Template for Performance Based Navigation (PBN)

State Implementation Plan

[State name]

International Civil Aviation Organization

Instructions

[This document is an example template of a State PBN Implementation Plan and provides step-by-step guidance to States on how to establish their own national plan in a standard consistent way in relation to Assembly Resolutions, ICAO SARPs, GANP, GASP, Regional plans and other related documents.

The requirement for a State PBN Implementation Plan is detailed in Assembly Resolution 37-11.

In developing a State Implementation Plan, it is essential that all aviation stakeholders are involved. This is a collaborative exercise, and input from the airspace users is key to developing an effective and achievable plan. (See Doc 9992).

This template includes, boilerplate text, and fields that should be replaced with the values specific to the State PBN Implementation Plan.

- ***Blue** italicized text enclosed in square brackets ([text]) provides instructions to the document author, including explanation on the intent, assumptions and context for content that should be included in this document.*

- *Text and tables in **Black** are provided as boilerplate examples of wording and formats that may be used or modified as appropriate to a specific plan. These are offered only as suggestions to assist in developing planning documents; they are not mandatory formats.*

When using this template for your PBN Implementation Plan, it is recommended that you follow these steps:

1. *Modify boilerplate text as appropriate to address the State's own requirements.*
2. *Add extra chapters and sections which are not included in the template to provide more detail information or to address specific State issues.*
3. *Complete the chapters and sections that the template contains as these are mandatory fields to be filled.]*

ICAO Reference documents:

Assembly Resolution A37-11
Global Air Navigation Plan (GANP)
Performance-based Navigation (PBN) Manual (Doc 9613)
Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444)
Procedures for Air Navigation Services — Aircraft Operations (PANS-OPS, Doc 8168)
Continuous Descent Operations (CDO) Manual (Doc 9931)
Continuous Climb Operations (CCO) Manual (Doc 9993)
Manual on the Use of Performance-based Navigation (PBN) in Airspace Design (Doc 9992)
PBN Business Case Development guidance (TBD)

LIST OF PERSONS IN CHARGE OF PREPARATION, VERIFICATION AND APPROVAL OF THE DOCUMENT

	Name	Functions	Date	Signature
Prepared by				
Verified by				
Approved by				

LIST OF AMENDMENTS

Date	Amendment #	Title

EXECUTIVE SUMMARY

[This section provides a summary of the key points of the plan including the actions to be taken by all stakeholders.]

It should briefly describe:

- *the purpose of the plan*
- *the key stakeholders that were involved;*
- *the strategic objectives, ,*
- *the airspace affected, ,*
- *the benefits that are expected and;*
- *the final end state to be achieved.*

TABLE OF CONTENTS

3.8. Air Navigation Service Providers (ANSPs)

Chapter 4 – Implementation Targets

4.1. Short Term

4.2. Medium Term

4.3. Long Term

4.4. End State

Chapter 5 – Plan Coordination

5.1. Coordination and Consultation

5.2. Plan Responsibility

5.3. Plan Review

Chapter 6 – Safety

6.1. Preliminary safety assessment and risk analysis

6.2. Implementation safety assessment

Appendices [add as required]

A. A37-11 General Assembly Resolution

B. PBN Implementation Schedule for En-Route, terminal and approach

C. References

D. Miscellaneous

Glossary of Definitions/Acronyms/Abbreviations

The following table provides definitions and explanations for terms and acronyms relevant to the content presented within this document.

Term	Definition
ANSP	Air Navigation Service Provider
APCH	Approach
ATM	Air Traffic Management
CNS	Communication, Navigation, Surveillance
GANP	Global Air Navigation Plan
GASP	Global Air Safety Plan
ICAO	International Civil Aviation Organization
NAVAID	Navigation Aid
PBN	Performance-based navigation
RNAV	Area Navigation
RNP	Required Navigation Performance
SARPs	Standards and Recommended Practices
SID	Standard Instrument Departure
STAR	Standard Terminal Arrival

CHAPTER 1

OVERVIEW

1.1. BACKGROUND

[This subsection provides an overall system overview, any requirements to implement the system. This section should be completed at a very high level. It may be as long as necessary, but most information should be contained in a half of a page. This section is intended to provide the background information necessary to indicate the process that the system has been going through from past to present.]

