



# Global Air Navigation Plan Consideration on Navigation Infrastructure to Support PBN

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International Civil Aviation Organization*

Workshop for The Implementation of Navigation Infrastructure to Support  
PBN and GNSS Precision Approach Operations in NAM/CAR/SAM regions,  
15 -17 August 2016, Lima, Peru



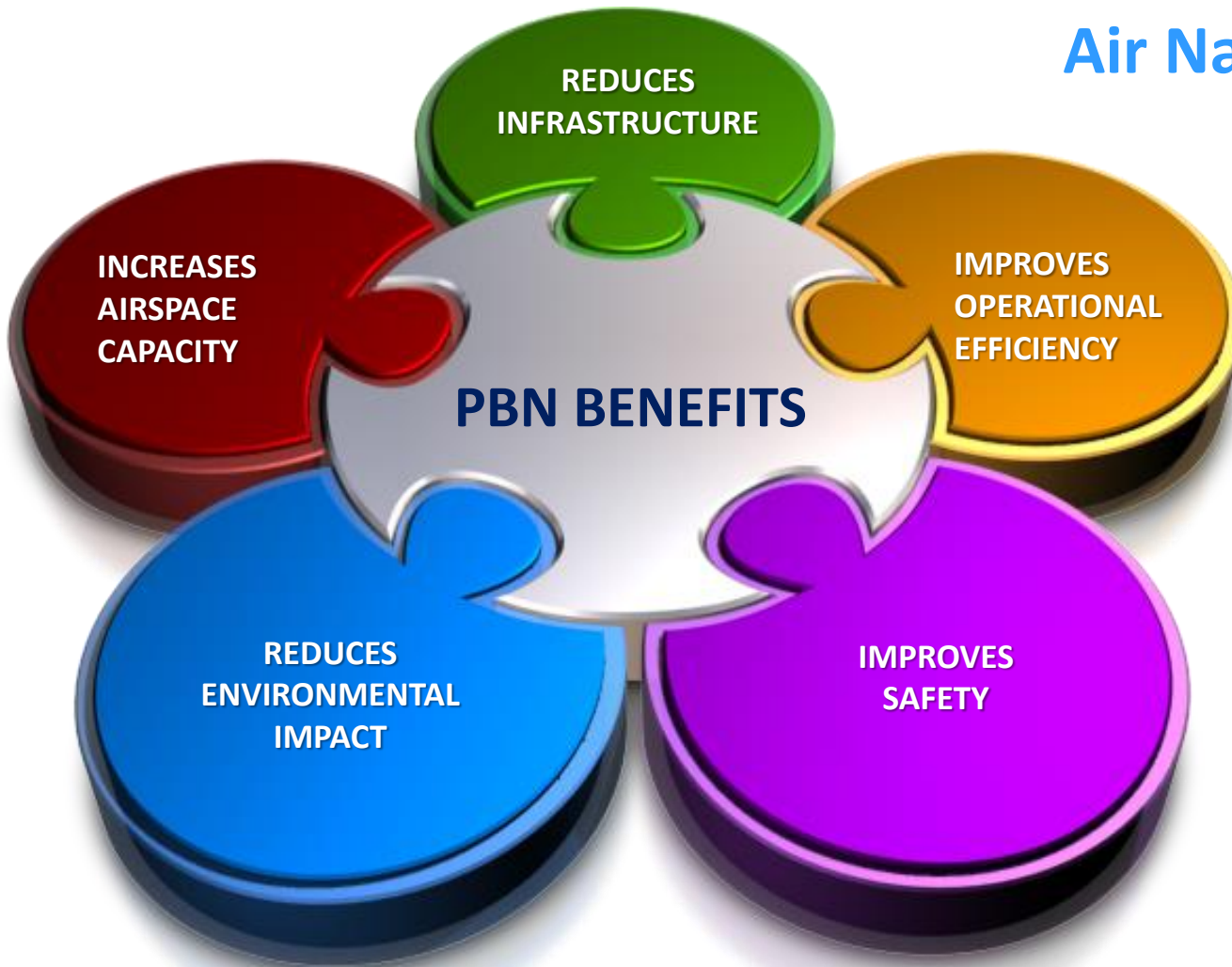
# Outline

- Why PBN?
- Current Status
- Way Forward



# Why PBN?

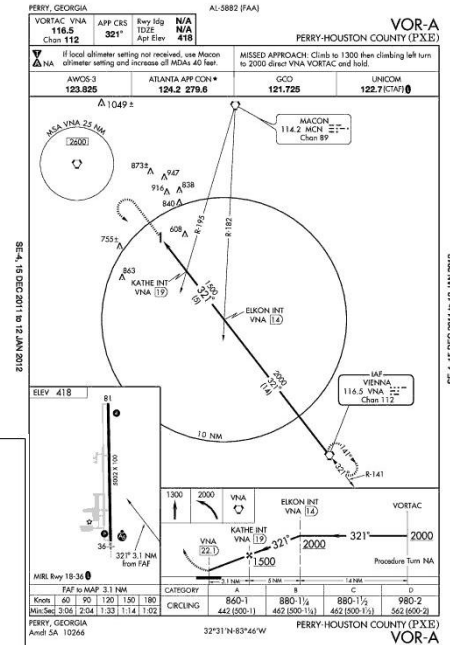
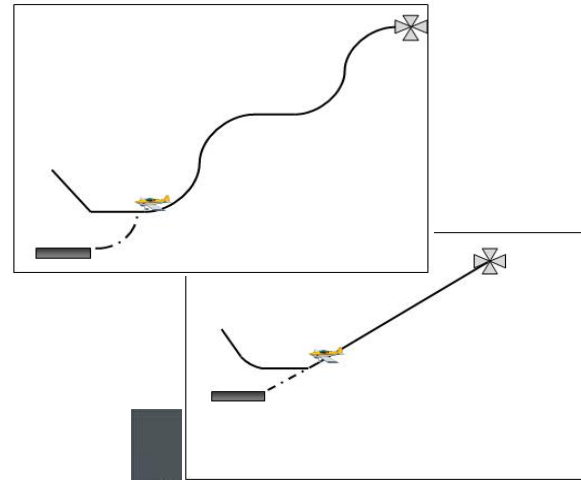
## Air Navigation Priority



