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PBN IMPLEMENTATION

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PRESENTATION OUTLINE

- Assembly Resolution 37-11
- PBN Regional implementation
- Successes; Standards & Guidance material
- PBN Airspace Concept
- Formulate an airspace concept
- Measuring success



38th ICAO General Assembly (A37-11)

- All States to complete a national PBN implementation plan as soon as possible;
- All States to implement RNAV and RNP ATS routes and approach procedures in accordance with the ICAO PBN concept laid down in the *Performance-based Navigation (PBN) Manual* (Doc 9613);
 1. **implementation of RNAV and RNP operations** (where required) **for en route and terminal areas** according to established timelines and intermediate milestones; and
 2. **implementation of approach procedures** with vertical guidance (APV) (Baro-VNAV and/or augmented GNSS), including LNAV only minima **for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016** with *intermediate milestones* as follows: ***30 per cent by 2010, 70 per cent by 2014***; and
 3. **implementation of straight-in LNAV only procedures, as an exception to 2) above**, for instrument runways at aerodromes where there is no local altimeter setting available and where there are no aircraft suitably equipped for APV operations with a maximum certificated take-off mass of 5 700 kg or more;
- ICAO develop a coordinated action plan to assist States in the implementation of PBN and to ensure development and/or maintenance of globally harmonized SARPs, Procedures for Air Navigation Services (PANS) and guidance material including a global harmonized safety assessment methodology to keep pace with operational demands;



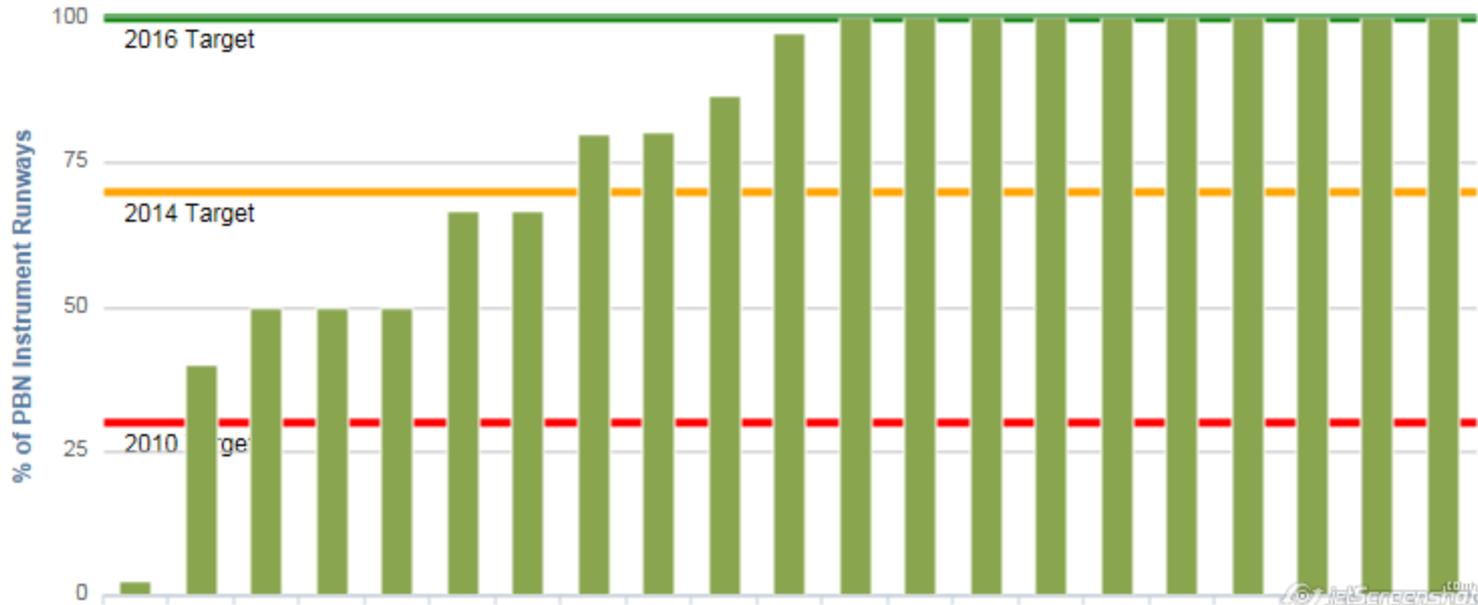
STAGE	OPERATIONAL IMPROVEMENT
Stage I (2010 2011)	<p><u>Review of ATS route network in the CAR Region</u></p> <ul style="list-style-type: none">• Gathering data on aircraft PBN capacity• Review of CNS infrastructure• Realignment and implementation of new RNAV routes in the upper airspace based on RNAV 5• Implementation of RNAV routes in the lower airspace based on RNAV 1, RNAV 2 and RNP 1, as required• Implementation of PBN approach procedures in accordance with Assembly Resolution A37-11
Stage II (2011 2012)	<p><u>Review and interface of the ATS routes network in the CAR/SAM Regions</u></p> <ul style="list-style-type: none">• Realignment and implementation of new RNAV routes in the interface of the upper airspace between the CAR and SAM Regions, based on RNAV 5 or RNAV 2, as applicable• Implementation of CDO in international airports, as required
Stage III (2012 2014)	<ul style="list-style-type: none">• Elimination of conventional ATS routes in the upper and lower airspace, as required• Implementation of random routes, by airspace altitude stratum• Review of the upper airspace configuration• Review of the lower airspace configuration• Implementation of flexible use of airspace (FUA)• Implementation of dynamic ATS route management



