Agenda

- EGNOS for RNP Approaches. LPV implementation status
- EGNOS for Helicopters
- EGNOS for ADS-B
- EGNOS for Drones
- Future applications
GSA and aviation stakeholders join forces to bring EGNOS to users

EGNOS Service provider
Technical assistance to foster EGNOS adoption

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

Safety oversight
PBN Implementation, GNSS regulatory advice
Safety, pilot training, airworthiness criteria

User organisations: business, general aviation, user associations, avionics manufacturers
### Working with Aviation value chain

<table>
<thead>
<tr>
<th>Device manufacturers</th>
<th>Aircraft manufacturers</th>
<th>Airlines/Aircraft owners</th>
<th>Air Navigation Service Provider</th>
<th>Aerodromes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Players:</strong></td>
<td><strong>Main Players:</strong></td>
<td><strong>Main organisations:</strong></td>
<td><strong>Main Organisations:</strong></td>
<td><strong>Main Categories:</strong></td>
</tr>
<tr>
<td>Thales</td>
<td>Airbus</td>
<td>EBAA</td>
<td>CANSO</td>
<td>- International airports</td>
</tr>
<tr>
<td>Rockwell Collins</td>
<td>AgustaWestland</td>
<td>ERA</td>
<td>NATS</td>
<td>- Regional airports</td>
</tr>
<tr>
<td>Universal Avionics</td>
<td>Saab</td>
<td>EHA</td>
<td>DGAC</td>
<td>- Private airports</td>
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<tr>
<td>Honeywell</td>
<td>Diamond</td>
<td>PPL/IR Europe</td>
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<tr>
<td>Garmin</td>
<td>Cessna</td>
<td>AOPA</td>
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<td></td>
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<td>AOPA</td>
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</tbody>
</table>

### 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

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*Examples of GSA initiatives:*

- EGNOS, it's there. Use it.
- Precise navigation, powered by Europe.
FOCUS ON LPV
NEW TOOLS, NEW OPPORTUNITIES
Procedures results and trend are encouraging: 202 Operational LPVs

202 operational LPV in 130 airports in 18 countries
+ 69 additional ‘EGNOS Enabled’ APV-Baro
...+ Tailored/PinS LPV

22% directly supported by GSA

Welcome to countries with first LPV in end 2014/2015!
- Denmark: Aarhus and Karup
- Portugal: Lisbon
- Slovakia: Bratislava and Kosice
- Sweden: Gothenburg City and Storuman

Looking forward to the upcoming ones
- Belgium: Antwerp
- Croatia: Dubrovnik
- Ireland: Dublin
- Romania: Cluj Napoca

http://egnos-user-support.essp-sas.eu/egnos_ops/lpv_map/map.php
Joint work in Denmark

- **2012**: GSA Analysis of EGNOS based RNP APCH potential benefits for Danish regional airports
- **2013**: Coordination with Naviair, Trafikstyrelsen and regional airports
- **2014-2015**: Support to RNP APCH Implementation at Aarhus and Karup

**AARHUS AIRPORT** *(EKAH)*

- 6000 movements and 468 000 passengers (2010 data)
- Instrument Procedures available:
  - ILS cat I RWY 10R
  - ILS cat II RWY 28L
  - VOR/DME RWY 10R/28L
- LPV as backup for ILS, and ability to decommission Cat I in the future

**KARUP AIRPORT** *(EKKA)*

- Combined military and civil airport
- 3800 movements and 200 000 passengers (2010 data)
- Instrument Procedures available:
  - ILS RWY 27L/09R
  - VOR/DME RWY 27L/09R
  - NDB/DME RWY 27R
- LPV as backup for ILS
Different users...different needs

One solution DOES NOT fill all
General aviation (I): Demand LPV to less equipped airfields

The challenge:
LPV to non-instrument runway
(ATS? Runway? MET/COM?)

"GA need help to increase GNSS approaches implementation and increase safety"
Paul Sherry, PPL/IR Europe.