# Why PBN?

- **Safety**

- Approach procedures to runways that do not currently have an approach procedure
- Straight-in approach procedures (vice circling)
- Approach procedures with vertical guidance (APV)
- Back up procedures to existing conventional precision approaches



**JULY 7, 2013:**  
**ASIANA AIRLINES FLIGHT 214**  
**CRASH LANDING IN SAN FRANCISCO**  
 A TIMELINE OF EVENTS

The devastating Asiana Airlines crash landing that killed two and injured nearly 200, happened in the final seconds of a 10 and a half hour flight from Seoul, South Korea, to San Francisco on July 6, 2013. The aircraft was carrying 291 passengers and 16 crew members. Here's a timeline of events:

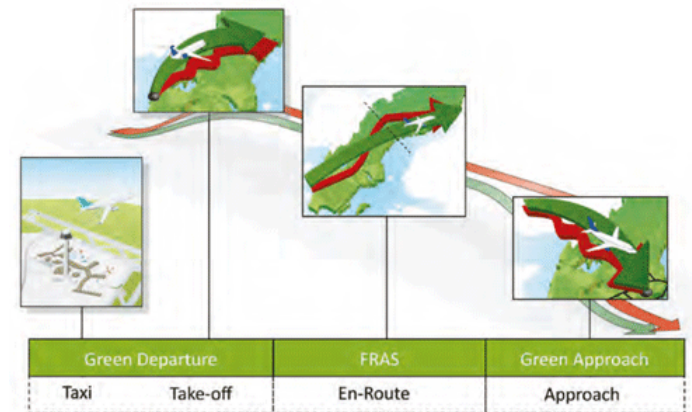
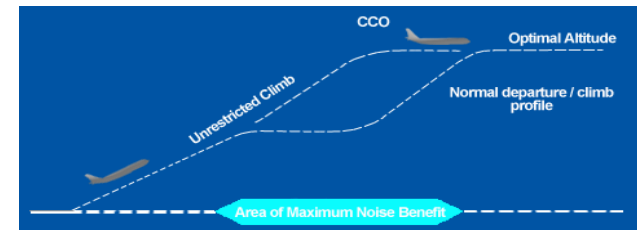
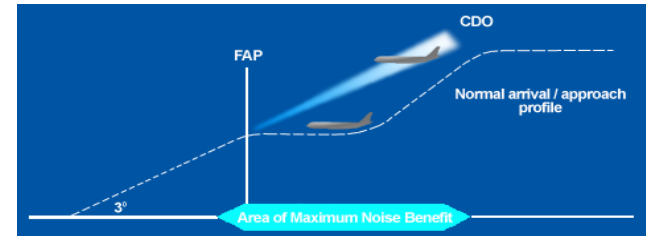
Click on the dates below to find out more

11:27 a.m. PT Plane Crashes 11:35 a.m. PT 1 p.m. PT 4:18 p.m. PT 7:47 p.m. PT Video 1 Video 2

Share Tweet 14 View BY TIMELINE BY LIST

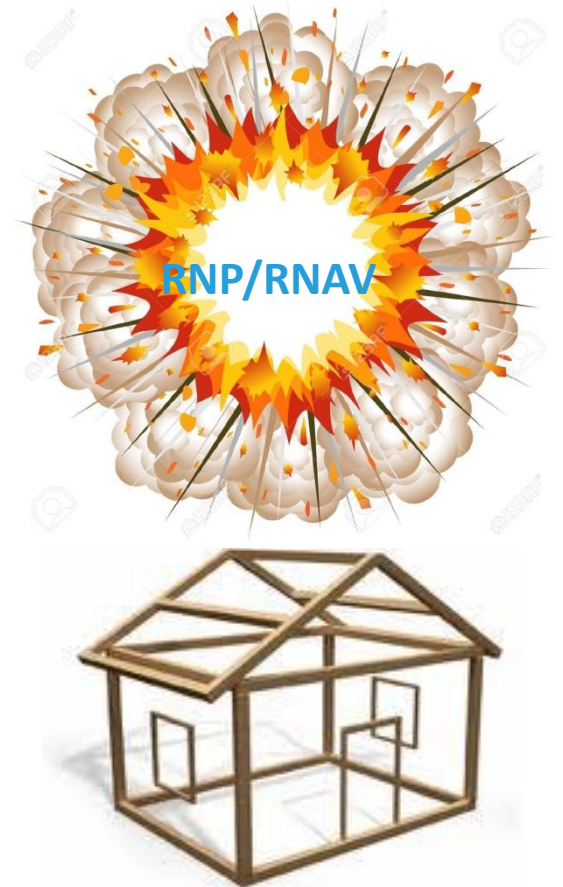
# Why PBN?

