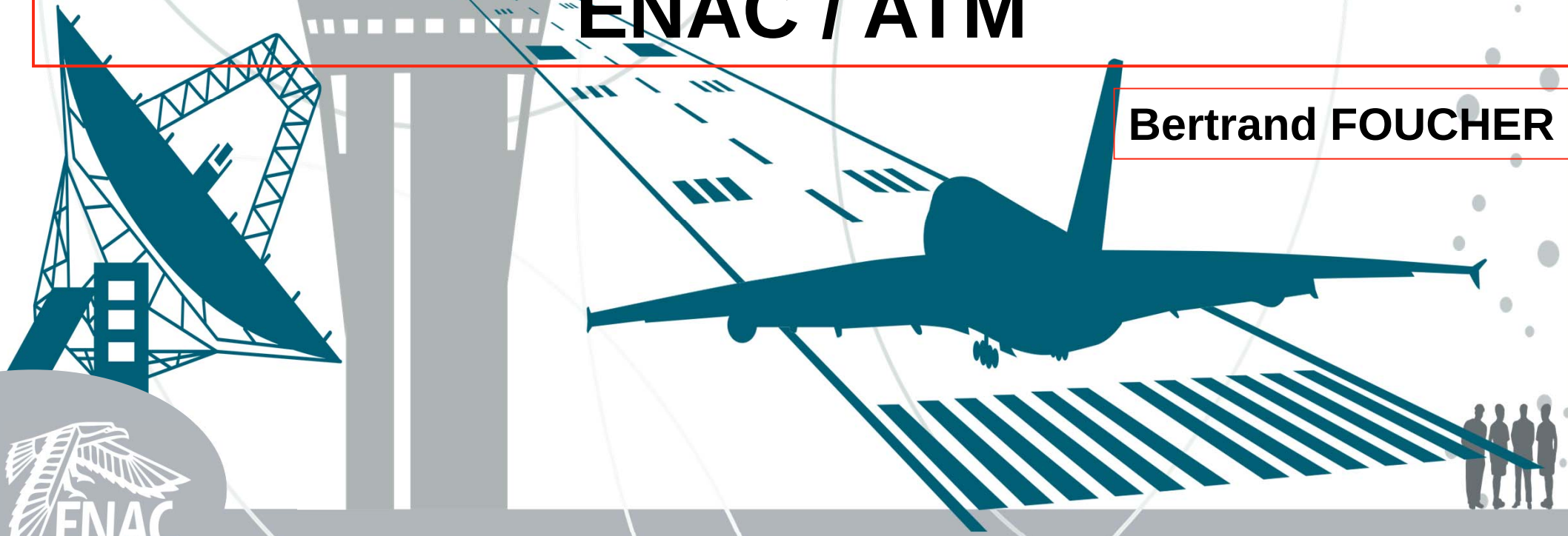
ICAO PBN GO TEAM
PBN Implementation Workshop

Tunis, 24-28 February 2014

ENAC / ATM

Bertrand FOUCHER



École nationale de l'aviation civile • The French Civil Aviation University

ENAC
La référence aéronautique

www.enac.fr

PERSONAL BACKGROUND

- ATC in Paris Charles de Gaulle
- ATC Supervisor in Paris Charles de Gaulle,
- ATC Instructor at ENAC/ATM: *TWR/APP/ACC* (Toulouse/ France),
- ATC Training Manager at ENAC/ATM:
  - In charge of French ATC cadets training
  - Involved in ATCO PBN Training (France, India, China..)
  - Member of ICAO EUR-NAT PBN Task Force,
  - Member of French PBN Implementation group,

PBN ATCO TRAINING ISSUES
Preamble

QUESTION

ATCO TRAINING:

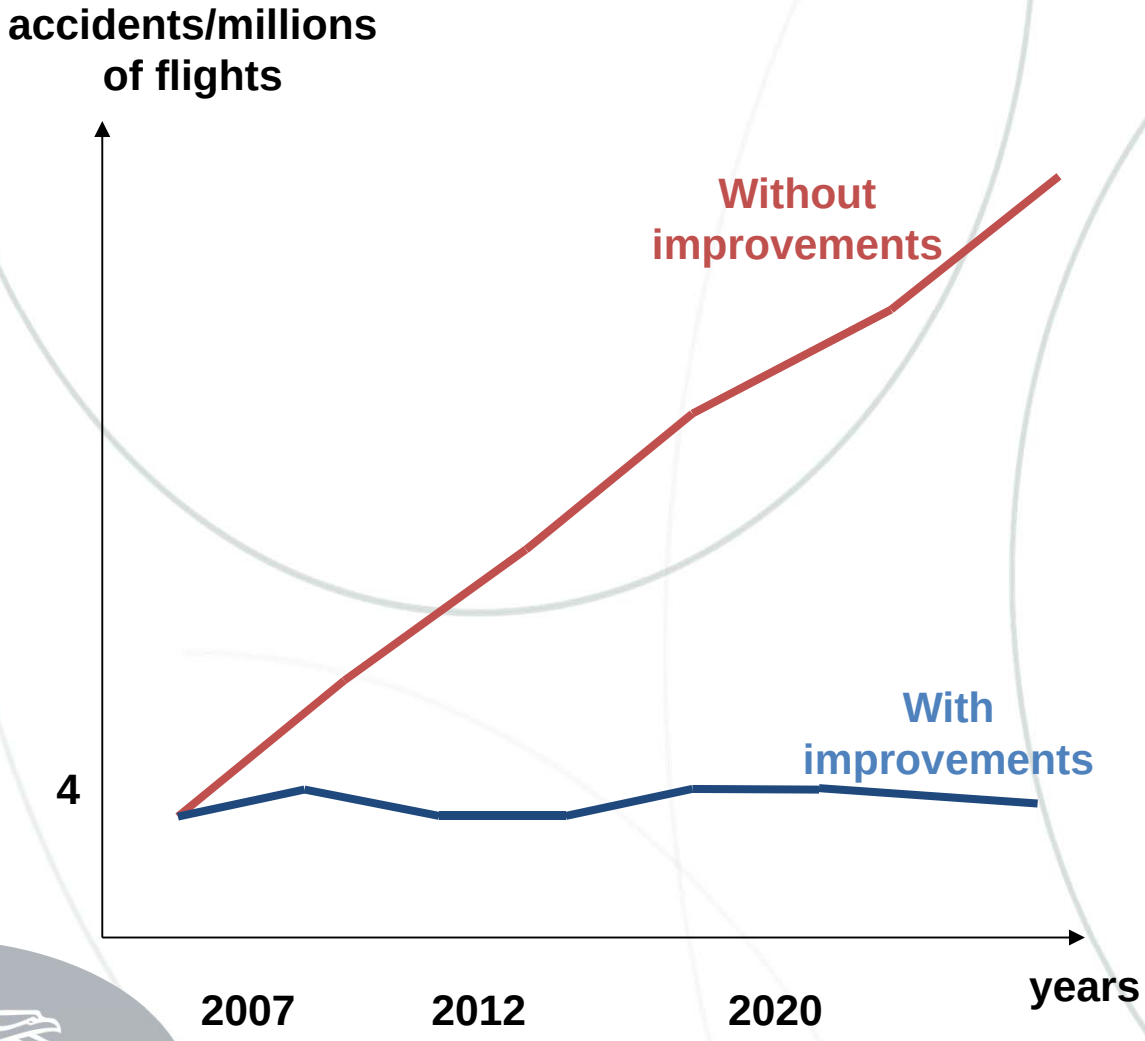
« What milestones do we have to consider before implementing PBN locally»

QUESTION

<u>ATCO TRAINING:</u>

« A Key element !!!»

Two different futures for aviation



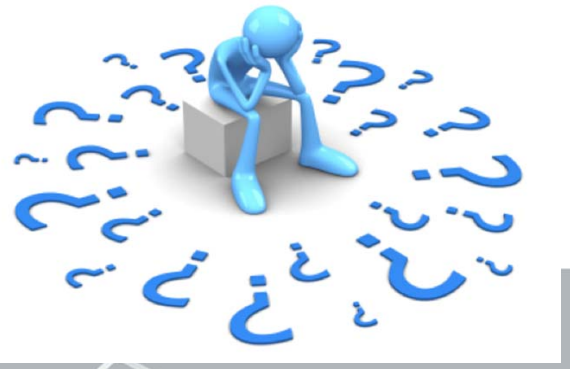
New procedures and technologies have improved the system, thanks to it the rate of accidents is flat for years even if the traffic is increasing

But what can we enhance now?

QUESTION

ATCO TRAINING: Why?

- *Prepare ATCos for new technologies or concepts,*
  - *CPDLC (ACARS and/or ATN Network),*
  - *AMAN, DMAN*
  - *Surveillance tools: ADS/ Mode S,*
  - *Electronic stripping/Stripless/ MTCD/ APW/ MSAW,*
  - *A-CDM…*
- *And what about PBN?*



QUESTION

ATCO TRAINING: Why?

- *We have all heard about PBN itself:*
  - *RNAV1/ RNP4, RNP APCH…*
- *Or PBN Applications:*
  - *RNAV SIDs/STARs,*
  - *CDO/CCO,*
  - *Free Routes,*
  - *Merge Point in TMA or Extended TMA…*

QUESTION

ATCO TRAINING: Why?

« Therefore, It was compulsory for us , ENAC, to develop a specific PBN Training for ATCos »

SAFETY

PBN ATCO TRAINING ISSUES
Proposals

AGENDA

1. PBN Training for ATCO: Issues and solutions
2. A reference Doc: ICAO Doc 9613,
3. PBN in context,
4. An adapted Training,
5. Questions ?