RNP Approach procedures

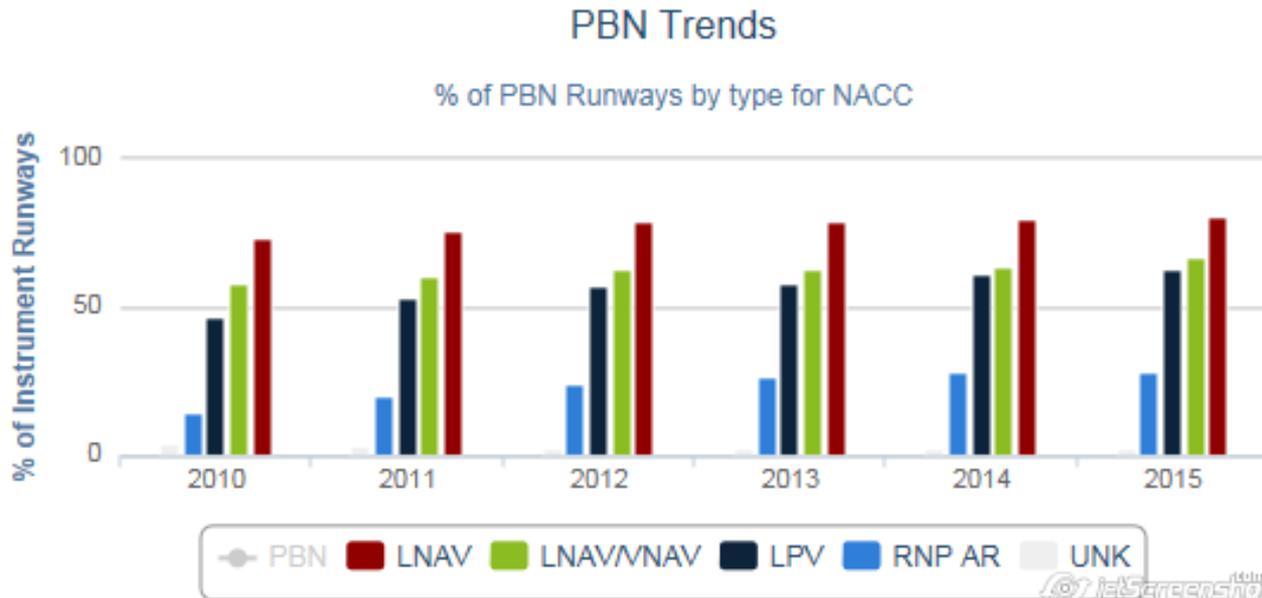
Regional PBN Implementation

% of PBN Runways per Country for NACC





