

AFCAC/ICAO Joint Workshop
Walter White

**NATIONAL PBN
IMPLEMENTATION
PLAN TEMPLATE AND
GUIDELINES**

PERFORMANCE-BASED NAVIGATION PLANS

- “ Where are you ?
- “ Where do you want to go ?
- “ Link with ICAO Block Upgrades and regional plans.
- “ National PBN implementation plan template and guidelines.

Roadblocks

”Lack of expertise

” Airspace development

” Operational approval process

” Pilots and ATC Controllers training

”Coordination between Stakeholders

” National

” Regional

”Clear Cost vs Benefit Analysis

And some Misconceptions

Misconceptions on PBN

“PBN, it **looks** complicated but it is not:

“ It does **not** add new navigation philosophy, but just is a pragmatic tool to implement navigation procedures for aircraft capability that exists for more than 30 years!

“ It does **not** require States to completely overhaul navigation infrastructure, but can be implemented step-by-step

“ It does **not** require States to implement the most advanced navspec, only needs to accommodate operational needs

2010 . ASSEMBLY RESOLUTION A37-11: PBN GLOBAL GOALS

**Supersedes A36-23*

The Assembly:

1. Urges states to implement RNAV and RNP air traffic services (ATS) routes and approach procedures in accordance with the ICAO PBN concept laid down in the 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** (Lateral Navigation) **only minima**, for all instrument runway ends; either as a primary approach or as a back-up for precision approaches **by 2016** with intermediate milestones as follows:
30 percent by 2010, 70 percent 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 implementation of PBN..

PERFORMANCE-BASED IMPLEMENTATION PLANS

The implementation of PBN in the State should be based on the following principles:

- a) Continued application of conventional air navigation procedures during the transition period, to guarantee availability by users that are not RNAV- and/or RNP-equipped;
- b) Development of airspace concepts, applying airspace modelling tools as well as real-time and accelerated simulations, which identify the navigation applications that are compatible with the aforementioned concept;
- c) Conduct of cost-benefit analyses to justify the implementation of the RNAV and/or RNP concepts in each particular airspace;
- d) Conduct of pre- and post-implementation safety assessments to ensure the application and maintenance of the established target levels of safety.
- e) Must not conflict with the regional PBN implementation plan.

PERFORMANCE-BASED IMPLEMENTATION PLANS

- “ Do not have to be complicated.
- “ Keep it simple.
- “ Start with airports and capabilities.
- “ Decide on RNAV/RNP approaches.
- “ Decide on SIDs/STARs.
- “ List implementation according to priorities and timeframes.

Example PBN Implementation Plans



01 Short Term 2010 ~ 2012

All current RNAV routes in Korea will be readjusted to meet ICAO's PBN concept and clearly state navigation specification.

En route All the current RNAV routes will be changed to RNAV 5. RNAV 2 will be introduced to establish unidirectional parallel routes on heavily congested routes such as B576 to improve air traffic flow and the number of aircraft that can be handled without adding the workload to air traffic controllers will be increased in the future as well. Those routes will be separated by at least 8NM laterally. In addition, efforts will be made to harmonize navigation specifications on routes connected with neighboring countries like Japan.

Terminal Current RNAV STAR and SID will be switched over to RNAV 1 which will also be applied to new STAR and SID during this term. In this case, priority will be given to easing congestion of airspace in the capital region and reducing the controller's workload. This is both to cope with the congestion and growing air traffic demands and at the same time to improve flight safety by lowering the incidence of aircraft proximity and other safety impediments. When selecting SID courses, RNAV's track keeping advantages will be utilized to the fullest to give consideration to avoiding heavily populated residential areas. And, continuous descent operations (CDO) will be expanded to all major airports including Incheon and Jeju.