AGENDA

1. PBN Training for ATCO: Issues and solutions
2. A reference Doc: ICAO Doc 9613,
3. PBN in context,
4. An adapted Training,
5. Questions ?

How to explain PBN Concept?

- Issues:
  - Technical Subject,
  - Many acronysms,
  - In Operational Situations?

How to explain PBN Concept?

- Some solutions: Specific PBN Training
  - Step by step,
  - Explain RNAV Concept,
  - Explain GNSS Concept,
  - **Then** explain PBN Concept
  - Use of pedagogical material,

  - **Locate the ATC in PBN field**.

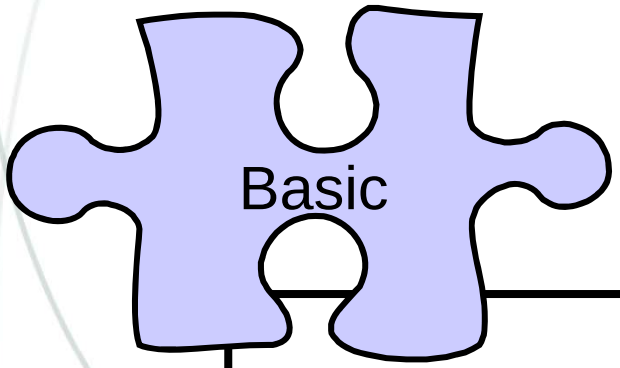
How to explain PBN Concept?

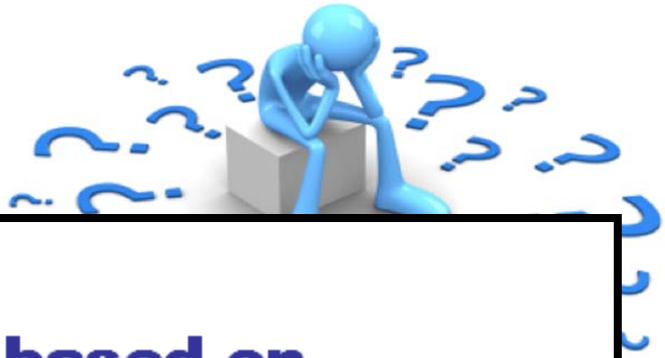
- Some solutions:
  - **Step by step**,
  - Explain RNAV Concept,
  - Explain GNSS Concept,
  - **Then** explain PBN Concept
  - Use of pedagogical material,

  - **Locate the ATC in PBN field**.

How to explain PBN Concept? What have we learned from the past?

How to explain PBN Concept?





Positioning : Sensors

Lateral positioning based on

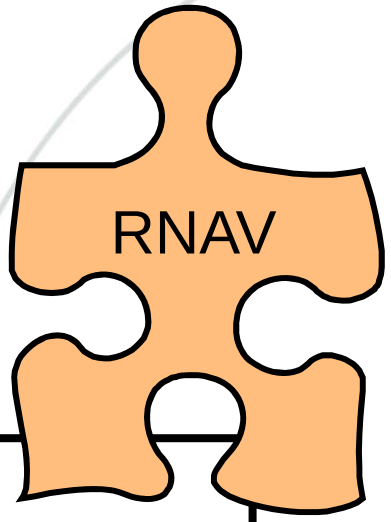
Aircraft systems	Ground systems	Satellite systems
IRU or INS	DME/DME VOR/DME	GNSS

How to explain PBN Concept?

- Some solutions:
  - Step by step,
  - **Explain RNAV Concept**,
  - Explain GNSS Concept,
  - **Then** explain PBN Concept
  - Use of pedagogical material,

  - **Locate the ATC in PBN field**.

How to explain PBN Concept?



You have to distinguish those two notions

Position → Navigation

Ground and satellite Facilities

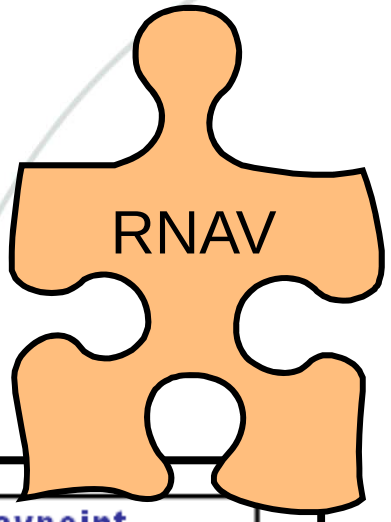
Conventional Navigation

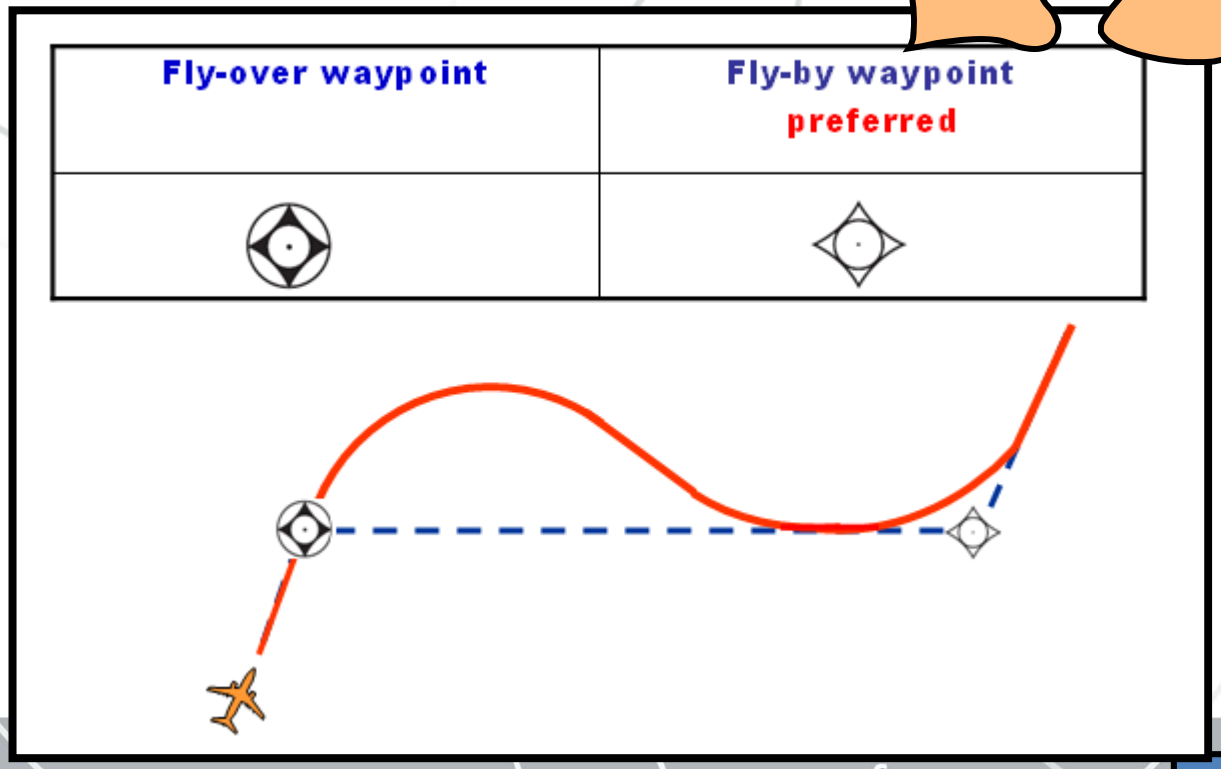
aRea NAVigation (RNAV)

But all ground facilities don't permit aRea NAVigation during all flight phases

How to explain PBN Concept?

How to explain PBN Concept?



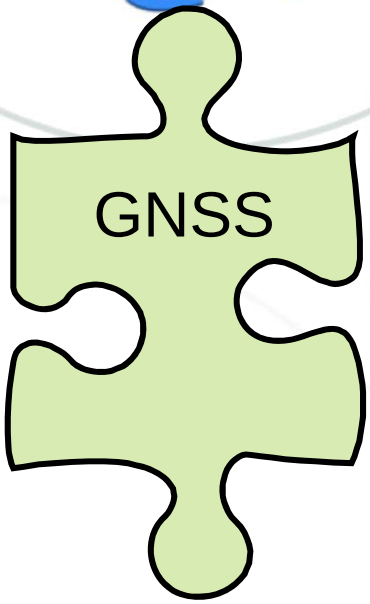


How to explain PBN Concept?

- Some solutions:
  - Step by step,
  - Explain RNAV Concept,
  - **Explain GNSS Concept**,
  - **Then** explain PBN Concept
  - Use of pedagogical material,

  - **Locate the ATC in PBN field**.

How to explain PBN Concept?



1. Positioning System: GPS, GLONASS, GALILEO…
2. Augmentation System: ABAS, SBAS, GBAS
3. On-board receiver: Stand alone, multisensors

How to explain PBN Concept?

- Some solutions:
  - Step by step,
  - Explain RNAV Concept,
  - Explain GNSS Concept,
  - **Then explain PBN Concept**
  - Use of pedagogical material,

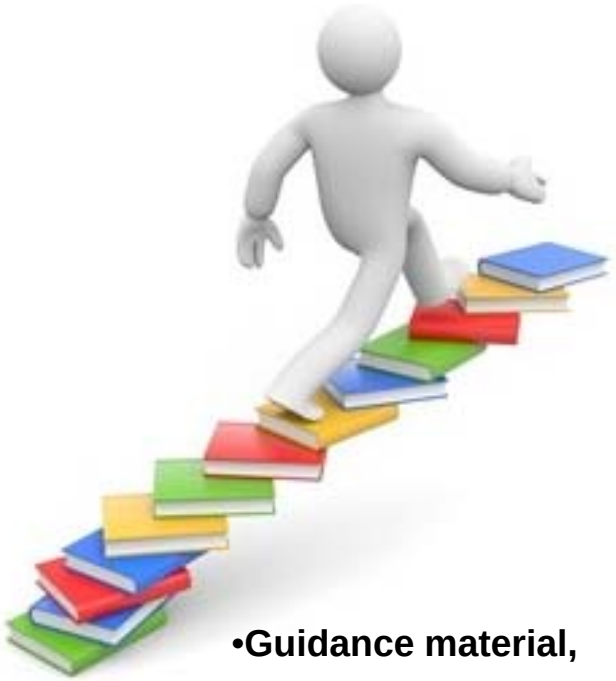
  - **Locate the ATC in PBN field**.

