PBN
Performance Based Navigation
- PBN & Airspace Concepts -

Components of PBN Concept

1. NAVIGATION INFRASTRUCTURE
2. NAVIGATION SPECIFICATION
3. NAVIGATION APPLICATION

Components of PBN Concept
- Navaid Infrastructure -

- Ground-based Navigation Aids (Navaids)
  - VOR; DME; (Not NDB)
- Space-based Navaids
  - GNSS
    - GPS; Glonass; future Galileo

Components of PBN Concept
- Navigation Specification -

- What PERFORMANCE is required of the RNAV system?
- What Functionalities must RNAV system have to achieve Performance?
- What Navigation Sensors must be integrated in RNAV system to achieve Performance?
- What requirements are placed on the Air crew to achieve the required Performance from the RNAV system?

Components of PBN Concept
- Navigation Specification -

- What PERFORMANCE is required of the RNAV system?
- What Functionalities must RNAV system have to achieve Performance?
- What Navigation Sensors must be integrated in RNAV system to achieve Performance?
- What requirements are placed on the Air crew to achieve the required Performance from the RNAV system?

Document used by State as basis for developing Certification & Operational Approval

Aim is to limit number of Nav. Specs in global use


Accuracy Integrity Continuity Availability
Components of PBN Concept - Navigation Specification -

- Performance
- Functionalities
- Navigation Sensors
- Air crew requirements


Components of PBN Concept - Navigation Specification -

- 2 NAVIGATION SPECIFICATION
- Previous RNP Concept

Document used by State as basis for developing Certification & Operational Approval

Components of PBN Concept - Navigation Specification -

- 2 NAVIGATION SPECIFICATION
- RNAV System PERFORMANCE

Document used by State as basis for Certification & Operational Approval

On-Board performance Monitoring and Alerting

Components of PBN Concept - Navigation Specification -

- RNAV
- RNP

On-Board performance Monitoring and Alerting

- On-board performance monitoring and alerting does not only refer to 'containment' in the MASPS; Annex 11 or PANS-OPS.
- On-board performance monitoring and alerting allows the air crew to detect that the RNP system is not achieving the navigation performance required of the RNP system

Components of PBN Concept - Designation -

- 1 NAVIGATION APPLICATION
- 2 NAVIGATION SPECIFICATION
- 3 NAVIGATION SPECIFICATION
- 1 NAVID INFRASTRUCTURE
- 2 NAVID INFRASTRUCTURE
- 3 NAVID INFRASTRUCTURE

Potential Nav Specs

RNP 4
For Oceanic & Remote Continental navigation applications

RNP AR APCH
RNP APCH
For various phases of RNP

International NS in Volume II of PBN Manual

RNP 10 (RNP10)
RNAV 10
For En Route & Terminal navigation applications

RNAV 5
RNAV 2
RNAV 1
For Oceanic & Remote Continental navigation applications

RNP APCH
RNP AR APCH
RNP 4D for various phases of RNP

* Potential Nav Specs

11/44

Components of PBN Concept

- Designation

- RNAV
- RNP

On-Board performance Monitoring and Alerting

- On-board performance monitoring and alerting does not only refer to ‘containment’ in the MASPS, Annex 11 or PANS-OPS.
- On-board performance monitoring and alerting allows the air crew to detect that the RNP system is not achieving the navigation performance required of the RNP system

International NS in Volume II of PBN Manual
Components of PBN Concept - Navigation Application -

- The APPLICATION (use of) the Navigation Specification and Navaid Infrastructure -
  - For example: Routes based on RNAV and RNP Specifications (these rely on the Navaid Infrastructure);
  - For example: SIDs/STARs based on RNAV and RNP Specifications;
  - For example: Approach procedures based on RNP Specifications

---

Example: RNAV 1 Specification

**ICAO RNAV 1 Specification**

- (1) DME/DME/IRU
- (2) DME/DME
- (3) GNSS

**NAVIGATION SPECIFICATION**

**NAVIGATION APPLICATION**

**NAVIGATION INFRASTRUCTURE**

---

E.G: RNAV 1 Specification (A)

