E-GNSS in Aviation: status and trends, aviation grants

Workshop “Deployment of Galileo and EGNOS in Portugal”

Carmen Aguilera, Aviation & H2020 Coordinator

21st September, Lisbon
E-GNSS applications in aviation

**Performance Based Navigation (PBN):** applications used when an aircraft follows a specific procedure or route within a prescribed error margin (e.g., airport approach).
- Different applications for fixed wing (e.g., LPV, SBAS Cat-I) and rotorcraft (PinS, SNI, RNP0.3)
- **GBAS:** Galileo as an enabler for GBAS CAT II/III

**Navigation aid:** systems designed as additional aid to GA pilots flying according to (Visual Flight Rules). They are also used to alert when they get too close to restricted airspace

**Emergency Locator Transmitters (ELTs):** equipment helping Search & Rescue operations. Many ELTs utilize GNSS to report their position when triggered.
- ELT is mandatory in all EU aircraft with more than 6 seats

**Personal Locator Beacons (PLBs):** portable devices which are almost always equipped with GNSS, that support localization in case of emergency.
- PLB (or ELT) is mandatory in aircraft/helicopters of six or less seats.

**Automatic Depended Surveillance – Broadcast (ADS-B):** surveillance technique whereby an aircraft automatically provide, via a data link, data derived from on-board navigation and position-fixing systems

**Unmanned Vehicles Systems:** growing market, demanding robust positioning and navigation
EGNOS Safety of Life

- EGNOS SoL service operational since 2\textsuperscript{nd} March 2011
- Current SoL SDD commitment is \textit{SoL SDD v3.1, Sept 2016}
LPV availability in South-West region

From July-2015 until March-2017
Main EGNOS application in aviation: Navigation: EGNOS for 3D Approaches

ICAO Approach Classifications

Type A
- Minima ≥ 250 ft
  - Lateral (2D)
    - NPA (Non Precision Approaches)
  - Lateral and Vertical (3D)
    - APV (Approaches with vertical Guidance)

Type B
- Minima < 250 ft
  - Lateral and Vertical (3D)
  - PA (Precision Approaches)

EGNOS/SBAS

Conventional Procedure
- VOR/DME
- NDB
- LOC
- MDA/MDH

RNP APCH
- GPS (either ABAS or SBAS)
- GPS (ABAS) & Barometric Altimetry
- LP Minimum

RNP AR APCH
- GPS (ABAS) & Barometric Altimetry
- LP Minimum
- RNP Minimum
- LPV (d. to 200ft.)

RNP APCH (SBAS CAT I)
- GPS & SBAS
- LPV (d. to 200ft.)

Conventional Procedure
- GLS

ILS
- MLS

GLS
- SCAT 1

CAT I
- CAT II/III

GLS
- CAT II/III
EGNOS based approaches in the Regulatory Framework

• **Global and European Air Navigation Strategy is moving to GNSS based solutions**

• **PBN IR (under development): RNP APCH including LPV minima**
  - After 2020, at all Instrument Runway Ends (IRE) without existing Precision Approach (PA)
  - 2020-2024: develop RNP APCH for all IRE (with existing PA)
  - After 2024 all IRE with RNP APCH in place
  - Rationalisation of conventional navaids

• **REGULATION (EU) No 716/2014 (PCP):**
  - PBN RNP APCH vertically guided (LPV or LNAV/VNAV) at all major 24+1 airports by 01/01/2024

• **Commission Regulation (EU) 2016/539 (Crew training) & 2016/1199 (Air Ops)**
  - 2016/539 → PBN on regular training before **25/8/2020**
  - PBN as standard procedures for authorities and operators (vs previous SPA.)

