EGNOS and Galileo Status

Galileo and EGNOS for aviation

GSA activities to accelerate adoption
GSA role within the EU GNSS programmes

Political Oversight
- European Council and Parliament

Programme Oversight and Programme management
- European Commission

Execution
- European Space Agency (ESA)

System deployment
- Working Arrangement

Delegation
- European GNSS Agency (GSA)

 GNSS Programme Committee; H2020 Programme Committee

Ensuring the Security of the EGNSS
Exploitation of Galileo
Exploitation of EGNOS

Market Development: supporting the use of EGNSS

Upstream (space) industry
Downstream (applications) industry
GSA stays close to the aviation users and stakeholders to reap full EGNOS benefits

EGNOS Service Provider
Technical assistance to foster EGNOS adoption

Cooperation Framework to implement European Union GNSS policies as they apply to the field of aviation.

Task Force on GNSS aviation matters with EC

User organisations: business, general aviation, user associations, avionics manufacturers
EUROCONTROL & GSA Cooperation Framework

Framework Partnership Agreement (FPA) to implement EU policies for GNSS in aviation

- Coordinate users requirements for GNSS systems for ATM-Aviation needs and support the development of CNS applications in Europe, from research to deployment.
- Support operational implementation and standardisation-harmonisation activities for the use of GNSS in aviation.
- Develop exchanges and enabling activities through information-collaboration arrangements on GNSS with other organisations.
GSA introduction

EGNOS and Galileo Status

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EGNOS System Architecture & Service Area

- **2 Support Facilities**
- **4 Mission Control Centres**
- **6 Navigation Land Earth Stations**

EGNOS Satellite Footprints

- **39 Ranging & Integrity Monitoring Stations (RIMS)**
- **GPS signals**

Geostationary satellites:
- INMARSAT AOR-E 3F2 (15.5 W)
- SES 5 – (5 E)
- INMARSAT IOR-W 4F2 (64 E)
- ASTRA 5B – commissioning phase (31.5 E)

It's there, use it.
EGNOS SoL Service: Current levels

Non Precision Approach

- NPA

Approach with Vertical Guidance

- APV-I
- LPV-200

RNP APCH operations down to LPV minima (250ft)
RNP APCH operations down to LPV minima (200ft). ILS CAT-I look alike.

Maps showing current SoL SDD commitment (SoL SDD v3.0, Sept 2015)
Very good coverage of the ECAC landmasses
- All the LPV procedures available more than 99% of the time

Improvement on the overall performance has been observed despite the high solar activity in Spring and Autumn 2015
Galileo is being implemented
New satellites Up...and running!

**GALILEO:**
- Fully autonomous satellite-based positioning, navigation and timing capability
- Global high performance services.
- Run by civil authorities.
- Dual frequencies as standard.
- Interoperable with other GNSS.

---

**GIOVE A/B**
2 test satellites
2005/2008

**Galileo System Testbed v1**
Validation of critical algorithms
2003

**2013**
In-Orbit Validation
4 operational satellites and ground segment

**2016**
Initial services for OS, SAR, and demonstrator for CS

**2020**
Full Operational Capability
Full services, 30 satellites

---

- 10 satellites + 6 more coming in 2016
Galileo Search & Rescue for emergency response

Figure 4: 406 MHz MEOSAR System Concept

- 406 MHz Distress Beacon
- GPS-III
- GLONASS
- GALILEO
- RCC
- MEOLUT / MCC
- Galileo Return link Service Provider
GSA introduction

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GSA activities to accelerate adoption
Communication, Navigation and Surveillance applications will rely on E-GNSS

- **C**ommunications
  - Surveillance sensor data exchange with ATM systems

- **N**avigation
  - Performance Based Navigation
  - RNP and Precision Approaches
  - GBAS Cat II/III
  - All phases of flight with improved accuracy/integrity
  - Fleet management

- **S**urveilllance
  - Reliable PVT for cooperative ADS-B
  - Emergency Locator Transmitter & Personal Locator Beacon
Performance Based Navigation driving transition from traditional routing to GNSS navigation