Approach APV-Baro VNAV will be introduced to all international airports and high traffic domestic airports. At these airports, APV-Baro VNAV will be adopted at non-precision runways without ILS for priority operation over non-precision approach procedures and this will help to tackle problems off-set and step-down approach of non-precision approaches and eventually the flight safety and accessibility. Mixed navigation environment will be inevitable during the transition period. Therefore, taking air traffic control workload into account, instrument approach procedures will be designed as much as possible to have initial approach waypoints correspond with the initial approach fixes of conventional approach procedures. In addition, study on introduction of GBAS will be launched as well.

Example PBN Implementation Plans



02 Medium Term : 2013 – 2016

En route RNAV 2 or RNP 2 will be applied to new RNAV routes installed during this period. Routes between Korea and neighboring countries will be straightened out during this period as well and new routes will be established exclusively for overflights in an effort to diversify traffic. Concerned countries will be consulted for the development of new routes and for regional harmonization of navigation specifications.

Terminal Introduction of RNAV 1 or RNP 1 in International airports will be completed during this period and RNAV 1 or RNP 1 will be expanded to major domestic airports. And, as needed, RNAV 1 or RNP will be mandated within some congested TMAs. Continuous descent operation (CDO) will be expanded to domestic airport as well.

Approach Introduction of APV-Baro will be completed at all airports in Korea and trial operation of GLS (GBAS Landing System) will be started at the selected airports. During this term, studies will be conducted to review the progress of PBN implementation and to evaluate the need of each ground NAVAID. Thereafter, evaluation results will be noticed to public.

