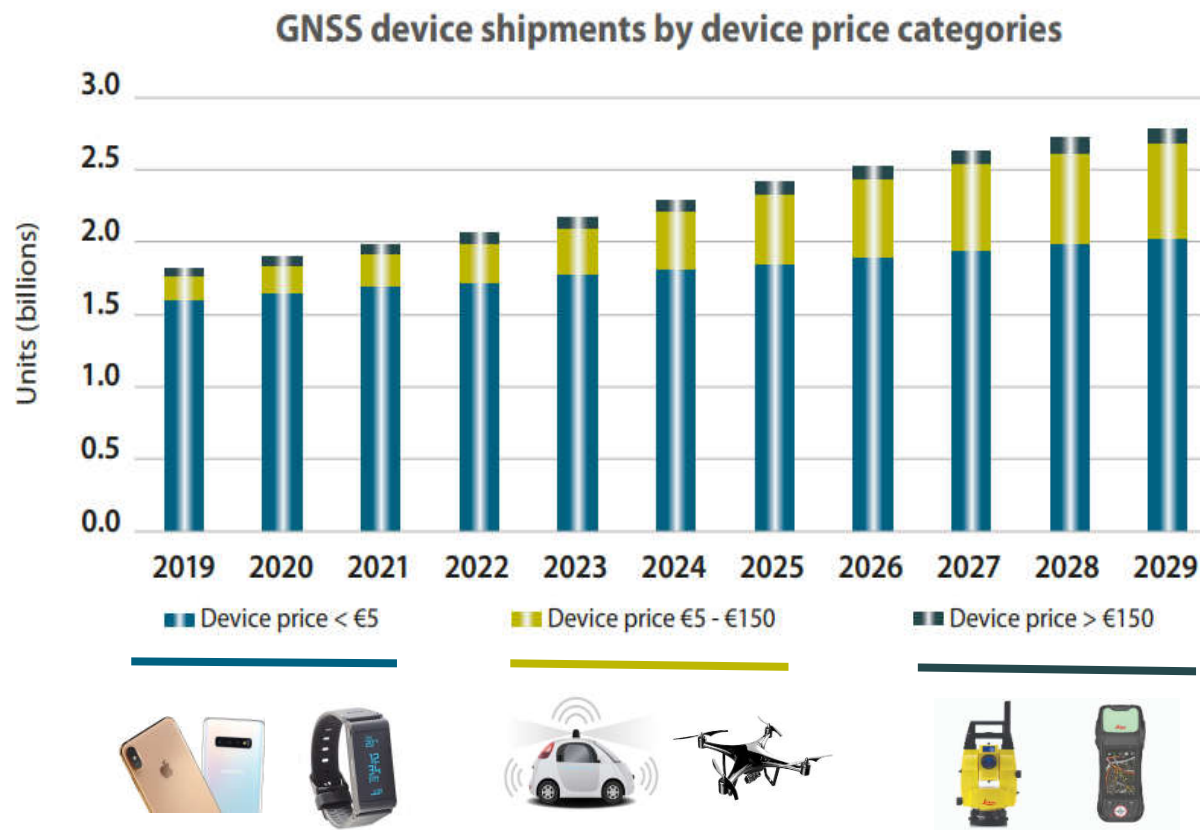


“
You've got to start with the
CUSTOMER EXPERIENCE and
work back toward the technology.”

- Steve Jobs



Users today are different from when the first GNSS were designed



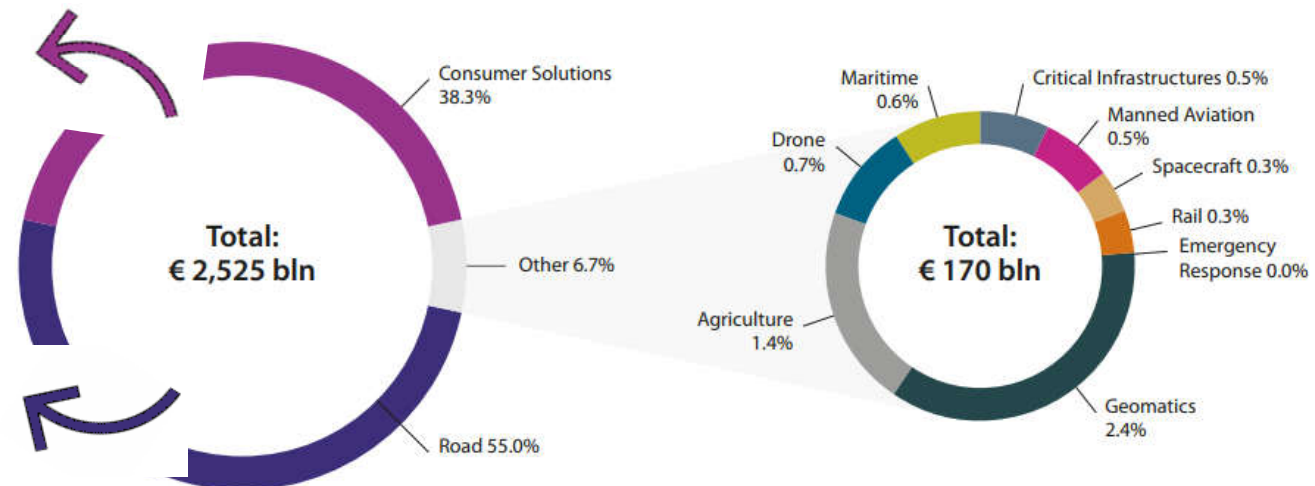
Automotive and Consumer solutions dominate the core revenues representing more than 93% of the market



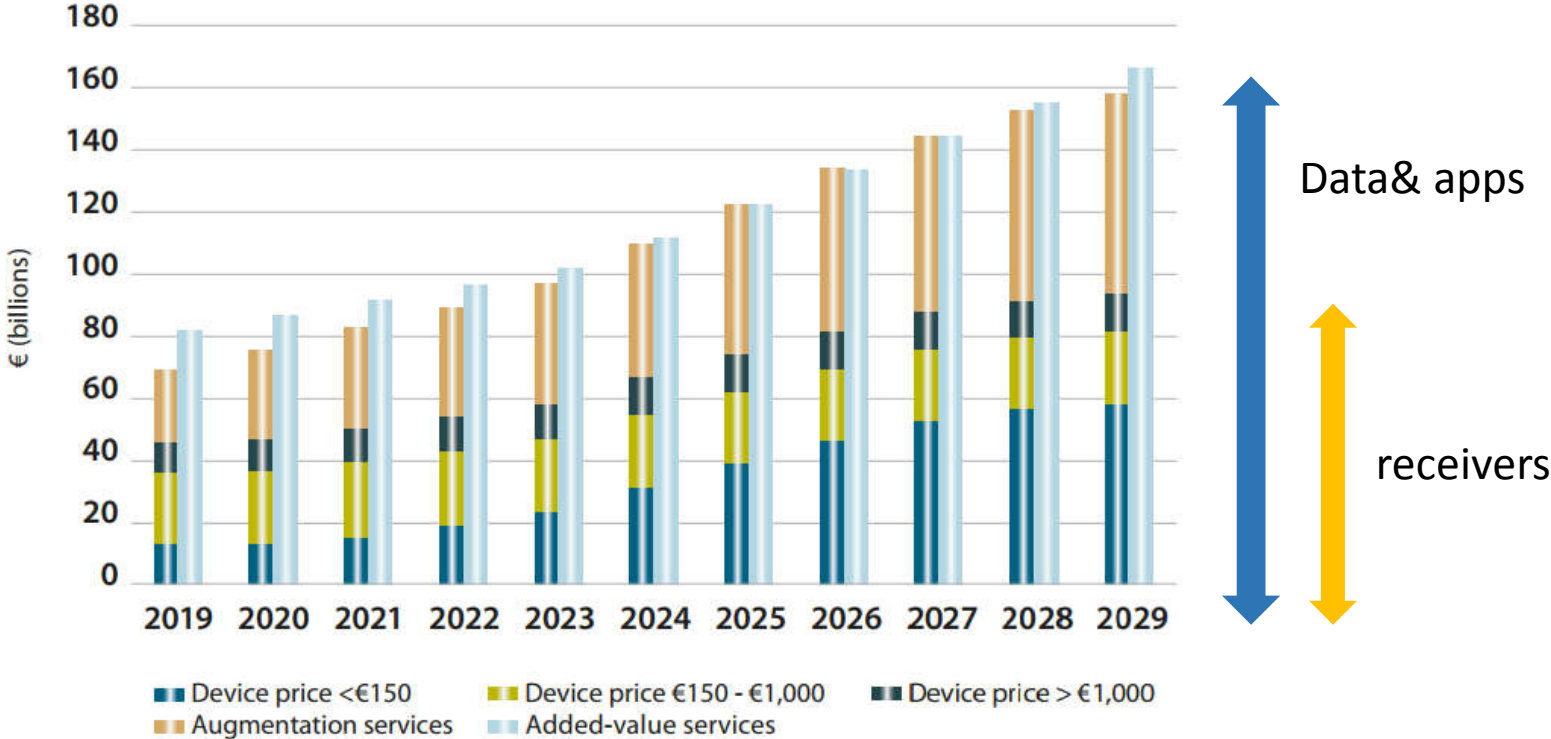
Cumulative Revenue 2019-2029 by segment

Main revenues from:
Data revenues of smartphones and tablets using location-based services

