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# ICAO PBN WORKSHOP


## Beijing June 2017

Philippe NOTRY  
ENAC/ATC Training Manager

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## PERSONAL INFORMATIONS



- **ATC in Paris Area Control Center(TCL),**
- **ATC Trainer at ENAC: TWR/APP/ACC** (Toulouse/ France),
- **ATC Training Manager at ENAC:**
  - In charge of french/egyptian/georgian/MUAC...ATCos
  - Involved in PBN Training for ATCO (France,China, India, Egypt, Africa, Soudan,Mongolia, Indonesia...)
  - Participation to ICAO PBN EUR TF,
  - Member of French PBN Implementation group,


1993

2001

2004..






**ATC BACKGROUND**

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UND

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## PERSONAL INFORMATIONS

**Until 2009, Expertise area as ATC Trainer:**

- **Air Law rules for ATC/Pilots,**
  - Doc 4444: PANS ATM,
  - Annex II: Rules of the Air,
  - Annex XI: Air Traffic Services,
- **CNS Tools and Concepts for ATCos,**
  - A-CDM,
  - CPDLC,
  - TCAS,
  - FUA/ ATFCM
  - AMAN, DMAN, XMAN,
  - SCTA, MSAW,
  - ADS-C/B,
  - SCTA, MTCD,
  - ...

OPERATIONAL EXPERTISE





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« A boat doesn't go forward if each one is rowing their own way »



Swahili proverb

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ICAO PBN WORKSHOP

THANK YOU TO ICAO FOR INVITATION

TO SHARE EXPERIENCE...

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## AGENDA



- 1. PBN and ATC**
  1. The Challenge: Airspace Capacity
  2. Performance Based?
  3. ATC: The heart of the system
- 2. ENAC PBN TRAINING: FRANCE AND ABROAD**
  1. PBN implementation in France
  2. PBN Training as a necessity
- 3. FEEDBACK ABOUT TRAINING ISSUES**
  1. The Training: CHINESE AND INDONESIAN EXAMPLES
  2. Case study presentation: INDIA 2010 KOCHIN
  3. French examples: LFPO/ LFPG/ POINT MERGE SYSTEM

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## WHAT IS THE CHALLENGE TODAY?



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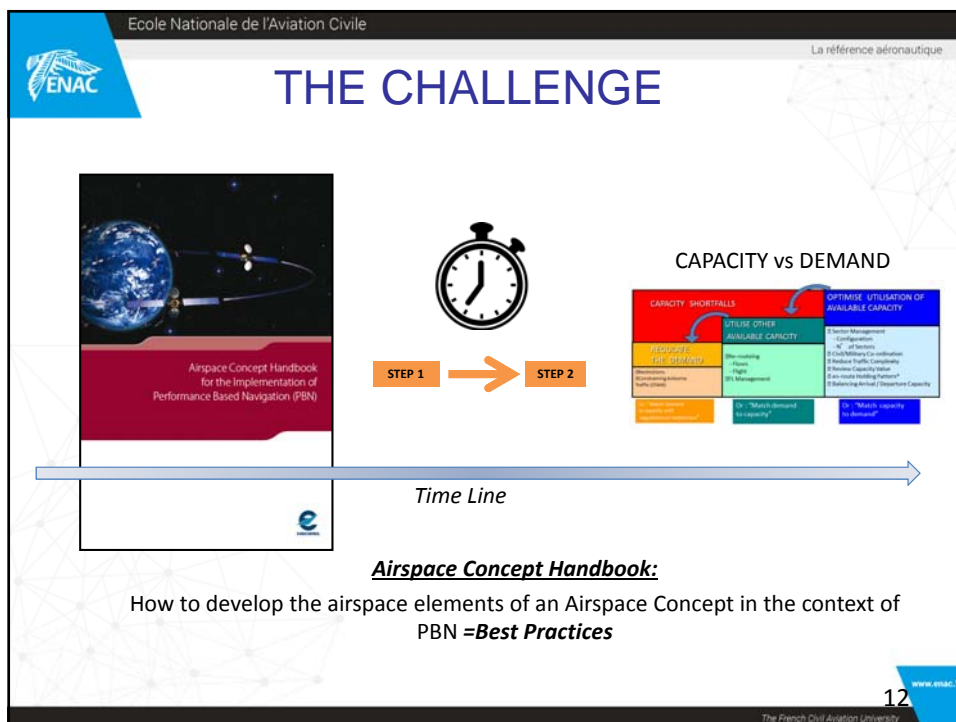
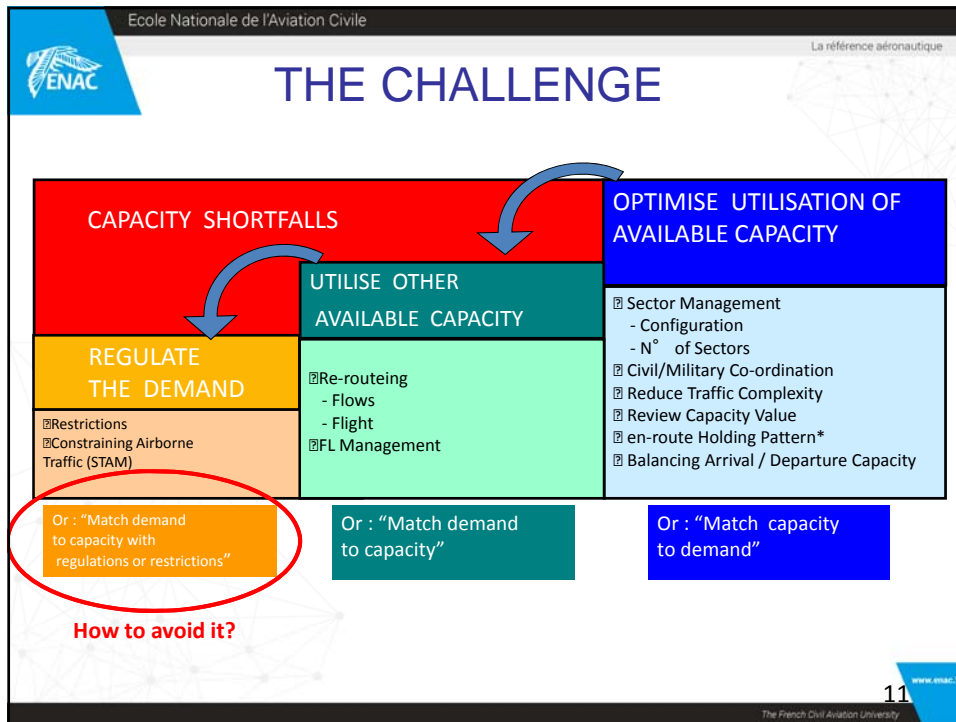
## THE CHALLENGE




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# PBN IN THE EQUATION


## ATM EQUATION?



$$\frac{\lim_{n \rightarrow \infty} \frac{2^{2n} (n!)^2}{(2n)!} \frac{1}{2^n}}{\int_0^{\infty} e^{-t^2} dt} = \frac{-e^{-\sum_{k=0}^{\infty} \frac{1}{(k+1)!(k+1)!}} \int_0^{\infty} \frac{2t}{t^2+1} dt}{\int_0^{\infty} \frac{2t}{t^2+1} \int_{-\infty}^{\infty} e^{-t^2} dt \int_0^{\infty} e^{-t^2} dt} = 50$$

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# PBN IN THE EQUATION

## ATM = ATS + ATFCM + ASM

Flight Information Service

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Air Traffic Control

Airspace Design

---

Flexible Use of Airspace

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ATM = ATS + ATFCM + ASM

Flight Information Service

Air Traffic Control

**Airspace Design**

Flexible Use of Airspace

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## PBN IN THE EQUATION

ATM = ATS + ATFCM + ASM

Flight Information Service

Air Traffic Control

**Airspace Design**

**CORE**

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## PBN IN THE EQUATION

« PBN is the cornerstone in the airspace optimization process »

« PBN is part of the solution to solve capacity issues »

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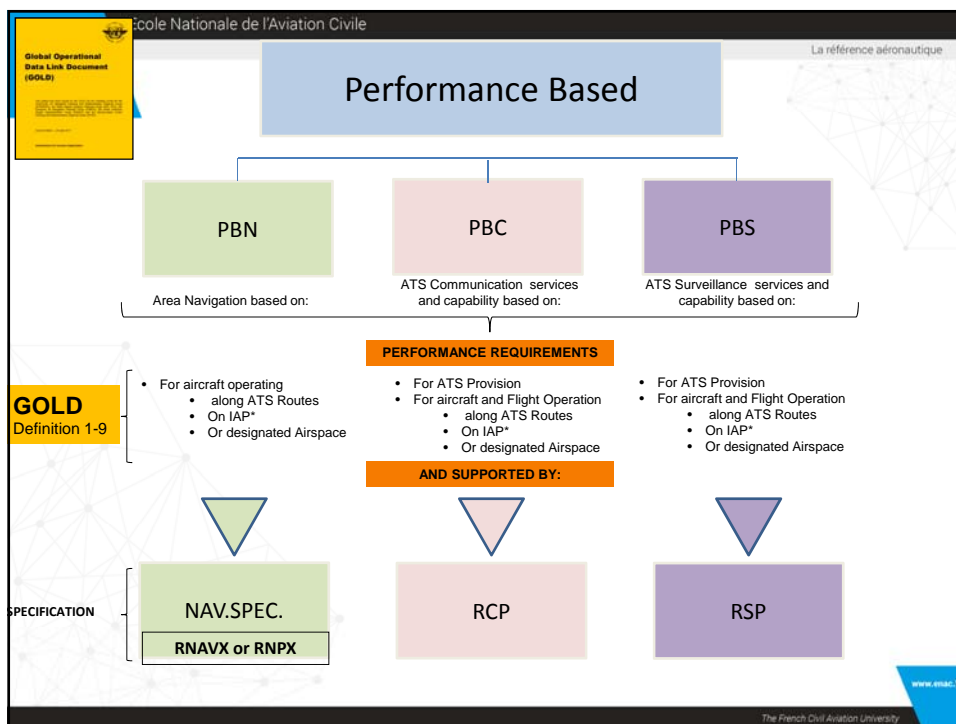


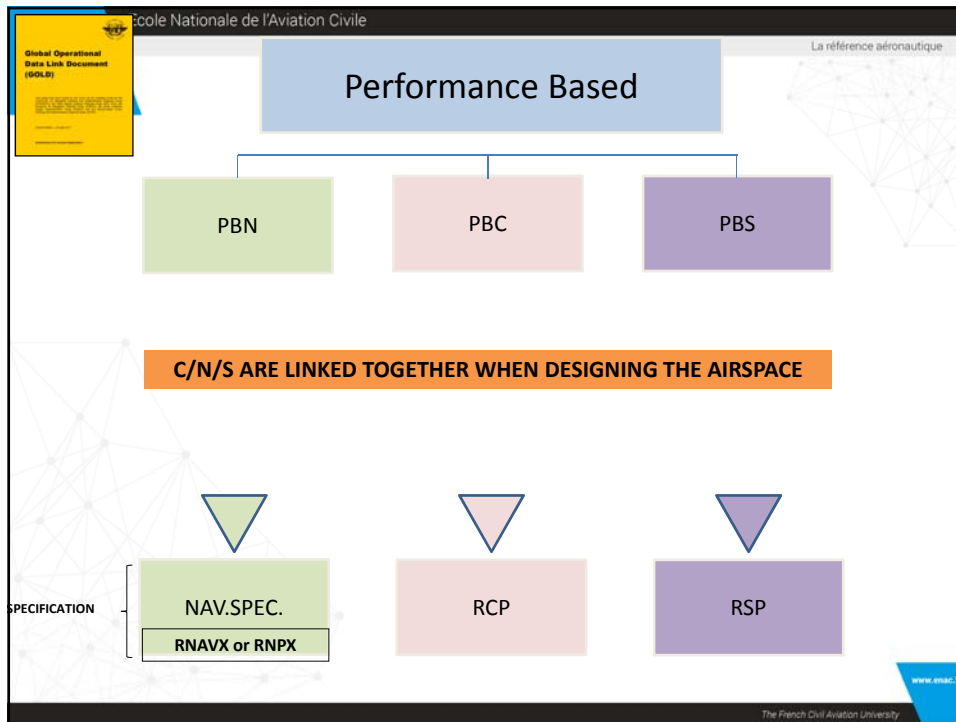
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## PBN AND ATC

- **PBN** a key enabler to airspace optimization
- **PBN** a key enabler to ATFM implementation as ATFM is the next challenge:

« *The best you design the airspace the best you use it* »

→Delays reductions:

- **India:** 6 ATFM Units in biggest airports linked to Central Unit in Delhi implementation phase
- **China:** ATFM centralised system on the way
- **Indonesia:** ATFM centralised system on the way. *City pairs regulations for the time*
- Asia/ Pacific has to cope with huge changes coming as written in the « **Asia/Pacific seamless ATM PLAN** »


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# PBN AND ATC



- Route optimization
- Airspace restructuration
- Sectors capacity increase
- Delays reduction



