EGNOS in aviation: strategy and implementation status

EGNOS Service Provision Workshop 2016
Warsaw, 27th September 2016

Carmen Aguilera, GSA
Jose Maria Lorenzo, ESSP
- **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
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
The EGNOS SoL service for aviation: EGNOS is an enabler of PBN

PBN EGNOS-based operations

RNP APCH

WITHOUT VERTICAL GUIDANCE

LNAV
- GPS NPA
  - Expected to be flown with CDFA

LP
- NPA SBAS supported
  - Localiser Performance

LNAV/VNAV
- APV Baro
  - (can also be supported by SBAS)

WITH VERTICAL GUIDANCE

LPV
- APV SBAS supported
  - Localiser Performance with Vertical Guidance

LPV-200
- SBAS CAT-1
  - (DA/H 200ft)

Current

Ongoing

Helicopter operations
## Working with Aviation value chain: actions suited to user needs

### Main Categories:
- International airports
- Regional airports
- Private airports

### Main Organisations:

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

#### Aircraft/rotorcraft manufacturers
- **Main Players:**
  - Airbus
  - AgustaWestland
  - Saab
  - ATR
  - Diamond
  - Cessna
  - Piper

#### Airspace users
- **Main organisations:**
  - EBAA
  - ERA
  - EHA
  - PPL Air
  - AOPA

#### Air Navigation Service Provider
- **Main Organisations:**
  - Canso
  - NATS
  - DGAC

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

### Actions:

<table>
<thead>
<tr>
<th>Device manufacturers</th>
<th>Aircraft/rotorcraft manufacturers</th>
<th>Airspace users</th>
<th>Air Navigation Service Provider</th>
<th>Aerodromes</th>
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<tbody>
<tr>
<td>Co-funding avionics development, equipage and simulators</td>
<td>Co-funding implementation</td>
<td>Cost benefit analysis: which solutions are demanded/available</td>
<td>Co-funding implementation</td>
<td>Cost benefit analysis</td>
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<td>Co-marketing</td>
<td>Technical assistance</td>
<td>Avionics database, guidance on crew training</td>
<td>PBN Training, Guidance material</td>
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**New operations and pioneers users, e.g. PinS, LP.**
GSA triggered the first LPV to 18 countries and supports 50% of implementations

<table>
<thead>
<tr>
<th>Country</th>
<th>1st LPV supported by GSA</th>
<th>ICAO code</th>
<th>Publication</th>
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<td>Rost</td>
<td>ENRS</td>
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<td>United Kingdom</td>
<td>Exeter</td>
<td>EGTE</td>
<td>August 2014</td>
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Looking forward to the upcoming 1st LPV in new countries!
Joint work in Poland

- Dedicated training on PBN implementation
- EGNOS mapping into the Polish PBN strategy
- EGNOS based APV down to LPV simulation at the Virtual Flight Laboratory at Silesian University of Technology (SUT), as training support to ANSP and airline operators

- Helicopter Emergency operations
- Excellent feedback from LPR operator:
  
  “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

First 2 operational LPV in Poland, 13th November 2014

PinS at Babice
Low Level Route to Lodz airport
Most new popular models include SBAS and availability of retrofit solution increases

- **Business and General aviation lead LPV adoption:**
  - 25% of Business aircraft will be LPV capable by end of 2016
  - 10% of General aviation aircraft are LPV capable

- **Many new popular aircraft models have standard SBAS capabilities:**
  - Commercial aviation: A350
  - Regional aviation: ATR42 & 72 – 600, Bombardier CRJ series,...
  - General aviation: DA42, Cessna all single engine, PC6, SR20,...
  - Business aviation: TBM900, Cessna citation family, G650,...
  - Helicopters: EC135, EC175, AW109, B505,...

- **Many in service aircraft types have retrofit solutions available:**
  - Over 50 STC’s and SB’s available for more than 20 different A/C types
  - New solutions being developed every day!
Support actions are tailored to each specific segment’s needs

<table>
<thead>
<tr>
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Demand approaches to non instrument runways:
- Pilot implementations
- Regulatory analysis

Cost efficient avionics solutions development
SBAS avionics database
PBN training material for flight schools
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- Demand approaches to non instrument runways:
  - Pilot implementations
  - Regulatory analysis

- Priority: airports with high BA traffic and limited navaids
  - Feasibility assessment, design

- Cost efficient avionics solutions development
- SBAS avionics database
- PBN training material for flight schools
- Co-marketing with manufacturers
- Analysis of operational benefits
- Support to obtain approval
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**General aviation**
- Low for LPV