1.2. PURPOSE OF THE PLAN

[This subsection describes the purpose of the plan and identifies the system to be implemented.]

1.3. STRATEGIC OBJECTIVES

[Describe objectives of the State PBN Implementation Planning.]

- *1- Efficiency and capacity: implementation of PBN routes, RNP SIDs and STARs, Terminal airspace redesigns*

  ✓ Maximize the use of current area navigation and existing (ABAS) and emerging augmented navigation systems (GBAS and SBAS) and aircraft avionics systems improvement

  ✓ Address current and forecast airspace capacity and operational efficiency issues through application of the ICAO PBN concept

- *2- Safety: implementation of RNP APCH procedures with vertical guidance, straight-in approach procedures)*

  ✓ Achieve a total performance-based area navigation environment with defined ICAO PBN Navigation Specification designator values for all operations and airspaces

- *3- Reduction of environmental impact, reduction in ground-based navigation aids, etc…).*

  ✓ Utilize PBN to reduce environmental impact from aviation through more efficient operations that result in a less gas emissions due to less fuel burn and noise emissions

1.4. ASSUMPTIONS

[This section describes the assumptions made regarding the development and execution of this document as well as the applicable constraints. It is useful to identify the most important assumptions in the State Implementation Plan to test these assumptions and to accommodate these unexpected outcomes. Some items to consider when identifying the assumptions and constraints are:

- *Capacity and efficiency*
- *Infrastructure and equipment*
- *Airspace*
- *Aircraft equipage*
- *Environmental factors,*

- *Existing and emerging Technology …]*

CHAPTER 2

PERFORMANCE-BASED NAVIGATION (PBN) OVERVIEW

2.1. PBN CONCEPT

[This section is provided to describe the general PBN Concept, show that the concept is fully understood, and explain how it will be implemented by the State. PBN sets clear performance requirements for flight operations. PBN involves a major shift from conventional ground based navigation and procedures to satellite based navigation and area navigation procedures. Details can be found in Doc 9613 and Doc 9992.]. Example text follows:

The PBN Concept is based on a shift from sensor-based navigation to performance based. The PBN concept specifies that aircraft area navigation system performance is defined in terms of integrity, accuracy, availability, continuity and functionality. It explains and describes the performance-based RNAV and RNP navigation specifications that can be applied to oceanic, En-Route and terminal airspace, to improve safety, efficiency and capacity, as well as reduce the environmental impact. These specifications also detail the navigation sensors and equipment necessary to meet the performance requirement.

The application of a PBN specification depends on many factors – the navigation infrastructure, communications capability, surveillance capability, the operational requirement, the aircraft fleet capability and operational approvals. etc. In determining which PBN specification to apply, these factors must be taken into consideration in consultation with all stakeholders.

For *[state the Country]*, the application of the PBN concept is important mainly for *[explain the main reasons – safety (procedures with vertical guidance), efficiency, capacity, environment, redundancy, etc]*

2.2. PBN APPROACHES WITH AND WITHOUT VERTICAL GUIDANCE

[This section provides information on the importance of instrument approach procedures with vertical guidance and on the current status of APV implementation.]

PBN facilitates the implementation of instrument approaches with vertical guidance (APV) to all runway ends. This has a significant safety impact, as non-precision approaches (dive and drive) with no vertical guidance can be removed. It has been proven that approach procedures with vertical guidance are 25% safer than procedures with no vertical guidance. Furthermore, PBN facilitates the design and implementation of APV to runways that do not currently have an approach capability, thus improving airport accessibility and flight operations efficiency.

Therefore, *[state Country, in collaboration with the airspace users]* places a high priority on the design and implementation of PBN approach procedures with vertical guidance in concert with Assembly Resolution A37-11, to improve both safety and efficiency.

2.3. CURRENT STATUS OF PBN IMPLEMENTATION

[This section provides information with respect to the current status of RNAV and RNP operations for different phases of flight in the State.]