Main revenues from:
In-Vehicle Systems (IVS), ADAS and fleet management



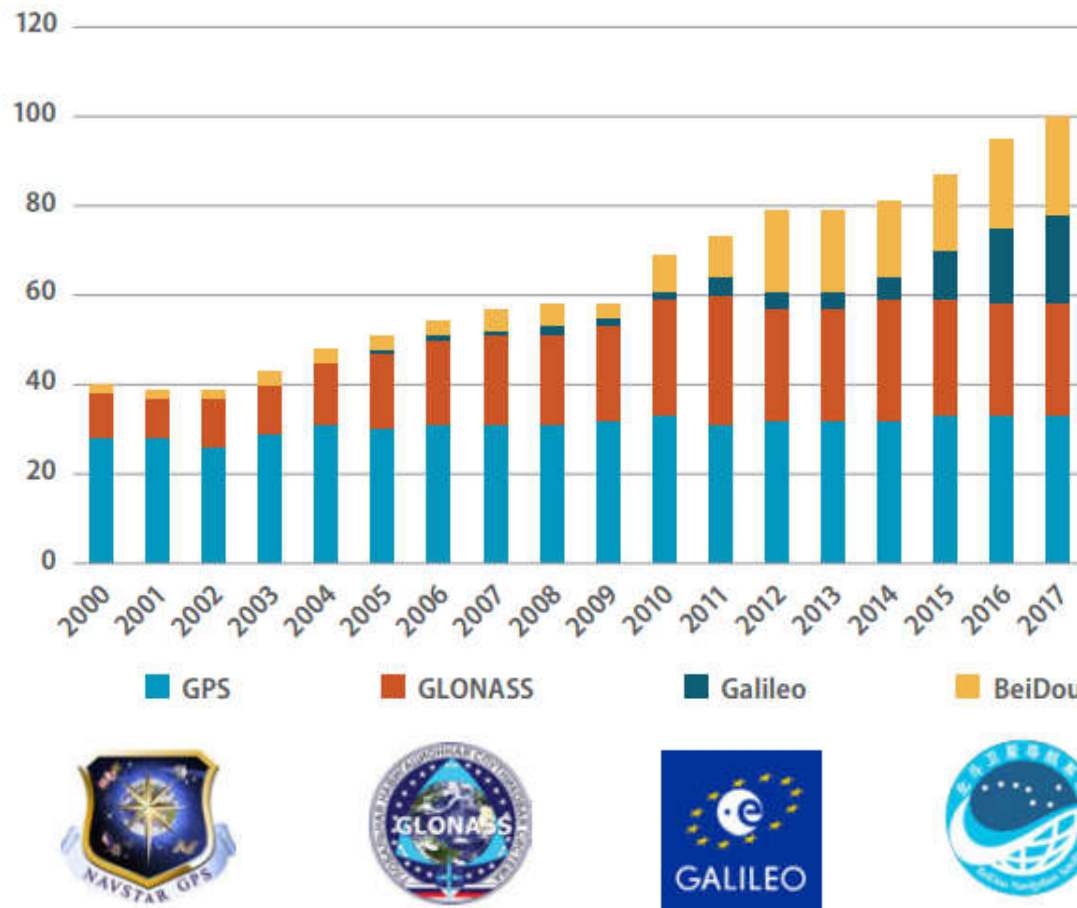
Value added services double the revenues from core GNSS industry



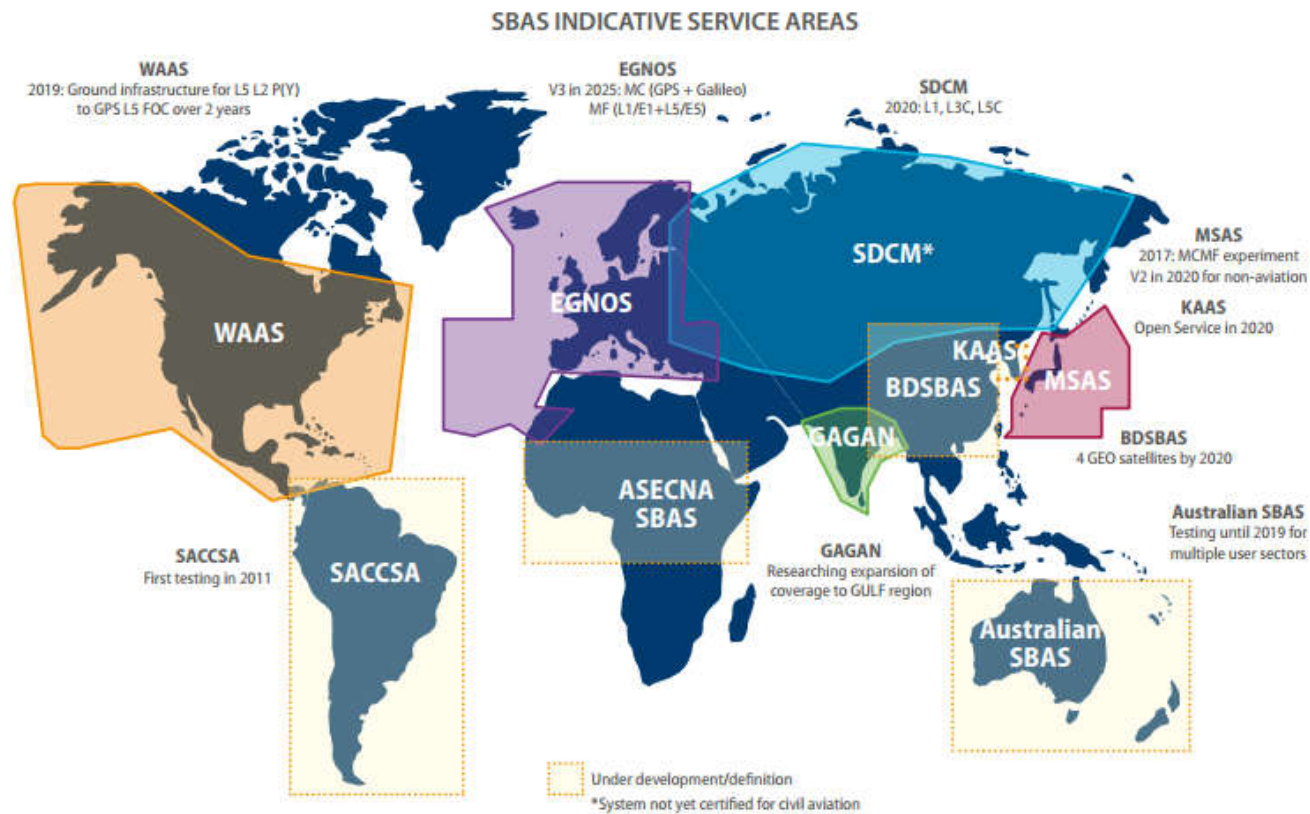
GNSS suppliers answer the increased demand for PVT