Growing availability of SBAS based procedures in European aerodromes

GNSS is more used in surveillance through technologies like ADS-B, complementing radar

GNSS enabled ELTs/PLBs are gaining importance

GNSS support recreational pilots using VFR

RPAS/UAV Market is taking off: although not quantified in GSA report, other sources estimate it at about €7bln

Multiconstellation/Multifrequency GNSS solutions and ARAIM enabling:
  - Advanced RNP
  - Aerodrome manoeuvring
  - GBAS CATII/III
  - Space based ADS-B

MARKET AND TECHNOLOGY TRENDS
**The EGNOS SoL service for aviation**

**PBN EGNOS-based operations**

- **RNP APCH**
  - WITHOUT VERTICAL GUIDANCE
    - **LNAV**
      - GPS NPA
        - Expected to be flown with CDFA
  - WITH VERTICAL GUIDANCE
    - **LP**
      - NPA SBAS supported
        - Localiser Performance
    - **LNAV/VNAV**
      - APV Baro
        - (can also be supported by SBAS)
    - **LPV**
      - APV SBAS supported
        - Localiser Performance with Vertical Guidance
    - **LPV-200**
      - SBAS CAT-1
        - (DA/H 200ft)

**Current**

- **RNP 0.3**
  - Helicopter operations

**Ongoing**
EGNOS SoL Service: Implementation

As of March 2016
257 LPV approaches
89 ‘EGNOS enabled’ APV Baro

Plans by 2016
> 340 LPV procedures planned
Most common SBAS ready aircraft/rotorcraft in Commercial, Business and General Aviation...

<table>
<thead>
<tr>
<th>COMMERCIAL/REGIONAL</th>
<th>AIRCRAFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATR42-600, 72-600</td>
<td>Airbus A350, Beluga</td>
</tr>
<tr>
<td>Bombardier CRJ 700/900/1000, CS100/300, Dash 8 Q400</td>
<td></td>
</tr>
<tr>
<td>AW109SP, AW119Kx, AW139, AW169, AW189</td>
<td></td>
</tr>
<tr>
<td>Bell 429, 505,650</td>
<td></td>
</tr>
<tr>
<td>H135, H145, H175, H225, EC135, EC145</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BUSINESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenger 300/350, Learjet 70/75/60XR</td>
</tr>
<tr>
<td>Citation Mustang, M2, CJ2+, CJ3+, CJ4, XLS+, Latitude, Sovereign+, X+ and Longitude</td>
</tr>
<tr>
<td>SB Falcon 900LX/5X/7X/2000LXS/2000S;</td>
</tr>
<tr>
<td>G650 and G280, SB G150/G550/G450/G350</td>
</tr>
<tr>
<td>King Air, Baron, Bonanza, Hawker 400XPR/800XPR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GENERAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citation, Caravan and Single Engine</td>
</tr>
<tr>
<td>Pilatus PC6, PC24 and PC12/47E (SB)</td>
</tr>
<tr>
<td>DA20, 40XLT, 40CS, D-Jet, 42 and 50</td>
</tr>
<tr>
<td>SR20, SR22, SR22T, and Vision SF50</td>
</tr>
<tr>
<td>Meridian, Seminole, Mirage, Matrix, Archer, Seneca V and Arrow</td>
</tr>
</tbody>
</table>
... and other have retrofit solutions available

GSA support focus on solutions to fleet flying to LPV priority destinations
User demand more than LPV

**Rotorcraft operations**

**EGNOS as enabler of:**
- Point in Space (Pins)
- Low Level RNAV Routes
- Simultaneous Non Interference
- Curved procedures/RNP-AR

**EGNOS benefits:**
- Increased accessibility in all weather
- Increased capacity

**RPAS/Drones**

**EGNSS Role:**
- Component of Guidance, Navigation and control
- Component of detect and avoid functions
- Support to integration in non segregated airspace

**EGNSS benefits:**
- Reliable PVT: precise positioning/ orientation
- Robust safe navigation

**Surveillance-ADS-B**

**EGNSS Role:**
- Current ADS-B Out European mandates requires GNSS:
  - June 2016 for new aircraft, June 7th 2020 for retrofit
  - GNSS required, not SBAS

**EGNSS benefits:**
- SBAS ensures 99% availability (= radar)
- Ground Infrastructure rationalisation
- Increased safety

**Search and Rescue**

**EGNSS Role:**
- ELT required for every aircraft with >19 passengers
- More and more pilots carry handheld PLB’s
- Many ELTs/PLBs use GNSS to report their position when triggered.