2.3.1. Oceanic, Remote and Continental En Route

2.3.2. Terminal Areas (SIDs and STARs)

2.3.3. Approach

2.3.4. Helicopter Operations

2.3.5. Military Operations

[Use of a table is recommended]

2.4. AIRCRAFT FLEET CAPABILITIES

[This section is provided to show the current PBN capability of aircraft flying within and over the State airspace and the traffic forecast over the timeframe of the plan, as this is essential for the development of the plan.]

2.5. CNS/ATM CAPABILITIES

[This section is provided to show the current status of Ground and Space based NAVAIDs, Communications and ATM infrastructure that the State has already established and which enables the implementation of PBN.]

2.6. PBN BENEFITS AND GLOBAL HARMONIZATION

[This section describes the benefits that the State is planning to achieve from the implementation of PBN and the cooperation with the other national, regional and international stakeholders in line with GASP, GANP and regional plans.]

PBN offers a number of advantages over the sensor-specific method of developing airspace and obstacle clearance criteria. For example:

a) It reduces the need to maintain sensor-specific routes and procedures and their associated costs (e.g. VOR, NDB, DME);
b) Enhances safety by allowing for straight-in approach procedures with vertical guidance as a primary approach or back up to existing precision approach procedures;
c) Improves airport accessibility under all weather conditions;
d) Allows for more efficient use of airspace, thus increasing capacity;
e) Improves operational efficiency through user preferred routings, reduced delays and holds, and enables continuous descent and continuous climb operations;
f) Lessens the environmental impact by contributing to reduced aircraft fuel burn and noise emissions

For *[state Country]*, the main focus is on *[explain the main benefits that the State wants to achieve and how this relates to harmonization within the region]*

CHAPTER 3

IMPLEMENTATION CHALLENGES

3.1. SAFETY

[This section describes what kind of challenges States face and what measures have been taken for the safe operations during the transition to PBN operations.]

3.2. AIRCRAFT EQUIPAGE

[This section describes the existing aircraft fleet capability for the air operators that transit the State airspace (fly in, out, and over) and the air operators that fly solely within the State airspace against the PBN concept.]

3.3. INFRASTUCTURE

[This section describes the challenges with respect to the equipment and infrastructure which are essential requirements for the implementation of PBN concept.]

3.4. CAPACITY AND EFFICIENCY

[This section shows that how the new system helped the State through the increase in the capacity and efficiency to meet the demand in the aviation sector.]

3.5. ENVIRONMENT (GAS AND NOISE EMISSIONS)

[This section shows the environmental challenges and how the PBN Concept helped State reduce the environmental effect of operations.]

3.6. REGULATORY

[This section shows the regulatory changes that may be necessary and the timelines to implement in order to facilitate implementation of the PBN Concept.]

3.7. RESOURCES

[This section identifies any additional resources that are required to facilitate implementation of the PBN concept.]

3.8. AIR NAVIGATION SERVICE PROVIDERS (ANSPs)

[This section identifies any issues that may need to be addressed with the ANSP. It may include ATCO training, procedure design training, etc.]

CHAPTER 4

IMPLEMENTATION TARGETS

[This section provides the targets and schedule for these targets to be accomplished in the short, medium and long term. It is recommended that the minimum time for each term is 3 years – State can assign a longer period if it so desires.]

4.1. SHORT TERM (Show applicable years – e.g 2017-2019)

4.1.1. Oceanic, Remote and Continental En Route

4.1.2. Terminal Areas (SIDs and STARs)

4.1.3. Approach

4.1.4. Helicopter Operations

4.1.5. Military Operations

4.2. MEDIUM TERM (Show applicable years – e.g. 2020-2022)

4.2.1. Oceanic, Remote and Continental En Route

4.2.2. Terminal Areas (SIDs and STARs)

4.2.3. Approach

4.2.4. Helicopter Operations

4.2.5. Military Operations

4.3. LONG TERM OBJECTIVES (Show applicable years – e.g 2023-2025)

4.3.1. Oceanic, Remote and Continental En Route

4.3.2. Terminal Areas (SIDs and STARs)

4.3.3. Approach

4.3.4. Helicopter Operations

4.3.5. Military Operations

[As this is further out, it may be more general and not follow the specific sub-paras above.]