- Efficiency/Environment
  - Increased airport accessibility
  - Reduced infrastructure operating costs
  - Reduced fuel burn and CO<sub>2</sub> emissions
  - Avoidance of noise sensitive areas
  - Supports Continuous Descent and Climb operations
  - Increased airspace capacity
  - Improved and more flexible use of terminal airspace (arrivals and departures)
  - User preferred routing



# WHY PBN? – Regional Disparity

- RNAV and RNP being applied inconsistently across the globe
- No central focus or control
- Need for standardization
- Need for overarching provisions
- Build the framework first!



# Why PBN? A37-11

Approach procedures with vertical guidance (APV (Baro-VNAV) including LNAV-only minima for all instrument runway ends by **2016**



*Time is running out to meet the Performance-based Navigation (PBN) objectives of **A37-11***

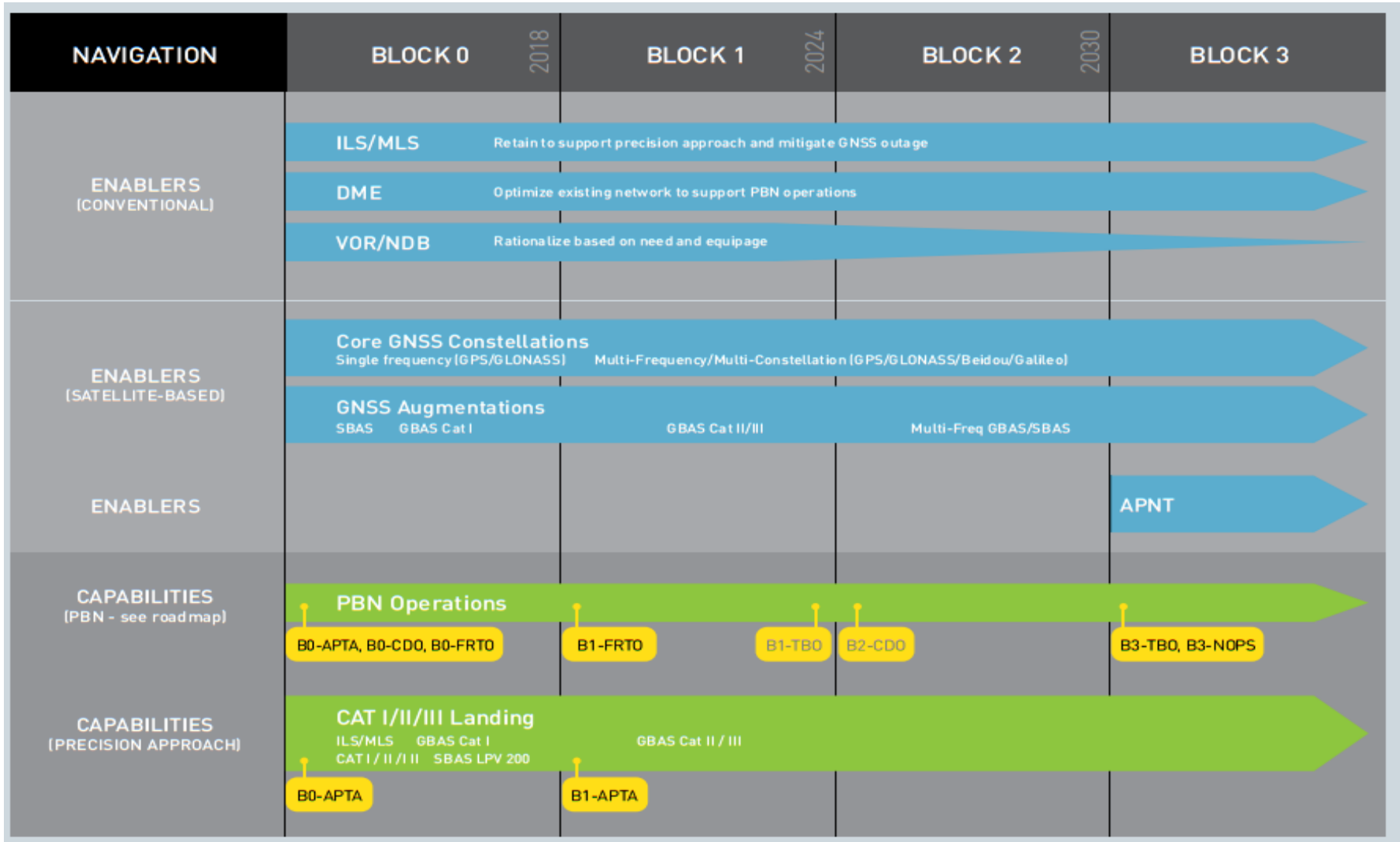
# Global Air Navigation Plan (GANP)

- ICAO focus is on development and implementation of:
  - PBN
  - CCO and CDO
  - ATFM (including runway sequencing capabilities (AMAN/DMAN))
- *“PBN is air navigation’s highest priority”*
- *“Implementation of PBN in terminal airspace is seen as key enabler for advanced terminal operations . . .”*
- *“Many major airports now employ PBN procedures . . . judicious design has resulted in significant reductions in environmental impacts.”*



