



EGNOS, it's there. Use it.

LPV implementation to non-instrument runways

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Combined GA TeB & GA Sectorial Committee
Cologne, June 1st 2017



European
Global Navigation
Satellite Systems
Agency



Precise navigation,
powered by Europe



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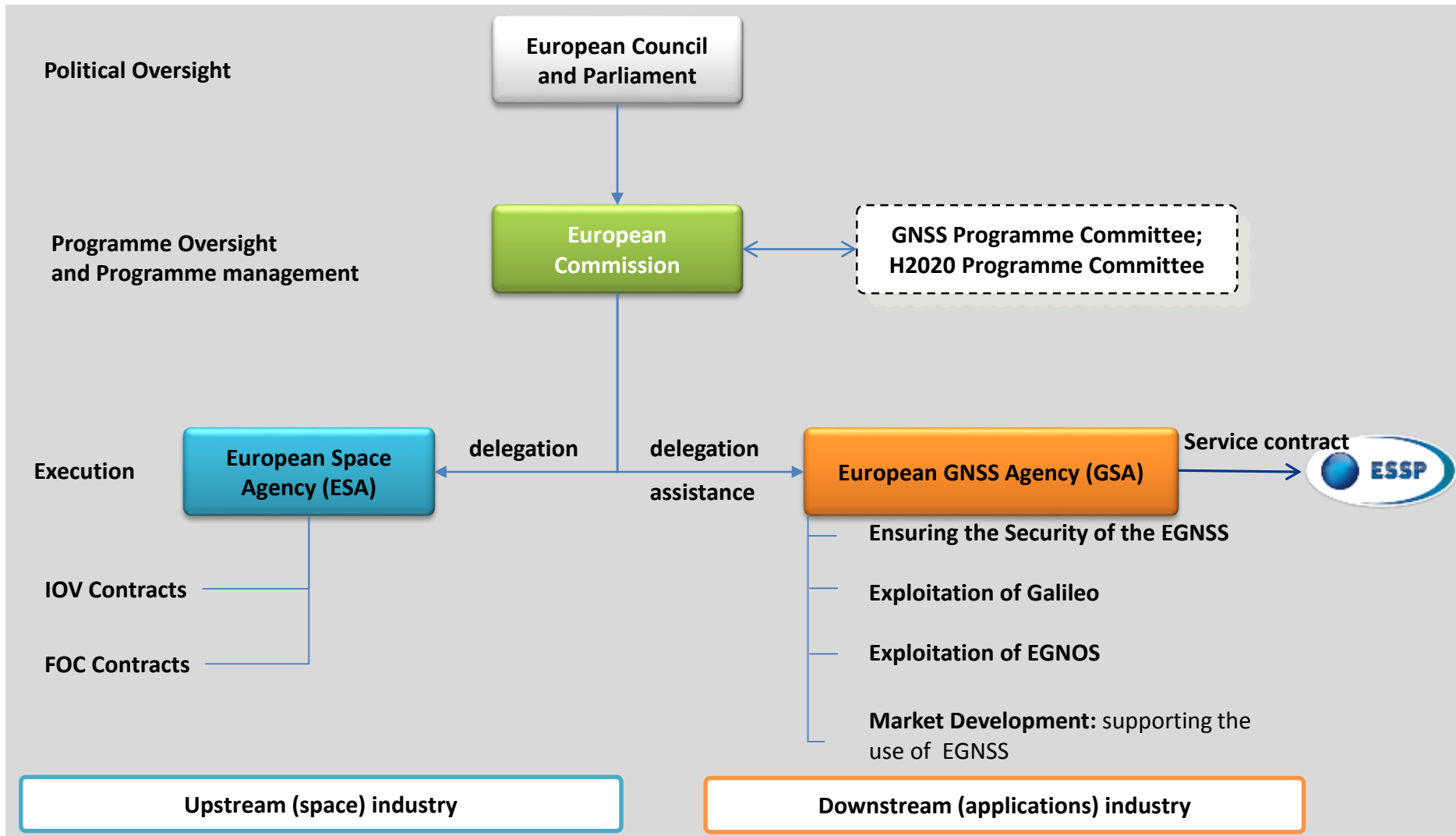
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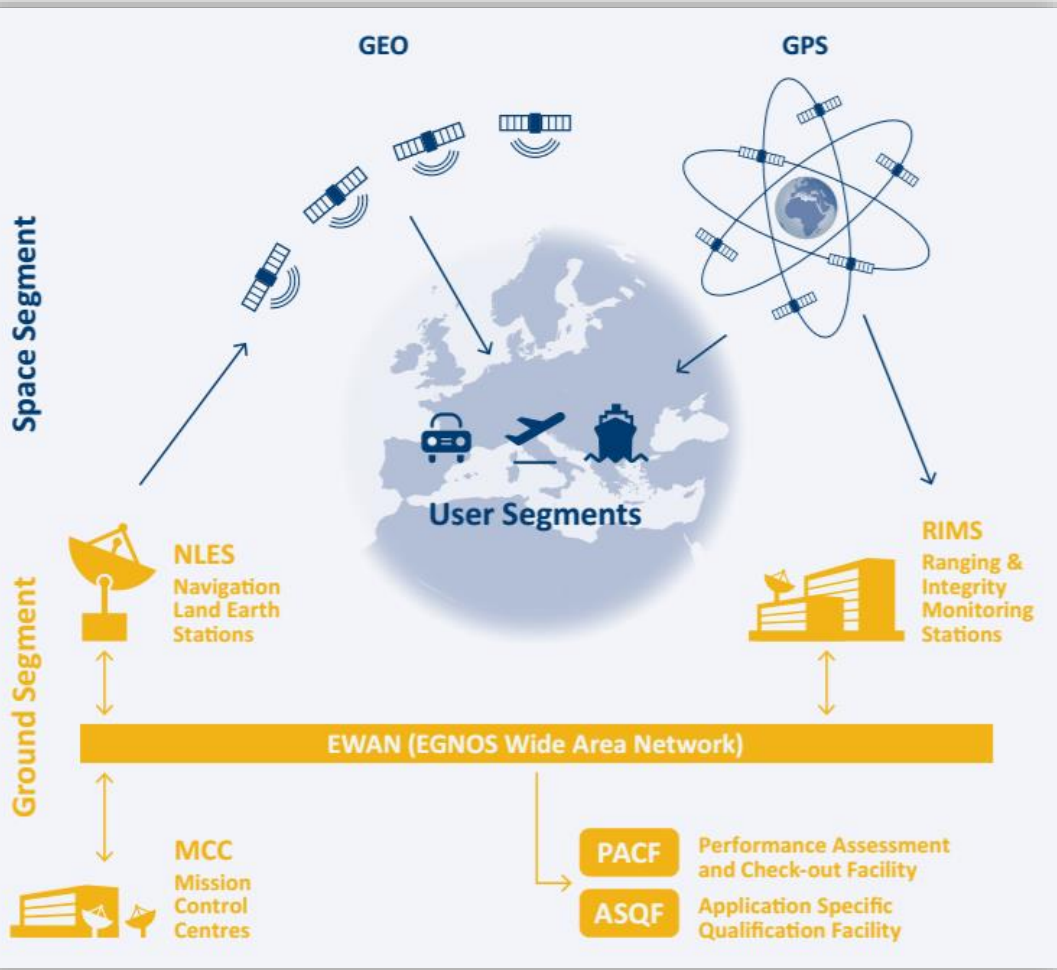
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EGNOS Programme Management and Service provision structure