4.4. END STATE (Show Year)

[Describe the end state and when it will be achieved. This can then be used in the executive summary]. The end state should relate to the Strategic Objectives and could also include:

- *PBN Specs implemented and where (Oceanic, Remote and Continental En Route, Terminal and Approach)*
- *Relationship to the objectives of A37-11 (met or partially met)*
- *Total expected Improvements to safety, efficiency and capacity*
- *Total expected environmental benefits from reduced fuel burn and noise emissions*

CHAPTER 5

PLAN COORDINATION

5.1. COORDINATION AND CONSULTATION

[This section addresses the coordination, collaboration and consultation process that the State will utilize with all stakeholders - the operators operating within the State, ANSPs, aerodrome operators, regional and international organizations - during the preparation and implementation phase of the plan. There should be consensus on the resultant implementation plan.]

5.2. PLAN RESPONSIBILITY

[Describe the appropriate authority having responsibility for the effective and efficient performance of the State's PBN implementation plan. Describe the ultimate responsibility for each organizations being involved to the plan to fulfil all requirements in order to achieve the targets set in the Plan.]

5.3. PLAN REVIEW

[Describe the amendment process to review the Plan. It is suggested to create a PBN Plan Committee composed of main stakeholders in charge of Plan review. The Plan would be reviewed yearly or at agreed periodicity but not after each term timeframe. Amendments will be solicited from all stakeholders and the plan will be amended as required by the Committee.]

CHAPTER 6

SAFETY

6.1. PRELIMINARY SAFETY ASSESSMENT AND RISK ANALYSIS

[This section defines the possible scenarios and safety analysis that may be required to identify hazards and control the potential consequences in order to reach an acceptable level of safety. It should include the safety assessment and risk analysis process performed in line with ICAO Safety Management Manual (Doc 9853).]

6.2. IMPLEMENTATION SAFETY ASSESSMENT

[This section provides information with respect to the analysis that will be performed after the implementation of PBN procedures to see if the safety requirements are met.]

APPENDIX A

Assembly Resolution A37-11

PERFORMANCE BASED NAVIGATION GLOBAL GOALS

Note: Resolution A37-11 is a result of the 11th Air Navigation Conference recommendations on area navigation implementation and Resolution A33-16 that requested Council to develop a program to encourage States to implement approach procedures with vertical guidance. The main points of Resolution A37-11 are as follows:

{Preamble Removed}

The Assembly

1. *Urges* all States to implement RNAV and RNP air traffic services (ATS) routes and approach procedures in accordance with 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;

        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% by 2010, 70% 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 and where there are no aircraft suitably equipped for APV operations with a maximum certificated take-off mass of 5700 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 ends serving aircraft with a maximum certificated take-off mass of 5700kg or more, according to established timelines and intermediate milestones;

4. *Instructs* the Council to provide a progress report on PBN implementation to the next ordinary session of the Assembly, as necessary;

5. *Requests* the Planning and Implementation Regional Groups (PIRGs) to include in their work programme, the review of status of implementation of PBNB by States according to the defined implementation plans and report annually to ICAO any deficiencies that may occur; and

6. *Declare* that this resolution supersedes Resolution A36-23.

APPENDIX B

PBN Implementation Schedule for en-route, terminal and approach

PBN Specification	En-Route (Oceanic, Remote, Continental)	Terminal Airspace SIDs, STARs	Approach Procedures
RNAV 10			
RNAV 5			
RNAV 2			
RNAV 1			
RNP 4			
RNP 2			
RNP 1			
Advanced RNP			
RNP APCH			
RNP AR APCH			
RNP 0.3			

[For each box indicate timeframe for implementation and where specifications will be used (if applicable. For example, indicate the airports, terminal airspace or En-Route airspace). If some are not to be used or are not applicable, indicate N/A.]

APPENDIX C

References

[Insert the name, version number, description, and physical location of any documents referenced in this document. Add rows to the table as necessary.]

The following table summarizes the documents referenced in this document.

Document Name	Description	Location
<Document Name and Version Number>	*<Document description>*	*<URL or location where document is located>*

[This should include other documents besides ICAO docs – regional plans, state plans, etc…]

APPENDIX D

Miscellaneous

[If required to support information in the main part of the plan. For example list of organizations that will be consulted, etc…].