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**ASIA/PACIFIC**

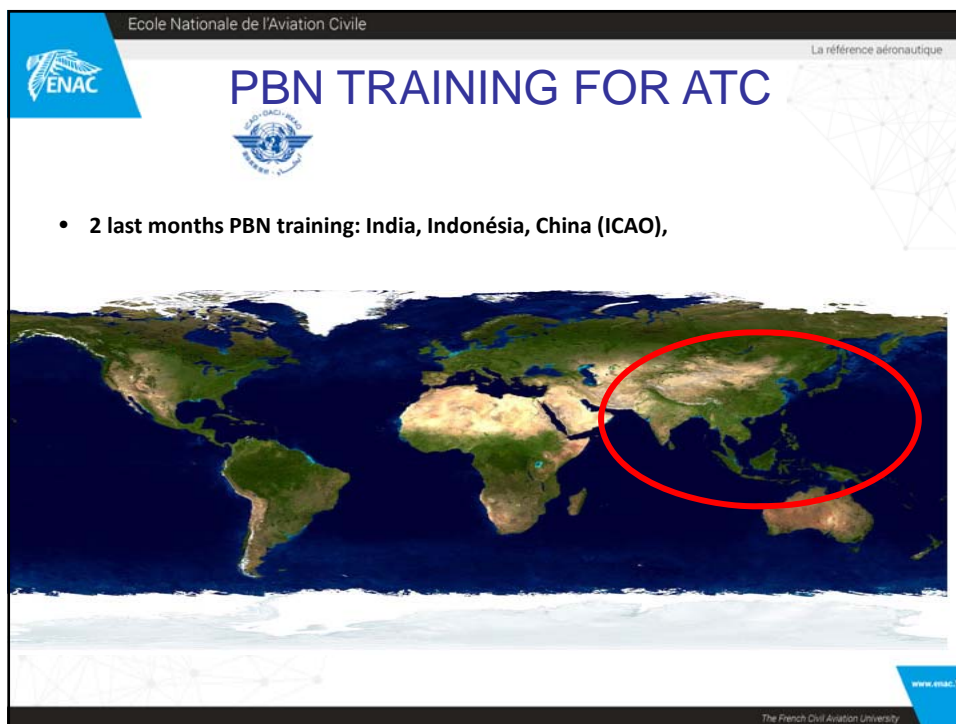
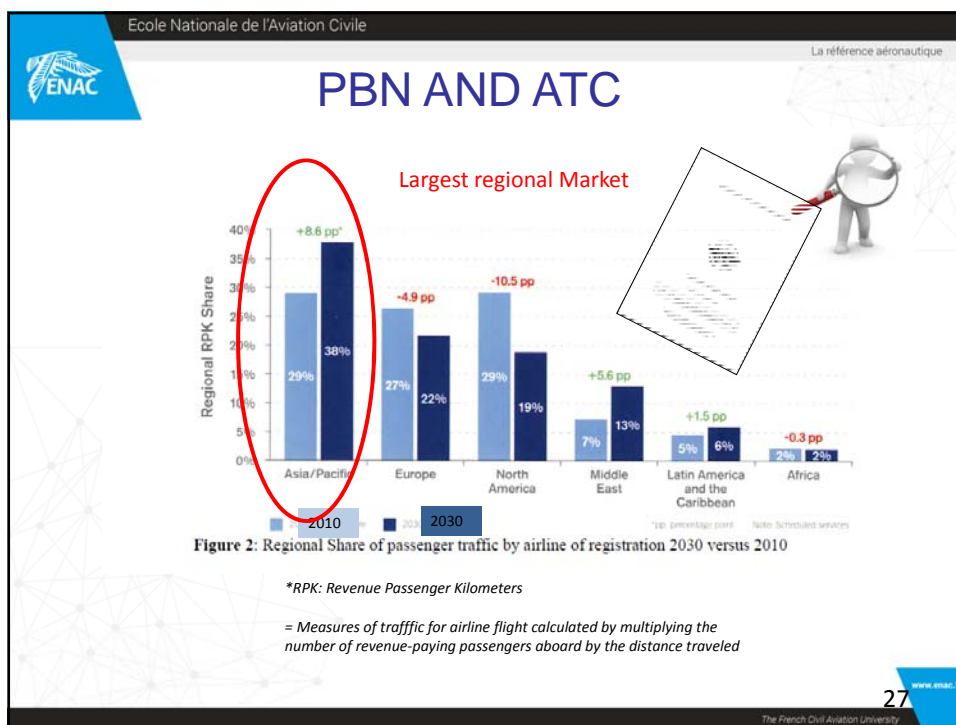
**PBN**  
*"The optimal use of appropriate PBN specification is a key enabler to progress Seamless ATM in the Asia/Pacific region."*



|   |                                  |  |   |
|---|----------------------------------|--|---|
| <b>GANP</b>   | GLOBAL STRATEGY                  |  |  |
|  |                                  |  |   |
| <b>A/P RANP</b>   | REGIONAL VISION                  |  |  |
| <b>A/P SEAMLESS ATM PLAN</b>  | REGIONAL IMPLEMENTATION STRATEGY |  |  |

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# PBN TRAINING FOR ATC



- 2 last months PBN training: India, Indonésia, China (ICAO),



**Lomé 06/2017**  
Togo CAA  
• PBN

**Hyderabad 04/2017**  
Indian CAA  
• CPDLC  
• A-CDM  
• AMAN-DMAN  
• ASM-FUA

**Jakarta 05/2017**  
Indonesian CAA  
• PBN  
• A-CDM  
• AMAN-DMAN

**Makassar 05/2017**  
Indonesian CAA  
• CPDLC  
• PBN  
• TBO

**Beijing 06/2017**  
ICAO  
• PBN

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# PBN TRAINING FOR ATC



Controller Pilot Data Link  
Communication (CPDLC)  
for ATCOs  
Makassar 18 - 19 Mei 2017

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## PBN AND ATC

ATC Work is more and more complex

↓ 

ATC Training: A **Safety** reason

↓

Trafic in Europ  Trafic in China 

THE TRAINING: New Technologies/ New Procedures

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## How to explain PBN Concept?

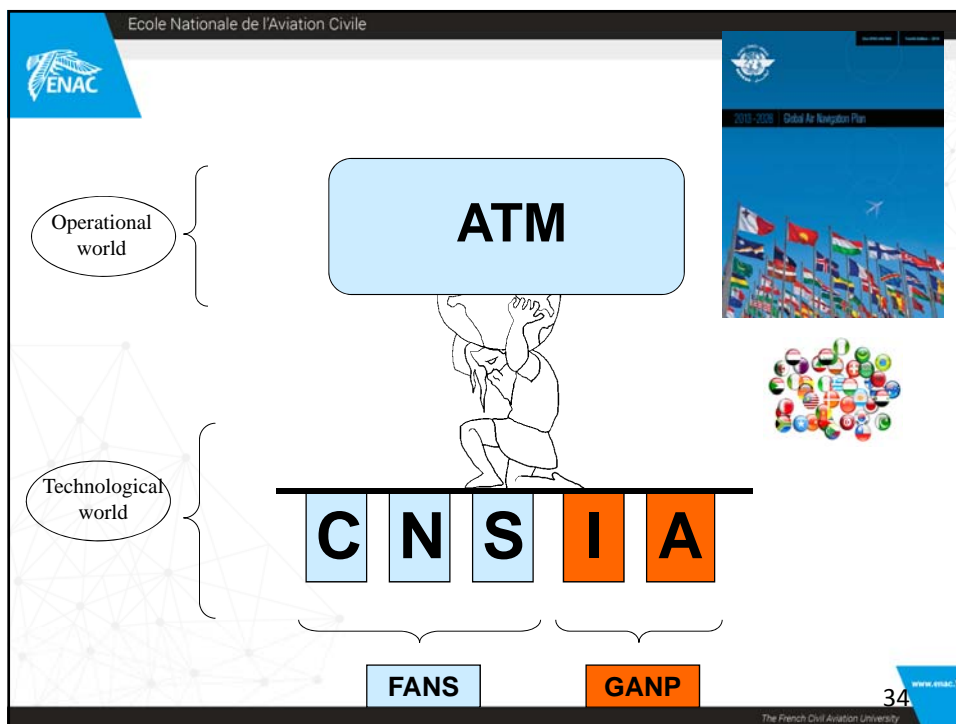
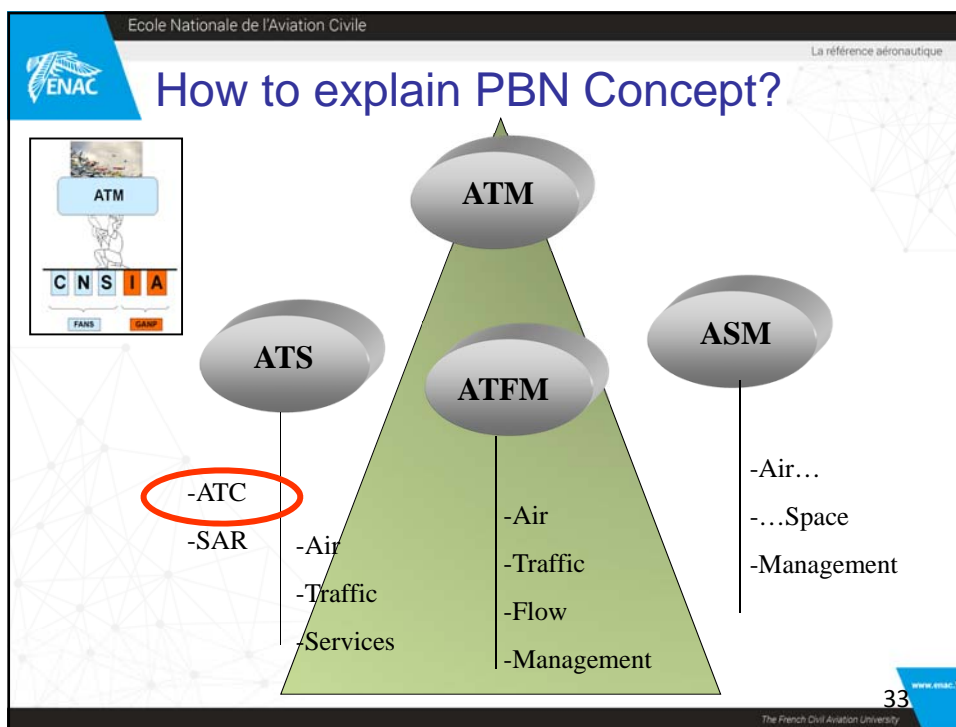
1. As an ATM component,
2. In which ATCOs are involved,



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## Our Priorities

### PBN: Our Highest Priority

Prior to the development of the ASBU Modules, ICAO focused its efforts on the implementation of Performance-based Navigation (PBN), Continuous Descent (C)



**Next Steps**

PBN is a complex and fundamental change affecting multiple disciplines and specializations within the aviation workforce. It is also a Standards-intensive area requiring both the development of new Standards and the fine-tuning of existing provisions.

Future implementation of PBN in terminal airspace is seen as a key enabler for the advanced terminal operations envisaged by a mature ATM modernization programme.

In light of these ongoing areas of priority, the following have been highlighted as the key outstanding areas of concern for States and industry to help ensure effective ongoing implementation of PBN:

- The need for guidance material, workshops and symposia.
- Computer-based learning packages.
- Formal training courses to ensure that PBN requirements and Standards are fully understood and properly implemented.
- Active, coordinated support for continuing Standards development and amendment
- Support in order to ensure harmonized and integrated implementation of related technologies and support tools to optimize performance capability objectives.

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## PBN Training as a key to PBN Implementation



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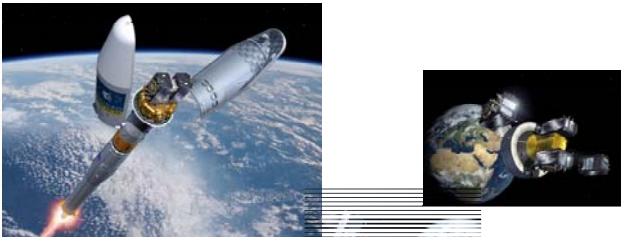
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## PBN IMPLEMENTATION IN FRANCE



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**Approches PBN PUBLIEES** | Date : 01 JANVIER 2017 - Cycle 02/17

**NPA** approche GNSS (norme OAD)

**APV SBAS ou Baro** approche avec gaadge vertical (norme OAD/ENR018)

**LORIENT NPA 0725** aéroport militaire

**MARSEILLE SBAS 13L/31R HEL** procédure spécifique hélicoptère  
\* participation du SIA-BPS

**SYNTHESE SIV/DSNA**

**Opérations avions GNSS :**  
202 QFU équipés NPA GNSS  
dont 5 NPA sur aérodromes militaires  
150 QFU équipés APV GNSS  
dont 9 QFU SBAS CAT1

**Opérations hélicoptères civils :**  
5 QFU équipés NPA GNSS  
3 QFU équipés APV GNSS

**SNA OUEST**

ANGERS SBAS 26  
BREEST \*SBAS+Baro 07R/Baro 296  
CAMI \*NPA 11 SBAS+Baro 31  
LORIENT NPA 0725  
MARSEILLE SBAS 13  
MONTAUBAN \*SBAS+Baro 39  
NANTES SBAS+Baro 03 NPA 21  
NARBONNE SBAS 0923  
ORLÉANS SBAS+Baro 12735  
REIMS SBAS 1412  
ROUEN SBAS 29  
Toulouse MFM 11 SBAS 28  
MONTPELLIER SBAS 04 SBAS 22

LE HAÏVRE \*NPA 04 SBAS 22  
LE MANO \*SBAS 02 SBAS 20  
L'ESPÉRET NPA 0725  
ROUEN MONTAUBAN SBAS 27  
NANTES SBAS+Baro 03 NPA 21  
NARBONNE SBAS 0923  
ORLÉANS SBAS+Baro 12735  
REIMS SBAS 1412  
ROUEN SBAS 29  
Toulouse MFM 11 SBAS 28  
MONTPELLIER SBAS 04 SBAS 22

**SNA RP**

LE BOURG \*SBAS 07 NPA 25  
LE BOURG SBAS 27  
PARIS CDG SBAS+Baro 08 CDG  
PARIS CDG SBAS+Baro 08/206  
PARIS ORLY SBAS+Baro 02/Baro 20  
PARIS ORLY SBAS+Baro 08/24  
PARIS ORLY SBAS+Baro 08/26  
PARIS ORLY SBAS+Baro 09/23  
TOULOUSE \*NPA 071

**SNA NORD**

ALBERT TRAY \*SBAS+Baro 09/27  
AMBERSBAS 30  
AMBIÈRE SBAS 0119  
BESANCON \*SBAS 12  
BORDEAUX SBAS 30  
BOURG EN BRESSE SBAS 06  
CALAIS SBAS 26  
CHALONS VATRY \*SBAS+Baro 10/28  
VALENCIENNES \*SBAS 11/29

LE TOULQUET \*SBAS 13/31  
LILLE \*SBAS+Baro 08/26  
LILLE SBAS 28  
LIMOUX \*SBAS 04  
LORIENT SBAS 0923  
LORIENT \*NPA 0422  
TROYES \*SBAS 17/25