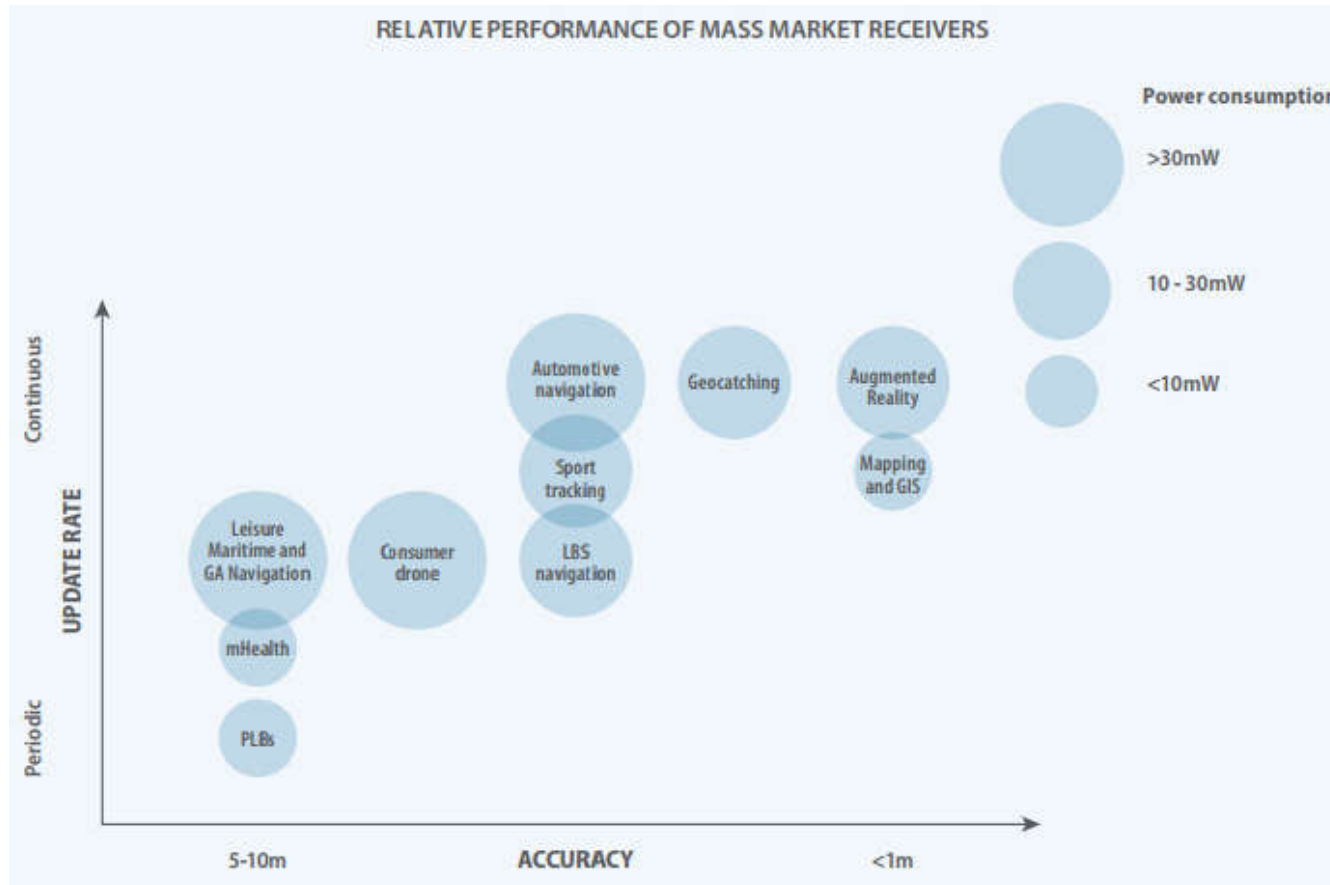
OPERATIONAL GNSS SATELLITES



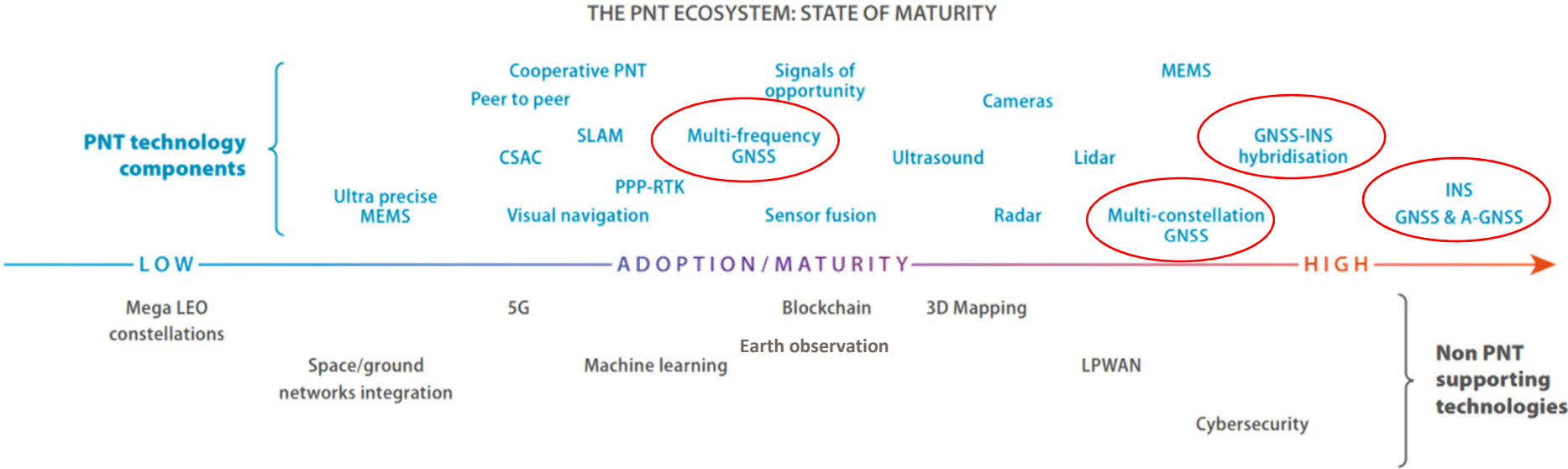
In addition to the global services, the SBAS coverage is increasing



Large diversity of user needs



No single technology can meet the user needs across industries



GNSS USER TECHNOLOGY REPORT
ISSUE 2

Global macrotrends affect the GNSS adoption by industries and individuals



Climate Change & circular economy



Big Data



The silver economy



Digitalization and artificial intelligence



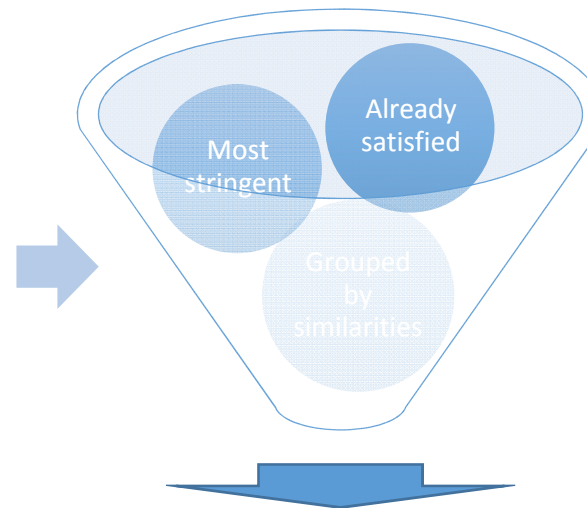
Cyber security



The sharing economy



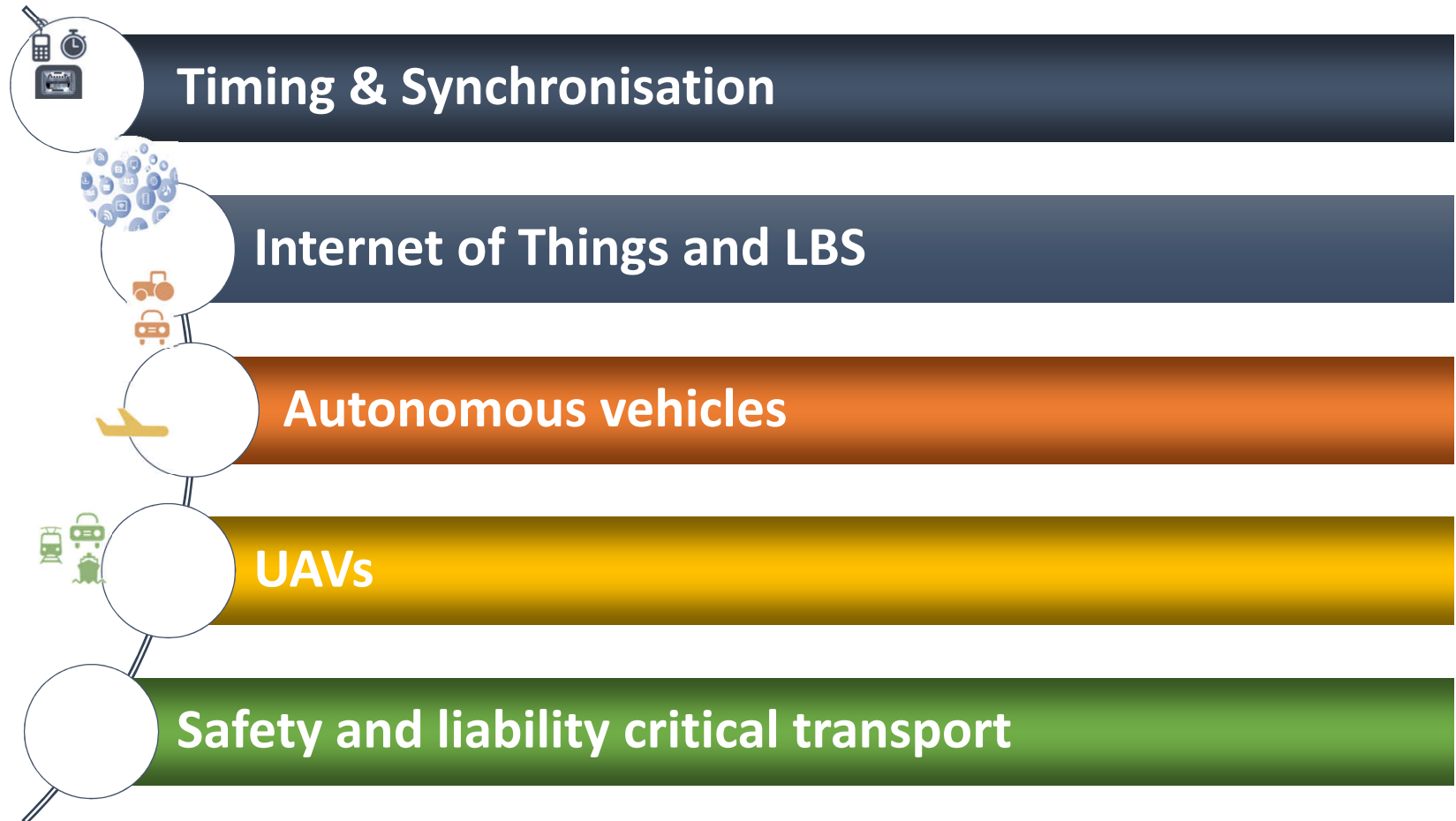
User needs and Galileo



- ✓ Needs not fulfilled
- ✓ In areas with growth potential
- ✓ In areas of high strategic value and socio-economic benefit
- ✓ With long time to maturity



