

Evolving and improving landing networks with EGNOS

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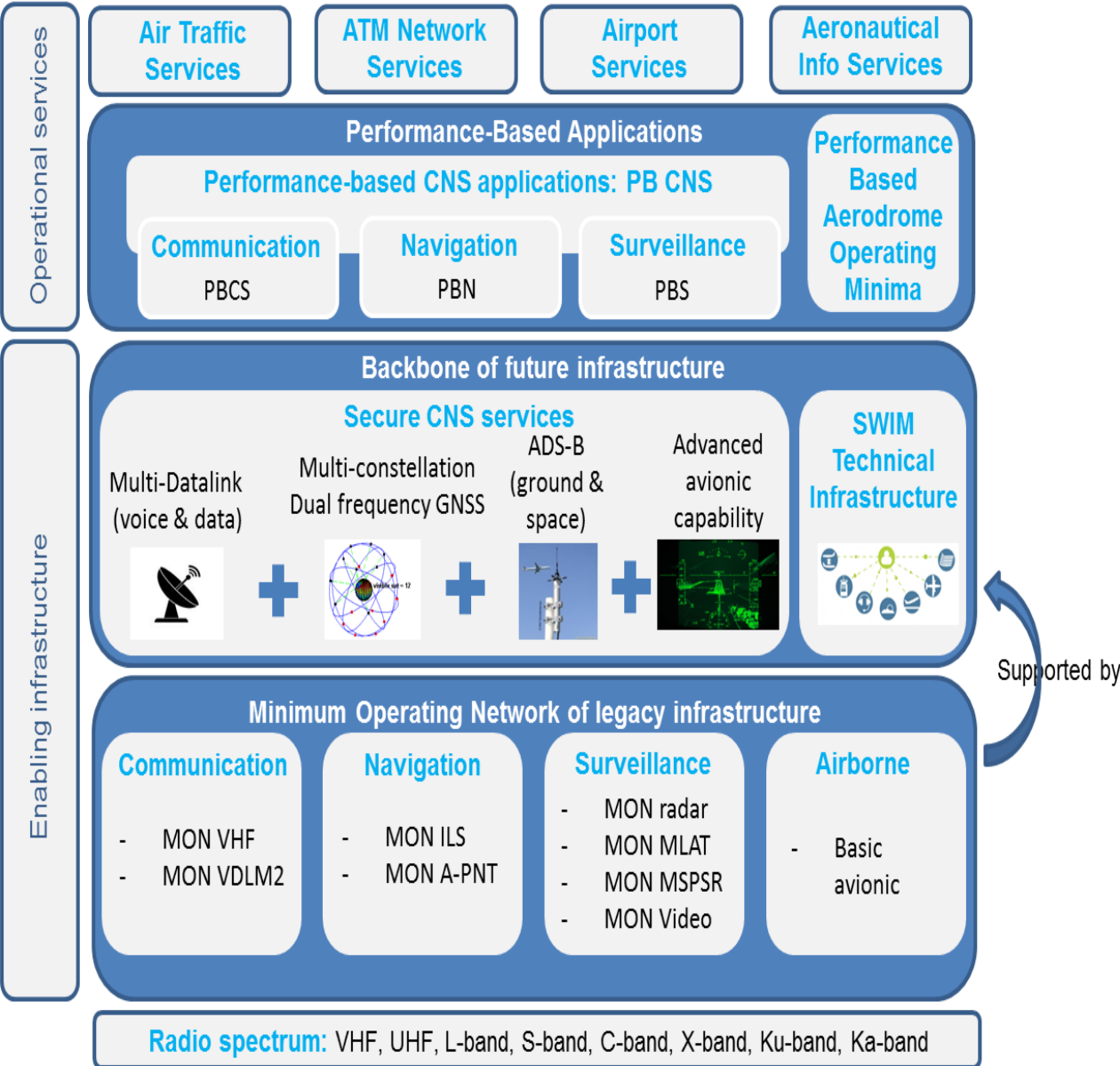
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INTRODUCTION

- **Satellite technology opportunities allow now ANSP and airports to complete/redesign approach and landing networks**
 - System layer: GNSS
 - Application layer: PBN (Performance Based Navigation)
- **Opportunities include reducing infrastructure costs, while maintaining and even improving airport accessibility and safety**
- **Consultation of airports and airspace users is required**
 - Building a common understanding
- **Assessing pro & con's of the different GNSS technologies is a key factor to implement the changes**
 - ABAS
 - GBAS
 - SBAS (EGNOS in Europe)