**SNA NORD-EST**

BALE-ARA-HORS SBAS 15/33  
BESANCON SBAS 12  
CHALONS CHAMPAGNE SBAS 10/28  
HELIKOPTER \*NPA A 22 HEL  
CHAMPAGNE \*NPA 21 (ARV)  
CHATELAIN SBAS 0119  
COGNAC SBAS 35  
DOLE SBAS 05  
EPHRAÏM SBAS 26  
LILLE MONTPELIER SBAS+Baro SBAS 22  
LORIENT \*NPA 0725  
LORIENT \*NPA 0725  
MONTPELLIER SBAS 04  
NEVERS SBAS 30  
REIMS NPA 25 SBAS 07  
STRAZBOURG SBAS 0923  
TULOUSE \*NPA 11/230

**SNA CENTRE-EST**

ANGERS SBAS 26  
ANGERS \*NPA 04 HEL  
ANGERS \*SBAS 15  
CANTON \*SBAS 06  
LYONS \*SBAS+Baro 09/27  
LILLE \*SBAS 15/33  
LYONS MONTPELIER SBAS+Baro 10/28  
LYONS MONTPELIER SBAS+Baro 10/28  
LYONS MONTPELIER SBAS+Baro 10/28  
NANCY SBAS 26  
REIMS NPA 25  
SAINT ETIENNE SBAS 18/36+Baro 18  
VALENCIENNES SBAS 11/29  
VALLENTIN \*NPA 18/0482

**SNA SUD-OUEST**

AJACCIO SBAS 20  
ANGERS SBAS 18/36  
BERGÉSBAS SBAS+Baro 10/28  
BOURG EN BRESSE \*SBAS+Baro 27  
BREST SBAS 27  
BREST \*SBAS+Baro 11 SBAS 29  
BORDEAUX \*SBAS+Baro 11 SBAS 29  
BORDEAUX \*SBAS+Baro 11 SBAS 29

CHATELAIN SBAS 0119  
L'ESPÉRET NPA 0725  
MONTAUBAN SBAS 27  
NANTES SBAS+Baro 03 NPA 21  
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ORLÉANS SBAS+Baro 12735  
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ROUEN SBAS 29  
Toulouse MFM 11 SBAS 28  
MONTPELLIER SBAS 04 SBAS 22

**SNA SUD**

ALBI SBAS+Baro 09/27  
ANGERS SBAS 18/36  
ANGERS SBAS 26  
BORDEAUX SBAS 18/36  
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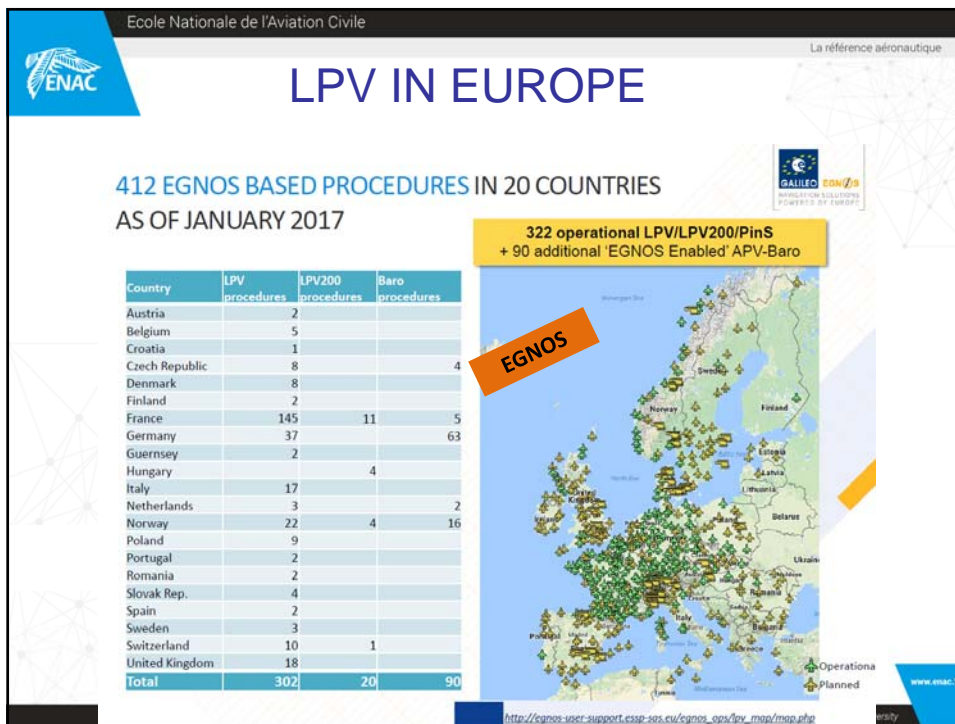
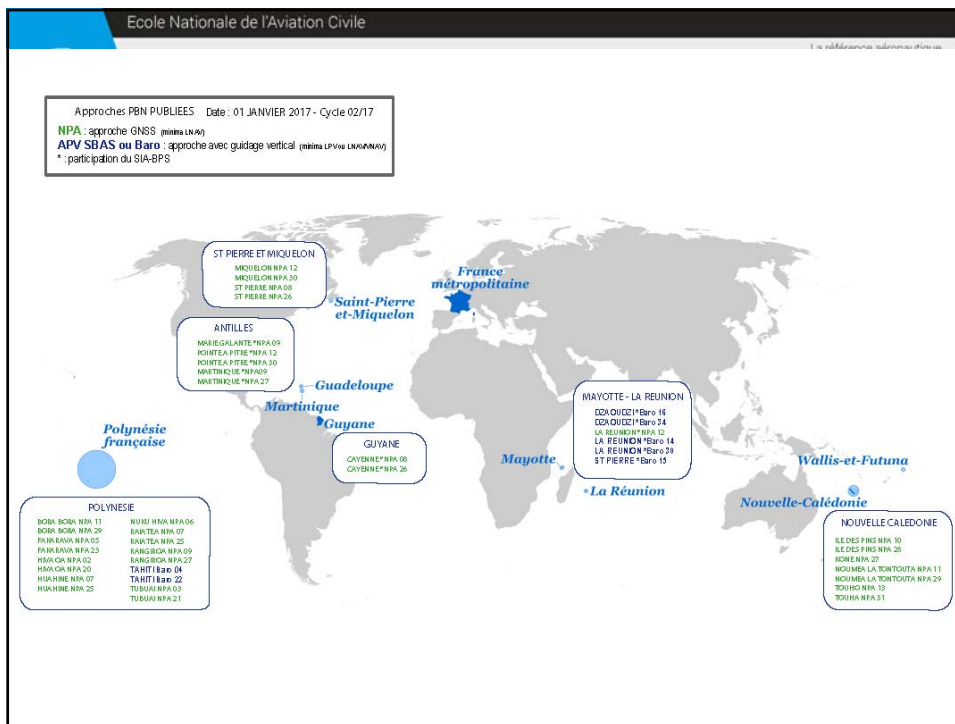
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MONTPELLIER SBAS 04 SBAS 22

**SNA SUD-SUD-EST**


BREST SBAS 27  
MONTPELLIER SBAS+Baro 10/28  
MONTPELLIER SBAS+Baro 10/28  
MONTPELLIER SBAS+Baro 10/28  
MONTPELLIER SBAS+Baro 10/28  
MONTPELLIER SBAS+Baro 10/28  
MONTPELLIER SBAS+Baro 10/28

Nb: tous les aérodromes ne sont pas représentés.

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## Satellite navigation & ILS Strategy

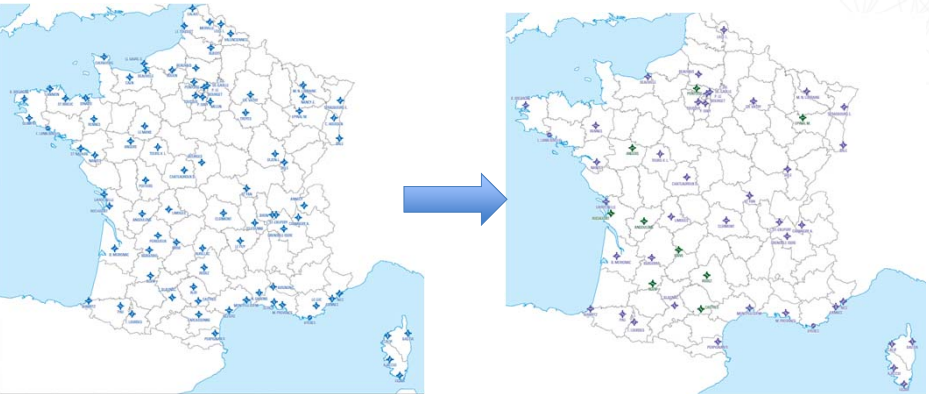
- **Building an optimized national approach and landing network:**
  - “Cat I everywhere, everytime”**
  - **This can be achieved through a mixed infrastructure: ILS and EGNOS Cat I**
    - When the ILS is out of service, or non existing over the runway in service, equipped airlines will benefit from an additional level of safety and airport accessibility thanks to EGNOS Cat I
    - Users not equipped with EGNOS can access the airport, but with less performing operational minima
    - Supports ILS reduced networks

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## SatNav with EGNOS supports France ILS CAT I rationalisation plan




**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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## 50 ILS rationalisation status

- **30 ILS now stopped**
- **6 ILS to be stopped (Poitiers/Aurillac, LeTouquet/Cherbourg, Lannion, Merville)**
  - DSNA is migrating most of these to EGNOS Cat I in 2017
- **8 ILS now transferred to the airport owner (Agen, Angers, Angoulême, Brive, Castres, Epinal, Rochefort, Rodez)**
- **5 ILS additional transfers on-going (Pontoise, Rouen, Caen, Avignon, Quimper)**
- **1 ILS in stand-by (St Nazaire)**
  - CATIII migration under discussion

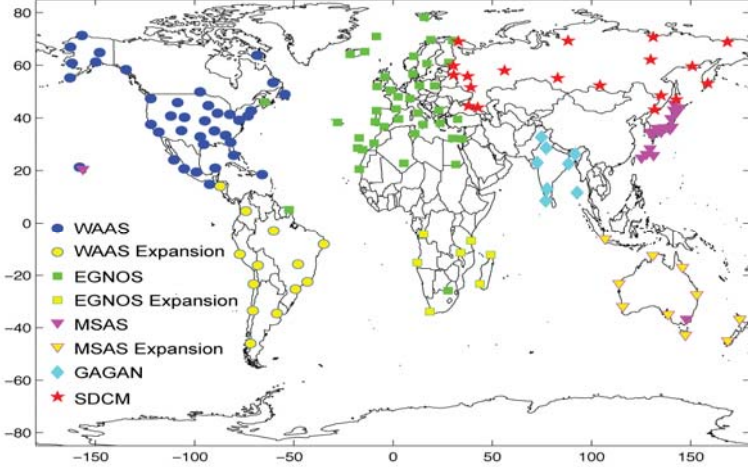
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## EXPANDED SBAS GROUND networks



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**ATC THEORETICAL KNOWLEDGE**

**BASIC**  
Air Law/ Avionic/Performances/Met...



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**Annex 11** **Annex 11** **Annex 11**

**ATS Units** → **ATS** → **Airspaces**

**ATC Units:** ACC, APP, TWR

**ATS:** Control= ATC services (a, b, c), Info = Flight Information Service (d), Alerting Service (e), ATAS = Air Traffic Advisory Service

**Airspaces:** A: Airspace (C, A, NCA), CT R, CTA, FIR, UIR, TMA, LTA, UTA, OCA, AWY, A, E, F, G

**Objectives of ATS : Annex 11 /2.2**

- a prevent collisions between aircraft;
- b prevent collisions between aircraft on the manoeuvring area and obstructions on that area;
- c expedite and maintain an orderly flow of air traffic;
- d provide advice and information useful for the safe and efficient conduct of flights;
- e notify appropriate organizations regarding aircraft in need of search and rescue aid, and assist such organizations as required.

**Traffic Information / Separation Regarding VFR & IFR**


Rules of Air (Annex 2) | Air Traffic Management (Doc 4444)

Flight information Center  
Air Traffic Services Reporting Office

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# ATC THEORETICAL KNOWLEDGE

**ADVANCED**

Advanced Training:

- AMAN-DMAN-XMAN
- TBO
- A-CDM
- ATFCM
- FUA/ASM
- CPDLC
- PBN
- ...