All EU Instrument Runway Ends with EGNOS approaches by 2024
450 EGNOS based procedures operational today (September 2017)

- 365 LPV approaches
- 5 RNP 0.3 Procedures
- 85 ‘EGNOS enabled’ APV Baro

Check link: [http://egnos-user-support.essp-sas.eu/egnos_ops/lpv_map/map.php](http://egnos-user-support.essp-sas.eu/egnos_ops/lpv_map/map.php)

Plans by 2018
> 500 ENGOS procedures planned
EGNOS Implementation Status & Plans in Portugal

<table>
<thead>
<tr>
<th>Airport name</th>
<th>Code</th>
<th>LPV Status</th>
<th>Publication Date</th>
<th>#ILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lisbon RWY 03/21</td>
<td>LPPT</td>
<td>Operational</td>
<td>2015</td>
<td>2</td>
</tr>
<tr>
<td>Porto RWY 17/35</td>
<td>LPPR</td>
<td>Ongoing</td>
<td>12/10/2017</td>
<td>1</td>
</tr>
<tr>
<td>Faro RWY 10/28</td>
<td>LPFR</td>
<td>Planned</td>
<td>2017</td>
<td>1</td>
</tr>
<tr>
<td>Vila Real RWY 02</td>
<td>LPVR</td>
<td>Planned</td>
<td>TBD</td>
<td>0</td>
</tr>
<tr>
<td>Cascais RWY 35</td>
<td>LPCS</td>
<td>Planned</td>
<td>TBD</td>
<td>0</td>
</tr>
<tr>
<td>Horta RWY 10/28</td>
<td>LPHR</td>
<td>Planned</td>
<td>2018</td>
<td>0</td>
</tr>
</tbody>
</table>
Operators flying with EGNOS today

Over 45 operators in 18 countries approved and certified to fly LPV
Operators flying to/from Portugal have LPV solutions ready to use

LPV capable operators flying to/from Portugal

**NETJETS**

- Bombardier Global 6000
- Bombardier CRJ1000
- Bombardier CS100

Planned LPV capable operators flying to/from Portugal

- EasyJet
  - Lunch customer of first LPV ready A320neos

Operators flying to/from Portugal with LPV SB or STC solutions available today

More LPV retrofit solutions and new LPV ready aircraft entering the market
EGNOS for rotorcraft operations

Satellite based Navigation Services (GPS and EGNOS) + Satnav Equipped & IFR certified = Point - in - Space (PINS) procedures

GSA supports ca. 50 % of all operational/planned PinS to LPV in Europe
Raising interest in connecting RNP routes

Initial Visual segment

Low level route

Final Visual segment

All weather conditions operations

600 flights/year cannot be performed to patients in need of urgent care

7,350,000 of profit/year is not perceived

Many lives cannot receive appropriate help when needed
Main HEMS operators are getting ready to fly with EGNOS

- 6x Sikorsky 92
- 2x EC-135
- 2x EC-145
- 2x Sikorsky 92
- 6x Sikorsky 92
- AW109

23 PinS
14 RNP 0.3 routes
29 rotorcraft retrofit
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R/Galileo Initial Service declared operational by EC on 15th December 2016

Performances are defined on the Galileo Service Definition Document (available on www.gsc-europa.eu)

- Single Burst Detection Probability > 90%
- Location Probability after 10 min > 98%
- Probability of Location Accuracy higher than 5km after 10 min > 95%
- SAR Ground Segment Availability > 95%
Galileo Return Link provides and unique capability to save more lives.

**Return Link Service (RLS)** will acknowledge the reception of distress signals (GNSS Regulation (EU) 1285/2013).

*Galileo is the only GNSS system offering return link.*

Manufacturers are implementing Galileo RLS in new beacons:

- Agreement on the message protocols in the beacon standard (T.001/T.007)
- Modifications in the MCC for the routing of messages (A.001/A.002)
- Second generation beacons specifications and type approval
AR beacons for aviation users

Personal Location Beacons (PLBs)

Emergency Locator Transmitter: ELT, Distress tracking ELT: ELT (DT), Survival ELT, ELT (S)
0% of SAR manufacturers include Galileo positioning in their product roadmaps...

