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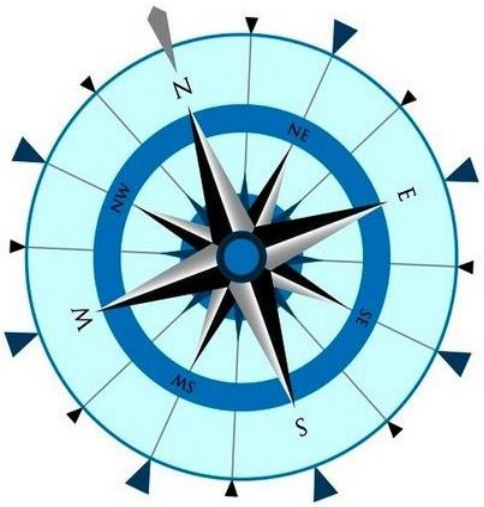

PERFORMANCE BASED NAVIGATION (PBN)

IMPLEMENTATION STRATEGY FOR BELGIUM

KINGDOM OF BELGIUM CIVIL AVIATION AUTHORITY
2012

RECORD OF AMENDMENTS

VERSION	DATE APPLICABLE	DATE OF EFFECTIVENESS	REASON FOR AMENDMENT	PAGES AFFECTED
0.01	17-02-2011	N/A	First straw-man	All
0.02	19-05-2011	N/A	First comments taken on board; text added	All
0.03	15-08-2011	N/A	First draft release for review	All
0.04	18-10-2011	N/A	Comments from first limited review	All
0.05	27-02-2012	N/A	Comments from second limited review	All
1.00	03-04-2012	N/A	Target dates added	All
1.01	14-08-2012	N/A	Approved version	i/ ii

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1. EXECUTIVE SUMMARY

This document is the Performance Based Navigation (PBN) implementation strategy for the Kingdom of Belgium. It is a high level strategy combined with a more detailed activity and implementation plan. This latter will be developed as a matter of priority immediately following approval of the high level strategy. In the first release version of the document, the activity plan has been worked out to make it suitable for discussion in a wider forum. Based on those discussions, the activity plan will be finalized and the implementation plan developed in detail. It will then be submitted to stakeholder review with a view to arrive at a full, final, agreed strategy for PBN implementation.

The purpose of the document is threefold.

The document provides general background information on PBN with a view to help decision makers in gaining a good understanding of the various aspects of this concept without necessarily having to consult the large amount of diverse material that is otherwise available on the subject. This background material has been written in a way that is less generic than the normal PBN documents so that the concept's applicability for Belgium can already be judged. Chapters on safety, cost-benefit and several operational considerations demonstrate why implementing PBN in Belgium is required and beneficial.

Secondly, the document contains brief explanations on the aspects of PBN that are of immediate concern for the implementer. For each aspect, the required actions have also been defined and these are listed in a well identifiable manner in the form of BCAA regulatory material. It is the intention that such material be transformed into actual regulations as necessary.

Finally the document contains the first frame for the actual PBN implementation plan. The plan is built around a number of defined implementation elements which in turn contain the defined implementation actions. The intention is to have a very clearly identified time-scale and line of responsibility for each implementation action. This part of the document in V1.00 is still just a first set-up and it will be further developed as the body of the strategy matures.

This strategy is built on the various ICAO, EASA, EC and EUROCONTROL documents published so far on the subject of PBN.

2. GENERAL CONSIDERATIONS

2.1. PURPOSE AND STATUS OF THE DOCUMENT

2.1.1. PURPOSE

This document is the Performance Based Navigation (PBN) Implementation Strategy for the Kingdom of Belgium (PBNISB). It has been developed to provide the necessary guidance and where appropriate, the required regulatory basis for the implementation of PBN for all aviation stakeholders in Belgium. It is also intended to foster a common understanding of the concept and practice of Performance Based Navigation. As such, it is fully in line with all PBN related provisions of the International Civil Aviation Organisation (ICAO), the European Commission (EC), and EUROCONTROL.

Explanatory text has been added where required to clarify certain aspects of the concept and provisions. Guidance material supports the implementation planners and regulatory material sets forth the requirements to be met in order to achieve the aims of this strategy.

2.1.2. REGULATRY STATUS

In Assembly Resolution A36-23 ICAO has prescribed the performance based navigation global goals, at the same time also urging its Member States to develop a PBN Implementation Strategy and Plan which is to guide relevant developments of the air navigation infrastructure of the Member States.

The Implementation Strategy for Belgium has been developed to fulfil this requirement. It comprises two types of content:

- *Explanatory and guidance material – such material does not have the force of law and serve only to help in understanding the PBN concept and practices;*
- *Regulatory material – such material has the force of law and compliance with it is mandatory. Acceptable means of compliance may also be provided as part of the regulatory material.*

The document is subject to version control. Versions which start with a 0 (e.g. 0.04) are drafts for discussion only with the content being only a proposal. The first release version will have the version number 1.00.

2.1.3. EDITORIAL PRACTICES AND TEXT CONVENTIONS

In order to facilitate the identification of the text in the PBNISB document, agreed editorial practices and text conventions have been used throughout. The aim is to clearly differentiate regulatory material which has the force of law and explanatory and guidance material the use of which is not mandatory.

Explanatory and guidance material is written in italics (as this text).

Regulatory material is written in non-italic bold typeface (as this text).

2.2. STRUCTURE OF THE DOCUMENT

The PBNISB document has been structured to reflect its dual aim, namely to provide information on PBN with a view to ensuring common understanding of the concept and practices of PBN and to describe the PBN implementation strategy for Belgium together with regulatory material needed to ensure proper implementation.

Chapter 2 contains the supporting information with Chapter 3 containing the strategy description and corresponding regulatory material. Chapter 4 contains guidance on regulatory oversight and performance evaluation.

Chapter 5 contains the PBN Activity and Implementation Plan developed in accordance with the strategy.

2.3. DOCUMENTS CONTAINING BACKGROUND INFORMATION RELEVANT TO THE STRATEGY

The following documents contain useful background information of relevance to this implementation strategy. The list is valid at the time of issue of a given version of the strategy. Only documents of direct relevance to PBN are listed.

2.3.1. BELGIAN NATIONAL DOCUMENTS

At the time of producing Version 1.00 of the document, no Belgian national documents of relevance have been identified.

2.3.2. EUROPEAN COMMISSION DOCUMENTS

At the time of producing Version 1.00 of the document, no European Commission documents of relevance have been identified. An SES Interoperability Implementing Rule on Performance Based Navigation (PBN IR) is currently under development.

2.3.3. ICAO DOCUMENTS

The following ICAO documents contain background information relevant to the Strategy:

ICAO Assembly Resolution A3623 – PBN Global Goals

Doc 9613 AN/937 Performance-based Navigation (PBN) Manual

2.3.4. EUROCONTROL DOCUMENTS

At the time of producing version 1.00 of the document, no EUROCONTROL documents of relevance have been identified.

2.4. PBN EXPLAINED

This section contains an explanation of the most important aspects of Performance Based Navigation as applied in a global context. As such, it contains elements that are of no consequence for Belgium, however they were included anyway for the sake of completeness.

2.4.1. INTRODUCTION

Aircraft operators in some parts of the world have already begun to experience the benefits of area navigation (RNAV) and required navigation performance (RNP). These benefits include safer, more efficient operations, increased air traffic management capacity and improved access to certain parts of the airspace and difficult to approach aerodromes. Once aircraft are freed from the limitations of ground based navigation aids and transitioning to satellite based navigation, more flexible and optimized routings become possible, creating more direct routings, saving fuel and reducing CO2 emissions.

Some of the definitions and concepts associated with RNAV and RNP as well as some RNP naming conventions were found to be inconsistent between various parts of the world, resulting in confusion among aircraft operators, manufacturers, regulators and air navigation service providers. This had a negative impact on the implementation of RNAV and RNP applications, slowing buy-in and increasing costs.

Performance Based Navigation (PBN) came into being as a result of collaboration between the International Civil Aviation Organisation (ICAO), industry, regulators and air navigation service providers to understand the issues leading to this confusion and to clarify and update the definitions and explanatory material about the RNAV and RNP concepts and applications. To ensure harmonisations and consistency, the effort was applied to all areas of flight from oceanic and remote to en-route, terminal area and approach.