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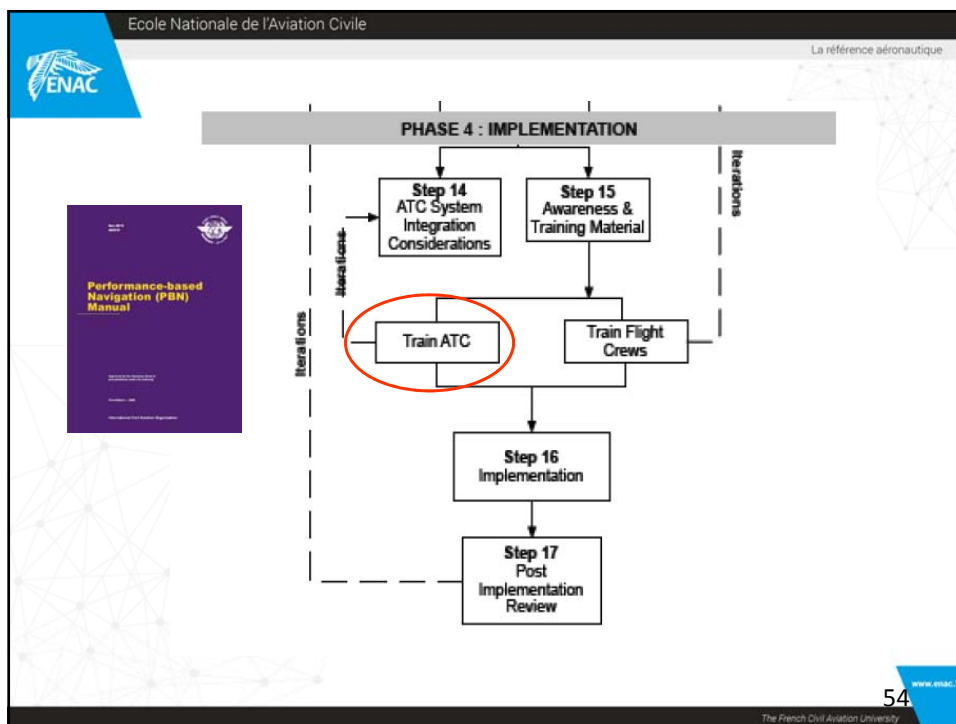
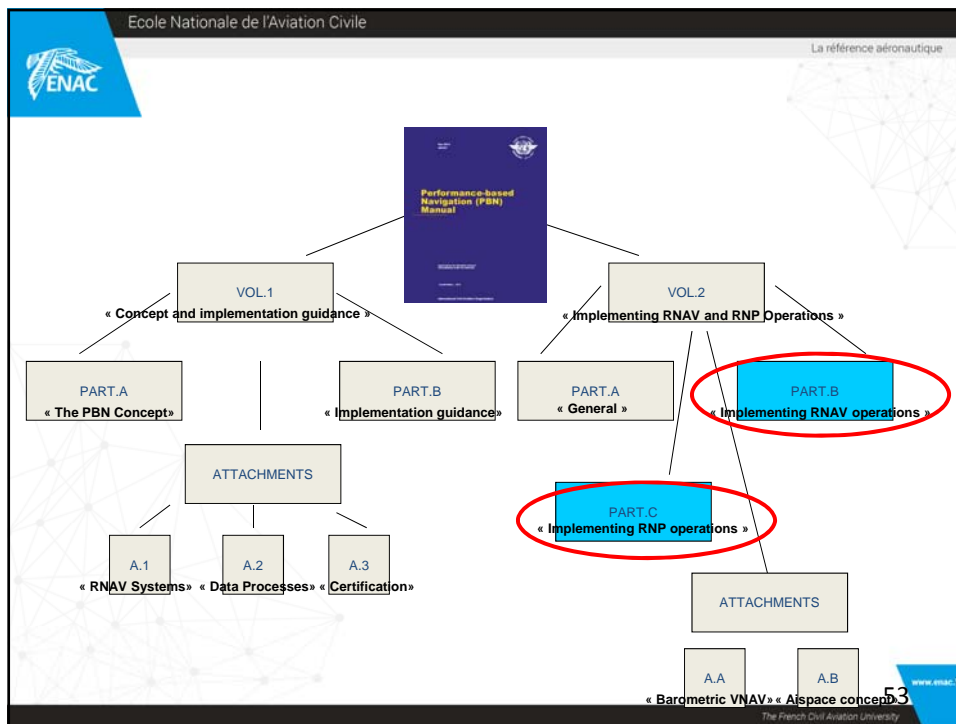


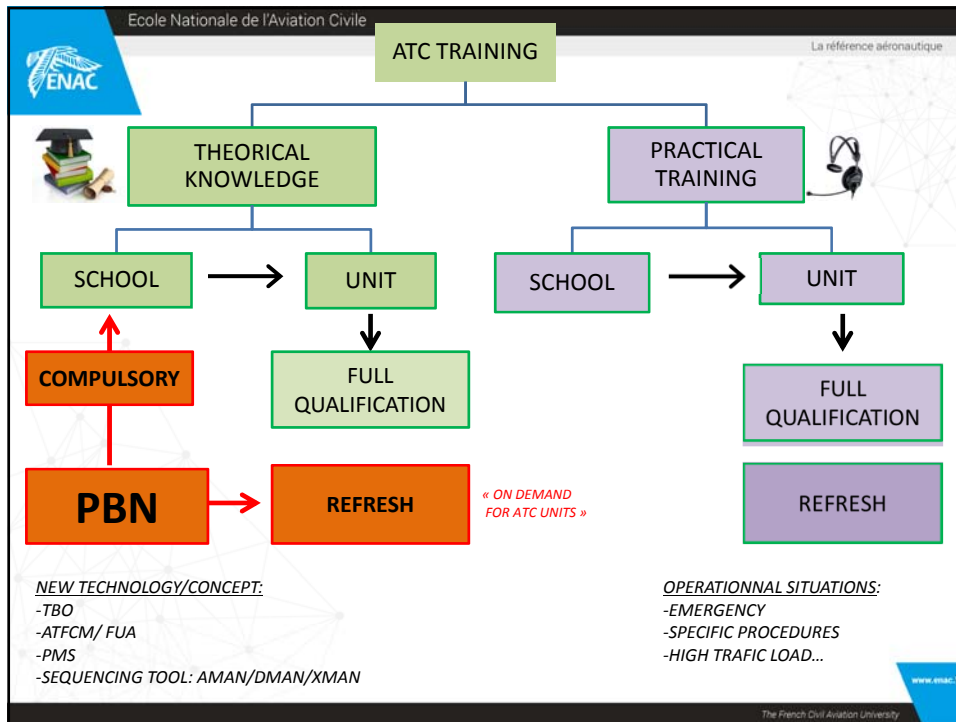
# PBN REFERENCE DOC.



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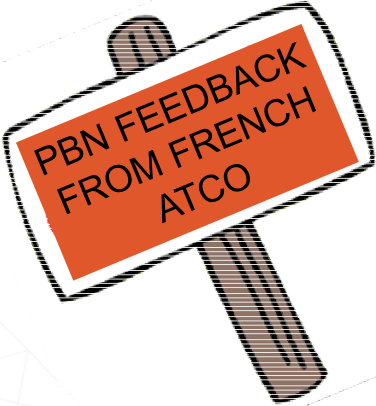
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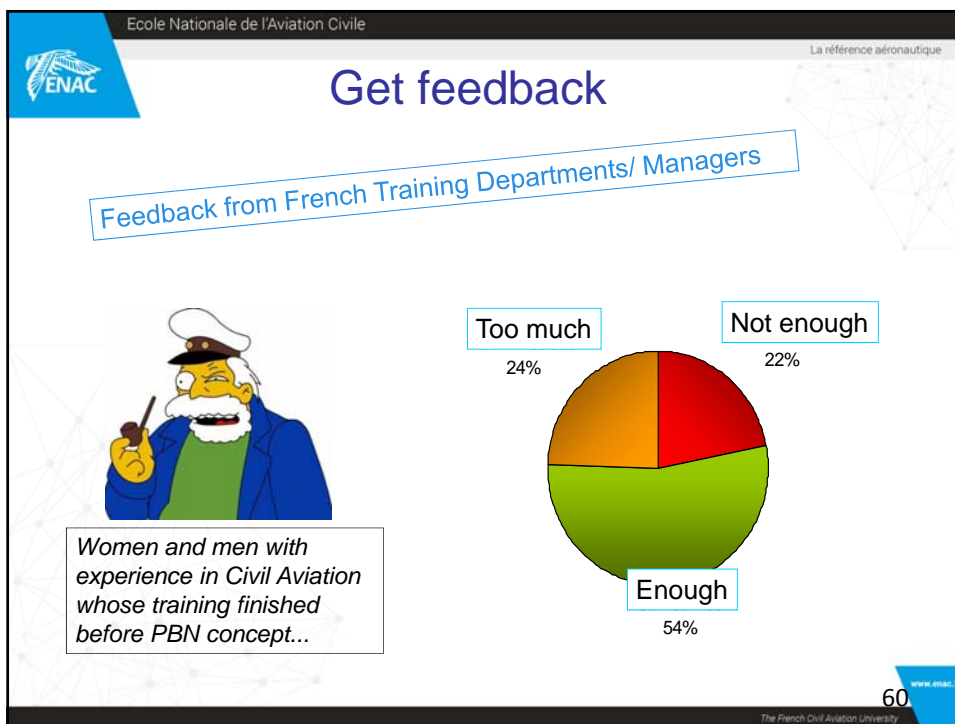
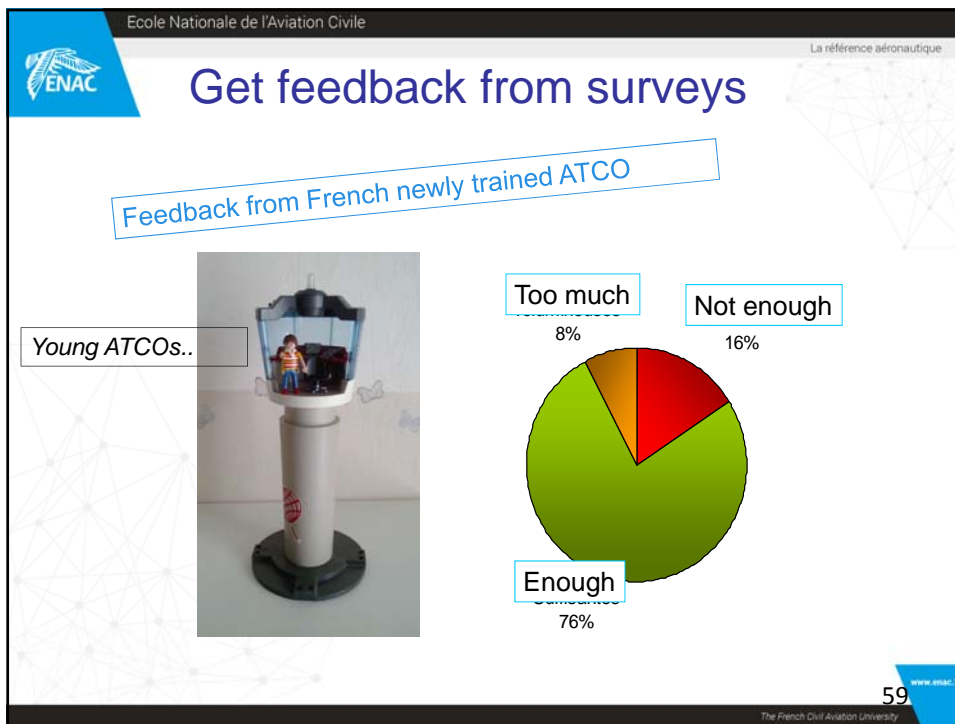


# Get feedback!!!!



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## Get feedback

Example of questions from French newly trained ATCO

- Why do we develop RNAV trajectories ?
- How many RNP APCH approaches are developed in our country each year ?
- Why don't we develop GBAS instead of SBAS ?
- Why don't we encourage GNSS use only ?
- **What is the ultimate point for vectoring towards RNAV APCH final ?**
- **Can we perform Low Visibility Procedure with RNAV ?**
- **Do we say « RNAV approach » or « GNSS approach » ?**
- **Why do we keep conventional procedures in case of RNAV overlay ?.....**

**OPERATIONAL QUESTIONS...**

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## THE SOLUTION:

**AN ADAPTED OPERATIONAL ATC TRAINING**



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 **An adapted Training: Abroad**

- Identify the needs by the RoadMap
- Adapt to the local needs,
- Answer operational issues
  - Operational impact for ATC,
  - Operational methods( « direct to » instructions, « speed » and « altitude » constraints, vectoring...,
  - Phraseology (« Cleared RNAV Approach..»)
  - Contingency situations, hazards...
- Train the Trainers,

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 **HOW TO TRAIN? →EXAMPLES**


**What we have learned!**

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# THE CHINESE EXAMPLE



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## CHINA CIVIL AVIATION Performance Based Navigation Implementation Roadmap



中国民用航空局  
Civil Aviation Administration of China

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**Many PBN Trainings in Tianjin in collaboration with CAUC**

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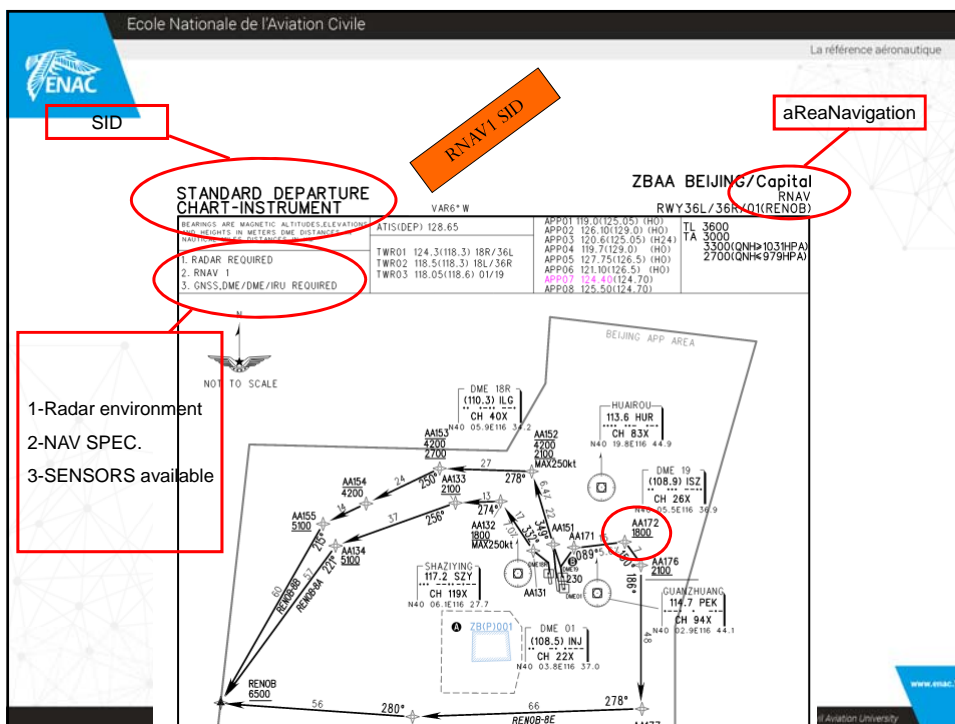
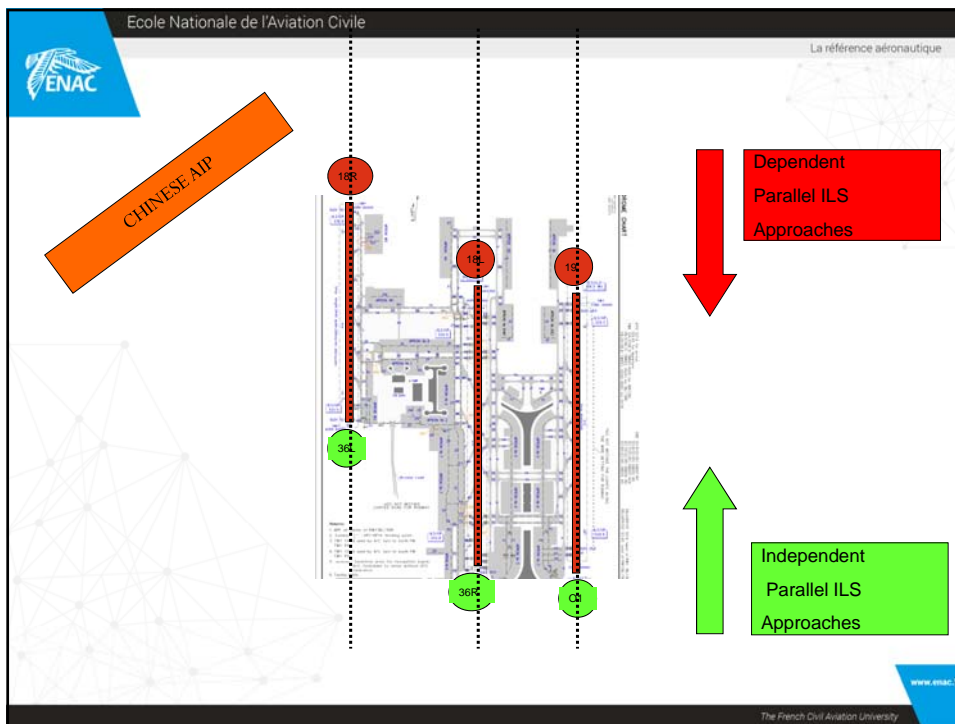


Example of PBN: IN BEIJING...