**Business aviation**
- High

**Regional aviation**
- Low

**Commercial aviation**
- High

**Helicopters**
- High

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**Demand approaches to non instrument runways:**
- Pilot implementations
- Regulatory analysis

**Cost efficient avionics solutions development**

**SBAS avionics database**

**PBN training material for flight schools**

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**Identification of priority airports with high RA/CA traffic**

**Co-funding STC/SB development**

**Cost Benefit analysis to airlines flying to LPV destinations**

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**Priority: airports with high BA traffic and limited nav aids**

**Feasibility assessment, design**

**Co-marketing with manufacturers**

**Analysis of operational benefits**

**CBA, Co-funding**

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**Support to obtain approval**

**Simulator upgrade**

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**Support actions are tailored to each specific segment’s needs**

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**Identification of priority airports with high RA/CA traffic**

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**PBN training material for flight schools**
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- Demand approaches to non instrument runways:
  - Pilot implementations
  - Regulatory analysis

- Priority: airports with high BA traffic and limited navaids
  Feasibility assessment, design

- Identification of priority airports with high RA/CA traffic

- PinS pioneer implementations
  Support to CAAs

- Cost efficient avionics solutions development

- Co-marketing with manufacturers

- Co-funding STC/SB development

- SBAS avionics database

- Analysis of operational benefits

- CBA, Co-funding

- Cost Benefit analysis to airlines flying to LPV destinations

- PBN training material for flight schools

- Support to obtain approval

- Simulator upgrade

- CAA requirements identification
GSA Aviation grants programme - 1st call (6M€)
Expected results from 13 projects

- **72** EGNOS based procedures in **37** airports
- **8** PinS at **7** helipads
- **68** aircraft/rotorcraft retrofit by **5** operators

Upgrade of 3 flight simulators

Already in the market

2017
GSA Aviation grants programme - 1\textsuperscript{st} call (6M€)

Expected results from 14 projects

47 aircraft retrofit by 7 operators
5 flight simulator upgrades
EGNOS for RPAS

Raytheon Beech 58
Bristow
ENAC

SAAB 340
DA40
DA42

General Aviation A/C:
1 Piper PA-28-161, 1 Cessna C172 SP, 1 Tecnam P5010, 1 Tecnam P2006T, 3 Cessna C172 S, 2 Cessna 172, 2 Piper Seneca PA34, 1 Cessna jet 525, 1 Beechcraft C90

Rotorcraft:
1 AS355 & 1 EC135

40 LPV procedures at 18 airports
2 LPV200 at 1 airport
15 PiNS LPV approach
2 RNP0.3 routes
Ongoing training to new EGNOS aviation users

- Pilot’s education & training
- EGNSS capacity building in Joint Service Provision

Area:
- Albania
- Republic of Bosnia and Herzegovina
- Kosovo
- Montenegro
- Serbia
- Hungary

EGNOS in the PBN plan
Procedure designers training
15 LPV implementation
- Greece
- Cyprus
- Malta

Additional countries:
- Republic of Moldova
- Montenegro
- Hungary
- Former Yugoslav Republic of Macedonia
- Kosovo
- Turkey
- Morocco
- Egypt
- Palestine
- Israel

Preliminary LPV design
Performance assessment
EGNOS for rotorcraft operations: a technology enabler in SESAR

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

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
Enabling pioneer implementation of PinS to LPV

Fostering the implementation of PinS procedures based on EGNOS in Rotorcraft industry

Research initiative in enhanced navigation concepts for Rotorcraft emergency missions in 5 different scenarios

Increasing safety and continuity of HEMS by building network the low-level routes and 17 PinS in Trente region together with retrofit of 2 AW139.

Working group for the harmonisation of PinS regulation in national authorities through Europe
Main EGNOS benefits for RPAS

Satellite Navigation (PinS) is an opportunity for RPAS operators

Better navigation performance through higher accuracy, specially vertical

Improved safety through position integrity in ADS-B source

Robust geofencing thanks to positioning integrity and reliability

Low-level routes, lower protection volumes, more opportunities under challenging environments

Easier integration into manned airspace through the use of compatible concept of operations

24/7 service
improved safety
more efficient
REAL: RPAS EGNOS Assisted Landings

EGNOS based navigation and surveillance sensor, coupled with autopilot and ground station
Contribute to the approval of innovative RPAS operations, supported by a Safety Case

