



European Global Navigation Satellite Systems Agency



GSA GNSS Technology Report Main highlights

IPIN 2018

Justyna Redelkiewicz, European GNSS Agency 25 September 2018, Nantes The European GNSS Agency (GSA) is responsible for market development and operations of Galileo and EGNOS



- Staff: around 150
- Nationalities: 22
- Headquarters: Prague, Czech Republic
- Other Locations:
 - France
 - The Netherlands
 - Spain
 - United Kingdom







GSA is presenting today the second issue of its flagship GNSS User Technology Report

The 2nd edition of the GSA's GNSS User Technology Report is available free of charge and includes:

- General overview of the latest GNSS receiver technology common to all application areas
- In-depth analysis of three key macrosegments:







High precision and

timing solutions

• Editor's special on Automation and the increasingly important role of GNSS



The users requirements for positioning differ significantly by application area





None of the PNT technologies alone can satisfy user needs in all use cases





THE PNT ECOSYSTEM: STATE OF MATURITY

The future of automated, intelligent positioning systems is based on 4 main dimensions





The evolution of GNSS infrastructure responds to the increasing user demand





OPERATIONAL GNSS SATELLITES

All global and regional GNSS constellations are developing, and modernising, with more than 100 GNSS satellites available today



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





What works best in geolocation? 1. Multiconstellation for better availability



Supported constellations by GNSS receivers

Multi – constellation is already widely used in many applications

The popular way to provide multi-constellation support is to cover all constellations, which represents over 30% of receivers

Main benefits include:
✓ Increased availability
✓ Increased accuracy
✓ Improved robustness

GNSS USER TECHNOLOGY REPORT ISSUE 2

Galileo is working!





Galileo is implemented in a step-wise approach

- 26 satellites have been launched
- 4 satellites still to be launched

2016	Initial Services Open Service (OS) Search and Rescue Service (SAR) Public Regulated Service (PRS)
2019	Test signal for OS Navigation Message Authentication (OS-NMA)
2020	Full Operational Capability All services, 30 satellites An independent civilian infrastructure

More than 400 million phones use Galileo, 18 months after it became operational







In March 2017, Huawei launched its new, Galileo-enabled P10 Plus smartphone during the Mobile World Congress 2017 in Barcelona

SAMSUNG



In March 2017, Samsung unveiled its first Galileo ready smartphones: the Samsung Galaxy S8 and the Samsung Galaxy S8+



In September 2017, Apple presented its new iPhone models: the iPhone 8, the iPhone 8plus and the iPhone X, all of them Galileo compatible

Check the full list of Galileo enabled smartphone models on http://usegalileo.eu



How to see Galileo live on your phone

,

GPSTest QR code

App available at:

goo.gl/4dHZJu





_	3	au	JS						
Lat: 65 53180			104°	04° Time:			21.01.20		
Long:		-13 8167265°				TTEE	13 sec		
Δl i		89.9 m		н	/V Acc:	6 0/0 0 m			
Alt (MSL):		31.2 m			# Sats	12/18			
Sneed		0.0 m/sec		B	earing.	124/15			
S Acc		0.0	117.50	.0	5	B. Acc:			
PDOP:		2.5		н/	V DOP:	1.1/2.3			
ID	GN	SS	CF	C/N	0	Flags	Elev	Azim	
4	œ			24.0)	AEU	73.0°	142.0°	
7				29.0)	AEU	53.0°	107.0°	
4	4		29.0)	AEU	46.0°	102.0°		
9	C	5		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 understand-

0+-+-

ing 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).





Galileo enters our cars, providing location info in case of emergency





Volvo is the first car maker to release European eCall

Swedish automobile manufacturer Volvo has taken the lead as the first car-maker to equip its vehicles with eCall. The new Volvo V60 was type approved at the beginning of 2018 and is already available on the market. It includes one eCall device, manufactured by ACTIA Nordic in Sweden and successfully tested by NavCert's eCall Laboratory in Germany.



VOLVO

More models fitted with eCall are to be released shortly by Volvo during this year, and from 2019 on, all of the new portfolio of Volvo models will be eCall-enabled. Cars equipped with eCall use the same location source as for their in-vehicle navigation systems, and Volvo had incorporated Galileo compatibility in all models from the previous year. In fact, currently in Europe alone, around 50,000 cars with Galileo satellite navigation capability are on the road already, and more than 150,000 will be enabled at the end of 2018.