The EGNOS System



EGNOS is the European SBAS augmenting GPS L1 signal over the ECAC area

- 2 GEO satellites
- 39x RIMS
- 2x MCC
- 4x NLES

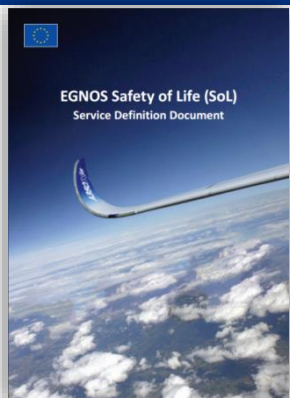


EGNOS Safety of Life

- Tailored to **safety-critical transport** applications in particular for aviation applications
- The **SoL service is based on integrity data** provided through the EGNOS satellite signals



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

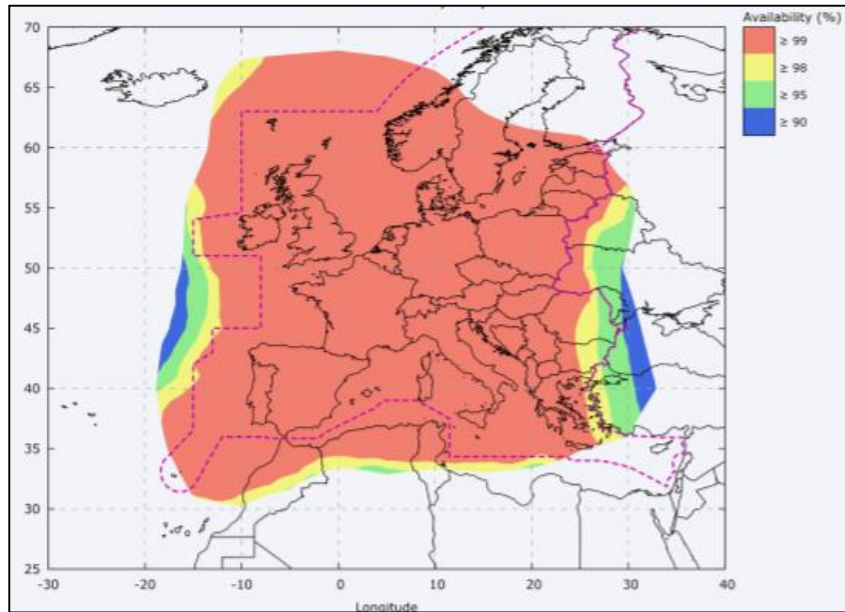
	Accuracy		Integrity				Continuity	Availability	EGNOS Service Level
	Horizontal Accuracy 95%	Vertical Accuracy 95%	Integrity	Time-To-Alert	Horizontal Alert Limit	Vertical Alert Limit			
<i>Typical operation</i>									
Initial/Intermediate approach, Non-precision approach (NPA)	220 m (720 ft)	N/A	$1-1 \times 10^{-7}/h$	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

