



EGNOS, it's there. Use it.

LPV implementation to non instrument runways

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European GNSS Agency

Combined GA TeB & GA Sectorial Committee
Cologne, November 3rd 2017



European
Global Navigation
Satellite Systems
Agency



Precise navigation,
powered by Europe



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1. The EGNOS System

2. EASA approach for GA

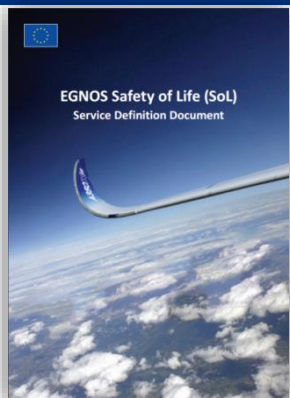
3. Instrument Approach Procedures for GA

- VFR approach - current scenario
- New scenario – Actors involved

4. Concept View

5. Proposed way-forward

EGNOS Safety of Life - Service Levels



Compliant with ICAO Annex 10 requirements for instrumental approaches with Vertical Guidance (APV-I) and Category I precision approaches

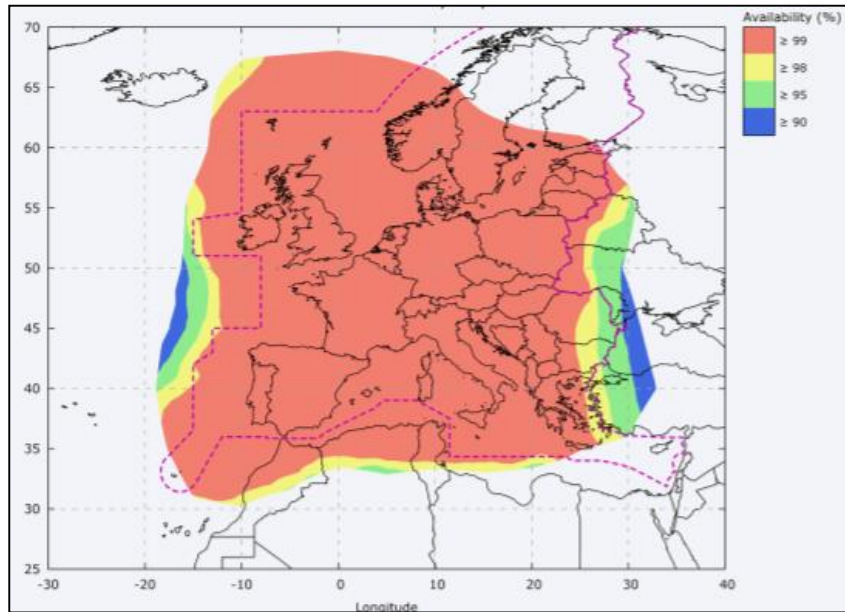
	Accuracy		Integrity				Continuity	Availability	EGNOS Service Level
	Horizontal Accuracy 95%	Vertical Accuracy 95%	Integrity	Time-To-Alert	Horizontal Alert Limit	Vertical Alert Limit			
<i>Typical operation</i>									
Initial/Intermediate approach, Non-precision approach (NPA)	220 m (720 ft)	N/A	$1-1 \times 10^{-7}/h$	10 s	556 m (0.3 NM)	N/A	$1-1 \times 10^{-4}/h$ to $1-1 \times 10^{-8}/h$	0.99 to 0.99999	NPA APV-I LPV-200
Approach with vertical guidance (APV-I)	16.0 m (52 ft)	20 m (66 ft)	$1-2 \times 10^{-7}$ /app	10 s	40 m (130 ft)	50 m (164 ft)	$1-8 \times 10^{-6}$ per 15 s	0.99 to 0.99999	APV-I LPV-200
Category I precision approach	16.0 m (52 ft)	6.0m to 4.0m (20 ft-13 ft)	$1-2 \times 10^{-7}$ /app	6 s	40 m (130 ft)	35.0m to 10.0 m (115ft-33ft)	$1-8 \times 10^{-6}$ per 15 s	0.99 to 0.99999	LPV-200

https://egnos-user-support.essp-sas.eu/new_egnos_ops/content/egnos-sdds

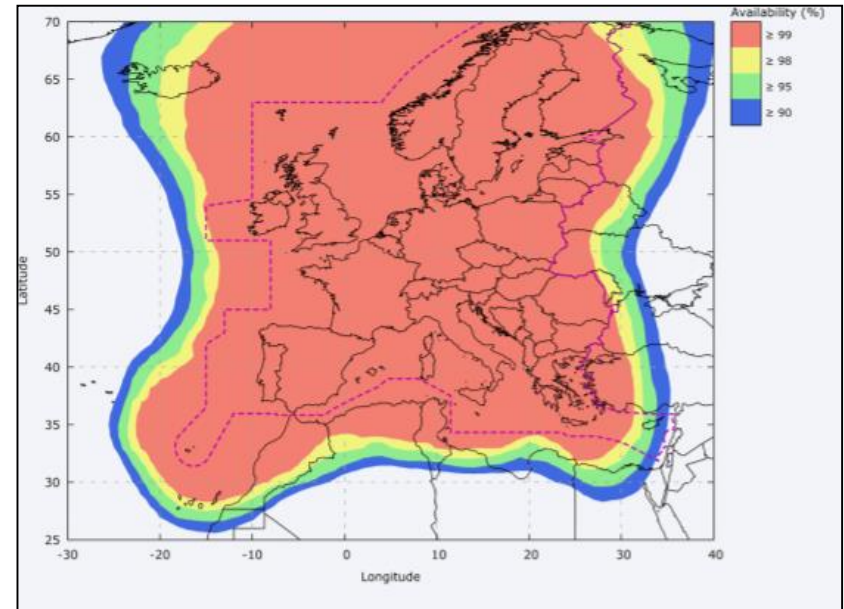
EGNOS SoL commitment maps

EGNOS Service Area comprises latitudes from 20° to 70° and longitudes from -40° to 40°