Key areas to watch



Application areas driving the PNT requirements: **Timing & Synchronization**



- ✓ Robustness
- ✓ Timing accuracy
- ✓ Continuity of service

Application areas driving the PNT requirements: **Internet of Things & LBS**



- ✓ Low energy per fix
- ✓ Fast acquisition
- ✓ Seamless indoor/outdoor PVT
- ✓ Connectivity

Areas driving the PNT requirements: Autonomous vehicles & robots



- ✓ Decimeter level accuracy
- ✓ Fast acquisition/convergence time
- ✓ Integrity
- ✓ Authentication
- ✓ Connectivity



Application areas driving the PNT requirements: **Drones/UAVs**



- ✓ Decimeter level 3D accuracy
- ✓ Integrity
- ✓ Authentication

Application areas driving the PNT requirements: **Safety critical transport**



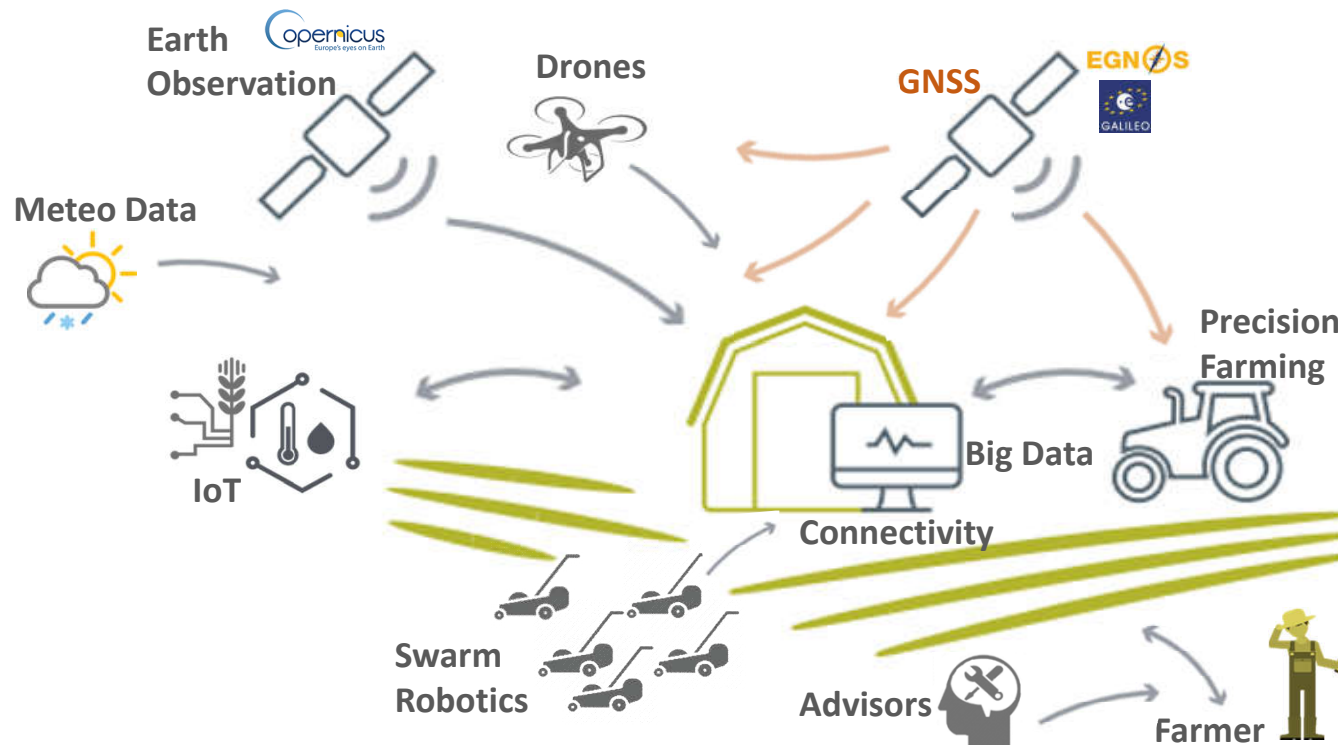
- ✓ Integrity
- ✓ Authentication

Special focus: remote activation of SAR beacons

Application areas driving the PNT requirements: **Farming of the future**



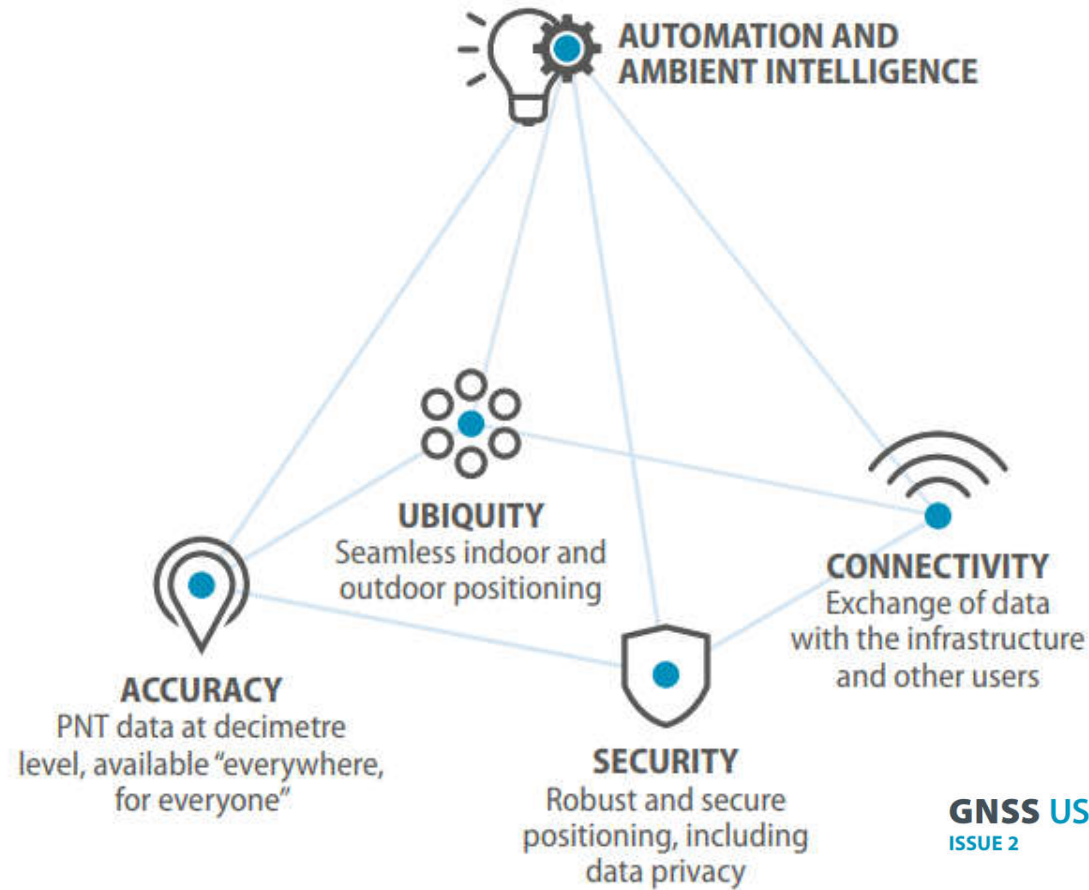
AUTONOMOUS FARM



GNSS is used for:

- Navigating autonomous tractors/harvesters
- Positioning of drones
- Navigation of swarm robots
- Geotagging of earth observation data
- Positioning of assets on the farm
- Geotraceability of agriculture products

4 pillars of change



GNSS USER TECHNOLOGY REPORT
ISSUE 2

Key market and technology trends are described in GSA publications



The **GNSS Market Report** is a comprehensive source of knowledge and information on the dynamic, global GNSS market. The report is published every two years, with the latest edition recently released in 2019

Download
for free at

<https://www.gsa.europa.eu/market/market-report>



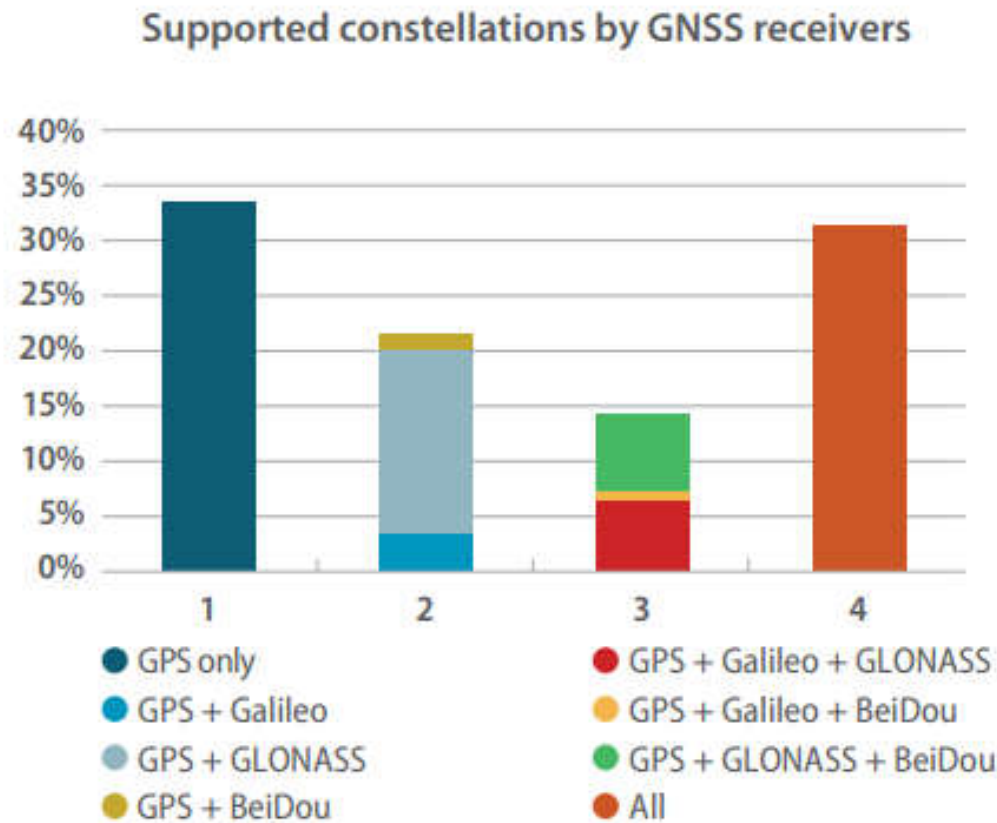
The **GNSS User Technology Report**, a sister publication to the GSA's GNSS Market Report, is published every two years and takes an in-depth look at the latest state-of-the-art GNSS receiver technology