2.4.2. HISTORICAL BACKGROUND

From the early days of commercial operations, aircraft have navigated using positions derived in relation to a ground based navigation aid like a Very-High Frequency Omni-Directional Range (VOR), Distance Measuring Equipment (DME) or Non-Directional Beacon (NDB). Because aircraft may fly the most direct routes in relatively few cases, this kind of navigation leads to very inefficient operations and procedures. Additional inefficiencies come from the need to apply large separations buffers to account for the inherent inaccuracies of navigation and to mitigate the effects of eventual operational errors, although this is less of an issue in a surveillance environment.

RNAV was borne as a means of navigating from any point to any other point, whether a point was marked by a navigation aid or not. The points could be defined as latitude and longitude and an aircraft's position relative to them could be established by a variety of means. For the first time it became practicable to operate on a flight profile that did not have to pass overhead a series of ground based aids.

RNP builds directly on RNAV. When ICAO was faced with the fact that Global Navigation Satellite Systems (GNSS), the navigation infrastructure, aircraft systems and the requirements of the airspace systems were developing faster than what the traditional processes for systems could cope with, the decision was made to define a concept that would allow airspace designers to specify airspace and operational requirements without relying on specific equipment or systems. This concept was named Required Navigation Performance or RNP. The original RNP concept was oriented towards en-route, remote and oceanic airspace and precise navigation and safe separation of routes.

As it had happened so often in the past also with other new ideas, as RNP developed, certain elements were implemented inconsistently while the RNP applications themselves lacked a common basis for interoperability. This led to confusion and slowed down adoption.

When work on guidance also for other phases of flight begun, it was soon realised that it would be impossible to achieve global interoperability with these new concepts unless the assumption on which they are based, like RNP, were consistently applied.

PBN must be seen as the solution that enables future efficiency-enhancing operational concepts.

2.4.3. TRANSITION TO PBN

One of the definitions of PBN is that it is a "framework for defining navigation performance requirements that can be applied to a route, instrument procedure or defined airspace". PBN, which comprises both RNAV and RNP specifications, provides a basis for the design and implementation of flight profiles that will facilitate airspace design, the flow of traffic and improved access to runways.

In fact one may even argue that the N in the PBN abbreviation should be replaced by an O, for Operations, since the original, navigation focused paradigm is evolving into a paradigm that encompasses much more than navigation in the traditional sense of the word. Performance Based Operations, PBO, would be a more appropriate term to use in the longer term.

The PBN concept specifies that aircraft RNAV system performance requirements be defined in terms of accuracy, integrity, availability, continuity and functionality required for the proposed operations in the context of a particular airspace concept, when supported by the appropriate navigation infrastructure. In that context, the PBN concept represents a shift from sensor-based to performance-based navigation. Performance requirements are identified in navigation specifications, which also identify the choice of navigation sensors and equipment that may be used to meet the performance requirements. These navigation specifications provide specific implementation guidance for States and aircraft operators in order to facilitate global harmonization.

Under PBN, generic navigation requirements are first defined based on the operational requirements. Aircraft operators then evaluate options in respect of available technology and navigation services. A chosen solution would be the most cost-effective for the aircraft operator, as opposed to a solution being established as part of the operational requirements. Technology can evolve over time without requiring the operation itself to be revisited as long as the requisite performance is provided by the RNAV system.

2.4.4. NAVIGATION SPECIFICATION

The navigation specification is used by a State as a basis for the development of their material for airworthiness and operational approval. A navigation specification details the performance required of the RNAV system in terms of accuracy, integrity, availability and continuity; which navigation functionalities the RNAV system must have; which navigation sensors must be integrated into the RNAV system; and which requirements are placed on the flight crew.

A navigation specification is either an RNP specification or an RNAV specification. An RNP specification includes a requirement for on-board self-contained performance monitoring and alerting, while an RNAV specification does not.

2.4.5. ON-BOARD PERFORMANCE MONITORING AND ALERTING

On-board performance monitoring and alerting is the main element that determines if the navigation system complies with the necessary safety level associated to an RNP application; it relates to both lateral and longitudinal navigation performance; and it allows the flight crew to detect that the navigation system is not achieving, or cannot guarantee with 10^{-5} integrity as specified in ICAO Doc 9613, the navigation performance required for the operation.

RNP systems provide improvements on the integrity of operations; this may permit closer route spacing and can provide sufficient integrity to allow only RNAV systems to be used for navigation in a specific airspace. The use of

RNP systems therefore offer significant safety, operational, efficiency and environmental benefits.

2.4.6. DESIGNATION OF RNP AND RNAV SPECIFICATIONS

2.4.6.1. OCEANIC, REMOTE CONTINENTAL,EN-ROUTE AND TERMINAL OPERATIONS

For oceanic, remote, en-route and terminal operations, an RNP specification is designated as RNP X ,e.g. RNP 4. An RNAV specification is designated as RNAV X, e.g. RNAV 1. If two navigation specifications share the same value for X, they may be distinguished by use of a prefix, e.g. Advanced-RNP 1 and Basic-RNP 1.

Note: The terms "advanced" and "basic" are used here only to illustrate the system of RNP designations. In actual use, the Basic-RNP 1 navigation specification is intended to provide a means to develop routes for connectivity between the en-route structure and terminal airspace with no or limited ATS surveillance, with low to medium density traffic. The Advanced-RNP 1 specification is still to be developed.

For both RNP and RNAV designations, the expression "X" refers to the lateral navigation accuracy in nautical miles, which is expected to be achieved at least 95 per cent of the flight time by the population of aircraft operating within the airspace, on the route or using the given procedure.

2.4.6.2. APPROACH

Approach navigation specifications cover all segments of the instrument approach. RNP specifications are designated using RNP as a prefix and an abbreviated textual suffix, e.g. RNP APCH or RNP AR APCH. There are no RNAV approach specifications.

2.4.6.3. UNDERSTANDING RNAV AND RNP DESIGNATIONS

In cases where navigation accuracy is used as part of the designation of a navigation specification, it should be noted that navigation accuracy is only one of the many performance requirements included in a navigation specification.

It may seem logical, for example, that an aircraft approved for Basic-RNP 1 be automatically approved for RNP 4; however, this is not the case. Aircraft approved to the more stringent accuracy requirements may not necessarily meet some of the functional requirements of the navigation specification having a less stringent accuracy requirement.

2.4.6.4. ACCOMMODATING INCONSISTENT RNP DESIGNATIONS

Although not relevant in Belgium, it should be noted that the existing RNP 10 designation is inconsistent with PBN RNP and RNAV specifications. RNP 10 does not include requirements for on-board performance monitoring and alerting. For purposes of consistency with the PBN concept, RNP 10 is referred to as RNAV 10. Renaming current RNP 10 routes, operational approvals, etc., to an RNAV 10 designation would be an extensive and expensive task, which is not cost-effective. Consequently, any existing or new operational approvals will continue to be designated RNP 10, and any charting annotations will be depicted as RNP 10.

In the past, the United States and member States of the European Civil Aviation Conference (ECAC) used regional RNAV specifications with different designators. The ECAC applications (P-RNAV and B-RNAV) will continue to be used only within those States. Currently it is not expected to rename B-RNAV to RNAV 5 (even though the specifications are identical). The specifications for P-RNAV are not identical to ICAO's RNAV 1. The differences are mainly in the list of acceptable ground navigation aids and the additional requirements an aircraft operator already

approved for P-RNAV has to meet in order to be approved for RNAV 1. Since P-NAV can be seen as the European application of RNAV 1 it is not envisaged to migrate from P-RNAV to RNAV 1.

The United States migrated from the USRNAV Types A and B to the RNAV 1 specification in March 2007.

2.4.7. NAVIGATION AID INFRASTRUCTURE

The navigation aid infrastructure refers to ground- or space-based navigation aids. Ground-based navigation aids include DME and VOR. Space-based navigation aids include the GNSS elements.

2.4.8. NAVIGATION APPLICATIONS

A navigation application is the application of a navigation specification and associated navigation aid infrastructure to ATS routes, instrument approach procedures and/or defined airspace volume in accordance with the airspace concept. An RNP application is supported by an RNP specification. An RNAV application is supported by an RNAV specification.

The navigation applications, together with communications, surveillance and air traffic management procedures are the elements which are required to meet the strategic objectives defined for a given airspace concept.

2.4.9. THE AIRSPACE CONCEPT

In order to understand the practical implications of PBN, we must also understand the so called airspace concept and its relationship with navigation applications.