- Commitment maps (based on ESR v2.4.1M in service) :



LPV-200 Availability Map



APV-I Availability Map

EGNOS SoL implementation status

- **As of 12th of October 2017: 377 LPVs (322 APV-I and 55 LPV-200) serving 219 airports.**
- **Plans by 2018 > 440 LPV procedures planned**
- Numerous LPV publications expected in UK, Sweden, Austria, Slovak Republic and Spain, as a result of **GSA's Call for Grants.**
- Boost expected in the incoming years due to **EU Navigation strategy** and EASA effort on the **introduction of IFR for GA**

Real-time information can be found at:
<http://egnos-user-support.essp-sas.eu>

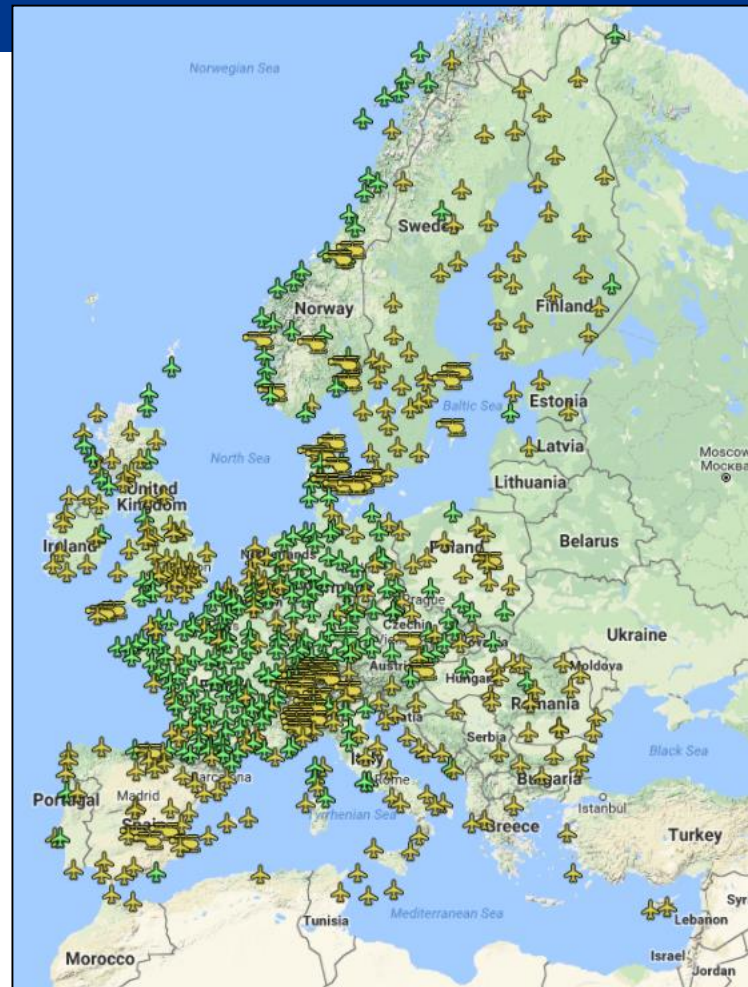


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EASA Roadmap for GA



General Aviation

6 Objectives we are committed

IFR Flying

Easier access of GA pilots to IFR rating, as a concrete measure that will improve safety.

Training

By end of 2018 the 3rd option for licensing will be fully developed providing a simple system for pilot training outside ATO.

Part-M 'Light'

Work towards a simpler and more proportionate framework for aircraft maintenance and license: a Part-M 'Light'.

Technology

Continue development of CS-STAN and other similar tools to enable the introduction of new technologies which contribute to safety.

Simpler Certification

Towards a simpler framework for certifying LSA aircraft in the short term by increasing the support to applicants e.g. workshops, document templates etc. in the long term by amending applicable regulations in order to bring a radical simplification.

Industry standards

Build on the improvements of CS-23/Part-23 on other CS or regulations in order for EASA to focus on its safety objectives and to delegate the preparation of associated standards to industry groups (ASTM, ASD etc.)

EASA has determined among its strategic objectives for GA **the introduction of IFR procedures**

...*jointly with* new ICAO RWY classification, that enables the use of IFP at non-instrument RWYs, allows GA take advantage of satellite based procedures to increase the level of safety of non-commercial operations

EASA Basic Regulation - Scope



Basic Reg. 216/2008

EASA Opinion 03-2016
(Reg.139/14 scope amended)

Local CAA

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

- Open to public use, and
- Serve Commercial Air Transport, and
- **Using instrument approach** or departure procedures, and
- [Paved RWY \geq 800m] or [Exclusively serve helicopters]



777



420



475



366

EU28 – 2673 airports with non-instrument RWYs

Article 4 (3b) Member States may decide to exempt from the provisions of this Regulation an aerodrome which:

- handles no more than **10 000 passengers** per year, and
- handles no more than **850 movements** related to cargo operations per year.

(https://www.easa.europa.eu/system/files/dfu/EASA_MS_Aerodromes_in_the_scope_Art_4_of_Regulation_139.2014.pdf)

Non-instrument RWYs definition

ICAO Annex 14 Amendment 11-B (Nov 2014), EASA Opinion 03-2016:

“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.