Scenario 1
Urgent Medicine Transport

Scenario 2
Fire Extinction Operations
Table of Contents

01 LPV Implementation Status

02 EWA for non-EU Countries

03 EGNOS at Non-Instrument RWY
LPV: WHO DOES WHAT?

EGNOS Service Provider
Certified as SES ANSP (Navigation)
EGNOS SoL Service Safe introduction
EGNOS DoV produced

ATS Service Provider
Certified as SES ANSP
Standard Approach Procedure Approval Process:
✓ Operational Safety Assessment
✓ IFP Design (PANS-OPS)
✓ Flight Validation, etc.
✓ Specific National Requirements

EGNOS Working Agreement (EWA)

Supervisory Body
EGNOS Service Provision Workshop 2016
LPV Implementation Status - EWAs

47 EWAS IN PLACE

28 EU Member States

EWA
No EWA

15th September 2016

(*) non-EU country

EGNOS Service Provision Workshop 2016
LPV Implementation Status - EWAs

Latest (2016)
- Tallinn Airport Ltd (Estonia)
- BAE Systems Marine Ltd (UK)
- Coventry Airport Ltd (UK)
- City of Derry Airport Operations Ltd (UK)
- Brighton City Airport Ltd (UK)
- Esbjerg Airport (Denmark)
- Serco Ltd (UK)

In progress
- Sonderborg (Denmark)
- Norwich Airport Ltd (UK)
- MATS (Malta)

Initiated
- EANS (Estonia)
- Latvijas Gaisa Satiksme (Latvia)
- Kortrijk Airport (Belgium)
- FerroNATS (Spain)
### LPV Implementation Status

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>Airports</th>
<th>LPV Procedures</th>
<th>APV baro Procedures</th>
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<td>APV-I</td>
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<td><strong>284</strong></td>
<td><strong>12</strong></td>
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**15th September 2016**

LPV Implementation Status

EWA as a Driver to Support LPV Implementation

Publications by EWA

- 45% With NO LPV published
- 55% With at least one LPV published

Publications by Country

- 80% With at least one LPV published
- 20% With NO LPV published

21 EU + 4 non-EU
LPV Implementation Status

Publications by EWA

- Signed EWAs Short Term Forecast
  - 96% with NO LPV published
  - 4% with at least one LPV published

Publications by Country

- 100% with at least one LPV published
- 0% with NO LPV published

EWA AS A DRIVER TO SUPPORT LPV IMPLEMENTATION

21 EU + 4 non-EU

EGNOS Service Provision Workshop 2016

27-28/09/2016
As of 15th of September 2016: **296 LPVs** (APV-I and LPV-200 Service Levels) serving **168 airports**.

- Numerous LPV publications expected in Denmark, France, Germany, Italy, Norway, Poland, Spain, Sweden, Switzerland and UK.
- Significant increase of new plans also in Belgium, Bulgaria, Hungary, Ireland, and Romania.
- **>440 LPV publications expected for 2018.**

ESSP’s LPV supported by ESSP (Sweden: Norrköping)
EGNOS-based procedures implementation map and detailed list included in the ESSP User Support Website: [http://egnos-user-support.essp-sas.eu/](http://egnos-user-support.essp-sas.eu/)

All information coordinated with Eurocontrol’s PBN Approach Map Tool available at: [https://ext.eurocontrol.int/pbn/](https://ext.eurocontrol.int/pbn/)
Existing EWAs with non-EU countries (compliant with SES Regulation):
- Bailiwick of GUERNSEY (Channel Islands – 2011).
- Switzerland (2011).
- Norway (2013).
- Bailiwick of JERSEY (Channel Islands – 2014).

Explicit interest expressed by several neighbouring regions/countries:
- An International Agreement (between EC and the non-EU State), defining the overall framework for the use of the EGNOS SoL Service.
  - An agreement/coordination scheme: if deemed necessary between EASA and the Civil Aviation Authority of the non-EU country.
- EWA (EGNOS Working Agreement with ESSP): Established on the basis of the previous agreement/s.
EGNOS Working Agreements for non-EU countries

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ICAO new RWY classification
EASA Opinion No 03/2016

Reg.139/2014 (Feb 2014) - Aerodromes:
“non-instrument runway” - a runway intended for the operation of aircraft using visual approach procedures.

ICAO Annex 14 Amendment 11-B (Nov 2014):
“non-instrument runway” - a runway intended for the operation of aircraft using visual approach procedures or an instrument approach procedure to a point beyond which the approach may continue in visual meteorological conditions.