An airspace concept may be viewed as a general vision or a master plan for a particular airspace. Based on particular principles, an airspace concept is geared towards specific objectives. Airspace concepts need to include a certain level of detail if changes are to be introduced within an airspace. Details could explain, for example, airspace organization and management and the roles to be played by various stakeholders and airspace users. Airspace concepts may also describe the different roles and responsibilities, mechanisms used and the relationships between people and machines.

Strategic objectives drive the general vision of the airspace concept. These objectives are usually identified by airspace users, air traffic management (ATM), airports as well as environmental and government policy. It is the function of the airspace concept and the concept of operations to respond to these requirements. The strategic objectives which most commonly drive airspace concepts are safety, capacity, efficiency, access and the environment. Strategic objectives can result in changes being introduced to the airspace concept.

2.4.10. AIRSPACE CONCEPTS AND NAVIGATION APPLICATIONS

Strategic objectives generate requirements against communications, navigation, ATS surveillance, air traffic management and flight operations. Navigation functional requirements — now within a performance-based navigation context — need to be identified. These navigation functionalities are formalized in a navigation specification which, together with a navigation aid infrastructure, supports a particular navigation application. As part of an airspace concept, navigation applications also have a relationship to communication, ATS surveillance, ATM, ATC tools and flight operations. The airspace concept brings all these elements together in a cohesive whole.

2.4.11. AIRSPACE CONCEPTS BY AREA OF OPERATION

2.4.11.1. OCEANIC AND REMOTE CONTINENTAL

Oceanic and remote continental airspace concepts are currently served by two navigation applications, RNAV 10 and RNP 4. Both these navigation applications rely primarily on GNSS to support the navigation infrastructure element of the airspace concept. In the case of the RNAV 10 application (which retains the RNP 10 designation as explained above), no form of ATS surveillance service is required. In the case of the RNP 4 application, ADS contract (ADS-C) is used.

2.4.11.2. CONTINENTAL EN-ROUTE

Continental en-route airspace concepts are currently supported by RNAV applications. RNAV 5 is used in the Middle East (MID) and European (EUR) Regions but for the time being it is designated as B-RNAV (Basic RNAV in Europe and RNP 5 in the Middle East). In the United States, an RNAV 2 application supports an en-route continental airspace concept. At present, continental RNAV applications support airspace concepts which include radar surveillance and direct controller pilot communication (voice).

Note: RNAV1/RNP1 is now also being considered for continental en-route application but no decisions have yet been made in this respect.

2.4.11.3. TERMINAL AREA AIRSPACE, ARRIVAL AND DEPARTURE

Existing terminal airspace concepts, which include arrival and departure, are supported by RNAV applications. These are currently used in the European (EUR) Region and the United States. The European terminal area airspace RNAV application is known as P-RNAV (Precision RNAV). Although the RNAV 1 specification shares a common navigation accuracy with P-RNAV, this regional navigation specification does not satisfy the full requirements of the ICAO RNAV 1 specification. The United States terminal airspace application formerly known as US RNAV Type B has been aligned with the PBN concept and is now called RNAV 1. Basic-RNP 1 has been developed primarily for application in non-radar, low-density terminal airspace. In future, more RNP applications are expected to be developed for both en-route and terminal airspace.

2.4.11.4. APPROACH

Approach concepts cover all segments of the instrument approach, i.e. initial, intermediate, final and missed approach. They will increasingly call for RNP specifications requiring a navigation accuracy of 0.3 NM to 0.1 NM or lower. Typically, three sorts of RNP applications are characteristic of this phase of flight: new procedures to runways never before served by an instrument procedure, procedures either replacing or serving as backup to existing instrument procedures based on different technologies, and procedures developed to enhance airport access in demanding environments. The relevant RNP specifications are RNP APPROACH (RNP APCH) and RNP AUTHORIZATION REQUIRED APPROACH (RNP AR APCH). This latter is not relevant in Belgium.

2.4.12. NAVIGATION SPECIFICATION APPLICABILITY BY FLIGHT PHASE

The numbers shown in the following table refer to the 95 % accuracy requirements, expressed in Nautical Miles. RNAV 5 is an en-route navigation specification which may be used for the initial part of the STAR outside 30 NM and above the minimum sector altitude.

Navigation specification	Flight phase							
	En-route oceanic/remote	En-route continental	Arrival	Approach				Departure
				Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1[b]	1
RNP 4	4							
Basic-RNP 1			1[a,c]	1[a]	1[a]		1[ab]	1[a,c]
RNP APCH				1	1	0.3	1	

a. The navigation application is limited to use on STARs and SIDs only.
b. The area of application can only be used after the initial climb of a missed approach phase.
c. Beyond 30 NM from the airport reference point (ARP), the accuracy value for alerting becomes 2 NM.

It will be clear from the table above that for any particular PBN operation, it is possible that a sequence of RNAV and RNP applications is used. A flight may commence in an airspace using a Basic-RNP 1 SID, transit through en-route then oceanic airspace requiring RNAV 2 and RNP 4, respectively, and conclude with terminal and approach operations requiring RNAV 1 and RNP APCH.

As mentioned earlier, in the ECAC member States the P-RNAV specification is used and this is considered as a specific application of RNAV 1. The applicability of P-RNAV is the same as that of RNAV 1.

2.4.13. THE SCOPE OF THE ICAO NAVIGATION SPECIFICATIONS

The ICAO navigation specifications contained in the ICAO PBN Manual (Doc 9613) do not address all requirements that may be specified for operation in a particular airspace, route or in a particular area. Such additional requirements are to be specified in other documents such as operating rules, aeronautical information publications (AIPs) and the ICAO Regional Supplementary Procedures (Doc 7030). Operational approval primarily relates to the navigation requirements of the airspace concerned. Operating flights into an airspace, is contingent upon aircraft operators and flight crew taking account of all operational documents relating to that airspace. In turn, it is the responsibility of the State having jurisdiction over the airspace concerned to undertake a safety assessment in accordance with the applicable ICAO provisions.

2.4.14. NAVIGATION SPECIFICATIONS AND THE APPROVAL PROCESS

A navigation specification does not in itself constitute regulatory guidance material against which either the aircraft or the operator will be assessed and approved. Aircraft are certified by their State of manufacture. Operators are approved in accordance with their national operating rules. The navigation specification provides the technical and operational criteria, and does not imply a need for recertification. Therefore, with RNAV 2/RNAV 1, for example, there is still a need to have an approval process. This could be either through a dedicated approval document or through recognition that existing regional RNAV implementation certification documents can be applied with the necessary differences, to satisfy the objectives set out in the navigation specification.

Compliance is to be determined against each relevant navigation specification. Compliance with one navigation specification does not automatically imply compliance with another.

2.4.15. SUMMARY

ICAO's PBN concept aims to ensure global standardization of RNAV and RNP specifications and to limit the proliferation of navigation in use world-wide. It is a new concept based on the use of Area Navigation (RNAV) systems. It is a move from a limited statement of required performance accuracy to more extensive statements of required performance in terms of accuracy, integrity, continuity and availability, together with descriptions of how this performance is to be achieved in terms of aircraft, flight crew and ATM operational requirements.

For effective operations, an airspace concept is to be defined and PBN is one of the enablers of this. The others are communications, air traffic services surveillance and air traffic management.

The PBN concept is comprised of three components as follows:

- *The Navigation Specification prescribes the performance requirements in terms of accuracy, integrity, continuity and availability for proposed operations in a particular airspace. The Navigation Specification also describes how these performance requirements are to be achieved in terms of the required navigation functionalities. Associated requirements describe the necessary flight crew knowledge, training and operational approval process. A Navigation Specification is either a RNP specification or a RNAV specification. An RNP specification includes the requirement for on-board self-contained performance monitoring and alerting while a RNAV specification does not.*
- *The navigation aid infrastructure relates to ground or space based navigation aids that are listed in each Navigation Specification.*
- *The Navigation Application refers to the application of the Navigation Specification and navigation aid infrastructure in the context of an airspace concept to routes, areas and/or instrument flight procedures.*

The details of the PBN concept are contained in ICAO Doc 9613, Performance Based Navigation (PBN) Manual.