**EGNSS benefits:**
- EGNOS improves accuracy
- Galileo SAR in Second Generation Beacons
GSA introduction

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GSA activities to accelerate adoption
Working with Aviation value chain

**Device manufacturers**
- Main Players:
  - Thales
  - Rockwell Collins
  - Universal Avionics
  - Honeywell
  - Garmin

**Aircraft manufacturers**
- Main Players:
  - Airbus
  - AgustaWestland
  - Saab
  - Bombardier
  - Diamond
  - Cessna

**Airlines/Aircraft owners**
- Main organisations:
  - EBAA
  - ERA/AIR EUROPE
  - CATS

**Air Navigation Service Provider**
- Main Organisations:
  - CANSO
  - NATS
  - DGAC
  - DSNA

**Aerodromes**
- Main Categories:
  - International airports
  - Regional airports
  - Private airports

**Examples of GSA initiatives**
- **Device manufacturers**
  - Technical & financial support for avionics development
  - Prototyping
  - Research on new functionalities

- **Aircraft manufacturers**
  - Cost benefit analysis
  - Co-funding of Service Bulletin
  - Facilitate operators’ request for LPV

- **Airlines/Aircraft owners**
  - Technical & financial support for upgrade to LPV capabilities
  - Dedicated training
  - Cost benefit analysis
  - Avionics analysis

- **Air Navigation Service Provider**
  - Dedicated Training
  - Technical & financial support
  - Contribution to regulation evolution

- **Aerodromes**
  - Technical & financial support for procedure implementation
  - Cost benefit analysis
GSA provides adhoc focused support to pioneer EGNOS users

Welcome to countries with first LPV in 2015!

- Belgium: Antwerp
- Croatia: Dubrovnik
- Ireland: Dublin
- Denmark: Aarhus and Karup
- Portugal: Lisbon
- Slovakia: Bratislava and Kosice

Looking forward to the upcoming ones

- Romania: Cluj Napoca
User fora (I): Business aviation

**Objectives**
- Promote EGNOS RNP Approaches to regional airports in Europe
- Enable LPV operations
- Identify other user needs: feasibility of advanced operations

**Structure**
- Chair: EBAA. Co-chair: GSA
- Participants:
  - Flying Group (BA operator)
  - Netjets (BA operator)
  - Abelag (BA operator)
  - ANSPs: NATS, Skyguide, DSNA

**Status**
- Implementation ongoing to 10 priority airfields
- EBAA SBAS fleet capability assessment completed
- Operational approval guidelines developed
FUNDING OPPORTUNITIES TO FOSTER EGNOS AND GALILEO ADOPTION IN AVIATION
R&D address different elements of the value chain and have different objectives.

**DOWNSTREAM VALUE CHAIN**

- **Navigation service provision**
- **Chipset, Receivers, Devices**
- **Content & Applications**
- **Service Providers**
- **Users & Stakeholders**

**R&D Tools**
- Fundamental Elements
- Horizon 2020

**Other MKD initiatives**
- e.g. user satisfaction management, users needs and requirements definition, market analysis, input for regulation

**GSA MARKET DEVELOPMENT STRATEGY**

**ADOPTION ROADMAPS** targeting users and value chain
### H2020 Galileo calls funding devoted to GNSS applications in Aviation