How to explain PBN Concept?

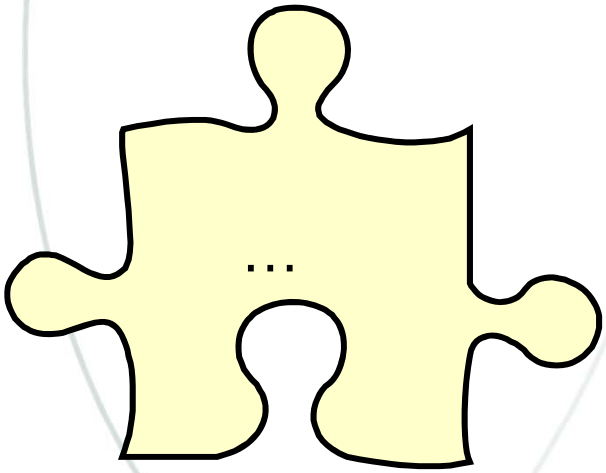
- Some solutions:
  - Step by step,
  - Explain RNAV Concept,
  - Explain GNSS Concept,
  - **Then** explain PBN Concept
  - **Use of pedagogical material,**

  - **Locate the ATC in PBN field**.

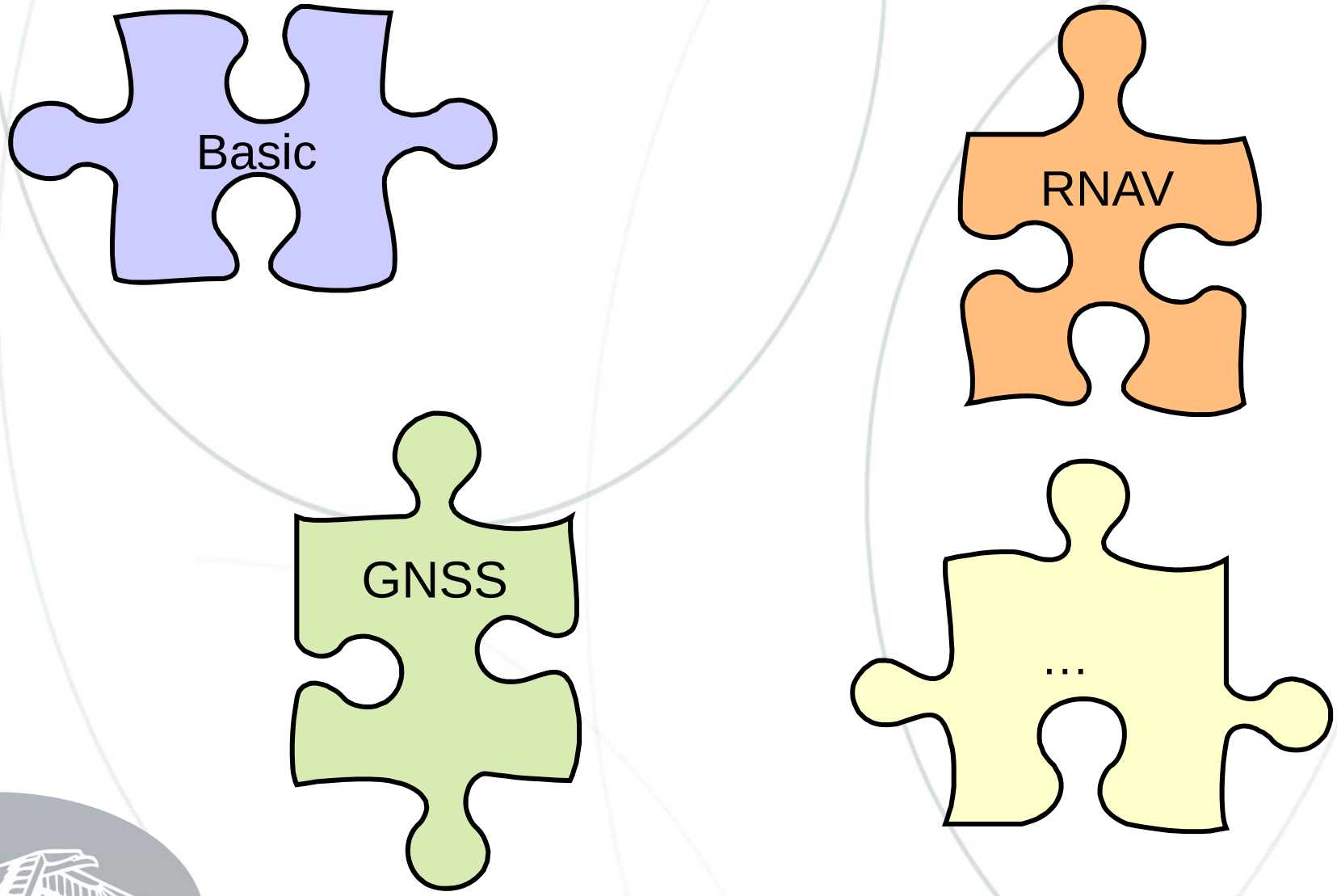
How to explain PBN Concept?



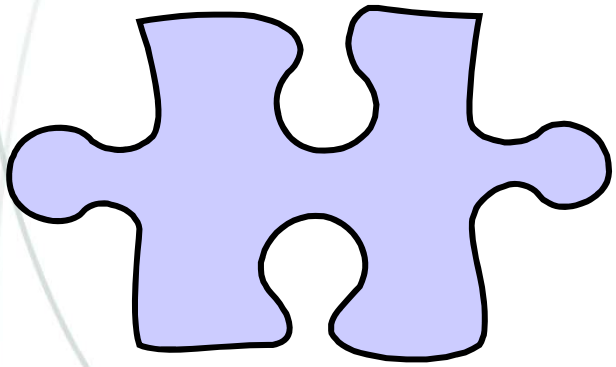
- **Guidance material,**
- **Formal Training,**
- **PBN Tools,**
- **CBT,**
- **Continuous Training,**



How to explain PBN Concept?

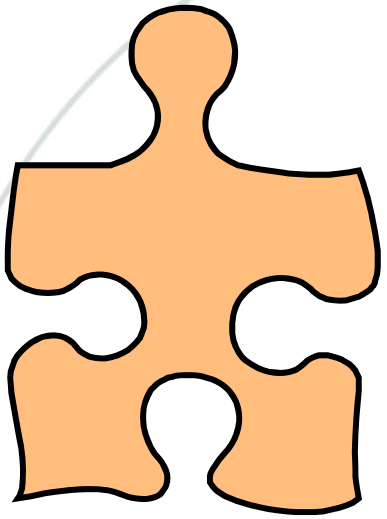


How to explain PBN Concept?

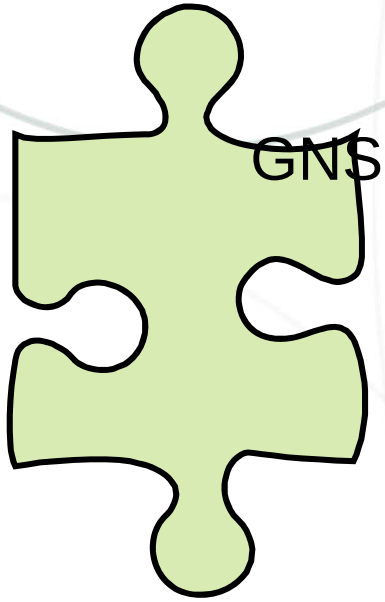


BASIC

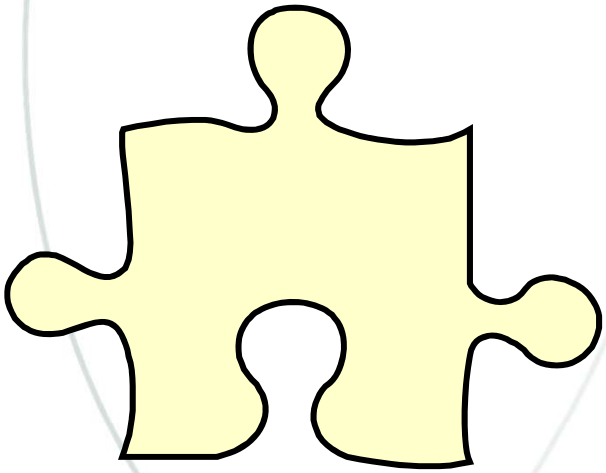
RNAV



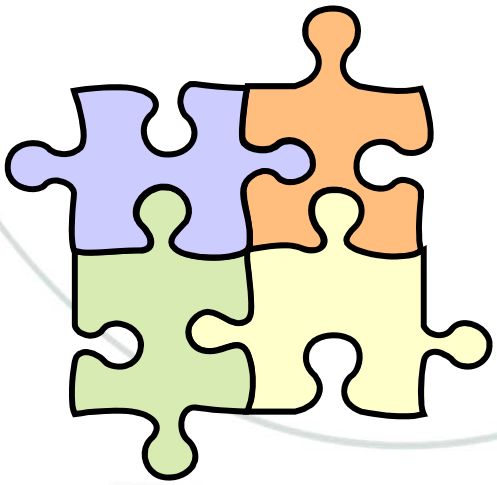
GNSS

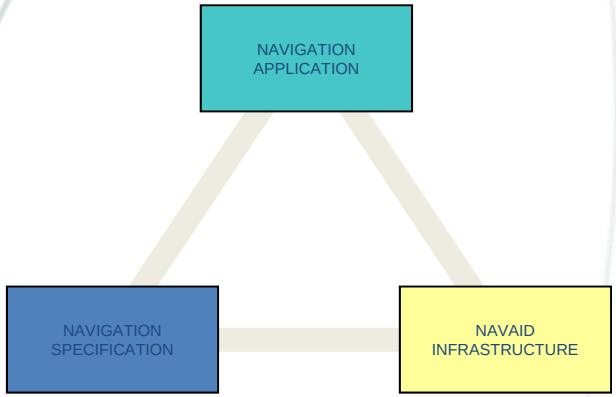


...