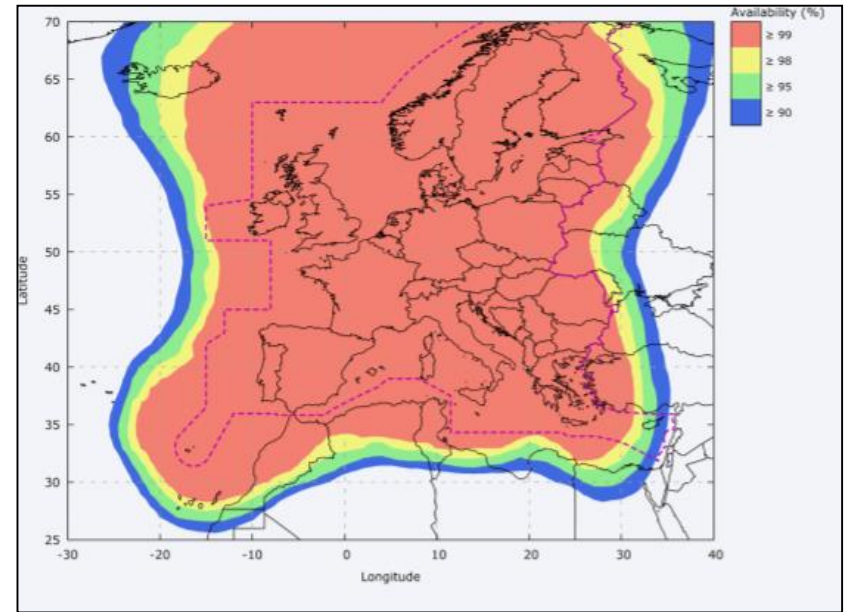
EGNOS APV-I commitment maps

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 27th of April 2017: 358 LPVs (316 APV-I and 42 LPV-200) serving 205 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

IFR Flying

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

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

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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 DA/H $\geq 200'$	Non Precision Approach RWY			
System Performance Procedures	Annex 10 PANS-OPS Vol. II	APV	Azimuth, GNSS			
		PA	GNSS/Baro/SBAS		ILS, MLS, SBAS, GBAS	

	777		420	EU28 – 2673 airports with non-instrument RWYs
	475		366	

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**

IFR/SBAS benefits

IFR

- **Enhance Safety**
CFIT **reduction** due to instrumental aids and space based vertical guidance for the approach procedure
- **Increases airport accessibility**
Reduction of disruptions (cancellations, diversions and delays)
- **Reduced environmental impact**
More direct routes, fuel consumption and noise footprints reduction

SBAS

- LPV approach procedure is **ILS look a-like**
- **No need of investments on ground infrastructure at the airport**
- **Higher performances** in accuracy and integrity leads to lower minima
- No operational limitation due to **cold temperature**
- **No RAIM check**
- **EGNOS navigation service is provided to aviation users for FREE**

RNP APCH based on GNSS

RNP APCH chart

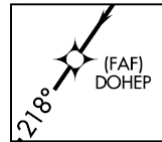
RNAV (GPS) RWY 22
TOMPKINSVILLE-MONROE COUNTY (TZV)

*RNP APCH at
Monroe County AD
(UNICOM, USA)*

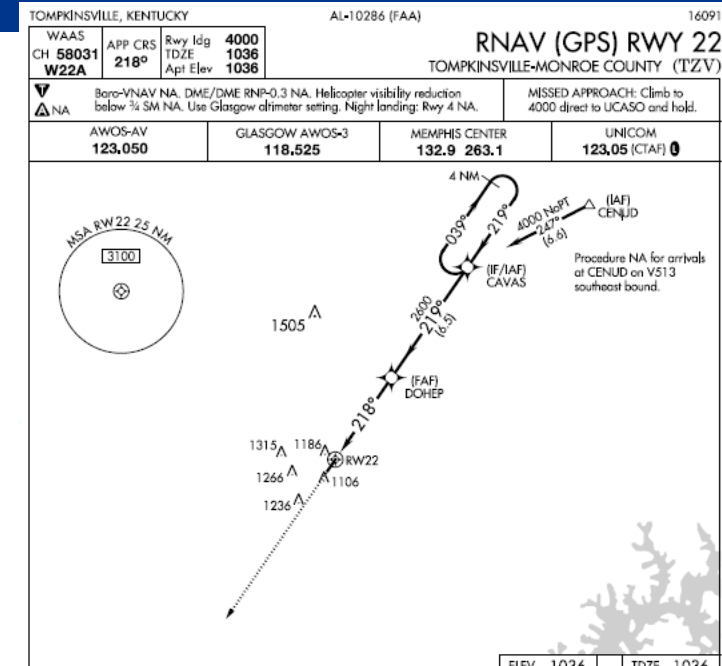
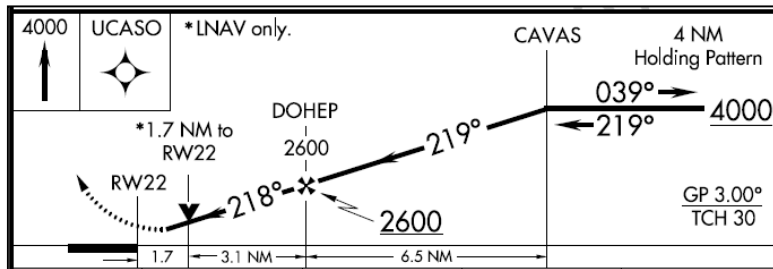
✓ 3 line minima