...without the need to upgrade runway infrastructure

New Approach Classification						
Domain	Document	Aspect				
Approach Operations	Annex 6	Classification	Type A ($\geq 250'$)		Type B CAT I ($\geq 200'$) CAT II ($\geq 100'$) CAT III ($<100'$)	
		Method	2D	3D		
		Minima	MDA/H	DA/H*		
Approach Runways	Annex 14	M(DA/H) \geq VMC	Non Instrument RWY			
		M(DA/H) $\geq 250'$ Visibility=1 000m	Non Precision Approach RWY			
		DA/H $\geq 200'$ Visibility ≥ 800 m or RVR ≥ 550 m	Precision Approach RWY, Category I			
		DA/H $\geq 100'$ RVR ≥ 300 m	Precision Approach RWY, Category II			
		DA/H $\geq 0'$ RVR ≥ 0 m Precision Approach RWY, Category III (A, B & C)				
System Performance Procedures	Annex 10 PANS-OPS Vol. II	NPA	NDB, Lctr, LOC, VOR, Azimuth, GNSS			
		APV	GNSS/Baro/SBAS			
		PA	ILS, MLS, SBAS, GBAS			

Most likely scenario for GA:

- ✓ 3D type A approach
DH ≥ 250 ft
- ✓ Non instrument RWY ending in VMC conditions
- ✓ GNSS+SBAS



**EGNOS APV-I
SoL Service level**

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GA. Current VFR scenario

VFR Visual approach Chart



VFR-No instrumental guidance

Class G

AERODROME WITHOUT CONTROL SERVICE
The frequency is only available for AIR/AIR communications.

ARRIVALS
VFR traffic bound for Teruel AD shall remain in the A/A frequency. Entry into ATZ shall be via the established routes to join the aerodrome traffic circuit, communicating its position at the points N (Junction over A-23, Villarquemado link), W (Gea de Albarracin) and E (Junction over A-23, N-420 link). Entry into air traffic circuit, on downwind and final segments shall be notified.

Aircraft joining the circuit shall overfly the aerodrome maintaining 2000 ft AGL. They must then descend to circuit height on the inactive (dead) side of the RWY in use and join the circuit by crossing the upwind end of the RWY in use.
Aircraft joining directly on the crosswind leg must arrange their flight to track over the upwind end of the RWY in use, in the same position as if approaching it from the 'deadside'. This must be at circuit height.

VAC TERUEL AD (FR)

AD Traffic
circuit

AD SIN // WITHOUT ATS
FREQ A/A 122.675

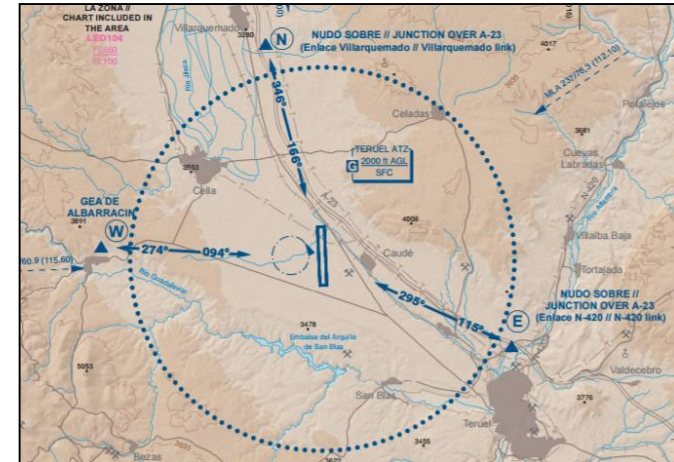
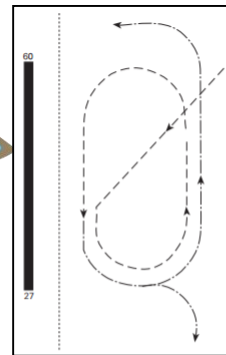
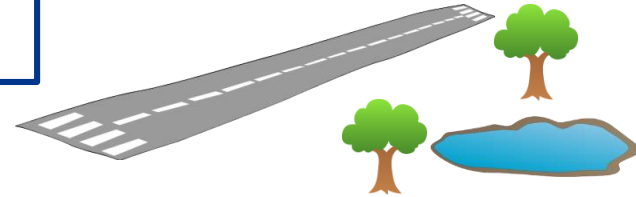


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IFP for GA

New scenario – Actors involved

IFR – RNP APCH
down to LPV minima

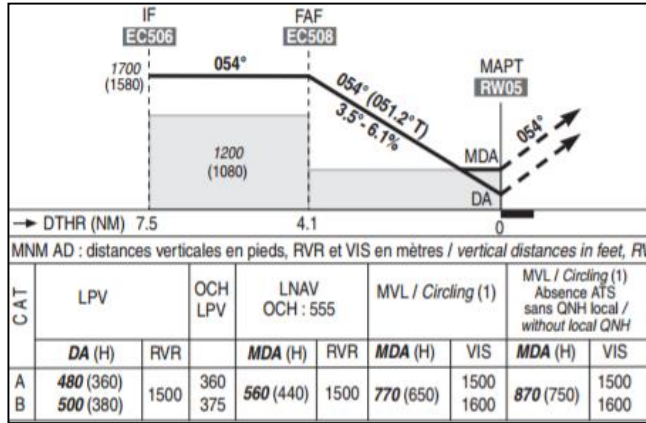
SBAS capable A/C

Pilot licensing



3D, IFR
'similar to PinS'

Class E
----- 1000 ft
Class G



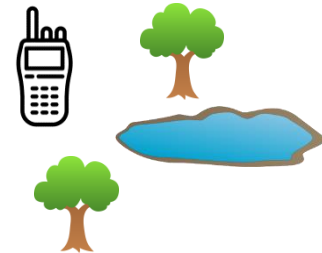
RNAV (GNSS) RWY05 OUESSANT AD (FR)



Navigation service provider

missed approach

AFIS/UNICOM
A/A, A/G frequency



ASD

AIS
NOTAM Info

MET
QNH, VMC/IMC conditions

AD operator
Non instrument RWY

Shaping the topic: solutions and next steps

For each element:



Implementation Solution

- Practical examples
- Best practices
- Cost efficient/proportionate solutions

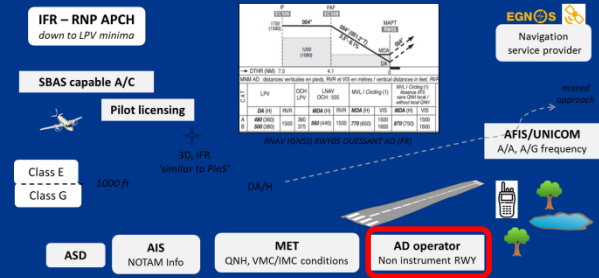
NEXT STEP?