Pilot cases in UK and Spain

Towards an harmonised implementation framework
Together with
General Aviation (II): Demand cost effective avionics

GSA has supported the EASA approval for the avionics system most widely used by GA pilots: Garmin GNS430 & GNS530

(September 2015)

- Garmin GNS 430W/530W: GNSS/SBAS avionics most used by IFR GA in EU
- LPV retrofit with GNS 430W/530W is considered a Major Modification

Solution: Approved All Model List STC for LPV capability

- Applicable to CS 23 (light GA aircraft)
- Existing Garmin GPS unit of the following versions GNS530W, GNS530AW, GNS530W-TAWS, GNS530AW-TAWS, GNS430W and GNS430AW.
- Cost €300 per aircraft registration for GNS-W versions

From 10000 € To 300€

Together with: PPL/IR EUROPE
EGNOS is the preferred option for Business Operators

Memorandum of Understanding (MoU) to promote the wide use of EGNOS – precision-based navigation (PBN) – at regional airports in Europe

Demand for LPV procedures
- 10 priority airfields selected
- Implementation ongoing

The fleet is already equipped and ready to fly LPV.
- Most OEMs for business aviation and high end helicopters provide SBAS/EGNOS equipage in new models
- Analysis of members fleet and availability of retrofit solutions

Operational approval guidelines developed with ESSP
GSA support to Regional airlines

**Upgrade in 2015**
- **Chalair**
  - Beechcraft1900
- **Wideroe**
  - DHC 8-100

**New funded projects**
- **HOP!**
  - 13x ATR42-500
    - Equipment: CMC electronics
    - STC development: AeroConseil
- **Air Baltic**
  - 12xDHC-8-402
    - Equipment: x8 UNS-1E, x4 UNS-1Ew
- **Jetstream 41**
  - 17x
    - Equipment: UNS1-LW FMS + LPV monitor
    - STC development: CranField Aerospace Ltd
- **Saab 2000**
  - 9x
Developing a new tool for airspace users: Identify a suitable STC for LPV

Main features:

✓ Direct and continuous entry of data into the database
✓ Easy interface for user to find LPV solutions matching their aircraft
✓ Market information for manufacturers and MRO’s

www.sbas4aviation.eu
EGNOS for rotorcraft operations: a technology enabler in SESAR

Current situation and needs

- IFR Rotorcraft are constrained to use procedures designed for airplanes.
- Generally heliports are not well equipped in terms of ground navigation aids.
- Rotorcraft operations should not be limited to VFR/VMC conditions (specially HEMS)!

Enabler for IFR rotorcraft operations

- Direct Approach with Vertical guidance (LPV)
- Point in Space
- Curved procedures/RNP-AR (with RF)
- Low Level RNAV routes
- Simultaneous non interfering operations
Rotorcraft Point-in-Space

PinS APCH at Insel hospital heliport

- RNP APCH
- First PinS LPV procedure approved within Europe
- Proceed Visually
Rotorcraft Point-in-Space

PinS at Babice with Low Level Route to Lodz airport

Simulator pre-flight

EC-135 Validation Flights
“Our priority is safety for the client and the pilot: to be safe back home when after take-off the weather doesn’t allow performing the mission. Here is when EGNOS comes into the picture. You can fly safely also at night!”.  
Mieszko Syski, LPR
Coming soon:
13 GSA funded projects kick off

- 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

EC-135
EC-145
Jetstream 41
Saab 2000
AW109
ATR42-500
DHC-8-402
EC-135
EGNOS FOR ADS-B
GNSS source for ADS-B

GNSS is required for the horizontal position and velocity data source.

In principle, EGNOS (SBAS) and GNSS + RAIM (ABAS) can support ADS-B Out.