CATEGORY	A	B	C	D
LPV DA	1385-1¼	349 (400-1¼)		NA
LNAV/VNAV DA	1593-2	557 (600-2)		NA
LNAV MDA	1620-1	584 (600-1)	1620-1¾ 584 (600-1¾)	NA
CIRCLING	1640-1 604 (700-1)	1800-1 764 (800-1)	1840-2¼ 804 (900-2¼)	NA

✓ Way-points, fixed by coordinates allows a flexible IFP design



✓ RNP APCH down to LPV minima is considered a 3D approach similar to ILS




RNP APCH operation at non-towered AD (USA)

...the RNP APCH start within controlled airspace (Class E until 700ft AGL) with an ATC clearance from Memphis APP

 **CAP4294 entering in Monroe County AD vicinity at 4000ft and 7 NM from FAF asking for ATC clearance to perform RNAV (GNSS) RWY 22**

...only one A/C is cleared to enter in the vicinity of the AD at the same time

 **OK CAP4294, Memphis APP clear to approach at Monroe County AD, remember to contact other airspace users in UNICOM freq. 123,05Mhz. Please notify when you have already landed**

GLASGOW AWOS-3 118.525	MEMPHIS CENTER 132.9 263.1	UNICOM 123.05 (CTAF) 
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...then the A/C enters at uncontrolled airspace (Class G), with no separation from IFR/VFR aircraft, using see and avoid and contacting other airspace users by UNICOM frequency and performs the IAP with SBAS-based vertical guidance (RNP APCH down to LPV minima). MET info is provided by automated systems (AWOS/ASOS)

 **Memphis APP, Malibu three two charlie safely on the ground, please close the IFR flight plan**

...airspace free for another clearance to conduct a new IFR approach

 **CAP4294, have a nice day**

RNP APCH - Non instrument RWY – non towered AD Current VFR scenario

VFR Visual approach Chart



VFR-No instrumental guidance

Class G

AD Traffic
circuit

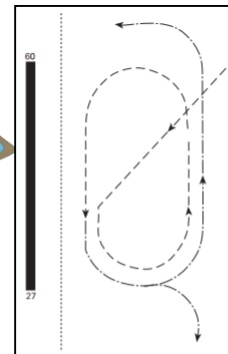
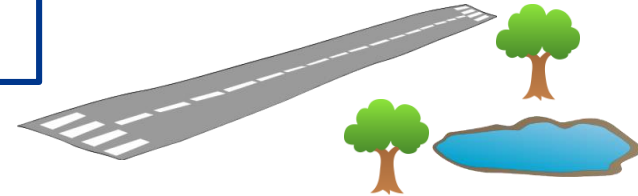
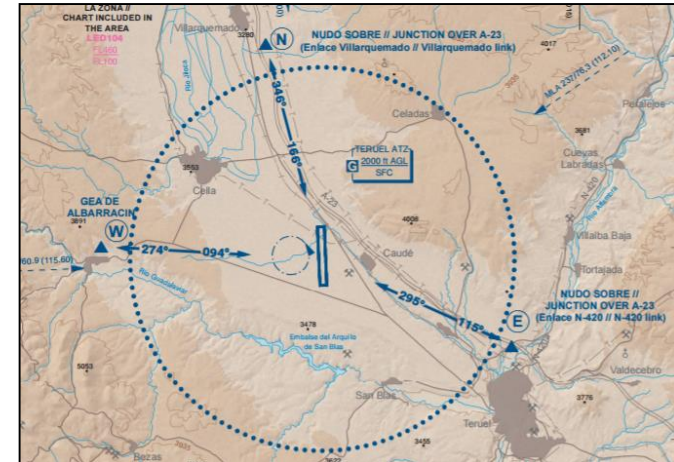
AERODROME WITHOUT CONTROL SERVICE
The frequency is only available for AIR/AIR communications.