How to explain PBN Concept?





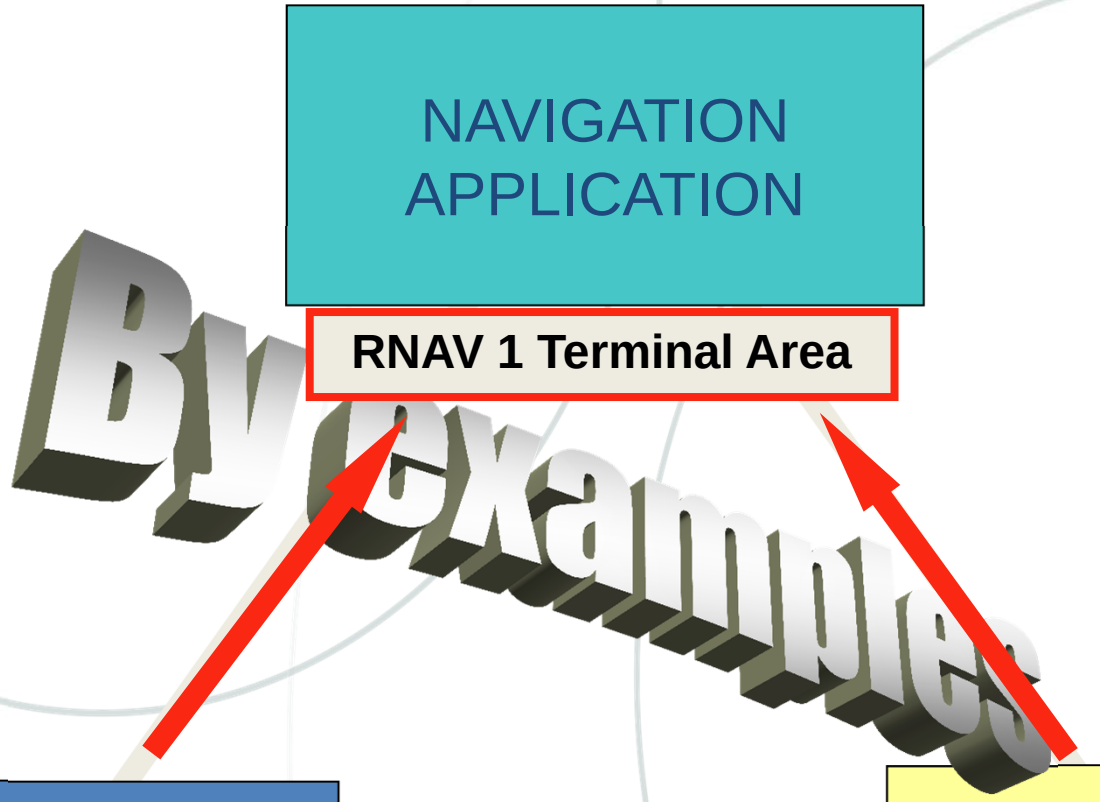
Components of PBN Concept

NAVIGATION APPLICATION

NAVIGATION SPECIFICATION

NAVAID INFRASTRUCTURE

Components of PBN Concept



How to explain PBN Concept?

- Some solutions:
  - Step by step,
  - Explain RNAV Concept,
  - Explain GNSS Concept,
  - **Then** explain PBN Concept
  - Use of pedagogical material,

  - **Locate the ATC in PBN field…**

How to explain PBN Concept?

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

How to explain PBN Concept?

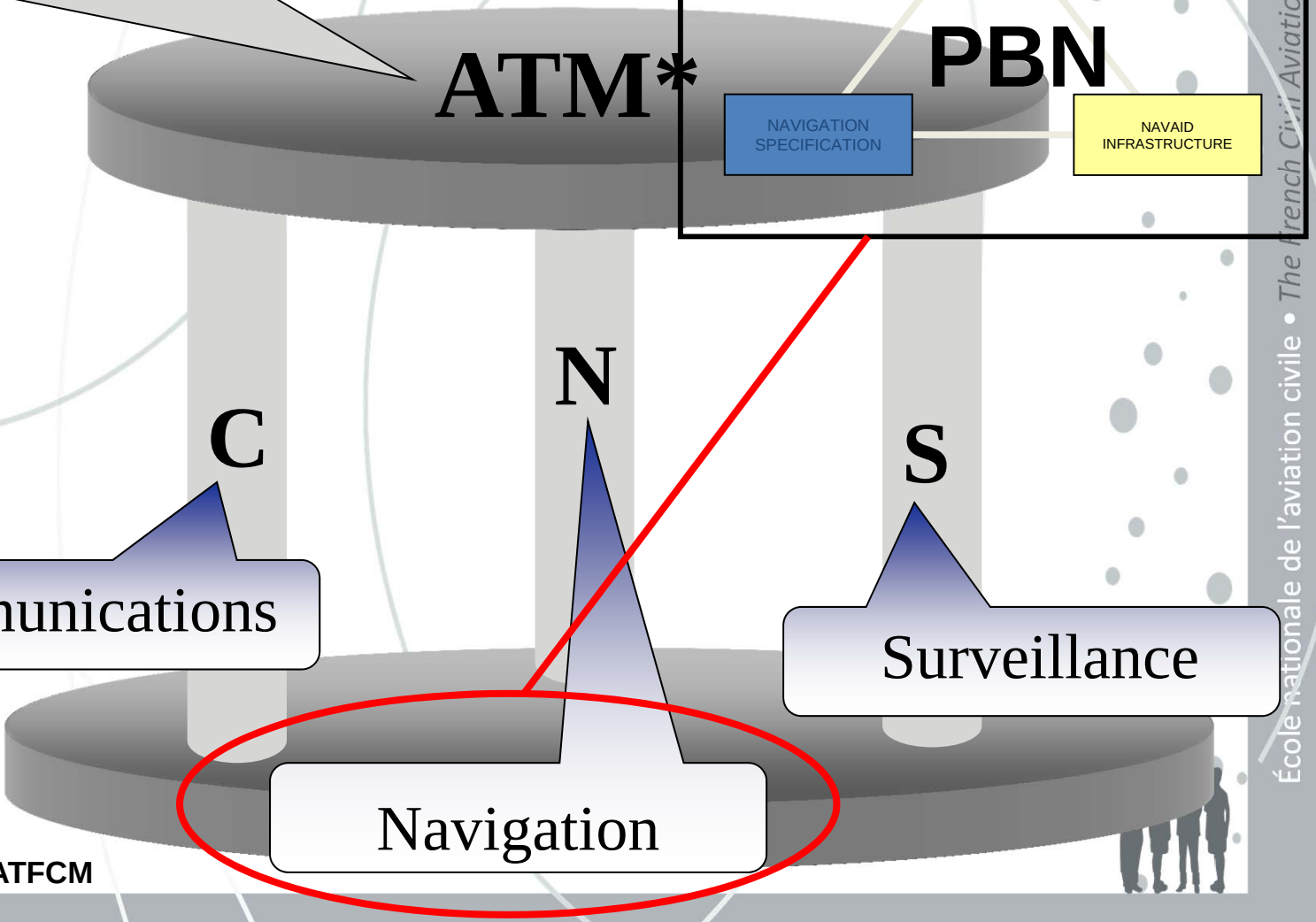
1. As an ATM component,
2. In which ATCs are involved,

How to explain PBN Concept?