<table>
<thead>
<tr>
<th>Topic</th>
<th>Overall indicative budget</th>
<th>No of proposals evaluated</th>
<th>No of proposals funded</th>
<th>No of Aviation projects (including SAR)</th>
<th>No of UAV/RPAS projects</th>
<th>Projects execution</th>
</tr>
</thead>
<tbody>
<tr>
<td>GALILEO-1-2014</td>
<td>€ 40.4 M</td>
<td>105</td>
<td>27</td>
<td>6</td>
<td>4</td>
<td>2015-2017</td>
</tr>
<tr>
<td>GALILEO-1-2015</td>
<td>€ 24.9 M</td>
<td>89</td>
<td>13</td>
<td>3</td>
<td>2</td>
<td>2016-2018</td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td><strong>€ 65.3 M</strong></td>
<td><strong>194</strong></td>
<td><strong>40</strong></td>
<td><strong>9</strong></td>
<td><strong>6</strong></td>
<td></td>
</tr>
</tbody>
</table>
## Applications in Satellite Navigation-Galileo-2017

<table>
<thead>
<tr>
<th>Type of Action</th>
<th>Topic</th>
<th>Budget (EUR mln)</th>
<th>Funding rate</th>
<th>Indirect costs</th>
</tr>
</thead>
</table>
| IA             | EGNSS Transport Applications               | 14.50            | 70% (except for non-profit legal entities, where a rate of 100% applies)      | 25% of the total eligible costs excluding:  
• Subcontracting  
• Costs of resources made available by 3rd parties  
• Financial support to 3rd parties |
| IA             | EGNSS Mass Market Applications             | 9.00             |              |                                                                                |
| IA             | EGNSS Professional Applications            | 8.00             |              |                                                                                |
| CSA            | EGNSS Awareness raising and capacity building | 1.50             | 100%         |                                                                                |
| **Total budget:** |                                            | **33.00**        |              |                                                                                |

**Opening:** 08 November 2016  
**Deadline:** 01 March 2017

**IA:** activities aimed at producing plans and arrangements or designs for new, altered or improved products, processes or services.  
**CSA:** consisting of accompanying measures such as standardisation, dissemination, awareness-raising and communication, networking, policy dialogues and studies.
Fundamental elements: the new EU funding tool for GNSS receivers

Programme created by the 2013 GNSS Regulation

High-level objectives:
- Facilitate the adoption of the European GNSS Systems building on innovative services and differentiators
- Increase the EU industry competitiveness
- Address the user needs in priority market segments, maximising the benefits for citizens

Budget envelope of 111.5 million € (2014 and 2020)

<table>
<thead>
<tr>
<th>Name</th>
<th>Proc/ grant</th>
<th>Indicative publication date</th>
<th>Indicative budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFMC SBAS Aviation Receiver</td>
<td>Proc</td>
<td>August 2015</td>
<td>9 Mil EUR</td>
</tr>
<tr>
<td>Advanced RAIM (ARAIM) Multiconstellation Receiver</td>
<td>Grant</td>
<td>July 2016</td>
<td>2.5 Mil EUR (for 1-2 projects; TBD)</td>
</tr>
<tr>
<td>MEOSAR Beacon prototyping</td>
<td>Grant</td>
<td>October 2016</td>
<td>4 Mil EUR</td>
</tr>
</tbody>
</table>
Acceleration of EGNOS adoption in civil aviation: Aviation grants

New programme created within the EGNOS programme budget

Objectives:

• Foster the implementation of EGNOS based operations
• Development and/or installation of GPS/EGNOS enabled avionics
• Development of enablers to accelerate EGNOS adoption and preparation for future capabilities, including RPAS

Programme status:

• Call 1 (2014): 6 mln €, 13 projects ongoing
• Call 2 (2015): 6 mln €, call under evaluation
• Call 3 (2016): planned for publication
2014 Call results: 13 GSA funded projects ongoing

- 69 EGNOS based procedures at 36 airports
- 8 PinS at 7 helipads
- 65 aircraft retrofit by 4 operators

- 3 rotorcraft upgrades
- 3 Flight simulators upgrades
Latest information at GSA website and social networks

www.gsa.europa.eu
http://www.gsa.europa.eu/gsa/grants
https://www.facebook.com/EuropeanGnssAgency
https://twitter.com/EGNOSPortal
Thank you!

For further information contact:

Carmen Aguilera
Carmen.aguilera@gsa.europa.eu