AD SIN // WITHOUT ATS
FREQ A/A 122.675

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.



RNP APCH - Non instrument RWY – non towered AD

New scenario – Actors involved

IFR – RNP APCH
down to LPV minima

SBAS capable A/C



3D, IFR
'similar to PinS'

1000 ft

Class E
Class G

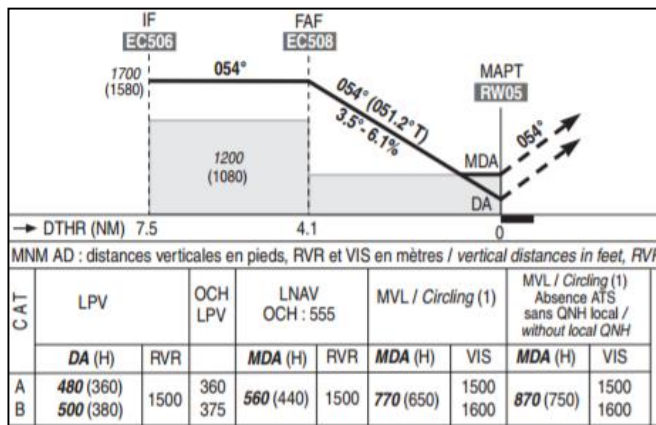
DA/H

CAA

AIS
NOTAM Info

MET
QNH, VMC/IMC conditions

AD operator
Non instrument RWY



RNAV (GNSS) RWY05 OUESSANT AD (FR)



Navigation service provider

missed approach

UNICOM
A/A, A/G frequency

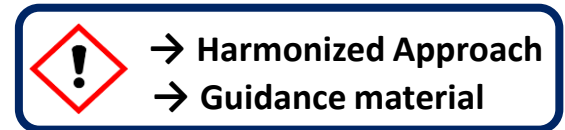


UNICOM

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. (NPA 2016-09)

16035			
RNAV (GPS) Z RWY 23			
FREDERICK MUNI (FDK)			
APALS	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	POTOMAC CLNC DEL	UNICOM
5	121.975	126.9 (when tower closed)	122.95

- **UNICOM is the most feasible solution for non-towered aerodromes, designed to fill the gap between AFIS and no aerodrome service at all.**
- Each Member State shall determine, considering the conditions of each scenario the level of ATS ATC/AFIS/None (UNICOM) required in a case by case analysis.
- Airspace Class G:
 - NO ATC clearance or IFR separation is provided.
 - SERA.6001 requires flight information shall be available if requested and IFR flights equipped with air-ground communications



To keep the IFR as much as possible in controlled airspace, airspace Class E lower limit could be reduced down to a determined altitude (i.e 1000 ft) in the surroundings of the uncontrolled AD to provide ATC clearance for the approach before entering within airspace Class G

GNSS Navigation Receivers

→ GNSS receivers

ETSO-C129 / TSO-C129

Airborne supplemental navigation sensors using **GPS+RAIM**

- 1st MMR generation
- Selective availability “ON” – accuracy 100m
- 6 satellites needed (or 5+baro aid).
- RNP APCH 2D
- Vertical guidance with Baro aid (LNAV/VNAV)
- ADS-B Out compliant, pre flight check needed

ETSO-C129 / TSO-C129

Airborne supplemental navigation sensors for **GPS+ABAS**

- 2nd MMR generation
- Selective availability “OFF” – accuracy 15m
- 6 satellites needed (or 5+baro aid).
- RNP APCH 2D
- Vertical guidance with Baro aid (LNAV/VNAV)
- ADS-B Out compliant, pre flight check needed