...still work to do:

- Guidelines
- Clarifications
- Impact on EASA RMT

Aerodrome



New ICAO RWY classification...

....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**" (EASA Opinion 03/2016)

PBN based solutions with vertical guidance are highly recommended (3D approach type A)

Implementation Solution

- No upgrade on runway infrastructure is needed
- There is no additional lighting system requirements.
- There is no additional OLS requirements

A change on ADR certificate is needed to introduce IFR operations

AMC/GM TO ANNEX II - PART-ADR-AR SUBPART C - OVERSIGHT, CERTIFICATION AND ENFORCEMENT

GM1 ADR.AR.C.035(e) Issuance of certificates

MODEL FOR THE TERMS OF THE CERTIFICATE TO BE ATTACHED TO THE CERTIFICATES

TERMS OF THE CERTIFICATE	
Certificate reference: [STATE CODE] ¹ :	
Aerodrome name – ICAO location indicator ² :	
Conditions to operate ³ :	
Runway – declared distances ⁴ :	
Types of approaches ⁵ :	
Aerodrome reference code ⁶ :	
Scope of aircraft operations with a higher aerodrome reference code letter ⁷ :	
Provision of apron management services ⁸ :	
Rescue and firefighting level of protection ⁹ :	
Other ¹⁰	

¹ The certificate must be given the State Code [The two-letter ISO code should be used (ISO 3166 alpha-2), except for Greece and the United Kingdom, for which the abbreviations EL and UK are recommended] and a unique ascending number. Example: EL - 001

² To be specified: the official name of the aerodrome and the ICAO location indicator for the aerodrome.

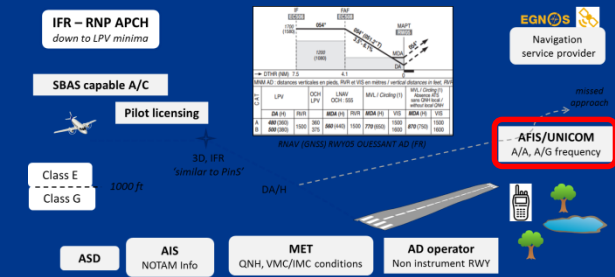
³ To be specified: day/ night and IFR/ VFR.

⁴ To be specified: ASDA, LDA, TODA, TORA in metres for each direction of each runway, including intersection take-off if applicable.

⁵ To be specified: approval of the runway for non-instrument, instrument, non-precision approach. In case of precision approach (-es) it is to be indicated, which of the following precision approach (-es) is (are) approved:

- Standard Category I;
- Lower than Standard Category I;
- Precision Approach Category II;
- Other than Standard Category II;
- Precision Approach Category III-A;

AFIS with a limited certificate



A limited certificate is a figure intended for small service providers, **within EU SES frame**:

- **Scope:** small entities providing services at locations with low traffic

*Aerial work/ **general aviation**/ CAT <20 pax*

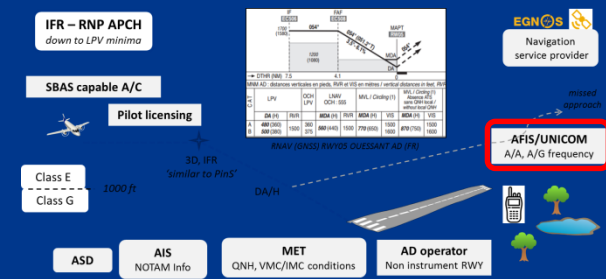
- Reg 373/2017 (ATM/ANS), ATM/ANS.OR.010:
 - (1) ATM/ANS.OR.B.001 *Technical and operational competence and capability;*
 - (2) ATM/ANS.OR.B.005 *Management system;*
 - (3) ATM/ANS.OR.B.020 *Personnel requirements;*
 - (4) ATM/ANS.OR.A.075 *Open and transparent provision*

Services/Functions	Type of Service/Function	Scope of Service/Function	Limitations (*)
Air traffic services (ATS) (****)	Air traffic control (ATC)	Area control service	
		Approach control service	
		Aerodrome control service	
	Flight information service (FIS)	Aerodrome flight information service (AFIS)	
		En-route flight information service (En-route FIS)	
Advisory service	n/a		

The approach has changed, not longer considered as a derogation of existing safety provisions, now it has its own applicable item

NO change management, occurrence reporting, contingency plans, Operations Manual or **liabilities and insurance cover** (ATM.ANS.OR.D.020)

UNICOM



A **UNICOM** is an aeronautical air-ground facility to provide air-ground and air-air communications, **not addressed by EU ATS rules**, intended to support GA activities. (EASA NPA 2016-09)

16035		
RNAV (GPS) Z RWY 23 FREDERICK MUNI (FDK)		
ALTS	MISSED APPROACH: Climb to 3000 direct BIYAS WP and via 139° track to FEDIT WP and via 059° track to EMI VORTAC and hold	
N	CLNC DEL 121.975	POTOMAC CLNC DE 126.9 (when tower closed)
5		UNICOM 122.95

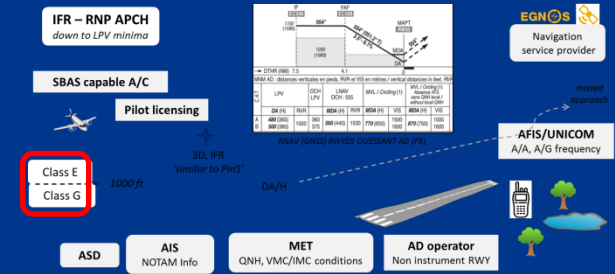
- **UNICOM is designed to fill the gap between AFIS and no aerodrome service at all.** Out of EASA scope, each Member State shall set the frame for its provision.