Example PBN Implementation Plans

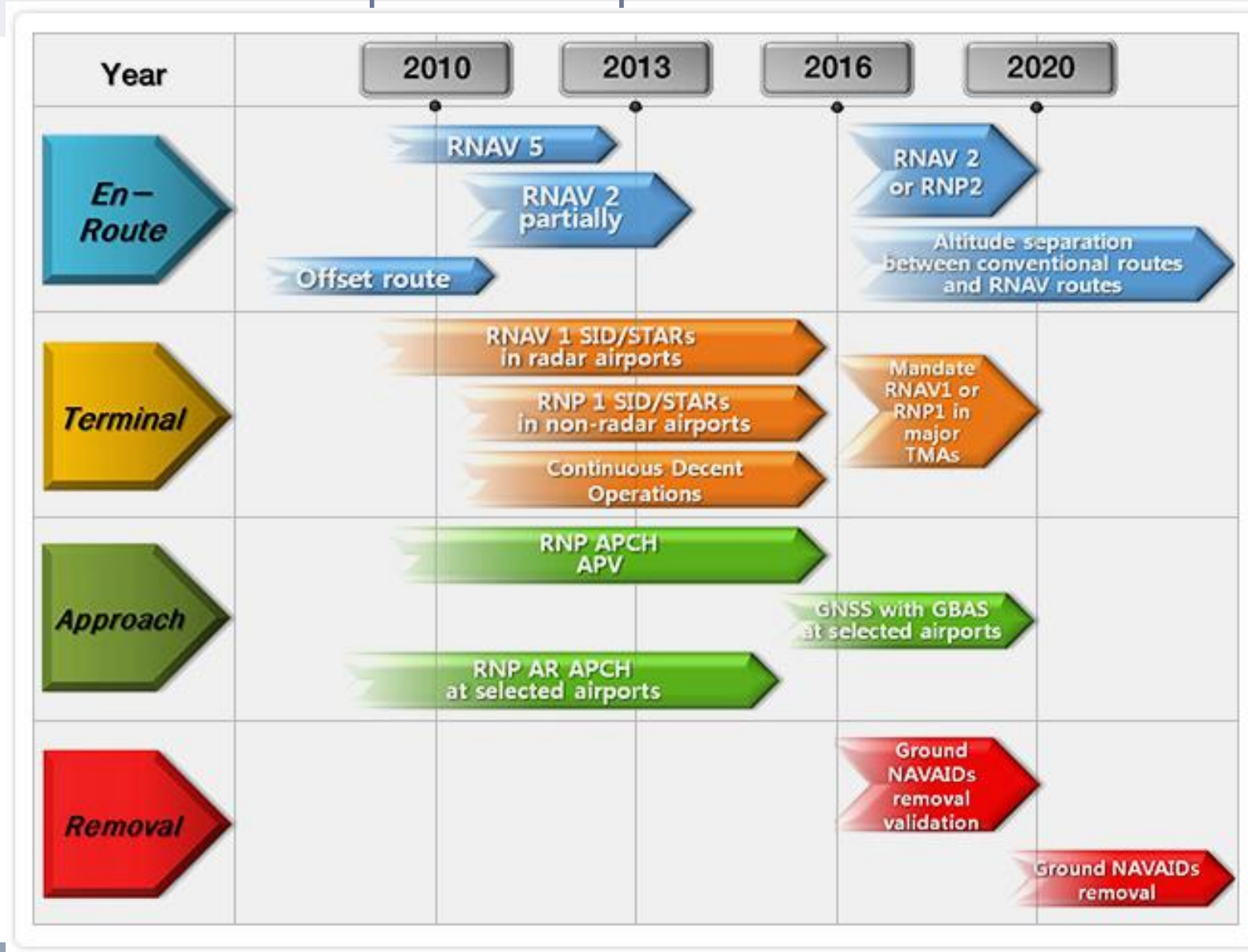
03 Long Term 2017 ~

According to the initial PBN implementation plans, for this phase, all RNAV 5 routes in operation will be switched over to RNAV 2 or RNP 2 and Approach procedures using GBAS will be expanded to other airports. VOR routes and RNAV routes will be completely separated at specific altitudes. Ground NAVAIDs on the removal notice will be out of commission gradually from 2021 and conventional routes will be replaced with RNAV routes. The safety assessment associated with the removal of existing ground equipment will be conducted with consideration of ensuring TLS be kept at involved airspace.