ETSO-C145/146 / TSO-C129

Airborne supplemental navigation sensors using **GPS+SBAS**

- 3rd MMR generation
- **SBAS augmentation – accuracy 3m+integrity**
- 4 satellites needed (availability increased).
- RNP APCH down to LPV minima (and LNAV/VNAV)
- ADS-B Out compliant, with maximum availability
- AMC 20-24 explains SBAS provides additional capabilities

SBAS receivers are the only guaranteeing LPV capacity and maximizes ADS-B availability without any other equipage/checks.

GPS+RAIM receivers need pre flight checks to ensure the availability of the IFP and Baro-aid (from an independent equipment) to perform 3D approaches

Training/AIR-OPS

EASA has launched a set of RMT to enable the use of IFR based on PBN for GA:

- EASA Easier access for general aviation pilots to instrument flight rules flying (NPA 2016-14) introduces the **Basic Instrument Rating (BIR)**, which is a qualification to fly in Instrument Flight Rules (IFR) based on proportionate requirements tailored GA pilots
- BIR holders will be restricted on an approach procedure, down to a **maximum of 500 ft** above ground level (AGL) for a 3D approach, or 600 ft AGL for a 2D approach
- **Declared Training Organisation** – EASA proposes simplified pilot training standards for leisure flying, an option to provide training for GA-related non-commercial licences outside an Approved Training Organisation (ATO)
- The most used PBN operations, and in particular **RNP APCH does not longer need to hold a specific approval.**

AIS – NOTAM

According AIR OPS PBN provisions, the pilot in command is required, **before commencing a flight to ascertain that the space based facilities needed for the flight are available**, specially the navigation aids critical for the intended PBN procedure, remarking that this information shall be obtained *“by a reasonable mean”*.

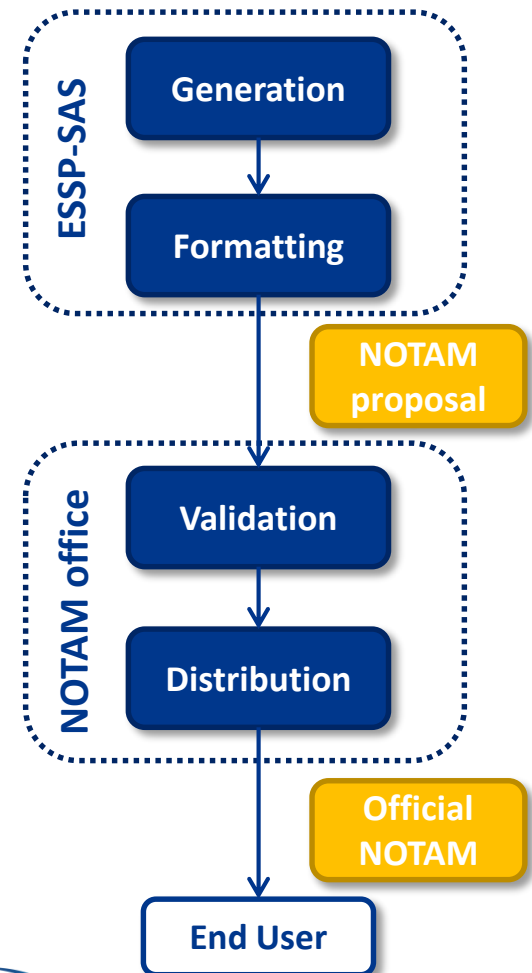


EGNOS NOTAM proposal service



EU/ICAO provisions do not require publishing IAP Charts within national AIP when there is no international traffic operating at the AD

→ EASA shall provide guidance to harmonize IAP publication



Airspace design

Flight Validation – Safety Assessment

IFP Design process:

Implementation is intended for small ADs. Some steps on the design process could drive to a non-effective cost implementation:

- Safety Case:

A risk assessment involving a complete safety case within an acceptance process by the NSA (as it can be considered a *new aviation standard* according to Reg 1034/2011 *Safety Oversight*)

- Flight validation:

Although it is not *always* required by ICAO 9906 (only ground validation is mandatory), it is commonly conducted for new IFP.