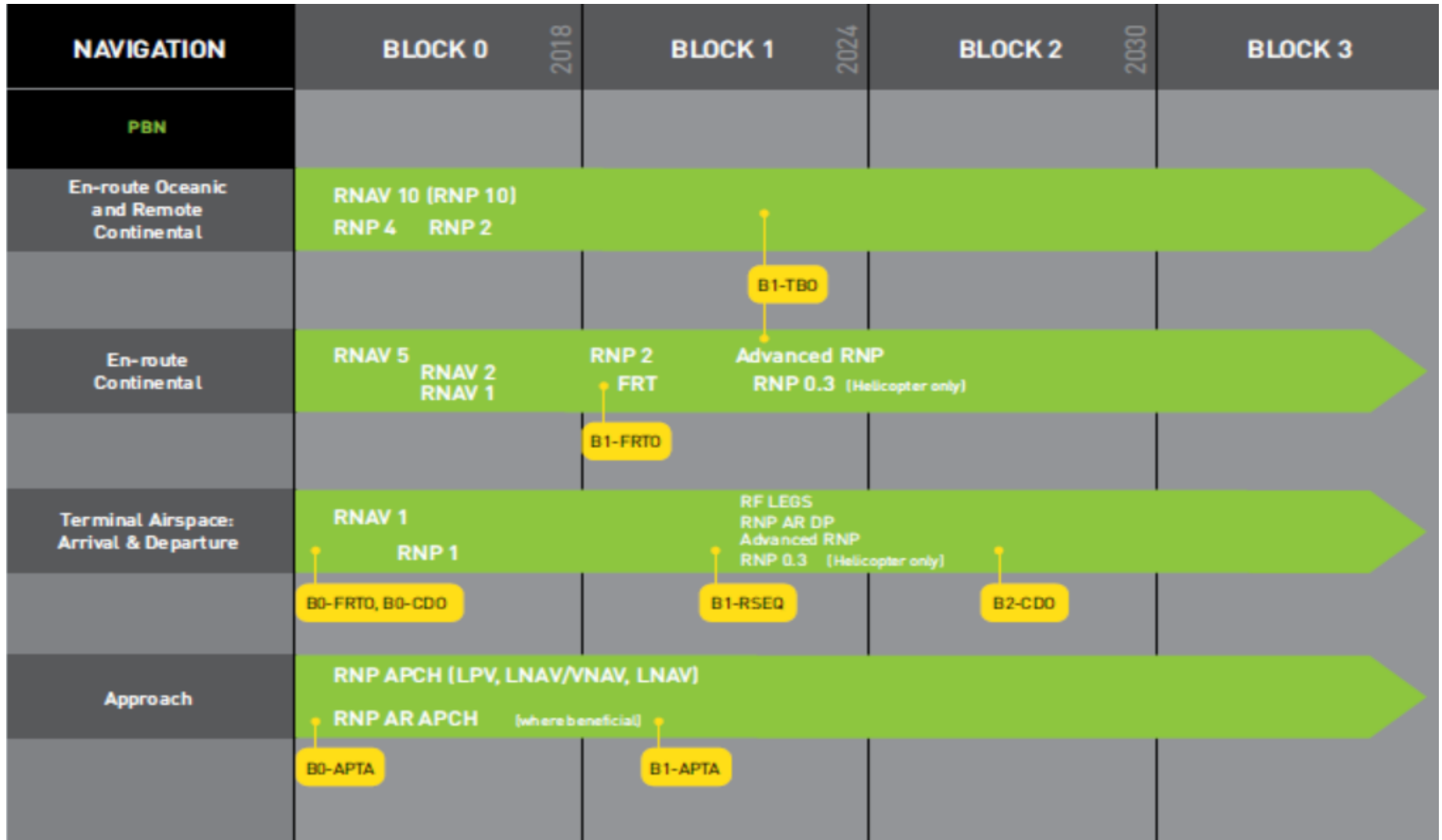


# Navigation Roadmap





# PBN Roadmap



# Global Air Safety Plan (GASP)

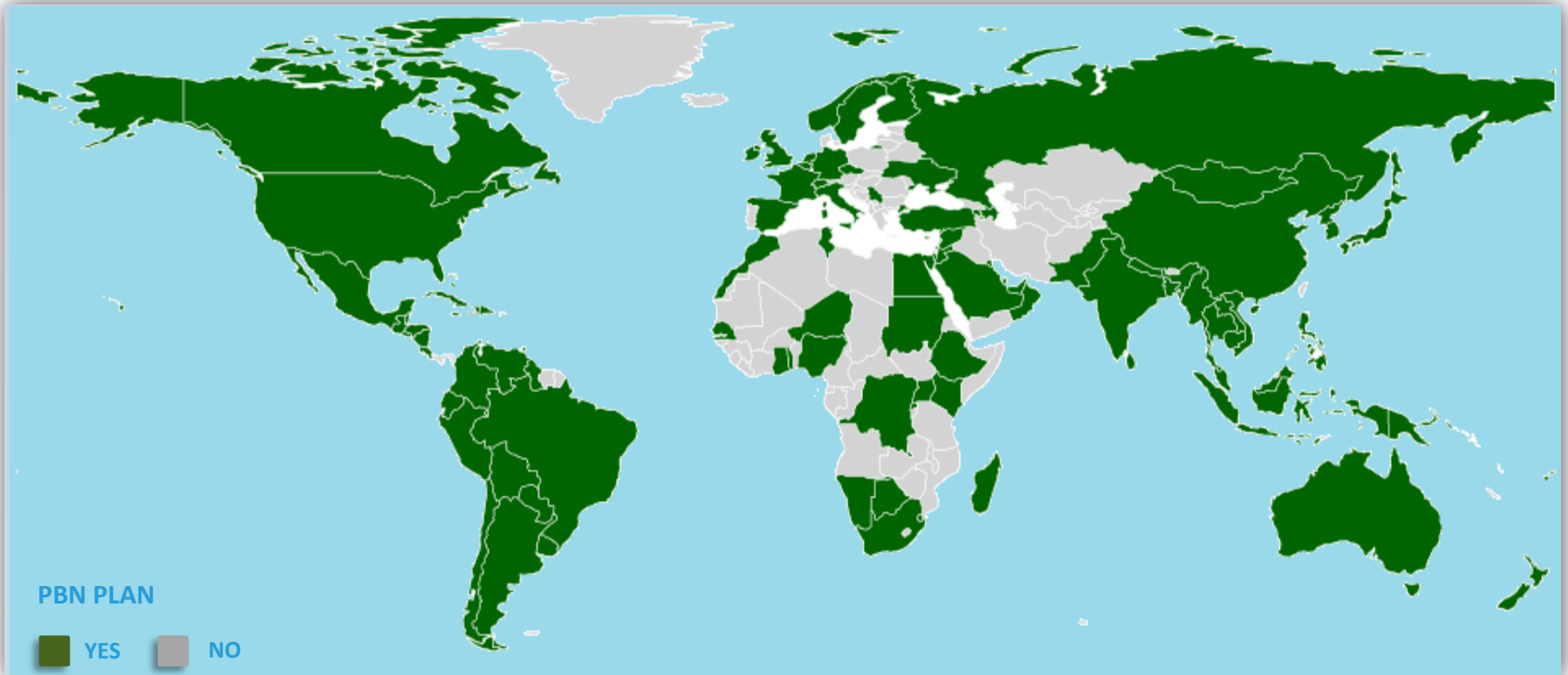
- Identifies **PBN Products and Services** as one of the main implementation activities available to States (*No Country Left Behind*)
- “*Many safety benefits can be gained from PBN implementation*”
  - PBN instrument approaches with vertical guidance (APV) can help reduce probability of runway excursions and CFIT