Air Traffic Management

Operational world

Technological world



*ATM = ATS+ ASM + ATFCM

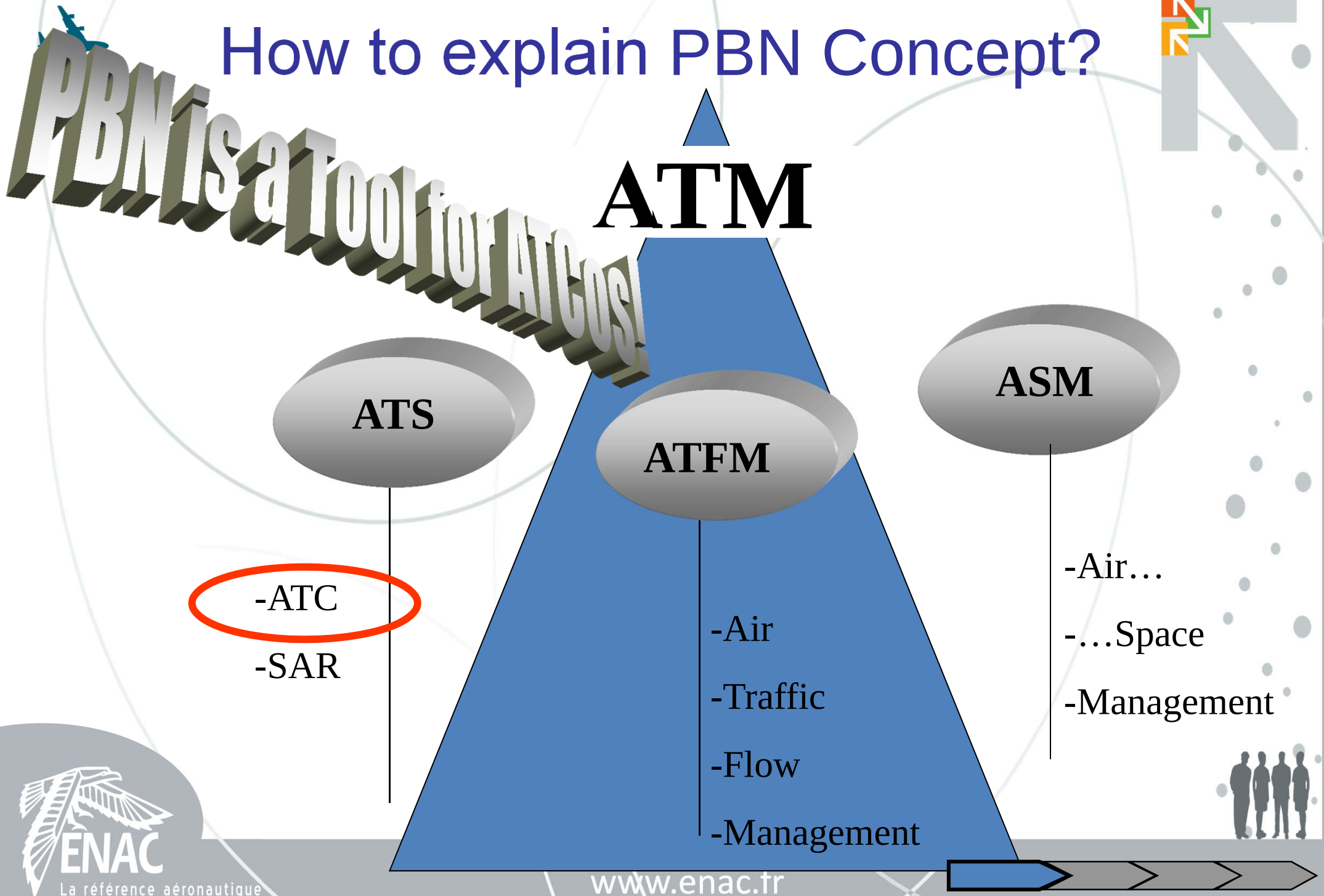
How to explain PBN Concept?

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

How to explain PBN Concept?

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

How to explain PBN Concept?



AGENDA

1. PBN Training for ATCO: Issues and solutions
2. A reference Doc: ICAO Doc 9613,
3. PBN in context,
4. An adapted Training,
5. Questions ?

AGENDA

1. PBN Training for ATCO: The issues,
2. A reference Doc: ICAO Doc 9613
3. PBN in context
4. An adapted Training,
5. Questions?

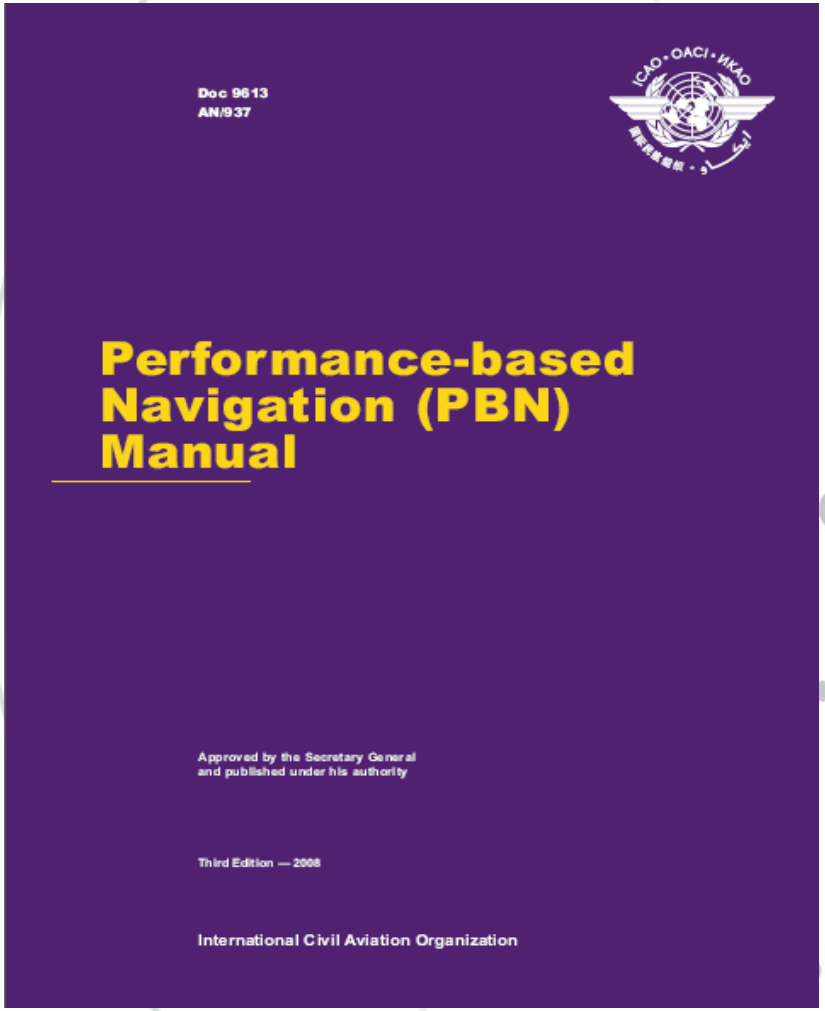
A Reference Doc.: Doc.9613(4th)

PBN Origin

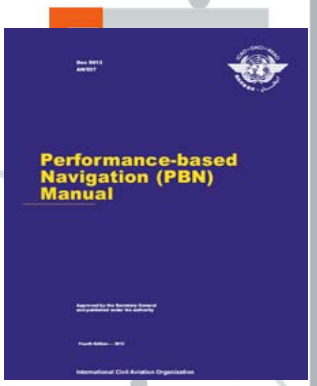
Necessity to homogenize and to standardize those operational requirements

So ICAO created the PBN concept

- The PBN Manual
- Doc 9613
- has been published by ICAO



The reference Documentation: **DOC.9613**



VOL.1
« Concept and implementation guidance »

PART.A
« The PBN Concept»

PART.B
« Implementation guidance»

ATTACHMENTS

A.1
« RNAV Systems»

A.2
« Data Processes»

A.3
« Certification»

VOL.2
« Implementing RNAV and RNP Operations »

PART.A
« General »

PART.B
« Implementing RNAV operations »

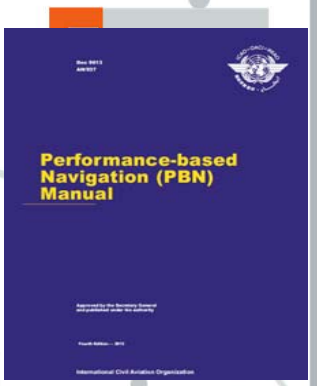
PART.C
« Implementing RNP operations »

ATTACHMENTS

A.A
« Barometric VNAV»

A.B
« Aispace concept»

The reference Documentation: **DOC.9613**



VOL.1
« Concept and implementation guidance »

PART.A
« The PBN Concept»

PART.B
« Implementation guidance»

ATTACHMENTS

A.1
« RNAV Systems»

A.2
« Data Processes»

A.3
« Certification»

VOL.2
« Implementing RNAV and RNP Operations »

PART.A
« General »

PART.B
« Implementing RNAV operations »

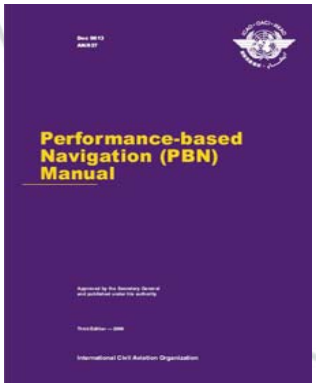
PART.C
« Implementing RNP operations »