INTRODUCTION



- This landing networks evolution is in line with SESAR recommendations to start building Minimal Operating Networks (MON)

CONVENTIONAL NAVIGATION APPROACH AND LANDING SYSTEMS LESSONS LEARNED



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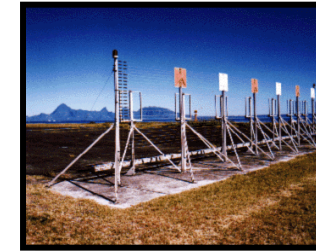
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Conventional Navigation networks

France

- **Instrument Landing System (ILS)**

- 23 owned ILS Cat III no change
- 98 DSNA owned ILS Cat I, now down to a **Minimal Operating Network (MON) of 49 DSNA owned ILS**



- **VHF Omni Range (VOR)**

- 96 DSNA owned VOR
- **Minimal Operating Network studies launched**



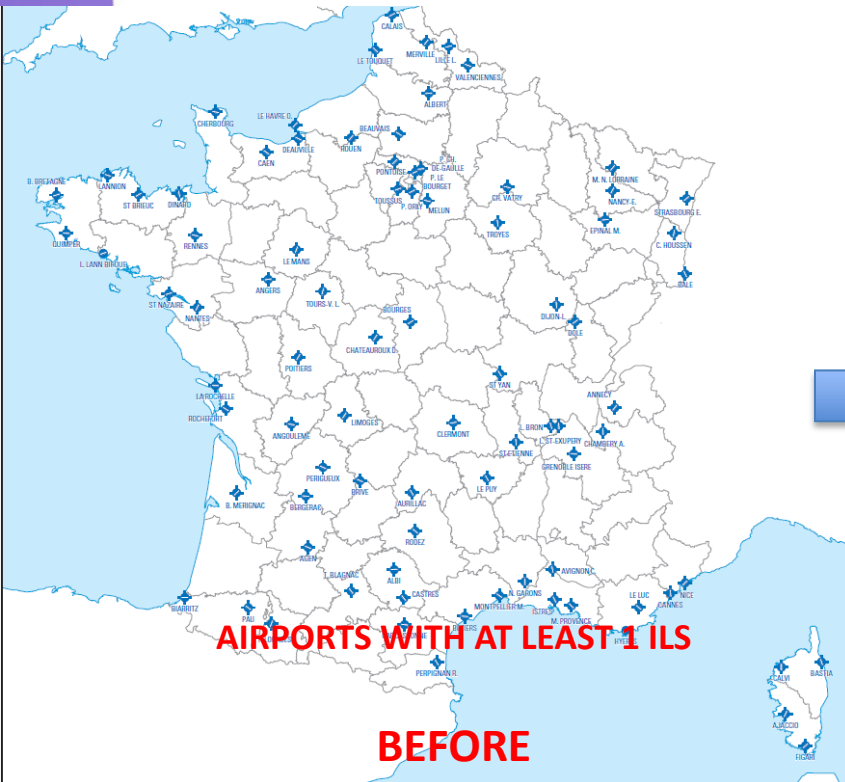
- **Non Directional Beacon (NDB)**

- 104 DSNA owned NDB

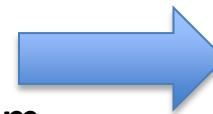
Minimal Operating Network studies launched



ILS CAT I MON actual implementation



**About 5 M€ yearly savings
Contributes to the French
Landing Tax reduction program**



- 2018 : 225,50 €
- 2017 : 224,45 €
- 2016 : 227,1 €
- 2015 : 228,62 €
- 2014 : 233,23 €



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Conventional approaches lessons learned

- **Cat I level of performance is ideal for most airports**
 - Supports accessibility **95% or more of the time** for French airports
 - **Vertical guidance** supports improving safety
 - **Ideal target for PBN procedures and avionics** in the future
 - NB: Near Cat I (i.e. SBAS APV I) is also meeting such objectives
- **Rationalizing ILS « quite easy »**
 - Depends on the density of the initial network
 - **Availability of SBAS signal is a key asset** to maintain equivalent accessibility
 - **In this context, GBAS Cat I unfortunately not helpful** due to ground stations cost and lack of user avionics for the smaller airports
 - **European (GSA) avionics subvention plan** was an important tool