Only SBAS source can provide an equivalent level of service as for Radar Surveillance:

SBAS ensures 99.9% of availability.
WAAS role for ADS-B introduction in US

The FAA only recognizes SBAS as the only way to get 99.9 % availability

SBAS is “de facto” required

<table>
<thead>
<tr>
<th>Positioning Service (receiver standard)</th>
<th>Predicted Availability (ADS-B Compliance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS (TSO-C129) (SA On)</td>
<td>≥ 89.0%</td>
</tr>
<tr>
<td>GPS (TSO-C196) (SA Off)</td>
<td>≥ 99.0%</td>
</tr>
<tr>
<td>GPS/ SBAS (TSO-C145/TSO-C146)</td>
<td>≥ 99.9%</td>
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</table>

The combined use of SBAS source for Navigation and Surveillance brings significant Safety improvements to the system and allows Ground Infrastructure Rationalization
**Leveraging EGNOS and Galileo for robust platform navigation and application development**

<table>
<thead>
<tr>
<th>Projects concluded 2010-2014</th>
<th>Projects ongoing 2015-2017</th>
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<tr>
<td><strong>FIELDCOPTER</strong></td>
<td><strong>MISTRALLE</strong></td>
</tr>
<tr>
<td>EGNOS Based Precision Agriculture Using Unmanned Aerial Vehicles</td>
<td>Monitoring of Soil moisture and water-flooded areas for agriculture and environment</td>
</tr>
<tr>
<td><strong>LOGAM</strong></td>
<td><strong>COREGAL</strong></td>
</tr>
<tr>
<td>Low cost GNSS attitude and navigation system with inertial MEMS aiding</td>
<td>Combined Positioning-Reflectometry Galileo Code Receiver for Forest Management</td>
</tr>
<tr>
<td><strong>CLOSE-SEARCH</strong></td>
<td><strong>MAPKITE</strong></td>
</tr>
<tr>
<td>Accurate and safe EGNOS-SoL Navigation for UAV-based low-cost SAR operations'</td>
<td>EGNOS-GPS/GALILEO-based high-resolution terrestrial-aerial sensing system.</td>
</tr>
</tbody>
</table>

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[EGNOS](https://www.egnss.eu/) logo and text: EGNOS, it’s there. Use it.

[European Space Agency (ESA)](https://www.esa.int/) logo and text: EGNOS, it’s there. Use it.
Regulatory framework for drones

The use of RPAS is growing rapidly worldwide.
High industrial interest to use drones in civil applications
Regulatory initiatives
Drones require safe navigation
EGNOS contributes to accurate, safe navigation

**EGNOS supports drone navigation with higher accuracy and integrity**

- Combined GNSS/inertial measurements meet user navigation requirements
- EGNOS enhances positional accuracy (horizontal and vertical)
- EGNOS integrity data can be used in the control law/Kalman filtering
- EGNOS integrity data can be used to compute protection levels suited to drone navigation
- Autonomous flights require EGNOS to increase safety (although not only…)

**Ongoing work**

- Navigation requirements and EGNOS contribution per application
- Explore the contribution of EGNOS reliable PVT for navigation/‘detect-and-avoid’ function
- Respond to users flying at low altitude
2015 Call for proposals to foster EGNOS adoption in aviation

Objectives

- Foster the implementation of EGNOS based operations: RNP APCH, PinS LPV
- Development and/or installation of GPS/EGNOS enabled avionics
- Development of Service Bulletin and/or Supplemental Type Certificate
- Other EGNOS based operations and development of Enablers
- EGNOS for drones

EU Funding

- Maximum budget of this call: 6 M€
- Maximum EU financing rate:
  - Direct costs: 60% funding; Indirect costs: flat rate 7% of the direct costs

Timing

- Publication: 24 June 2015
- Deadline for submitting applications: 10 October 2015
2015 Call for proposals to foster EGNOS adoption in aviation

Objectives

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10 Days left!

Timing

Publication: 24 June 2015
Deadline for submitting applications: 10 October 2015
Opportunities and challenges ahead

Looking at LPV...

- LPV in Non Instrument Runways
- Helicopter operations i: PinS, RNP 0.3
- Combined use of SBAS receiver for Navigation (LPV) and Surveillance (ADS-B)
- High demand at high latitudes
- Increase availability for LPV retrofit solutions
- LPV-200 capability, enabling CAT I approach procedures

And beyond...

- EGNOS for other applications: Surveillance, Vertical Separation
- EGNOS added value for drones
- Multi-constellation Multi-frequency concept of operations
THANK YOU FOR YOUR ATTENTION

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