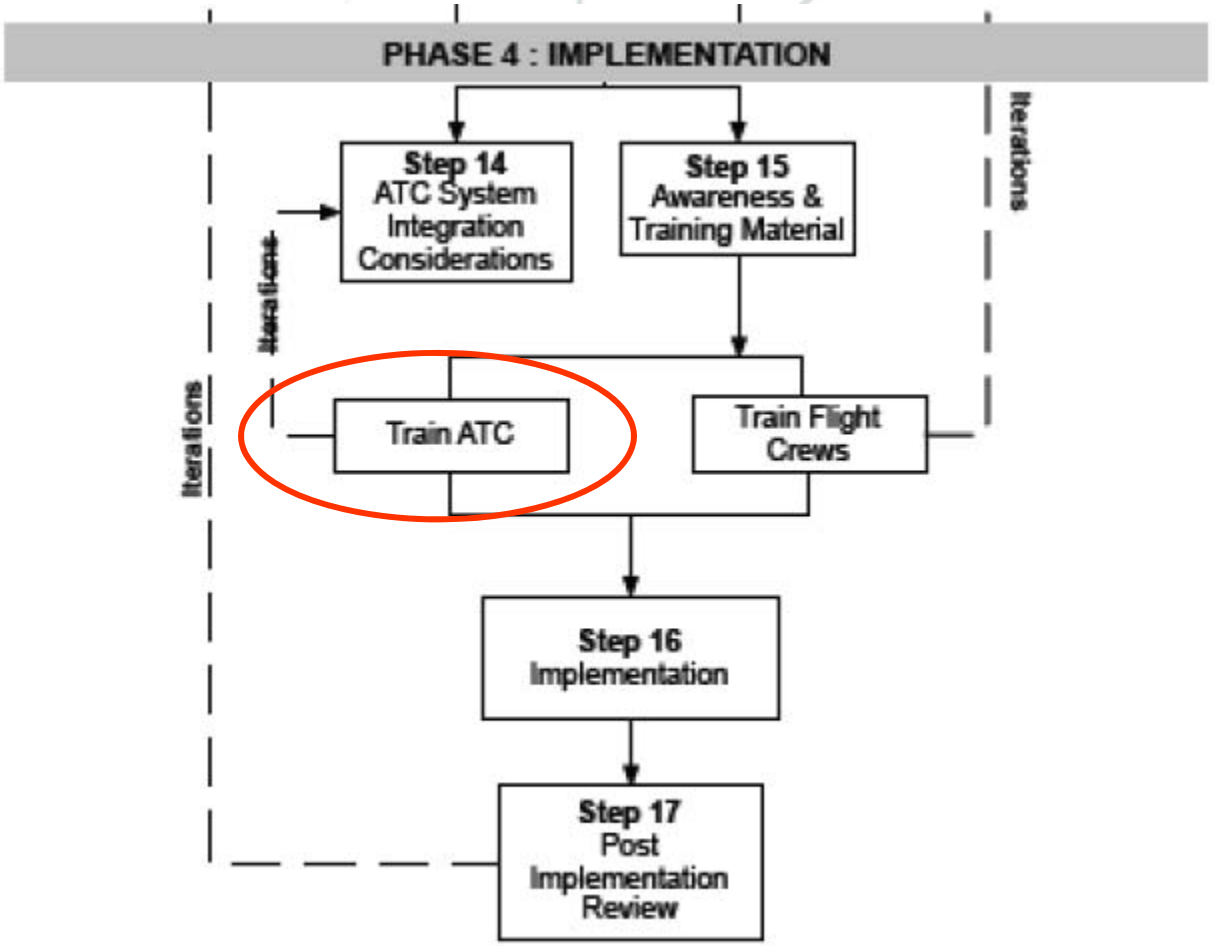
ATTACHMENTS

A.A
« Barometric VNAV»

A.B
« Aispace concept»

A Reference Doc.: Doc.9613





A Reference Doc.: Doc.9613

- The different ICAO Navigation Specification:
  - **RNAV 10/RNP 10,**
  - **RNAV 5,**
  - **RNAV 2/1,**
  - **RNP 4,**
  - **RNP 2,**
  - **RNP 1,**
  - *ADVANCED RNP*,
  - **RNP APCH,**
  - **RNP AR APCH,**
  - *RNP 0,3: For helicopters needs.*

A Reference Doc.: Doc.9613

- The different ICAO Navigation Specification:
  - RNAV 10/RNP 10,
  - **RNAV 5,**
  - **RNAV 2/1,**
  - **RNP 4,**
  - **RNP 2,**
  - **RNP 1,**
  - *ADVANCED RNP,*
  - **RNP APCH,**
  - **RNP AR APCH,**
  - *RNP 0,3: For helicopters needs.*

Each ATCo Training SHOULD BE divided in 2 parts:

1- Core Training

2- NaV Spec. Training = **RNAV 2/1 Training**

TRAINING

AGENDA

1. PBN Training for ATCO: The issues,
2. A reference Doc: ICAO Doc 9613
3. PBN in context
4. An adapted Training,
5. Questions?

PBN in context

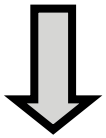
Benefits for:

- Airlines,
  - Improved Fuel consumption,
  - Optimised flight levels(more routes/more solutions)
  - Visual RNAV…
- Aircraft Manufacturers,
- Sustainable environment,
  - Reduce carbon emissions
  - Reduce noise/ fuel burn…
- ATC,
  - Strategic separations,
  - Optimised trajectories,
  - Flight predictability

PBN in context

Share Know-how and experience:

- At **ENAC**: guided tailored training
- On site: on demand

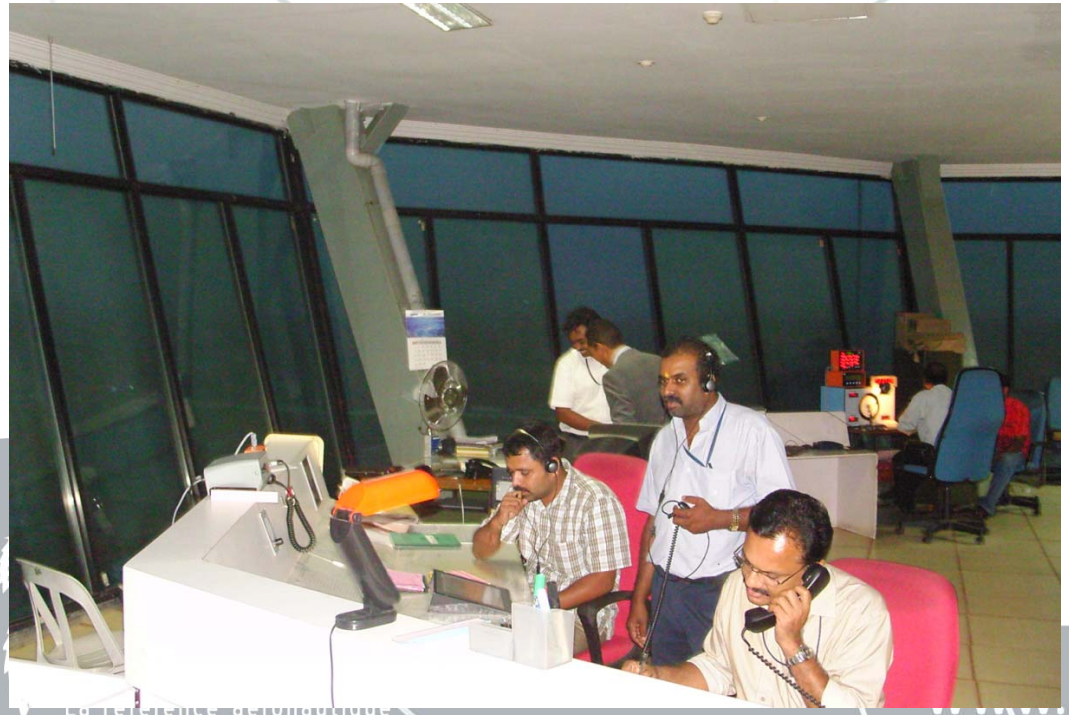


e-g: Training in South INDIA with support of AIRBUS

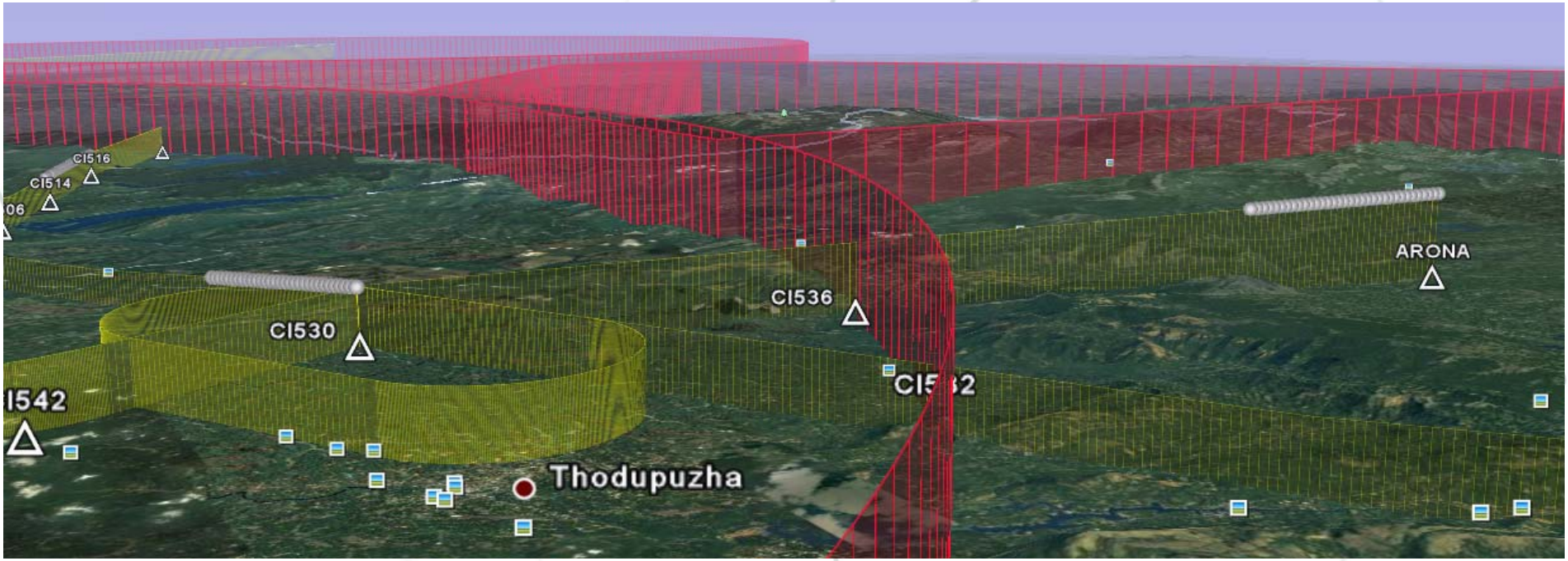
- **Expertise,**
- **ATCO Training.**

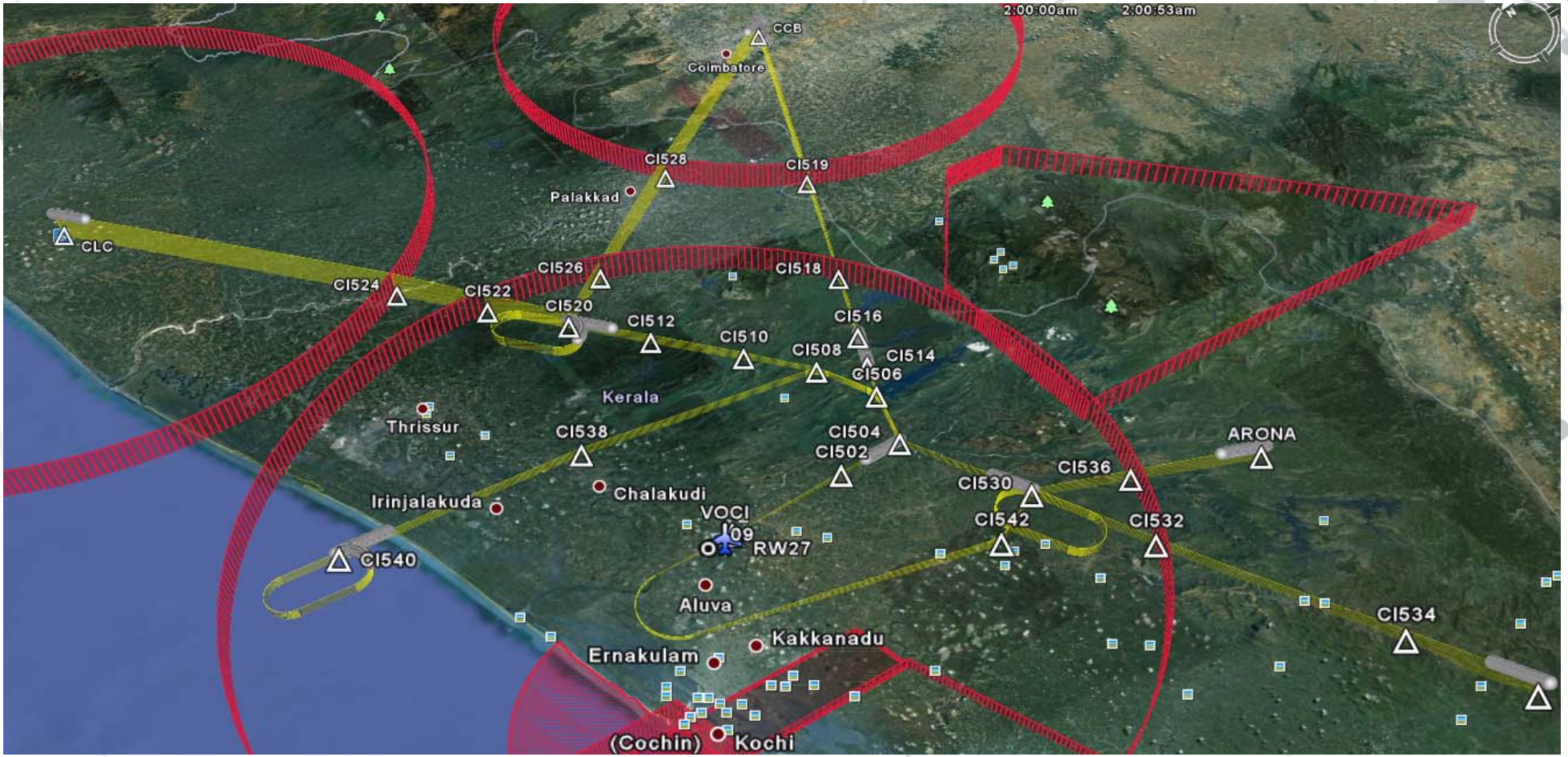
PBN in context

e-g: Training in INDIA with support of AIRBUS




Trivandrum
Tirunelveli
TUMLA
CI534
(Cochin)
CI542
ARONA
CI530
Ernakulam
CI540
CI502
RW27
Madurai
CI506
CI538
CI510
CI512
CI518
CI524
CI528
CI526
CLC
Coimbatore
CCB
Thiruchirapalli
Tamil Nadu
Erode

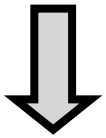

CI516
CI514
CI530
CI536
ARONA
Thodupuzha



PBN in context

Share Know-how and experience:

- **At ENAC**: guided tailored training
- On site: on demand

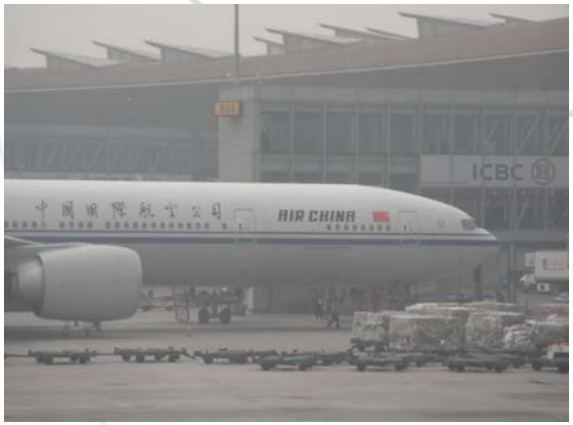


e-g: Training in CHINA for ATCO and Managers

- **New airspaces,**
- **New environment,**
- **New Training.**

PBN in context

e-g: Training in CHINA for ATCO



AGENDA

1. PBN Training for ATCO: The issues,
2. A reference Doc: ICAO Doc 9613
3. PBN in context
4. An adapted Training,
5. Questions?

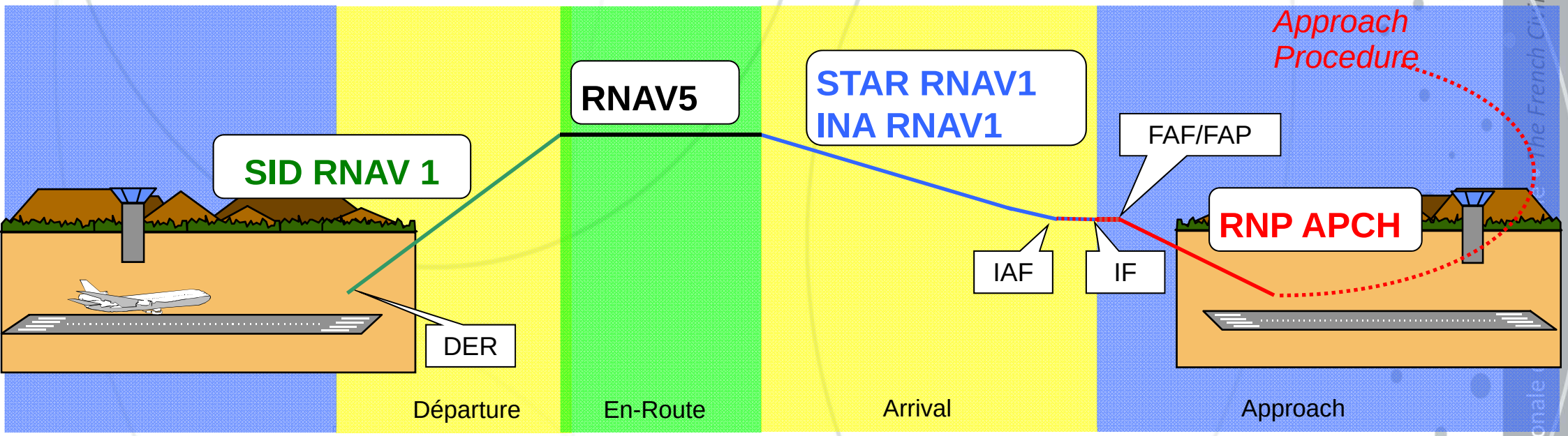
In 4 steps!

An adapted Training

- Identify the needs and adapt to local specificities,
- 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,
- Get some feedback and adapt

Example of PBN application in FRANCE

Course and PBN CBT



Accuracy 95% of flight time

1NM	5NM	1NM	0.3NM then 1NM

Sensors example

•DME/DME •GNSS	•DME/VOR	•GNSS	•GNSS

Example of phraseology in Non Radar environment

QATAR 123

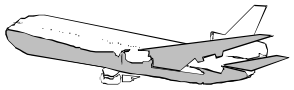
INDIGO 054

Qatar 12 chin, cleared for take

Indigo 05 ochin, CI540 RNAV

Indigo 054, Cochin, cleared CI540 RNAV approach runway 27 QNH 1023, report CI508

Cochin, Qatar 123, passing CIA 26 NM DME



CI522
CI526
CI520
CI512
CI518
CI510
CI540
CI538
CI516
CI508
CI514
CI506
CI502
RW27
CI501
CI504
CI544
CIB
CI530
CI542
CI536
CI532

D-172A
R-191A
D-172B
R-191B
R-182A

Example of WEB PBN for ATCO

https://e-campus.enac.fr

Train the Trainers in 7 milestones

ATC Impact

PBN Ops. | Flight Prep. | ATC Interface | Phraseology | Speed use | Direct Route | Proc.Interruption

Local constraints ???