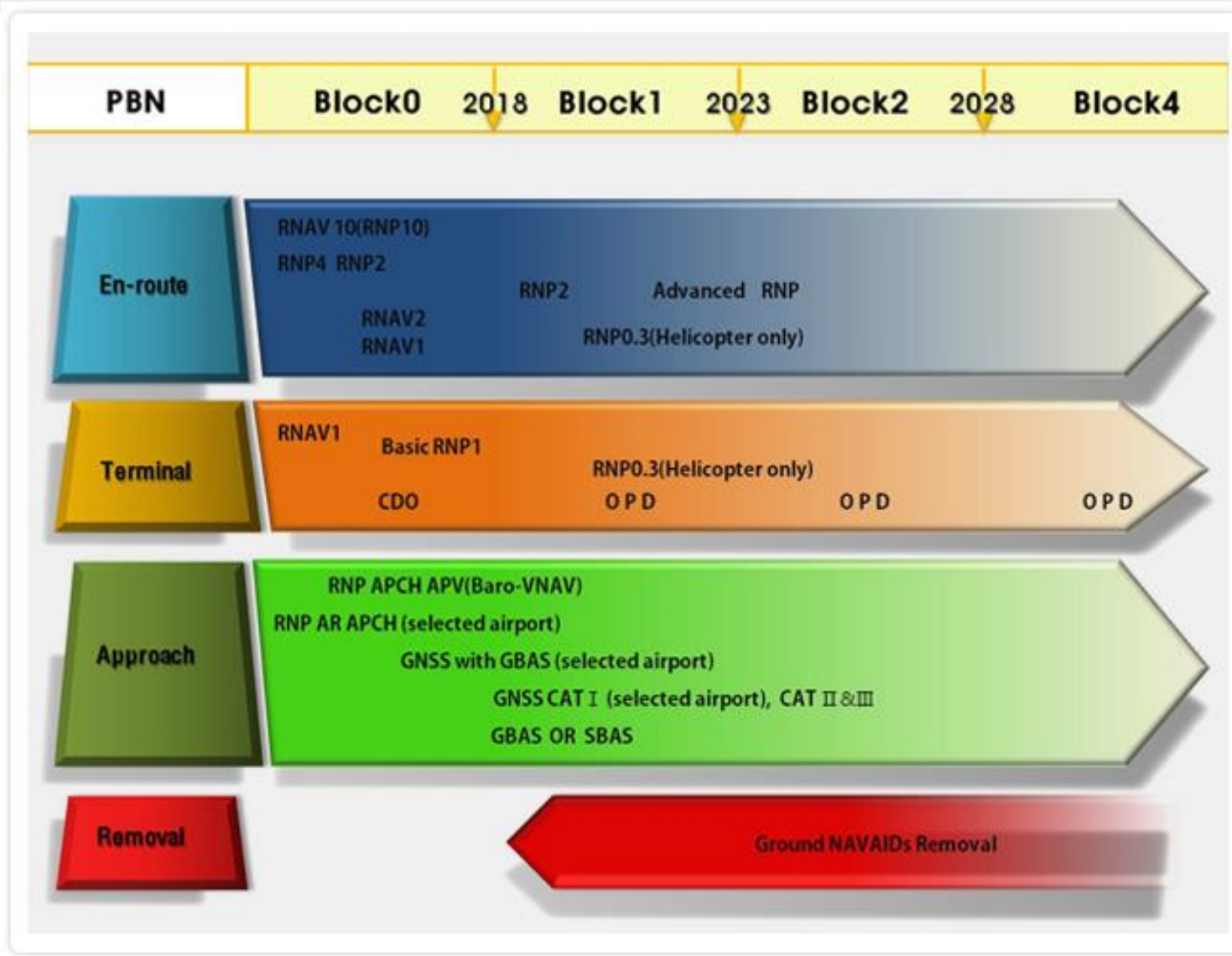
Given the latest development of ICAO's air navigation policy, the ROK's MOLIT intends to integrate its long-term PBN implementation plans into its ASBU (Aviation System Block Upgrades) management structure. Post 2016 when PBN's medium-term implementation phase concludes, the shift to PBN system will continue as part of the Efficient Flight Path Area of aviation system upgrade blocks. The details of which show in the following figures (for more information regarding the Aviation System Block Upgrades (ASBU), please consult ICAO web site at <http://www.icao.int/sustainability/Pages/ASBU-Framework.aspx>)

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Example PBN Implementation Plans



Example PBN Implementation Plans



Documentation Framework



- “ PANS Ops Volume II
- “ PBN Manual (Doc 9613) 4th Edition
- “ RNP AR Procedure Design Manual (Doc 9905)
- “ PBN Ops Approval Manual (Doc 9997)
- “ Manual on Use of PBN in Airspace Design (Doc 9992)
- “ CDO Manual (Doc 9931)
- “ CCO Manual (Doc 9993)
- “ GNSS Manual (Doc 9849)
- “ Procedure QA Manual (Vol 1 to Vol 6) (Doc 9906)

NATIONAL PBN IMPLEMENTATION PLAN

“ Improve Safety of Approach Operations

- “ Implement PBN instrument approach procedures

- “ Meet A37-11 timelines

 - “ Mid term- 2013-2016 Implementation targets.

 - “ RNP APCH (APV) (Baro-VNAV or Augmented GNSS) in 100% of instrument runways where practical, by 2016

 - “ RNP APCH (LNAV only minima) in 70% of instrument runways by 2014, 100% by 2016

“ Improve efficiency of flight paths

- “ Airspace optimization

- “ Properly connecting En Route-to-TMA

- “ Enable CDO/CCO operations

“ Starting Point

- “ The National PBN Implementation Plan

NATIONAL PBN IMPLEMENTATION PLAN - INTENT

“ What stakeholders of the aviation community

- “ Airspace operators and users
- “ Air navigation service providers
- “ Regulating agencies
- “ National and international organizations

