AFI

Regional Performance Based Navigation Implementation Plan

Version 2.1
Adopted by AASPG/2
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Table of Contents

RECORD OF AMENDMENTS **3**
Executive summary **4**
Glossary **5**
Acronyms **6**
1. Introduction **8**
2. BACKGROUND **9**
3. AFI PBN Implementation Objectives and performance measurement **10**
4. Planning Principles **12**
5. PBN Implementation requirements **12**
6. STAKEHOLDERS **15**
7. Safety Assessment & Monitoring Requirements **16**
8. Current status **16**
9. PBN strategies **17**
10. AFI PBN Implementation Targets (2027-2032) **25**
11. KEY RESEARCH AREAS **27**
APPENDICES **29**
APPENDIX A- Template of National PBN Implementation Plan (NPIP) **29**
APPENDIX B – Useful links **29**

RECORD OF AMENDMENTS

Version	**Effective Date**	**Endorsement authority**	**Remarks**
1	August 2010	Endorsed by APIRG/17	Initial version
2	7 Nov 2026	Endorsed by AASPG/2	Revised targets and alignment with GANP 6th-8th Editions And Doc 9613

Executive summary

Resolution A 36/23 adopted by ICAO Assembly in its 36th Session held in September 2007 and resolution A37-11 adopted by ICAO Assembly in its 37th Session held in September 2010 provide directives on the global implementation of Performance-Based Navigation (PBN). The Regional PBN Plan addresses the strategic objectives for PBN implementation based on clearly established operational requirements, avoiding equipage of multiple on-board or ground-based equipment, avoiding multiple airworthiness and operational approvals and explaining in detail contents relating to potential navigation applications. The updated Plan envisages the conduct of pre- and post-implementation safety assessments and continued availability of conventional air navigation procedures in the context of resilient operations. The updated Plan also discusses issues related to implementation which include traffic forecasts, aircraft fleet readiness, adequacy of ground-based CNS infrastructure etc. The new implementation targets the period 2027-2036, while aligning with the AFI seamless ATM master Plan, which has a planning horizon until 2036. It is expected that during the new regional PBN implementation cycle (2027-2036), GNSS would be the primary navigation infrastructure with established operational resilient procedure to mitigate safety issues posed by GNSS radio frequency interference (GNSS RFI). It was also expected that precision approach capability using GNSS and its augmentation systems would become available for all runway ends at all international airport in AFI.

Glossary

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.
AFI Regional PBN Implementation Plan: A regional document adopted by AASPG, often referred to as the "The AFI PBN Plan", offering appropriate guidance for air navigation service providers, airspace operators and users, regulating agencies, and international organizations on the evolution of navigation capabilities as one of the key systems supporting air traffic management, and which describes the RNAV and RNP navigation applications that should be implemented in the short, medium and long term in the AFI Region.
Performance requirements: are expressed in navigation specifications (RNAV navigation specification, RNP navigation specification) in terms of accuracy, integrity, continuity and functionality needed for the proposed operation in the context of a particular airspace concept.

Acronyms

AAPSG	Africa Indian-Ocean Aviation System Planning and Implementation Group
ABAS	Aircraft-Based Augmentation System
AFI	Africa Indian-Ocean Region
ADS-B	Automatic Dependent Surveillance-Broadcast
ADS-C	Automatic Dependent Surveillance-Contract
APCH	Approach
APV	Approach procedure with vertical guidance
ATC	Air Traffic Control
ATM	Air Traffic Management
Baro VNAV	Barometric Vertical Navigation
CCO	Continuous Climb Operations
CDO	Continuous Descent Operations
CPDLC	Controller-Pilot Data link Communications
CNS	Communications, Navigation, Surveillance
DME	Distance Measuring Equipment
EFVS	Enhanced Flight Visibility System
GA	General Aviation
GBAS	Ground-Based Augmentation System
GLS	GNSS Landing System
GNSS	Global Navigation Satellite System
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
LNAV	Lateral Navigation
LPV	Localizer Performance with Vertical Guidance

NAS	National Airspace System
NAVAID	Navigation Aid
NDB	Non-directional radio Beacon
NM	Nautical Miles
PBN	Performance Based Navigation
RCP	Required Communications Performance
RF	Radius-to-Fix
RNAV	Navigation specification designator, followed by the lateral navigation accuracy in nautical miles
RNP	Required Navigation Performance
RCP	Required Communication Performance
RSP	Required Surveillance Performance
SID	Standard Instrument Departure
STAR	Standard Instrument Arrival
TMA	Terminal Control Area
VNAV	Vertical Navigation
VOR	VHF Omni-directional Radio-range
WGS-84	World Geodetic System-1984

2. Introduction

Need for the regional PBN Implementation Plan

2.1 Resolution A 36/23 adopted by ICAO Assembly in its 36th Session urged States and PIRGs to complete a regional PBN implementation plan by 2009.