The ICAO PBN concept replaces the RNP concept of the 1990s. Most of the terminology associated with the old RNP concept (e.g. RNP type and RNP value) does not exist in the PBN concept. The abbreviation RNP is still used as such but its only connotation is RNP specifications or applications requiring on-board performance monitoring and alerting.

Although one of the aims of the new PBN concept from ICAO has been to create a uniform environment world-wide in terms of requirements and terminology, some significant differences remain.

- *Although not relevant for Belgium, it should be noted that the existing RNP 10 designation is inconsistent with PBN RNP and RNAV specifications. RNP 10 does not include requirements for on-board performance monitoring and alerting. For purposes of consistency with the PBN concept, RNP 10 is referred to as RNAV 10.*

- *The ECAC B-RNAV standard is identical to the ICAO RNAV 5 specification but there is for the time being no intention in Europe to rename B-RNAV to RNAV 5.*

- *The ECAC P-RNAV standard is not identical to ICAO RNAV 1. Since the differences are relatively minor (list of acceptable ground navigation aids and a number of requirements additional to P-RNAV for obtaining RNAV 1 approval), P-RNAV may be considered as the European application of the RNAV 1 specification. There are no plans to migrate from P-RNAV to the RNAV 1 specification in the ECAC airspace. However, as more and more aircraft become approved for RNAV 1 to operate in parts of the world where this specification is applicable, an "involuntary" migration is likely to take place for at least part of the fleet.*

2.5. THE EXPECTED BENEFITS

2.5.1. SAFETY BENEFITS

Lateral and vertical track-keeping is much more accurate and reliable due to new three dimensional guided arrival, approach and departure procedures that cannot be defined by conventional navigation aids. For all controlled flight- into-terrain accidents, 60 percent occur on non-precision approaches using conventional navigation aids. PBN also reduces the flight crew's exposure to operational errors.

2.5.2. CAPACITY BENEFITS

Delays, congestion and choke points at airports and in crowded airspace can be reduced because of new and parallel offset routes through terminal areas, additional entry/exit points around busy terminal areas, more closely spaced procedures for better use of airspace in general and reduced or eliminated conflicts in adjacent airport flows.

2.5.3. EFFICIENCY BENEFITS

Enhanced reliability, repeatability, and predictability of operations lead to increased air traffic throughput and smoother traffic flow. Enhanced reliability, repeatability and predictability of operations have been demonstrated by PBN based operations primarily in difficult terrain environments. The same or very similar aims have been defined also for other advanced features of the future air traffic management environment, like for instance Collaborative Decision Making (CDM) where improved predictability is one of the most important benefits. Interpolating the effects of PBN into high traffic density areas shows clearly that the industry level expectations of increased traffic throughput and smoother traffic flows are well founded. Of course the actual level of the benefits is likely to vary by location.

2.5.4. ACCESS

Obstacle clearance and environmental constraints can be better accommodated by applying optimized PBN profiles.

2.5.5. ECONOMIC BENEFITS

PBN reduces the need to maintain sensor-specific routes and procedures, and their associated costs. For example, moving a single VOR ground facility can impact dozens of procedures, as VOR can be used on routes, VOR approaches, missed approaches, etc. Adding new sensor-specific procedures would compound this cost, and the rapid growth in available navigation systems would soon make sensor-specific routes and procedures unaffordable.

PBN also avoids the need for development of sensor-specific operations with each new evolution of navigation systems, which would be cost-prohibitive. The expansion of satellite navigation services is expected to contribute to the continued diversity of RNAV systems in different aircraft.

RNAV arrivals and departures and the potential for reduced track distances and earlier climb to en-route levels enable reduced fuel burn translating to major savings for the airspace users. The realisation of these benefits depends on the prevailing operational environment and changes may be required to that environment to achieve the benefits. This may not be feasible everywhere. At the same time it should be noted that PBN-based procedures have resulted in 10 to 20 additional departures at some airports in the United States.

2.5.6. ENVIRONMENTAL BENEFITS

PBN also offers environmental benefits by saving fuel, reducing C02 emissions and eliminating high-thrust go-arounds. Flying down the middle of a defined flight track means less throttle activity and better avoidance of noise-sensitive areas, so people on the ground perceive less noise and are exposed to fewer engine emissions. Such savings improve the carbon footprint of the airports concerned.

3. BELGIAN PBN IMPLEMENTATION STRATEGY

3.1. INTRODUCTION

3.1.1. THE CURRENT SITUATION

At the time of creation of this Strategy, there is no requirement for B-RNAV capability for flight in the Brussels FIR below Flight Level 95. Above Flight Level 95 RNAV capability meeting at least RNP 5 is mandatory (except for State aircraft). The acceptable means of compliance are contained in a Circular published by BCAA (CIR/OPS-19-Ed.01-11-97).

Several B-RNAV routes have been established with a width of 10 NM.

The Standard Instrument Arrivals (STAR) in use are all conventional while of the Standard Instrument Departures (SID), four at Brussels Airport are B-RNAV SIDs. Most of the SIDs havea performance based first turn (turn at an altitude).

All precision approaches in Belgium are based on ILS. Several runways have non-precision approaches defined, based on VOR and DME, where these are available or NDB where not.

No RNAV (GNSS) approaches have been defined.

3.1.2. THE TARGET SITUATION

The intention is to achieve a new Belgian air navigation infrastructure where the benefits offered by PBN-based operations are realized to the maximum extent possible. The benefits must accrue to all stakeholders involved, both on the ground and in the air. The PBN environment must be at least as safe as the traditional environment it replaces and it must in no way limit access to Belgian airspace while encouraging equipage with new, advanced capabilities.

3.1.3. TRANSITION CONSIDERATIONS

Transition to PBN-based operations will be achieved primarily on a voluntary basis. Building on a shared awareness of the costs and benefits as they apply to different stakeholders achieved via wide consultation, the transition steps will be defined in a way that ensures early benefits wherever possible while not placing undue burden on any stakeholder. Measures to encourage and reward early adoption of PBN-related capabilities may be considered during the transition phase.

3.2. RELATIONSHIP WITH OTHER PROJECTS

3.2.1. FUNCTIONAL AIRSPACE BLOC EUROPE CENTRAL - FABEC

FAB is not a construct recognized by ICAO. Consequently, the PBN concept is described as applicable in the airspace of the ICAO Member States with FAB as such not being mentioned at all. However, considering that all States participating in FABEC are also members of ECAC, by consequence the PBN concept is applicable also in FABEC as a whole. If all FABEC members properly use the ICAO provisions, seamless interoperability should be ensured. Nevertheless, compliance with ICAO's PBN provisions must be part of the FABEC harmonization effort.

Compliance with the ICAO PBN concept shall be included in the FABEC goals and work program for Belgium.

3.2.2. SESAR

The SESAR Concept of Operations has two relevant connections with the strategic guidance on air traffic management developed by ICAO.

On the one hand, while the SESAR CONOPS is compatible in all respects with the ICAO Global Air Traffic Management Operational Concept, it is not a copy in content or structure of the ICAO material. The SESAR CONOPS represents a specific application of the global concept, adapted and interpreted for Europe with due regard to the need for global interoperability.

At the same time, the SESAR CONOPS describes an ATM paradigm that represents trajectory based operations (TBO) realized in a net-centric environment. As such, it is in many ways (e.g. 4 D solutions) more advanced than the RNAV/RNP specifications currently included in the PBN concept.

The SESAR CONOPS, itself being performance based, can be seen as building on compatibility with the PBN concept while possible generating new requirements that will need to be cascaded back into the PBN concept itself.

3.3. OBJECTIVES OF THE IMPLEMENTATION STRATEGY AND PLAN

The PBN Implementation Strategy for Belgium has been created to meet the following objectives:

- *Provide a high level strategy and a detailed activity and implementation plan for the evolution of the navigation applications to be implemented in Belgium in the short term (2012-2015) and the medium term (2016-2020);*
- *Ensure that the implementation of the navigation portion of the CNS/ATM system in Belgium is based on clearly established operational requirements;*
- *Enable the full realization of all PBN benefits;*
- *Avoid unnecessarily imposing mandates for multiple equipment on board or multiple systems on the ground;*
- *Avoid the need for multiple airworthiness and operational approvals for intra- and inter-regional operations;*
- *Prevent commercial interests from preceding air traffic management operational requirements resulting in unnecessary costs for Belgium and/or the airspace users;*
- *Ensure harmonization with other FABEC member States;*
- *Ensure that no conflict arises with the PBN implementation activities in the EUR Region.*

3.4. APPLICABLE PRINCIPLES

This implementation strategy and implementation plan is based on the following principles:

- *Airspace concepts are to be developed to provide the framework for PBN implementation;*
- *Conventional air navigation procedures will continue to be available during the transition period to guarantee access for users who are not RNAV and/or RNP equipped;*
- *Airspace modelling tools and real-time/fast-time simulations, as appropriate, are to be used to identify the navigation applications that are most suited to the airspace concept developed for Belgium;*
- *Every decision concerning PBN implementation is to be supported by a cost/benefit analysis;*
- *Pre- and post-implementation safety assessments must be performed to ensure that the required safety levels are being met.*

3.5. STRATEGY SCOPE

The strategy and plan are based on the ICAO PBN concept.