“ Assist stakeholders

- “ Plan a gradual transition to the RNAV and RNP concepts
- “ To investment strategies
- “ Airlines/Operators: plan future equipage and additional navigation capability investments
- “ ANSPs: to plan a gradual transition for the evolving ground infrastructure
- “ Regulating agencies: plan for criteria needed in the future and future regulatory workload and associated training requirements for work force

NATIONAL PBN IMPLEMENTATION PLAN-DEVELOPMENT PRINCIPLES

“ Transition period

“ Continued application of conventional air navigation procedures during the transition period, to guarantee availability by users that are not RNAV- and/or RNP-equipped

“ Airspace concept

“ Development of airspace concepts, applying airspace modelling tools as well as real-time and accelerated simulations, which identify the navigation applications that are compatible with the aforementioned concept

“ Cost-benefit analyses

“ to justify the implementation of the RNAV and/or RNP concepts in each particular airspace

NATIONAL PBN IMPLEMENTATION PLAN-DEVELOPMENT PRINCIPLES

” Safety assessments

” Conduct of pre- and post-implementation safety assessments to ensure the application and maintenance of the established target levels of safety

” National PBN Implementation Plan

” Must not conflict with the regional PBN implementation plan

NATIONAL PBN IMPLEMENTATION PLAN-CONTENT

- “ Area Navigation (RNAV)
- “ Benefits of RNAV and Global Harmonization
- “ Challenges in En Route (Continental and Oceanic), Terminal Areas and Approaches operations
 - “ Increasing demands;
 - “ Efficient operations; and
 - “ Environment
- “ Implementation of En Route (Continental and Oceanic), Terminal Areas and Approaches, and helicopters operations
 - “ Short Term (2008-2012);
 - “ Medium Term (2013-2016); and
 - “ Long Term (2017 and beyond)
- “ Appendices for implementation operations
 - “ En Route (Continental and Oceanic);
 - “ Terminal Areas and Approaches; and
 - “ Helicopters operations

PBN IMPLEMENTATION PLAN TARGETS 2013-2016

- “ RNP APCH (APV - Approach Procedure with Vertical Guidance) (Baro-VNAV or Augmented GNSS) in 100% of instrument runways by 2016.
- “ RNP APCH (LNAV -Lateral Navigation- only minima) in 70% of instrument runways by 2014, 100% by 2016
- “ Straight-in LNAV only procedures for instrument runways where there is no local altimeter setting available and where acft are not equipped for APV operations.
- “ RNAV-1 or RNP-1 SID/STAR for 100% of international airports by 2016
- “ RNAV-1 or RNP-1 SID/STAR for 70% of busy domestic airports where there are operational benefits
- “ Implementation of additional RNAV/RNP routes as required

PBN IMPLEMENTATION PLAN TASKS 2013-2016

- “ RNP APCH (APV) (Baro-VNAV or Augmented GNSS) in 100% of instrument runways by 2016. - **IDENTIFY RUNWAYS**
- “ RNP APCH (LNAV only minima) in 70% of instrument runways by 2014, 100% by 2016 - **IDENTIFY RUNWAYS**
- “ Straight-in LNAV only procedures for instrument runways where there is no local altimeter setting available and where acft are not equipped for APV operations. - **IDENTIFY RUNWAYS**
- “ RNAV-1 or RNP-1 SID/STAR for 100% of international airports by 2016 - **IDENTIFY AIRPORTS**
- “ RNAV-1 or RNP-1 SID/STAR for 70% of busy domestic airports where there are operational benefits - **IDENTIFY AIRPORTS**
- “ Implementation of additional RNAV/RNP routes as required - **IDENTIFY ROUTES AND COORDINATE STRUCTURE**