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# THE INDONESIAN EXAMPLE




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# PBN ICG/3: O3/2016



## PBN IMPLEMENTATION AND IDENTIFIED ISSUES/ INDONESIA

PBNICG/3 –IP/14  
Agenda Item 10  
07/03/16



*International Civil Aviation Organization*  
**THE THIRD MEETING OF PERFORMANCE BASED NAVIGATION  
IMPLEMENTATION COORDINATION GROUP (PBNICG/3)**  
Bangkok, Thailand, 08 – 10 March 2016

**Agenda Item 10: Issues and challenges regarding PBN implementations**


**INDONESIA PBN IMPLEMENTATION AS EFFICIENCY/ENVIRONMENTAL MEASURE  
AND STAKEHOLDERS INVOLVEMENT**  
(Presented by DGCA Indonesia)

**SUMMARY**  
This paper presents the inclusion of PBN implementation in Indonesia in its State Action Plan for Emissions Reduction in Aviation, expected environmental benefits, and the related support actions taken: creation of a PBN implementation stakeholder Working Group.


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## PBN ICG/3: O3/2016



PBN IMPLEMENTATION :  
MAIN IDENTIFIED ISSUES



- Some airports, which already have PBN procedures, are still **not being used** effectively
- Approved and published procedures are **not flown by operators**
- Approved and published procedures are normally not **cleared by ATC**

- Training local ATC's would improve confidence on management of PBN traffic and provide a better perception of benefits in terms of workload and complexity reduction

- Operational approvals of aircraft operators are below fleet's operational capabilities

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## PBN WORKSHOP: 02/2016 INDONESIA




DGCA/ICAO INS13801 CIVIL AVIATION ENVIRONMENT PROGRAM  
PERFORMANCE BASED NAVIGATION (PBN) FULL IMPLEMENTATION WORKSHOP  
(Bogor, 22 – 26 February 2016)

6) Barriers of **ATC's access to training:**

- ✓ Indonesia regulation requires certified centers to provide PBN training. But ICAO does not require any approved certificate and approved center for PBN. The purpose of ATC training for PBN procedures is to provide familiarization on new procedures, not certified training.



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**FEEDBACK**

**ADAPT THE TRAINING TO LOCAL CONTEXT...**


1. BASIC TRAINING +
2. TRAIN THE TRAINER ABOUT LOCAL CONTEXT ISSUES

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# KOCHIN




2010...

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# CASE STUDY: KOCHIN

**Context:**

- First GNSS Approach in India in collaboration with AIRBUS

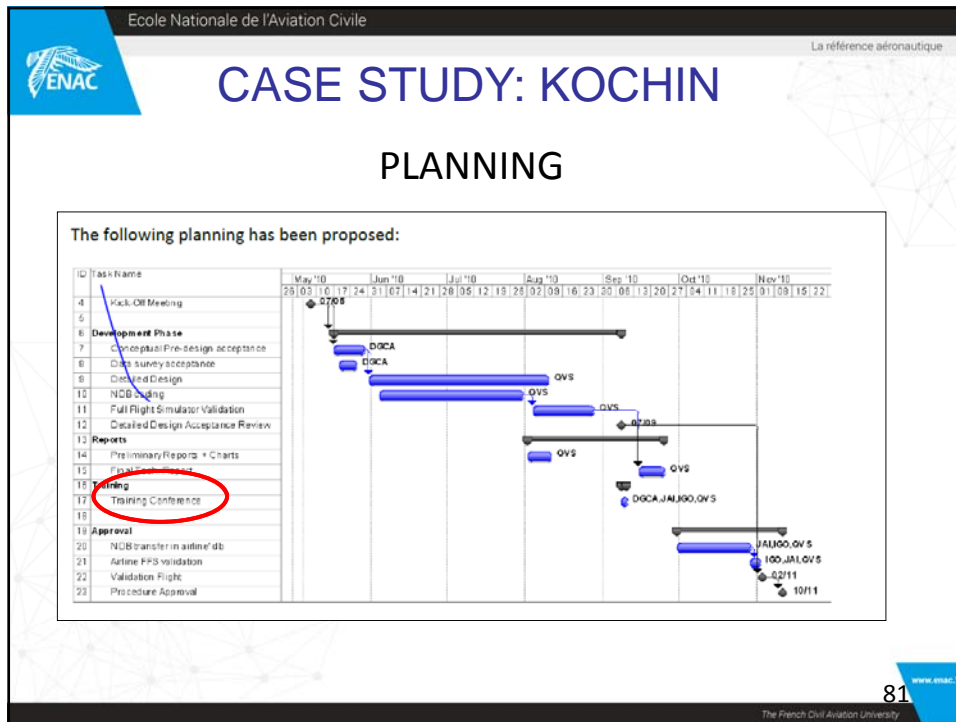


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## CASE STUDY: KOCHIN

### PILOT TRAINING IS NOT ATC TRAINING...

Training: Quovadis, Jet Airways and Indigo will assess if there are training needs for flight crews. Depending on training needs, Quovadis, Jet Airways and Indigo will define the training syllabus. The ATC representatives should participate to this training and to simulator session validation.

### ATC: CONFIDENCE ISSUES

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# CASE STUDY: KOCHIN

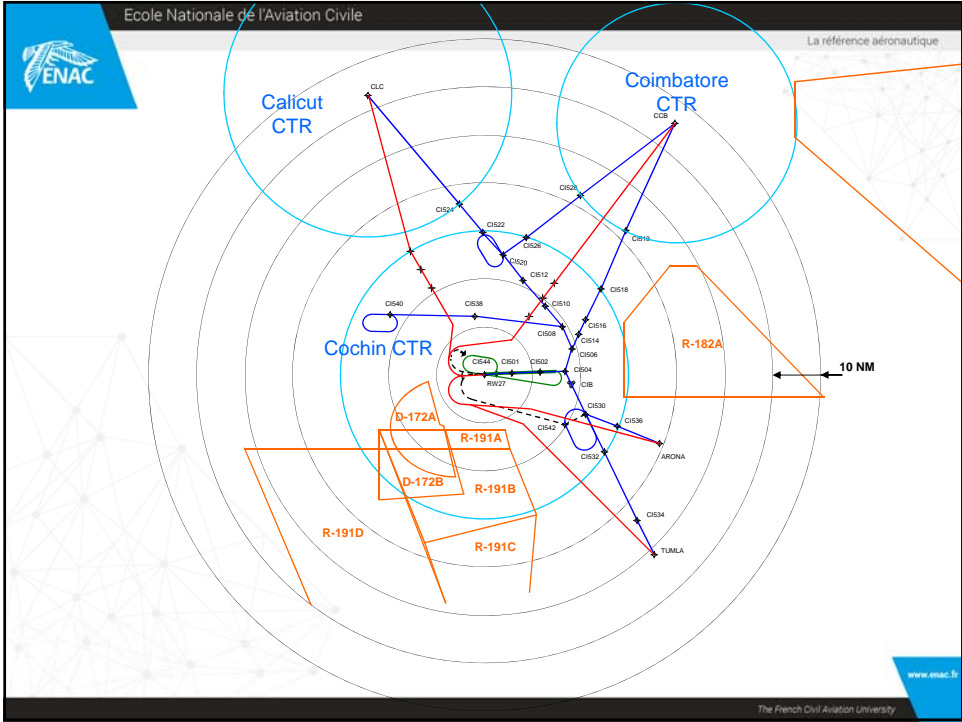
## SOLUTION: A SPECIFIC ATC TRAINING

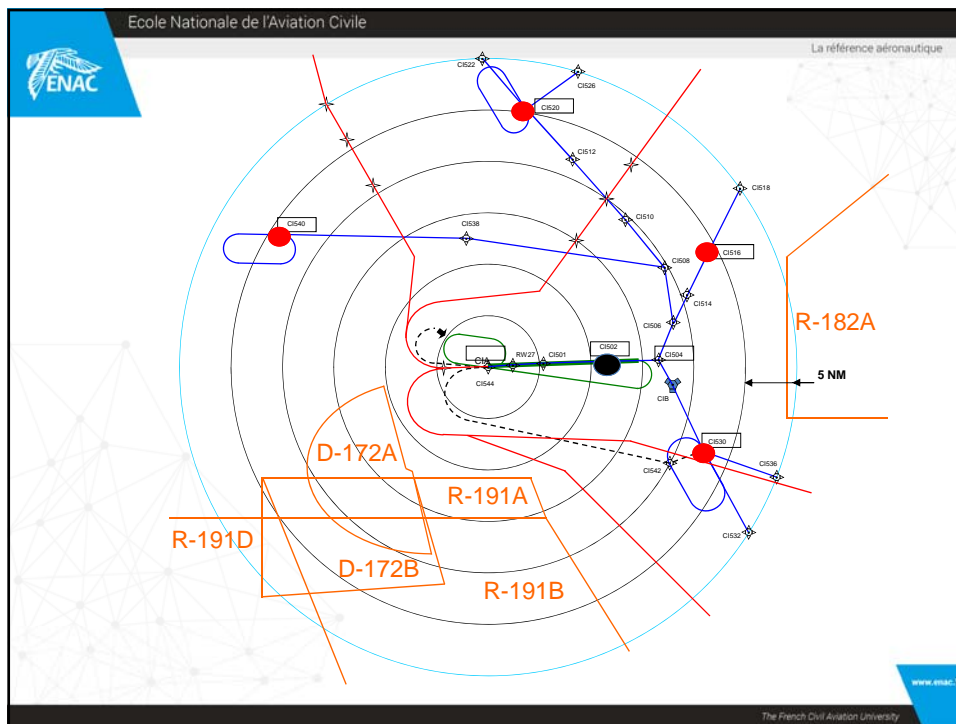
An ATC Training will be required. A draft of the ATC training content proposed by Quovadis, in collaboration with French DGCA, will be sent to Mrs Nair (ATC Kochi).



**PBN ATC TRAINING BY ENAC ATC TRAINERS**

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In order to understand the following scenario, please read the explanations below

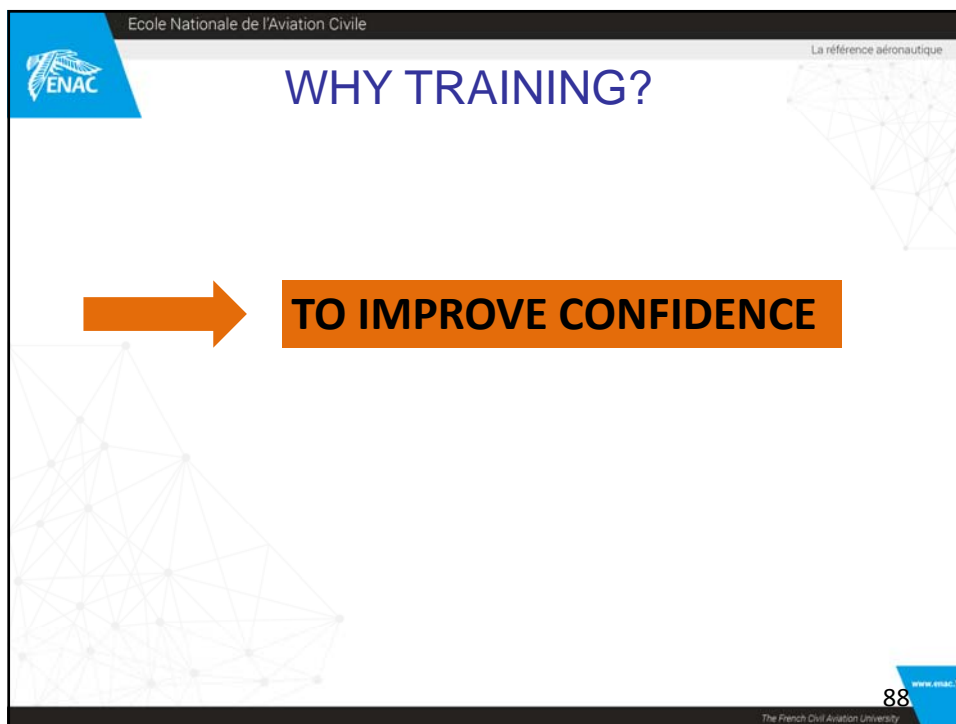
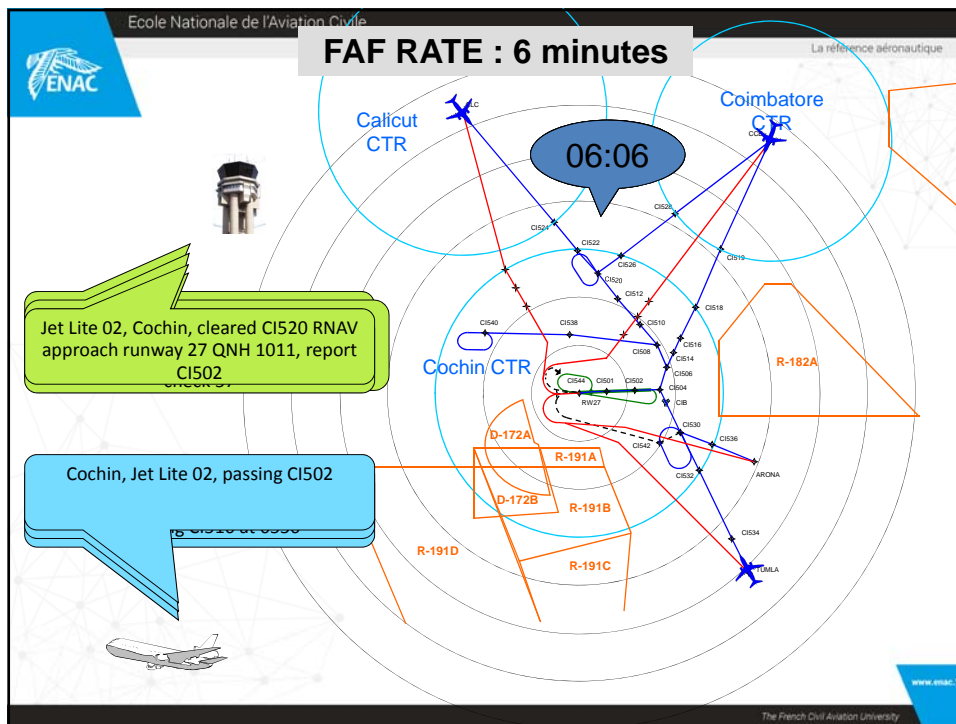
Arriving aircraft pilot call

COCHIN TWR call

! In order to simplify scenarios, ATC organism will always be called « COCHIN » keeping in mind that in the reality APP or TWR is in charge of the traffic.

