

Performance-based Navigation I

Classroom and In-Company Course (5 days/40 hours)

Performance-based Navigation (PBN) is the most practical solution for the regulation of new navigation systems technology. PBN is based on Area Navigation, or RNAV, a method of navigation which permits aircraft operation on any desired flight path within coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

The PBN Manual (ICAO Doc. 9613) defines and standardizes this navigation capability. It contains a menu of navigation specifications and implementation guidance for States, aircraft operators and air navigation service providers. Due to implementation being slower than agreed under Assembly Resolution A37-11, PBN implementation of RNAV and RNP air traffic services routes and approach procedures is currently a top priority of ICAO.

Be brought up to date on the PBN concept, GNSS theory, RNAV, RNP and airspace planning and design with this foundation course. [PBN II](#) and [PBN Operational Approvals](#) are follow-on courses on PBN implementation.

Objectives

Upon completion of this course you will be able to:

- Explain what ICAO PBN is about
- Understand the role of PBN in Aviation System Block Upgrades (ASBU) and Continuous Descent and Continuous Climb Operations
- Distinguish between different types of Area Navigation (RNAV) systems
- Explain the fundamentals of GNSS theory and GNSS separation standards and benefits
- Know the basics of RNAV and RNP procedures design
- Better understand Instrument Approach Procedures, Standard Instrument Departures and Arrivals (SIDs, STARs)

Target audience

- Air Traffic Controllers, ANSP managers and supervisors
- Beginner ATC procedures and airspace designers
- Aircraft operators especially flight operations and planning managers and personnel
- National and civil aviation authorities

Key topics

- **History and evolution of ICAO Navigation Specifications leading up to the PBN Concept**
 - The need for a Global Plan for implementation and global harmonization of CNS/ATM systems
 - ICAO Global Air Navigation Plan and timeline
 - FANS, CNS/ATM, RNP, RNP/RNAV
 - Relevant ICAO Specifications, in particular for Enroute, Terminal Area and Approach
 - Regional differences and harmonization
 - PBN in relation to existing and future airspace structures
- **Types of Area Navigation (RNAV) systems**
 - RNAV systems and the following individual navigation system technologies: DME/DME, IRU, INS, GNSS, GPS, SBAS, GBAS, Galileo
- **Fundamentals of GNSS theory and GNSS separation standards and benefits**
 - The evolution of GNSS constellations and their augmentations systems (ABAS)
 - Space-based and ground-based GNSS augmentations (SBAS, GBAS)
 - GPS receiver and Receiver Autonomous Integrity Monitor (RAIM)

Key topics *cont.*

- GNSS interference and relevant NOTAMs
- GNSS approvals
- GNSS (RNAV) approaches
- Lateral and longitudinal GNSS (RNAV) separation standards and benefits
- Other RNAV (GNSS) procedures
- Overview of how to validate RNAV and RNP procedures
- **Fundamentals of RNAV and RNP procedure design**
 - Enroute and Terminal Manoeuvring Area (TMA) RNAV procedures
 - Enroute Area Navigation, route spacing and the TLS
 - Terminal Manoeuvring Area (TMA) Area Navigation
 - Planning TMA Area Navigation Design and Implementation
 - Different types of RNP and RNAV, regional variants
- **Instrument Approach Procedures**
 - Conventional and Area Navigation (RNAV) procedures and their influence on airspace design
 - Procedure protection areas and their effect on airspace structure
- **Controlling aircraft using Standard Instrument Departures and Arrivals (SIDs, STARs)**
 - Modular approach to TMA area navigation implementation
- **Area Navigation review**
 - In-depth discussion on PBN and in particular RNAV and RNP to summarize all topics covered.

Activities

- Several practical exercises

Prerequisites

Participants should have prior knowledge of:

- ICAO Doc 9750 Global Air Navigation Plan, ICAO Doc 9613 Performance-based Navigation Manual

Recommended level

- Intermediate, Advanced

Certificate awarded

- An IATA Certificate is awarded upon successful completion of the course and final examination.
- You can also apply this course towards an IATA Diploma in Air Navigation Services Management.

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Course schedule

Day 1

- **Introduction to PBN**
 - What is the PBN concept
 - PBN Navigation Specifications
 - What is meant by 'Performance-based'
 - Distinction between RNAV and RNP
 - Components of PBN
 - ICAO vision
 - ICAO Assembly Resolution A37-11
- **Area navigation**
 - Conventional navigation
 - Area navigation route components
 - ARINC leg types
 - Area navigation turns
 - Fly-by and Fly-over
- TO-TO navigation
 - Waypoint sequencing
 - TO-FROM navigation
- Area navigation system technologies
- **Area navigation systems**
 - Area navigation system technologies
 - Ground-based aid dependent
- DME/DME, VOR/DME, DME/DME/IRS, INS, GNSS

Day 2

- **PBN NavSpec applications**
 - Issues associated with each NavSpec
 - Subtle differences between:
 - RNP 10 and RNAV 10
 - RNAV 10 and RNP 4
 - RNAV 5 and RNAV 2
 - RNAV 2 and RNAV 1
 - RNAV 1 and RNP 1
 - RNP 0.3 and RNP APCH
 - RNP APCH and RNP AR APCH
- **GNSS theory**
 - Global Navigation Satellite System (GNSS)
 - Core satellite constellations
 - GPS Segments
 - Position Determination
 - GPS Accuracy
 - GNSS Interference
- **GPS Receiver and RAIM**
 - GNSS Receiver
 - TSO-C129
 - RAIM
 - Integrity limits
 - Where do integrity limits change?
 - Fault detection and exclusion

Day 3

▪ GNSS augmentations

- Wide Area and Local Area Augmentations
- SBAS and GBAS
- Satellite Based Augmentations Components
- Satellite Based Augmentation Accuracy
- SBAS Coverage and Service Areas
- Ground Based Augmentation System
- GBAS Accuracy
- GBAS Benefit

▪ RNP APCH

- [RNAV(GNSS) Approach]
- Approach Segments

- Approach Minima – MDA

- Fix naming

- Approach Procedure with Vertical Guidance

▪ RNP AR APCH

- RNP AR APCH Terminology

- Common name, Charting designation, PBN Name

- Approach Segments

- Approach Minima – DA

- Approach Procedure with Vertical Guidance

Day 4

▪ A basics, STARs and SIDs

- Operator goals in the TMA
- TMA Design to achieve these goals
- Things to avoid...
- CDOs and CCOs
- Area Navigation STARs
- Area Navigation SIDs
- Terminal Arrival Area (TAA)
- Open STARs

▪ TMA airspace design

- Operator goals in the TMA

- TMA Design to achieve these goals

- Things to avoid...

- CDOs and CCOs

- Area Navigation STARs

- Area Navigation SIDs

- Terminal Arrival Area (TAA)

- Open STARs

Day 5

▪ ATC separation and route spacing

- PBN and separation
- Background and history of route spacing
- CRM and TLS directly impact separation
- What's new?

- PANS-OPS areas for aircraft-to-aircraft separation in TMAs

- GNSS track separation

- GNSS separation standards based on DME for longitudinal separation

This course can be customized for your company and delivered at the location of your choice.
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