OTHER ENABLERS TO ACHIEVE THE TRANSITION TO AN ILS MON



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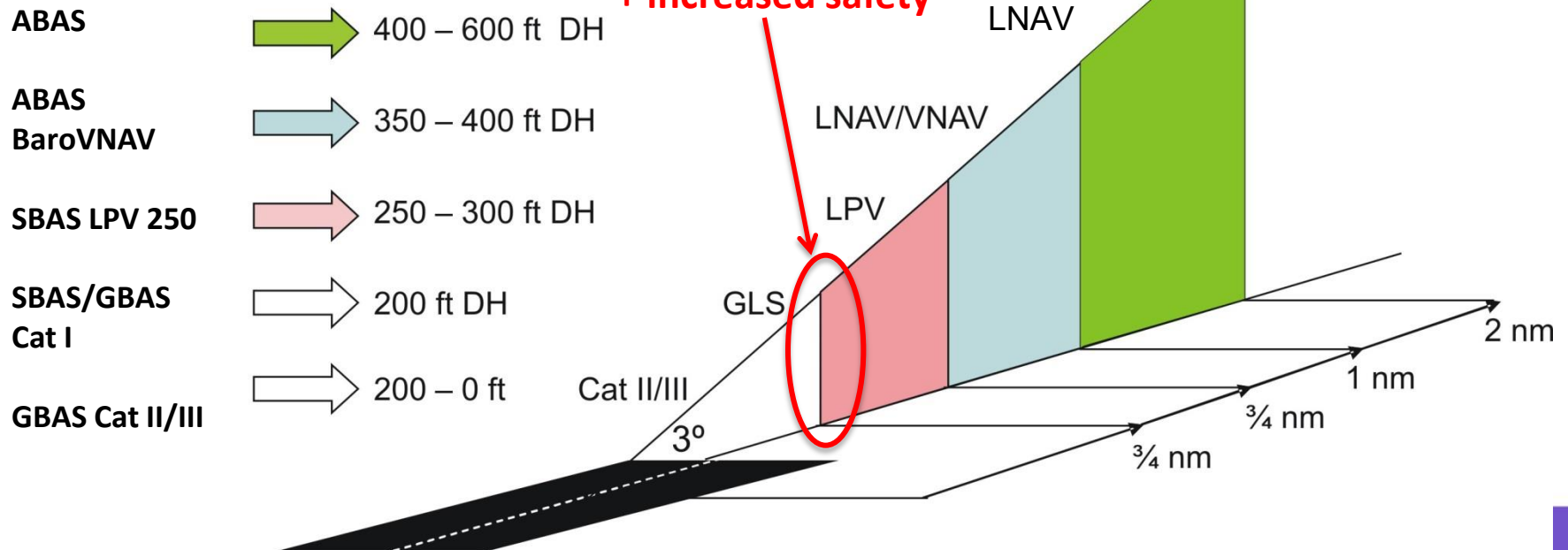
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PERFORMANCE BASED NAVIGATION (PBN) APPROACH MINIMA

- Typical performance of 2D/3D GNSS guided approaches

France PBN target:

**LPV 250/Cat I means
airports accessibility
95% of the time
+ increased safety**



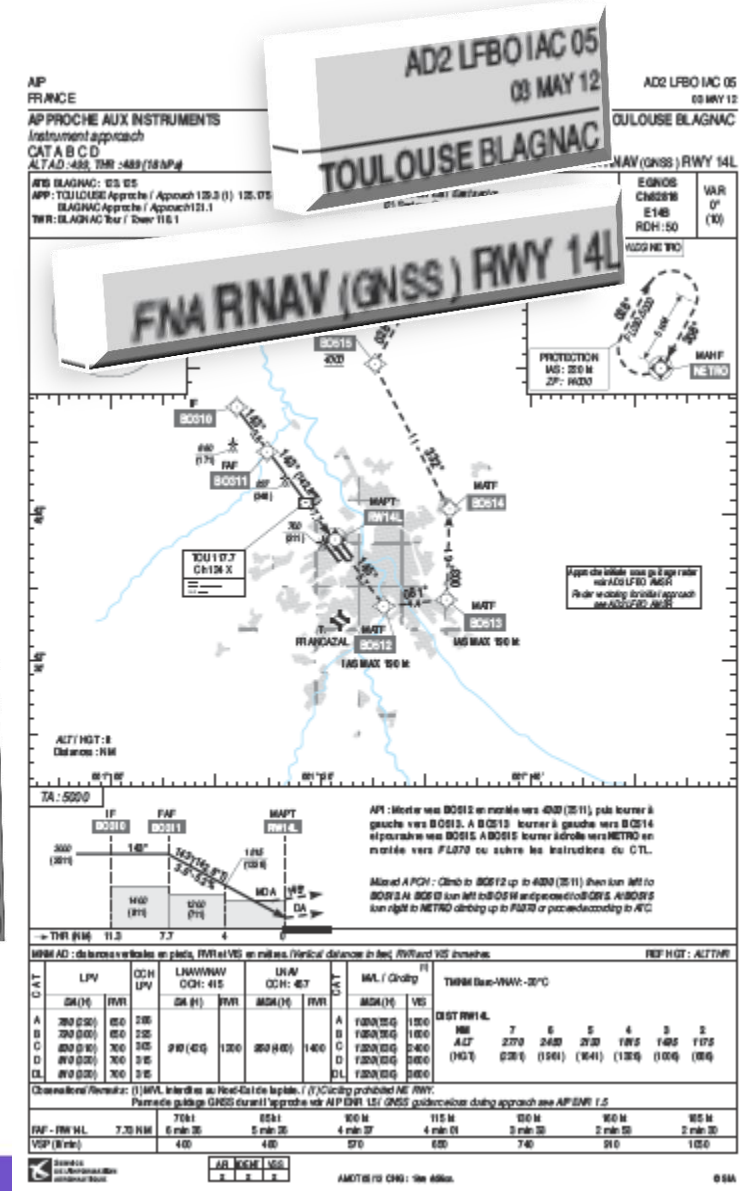
PBN LANDING CHART

- France implements ICAO charting concept for PBN, down to LPV 250 ft or Cat I

- Supports an easy introduction over airports
- Manages smoothly different generation of avionics
- Avionics equipment transparent to ATC

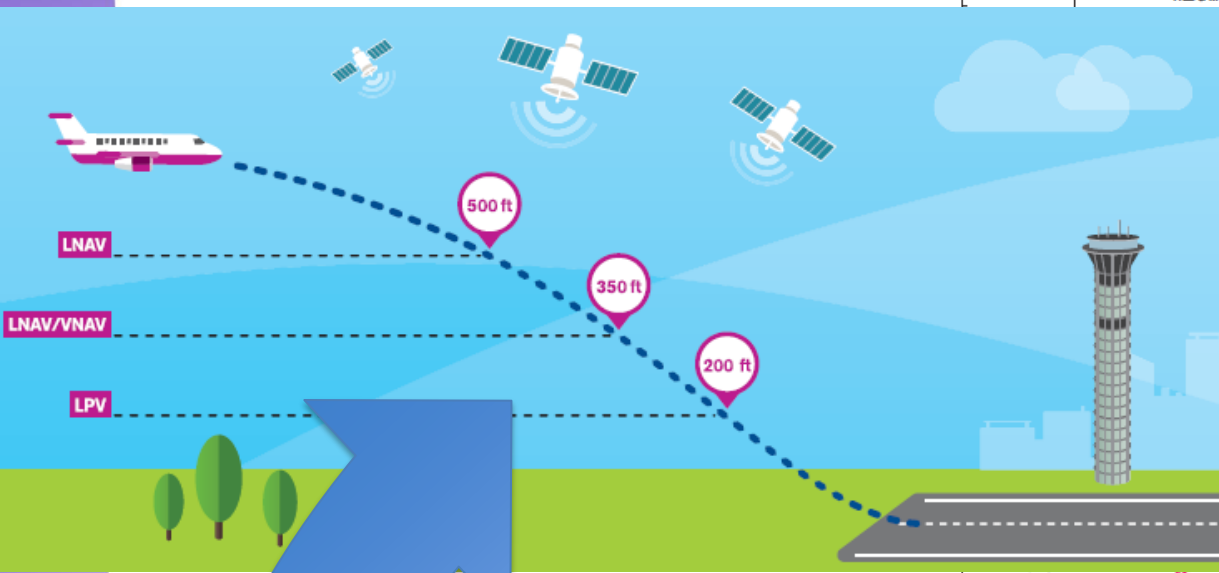
EGNOS minima GPS ABAS+BaroVNAV minima GPS ABAS minima

CAT	LPV		OCH LPV	LNAV/VNAV OCH: 415		LNAV OCH: 457		CAT	MNL / Circling	
	DA (ft)	RVR		DA (ft)	RVR	MDA (ft)	RVR		A	B
A	780 (290)	680	286	910 (420)	1200	950 (460)	1400	A	1030 (580)	1600
B	790 (300)	680	296					B	1090 (580)	1600
C	800 (310)	700	306					C	1320 (830)	2400
D	810 (320)	700	316					D	1320 (830)	3000
DL	810 (320)	700	316					DL	1320 (830)	3000



EGNOS CAT I SERVICE

PARIS CDG CHART



AIP FRANCE
 APPROCHE AUX INSTRUMENTS
 Instrument approach
 CAT A B C D
 ALT AD : 392, THR : 316 (12 hPa)
 FREQ : Voir / See AD 2 LFPG IAC COM 01