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# FEEDBACK

## CONFIDENCE IN TRAINERS IS ESSENTIAL...

→ ATC Trainers

- ATC Reluctance to change,
- Pilot needs are not ATC needs in term of Training,
- For ATC:
  - Explain limitations, hazards,
  - Explain contingency procedures,
  - Explain IAP ICAO Classification: PA-NPA-**APV**
  - Explain the coming changes: arrival sequence, FAF Rate,...
  - Adapt to local constraints,
  - Train the Trainers

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# THE FRENCH EXAMPLE



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# LFPO: ORLY



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# LFPO: RNAV APPROACH TO ILS



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# CASE STUDY: LFPO

APR 2017

FRANCE

AD 2 LFPO (AC) RWY 06-24 RNAV 1 (RNP 100) CAT II

APPROCHE AUX INSTRUMENTS

Subsistent Approach

CITAB CD

RNAV 1 (RNP 100) (DME/DME) ODILO 04 RWY 06

RNAV 1

Available sensors:  
GNSS/DME-DME

RNAV APPROACH LEADING TO CONVENTIONAL FINAL ILS TYPE

TO ILS FINAL

« Cleared ODILO 1A for ILS Approach RWY... »

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# LFPO: ONLY

## ILS BUT ALSO:

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# CASE STUDY

**APRÈS FRANCE**  
**APPROCHE AUX INSTRUMENTS**  
 Instrument Approach  
 CAT A, S, C-D  
 ALT AD : 201 (DFHR : 200 (17) hPa)  
 PROC : voir l'axe ADZ LPV/OM-III

APR : Métré-IRM 001' vers 2000 (177) puis prélével guidage ILS.  
 En cas d'approche métré, métré-IRM 001' vers 2000 (177), A POKETI (point d'attente) vers MOLA, A 16,8 NM, N, (niveau vers 4000 (2717)), A MOLA (niveau vers 1500 (1077)) vers MOLA, Métré-IRM 1500 (1077) avant d'acquiescer au public.  
 Métré-APCH : C-IRIS MAG 001' ap à 2000 (177) then plan instrument.  
 Ifرادقرفقرفق, c'IRIS MAG 001' ap à 2000 (177), A POKETI (point d'attente) vers MOLA, A 16,8 NM, N, (niveau vers 4000 (2717)), A MOLA (niveau vers 1500 (1077)) vers MOLA, C-IRIS ap à 1500 (1077) avant d'acquiescer au public.

| TYPE | LN/VN/VNAV | COCH | LN/VN/VNAV | COCH | MIN | DIST |
|------|------------|------|------------|------|-----|------|
| C    | LPV        | COCH | LN/VN/VNAV | COCH | 115 | 11   |
| A    | LPV        | COCH | LN/VN/VNAV | COCH | 115 | 11   |
| B    | LPV        | COCH | LN/VN/VNAV | COCH | 115 | 11   |
| C    | LPV        | COCH | LN/VN/VNAV | COCH | 115 | 11   |
| D    | LPV        | COCH | LN/VN/VNAV | COCH | 115 | 11   |

**RNP APCH LEADING TO**  
**-LPV**  
**LNAV-VNAV**  
**-LNAV**

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# FEEDBACK

**MIXED PROCEDURES ARE POSSIBLE:  
RNAV Approach leading to ILS final...**

- Phraseology to be explained to ATC
- Discuss the different cases


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# LFPG: ROISSY



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# LFPG: LPV 200 ft = CAT I PA




- ▶ Surface area :3200 ha
- ▶ 4 RWYs : East / West
- ▶ 80 km Taxiways
- ▶ 8 ILS CAT 3

**Statistics 2009**

- ▶ Airport traffic: 525 000 ops (ARR/DEP)
- ▶ Approach traffic 606 000 ops (with Le Bourget)
- ▶ 60 million passengers
- ▶ About 200 Aircraft Operators
- ▶ Peak day: 1773 ops / 2091 ops (App)
- ▶ Peak hour : 120 ops
- ▶ Capacity: ARR 69 / DEP 75

**Weather conditions:**

- ▶ Low Visibility Procedures (LVP) in progress less than 4% of time
- ▶ Few snowy days (except last winter: 25 days)



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# LFPG OPERATIONS

|  |  |
|--|--|
| <p><b>Nominal situation</b></p> <p>LFPG Charles de Gaulle</p> <p>Le Bourget LFPB</p> | <p><b>West configuration</b></p> <ul style="list-style-type: none"> <li>Simultaneous triple independent parallel ILS approach operations (Paris CDG RWYs 27R, 26L and Paris Le Bourget RWY 27)</li> <li>Interception altitude difference of 1000 ft</li> </ul> |
| <p><b>Nominal situation</b></p> <p>LFPG Charles de Gaulle</p>                        | <p><b>East configuration</b></p> <ul style="list-style-type: none"> <li>Simultaneous independent parallel ILS approach operations (Paris CDG RWYs 09L and 08R)</li> </ul>  |
| <p><b>Degraded situation (ILS in maintenance, runway closed,...)</b></p>             | <ul style="list-style-type: none"> <li>Departure runway also used for landing</li> </ul>   |

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## PARIS CDG TARGETS

- The 8 ILS of the 8 CDG runways have to be replaced between 2016 and 2020**
  - Decision to implement PBN, with vertical guidance required, as the main backup to mitigate ILS unavailability ( around 2 month per ILS)
  - Implementing LPV 200 was an opportunity to demonstrate to the community the potential benefits of LPV over a major European airport
  - We also have LPV 200 early users (Vietnam Airlines A350, HOP ATR 42, SWISS Bombardier,...)
- Inaugural LPV 200 flight conducted the 3<sup>rd</sup> May 2016**
  - With Airbus A350, a Falcon 2000X and an ATR42-600

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# LFBG EXPERIMENTATION

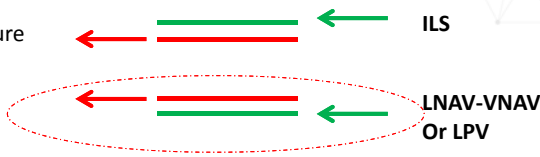
**SOUTHERN ILS IS MANUALLY STOPPED**

**WHY?**  
 → To promote RNAV APP  
 → To train ATC in case of ILS failure

**WHERE?**  
 → Southern RWY

**WHEN?**  
 → Every Friday afternoon 13.30/17.00 Local time

**CONDITIONS?**  
 → Ceiling >= 500ft  
 → Visibility >= 1000m  
 → No storm/ No deviation from tracks ( CB cells...)

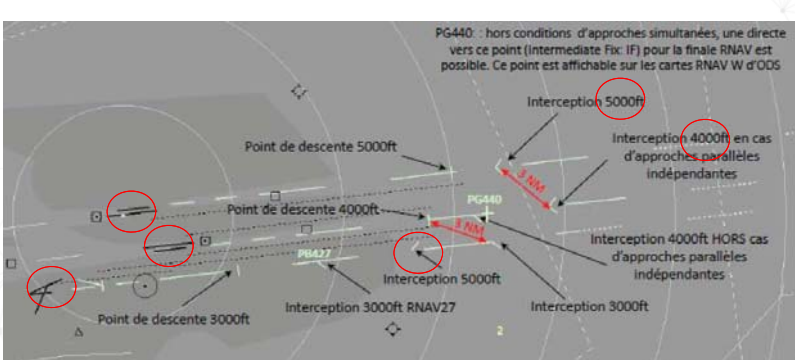


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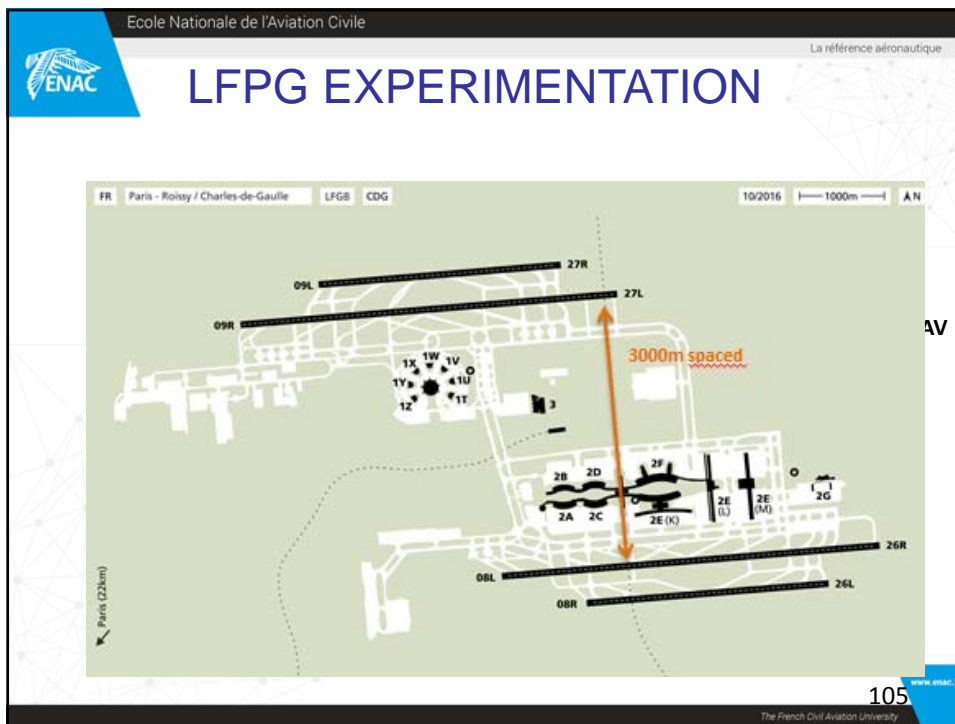
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## LFBG EXPERIMENTATION

ATIS?  
→ Specific message

« This is information A recorded at...caution **parallel RNAV final** on progress, LNAV minima impossible, inform Approach on 1st contact if non LNAV-VNAV capable »


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# LFPG EXPERIMENTATION

**RADAR VECTORING PHRASEOLOGY?**  
**1/ Before IAF**

« ACA870, cleared MOPAR 3W approach,  
**radar RNAV 26L** »




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# LFPG EXPERIMENTATION

**RADAR VECTORING PHRASEOLOGY?**  
**2/ For vectoring**

«ACA 870, turn right heading 300,  
intercept final approach course RWY  
26L »



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**RADAR VECTORING PHRASEOLOGY?**  
**3/ Final clearance**

«ACA 870, cleared RNAV final Rwy 26L » »



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**HOW TO KNOW RNAV CAPABILITY ?**  
 → Flight Plan not accurate enough  
 → Development of local tool

ENTER CALLSIGN

**Mopar**  
 VQBZM R14 Non RNAV  
 AFR181M E21 OK RNAV  
 BAW36CT A10 Non RNAV  
 AFR565T E10 Non RNAV  
 EZY36TD D06 Non RNAV  
 EIN52H T01 OK RNAV  
 BMR87CE Q07 OK RNAV

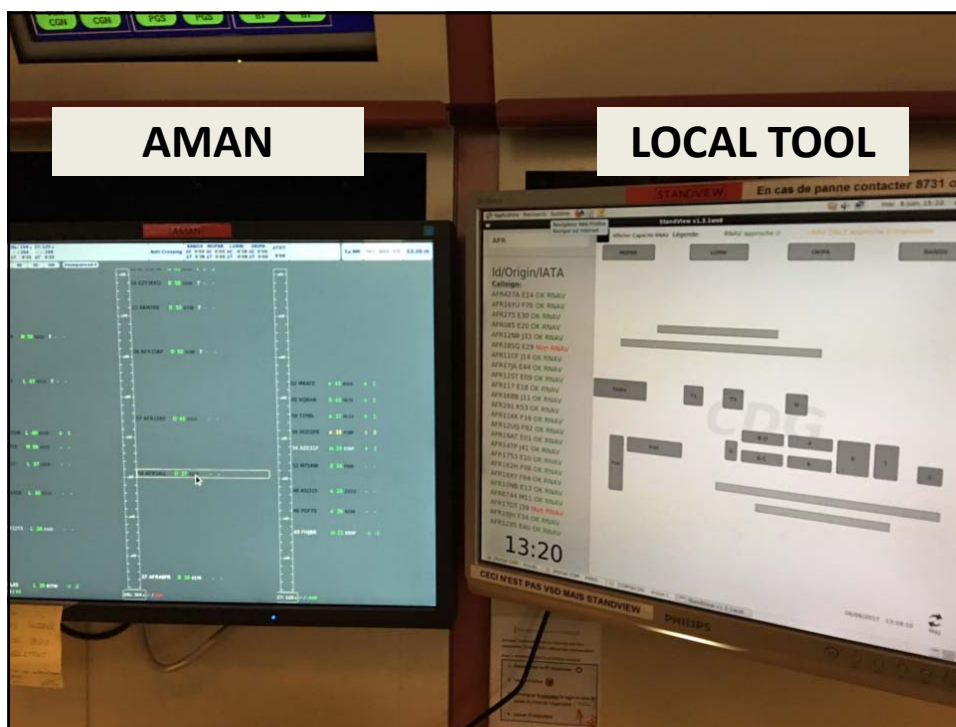
**LOCAL TOOL**

- Based on ATC feedback
- Put « V » on strip for RNAV
- In case of doubt:  
 « ACA870, are you able RNAV final 08R with LNAV VNAV minima ? »

|                     |      |       |                 |                 |                |
|---------------------|------|-------|-----------------|-----------------|----------------|
| E Z Y 1 3 4 R 1000  | 110  | BANOX | 110 120 130 140 | 150 160 170 180 | RA             |
| -XXX- 117 LFBZ LFPG | 300  | 118   | 100             | 90 80 70        | 16<br>14<br>14 |
| K                   | 300  |       |                 |                 | 16<br>14<br>14 |
| G66L                | 1114 |       |                 | 5000 4000 3000  | 16<br>14<br>14 |