This Training can be adapted for:

- *Pilots,*
- *Engineers,*
- *Operational staff..*

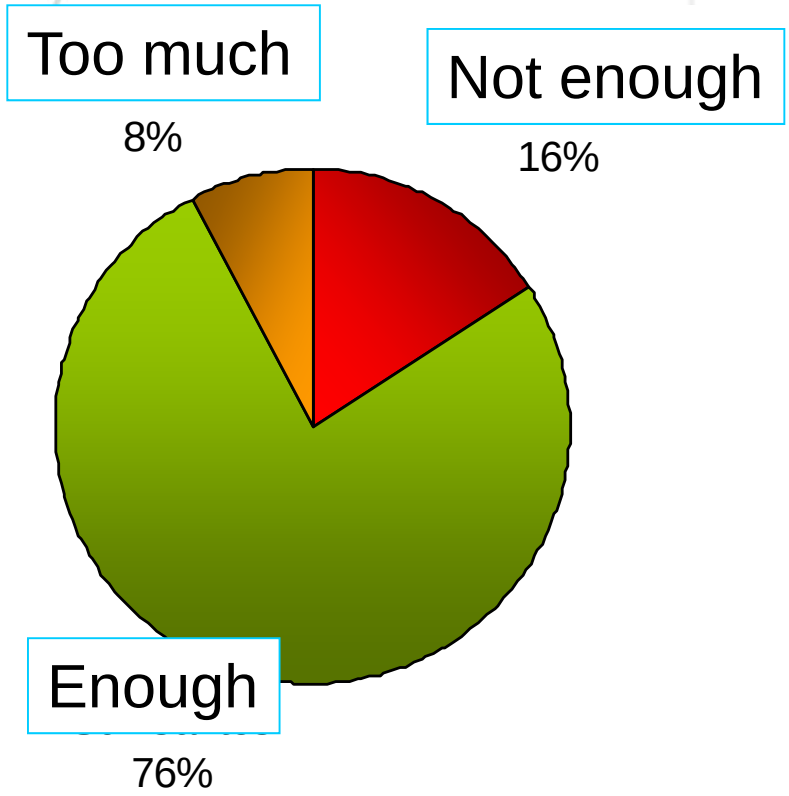
Get feedback

Feedback from ATCO about PBN training

Feedback from local Training Department about PBN training

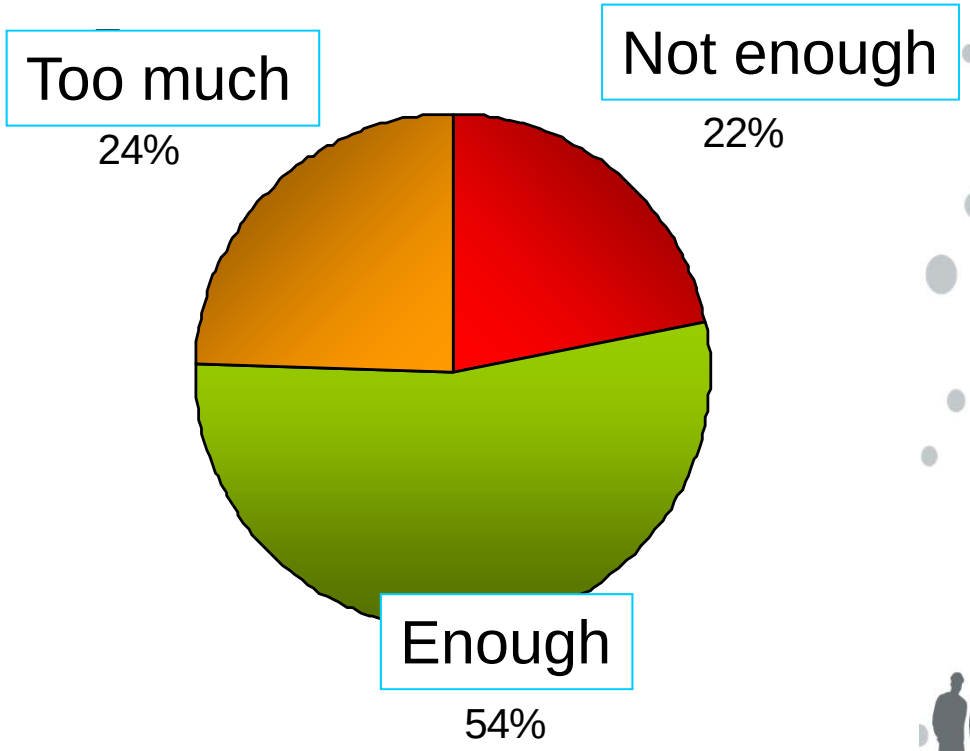
Get feedback

Feedback from French newly trained ATCO (2013)



Get feedback

Feedback from French Training Departments (2013)



Get feedback

Example of questions from French newly trained ATCO (2013)

- 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 RNP 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 ?.....

As a conclusion…

ICAO GANP (Doc 9750)
2013-2028 Global Air Navigation Plan

ICAO (Doc 9750)
2013-2028 Global Air Navigation Plan

Our Priorities

PBN: Our Highest Priority

Prior to the development of the ASBU Modules, ICAO focused its efforts on the development and implementation of Performance-based Navigation (PBN), Continuous Descent Operations (CDO), Continuous Climb Operations (CCO) and Runway Sequencing capabilities (AMAN/DMAN).

The introduction of PBN has met the expectations of the entire aviation community. Current implementation plans should help deliver additional benefits but remain contingent upon adequate training, expert support to States, continued maintenance and development of international SARPs, and closer coordination between States and aviation stakeholders.

ICAO (Doc 9750)
2013-2028 Global Air Navigation Plan

Next Steps

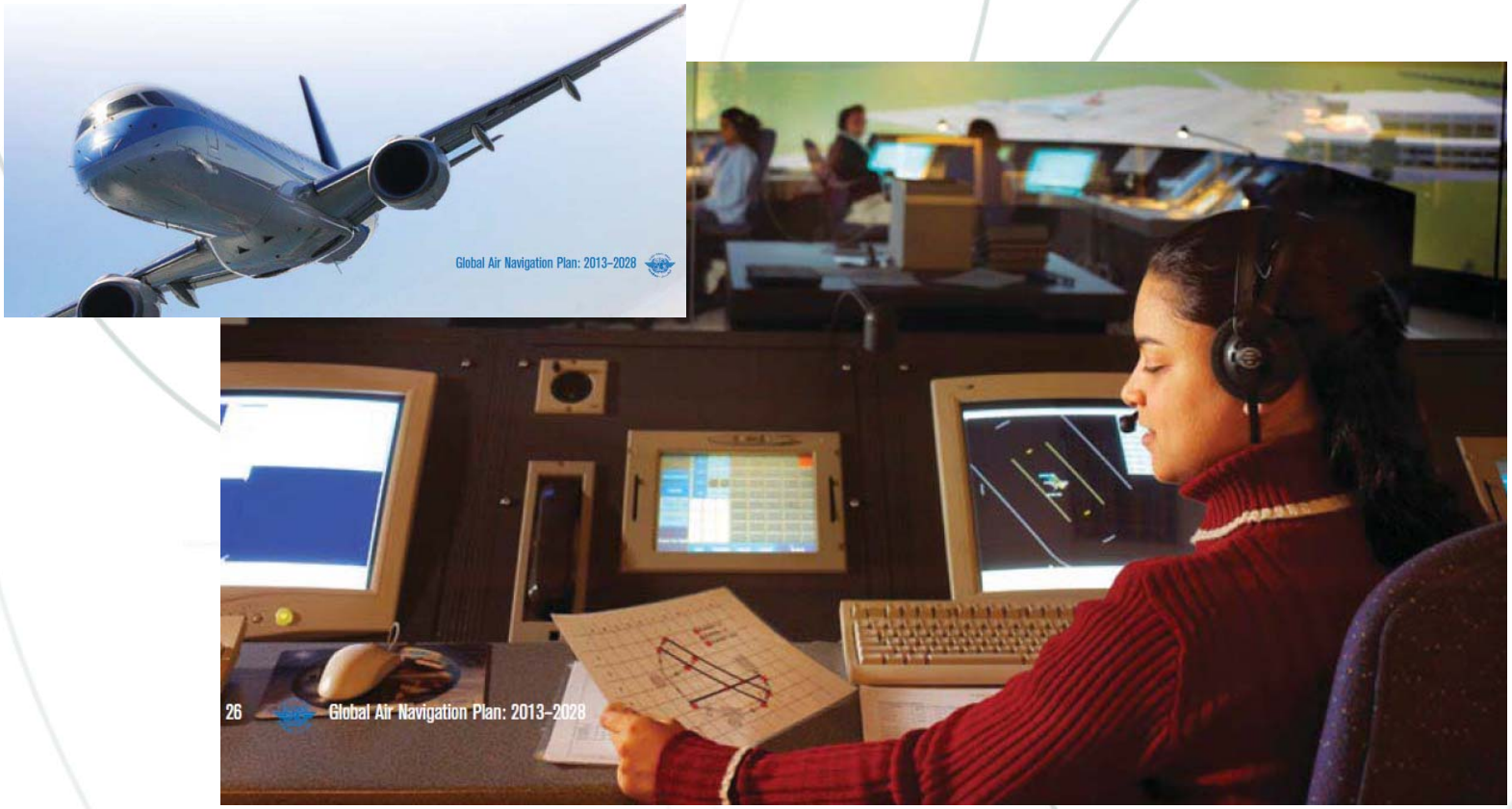
PBN is a complex and fundamental change affecting multiple disciplines and specializations within the aviation workforce. It is also a Standards-intensive area requiring both the development of new Standards and the fine-tuning of existing provisions.

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.

PBN Training as a key to PBN Implementation



PBN Training as a key to PBN Implementation

« We, ENAC, will be honoured to bring you our expertise and help in order to implement PBN by:

- ***Participating seminars, conferences,***
- ***Joining expertise groups,***
- ***Sharing our Training experience in different fields:***
  - ***ASM/ FUA/ ATFCM/ Aviation Law/ A-CDM…***
  - ***And of course PBN Implementation! »***

AGENDA

1. PBN Training for ATCO: The issues,
2. A reference Doc: ICAO Doc 9613
3. PBN in context
4. An adapted Training,
5. Questions ?

Contacts: bertrand.foucher@enac.fr ATC training

david.szymanski@enac.fr Procedure design