PERFORMANCE BASED NAVIGATION (PBN) IMPLEMENTATION PROJECT

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AGENDA

• Assembly Resolution A37-11

• 4th edition of the Global Air Navigation Plan

• Aviation System Block Upgrades (ASBU), regional perspective

• Regional performance based air navigation implementation plan (RPB-ANIP)

• Implementation of performance based navigation (PBN)

• Regional PBN Progress

• Global & Regional report
1. Urges 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);

2. Resolves that:
   
a) States complete a PBN implementation plan as a matter of urgency to achieve:
   
   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;

b) 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;

3. Urges that States include in their PBN implementation plan provisions for implementation of approach procedures with vertical guidance (APV) to all runway end serving aircraft with a maximum certificated take-off mass of 5 700 kg or more, according to established timelines and intermediate milestones.
GANP (DOC 9750)

GANP History
- Appendix to FANS Report, 1992
- Doc 9854, 2005 Global ATM Operational Concept
- Doc 9882, 2008 ATM System Requirements

Related documents


- Encompasses Performance Framework
- Addresses ANSP, Regulatory and User requirements
- Includes ASBU Methodology

GANP (Global Air Navigation Capacity and Efficiency Plan)
Many Regional and National ATM modernization programmes are being developed worldwide

- They are following ICAO’s Global Air Navigation Plan and Operational Concept, but nevertheless they are different in their own way
- thus resulting in interoperability challenges
Threads Between Modules... and Across Blocks

Airport Operations

Block 0
Improved Traffic Flow through Runway Metering

Block 1
Improved Approach & Departure Management through Integration

Block 2
Linked AMAN/DMAN

Block 3
Integrated AMAN/DMAN/SMAN

Available Now  2018  2023  2028>
ASBU: Understanding the Relationships

Performance Improvement Areas

- Airport Operations
- Globally Interoperable Systems and Data
- Optimum Capacity and Flexible Flights
- Efficient Flight Path

Block 0
18 Modules (2013)

Block 1
17 Modules (2018)

Block 2
10 Modules (2023)

Block 3
7 Modules (2028 & >)
Performance Improvement Areas

- Airport Operations
- Globally Interoperable Systems and Data
- Optimum Capacity and Flexible Flights
- Efficient Flight Path

ToC

Infrastructure

ToD

Information

Network

ASBU Block 0 in Perspective

Performance Improvement Areas

- B0-AMET – Meteorological information supporting enhanced operational efficiency and safety
- B0-ACDM - Improved Airport Operations through A-CDM
- B0-RSEQ - Improved Runway Traffic Flow through Sequencing (AMAN/DMAN)
- B0-SURF – Safety & Efficiency of Surface Operations (A-SMGCS 1-2 & cockpit moving map)
- B0-ACIM - Service Improvement through Digital Aeronautical Information Management
- B0-ASUR – Initial surveillance capability ADS-B Out, MLAT
- B0-FRTO - Improved Operations through Enhanced En-Route Trajectories
- B0-ASEP – Air Traffic Situational Awareness (ATSA)
- B0-OPFL – Improved Access to optimum FL through climb/descent procedures using ADS-B
- B0-DAM - Improved Flexibility & Efficiency through Planning based on a Network-Wide view
- B0-TBO – Improved Safety & Efficiency through the initial application of Data Link En-Route
- B0-APT – Optimisation of approach procedures including vertical guidance
- B0-SNET – Baseline Ground-based Safety Nets

November 2013
Block 0: Priority

- Block 0 initiatives must leverage on existing on-board avionics
- 3 Priorities have been agreed to by the Global community:
  - Performance Based Navigation (PBN)
  - Continuous Descent Operations (CDO)
  - Continuous Climb Operations (CCO)

- Block 0 risks are minimum
  - Global Readiness Checklist is complete
  - The Modules are well understood and supported
- States need to ensure successful deployment of Block 0
  - If Block 0 is not implemented as a foundation, certain functionalities may not be available as enablers for future blocks
- Identify and resolve policies necessary to enable the future blocks now
Global agreement on PBN
Complete ICAO tools

Annexes
Guidance Material

Doc 9613 Manual
PBN

Volumen I
Parte A - Airspace Concept
Parte B – Implementation Processes

Volumen II – Navigation Specifications

ICAO Doc 8168, PANS-OPS Vol II
Doc 9906, Vol I, FPD QA System
  Vol 2, FDP Training
  Vol 3, FPD Software validation
  Vol 5, Validation of FPD
  Vol 6, Flight validation, Pilot Training and evaluation
Doc 9905, RNP AR Procedure Design Manual
Doc 9902, PBN in Airspace Design
Doc 9933, CCO Manual
Doc 9931, CDO Manual
Introduction