...still work to do:

Develop guidance on:

- Common EU frequency and language to be used.
- Operational procedures when there is no UNICOM service available (blind messages)
- Personnel requirements for UNICOM officers:
 - Basic aeronautical training
 - Info to be provided (RWY status, weather info, navaid status/NOTAMs and advisory traffic information when available)
 - Responsibilities (none, only info is provided, pilots are the responsible of the operation)

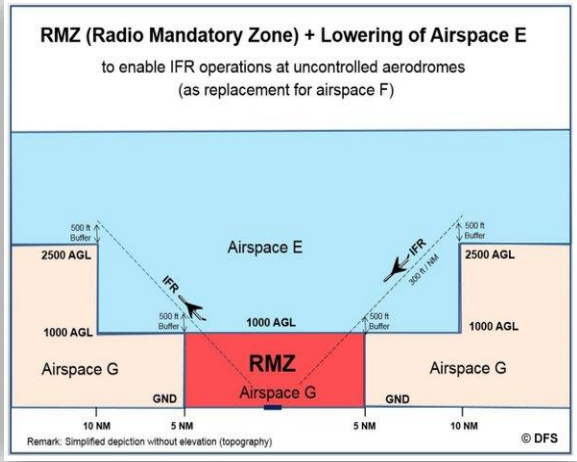
Airspace Design Airspace Structure



- **AFIS/UNICOM** service needs an airspace structure (class G) to define the boundaries where the service is available and the requirements for aircraft operating inside this area.

Implementation Solution

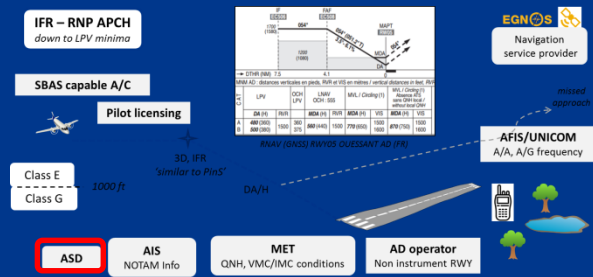
A Radio Mandatory Zone (RMZ) Class G seems to be the most suitable airspace structure.



This solution has been already implemented in Germany (RMZ Class G + Airspace Class E 1000ft)

Source: German AIP

Airspace design Flight Validation – Safety Assessment



IFP Design process:

The sponsor of the implementation process can be the ATSP, the AD, national authority or even interested users

High cost for GA

...still work to do:

Ask EASA for proportionate IFP requirements , a 'light' part-ASD.

...still work to do:

- EU proportional risk assessment methodology tailored for GA ('SORA-like' as for drones).
- Flight validation: When it is not mandatory to be conducted? innovating solutions, i.e. simulation studies, drone validation
- Adapt ICAO EUR Doc 025 contents for GA + SBAS
- Concept IFP design material (T or Y bar RNP APCH with LPV minima, segment lengths, glide paths and minimum heights defined based on a standard scenario)

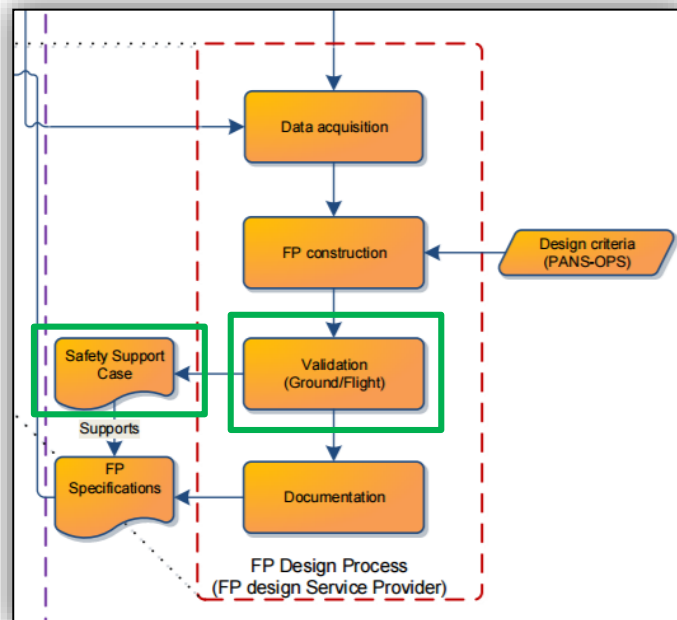
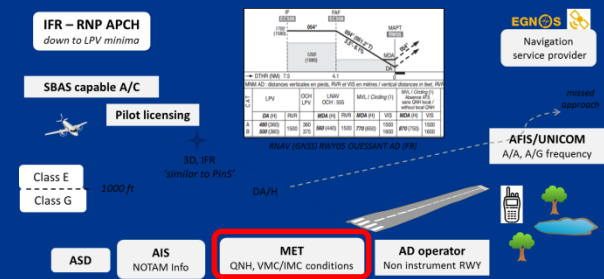


Figure extracted from NPA 2016-13, Figure 1 — Interactions between airspace change process and flight procedure design process

MET



“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**.