# Current Status - Where are we today?

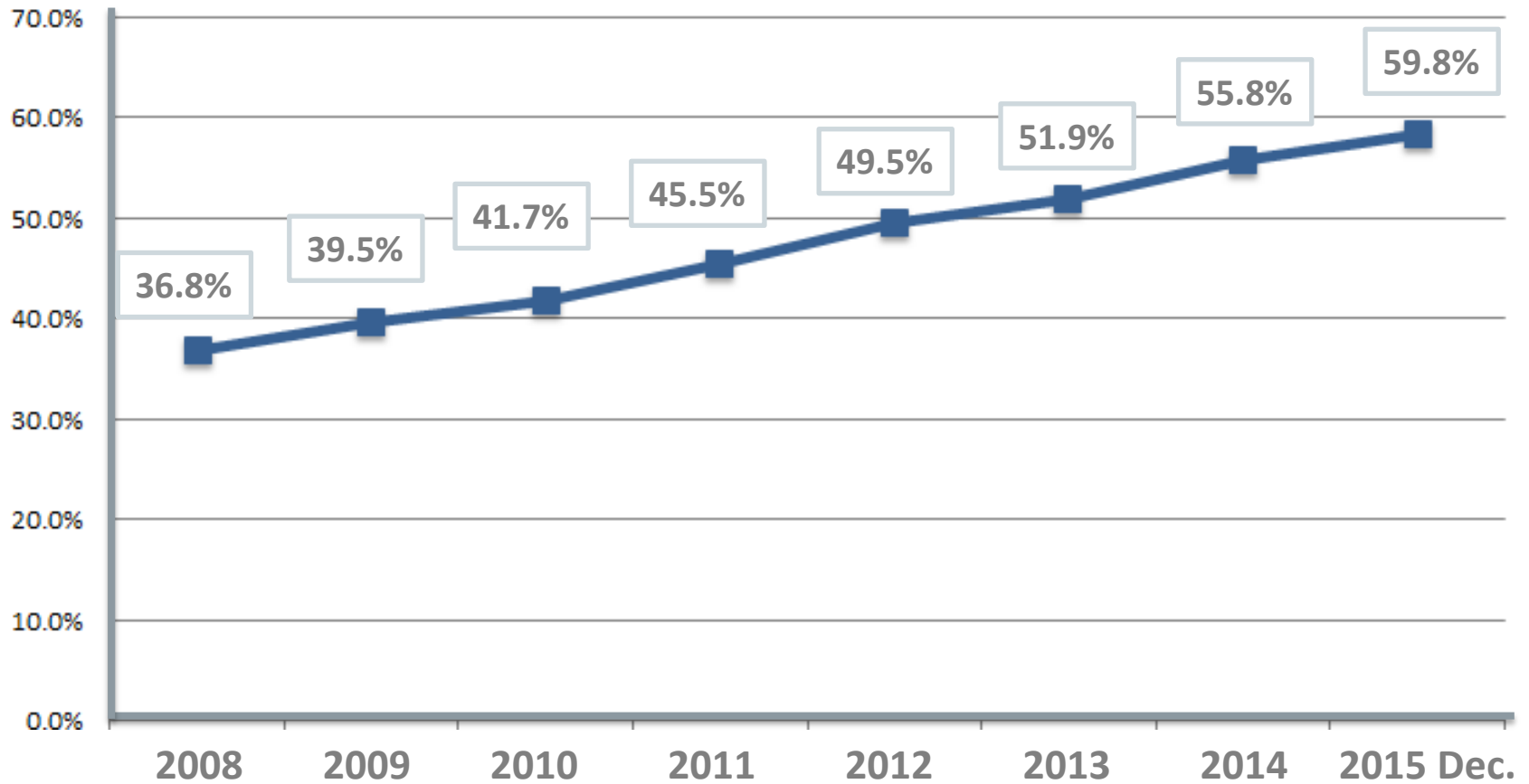


# Global Status of PBN Implementation Plans

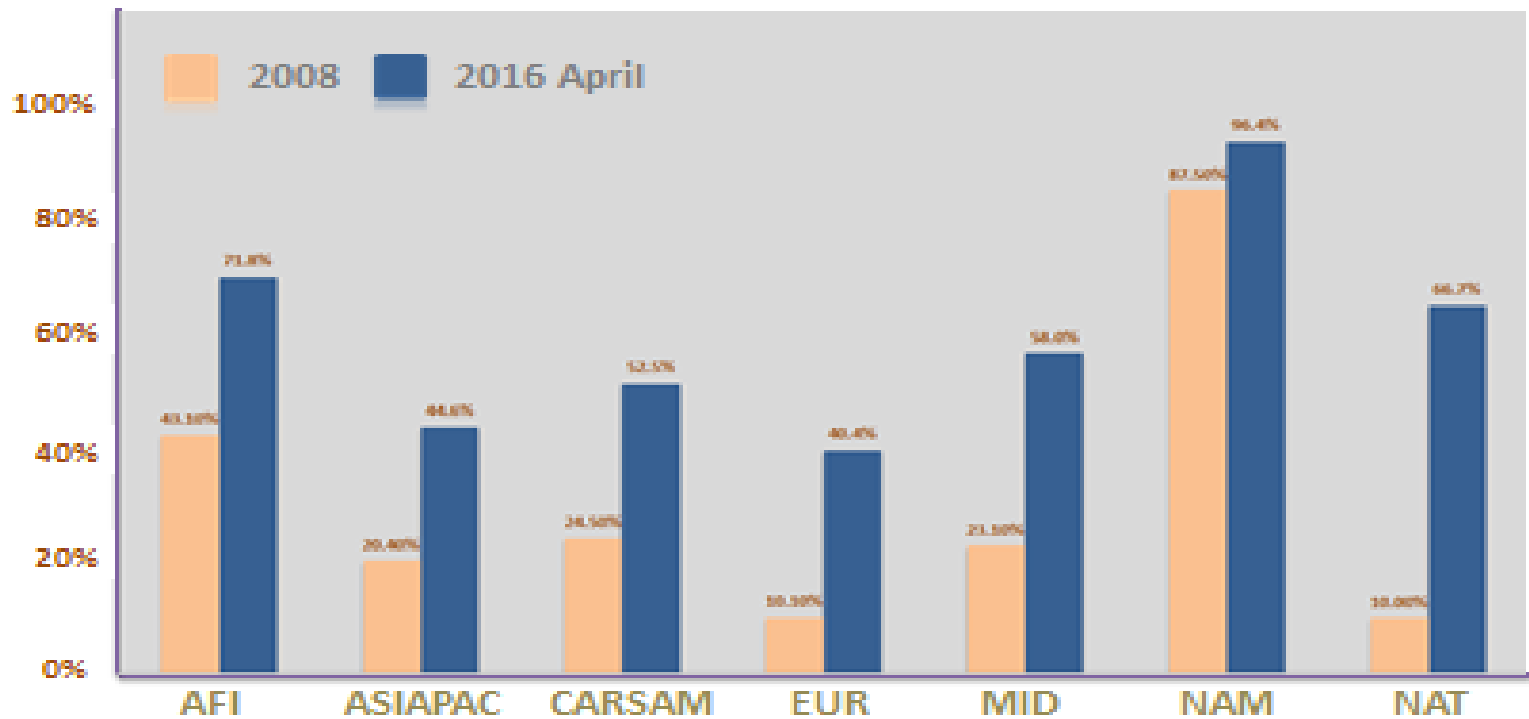


**109 States**

## Percentage of PBN Runways for World



### Percentage of PBN Runways for Each Region



# What is ICAO doing to help States with implementation? . . .



# State Feedback



# PBN Programme - Focus

- Regional Coordination and Support
- Development of the PBN concept
- Providing guidance/information on PBN
- Products and Services
- Promotion



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## Coordination with RO's

- PBN Focal points established
- PBN TF's, ICGs – awareness and coordination among States
- Implementation Projects
- Workshops
- Symposia



# Partnerships



## Industry Declaration in support of Performance-based Navigation (PBN)



### We, as representatives of the air transportation community,

Affirming our joint responsibility to seek continual improvements to the safety, access, capacity, efficiency and environmental sustainability of the air transportation system,

Recognizing that Performance-based Navigation (PBN) provides a catalyst for these improvements to air traffic operations, while enabling a seamless and cost effective solution throughout the entire flight,

Recognizing the work of ICAO in formulating and publishing globally harmonized Area Navigation (RNAV) and Required Navigation Performance (RNP) provisions, now known as Performance-based Navigation (PBN),

Recalling that Resolution A36-23 of the 36th ICAO General Assembly whereby States are urged to implement PBN procedures in accordance with the established timetable,

### We resolve:

To support the timetable set out by ICAO for the global implementation of PBN,

To collectively work to facilitate the implementation of PBN, and

To assist States, regions and other stakeholders in their development and execution of a complete PBN implementation plan.

### We call upon:

All leaders of the civil aviation community, to fully support implementation of PBN into the air navigation system according to the ICAO provisions and established timetable.