**STATE (A)**

**RNAV 1 APPLICATION**

**NAVIGATION INFRASTRUCTURE**

---

E.G: RNAV 1 Specification (B)

**STATE (B)**

**RNAV 1 APPLICATION**

**NAVIGATION INFRASTRUCTURE**

---

Context of PBN

Airspace (Operational) Concept

**Com** **Nav** **Sur** **ATM**

**PBN** **NAVIGATION SPECIFICATION** **NAVIGATION APPLICATION** **NAVIGATION INFRASTRUCTURE**
Context of PBN

ICAO GLOBAL ATM CONCEPT

NAVIGATION
APPLICATION
NAVAID INFRASTRUCTURE
NAVIGATION
SPECIFICATION
COM NAV SUR ATM

PBN

What is an Airspace Concept?

- General Vision or Master Plan for an airspace
- Geared towards Strategic Objectives
- Covers all air traffic system “Enablers”

What is an Airspace Concept?


Answer the question: What Do We want to Achieve?

Strategic Objectives

Examples: Strategic Objectives

Safety
- Reduce Controlled Flight Into Terrain via lateral & vertical course guidance to runway

Capacity
- Increase number of air traffic routes to reduce congestion; accommodate projected growth

Efficiency
- Reduce delays that result from excessive ‘levelling off’ flight profiles
- Reduce noise over sensitive areas

Environment
- Improve airport and airspace access in all weather conditions

Access

Airspace Concept

Airspace Concept: Enablers

Communications
Navigation
Surveillance
Air Traffic Management

CNS/ATM
Airspace Concept: Enablers

Communications
Navigation
Surveillance
CNS/ATM
Air Traffic Management

Airspace Concept Development

Airspace Concept development requires the combined efforts of

- Air Navigation Service Providers ("Air Traffic");
- Regulators; and
- System Users

"STAKEHOLDERS"

To Do What?

Airspace Concept: Stakeholder Roles

Air Traffic Service Providers, Regulators and System Users:

1. Identify strategic objectives
   - Safety?
   - Efficiency?
   - Capacity?
   - Environment?
   - Access?

2. Prioritise strategic objectives
   - Safety?
   - Capacity?
   - Access?
   - Efficiency?
   - Environment?

3. Address enablers

CNS/ATM

Addressing Enablers

Communications
- WHF? HF? Two Way?
- NAVAIDs?
- Primary/Reversionary?
- Aircraft and Operator Capabilities?

Navigation
- Radar? Non-Radar?

Surveillance
- ATC Procedures? Workload? Automation?

Air Traffic Management
- Reduce delays that result from excessive "leveling off" flight profiles

Objectives Implementation

Safety
- Reduce Controlled Flight Into Terrain via lateral & vertical course guidance to runway

Capacity
- Increase number of ATS routes to reduce congestion; accommodate projected growth
- RNP approach to replace circling approach
- Parallel RNP-2 ATS routes between cities

Efficiency
- Reduce delays that result from excessive "leveling off" flight profiles
- RNP (AR) APCH w/ gilded Curved Missed Approach Segment
- RNP approach allowing lower minima

Environment
- Reduce noise over sensitive area

Access
- Improve airport and airspace access in all weather conditions

Airspace Concept Use

Airspace Concept development requires the combined efforts of

- Air Navigation Service Providers ("Air Traffic");
- Regulators; and
- System Users
- PANS-OPS specialist

"STAKEHOLDERS"

To identify and prioritise Strategic Objectives, considering the entire CNS/ATM environment
Case Study

Case Study - Day 1
Case Study - Day 2
Case Study - Day 3

Case Study

Fictitious Airport (Does not exist!)

Case Study

Fictitious Airspace (Does not exist!)

Case Study

Accommodate increased traffic
Minimise noise impact
Develop and Instrument Approach Procedure

Case Study

Audience Response System
Questions

Next
Processes 1, 2, 3
Will make Reference to our Case Study
At end of each day, will present Case Study