→ Proportional reqs.

→ Guidance material



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powered by Europe

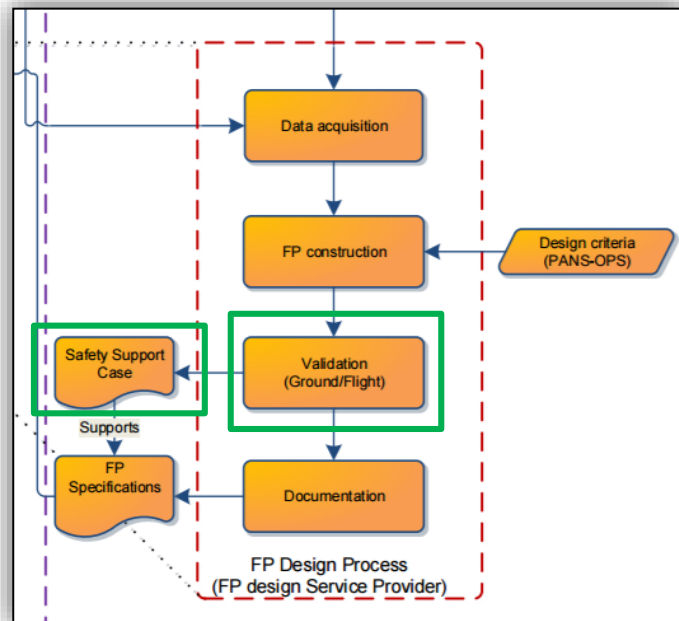


Figure extracted from NPA 2016-13, Figure 1 — Interactions between airspace change process and flight procedure design process

MET/COM

*“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

- The approach is completed in VMC. A MET observer (certified?) is required to determine :
 - IMC/VMC conditions,
 - other meteorological data relevant for the operation (QNH, RVR/visibility, cloud ceiling, etc.)
- ...can a remote or an automated MET provider be used?*
- Remote Altimeter settings are described within PANS OPS, increasing the OCA/H when the altimeter setting is derived from a source is farther than 5 NM from the RWY threshold.

→ Strong requirements on a MET/COM provider could difficult the results of the business case

COM

- UNICOM is based on communications between airspace users.
- A COM provider (certified?) to guarantee the service may be defined.



→ **Guidance material**
→ **Proportional reqs for GA**

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Non-instrument RWYs Conclusions

- **EASA strategic objective is focused on enabling IFR operations for GA** to increase the safety of the procedure
- **New ICAO approach RWY** classification permits the implementation of IFR approach procedures without the need of infrastructure investments.
- GNSS based operations are the most cost-effective solution to introduce IFR for GA.
- **Harmonized approach with proportional requirements is required** with GA stakeholders should be actively involved in EASA RMTs
- With the absence of a certified ANSP, **guidance material** to support the implementation of IAP at non-inst. RWY is needed:
 - To clarify all the aspects related to UNICOM operation (no ATS considered and out of the scope of SES regulation).
 - To set the agreements needed between the actors involved on the implementation.

Proposed Way-forward

Develop a **Draft on Concept of Operations of EGNOS based operations at non-instrument RWYs:**

- ✓ Identify the main **EASA RMT** involved on the implementation process
- ✓ Compile **best practices in EU/USA/Australia**
- ✓ Identify **open issues** and **implementation risks/barriers**
- ✓ Propose **operational solutions** for different scenarios
- ✓ **Develop a roadmap of activities**
- ✓ **Share results in relevant user fora**

GA community should lead the process

Contributions are welcomed



THANK YOU FOR YOUR ATTENTION



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QUESTIONS?