Roberto Kobeh González, Council President



Giovanni Bisignani, Director General and CEO



Alexander ter Kuile, Secretary General



Marc Baumgartner, President & CEO



Capt. Carlos Limon, President



Donald D. Spruston, Director General



François Gayet, Chairman



Angela Gittens, Director General



Matthew S. Zuccaro, President



William R. Voss, President & CEO

Training

Workshops

Implementation support

Promotion

Go Teams

# Flight Procedures Programme (FPP)

- Very successful programme overall
- Asia-Pacific FPP
  - Beijing, China
  - Phase III approved
  - Extended another 3 years to 2020
- African FPP
  - Dakar, Senegal
  - FPP Office established 2014 (covers all African States)
- MID FPP – To be established JAN 2017



# PBN Programme - Focus

- Regional Coordination and Support
- **Development of the PBN concept**
- Providing guidance/information on PBN
- Products and Services
- Promotion



# PBNSG Main Tasks

- Reconvened to further mature the PBN Concept
  - Update the PBN Manual
    - Use of RF Legs
    - Safety case guidance
    - Functionality updates
  - Develop guidance material to close the gap
    - Mixed mode operations
    - RNP AR departures
    - Ops approvals
    - Reversion capability
    - Improved terminal efficiency
- Coordinate with other ICAO Panels
  - to ensure consistency within the PBN framework



# Navigation System Panel (NSP) Tasks

Include

- ❖ GNSS Evolution - Multi-constellations
- ❖ GNSS Evolution – Advanced Receiver Autonomous Integrity Monitoring (ARAIM)
- ❖ GNSS Radio Frequency Interference
- ❖ Alternative Position Navigation and Timing (APNT)



***ICAO standardization of the new systems to ensure global harmonization as well as enable full PBN benefits***

# PBNSG Inter-Panel Coordination

PANEL	COORDINATION AREAS
<b>IFPP</b>	Instrument flight procedures – updated and new PBN criteria (RNP AR DP), charting database harmonization, PBN to XLS, LP/LPV harmonization, temperature compensation
<b>FLTOSP</b>	Making PBN the norm in flight training & operations Visual Guided Approach Concept
<b>NSP</b>	GBAS for positioning in the terminal area, terrestrial navigation strategy, advanced RAIM, multi-frequency/multi-constellation issues
<b>SASP</b>	Reduced separation standards resulting from PBN
<b>ATMOSP</b>	ATM procedures, PBN Phraseology
<b>ATMRPP</b>	PBN Flight Plan Codes, FF-ICE
<b>RPASP</b>	Coordinate use of PBN in RPA operations

# PBN Programme - Focus

- Regional Coordination and Support
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- **Providing guidance/information on PBN**
- Products and Services
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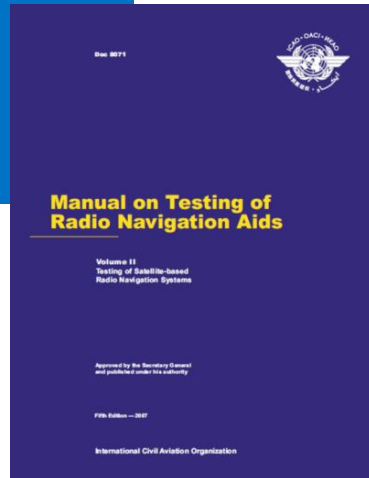
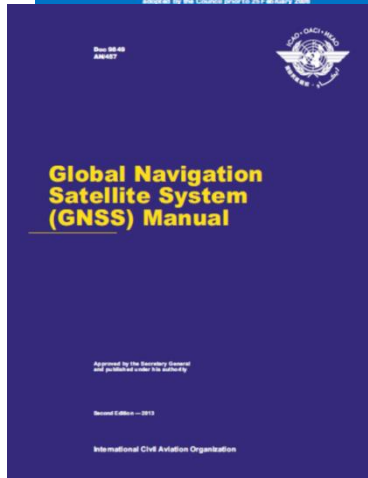
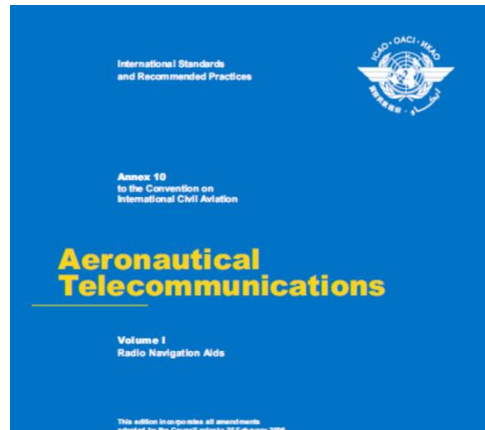


# PBN Documentation Framework



- PBN Manual (Doc 9613) 4<sup>th</sup> Edition
- PBN Ops Approval Manual (Doc 9997)
- Manual on PBN Use in Airspace Design (Doc 9992)
- RNP AR Procedure Design Manual (Doc 9905)
- PANS Ops Volume I & II
- CDO Manual (Doc 9931)
- CCO Manual (Doc 9993)
- Procedure QA Manual (Vol 1 to Vol 6) (Doc 9906)

# NAV Infrastructure Specification Documentation to Support PBN (especially related to GNSS)



- Annex 10 Aeronautical Telecommunications Volume I, Radio Navigation Aids, CHAPTER 3. Specifications for radio navigation aids Appendix B Technical specifications for the Global Navigation Satellite System (GNSS) And other attachments includes:  
Attachment B, Strategy for Introduction and Application of Non-visual Aids to Approach and Landing and Attachment D Information and material for guidance in the application of the GNSS Standards and Recommended Practices
- DOC 9849 Global Navigation Satellite System (GNSS) Manual
- Doc 8071 Manual on Testing of Radio Navigation Aids, Volume II, Testing of Satellite-based Radio Navigation Systems