Download
for free at

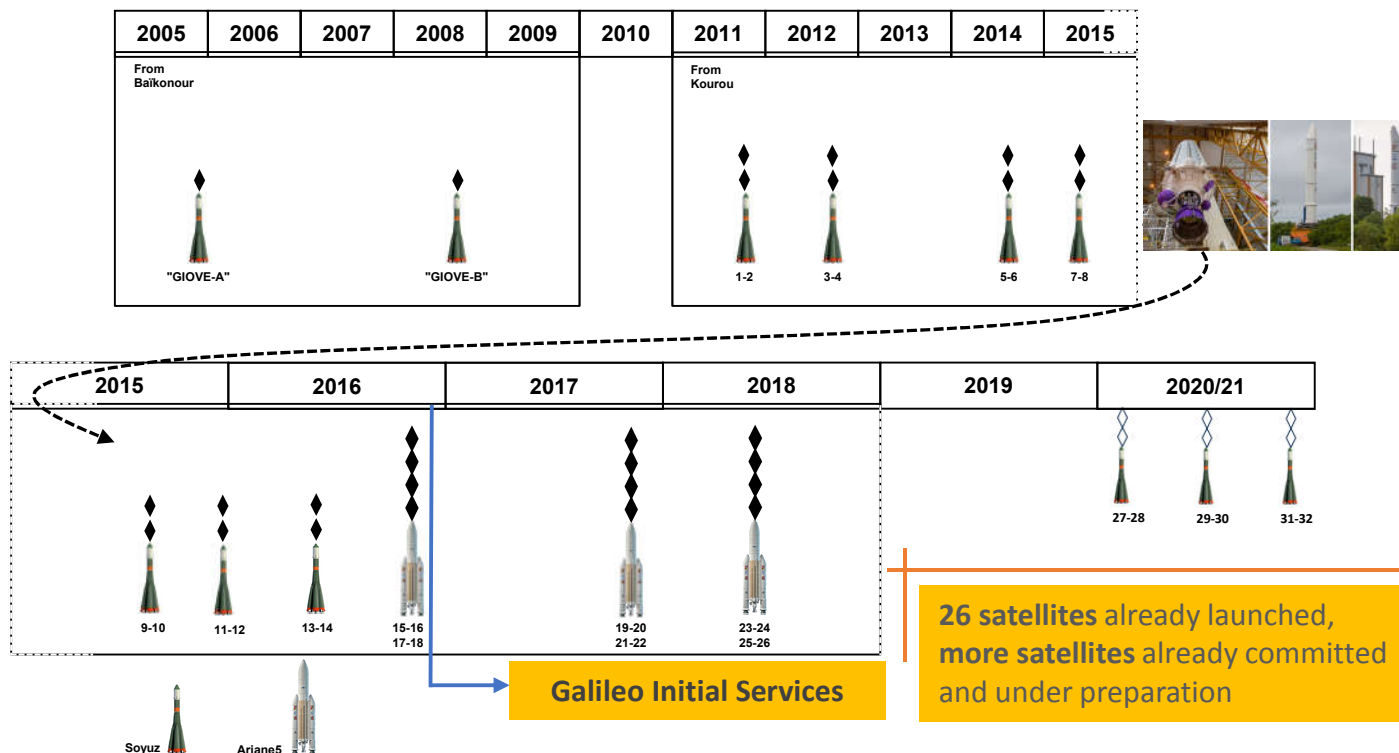
<https://www.gsa.europa.eu/european-gnss/gnss-market/gnss-user-technology-report>

What works best in geolocation?

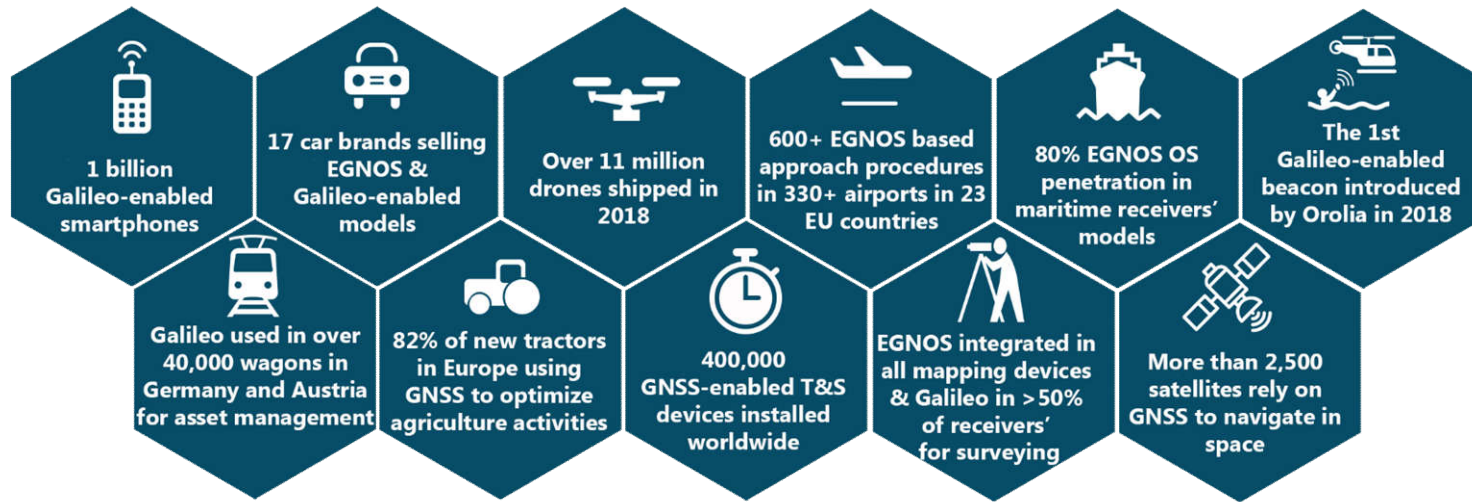
1. Multiconstellation for better availability