It shall be applied to GAT aircraft operations in the Brussels FIR/UIR involving instrument approaches, standard departure routes (SID), standard arrival routes (STAR) and ATS routes.

Existing procedures, where the original design criteria did not meet the ICAO PBN provisions, shall be evaluated and redesigned if necessary to meet the currently applicable requirements not later than 31-12-2013 (with applicability date being a suitable AIRAC date in 2014).

If an existing procedure is to be changed for any reason, it shall be made to meet the requirements of this Strategy at the time the change becomes applicable.

All new procedures shall be designed to meet the requirements of this Strategy.

The strategy shall be supported by an appropriate business case and safety case.

3.6. IDENTIFYING USER REQUIREMENTS

The development of the PBN implementation plan must be seen as a collaborative effort, involving all aviation stakeholders. User requirements in this context refer to the requirements of all users of Belgian airspace as well as service providers in that airspace. This includes also the military, the aircraft operating units as well as units that use airspace for other purposes.

It must be remembered that the various stakeholders all have their business or mission priorities some of which may be in conflict with each other. User requirements must be ranked and prioritized with due regard to the applicable principles of safety, national security, access and equity while also maintaining a commercially level playing field.

The task shall be completed not later than 30 November 2012.

3.7. DEVELOPING THE AIRSPACE CONCEPT

The airspace concept is in fact a general vision of the airspace under the jurisdiction of BCAA. The airspace concept is driven by the strategic objectives identified by and agreed between the airspace users, the air traffic

management organization and the airports with due consideration to the applicable government policies, including environmental policies, in so far as these are available. The strategic objectives may change over time and it is possible that the airspace concept needs to be changed in order to continue its best possible alignment with the objectives. The airspace concept is supported by agreed enablers. These enablers must be developed and implemented as part of the overall plan to ensure their cohesion and the realisation of the benefits in a cost-effective manner.

Individual airspace concepts shall be developed for each airspace type of concern to Belgium.

3.8. THE PBN COST-BENEFIT ANALYSIS

This chapter will contain the main conclusions of the PBN cost-benefit analyses to be conducted in support of the applications put forward for implementation in Belgium. The complete material will be reproduced in Chapter 9.

3.9. THE PBN SAFETY CASE

This chapter will contain the main conclusions of the PBN safety cases. The complete safety case material will be reproduced in Chapter 10.

To be completed.

3.10. PREPARING FOR IMPLEMETATION

3.10.1. FINANCING THE IMPLEMENTATION

Financing the implementation is a crucial question that can mean the difference between success and failure of this strategy. Experience shows that even the existence of a positive business case is often not enough to start aircraft equipage and/or the initiation of the required changes in ground systems and procedures. In cases where initial benefits take several years to materialize the willingness to invest is very low or none-existent. This is especially true in the current economic climate. It is also important to keep in mind that PBN implementation is in many ways competing with other requirements and mandates arising from the SES and SESAR and setting the correct priorities is a challenge.

Jump-starting avionics equipage in other contexts, namely the implementation of air/ground digital link services, by providing seed-money to a first set of airlines has shown its value. It is therefore important to develop innovative ideas also for the financing of PBN implementation including the use of public funds that may be available on the European level.

The possibilities and proposals for financing need to be clarified and agreed before the strategy is released for wider consultation. In this context it is important to keep in mind that the strategy consultation should not be unduly delayed on this account.

3.10.2. SETTING UP A NATIONAL PBN PROJECT

3.10.2.1. PREPARATION

In order to properly design the main implementation project, a small project-preparation group will be established, composed of experts at least from BCAA and Belgocontrol tasked with finalizing the implementation project

activity list (refer to Chapter 5) and the project details and also, after the consultation on the activity list has been completed, the creation of the detailed implementation plan.

The project preparation group shall complete its first task within 6 weeks of starting work and the second task within 8 weeks after completion of the activity list consultation.

3.10.2.2. PBN PROJECT

Once the user requirements have been collected, analysed and prioritized, the implementation activity is to be undertaken in the frame work of a national PBN project, managed by BCAA. The project is led by BCAA to ensure that it can operate with the required authority.

While participating in the project is free for all stakeholders with a substantive interest in the subject, it is not the intention to have all stakeholders participate directly. Indirect participation can take place in the form of active engagement in the consultation process for example.

The project must be achievement focused and work to the most efficient timeline compatible with the strategic aims, user requirements and business priorities of the aviation community in Belgium.

Decision making in the project must be set up such that it becomes impossible for any individual participant to block progress.

After having reached agreement from all stakeholders concerned, the strategy timeline and milestones shall be set by BCAA and they shall be adhered to except in cases of proven force majeure.

3.10.3. CONSULTATION AND INFORMATION PUBLICATION

In order to achieve early and the fullest possible buy-in from all aviation stakeholders in Belgium, appropriate consultation and promulgation of information must be one of the highest priorities of the project.

Appropriate consultation mechanisms must be set up, ensuring that also hard-to-reach stakeholders are given an opportunity to be involved.

A sphere of "ownership" must be created with the particular benefits for individual stakeholders being made abundantly clear to generate support on all levels.

3.10.4. STRATEGY TIMELINE AND MILESTONES

(Following finalisation of the strategy, the agreed timeline and corresponding milestones will be listed here.)

3.11. REGULATORY ASPECTS

3.11.1. USE OF EXISTING REGULATIONS

Although PBN is a new concept, many of the existing regulatory provisions continue to be applicable also in a PBN environment. Nevertheless, it is necessary to perform an inventory of existing regulations to identify/confirm which can continue to be used unchanged and which need possible amendment.

An inventory of regulations shall be performed and regulations that can continue to be used unchanged shall be identified; regulations that need to be amended shall also be identified and the amendments shall be developed and submitted for approval. This task shall be undertaken by BCAA and shall be completed not later than 31 July 2012.

3.11.2. IDENTIFICATION OF REQUIRED NEW REGULATIONS

Since PBN is a new concept, it can happen that its implementation requires certain new regulatory provisions to be developed. These often represent provisions that have never been used in a given jurisdiction and their development may require specific operational and legal expertise.

As a continuation of the activity described in para. 3.10.1 above, a gap analysis shall be performed to identify any new regulations that need to be developed in order to cover all aspects of operating in the Belgian PBN environment. Such new regulations shall be developed and submitted for approval. This task shall be undertaken by BCAA and shall be completed not later than 30 November 2012.

3.12. STANDARDISATION ASPECTS

3.12.1. USE OF EXISTING STANDARDS

The global interoperability of PBN is based on the use of global standardisation. It is necessary to check the applicable national standards to ensure that these are in line with the global requirements.

An inventory of applicable national standards shall be made with a view to ensuring that these comply with the global requirements. Where discrepancies are found, a proposal for their resolution shall be developed. This task shall be undertaken by BCAA and shall be completed not later than 30 November 2012.

3.12.2. IDENTIFICATION OF REQUIRED NEW STANDARDS

It is possible that some of the global standards required by PBN have not been adopted nationally (e.g. in cases where they have not been required in any context in the past). The timely introduction of such standards into the national standards set is essential prerequisite of PBN implementation.

As a continuation of the activity described in para. 3.11.1 above, a gap analysis shall be performed to identify any new standards that need to be adopted in order to cover all aspects of operating in the Belgian PBN environment. Such new standards shall be described and submitted for approval. This task shall be undertaken by BCAA and shall be completed not later than 30 November 2012.

3.13. GROUND BASED NAVIGATION AID ASPECTS

One of the most important benefits expected from PBN is the opportunity to rationalize the ground based navigation aid infrastructure resulting in substantial cost savings. In practice this translates to a co-ordinated withdrawal of certain navaids (e.g. NDB, VOR). This withdrawal must be planned with due regard to related activities on the European level as well as Belgian national requirements.