PBN IMPLEMENTATION PLAN TEMPLATE

PBN Implementation Plan State X Version 1

www.icao.int/pbn

PBN IMPLEMENTATION PLAN TEMPLATE - SHORT

1. Background
2. Area Navigation (RNAV)
 - 2.1 Capabilities
 - 2.2 Current status of RNAV operations in State x
3. Benefits of RNAV and Global Harmonization
4. Challenges
 - 4.1 Increasing Demands
 - 4.1.1 En route
 - 4.1.1.1 Oceanic and Remote Continental
 - 4.1.1.2 Continental
 - 4.1.2 Terminal Areas (Departures and Arrivals)
 - 4.1.3 Approach
 - 4.2 Efficient Operations
 - 4.2.1 En route
 - 4.2.2 Terminal Areas
 - 4.2.3 Approach
 - 4.3 Environment

PBN IMPLEMENTATION PLAN TEMPLATE - SHORT

5. Implementation

5.1 Short term (2008-2012)

5.1.1 En route

5.1.1.1 Oceanic and Remote Continental

5.1.1.2 Continental

5.1.2 Terminal Areas (Departures and Arrivals)

5.1.3 Approach

5.1.4 Helicopter operations

5.2 Medium term (2013-2017)

5.2.1 En route

5.2.1.1 Oceanic and Remote Continental

5.2.1.2 Continental

5.2.2 Terminal Areas (Departures and Arrivals)

5.2.3 Approach

5.2.4 Helicopter operations

5.3 Far term (2018-2022)

PBN IMPLEMENTATION PLAN TEMPLATE - SHORT

Appendix A

- . Oceanic and Remote Continental implementation schedule by area or city pair

Appendix B

- . En route continental implementation schedule by area or city pair

Appendix C

- . Terminal area and approach implementation schedule by aerodrome

Appendix D

- . Helicopter terminal area and approach implementation schedule by landing location

PBN IMPLEMENTATION PLAN TEMPLATE - SHORT

APPENDIX:

- ” List Airports/Runways/Approaches
- ” List airways and coordination points
- ” Define action plan with interim milestones

			PBN PLAN			
INTERNATIONAL AIRPORTS						TIMELINE
Airport	Runway	Current Approach	RNP Approach	SID	STAR	
VWXY	01	ILS	APV	RNP 1	RNP 1	2014
	19	ILS	APV	RNP 1	RNP 1	2014
	05	VOR/DME	APV	RNP 1	RNP 1	2014
	23	VOR/DME	APV	RNP 1	RNP 1	2014
UVWX	04L	ILS	APV	RNAV 1	RNAV 1	2015
	04R	ILS	APV	RNAV 1	RNAV 1	2015
	22L	ILS	APV	RNAV 1	RNAV 1	2015
	22R	ILS	APV	RNAV 1	RNAV 1	2015
MAJOR DOMESTIC AIRPORTS						
WXYZ	06	ILS	APV	RNAV 1	RNAV 1	2016
	24	VOR/DME	APV	RNAV 1	RNAV 1	2016
TUVW	08	NONE	LNAV	RNP 1	RNP 1	2015
	26	VOR/DME	LNAV	RNP 1	RNP 1	2015

PBN IMPLEMENTATION PLAN TEMPLATE - LONG

1. Executive Summary
2. Explanation of Terms
3. Acronyms
4. Introduction
5. Present and Planned Capabilities
6. Formulation of Regulations, Standards & Processes for Approval
7. PBN Operational Requirements and Implementation Strategy
8. Transition Strategies
9. Safety Assessment and Monitoring Requirements
10. Expected Operational Benefits

PBN IMPLEMENTATION PLAN TEMPLATE - LONG

1. Executive Summary

2. Explanation of Terms

- “ PBN Implementation Plan
- “ Performance Based Navigation
- “ Performance requirements

3. Acronyms

PBN IMPLEMENTATION PLAN TEMPLATE - LONG

4. Introduction

"Need for the PBN Implementation Plan

- ✓ ICAO initiative, global harmonisation and standardisation, safety, efficiency