What works best in geolocation? 2. Authentication for robustness



201 2016 2018 First commercial First low cost BladeRF HackRF LimeSDR-mini A USB3 to record, replay GPS simulator: SDR board able one SDR VGA adapter able to replay STR2740 and GPS to simulate board simulator simulation **GNSS** signal **GNSS** signal 99€ 5€ 150,000€ 6,000€ 650€ 300€

GNSS SPOOFING CAPABLE DEVICES EVOLUTION COST

What works best in geolocation?3. Multifrequency for better accuracy

Receivers beyond traditional highprecision applications are also demanding performance that can best be supported by multi-frequency

This has resulted in a drop of nearly 10% in the production of single-frequency receivers over the last two years

Main benefits include:

- ✓ Increased accuracy
- Improved robustness

Supported frequencies by GNSS receivers



GNSS USER TECHNOLOGY REPORT ISSUE 2

Dual-frequency entered mass market addressing consumer demand for accuracy



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



Which frequencies to choose?



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 targets 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

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



Google made GNSS raw measurements available on Android Nougat and higher in 2016 opening the door for the use of advanced GNSS processing techniques

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

Growing potential for high precision solutions delivered through mobile devices





Application areas driving the PNT requirements: Autonomous vehicles





Audi and Italdesign presenting Pop.Up in 2018



NEXT self-driving pods – live tested in Dubai 2018

Above innovations are not possible without high precision positioning and navigation: -management of autonomous fleet -navigation to customer and to destination -precise "docking" of drones on the vehicles and merging of pods

Application areas driving the PNT requirements: Autonomous robots



- Real world objects and their position in relation to the robot need to be understood with a high degree of precision
- To mitigate the risk of a robot entering an area it should not, GNSS-based geofencing is being increasingly utilised thanks to its accuracy and availability





Application areas driving the PNT requirements: Drones/UAVs





Challenges for the drone market:

- ✓ Precise and reliable tracking information
- ✓ Diverse connectivity requirements
- ✓ Hybridisation of various data sources
- \checkmark Harmonisation of regulation





GNSS: Centimetre level accuracy, high update rate Connectivity: High bandwidth important, range might be compromised

Example technology requirements:



Rural environment

GNSS: Metre level accuracy, update rate can be compromised Connectivity: Long range connectivity, bandwidth might be compromised

Dual-frequency GNSS, differencial GNSS, 5G

Dual-frequency GNSS, 5G, Satcom

Low cost GNSS, Satcom, ADS-8

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

Application areas driving the PNT requirements: Augmented Reality (AR)



The use of AR in high precision market includes:

City Planning:

✓ In-situ design

Construction:

- ✓ Showcase projects
- Control progress of work and anticipate problems

Mining:

- ✓ Definition of mining area
- Assessment of environmental licensing scenarios

In mass market AR is used by a large number of applications for:

- ✓ Image recognition
- ✓ Overlay basic information on outdoor locations



GNSS receivers already meet the key performance parameters required to enable AR: Accuracy and Availability

Safety critical transport looks for more performant SBAS



Across the world SBAS systems are testing and implementing changes to support dual-frequency and, in many cases, multiple constellations



Aviation looks beyond GPS L1

EUROCAE is working in standardisation to adopt a second GNSS frequency the L5/E5a signal with EGNOS V3

Use of L5 will improve service robustness against errors and propagation delays caused by ionosphere



SBAS safety of life service for maritime

IALA is considering SBAS as an alternative/supplementary source of corrections for the current DGNSS system

New SBAS upgrades could provide a maritime safety of life service as it currently does for aviation

Features beyond PNT add value to users: Galileo Return Link (RLS)





Galileo RLS service is perceived to bring added benefits to the current SAR operations as:

- The production of SAR beacons is increasing at an annual growth rate of 5%
- ✓ 70% of the surveyed SAR manufacturers plan to include Galileo in new products



Galileo SAR enhanced capabilities from 2019 will allow:

- ✓ Acknowledgement of receipt message
- ✓ Remote activation of beacons
- Possibility of detecting false alarms

Funding programmes available to support innovation around GNSS





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

20 €mln is the budget dedicated to EGNSS applications and products in the 4rd H2020 call

The call is divided into four topics :

- ✓ Green, safe and smart mobility
- ✓ Digitisation
- ✓ Societal resilience and environment
- Awareness raising and capacity building

Opening: 16 October 2018

Deadline: 05 March 2019



Fundamental Elements

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

Projects to be published soon:

- Enhanced receiver for autonomous driving
- ✓ Multi-Frequency multipurpose Antenna for Galileo
- ✓ Advanced Interference detection and robustness
- ✓ Filling the gaps in EGNSS and associated receiver technologies

European Space Week



3-6 December 2018, Marseille

- Update on European Satellite Navigation and Earth Observation
- Innovations across all application areas
- User Assembly



#EUSpaceWeek





Linking space to user needs