MET

Relevant info needed for IFR landing

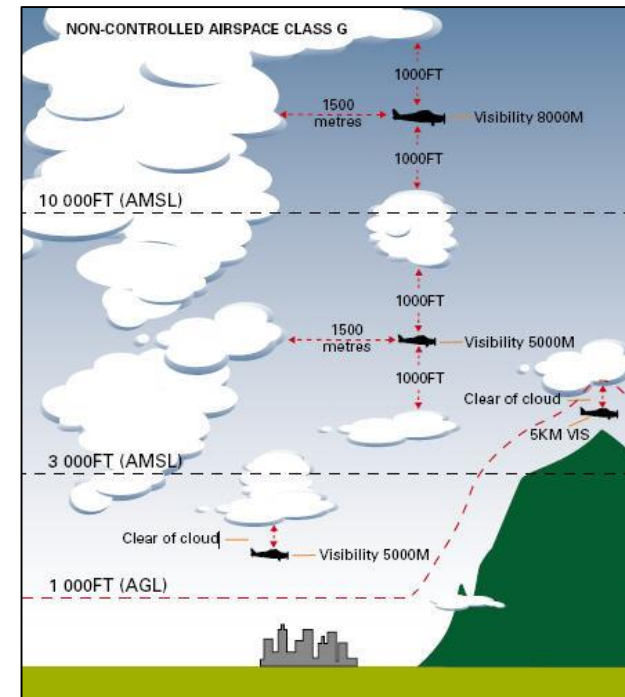
...wind, visibility, RVR, clouds, air temperature and QNH

Implementation solution

- Near MET Station (widely adopted on EU countries)
- Automated Weather System (France)

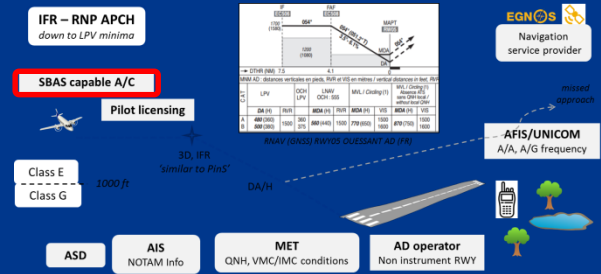
...still work to do:

Ask EASA to clarify the frame to implement automated MET provision.



VMC conditions: source Australian CAA

SBAS-capable GNSS Receivers



AMLs available

GARMIN



GNS 430W / 530W



GTN 6XX / 7XX TS



G1000, G2000, G3000, G5000



Implementation solution
ETSO-145()/ETSO-146()
are the available standards
for SBAS based IAP

BendixKing
by Honeywell



KSN 765/770 TS

AVIDYNE



IFD540 & IFD440 TS

AMLs available



Entegra Release 9

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RNP APCH - Non instrument RWY – non towered AD

New scenario – Implementation Solution

IFR – RNP APCH
down to LPV minima

but....still work to do



Navigation service provider

SBAS capable A/C

ETSO 145-146

Pilot licensing

BIR/DTO

AFIS (limited cert.)
UNICOM

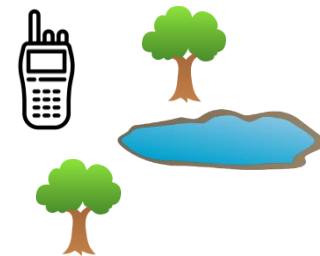
missed approach

UNICOM/AFIS
A/A, A/G frequency

3D, IFR
'similar to PinS'

DA/H

Class E
----- 1000 ft
Class G



ASD

AIS

NOTAM Info

MET

AD operator

Non instrument RWY

RMZ+Class G

National
AIP/AIS

QNH, VMC/IMC conditions

- Auto MET
- Near station

No RWY
upgrade



Precise navigation,
powered by Europe



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Proposed Way-forward

- ✓ Comments to the paper '**IFP to non instrument runways (by 30 Nov)**'
 - Review of the content → special focus on risks
 - Suitability of proposed solutions → special focus on costs
 - Set priorities on “still work to do” → special focus on proportionality
- ✓ Reviewed version intended for 15 December
- ✓ The final proposed implementation solution should go through a Risk Assessment to define feasibility.

Contributions are welcome

THANK YOU FOR YOUR ATTENTION



European
Global Navigation
Satellite Systems
Agency

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www.gsa.europa.eu



EGNOS, it's there. Use it.