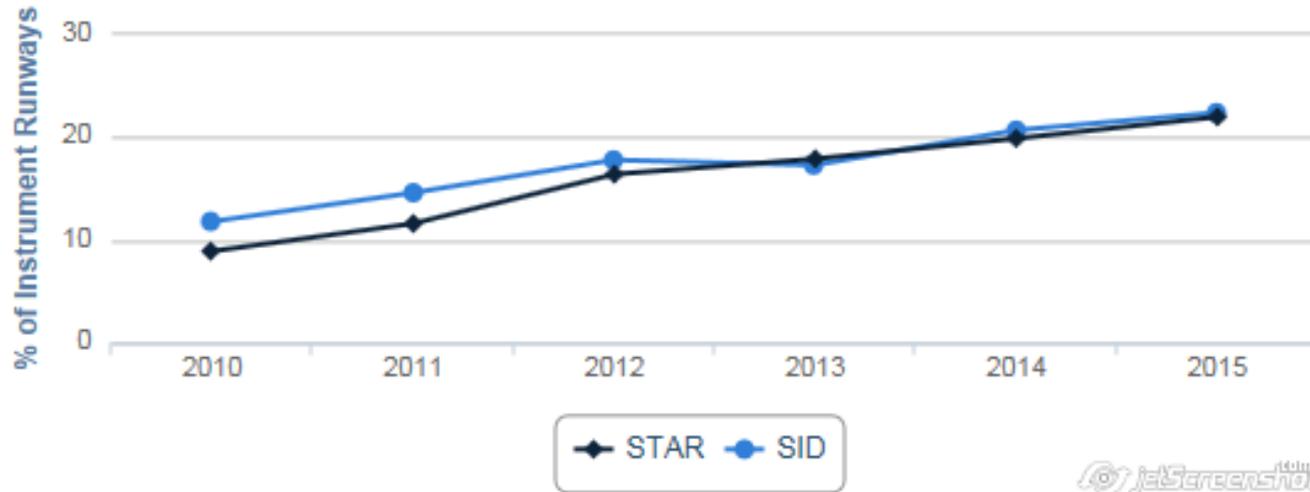
RNP Approach procedures





SID/STAR Trends

% of SID/STAR Runways for NACC





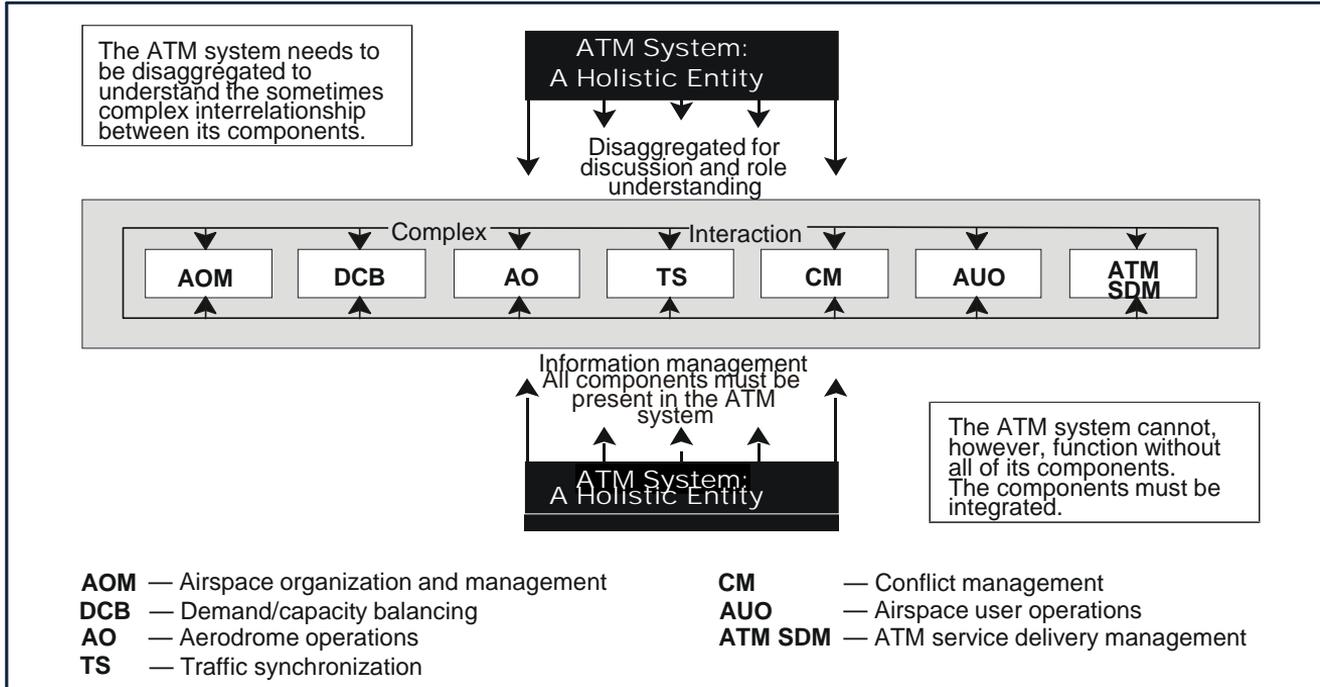
SUCCESS!