Galileo deployment is progressing towards Full Operational Capabilities



More than 1 billion phones use Galileo



Check the full list of Galileo devices on <http://usegalileo.eu>

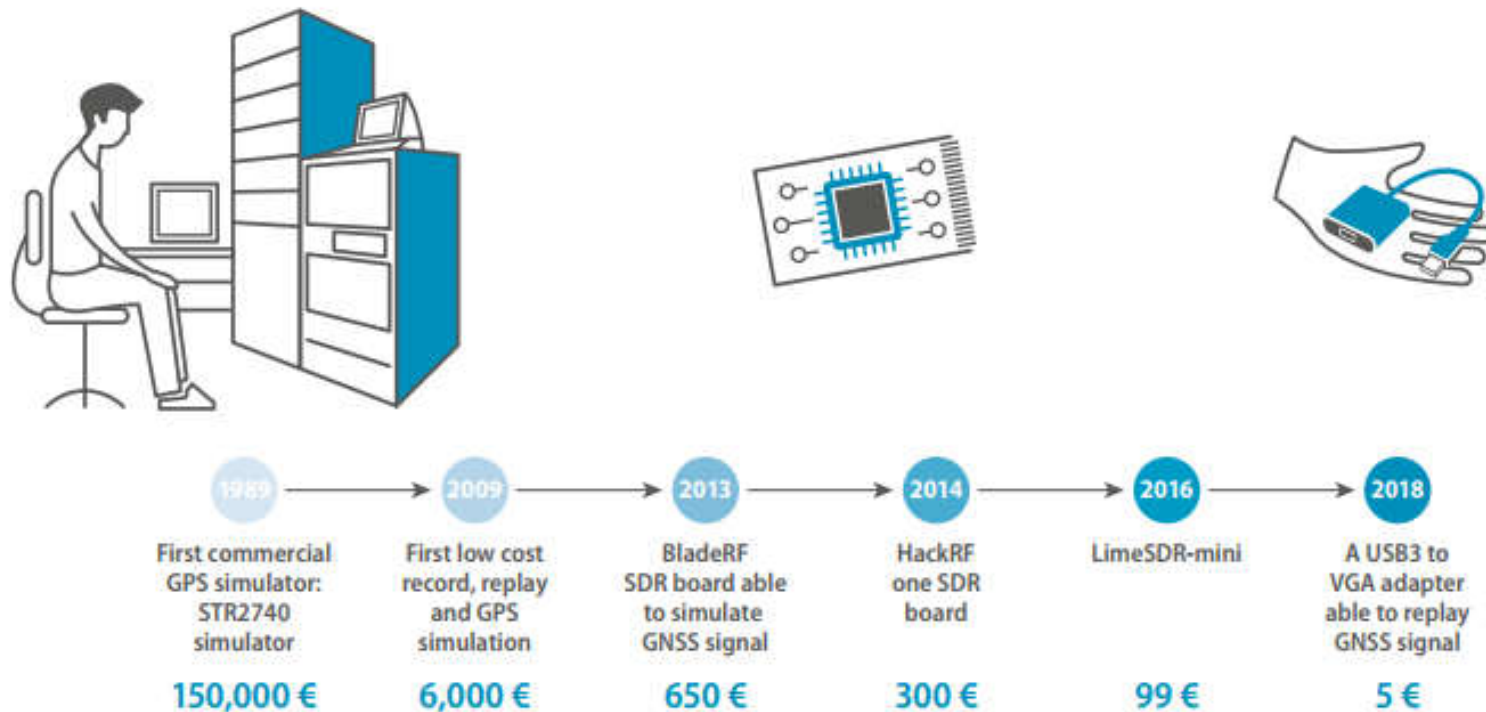


What works best in geolocation?



2. Authentication for robustness

GNSS SPOOFING CAPABLE DEVICES EVOLUTION COST



Galileo will soon deliver robust services leveraging authentication



Contributes to **mitigate** a well known **GNSS vulnerability** (spoofing)

Clear **differentiator w.r.t. other GNSS** available to the civil community

Fully **backward compatible**. Does not affect users not interested

Disseminated on the first Galileo frequency (**E1B**)

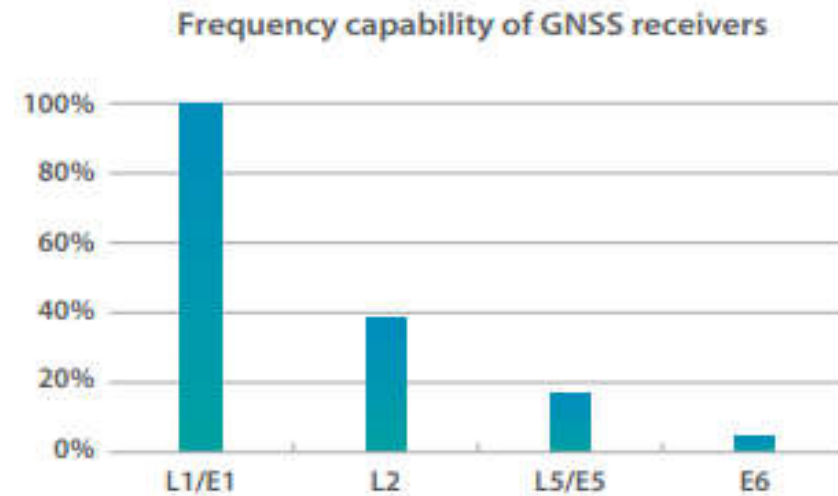
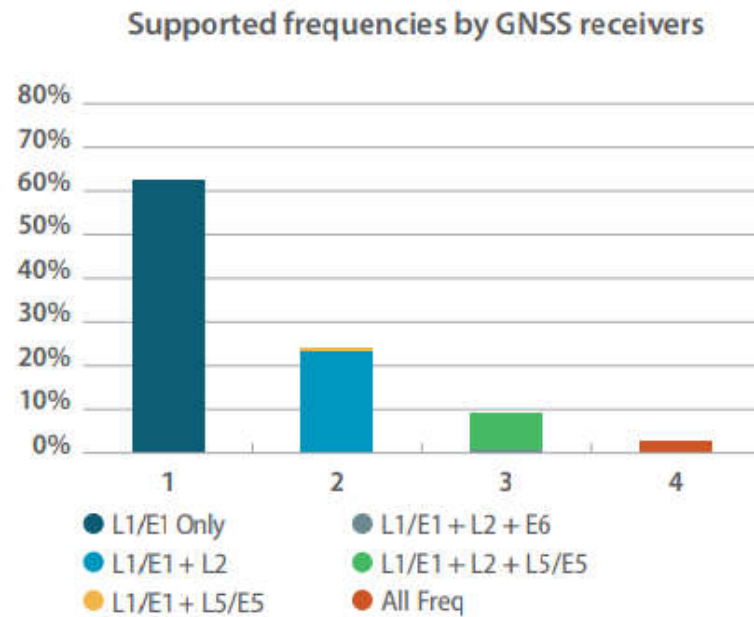
Open access: asymmetric cryptography. No need to store secret keys in the Rx, just public key

Long-term **cryptographically secure**



What works best in geolocation?

3. Multifrequency for better accuracy



Dual-frequency entered mass market

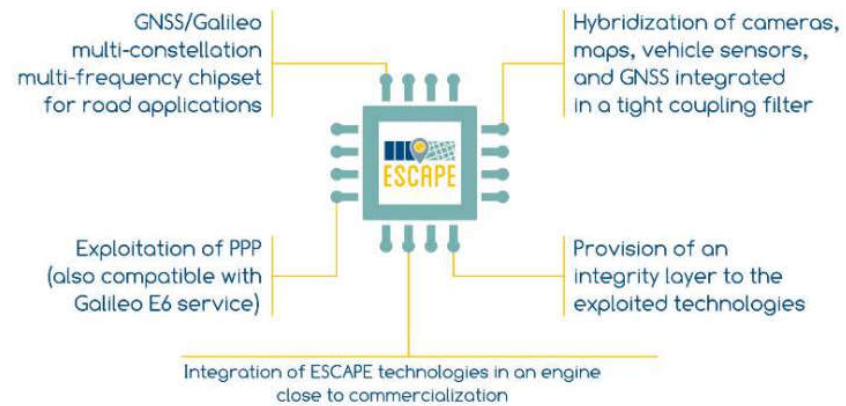


First dual frequency phone was launched in May 2018



Xiaomi Mi8
Powered by Broadcom 4775
Dual frequency E1/L1 and E5/L5

Dual frequency enters the functional safety automotive grade receivers



GSA funded project ESCAPE develops the highly automated positioning engine

Galileo introduced dual frequency



☰ **Status** 🔗 🔌

Lat: 65.5318004° **Time:** 21:01:20
Long: -13.8167265° **TTF:** 13 sec
Alt: 89.9 m **H/V Acc:** 6.0/0.0 m
Alt (MSL): 31.2 m **# Sats:** 12/18
Speed: 0.0 m/sec **Bearing:**
S. Acc: **B. Acc:**
PDOP: 2.5 **H/V DOP:** 1.1/2.3

ID	GNSS	CF	C/N0	Flags	Elev	Azim
4			24.0	AEU	73.0°	142.0°
7			29.0	AEU	53.0°	107.0°
4			29.0	AEU	46.0°	102.0°
9			27.0	AEU	43.0°	257.0°
30			27.0	AEU	41.0°	153.0°
21			14.0	AEU	40.0°	293.0°

GPSTest & Glossary

To clarify and explain the parameters used in satellite navigation performance testing, the GSA has recently published a dedicated glossary for smartphone users. The glossary is based on the smartphone app GPSTest (by barbeauDev), which facilitates visualisation and understanding in real time signal reception and positioning performance parameters. Users will be able to assess the impact of external factors and to identify, for example, which satellites are being tracked, to which constellation they belong, the signal strengths, and the carrier frequencies (for dual-frequency devices).



GPSTest QR code



App available at:
goo.gl/4dHZJu

Glossary available at: www.gsa.europa.eu

1:02 PM 📶 4G+ 🔋

A **GNSS Data Collector** 🔧 ⓘ

Location Data: Disabled in settings GNSS Data: Running
 MEMS Data: Disabled in settings PVT: Available

MEAS.	STA.	PVT	SKY.	MAP	MEMS
	ID	SNR	ADR	Status	
		E1 / E5	E1 / E5	E1 / E5	
	2	43.4 / 34.5	RE / RE	TWK / TWK	
	4	32.1 / 31.7	RE / RE	TWK / TWK	
	9	31.1 / —	RE / —	AMB / —	
	11	31.6 / 23.4	RE / RE	TWK / TWK	
	12	18.9 / 17.9	CS / CS	TWK / TWK	
	19	20.1 / —	RE / —	AMB / —	
	25	34.0 / —	RE / —	AMB / —	
	27	16.7 / 19.0	CS / CS	TWK / TWK	
	30	36.8 / 33.1	RE / RE	TWK / TWK	
	1	41.6 / 40.4	VA / VA	TWK / TWK	
	7	26.8 / —	CS / —	TWK / —	
	8	44.5 / 32.4	VA / CS	TWK / TWK	
	10	41.1 / 32.8	CS / VA	TWK / TWK	
	11	42.8 / —	VA / —	TWK / —	
	15	29.2 / —	CS / —	TWK / —	
	16	37.9 / —	VA / —	TWK / —	
	18	41.3 / —	VA / —	TWK / —	
	20	30.8 / —	CS / —	TWK / —	
	21	28.6 / —	CS / —	AMB / —	
	27	42.9 / 36.2	VA / CS	TWK / TWK	
	28	37.1 / —	CS / —	TWK / —	
	30	35.9 / 30.6	CS / VA	TWK / TWK	
	32	22.6 / 7.0	CS / CS	AMB / TWK	