<http://egnos-user-support.essp-sas.eu>



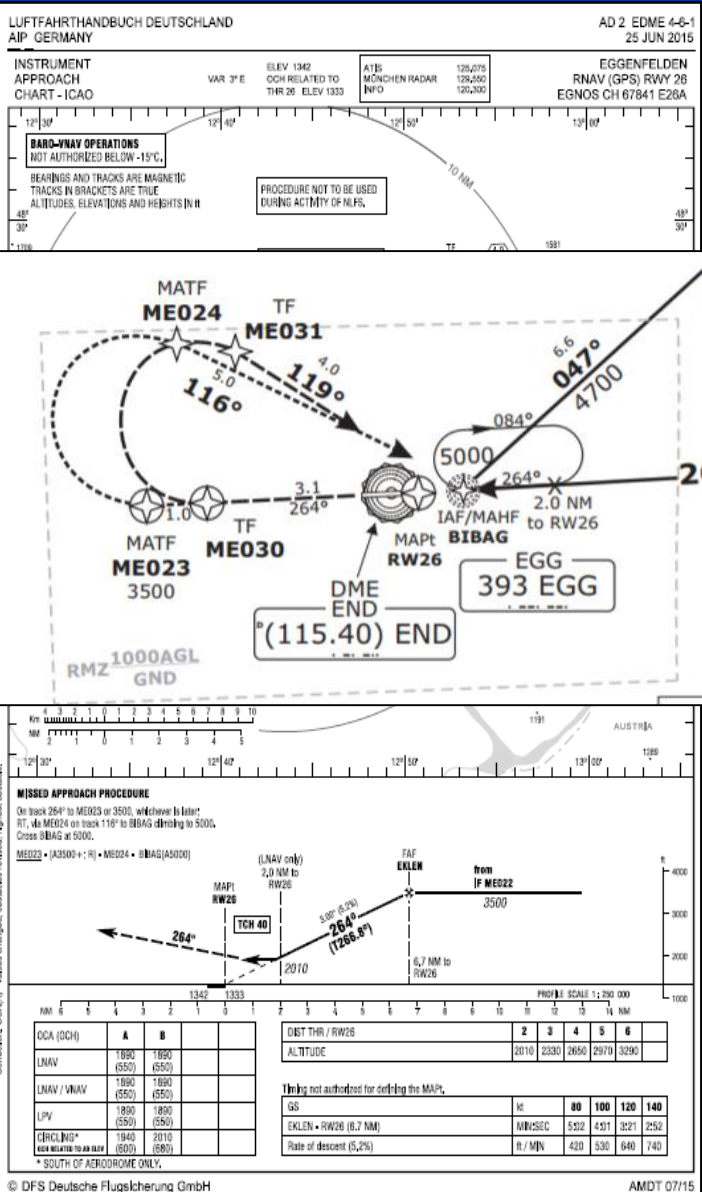
egnos-helpdesk@essp-sas.eu



+34 911 236 555 (H24/7)

BACK-UP SLIDES

Case of Study- Germany, Eggenfelden AD



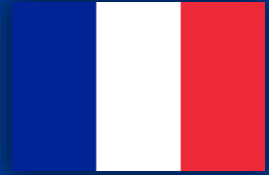
ATS service: ATIS+AFIS

MET: MET info in provided by external MET office

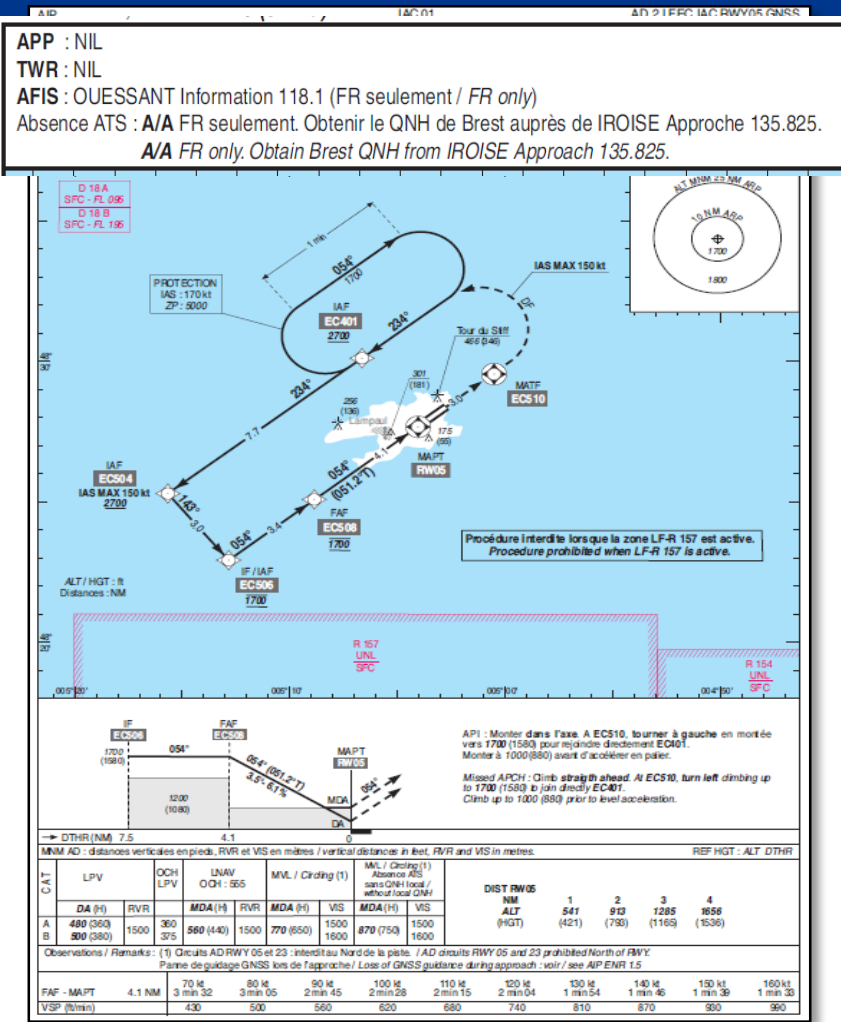
- Germany has accomplished changes on its airspace structures with the premise that an aircraft shall be within controlled airspace the most part of the time flight.
- The change consists of rounding uncontrolled AD, formerly VFR, with IFR operations with RMZ categorized as airspace Class G.
- Additionally the adjacent airspace (Class E) lower limit has been reduced to 1000 ft AGL.

This allows starting the approach procedure under ATC clearance, ending the approach with only flight information (if requested).