Chp. 1 Traffic Grow and distribution in NAM/CAR regions

Chp. 2 Aviation System Block Upgrades (ASBU) - B0
  Performance Improvement Area (PIA) Air Navigation Report Forms (ANRF)

Chp. 3 – Regional Performance Objectives (RPOs)
Relationship RPOs with modules of Bloque 0

<table>
<thead>
<tr>
<th>RPO</th>
<th>ASBU</th>
<th>PIA1 Airport Operations</th>
<th>PIA2 SWIM</th>
<th>PIA3 Global Collaborative ATM</th>
<th>PIA4 Trajectory-based Operations</th>
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- **PBN Implementation**: X
- **Implement FUA**: X
- **Improve DCB**: X
- **ATM Situational Awareness**: X
- **Improve Cap/Efficiency Aerodrome Operations**: X
- **Optimization of COM infrastructure**: X
- **Implement AIM**: X
- **Improve MET information**: X
- **Improve SAR**: X

**RPO completed**: RPO5 New ICAO Flight Plan model implementation

**RPO merged into other RPO**: RPO on WGS-eTOD implementation and RPO on WRC- State support and best use of radiofrequency spectrum
PBN Airspace Concept implementation (Annex 11, Doc 4444, Doc 9613)

- Airspace and Organization Management (AOM) Workshops planned for 2013-2015
  - Emerging ATC training techniques – Improve ATS Capacity
  - PBN Operational Approval (Doc 9997)
  - PBN Approach Procedures Design (Doc 8168, Doc 9905)
  - Safety Assessment (Doc 9859)

- Comprehensive PBN Airspace Concept redesign for en-route and TMAs airspace in CAR Region (Doc 9992)
  - 7 State projects ongoing

- Continuous Descent Operations /CDO (Doc 9931)
  - STARS
  - Potential benefit of 250 kg fuel per arrival

- Continuous Climb Operation /CCO (Doc 9933)
  - SIDs
PBN AIRSPACE CONCEPT

ATM

- ATM expectations / Objectives
- AOM
- Traffic Flows
- Homogeneous areas
- ATS airspace / routes
- Safety assessment (pre & post)

COM
NAV
SUR

Navigation Application

PBN

Navigation Specification

NAVAID Infrastructure
Airspace Concept

Assumptions: CNS/ATM/Traffic/RWY/MET

Inter-centre letters of Agreement

Traffic assignment
[incl. regulation]

Special techniques:
CDA; Point Merge

Flexible Use of Airspace

Airspace Classification

Airspace Design:
Routes; Volumes; Sectors.
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
<table>
<thead>
<tr>
<th>Stage</th>
<th>Operational improvement</th>
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| Stage I    | Review of ATS route network in the CAR Region  
- 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 |
| (2010-2011)|                                                                                                                                                                                                                      |
| Stage II   | Review and interface of the ATS routes network in the CAR/SAM Regions  
- 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 |
| (2011-2012)|                                                                                                                                                                                                                      |
| Stage III  |  
- 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 |
| (2012-2014)|                                                                                                                                                                                                                      |
PIRGs are progressing with planning and implementation of ASBUs

The next step calls for an air navigation performance measurement, monitoring and reporting strategy.

Methodology for reporting

- States to send data to RO through Air Navigation Report Form (ANRF) or equivalent form/on ongoing basis
- RO will consolidate data from all States and publish through Regional Performance Dashboard /on ongoing basis
- HQ will consolidate data from all ROs and publish Global Air Navigation Report/annually

The current Performance Framework Form (PFF) has been redesigned and aligned with ASBU framework and called the Air Navigation Report Form (ANRF)

- ANRF will be the basis for performance reporting of the ASBU implementation
- The ANRF templates for all the 18 Modules of ASBU Block 0 will be available in the upcoming Regional eANP.
Transparency and sharing of information are fundamental to a safe and efficient global air transportation system.

ICAO is introducing “Regional ‘Performance Dashboard’ - the homepages for every public website of the ICAO Regional Offices.

- These dashboards will illustrate the regional implementation status relating to the strategic objectives on Safety, Air Navigation Capacity and Efficiency, and Environmental Protection.
- The Dashboard will show targeted performance at the regional level and will, initially, contain graphics and maps with a planned expansion to include the Aviation System Block upgrades (ASBU) Block 0 Modules.
- This new interactive online system will be in place for March 2014 for the all ICAO regions and will be updated at regular intervals.
- Dashboard will be user friendly and able to deliver the message at glance.
The Safety and AN System
A Better Way for the Future?