Dual frequency brings better positioning performance



- Red: BCM4774 (L1)
- Green: BCM4775 (L1+L5) – dual frequency

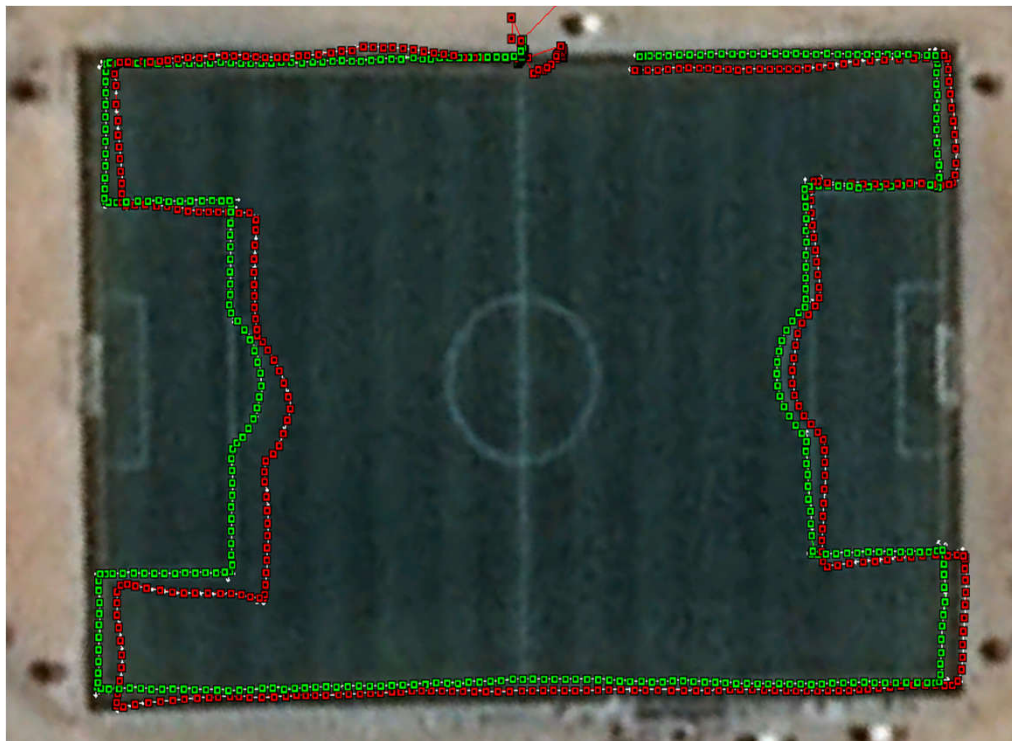
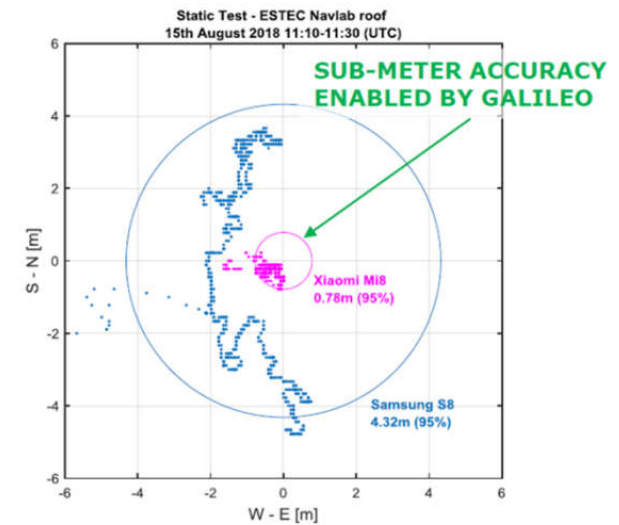


Image Courtesy of Broadcom



Source: ESA
22 operational
Galileo sat (E1/E5)

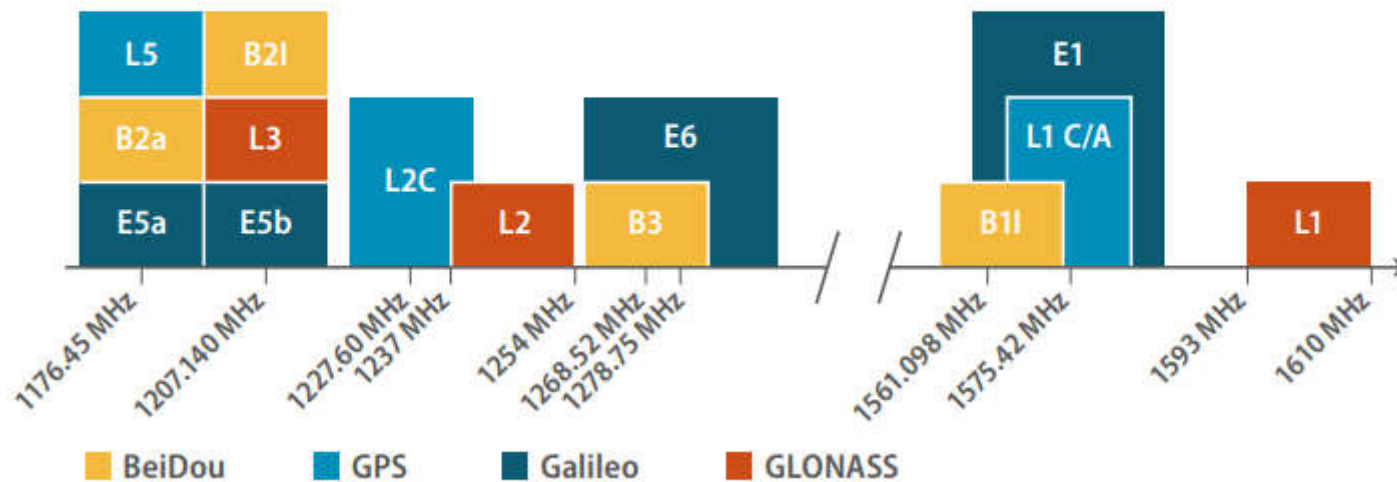


12 operational
GPS
Block IIF sat (L1/I5)

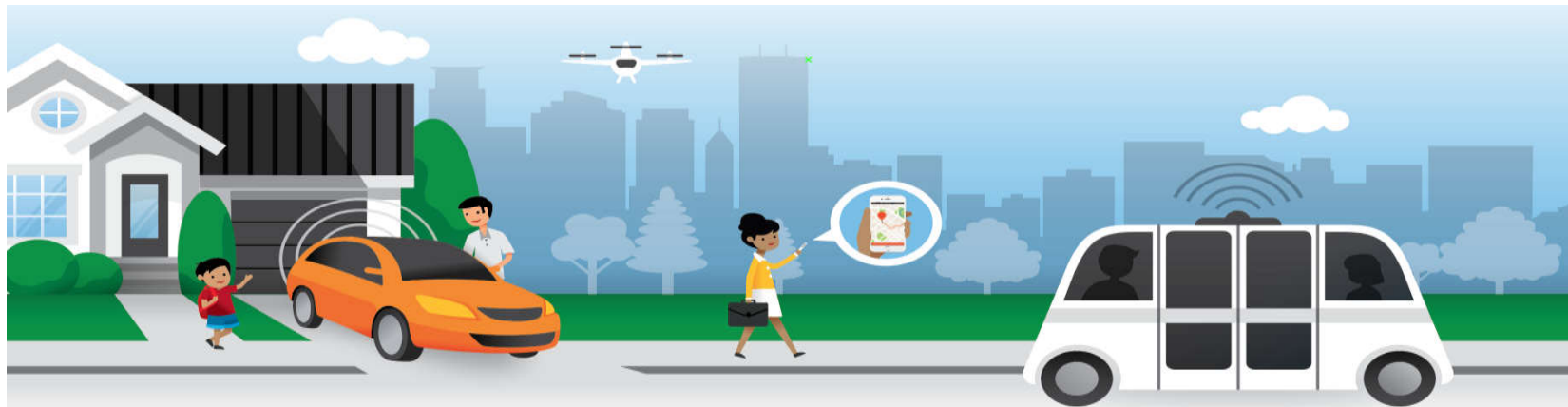
Which frequency will be the 3rd one?