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<tbody>
<tr>
<td>1</td>
<td>GPS</td>
<td>89%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Other</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>GLONASS</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Galileo</td>
<td>0%</td>
<td></td>
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**PLANNED**

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</thead>
<tbody>
<tr>
<td>1</td>
<td>GPS</td>
<td>90%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Galileo</td>
<td>70%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>GLONASS</td>
<td>30%</td>
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</tr>
<tr>
<td>4</td>
<td>Other</td>
<td>10%</td>
<td></td>
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</tbody>
</table>
...and Galileo Return Link is foreseen in most of new developments

Features foreseen in future beacons:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Embedded location data</td>
<td>100%</td>
</tr>
<tr>
<td>2. Battery status indicator</td>
<td>71%</td>
</tr>
<tr>
<td>3. Return-link service</td>
<td>71%</td>
</tr>
<tr>
<td>4. Embedded additional information (elapsed time, DOP, manual/automatic flag, remaining battery...)</td>
<td>43%</td>
</tr>
<tr>
<td>5. In-flight ELT activation</td>
<td>43%</td>
</tr>
<tr>
<td>6. Embedded altitude data</td>
<td>29%</td>
</tr>
</tbody>
</table>

Source: GSA survey to beacons manufacturers, 2015
ICAO requires for in-flight tracking of aircraft in distress by 2021

Global Aeronautical Distress and Safety System

1. Aircraft tracking
2. Autonomous Distress Tracking
3. Post Flight Localisation and Recovery

Objectives:
- Timely detection of aircraft in distress
- Tracking of aircraft in distress, timely/accurate location of end of flight
- Efficient & effective SAR operations
- Timely retrieval of Flight Recorder Data
Leading beacon manufacturers are developing advanced uses of Galileo RLS for aviation.

Operational concept and demonstration of automatic and remote beacon activation

Commercial aviation beacons (ELT-DT) in the market by 2019
GSA support tools for aviation users

GSA support: Aviation call for grants

- **12 Million €** in 2 calls
- More than **100 EGNOS based approach procedures**
- STC for **5 aircraft types** with a potential retrofit solution for more than **260 aircraft in EU**
- More than **15 operators equipped and certified for EGNOS based operations**
- 6 EGNOS enabled simulators
- More than 20 EGNOS enabled PinS procedures for rotorcraft

**Stay tuned!**

3rd Call to be open in October 2017

More information at: [https://www.gsa.europa.eu/gsa/grants](https://www.gsa.europa.eu/gsa/grants)
SA is actively contributing to relevant rulemaking activities...

- PBN implementation in the European Air Traffic Management Network
  PBN Guidance Material Task Force

- Revision of surveillance performance and interoperability - RMT.0679

- Unmanned Aircraft Systems (UAS) and Remotely Piloted Aircraft Systems (RPAS) – RMT.0230

- EASA General Aviation (GA) Sectorial Committee
and provide first hand answers to user needs

- **EBAA LPV WG**
  - LPV implementation to priority aerodromes
  - Guidance on operation approval
  - Retrofit solutions availability for the EBAA fleet
  
  ![Brussels](image)
  **Brussels**
  **22 September**

- **Support to ERA members**
  - Enable LPV operations to priority airports
  - Foster development of avionics solutions for E-GNSS operations
  - Increase awareness of EGNOS RNP APCH benefits to regional airports
  
  ![ERA General Assembly, Operations group: Athens](image)
  **ERA General Assembly, Operations group: Athens**
  **17-19 October**

- **Rotorcraft Working Group**
  - Harmonise implementation of EGNOS based Rotorcraft operations
  - Address operational and regulatory aspects
  - Identify service provision needs
  - Compliance criteria
  
  ![FLAG workshop](image)
  **FLAG workshop**
  **Barcelona, 30 Nov-1 Dec**