"Goals & Objectives of PBN Implementation

- ✓ National perspective
- ✓ Strategic Objectives

"Planning Principles

- ✓ Implementation in accordance with ICAO DOC 9613 and in alignment with Regional PBN plan
- ✓ Identify stakeholders, the method and level of communication and consultation with the stakeholders while developing the Plan
- ✓ Formation of National Working Group which includes relevant major and minor stakeholders
 - Regulator . Flight Operations, Airworthiness, ATS, external consultants
 - ANSP . PBN Project
 - Operators . Airlines, GA, User-Groups, Recreational, Military,
 - Community . Resident Groups, Councils, Government
 - International . neighbouring states

"Governance structure (making sure all stakeholders have the ownership of the process)

PBN IMPLEMENTATION PLAN TEMPLATE - LONG

5. Present and Planned Capabilities

“ Assessment of CNS / ATM infrastructure

- ✓ Navigation infrastructure
 - lifespan and supportability of existing conventional nav aids
 - compatibility of the existing navaid infrastructure with PBN applications
 - use of Global Navigation Satellite Systems (GNSS)
- ✓ Surveillance Infrastructure
- ✓ Communication Infrastructure
- ✓ ATM capabilities (existing and planned)
- ✓ WGS-84

“ Assessment of PBN Fleet Readiness (BPE 3)

- ✓ Domestic and Regional Traffic Forecasts
- ✓ Domestic and International Fleet Assessment
 - Data collection, via user survey, flight plan information, etc.

PBN IMPLEMENTATION PLAN TEMPLATE - LONG

6. Formulation of Regulations, Standards & Processes for Approval

- “ Lines of Authority
- “ Regulatory Framework
 - ✓ Rules development
 - ATS / AIS / IFP Design /
 - Operations and Airworthiness
- “ Approvals / Authorizations

PBN IMPLEMENTATION PLAN TEMPLATE - LONG

7. PBN Operational Requirements & Implementation Strategy

- ” Selection of applicable Navigation Specifications
 - ✓ Based on National Objectives
 - ✓ Ensuring Regional Harmonization
 - ✓ Aligned with ICAO implementation strategies / policies
- ” Realistic Near / Medium / Long term implementation roadmaps for:
 - ✓ Enroute Operations
 - Key traffic flows and City Pairs Identified
 - Harmonization and interoperability across FIR
 - ✓ Terminal Operations
 - Specific terminal areas selected for implementation
 - ✓ Instrument Approaches
 - Designation of airports eligible for RNP APCH and APV
 - Selection of airports requiring RNP AR APCH (based on operational justification)

PBN IMPLEMENTATION PLAN TEMPLATE - LONG

8. Transition Strategies

- “ Considerations for mandate or phased update of procedures or equipage
- “ Infrastructure
 - ✓ Navaid phase-out and replacement strategy (VOR / DME / NDB / ILS)
 - ✓ Requirements for continued application of conventional navigation procedures to accommodate non-RNAV / RNP users
 - ✓ Provisions for contingency operations
- “ Procedure
 - ✓ Strategy for mixed-mode operations
 - ✓ Integration with ATM system
- “ Personnel
 - ✓ Promotion and training for ATC, Operators and Inspectors
 - ✓ Broad aviation community awareness and education

PBN IMPLEMENTATION PLAN TEMPLATE - LONG

9. Safety Assessment & Monitoring Requirements

- “ Need for a safety assessment
- “ Pre and Post safety assessment in accordance with ICAO provisions
- “ Periodic safety reviews undertaken by the State or group of States where required
- “ Required Metrics

10. Expected Operational Benefits - specific implementations

- “ High-level business case for implementation near / mid long-term)