# PBN Related Tools

*to assist with implementation*

- PBN related Publications and Annexes
  - Bundled specifically for Stakeholders
  - Hard and soft copies
- PBN iKit (Updated)
  - First iKit produced
- CBT Training (iLearn)



Available through ICAO e-store: [www.store1.icao.int](http://www.store1.icao.int)

# PBN Programme - Focus

- Regional Coordination and Support
- Development of the PBN concept
- Providing guidance/information on PBN
- **Products and Services**
- Promotion



# PBN Tailored Products & Services

- PBN Start
- PBN Training
- PBN Publications and Bundles
- PBN Symposia/Workshops
- PBN Implementation Assistance
- PBN Business Planning
- PBN Financial Aid



Provided through ICAO HQ, Regional Offices, FPPs, ICAO Authorized Training Centers, On-line ICAO Store

# PBN Training

- Computer Based Training Courses (CBTs)

**PBN Overview**  
**PBN Ops Approval**  
**PBN Airspace Design**  
**PBN for Pilots**

**PBN for ATCOs**  
**(under development)**

- PBN Classroom Courses

**PBN Ops Approval**  
**PBN Airspace Design**

**IFP Design Courses**

# PBN Recognition of Compliance – IFP Organizations

- Recognition of Compliance of Instrument Procedure Design organizations
- To assist States with PBN Implementation
- Organizations recognized by ICAO:
  - ASAP s.r.o. (Slovakia)
  - Beijing Transafe Technology and Trade Company, Limited (China)
  - CAAC Central-Southern Airport Design & Research Institute (China)
  - CGX-AERO
  - China Academy of Civil Aviation Science and Technology (CAST)
  - Global Airspace Solutions
  - GroupEAD Asia-Pacific
  - Hughes Aerospace (USA)
  - Ingegneria Dei Sistemi S.p.A (Italy)
  - Shanghai Eastern China Civil Aviation Procedure Design and Research Institute – SECAF (China)
  - United for Aviation Technology Services



# PBN Programme - Focus

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- **Promotion**



# Global Promotion of PBN

ICAO CAPACITY & EFFICIENCY

Over 40 participants attend successful PBN Airspace Design Workshop in Dakar, Senegal.

Manual on the Use of Performance-based Navigation (PBN) in Airspace Design



**PBN UPDATE:** ICAO Facilitates successful PBN Implementation workshops in Turkey and Belarus.

Assembly Resolution A37-11 calls for 100% of runways to have a PBN approach by 2016

**Time is running out!**

ICAO SAFETY

Visit us today!  
[icao.int/safety/pbn](http://icao.int/safety/pbn)

ICAO CAPACITY & EFFICIENCY

Implementing Performance Based Navigation  
**Air Navigation's #1 Priority**

Are you having difficulty implementing Performance-based Navigation (PBN)?  
Are you missing out in achieving the safety and efficiency benefits that PBN provides?

ICAO can help tailor a solution for your needs!  
Through development and capability assessments to training and implementation assistance, we have the answers, team and resources to help you achieve your goals.

For more information on our PBN Implementation Services please visit:  
[icao.int/PBNImplementation](http://icao.int/PBNImplementation)

Banners – Flyers – Articles – Website – Seminars – Symposia – Social Media – Email promotions

# Way forward – Where are we going?



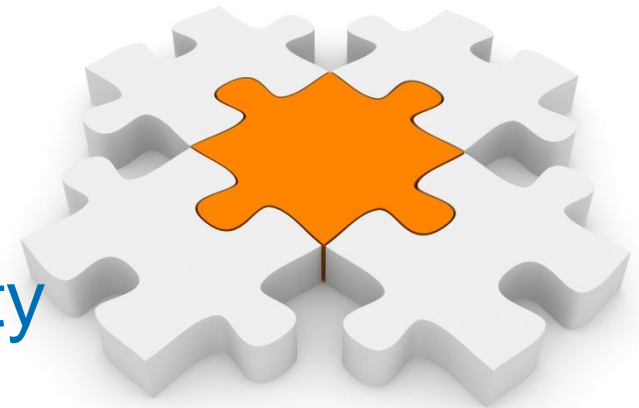
# ICAO Strategic Vision

- Integrate PBN into the mainstream
  - Effective and timely Regulatory Oversight
  - Operations and training
- Match current and emerging operational requirements
  - Removal of redundant specifications and systems
  - Nav specs tailored to long term requirements
  - Enable ASBU block 2 and 3 implementation (TBO, FRTO, CCO, CDO, RSEQ, APTA)
  - Efficient airspace design using advanced functionality
  - Enhanced safety



# ICAO Strategic Vision

- Develop a robust dependable system
  - Redundancy
  - Reversion capability
- Attain seamless interoperability between Industry and ICAO
  - Avionics, PBN Nav Specs, Flight Planning, Ops Approvals, Airworthiness, training,



# Summary

- PBN is the foundation for many safety, operational and environmental improvements
- PBN framework is well established and updates to guidance material are nearly complete
- Greater assistance to States is now available
  - Products and Services, Tools, Partnerships, FPPs
- Follow-on planning is needed to:
  - Bring PBN into mainstream navigation
  - Provide adequate enablers for future (Block 2 and 3 operational requirements)
  - Provide stakeholder confidence in their investments



ICAO

UNITING AVIATION



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THANK YOU