1	Designation and lateral limits	RMZ
2	Vertical limits	1000 ft AGL
3	Airspace classification	G

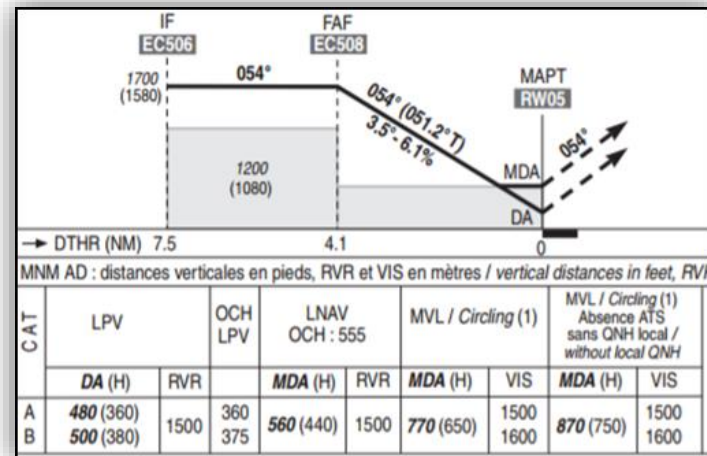


Case of Study- France, Ouessant AD



ENR 1.5.2.10 Utilization of IAP without ATS at the AD:

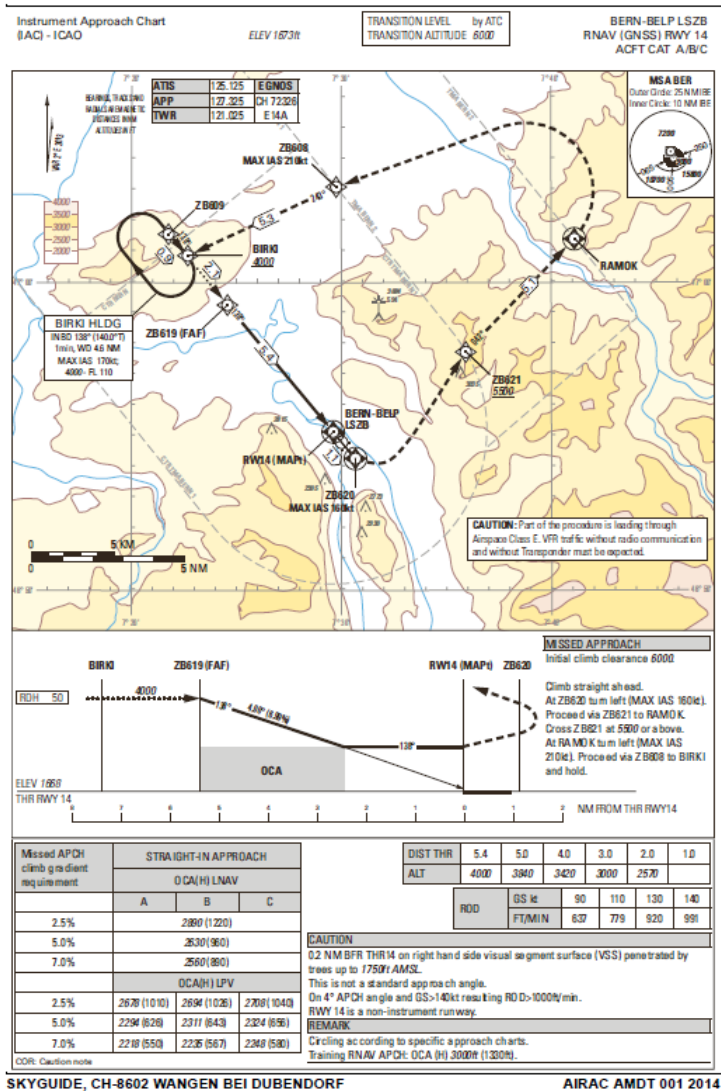
- the parameter "altimeter setting QNH" is transmitted by a STAP (Automatic transmission system of parameters) or by a designated station referred on the IAC.
- the IAP are compulsorily followed with a circling for which minima are possibly increased and published.





Case of Study- Switzerland, Bern AD

AIP SWITZERLAND LSZB AD 2.24.10 - 5 AIRAC 06 FEB 2014



ATS: ATC TWR+APP
MET: Own Office

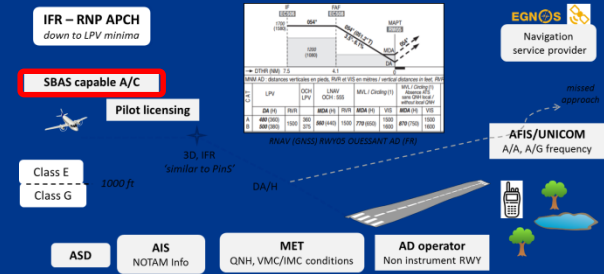
Designations RWY NR	SWY dimensions (m)	CWY dimensions (m)	Strip dimensions (m)	OFZ	Remarks REF: AD 1.1.6.2.4
1	8	9	10	11	12
14	NIL	60 x 150	1850 x 150	NIL	Non instrument RWY; (ESA: 90 m (both sides) FC1: 0.78/0.66 grooved 1730 m (full RWY length)
32		NIL			Non instrument RWY; (ESA: 90 m (both sides) FC1: 0.70/0.70 grooved 1730 m (full RWY length)

OCH minima: Over 500ft
(Directive SI/SB-001)

Missed APCH climb gradient requirement	STRAIGHT-IN APPROACH		
	OCA(H) LNAV		
	A	B	C
2.5%	2890 (1220)		
5.0%	2630 (960)		
7.0%	2560 (890)		
	OCA(H) LPV		
2.5%	2678 (1010)	2694 (1026)	2708 (1040)
5.0%	2294 (626)	2311 (643)	2324 (656)
7.0%	2218 (550)	2235 (567)	2248 (580)



Aircraft SBAS-capable



Cessna



Citation, Caravan and
Single Engine

PILATUS



Pilatus PC6, PC24
and PC12/47E (SB)

Diamond
AIRCRAFT



DA20, 40XLT, 40CS,
D-Jet, 42 and 50

Piper



Meridian, Seminole, Mirage, Matrix,
Archer, Seneca V and Arrow



SR20, SR22, SR22T
and Vision SF50