PBN WACAF

Name	PBN RWYs (%)	RNP/AR RWYs (%)	LPV RWYs (%)	LNAV/VNAV RWYs (%)	LNAV RWYs (%)	UNK RWYs (%)
BENIN	100	0	0	0	100	0
BURKINA FASO	100	0	0	0	75	25
CAMEROON	56	0	0	0	20	80
CAPE VERDE	0	0	0	0	0	0
CENTRAL AFRICAN REPUBLIC	100	0	0	0	50	50
CHAD	50	0	0	50	50	50
CONGO	67	0	0	0	0	100
COTE D'IVOIRE	50	0	0	100	100	0
DEMOCRATIC REPUBLIC OF THE CONGO	95	0	0	11	11	89
EQUATORIAL GUINEA	50	0	0	0	0	100
GABON	60	0	0	0	33	67
GAMBIA	100	0	0	0	0	100
GHANA	0	0	0	0	0	0
GUINEA	100	0	0	100	100	0
GUINEA-BISSAU	100	0	0	100	100	0
LIBERIA	0	0	0	0	0	0
MALI	33	0	0	0	100	0
MAURITANIA	100	0	0	0	50	50
NIGER	67	0	0	0	0	100
NIGERIA	18	0	0	100	100	0
SAO TOME AND PRINCIPE	0	0	0	0	0	0
SENEGAL	43	0	0	67	67	33
SIERRA LEONE	0	0	0	0	0	0
TOGO	50	0	0	0	100	0

PBN RUWAYS - ESAF

Name	PBN RWYs (%)	RNP/AR RWYs (%)	LPV RWYs (%)	LNAV/VNAV RWYs (%)	LNAV RWYs (%)	UNK RWYs (%)
ANGOLA	38	0	0	33	33	67
BOTSWANA	50	0	0	100	100	0
BURUNDI	0	0	0	0	0	0
COMOROS	100	0	0	100	100	0
DJIBOUTI	0	0	0	0	0	0
ERITREA	67	0	0	0	0	100
ETHIOPIA	70	0	0	0	0	100
KENYA	93	0	0	43	100	0
LESOTHO	100	0	0	100	100	0
MADAGASCAR	44	0	0	75	88	13
MALAWI	100	0	0	75	100	0
MAURITIUS	0	0	0	0	0	0
MOZAMBIQUE	100	0	0	29	100	0
NAMIBIA	67	0	0	100	100	0
RWANDA	0	0	0	0	0	0
SEYCHELLES	100	50	0	0	100	0
SOUTH AFRICA	26	0	0	27	100	0
SOUTH SUDAN	100	0	0	100	100	0
SWAZILAND	0	0	0	0	0	0
UGANDA	0	0	0	0	0	0
UNITED REPUBLIC OF TANZANIA	57	0	0	100	100	0
ZIMBABWE	0	0	0	0	0	0

PBN IMPLEMENTATION PLAN TASKS 2013-2016

- “ IDENTIFY INTERNATIONAL AIRPORTS**
- “ IDENTIFY BUSY DOMESTIC AIRPORTS**
- “ IDENTIFY INSTRUMENT APPROACH RUNWAYS**
- “ IDENTIFY LNAV RUNWAYS**
 - “ IDENTIFY RUNWAYS WITH NO LOCAL ALTIMETER SETTING**
- “ IDENTIFY ROUTES AND COORDINATE STRUCTURE**

PBN IMPLEMENTATION PLAN TASKS 2013-2016

- “ NOTE ANY CNS IMPROVEMENTS**
- “ IDENTIFY RESOURCES**
 - “ REGULATIONS WRITTEN**
 - “ REGULATORS TRAINED**
 - “ WGS-84**
 - “ REQUIREMENTS COMMUNICATED**
 - “ PROCEDURES DESIGNED Æ IN-HOUSE OR OUTSOURCED**
 - “ ATCS TRAINING**
- “ IDENTIFY LEAD ORGANIZATION**
- “ IDENTIFY LEAD CARRIER(S) / STAKEHOLDERS**
- “ IDENTIFY TIMELINES**

PBN IMPLEMENTATION PLAN TASKS 2013-2016

“ Exercises-----