Standards and Guidance Material

- ATM Operational Concept, Doc 9735, RPB/ANIP
- ATM system requirements
- PANS-ATM for ATS use based on radar, ADS-B, GNSS for lateral & longitudinal separation
- Safety assessment
- PBN airspace concept: Regional performance framework and training (pilots, ATCOs) for En-route (Oceanic/Domestic), TMA and RNP approach procedures
- Doc 7030 & Doc 8733; develop a PFA, as required (ANI/WG/3, WP xx)
- Update LOAs
- Development of transition strategies (pre-tactical)



ATM Operational Concept: Components





ICAO PBN Manual Doc 9613

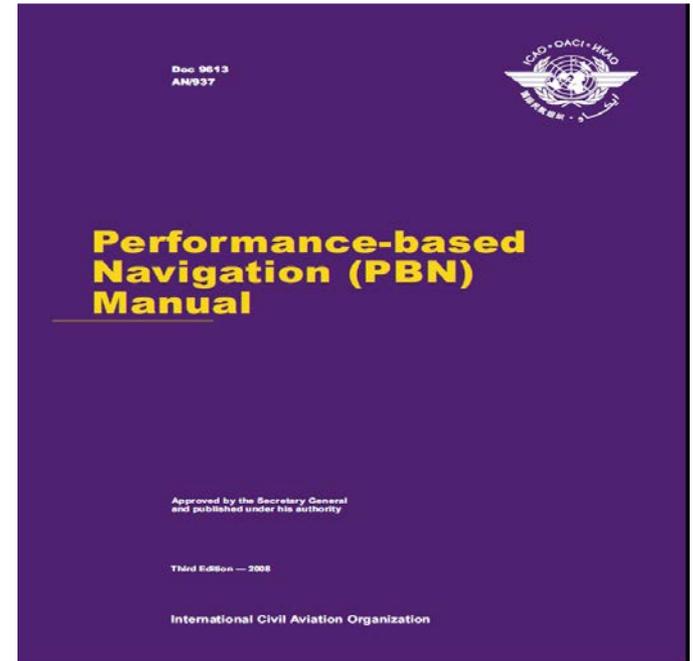
✈ Volume I

✈ *Airspace Concept*

✈ *Implementation Processes*

✈ Volume II

✈ *Navigation Specifications*





What is an Airspace Concept?

A master plan or scheme of the intended airspace design and its operation

- Describes the intended operations within an airspace
- Developed to satisfy specific strategic objectives (e.g. improved safety, increased air traffic capacity, improved efficiency, mitigation of environmental impact, etc.)