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## LFPG EXPERIMENTATION

### RNAV VECTORING PHRASEOLOGY ?

➔ « KLM 234, turn left heading 300, intercept final approach course 27L »

| CAPACITE FINALE RNAV PAR COMPAGNIE (su 13/07/16) |              |          |        |        |      |          |
|--|--------------|----------|--------|--------|------|----------|
| AAL  | A330         | B767     | B777   | B787   | B757 |          |
| ABR  | A742/72      | A320     |        |        |      |          |
| ACA  | A330         | B767     | B777   | B787   |      |          |
| ADR  | E145         |          |        |        |      |          |
| AEA  | B737         | A330     | E195   |        |      |          |
| AEE  | famille A320 |          |        |        |      |          |
| AFL  | A320         | B737     | A330   | B77W   |      |          |
| AFR  | famille A320 | A330     | A340   | A332   | A380 | B777     |
|  | E135/145     | E170/190 | CRJ1/7 | CRJX   | RJ85 | ATR42/72 |
| AHY  | A320         |          |        |        |      |          |
| AIC  | B787         |          |        |        |      |          |
| ALK  | A330         | A350     |        |        |      |          |
| AMX  | B787         |          |        |        |      |          |
| ANA  | B777         | B787     |        |        |      |          |
| ASL  | A319/20      | B737     |        |        |      |          |
| AUA  | famille A320 | B767     | B777   | Dash 8 |      |          |
| AUI  | B737         |          |        |        |      |          |
| AWE  | A330         | B767     |        |        |      |          |
| AZA  | A320/321     | A330     | B777   |        |      |          |
| AZI  | BAE146       | A320     |        |        |      |          |
| BAW  | famille A320 | B767     |        |        |      |          |
| BCI  | ATR42/72     |          |        |        |      |          |
| BCY  | RJ85         |          |        |        |      |          |
| BEE  | E170/190     | Dash 8   |        |        |      |          |
| BEL  | A320         | BAE146   |        |        |      |          |
| BER  | famille A320 | A330     | B73x   |        |      |          |
| BUE  | A320         | B73x     |        |        |      |          |
| HVN  | A330         | A350     | B777   | B787   |      |          |
| IBE  | all fleet    |          |        |        |      |          |
| ICE  | B757         | B767     |        |        |      |          |
| ISS  | A320         |          |        |        |      |          |
| IYE  | A320         | A330     |        |        |      |          |
| JAF  | B737         |          |        |        |      |          |
| JAI  | A330         | B777     |        |        |      |          |
| JAL  | B777         | B787     |        |        |      |          |
| KAC  | A320         | A300     | A340   |        |      |          |
| KLM  | B737         |          |        |        |      |          |
| KQA  | B777         | B787     |        |        |      |          |
| LBT  | A320         |          |        |        |      |          |
| LGL  | E145         | Dash 8   | B73x   |        |      |          |
| LZB  | E190         | A320     |        |        |      |          |
| NLY  | A319         | A320/321 | E190   |        |      |          |
| MAI  | B737-500     | B737-700 |        |        |      |          |
| MAS  | B757         | B777     |        |        |      |          |
| MAU  | A340         |          |        |        |      |          |
| MEA  | amille A320  | A330     |        |        |      |          |
| MGX  | E190         |          |        |        |      |          |
| MLD  | E190         | A330     |        |        |      |          |
| MSC  | A320         |          |        |        |      |          |
| MSR  | amille A320  | A330     | B73x   | B777   |      |          |
| OMA  | A330         |          |        |        |      |          |
| PGT  | A320         | B737     |        |        |      |          |
| QTR  | A320         | A330/340 | A350   | A380   |      |          |
| RAM  | B73x         | B747     | B767   | B787   |      |          |
| REU  | B777         | A330     |        |        |      |          |
| RJA  | amille A320  | A330     | B73x   |        |      |          |

**legende**

capable Minima LNAV/VNAV



capable Minima LNAV seulement

incapable finale RNAV

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**FEEDBACK**

**IDENTIFY FLEET CAPABILITY...**

**Example LFPG**

| Minima                          | Taux équipement à CDG (avril 2016) |
|---------------------------------|------------------------------------|
| LNAV                            | 90 %                               |
| LNAV/VNAV Appelées « BaroVNAV » | 80 %                               |
| LPV (≈ ILS cat I)               | < 1% (A350)                        |


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**PARIS ACC**



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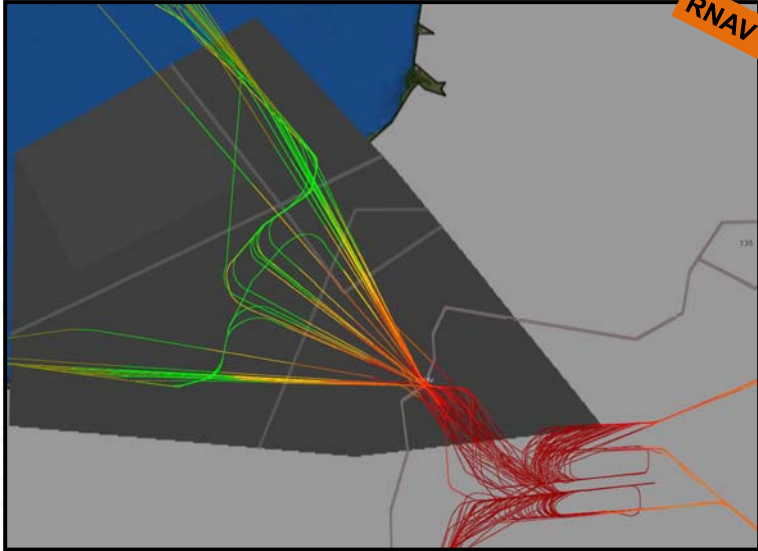
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## But also in Paris ACC: PMS

RNAV 1



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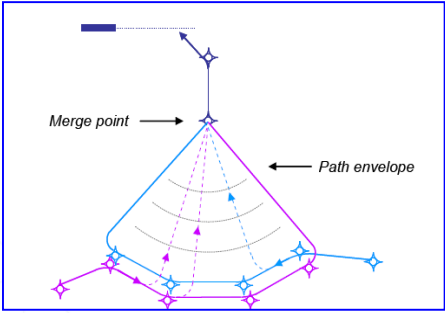
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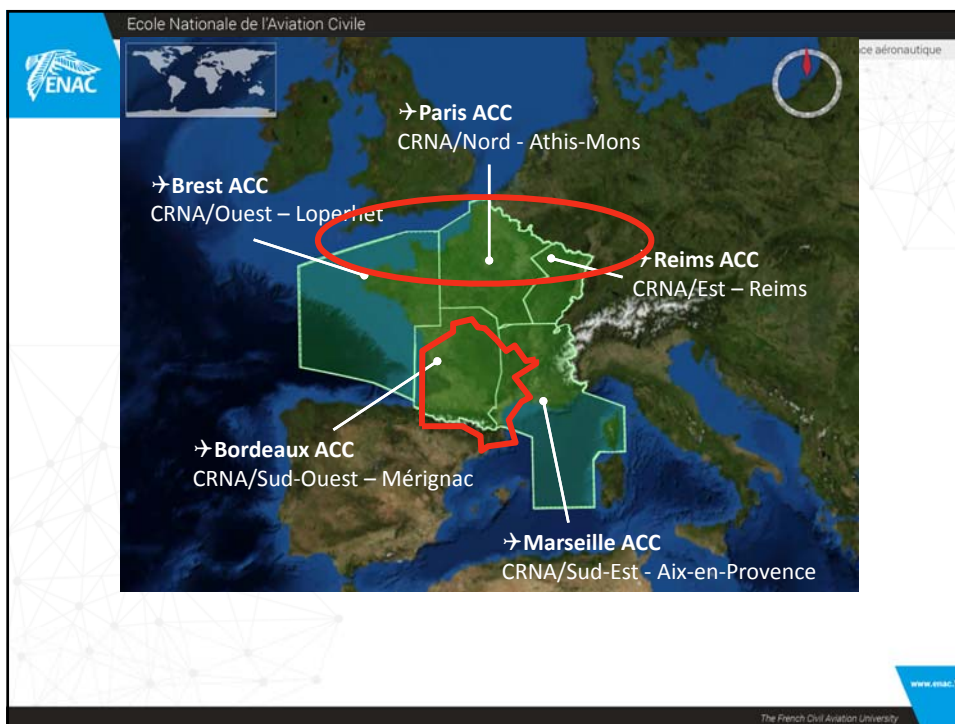
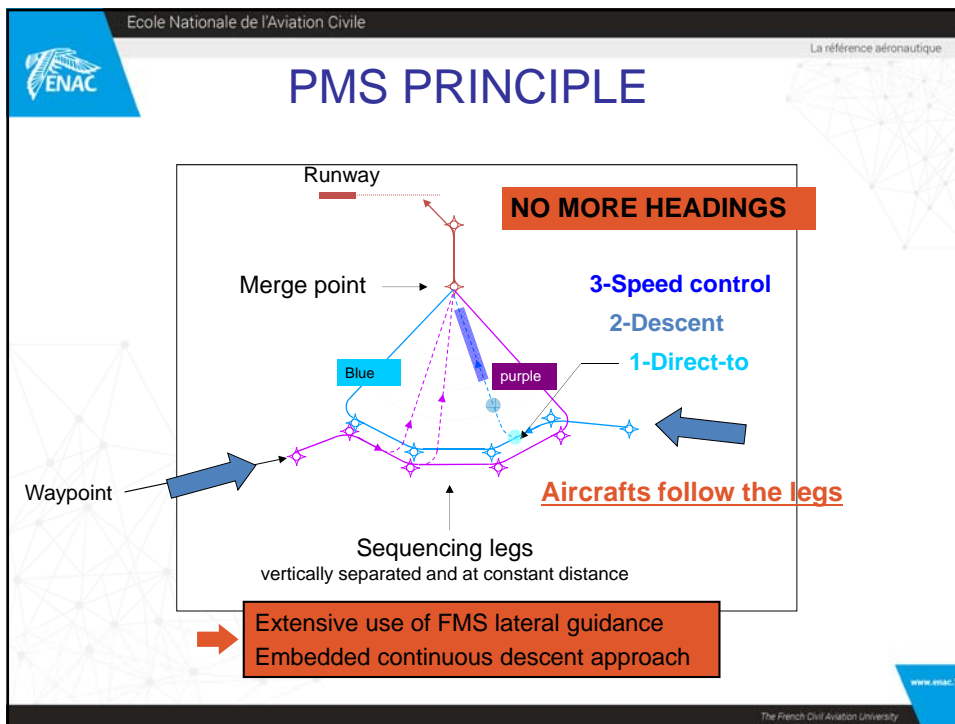
## PMS A SOLUTION

- Merge Point + Use of sequencing legs ( equidistant from this point)
- In order to sequence aircrafts



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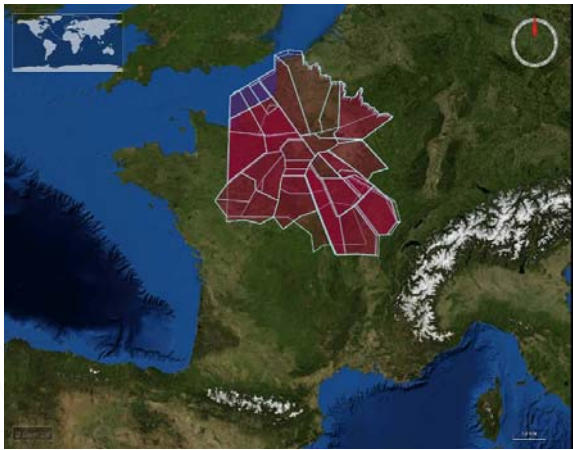


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## Paris area ATC organization



The map shows the geographical outline of France with a network of red lines representing ATC organizational boundaries. A small inset map in the top left corner shows the location of France within Europe. A compass rose is located in the top right corner of the map area.