The detailed PBN implementation plan shall indicate the strategy and time-line for the withdrawal of ground based navigation aids internationally and nationally agreed as no longer required in the Belgian PBN environment.

3.14. PROCEDURAL ASPECTS

Conventional procedures, particularly in the Terminal Control Areas (TMA) will be progressively withdrawn. The driver for this is in part the timetable for the withdrawal of certain navigation aids. Another driver is the introduction of more cost-effective procedures. The transition from the current procedural environment towards the future environment must ensure that support to different airborne capabilities is maintained for a reasonable period of time.

Transition to the future procedural environment shall take the following principles into account:

- **Conventional and RNAV procedures shall initially coexist to enable continued support to less capable aircraft;**
- **The date of final withdrawal of conventional procedures shall be made known at the earliest possible time. This date shall leave sufficient time for aircraft operators to equip in a cost-efficient and timely manner;**
- **The new procedures shall be designed in such a way that facilitates the introduction of advanced arrival procedures, such as "point merge" and full 4D trajectories;**
- **All new procedures shall be designed to facilitate the extensive use of continuous descent approaches;**
- **Developments in approach procedures shall be closely co-ordinated with the airport operators and airspace users representatives in Belgium;**

3.15. SPACE BASED NAVIGATION AID ASPECTS

Although PBN as currently defined is primarily based on GPS, the concept does not exclude at all the use of other GNSS equipment, e.g. Galileo. However, in order to ensure that no ambiguity exists for the airspace users and air navigation service providers at any given moment as to which signal in space they may use for their PBN operations, it is advisable that the acceptable GNSS source(s) be published by BCAA via the usual aeronautical channels. It should be noted that this is a blanket authorization and is not the same as information about the operational availability and usability of the signal from any particular system at any particular moment in time.

3.16. AVIONICS ASPECTS

The implementation of PBN applications does pose certain requirements against aircraft avionics which in some cases may involve retrofit or forward fit of specific equipment on certain aircraft types. The cost-benefit analysis of all applications put forward for implementation will take due account of the costs involved, however the detailed implementation plan must clearly indicate the performance requirements to be met.

3.17. ALTERNATE POSITION, NAVIGATION AND TIMING (APNT)

With the move to space-based signal sources for position, navigation and timing, interference with or failure of the signal source(s) has a potential for disrupting operations in a big area. With a substantial part of the benefits of PBN expected from the rationalisation of the ground navigation aid infrastructure, a situation of conflicting interests arises. The sensitivity of the space-based system requires some kind of back-up to exist while the ground

navigation aid infrastructure is being progressively dismantled in order to realize the potential cost savings. At the same time the obligation of the Belgian ANSP to provide the agreed services remains, irrespective of the changes in the navigation infrastructure. Clearly, a cost effective compromise is needed to ensure a robust PBN operation in all circumstances.

Work on APTN has identified several possible technical options, e.g. DME-DME, Wide Area Multi-Lateration (WAM), DME Pseudolites (DMPL) of various maturity. It is advisable to follow this work closely to ensure that the final agreed solution fits well with the Belgian national requirements.

3.18. TRAINING ASPECTS

3.18.1. GENERAL CONSIDERATIONS

It is important that the transition to PBN happen with maximum cost-efficiency. This has consequences also for the additional training to be provided to the different professionals (pilots, air traffic controllers, engineers, etc.).

Training needs to be approached from two viewpoints. ATC and pilot courses will have to have the PBN related material added to their normal syllabus. This is the responsibility of the institutions offering the course concerned.

Additional training for licensed personnel will take the form of electronic, interactive self study e-courses, to be developed for the purpose and made available free of charge in the form of an on-line application, removable media and downloadable material. Familiarity with the material will have to be declared at a future recurrent examinations event in the form of signing a Declaration on Honour document.

3.18.2. PBN E-COURSE CHARACTERISTICS

In view of the newness of the PBN concept and the many subtle and not so subtle differences it introduces from previous concepts like RNAV and RNP, the e-courses must see as their audience not only the different aviation disciplines but also people on all levels in those disciplines from high management through operations all the way to maintenance and repair organisations.

The PBN e-course concept is based on an approach that creates a one-stop package for all disciplines and levels. The course could be in the framework of a portal that allows access to general information and also to separate modules for each discipline and different levels within the disciplines with cross-references tying the material together.

This approach has the advantage of allowing all disciplines to look into the modules of the others and hence fosters an even stronger common understanding of the impact of PBN as seen from the cockpit, ATC or engineering.

A special module is reserved for general aviation pilots and also for the military to ensure that their specific world view is also properly covered.

The e-course also contains exams and a scoring system.

Preference is given to the on-line version since this allows the course to be completed in several instalments, with subsequent sessions starting where the student had left off. This is not possible with the version on removable media but this latter has certain advantages in terms of portability.

3.19. AWARENESS RAISING CAMPAIGN

3.19.1. INVOLVING ALL STAKEHOLDERS

The purpose of the awareness raising campaign is to ensure common understanding of the impact of PBN and its implementation in Belgium. The campaign must reach all stakeholders, however difficult they may be to contact otherwise.

The campaign is built on a layered approach that provides several types of information output that build on each other, reinforcing their impact and increasing their reach.

Cost-effectiveness considerations play an important role also in the design of the campaign.

The following tools should be considered as part of the awareness raising campaign:

- *Interactive web site*
- *PBN brochure*
- *PBN video*
- *PBN workshop*

3.19.2. INTERACTIVE WEB SITE

The interactive web site provides the focus for all information concerning PBN implementation in Belgium.

It contains background material, illustrations, links to relevant documents and of course it houses also the on-line version of the PBN e- course.

Details of the implementation plan, reports on progress and a forum are also available to users.

While the web-site must convey a very professional air and be worthy of being a product of BCAA, it must also have an engaging, attractive quality that encourages people to use it to both obtain information and express their views. The feedback available from users is a valuable asset in steering the implementation project.

3.19.3. PBN BROCHURE

While the main source of current PBN implementation information is the web site, an initial push is given by a very professional, engaging brochure that is delivered to all the aviation stakeholders, calling their attention to the availability of the web site. The brochure talks about PBN in broad terms, enough to catch the interest of the target audience who will then continue their engagement via the web.

3.19.4. PBN VIDEO

The PBN video is a short, multi-purpose product on a high professional level. It is multi-purpose because it is scripted in such a way that it is suitable for showing to managers, on international events, workshops and also for posting on video sharing sites. It highlights Belgium's PBN related activities and the most important milestones of the PBN plan.

3.19.5. PBN WORKSHOP

Following the creating of the web-site and the promulgation of the brochure, 1-3 workshops are organized to enable all stakeholders to come together and discuss their particular vision of PBN and its implementation in Belgium.

Initially the idea of the workshop focuses on one main event with wide participation, followed by 1-2 focused workshops organised for the benefit of specific user groups, e.g. general aviation and/or the military.

The timing of the workshops must be such that the views expressed by the stakeholders can still be taken into account in the finalization of the implementation plan.

4. REGULATORY OVERSIGHT AND PERFORMANCE EVALUATION

4.1. SAFETY ASSESSMENT

(Describe here in brief the methodology and basis on which the safety assessment of the elements of PBN forming the subject of this implementation strategy will be carried out.)

4.2. THE OPERATIONAL APPROVAL AND CERTIFICATION PROCESS

(Describe here the process of certification and operational approval applicable to the elements of PBN forming the subject of this implementation strategy.)

4.3. CONTINUOUS COMPLIANCE ASSURANCE

A continuous compliance assurance system should be set up to ensure the uninterrupted safe and efficient operation of PBN in Belgium.

The system shall be administered and supervised by BCAA and participation by all stakeholders concerned shall be mandatory.

4.4. REPORTING

BCAA shall develop a web-based electronic system for the secure, non-mandatory reporting of incidents related to or thought to relate to PBN. The same system shall also be suitable for submitting comments and improvement proposals.

The system shall comply with all applicable national aviation reporting requirements and data protection and privacy laws.

This system is not meant to replace the existing, mandatory or voluntary reporting mechanisms. Its purpose is to provide a facility for the continuous improvement of PBN-based operations in Belgium.