Opinion 03-2016 (Amending Reg.139/2014)
Executive summary:
It facilitates performance-based navigation approach operations with vertical guidance to be applied at non-precision approach runways, and instrument approach operations to be associated with non-instrument runways without the need in both cases to upgrade runway infrastructure.”
Non-instrument RWYs
EASA Basic Regulation - Scope

Basic Reg. 216/2008

Reg 216/2008, Article 4 (3a) - Basic Principles and applicability
- Aerodromes open to public use, and
- Serve Commercial Air Transport, and
- Using instrument approach or departure procedures, and
- [Paved RWY ≥ 800m] or [Exclusively serve helicopters]

Local CAA
Non-instrument RWYs
EASA Basic Regulation - Scope

Reg 216/2008, Article 4 (3a) - Basic Principles and applicability

- Aerodromes open to public use, and
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- **Using instrument approach** or departure procedures, and
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EU28 – 2673 aerodromes with non-instrument RWYs

- Germany 777
- United Kingdom 420
- France 475
- Italy 366
**ICAO new RWY classification**

**EGNOS SoL Service Levels**

<table>
<thead>
<tr>
<th>Domain</th>
<th>Document</th>
<th>Aspect</th>
<th>Type A</th>
<th>Type B</th>
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<tr>
<td><strong>Approach Operations</strong></td>
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<td><strong>Classification</strong></td>
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<td>CAT I (&gt;= 200°)</td>
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New Approach Classification as described in ICAO State Letter AN 11/1.1-12/40 June 2012
New Approach Classification as described in ICAO State Letter AN 11/1.1-12/40 June 2012
### New Approach Classification

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**APV-I Service Level:**
- Operation: Type A (DH >= 250'), 3D
- RWY: Non-instrument Non-precision approach

New Approach Classification as described in ICAO State Letter AN 11/1.1-12/40 June 2012
### New Approach Classification

#### Approach Operations

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</table>

#### Operation

- **Type A (DH ≥250ft), 3D**
- **Non-instrument Non-precision approach**

#### RWY

- **APV-I**
- **LPV-200**

### LPV-200 Service Level:

- **Operation:** Type A (DH ≥250ft), 3D
- **RWY:** Non-instrument Non-precision approach Precision approach Cat I

### APV-I Service Level:

- **Operation:** Type A (DH ≥250ft), 3D
- **RWY:** Non-instrument Non-precision approach

---

New Approach Classification as described in ICAO State Letter AN 11/1.1-12/40 June 2012
EGNOS based operations
New scenario

**UP TO NOW**

VFR

VMC

Non instrument RWY
EGNOS based operations
New scenario

AFTER EASA OPINION 03/16

VFR → IFR

VMC

Non instrument RWY
EGNOS based operations
New scenario

AFTER EASA OPINION 03/16

VFR → IFR

SBAS capable

DA/H

3D, Vertical guidance
‘similar to PinS’

Non instrument RWY

27-28/09/2016

EGNOS Service Provision Workshop 2016
EGNOS based operations
New scenario

**Option 1: Upgrade**

- VFR → IFR
- AIS
- SBAS capable
- DA/H
- VMC
- 3D, Vertical guidance
  - 'similar to PinS'

Non instrument RWY

EGNOS Service Provision Workshop 2016

27-28/09/2016
EGNOS based operations
New scenario

**AFTER EASA OPINION 03/16**

- **VFR** → **IFR**
- **AIS**
- **THE CHALLENGE!**

**NON INSTRUMENT RWY**

- **ATZ – Class G**
- **ATS**
- **3D, Vertical guidance**
  - *‘similar to PinS’*

**EGNOS**

- SBAS capable
- DA/H
- **VMC**

**OPTION 2: NO UPGRADE**

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EGNOS Service Provision Workshop 2016

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27-28/09/2016
EGNOS based operations
New scenario

Two projects funded by GSA fitting this new scenario:

- **Cumbernauld Airport (EGPG):**
  LPVs on both (non-instrument) runway ends.

- **GAGA Project (GNSS Approaches for General Aviation):**
  Stapleford Airport (EGSG), no ATS, 1 or 2 LPVs.

**UK CAA**
Assessing the case under CAP1122 framework

**ESSP is ready to support this kind of approaches providing:**
- NOTAM Proposals
- Collaborative Decision Making
- GNSS Data Recording
WHO’S NEXT?
QUESTIONS?