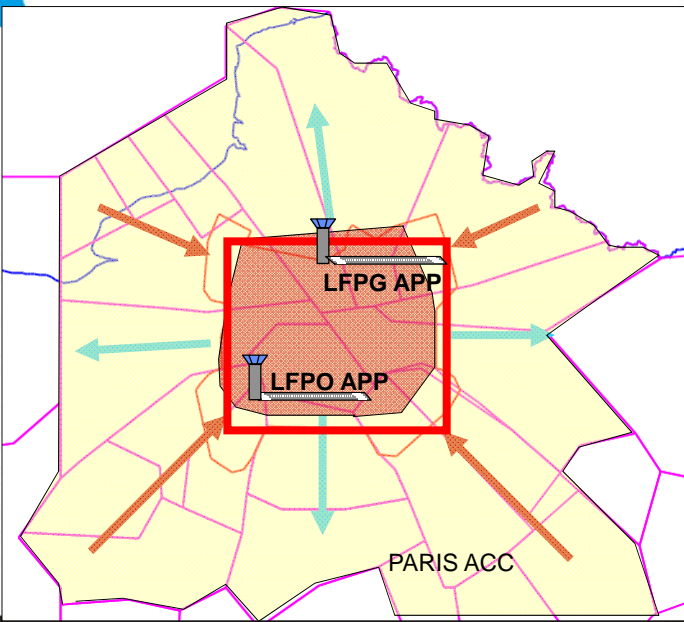
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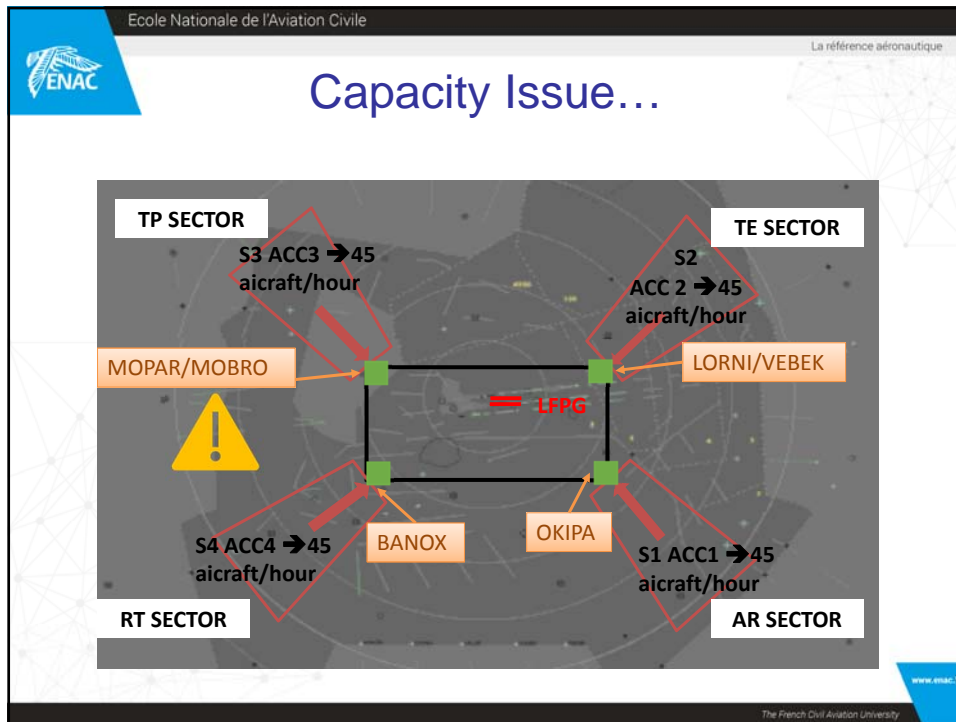
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The diagram illustrates the ATC organization structure in the Paris area. A central red-bordered area contains two towers: the top one is labeled 'LFPG APP' and the bottom one is labeled 'LFPO APP'. Below this central area, the text 'PARIS ACC' is displayed. The entire area is divided into several yellow-colored sectors by magenta lines. Orange arrows point from the central area towards the outer sectors, and light blue arrows point from the outer sectors towards the central area, indicating the flow of traffic and communication.

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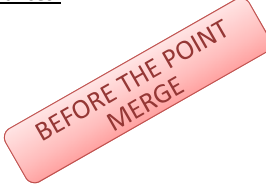
## Application to Extended TMA: Paris TMA

↓

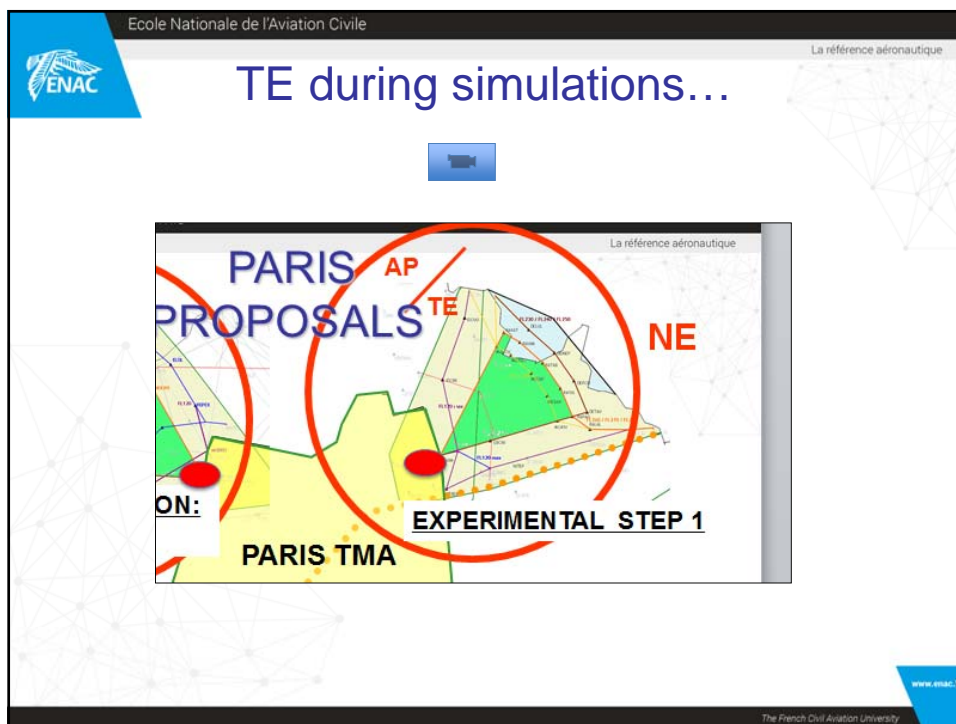
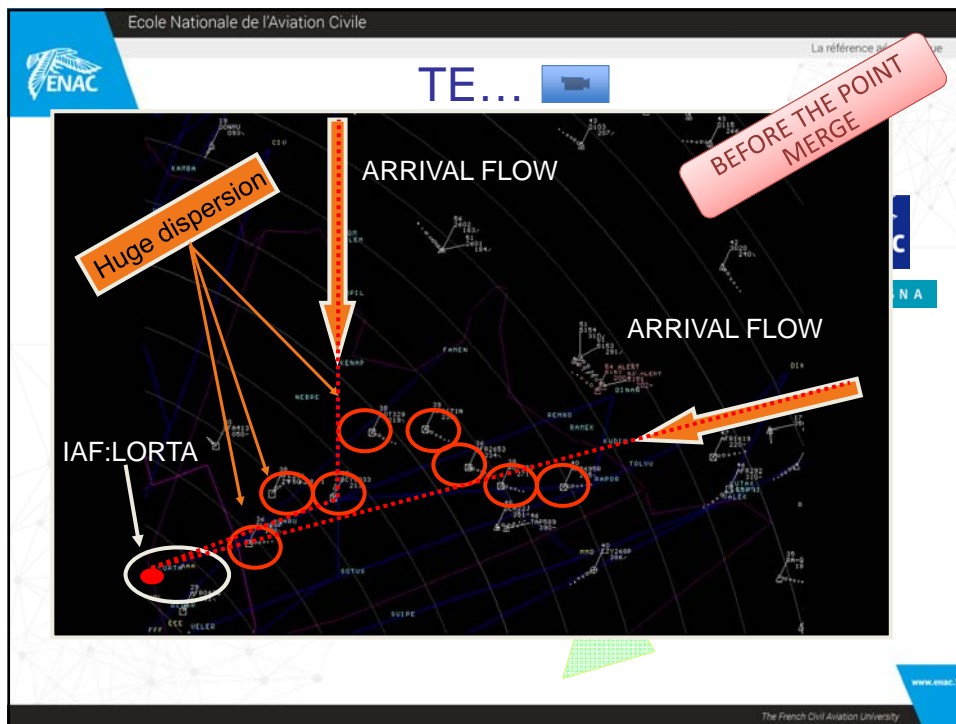
- How did it work in Paris extended TMA before November 2013 (Radar environment)?

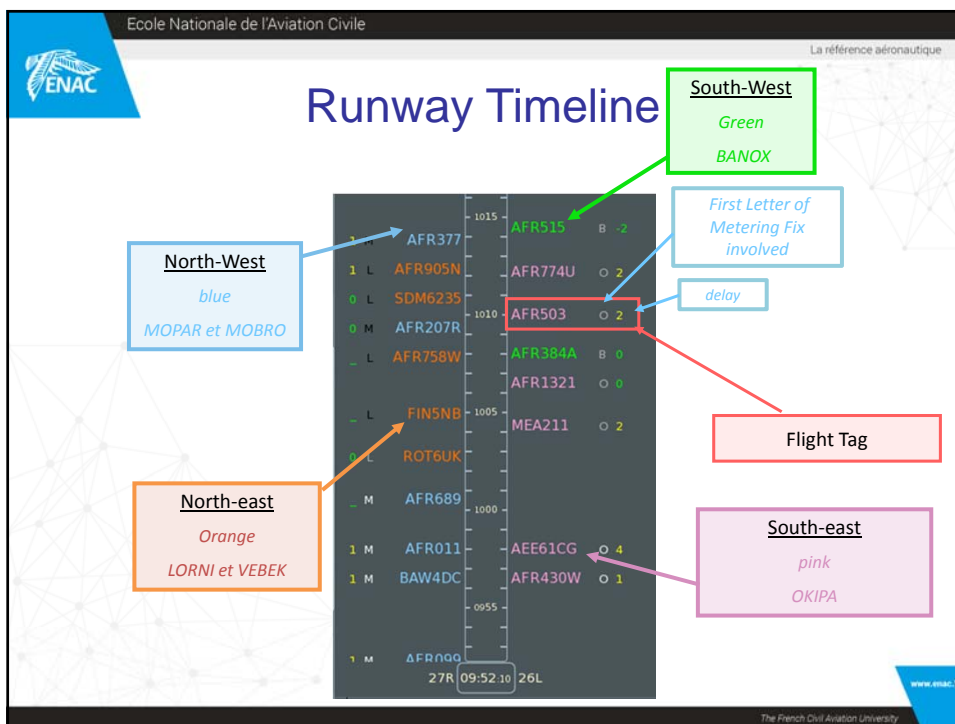
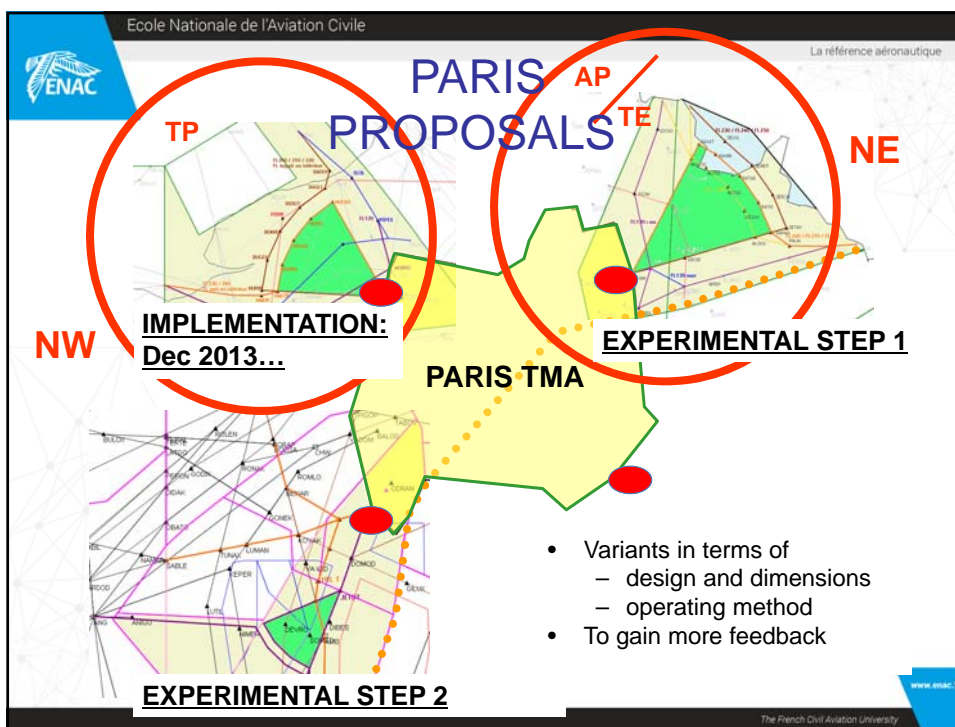
**Application to Extended TMA: Paris TMA**

- Sequencing using 3 Instructions/ Clairances:**
  - « Speedbird 243, turn left heading 240, continue descent 6000' QNH 1023, reduce speed 220 Kts »
    - Heading: Radar Vectoring
    - Flight Level/ Altitude
    - Speed Restriction

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## Sequencing in Terminal sectors with (TP) and without (TE) Merge Point

| North RWY    | South RWY   |
|--------------|-------------|
| 17 M AUA411C |             |
| 17 M AFR1473 |             |
| 17 M BAW304  |             |
| 17 M AFR1017 | AFR3785 M - |
| 17 M BT18G   |             |
| 17 M KLM77P  |             |
| 11 M AFR1089 |             |
| 12 M AFR801W |             |
| 11 M AFR551U |             |
| 9 M AFR1695  |             |
| 8 M EZY89AT  | AFR3125 M 1 |
| 9 H ACA870   | DAH1002 M 1 |
| 8 M AFR124R  | AFR3355 M 3 |
| 9 M AFR1559  | AF673KB M 1 |
| 9 M AFR1135  | LZ8431 M 1  |
| 9 M AFR1463  | VLG8242 M - |
| 10 M BEE218Z | AFR3401 M - |
| 10 H AAL42   | ASL310 M 1  |
| 5 M AFR1845  | AMC478 M 3  |
| 5 M AFR1275  | SWR67X M 4  |
| 5 M AFR148L  | AFR3513 M 2 |

- ✓ Reduction of workload and communication
- ✓ More optimized descent profiles
- ✓ Coupled with an AMAN
- ✓ Optimal for tactical flow management

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## FEEDBACK

**PBN IS JUST A BEGINNING...**

- Develop new RNAV procedures
- Train En-Route ATC on PBN **ALSO!**

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# ATC PBN TRAINING

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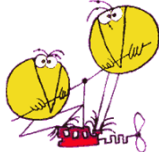
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# THANK YOUR FOR ATTENTION

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