A developed Airspace Concept:

- Describes in detail the planned airspace organization and its operations
- Addresses all of the strategic objectives identified for the airspace project
- Addresses all ATM requirements
- Identifies operational and technical assumptions



Airspace Concept

**Airspace Design:
particularly
Routes and
IFPs**

Conventional Navigation
Airspace Design based on assumptions that all aircraft equipped with NDB/VOR and/or DME and airspace designed

RNAV (pre-PBN)
Airspace Design based on assumptions that 'RNAV equipped' aircraft can use RNAV routes. Exceptionally, Nav Spec required e.g. RNP 4.

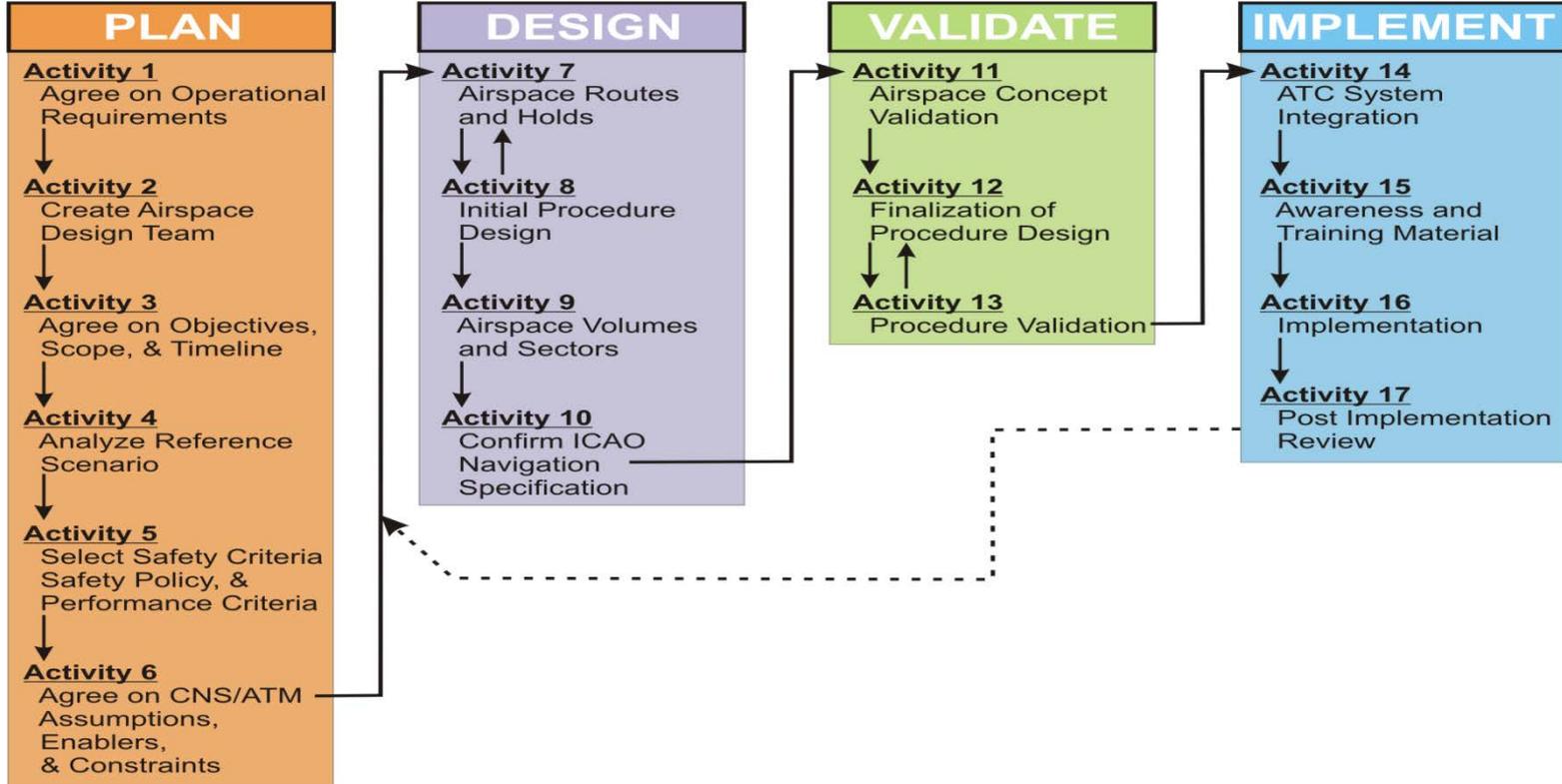
PBN
Airspace Design must in all cases match....