PARIS CHARLES DE GAULLE
 RWY 26L
 EGNOS CH 61919 E 26 A RDH : 57 VAR 1°W (10)

EN L'ABSENCE D'INSTRUCTION DU CONTRÔLE EN ROUTE
 WITHOUT ATC INSTRUCTION
 LPC En route convergente sous un angle inférieur à 070°, intercepter l'axe FNA (sauf instruction préalable de traverser l'axe)
 On a course converging at an angle of less than 070°, intercept FNA axis (unless previously instructed to cross the axis)

Approches simultanées avec RWY 27L ou 27R PARIS CDG et RWY 27 PARIS LE BOURGET (1)
 Simultaneous APCH with RWY 27L or 27R PARIS CDG and RWY 27 PARIS LE BOURGET (1)
 Prévenir l'ATC si seulement capacité LNAV. Advise ATC if only LNAV capable.

Prévoyez un guidage radar pour rejoindre l'axe de piste
 Expect radar vectoring to runway extended centerline
 Voir / See AD 2 LFPG AMSR

Distances : NM
 TA : 5000
 API : Monter dans l'axe vers 4000 (3684) puis prévoir guidage radar. En cas de panne radio, monter dans l'axe vers 4000 (3684).
 A PG442, tourner à droite vers PG443. A PG443 monter au FL 070 et suivre PON. A PON procéder MOPAR.
 Monter à 1200 (884) avant d'accélérer en palier.
 Missed APCH: Climb straight ahead up to 4000 (3684) then plan radar guidance. In case of radio failure, climb straight ahead up to 4000 (3684).
 AIPG442 turn right towards PG443. At PG443 climb up to FL 070 and follow PON.
 AIPON proceed MOPAR.
 Climb up to 1200 (884) prior to level acceleration.

THR ← (NM)
 MNM AD : distances verticales en pieds, RVR et VIS en mètres / vertical distances in feet, RVR and VIS in metres
 REF HGT : ALT THR

CAT	LPV		OCH LPV		LNAV-VNAV		OCH LNAV-VNAV		LNAV		OCH LNAV		MVL / Circling (2) 26L → 26R		DIST RWY 26L					
	DA (H)	RVR	DA (H)	RVR	DA (H)	RVR	DA (H)	RVR	MDA (H)	RVR	MDA (H)	RVR	MDA (H)	VIS	NM	11	10	9	8	7
C	520(200)	550	141	650 (330)	800	325	740 (420)	1200	418	920 (600)	3000	920 (600)	3000	3000	6	5	4	3	2	1
D			152	650 (340)	800	332	750 (440)	1300	432	920 (600)	3000	920 (600)	3000	3000	2284	1966	1647	1531	1213	894
L			178	660 (340)	800	339	770 (460)	1400	451	1020 (700)	3500	1020 (700)	3500	3500	1968	1650	1331	1194	876	557
D			188	670 (350)	900	346	790 (470)	1500	467	1070 (750)	4000	1070 (750)	4000							

Observations / Remarks: (1) Mouvements simultanés : voir consignes ADC 06 / Simultaneous movements : see instructions ADC 06.
 (2) MVL : voir consignes ADC 07 / Circling : see instructions ADC 07.
 Paire de guidage GNSS durant l'approche / Loss of GNSS guidance during approach : voir see ENR 1.5.

	FAF - THR	11.0 NM	70 kt 9 min 27	85 kt 7 min 47	100 kt 6 min 37	130 kt 5 min 45	160 kt 5 min 05	185 kt 4 min 08	185 kt 3 min 35
VSP (ft/min)			370	450	530	610	690	850	980



EGNOS IS

FREE

IN CONCLUSION, WHAT WE HAVE NOW IS:



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A COST EFFECTIVE BUT STILL PERFORMING NATIONAL APPROACH AND LANDING NETWORK:

- The network aims to:

“Cat I everywhere, everytime”

- This is achieved through a mixed infrastructure: **ILS and EGNOS**
 - When the ILS is out of service, or non existing over the runway in service, **equipped airlines benefit from an additional level of safety and airport accessibility thanks to EGNOS Cat I service**
- Thanks to the PBN approach chart concept, this network is also **accessible to airspace users not equipped with EGNOS**
 - In particular **GPS and BaroVNAV ABAS equipped users**
 - They use the same network, while ILS are maintained over the main airports
 - Acquisition of EGNOS avionics to access airports out of the ILS MON network is a case by case airspace user business case decision

Merci !



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