GNSS FREQUENCIES IN THE L BAND



A growing offer of high precision services is available targeting a wider customer base beyond professional



OPPORTUNITIES

- ✓ Commercial augmentation services providers offering PPP and RTK corrections start to target the mass market
- ✓ New high accuracy services are being proposed directly by system providers (e.g. Galileo HAS and QZSS CLAS)

CHALLENGES

- ✓ Improvement of the convergence time associated with PPP correction services needed to satisfy consumer expectations (e.g. automotive applications)
- ✓ Optimisation work will be needed to implement solutions based on PPP and RTK together

Galileo is planning to provide High Accuracy Service globally for free



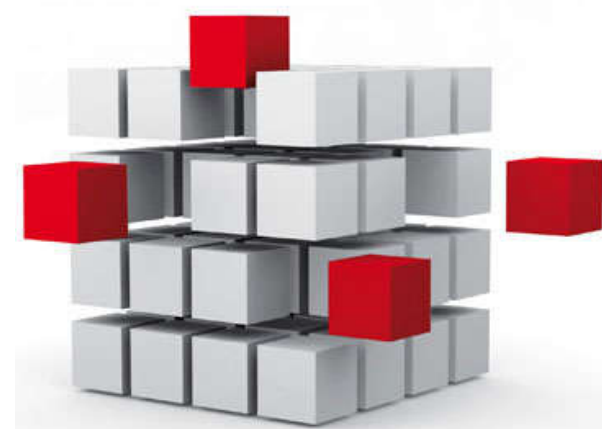
User positioning accuracy with **decimeter level error** ($\approx 20\text{cm}$)

No need of additional ground communication channel (*448 bps allocated on Galileo E6B*)

No need of proximity to base stations to access corrections (*as opposite to RTK*)

Triple frequency to further **increase accuracy** and **reduce PPP convergence time**

Improved line-of-sight and **better coverage** at high latitudes



Access to raw measurements on smartphones opens new possibilities for app developers and users



Join our GSA GNSS Raw Measurements Task Force:
<https://www.gsa.europa.eu/gnss-applications/gnss-raw-measurements>

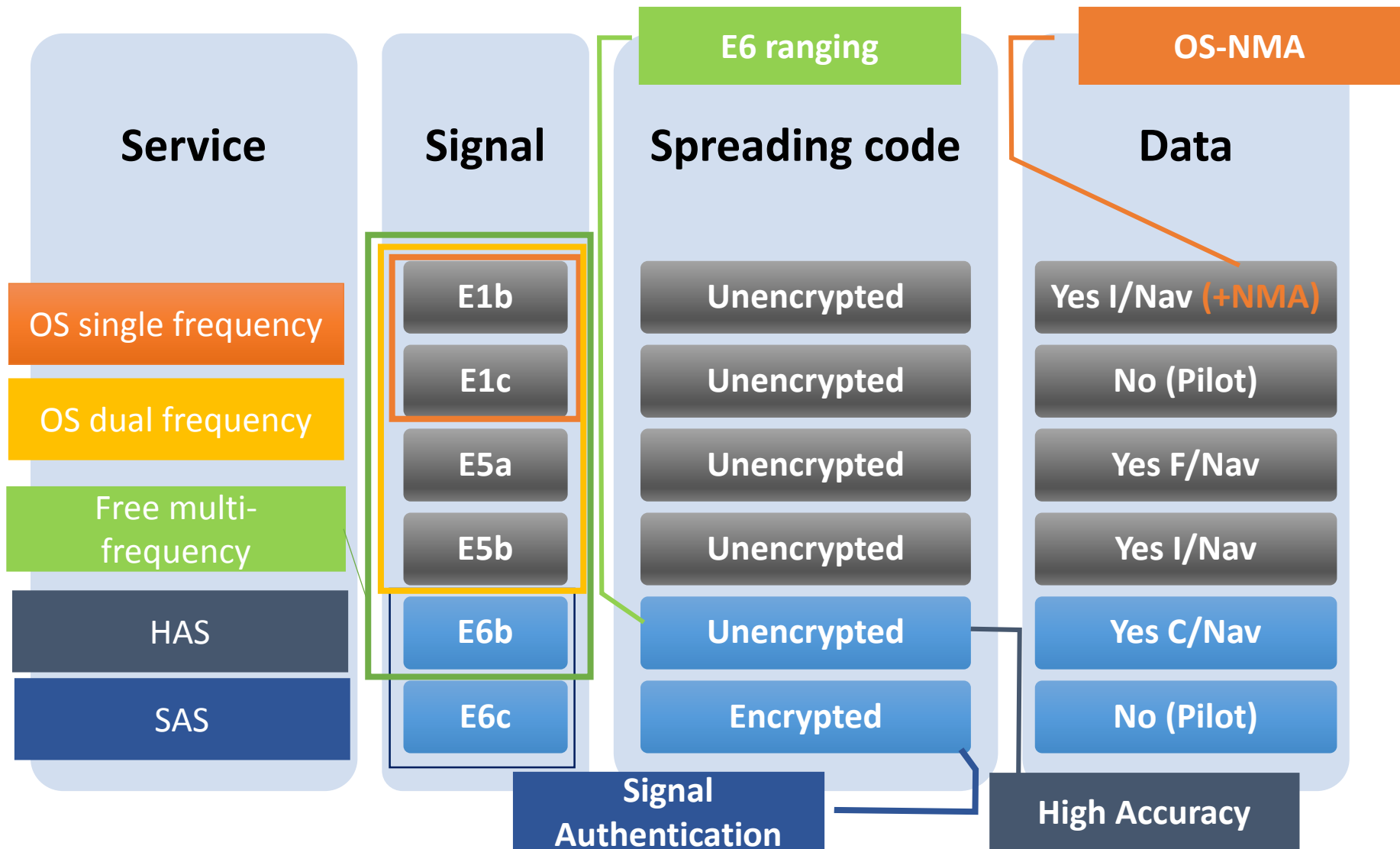
Four main areas of innovation enabled by GNSS android raw measurements :

- ✓ Scientific use and R&D
- ✓ Increased accuracy
- ✓ Integrity and Robustness
- ✓ Testing, performance monitoring and education



The white paper on “**Using GNSS Raw Measurements on Android devices**” is available at GSA website

Overview of Galileo services and signals



Towards Galileo 2nd generation - high level priorities



- Higher performance OS
 - Improved Accuracy, Robustness to interference
 - Faster TTFF, low energy per fix (new dedicated signal(s))
 - Enhanced Authentication (Anti Replay, Faster time to authentication)
 - Expand OS service volume to a Space Service Volume
- Improved High Accuracy Service
- Dedicated Timing Service (based on OS signals)
- Enhanced support of SoL missions
 - Broadcasts ISM to support ARAIM
 - Support modernised SBAS (EGNOS V3)
- Modernised SAR mission: Return link Service, Remote beacon activation
- Emergency Warning Service

Inspired? Submit your proposal!



Aims to foster adoption of EGNSS via content and application development and supports the integration of services provided by these programmes into devices and their commercialisation



Fundamental Elements

Fundamental Elements projects focus on fostering the development of innovative Galileo- and EGNOS-enabled receivers, antennas and chipsets technologies

Polish participation in the H2020 4th call



4th Call Evaluation results



- Applications: 12 Polish applications received out of 385
- Requested founding: 1.9 M€ requested by Polish institutions
- Participation: 4 Polish participants out of 85
- Funding: 0.9 M€ funded to Polish institutions

EGNSS market uptake 2020 call brings new funding opportunities, also for public authorities

Opened: 05 November 2019
Deadline: 05 March 2020

Type of Action	Topic	Indicative budget (EUR mln)	Funding rate
IA	EGNSS applications fostering green, safe and smart mobility	10	70% (except for non-profit legal entities, where a rate of 100% applies)
IA	EGNSS applications fostering digitisation	4	
IA	EGNSS applications fostering societal resilience and protecting the environment	4	
PCP	EGNSS applications for public authorities' pilot	3	90%

Overall indicative budget: 21 mln EUR

IA: activities aimed at producing plans and arrangements or designs for new, altered or improved products, processes or services
PCP: Pre-Commercial Procurement actions aim to encourage public procurement of research, development and validation of new solutions that can bring significant quality and efficiency improvements in areas of public interest, whilst opening market opportunities for industry and researchers active in Europe. It provides EU funding for a group of procurers ('buyers group') to undertake together one joint PCP procurement, so that there is one joint call for tender, one joint evaluation of offers, and a lead procurer³ awarding the R&D service contracts in the name and on behalf of the buyers group.

Fundamental Elements programme has also open and up-coming calls

- Enhanced GNSS User Terminal - M€ 3 (Transversal)
 - ✓ Deadline for submission of proposal: 11/12/2019
- Filling the gaps and emerging E-GNSS receivers technologies - M€ 5,0 (Transversal)
 - ✓ Deadline for submission of proposal: 13/12/2019
- Advanced Interference detection and robustness – M€ 2.2 (Transversal)
 - ✓ Deadline for submission: 23/01/2020

Calls to be launched still this year:

- Development of a drone-borne double frequency receiver - M€ 1,5 (Aviation)
- Shipborne double frequency multi-constellation receiver (E1/E5) - M€ 2,5 (Maritime)
- Receiver for localization in train signalling - M€ 3,5 (Rail)
- Receiver technologies for high-precision in mass market - M€ 1,5 (Transversal)

ESW 2019: a mix of panel discussions, networking opportunities, business matchmaking sessions and exhibitions



Helsinki Congress Paasitorni, Helsinki, Finland
December 3-5, 2019

<https://euspaceweek.eu/>

Meet GSA in the following sessions...:

- ✓ E-GNSS Service Provision Workshop
- ✓ E-GNSS User Assembly
- ✓ EU Space Applications and Funding Opportunities
- ✓ Investors meet Innovators
- ✓ SME fair
- ✓ EU Space Week plenary

...and take part in the hackathons!



Galileo Innovation Challenge



European Emergency Apps

Linking space to user needs



How to get in touch:



www.GSA.europa.eu



EGNOS-portal.eu



GSC-europa.eu



UseGalileo.eu



The European GNSS Agency is hiring!

Apply today and help shape the future of satellite navigation!