(a)
Aircraft fleet capability
which must match...

(b)
An ICAO PBN Navigation Specification

(c)
and available NAVAID Infrastructure







NAVEGATION SPECIFICATION	FLIGHT PHASE							
	En-route Oceanic/ Remote	En-Route Continental	Arrival	Approach				DEP
				Initial	Interm.	Final	Miss	
RNAV 10	10							
RNAV 5		5						
RNAV 2		2						2
RNAV 1		1		1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1				1 ^a	1 ^a		1 ^{ab}	1 ^{a,c}
Advanced RNP	2	2 or 1	1	1	1	0.3	1	1
RNP APCH				1	1	0.3	1	
RNP AR APCH				1-0.1	1-0.1	0.3-0.1	1-0.1	
RNP 0.3		0.3	0.3	0.3	0.3		0.3	0.3



Area of Application	Navigation Accuracy (NM)	Navigation Specification	Requirement onboard monitoring and alerting	Navaid Sensors
Oceanic/Remote	10	RNAV 10 / (RNP 10)	No	GNSS / INS-IRU
	4	RNP 4	Yes	GNSS
En route – Continental	5	RNAV 5	No	GNSS / INS-IRU / DME-DME / DME-DME-IRU / DME-VOR
En route – Continental and Terminal	2	RNAV 2	No	GNSS / DME-DME / DME-DME-IRU
	2	RNP 2 (TBD)	Yes	GNSS
Terminal	1	RNAV 1	No	GNSS / DME-DME / DME-DME-IRU
	1	Basic RNP 1	Yes	GNSS
Approach	0.3	RNP APCH	Yes	GNSS
	0.3-0.1	RNP AR	Yes	GNSS



Formulate Airspace Concept



STARTING POINT

Requirements :

- ✓ Needs of airspace users (military/civil (air carrier /business/general aviation etc.)
- ✓ Constraints on Service Providers
- ✓ ATM requirements (e.g. airspace planners, ATC).
- ✓ Policy directives (e.g. environmental mitigation requirements)
- ✓ Balancing the overall environmental capacity and efficiency
- ✓ Monitor implementation



Formulate Airspace..

Why is it needed:

- ✈ Identify what is going to be achieved
 - ✈ Route spacing
 - ✈ Route structure
 - ✈ Terminal Airspace or en-route requirements
- ✈ Sufficient detail to allow required navigation capability to be defined
 - ✈ Nav Functions,
 - ✈ Nav Infrastructure
 - ✈ Comms and Surveillance



Airspace User Requirements

- Addresses all users (military and civil aviation / IFR and VFR)
- Overall safety, capacity and efficiency requirements
- Primary and alternate means of meeting requirements should be considered.
- Cost vs benefit
- Transition steps
- Implementation timing



Airspace User...

Identify:

- ☑ Current traffic and expected growth.
- ☑ Traffic flows and composition
- ☑ Transition airspace - integrating operations across airspace boundaries and national borders.
- ☑ Required ATS Route spacing based on the overall safety, capacity and efficiency requirements
- ☑ Surveillance and communications infrastructure,
- ☑ Navigation infrastructure,
- ☑ Minimum navigation functions needed to support operational requirement



Measuring success

- capacity
- efficiency
- environment
- flexibility
- interoperability
- safety



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Asia and Pacific
(APAC) Office
Bangkok



Questions?

THANK YOU