The system should be in place and operational not later than 12 months following the implementation of the first PBN application.

4.5. PERFORMANCE EVALUATION

The business cases on which the implementation of the various PBN applications are based are created using different assumptions and they deliver corresponding benefit expectations. Whether or not these benefits are realised in actual operations needs to be checked periodically. The purpose of this is twofold: in the first instance to ensure that the originally planned benefits are actually realised; in the second it is important to ensure that in a changing operational environment the level of benefits remains and to identify when changes and new initiatives are required to maintain the benefits.

The system of performance evaluation shall be developed and administered by BCAA in cooperation with the stakeholders concerned.

The system of performance evaluation should be in place by the time the first PBN application is implemented.

5. BELGIAN PBN ACTIVITY AND IMPLEMENTATION PLAN

The implementation plan comproses two main parts. The first part is a list of high level activities considered essential for PBN implementation, showing also the organisation responsible and the draft time frame for each activity. The activities listed will have to be broken down into sub-activities as appropriate on the level of the various stakeholders. Once the list of activities and the responsible organisations have been agreed, a detailed plan will be developed, showing priorities, dependencies and the actual time frames.

Note: The editorial practices used in the rest of this document are not applicable in this chapter. Bold characters are used solely to aid in reading the chapter. The status of the plan will be determined after its approval.

5.1. ACTIVITY PLAN

5.1.1. AIRSPACE CONCEPT DEVELOPMENT ACTIVITIES

Action ID	Description	Responsible organisations	Start date	Target end-date
ACDP1	**Develop the airspace concept for Belgium**	**BCAA**		
ACDP1-1	Select relevant stakeholders and organize first consultation. Seek opinions in the preparation of proposed rulemaking on relevant issues, including: • RNP approach with BAROVNAV vs. SBAS; • Dates and phasing of ground navaid and conventional procedure withdrawal;			

ACDP1-2	Develop draft airspace concept and submit for review			
ACDP1-3	Develop plan for the withdrawal of ground navigation aids and submit for review			
ACDP1-4	Develop plan for the withdrawal of conventional procedures and submit for review			
ACDP1-5	Develop APNT plan and submit for review			
ACDP1-6	Organize second consultation with relevant stakeholders			
ACDP1-7	Update draft and circulate for final review			
ACDP1-8	Incorporate last updates and submit for formal approval			
ACDP2	Based on approved concept, develop list of required regulatory material and plan for its publication/effectiveness			

5.1.2. COST/BENEFIT ANALYSIS ACTIVITIES

Action ID	Description	Responsible organisations	Start date	Target end-date
CBAP1	**Prepare a preliminary CBA for PBN implementation**			
CBAP1-1	Select company to perform the CBA			
CBAP1-2	Collect cost and benefit data			

CBAP1-3	Run first analysis			
CBAP1-4	Organize first stakeholder workshop			
CBAP1-5	Run analysis incorporating workshop feedback			
CBAP1-6	Organize final stakeholder workshop			
CBAP1-7	Finalize analysis			
CBAP2	Publish results			

5.1.3. EN-ROUTE DEVELOPMENT ACTIVITIES

Action ID	Description	Responsible organisations	Start date	Target end-date
ERDP1	**Optimize en-route environment**			
ERDP1-1	Review and validate traffic forecasts for the Brussels FIR/UIR			
ERDP1-2	Review existing B-RNAV (RNAV 5) implementation, consider possible extension			
ERDP1-3	Considering the traffic forecasts, if needed, create detailed plan for the implementation of P-RNAV			
ERDP1-4	Develop and publish relevant information, including possible local mandates and other regulatory material			

5.1.4. TERMINAL AREA DEVELOPMENT ACTIVITIES

Action ID	Description	Responsible organisations	Start date	Target end-date
TADP1	**Implement, as standalone or where procedures exist as overlays, RNAV terminal procedures using the ECAC P-RNAV standard as a first step towards withdrawing conventional procedures.** Note: The development plan for instrument approach procedures is contained in the next paragraph.			
TADP1-1	Confirm with Belgian Defence and the USAF the conditions for the continued use of the DME element of military TACAN and VORTAC stations.			
TADP1-2	Analyse the need for DME stations in the new procedure environment, taking also DMEs outside the Brussels FIR into account			
TADP2	Execute the withdrawal of conventional procedures			
TADP2-1	Co-ordinate the date of withdrawal with all stakeholders			
TADP2-2	Evaluate the best legal basis for the withdrawal (e.g. local mandate for P-RNAV, European developments, etc)			
TADP2-3	Develop and publish relevant information, including eventual local mandates and other regulatory material			

5.1.5. INSTRUMENT APPROACH PROCEDURE DEVELOPMENT ACTIVITIES

Action ID	Description	Responsible organisations	Start date	Target end-date
IPDP1	**Implement PBN approach procedures on selected runways**			

IDP1-1	Define type of approaches to be implemented and the candidate runways			
IPDP1-2	Discuss with airport operators/users to establish actual requirements			
IPDP1-3	Review airspace structure changes required; implement changes			
IPDP1-4	Design procedures and implement them			
IPDP1-5	Develop and publish relevant information, including eventual local mandates and other regulatory material			

5.1.6. SAFETY CASE DEVELOPMENT ACTIVITIES

Action ID	Description	Responsible organisations	Start date	Target end-date
SCDP1	**tbd**	**tbd**	**tbd**	**tbd**

5.1.7. TRAINING DEVELOPMENT ACTIVITIES

Action ID	Description	Responsible organisations	Start date	Target end-date

TDP1	**Develop modular training package for pilots, air traffic controllers and airport operators**			
TDP1-1	Select company to be charged with this task			
TDP1-2	Develop printed material (need for this to be discussed)			
TDP1-3	Develop e-learning material			
TDP1-4	Develop access methods (who is entitled for free training, who pays and how much)			
TDP1-5	Organise dissemination of training (instructors, locations, audience, etc.)			

5.1.8. AWARENESS RAISING ACTIVITIES

Action ID	Description	Responsible organisations	Start date	Target end-date
ARP1	**Develop modular awareness raising material for pilots, air traffic controllers and airport operators** Note: Maximum use is to be made of existing material available from EUROCONTROL, ICAO, etc.			
ARP1-1	Select company to be charged with this task			
ARP1-2	Develop common website (to enable access to each other's material by pilots, air traffic controllers and airport operators)			
ARP1-3	Develop format and content of brochure			
ARP1-3-1	Print and distribute brochure			

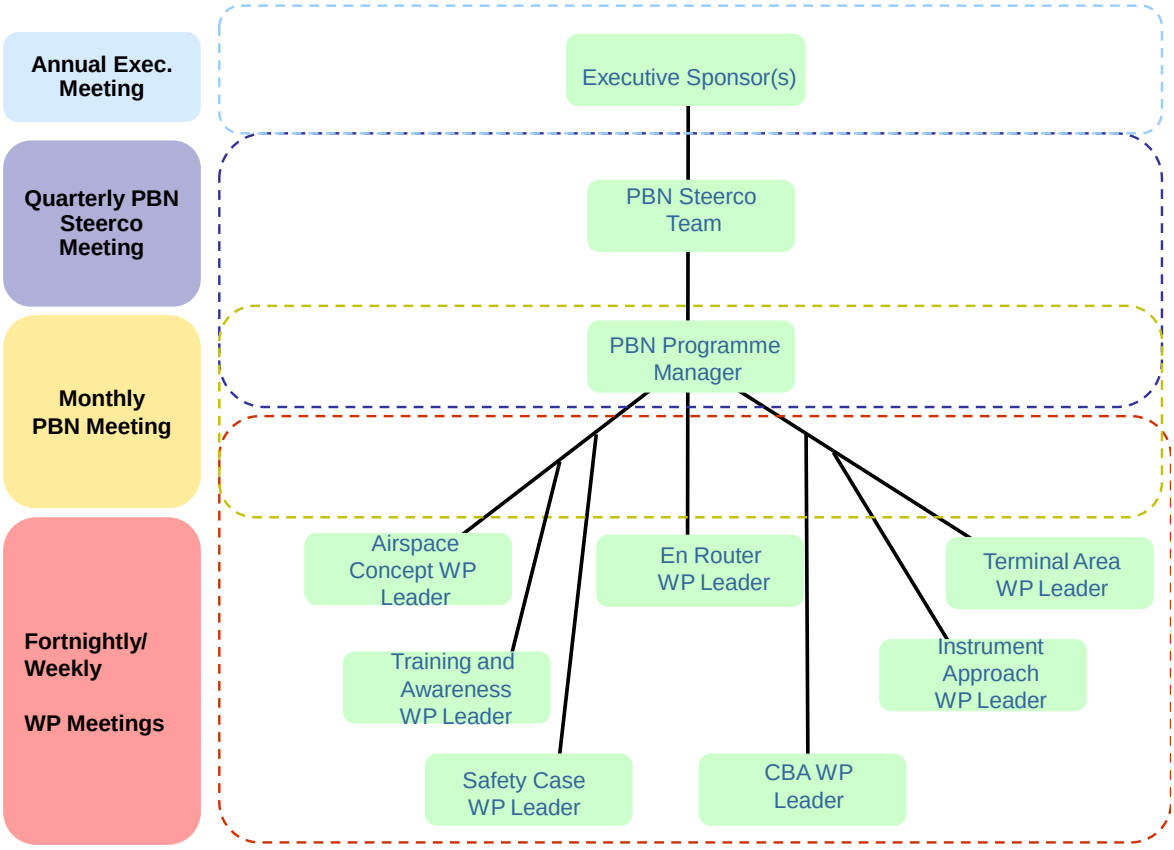
ARP1-5	Write script for PBN video			
ARP1-5-1	Produce video and arrange for distribution			
ARP2	Organize PBN workshop(s)			
ARP2-1	Organize PBN consultation type workshops (in support of specific implementation actions)			
ARP2-2	Organize PBN information type workshops (to provide general information)			