**GLOBAL PLANS**
Outlines Global Priorities and Targets
Reviewed by ANC; Approved by Council
Endorsed by Assembly

**GLOBAL PERFORMANCE REPORTS**
Reporting against Global Priorities
Global Reports (online) Annually
Special Version (print) for Assembly

**REGIONAL PERFORMANCE DASHBOARDS**
Adopts Global Priorities, sets additional as needed
Used by PIRGs and RASGs to Measure Performance
Regional Office Updates Dashboard (online) semiannually

PIRG-RASG agreed to establish by certain dates:
Safety (As soon as possible)
Air Navigation (May 2014)

Pending Council Approval
Available April 2014
Africa – Aug 2013
All Regions – March 2014

Feedback loop for continuous improvement
Regional Performance Dashboard
Indicators/metrics for Air Navigation

AIR NAVIGATION

Metrics

1. PBN TERMINAL
   % of international aerodromes with APV

2. PBN ENROUTE
   % of PBN routes/airspaces

3. CDO
   % of international aerodromes/TMAs with CDO

4. CCO
   % of international aerodromes/TMAs with CCO

5. Estimated Fuel Savings/ C02 Emissions Reduction Based on IFSET

6. ATFM
   % of ATS Units/International aerodromes providing ATFM service

7. AIM
   % of needed elements (from AIS to AIM Roadmap) facilitating the transition from AIS to AIM that have been implemented – PHASE I
This initial dataset for both Regional Performance Dashboard and the Global Air Navigation Report was recently agreed by the PIRG Chairs in a coordination meeting held on 19 March 2013

1. **Performance Based Navigation (PBN) - Terminal**
   % of international aerodromes with APV

2. **Performance Based Navigation (PBN) - Enroute**
   % of PBN routes/airspaces

3. **Continuous Descent Operations (CDO)**
   % of international aerodromes/TMAs with CDO

4. **Continuous Climb Operations (CCO)**
   % of international aerodromes/TMAs with CCO

5. **Estimated Fuel Savings/ C02 Emissions Reduction Based on IFSET**

6. **Air Traffic Flow Management (ATFM)**
   % of ATS Units/international aerodromes providing ATFM service

7. **Aeronautical Information Management (AIM)**
   % of needed elements (from AIS to AIM Roadmap) facilitating the transition from AIS to AIM that have been implemented – PHASE I
PBN implementation progress

100% NAM/CAR PBN implementation action plans

EN-ROUTE

- RNP 10 and random RNAV routes have been implemented in WATRS oceanic airspace, the Gulf of Mexico, and the Houston and Miami Oceanic FIRs.
- Random RNAV routes have been also implemented in the Piarco FIR.
- RNAV 5 routes in the upper continental airspace.

TMA

- 60% of international airports have implemented SIDs/STARs with PBN navigation specifications and continuous descent and climb operations (CDO/CCO) criteria.

Approach Procedures (A37-11 = 30% by 2010, 70 % by 2014)

- 60% of aerodromes have instrument approach procedures with vertical guidance (APV), (BARO-VNAV and/or GNSS augmentation) whether as primary approach or as support to precision approaches.

BENEFITS

- States use the IFSET electronic tool to report estimated fuel savings resulting from operational improvements.
  - In January 2013 of RNP 10 implementation in the upper airspace of the Gulf of Mexico indicates total fuel savings of 712,066 kg, resulting in cost savings of approximately $1,491,807 per month.
PBN Implementation Plans

104 out of 191 States submitted plan
Planes de Implementacion PBN, presentados a la OACI

![Bar chart showing PBN Implementation Plan Status for different regions.]

- EUR/NAT: Total 38, 16% Yes, 45% No, 39% No Information
- APAC: Total 24, 34% Yes, 66% No, 50% No Information
- ESAF: Total 24, 38% Yes, 13% No, 17% No Information
- WACAF: Total 21, 83% Yes, 17% No, 67% No Information
- NACC: Total 21, 100% Yes, 0% No, 77% No Information
- MID: Total 15, 13% Yes, 20% No, 67% No Information
- SAM: Total 13, 23% Yes, 77% No, 0% No Information

Total 191 States
Annual Report (ANRF): 2014

- Performance Monitoring
  - of individual modules
  - Air Navigation Report Form
- Annual Global Air Navigation Report
- Compare progress across regions
- Adjust ICAO work programme
What`s next?

PBN Airspace Design

7 Projects
- Costa Rica, El Salvador, Honduras, Jamaica, Mexico, Trinidad and Tobago, Turks & Caicos, COCESNA
PBN Multidisciplinary Team

- Lead by ATM / airspace specialist
- ATCOs (Air Traffic controllers)
- ATM & CNS specialist
- Procedure designers
- Technical pilots

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Thank You