5.2. IMPLEMENTATION PLAN

This chapter will be completed once agreement has been reached on the details of the activity plan.

6. IMPLEMENTATION PLAN GOVERNANCE

An important element of the plan is the definition of a clear governance structure that ensures proper stakeholder engagement and project accountability. In the following a draft governance plan is provided as a basis for discussion.


Annual Exec. Meeting
Quarterly PBN Steerco Meeting
Monthly PBN Meeting
Fortnightly/ Weekly
WP Meetings
Executive Sponsor(s)
PBN Steerco Team
PBN Programme Manager
Airspace Concept WP Leader
En Router WP Leader
Terminal Area WP Leader
Training and Awareness WP Leader
Instrument Approach WP Leader
Safety Case WP Leader
CBA WP Leader

7. DEFINITIONS AND ABBREVIATIONS

7.1. DEFINITIONS

When used in this document, the terms listed in the following table shall have the definition specified herein. Whenever ICAO has provided a definition of a given term, it is used here also.

Term	Definition
Aircraft Based Augmentation System (ABAS)	An augmentation system that augments and/or integrates the information obtained from the other GNSS elements with information available on board the aircraft. Note. — The most common form of ABAS is receiver autonomous integrity monitoring (RAIM).
Airspace concept	An airspace concept provides the outline and intended framework of operations within an airspace. Airspace concepts are developed to satisfy explicit strategic objectives such as improved safety, increased air traffic capacity and mitigation of environmental impact etc. Airspace Concepts can include details of the practical organization of the airspace and its users based on particular CNS/ATM assumptions, e.g. ATS route structure, separation minima, route spacing and obstacle clearance.
Approach Procedure with Vertical Guidance (APV)	An instrument procedure which utilizes lateral and vertical guidance but does not meet the requirements established for precision approach and landing operations.
Area Navigation	Area Navigation is a method of navigation enabling aircraft to fly on any desired flight path: • Within the coverage of referenced navigation aids; or • Within the limits of the capability of self-contained systems; or • A combination of these capabilities.
Conventional Navigation	Navigation technique that makes use of conventional ground based navigation aids (such as VOR, DEM, NDB) only.
Localiser Performance with Vertical Guidance (LPV)	Approach procedure supported by SBAAS and providing vertical guidance to down to a defined level (can be as low as 200 feet AGL).

Navigation aid infrastructure	Navigation aid infrastructure refers to space-based and or ground-based navigation aids available to meet the requirements in the navigation specification.
Navigation Application	The application of a navigation specification and the supporting navaid infrastructure, to routes, procedures, and/or defined airspace volume, in accordance with the intended airspace concept. Note.— The navigation application is one element, along with communication, surveillance and ATM procedures which meet the strategic objectives in a defined airspace concept.
Navigation Specification	A set of aircraft and aircrew requirements needed to support performance-based navigation operations within a defined airspace. There are two kinds of navigation specification: • RNAV specification. A navigation specification based on area navigation that does not include the requirement for performance monitoring and alerting, designated by the prefix RNAV; • RNP specification. A navigation specification based on area navigation that includes the requirement for performance monitoring and alerting, designated by the prefix RNP.
Non-precision Approach	An approach flown by reference to navigation aids in which glide slope information is not available.
Performance Based Navigation	Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace. Note — Performance requirements are expressed in navigation specifications in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.
Required Navigation Performance (RNP)	A statement of the navigation performance necessary for operation within a defined airspace.
RNAV application	Area Navigation applications assume aircraft operations on any desired flight path in the coverage area of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

RNP application	Required Navigation Performance applications are Area Navigation Applications requiring on-board performance monitoring and alerting.
RNP type	A containment value expressed as a distance in nautical miles from the intended position within which flights would be for at least 95 per cent of the total flying time.
Satellite Based Augmentation System (SBAS)	A wide coverage augmentation system in which the user receives augmentation information from a satellite-based transmitter.
Standard Instrument Arrival (STAR)	A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.
Standard Instrument Departure (SID)	A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.

7.2. ABBREVIATIONS AND ACRONYMS

When used in this document, the acronyms listed in the following table shall have the meaning specified herein.

Acronym	Meaning
ABAS	Aircraft based augmentation system
ADS-B	Automatic dependent surveillance - broadcast
ADS-C	Automatic dependent surveillance - contract
AFM	Aircraft flight manual
AIP	Aeronautical information publication
ANSP	Air navigation service provider
APNT	ALTERNATE POSITION, NAVIGATION AND TIMING
APV	Approach procedure with vertical guidance
ATM	Air traffic management
ATS	Air traffic services
BCAA	Belgian Civil Aviation Authority
CDI	Course deviation indicator
CDM	Collaborative Decision Making

CDU	Control display unit
CFIT	Controlled flight into terrain
CRC	Cyclic redundancy check
CRM	Collision risk model
DME	Distance measuring equipment
DMPL	DME Pseudolites
DTED	Digital terrain elevation data
EASA	European Aviation Safety Agency
EC	European Commission
ECAC	European Civil Aviation Conference
EUROCAE	European Organization for Civil Aviation Equipment
EUROCONTROL	European Organization for the Safety of Air Navigation
FAA	Federal Aviation Administration
FMS	Flight Management System
FRT	Fixed radius transition
FTE	Flight technical error
GBAS	Ground-based augmentation system
GNSS	Global navigation satellite system
GPS	Global positioning system

GRAS	Ground based regional augmentation system
ICAO	International Civil Aviation Organisations
INS	Inertial navigation system
IRS	Inertial reference system
IRU	Inertial reference unit
JAA	Joint Aviation Authorities
LNAV	Lateral navigation
LPV	Localiaser Performance with Vertical Guidance
MCDU	Multifunction control display unit
MEL	Minimum equipment list
MNPS	Minimum navigation performance specification
MSA	Minimum sector altitude
N/A	Not applicable
NAA	National airworthiness authority
NAVAID	Navigation aid
NSE	Navigation system error
OEM	Original equipment manufacturer
PBN	Performance Based Navigation
PBNISB	PBN Implementation Strategy Belgium
PSR	Primary surveillance radar

RAIM	Receiver autonomous integrity monitoring
RF	Radius to fix
RNAV	Area navigation
RNP	Required navigation performance
SBAS	Satellite-based augmentation system
SES	Single European Sky
SID	Standard instrument departure
SSR	Secondary surveillance radar

STAR	Standard instrument arrival
STC	Supplemental type certificate
tbd	To be defined
TLS	Target level of safety
TSE	Total system error
VNAV	Vertical navigation
VOR	VHF omnidirectional radio range

8. REFERENCE DOCUMENTS

ICAO Doc 9613 AN/937 – Performance-based Navigation (PBN) Manual

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9. PBN COST BENEFIT ANALYSIS

To be completed.

10. PBN SAFETY CASE

To be completed.