2.2 Assembly Resolution A37-11 set global PBN implementation targets and called on States and PIRGs to complete PBN implementation plan as a matter of urgency to timely achieve these targets.

2.3 The AFI air navigation call on AASPG to develop a regional PBN plan to ensure harmonized regional implementation and alignment with national PBN plans.

2.4 The AFI Regional Performance Based Navigation (PBN) Implementation Plan details the framework within which the ICAO PBN concept is implemented in the AFI Region for the defined timeframe. The Plan is guided by ICAO Doc. 9613- Performance Based Navigation Manual and relevant SARPs. The primary driver for this Plan is to maintain and increase safety, support air traffic demand and capacity, and services and technology in consultation with relevant stakeholders. The AFI Region Plan also supports national and international interoperability and global harmonization.

2.5 Furthermore, the AFI PBN Implementation Plan contains the basic material serving as guidance for regional projects for the implementation of air navigation infrastructure, such as ABAS, SBAS, GBAS, as well as for the development of national implementation plans and taking into account safety risks associated with GNSS.

Roles of Navigation in supporting ATM operations

2.6 An "airspace concept" may be viewed as a general vision or master plan for a particular airspace. Based on principles, an airspace concept is geared towards specific objectives. 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 concept are safety, capacity, efficiency, access, and the environment.

2.7 Navigation is one of several enablers of an airspace concept which also includes communication, ATS Surveillance and ATM.

2.8 The PBN concept specifies RNAV and RNP system performance requirements in terms of accuracy, integrity, availability, continuity and functionality needed 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 infrastructure (sensors and equipment) that may be used to meet the performance requirements. These navigation specifications are defined at a sufficient level of detail to facilitate global harmonization by providing specific implementation guidance for States and operators.

2.9 Under the PBN concept, the generic navigation requirements are defined based on operational requirements. Thus, users may evaluate the available options. To ensure synchronization of investment and interoperability of the airborne and ground systems, the selection of the solution should be in consultation with aviation stakeholders, including air operators, air navigation service providers, and regulators. The solution selected should also be the most cost-effective one.

2.10 The development of the PBN concept recognized that advanced aircraft RNAV/RNP systems are achieving an enhanced and predictable level of navigation performance accuracy which, together with an appropriate level of functionality, allows a more efficient use of available airspace to be realized. It also takes account of the fact that RNAV systems have developed over a 40-year period and as a result there were a large variety of differing implementations globally. Identifying navigation requirements rather than on the means of meeting the requirements will allow use of all RNAV/RNP systems meeting these requirements

irrespective of the means by which these are met.

Benefits of Performance-Based Navigation

2.11 PBN offers several advantages over the sensor-specific method of developing airspace and obstacle clearance criteria. These include:

a) Reduces 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, as part of missed approaches, etc. Adding new sensor specific procedures will compound this cost, and the rapid growth in available navigation systems would soon make system-specific routes and procedures unaffordable.
b) Avoids 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. The original Basic GNSS equipment is evolving due to the augmentations of ABAS, SBAS and GBAS. The use of GNSS/inertial integration has satisfactorily expanded globally to enable consistent regional PBN operations.
c) Allows more efficient use of airspace (route placement, fuel efficiency, noise abatement).
d) Clarifies the way in which RNAV systems are used.
e) Facilitates the operational approval process for operators by providing a limited set of navigation specifications intended for global use.
f) RNAV and RNP specifications facilitate more efficient design of airspace and procedures, which collectively result in improved safety, access, capacity, predictability, operational efficiency and environmental effects. Specifically, RNAV and RNP may:
    f1) Increase safety by using three-dimensional (3D) approach operations with course guidance to the runway, which reduce the risk of controlled flight into terrain.
    f2) Improve airport and airspace access in all weather conditions, and the ability to meet environmental and obstacle clearance constraints.
    f3) Enhance reliability and reduce delays by defining more precise terminal area procedures that feature parallel routes and environmentally optimized airspace corridors. Flight management systems (FMS) will then be poised to save operators time and money by managing climb, descent, and engine performance profiles more efficiently.
    f4) Improve efficiency and flexibility by increasing use of operator-preferred trajectories airspace-wide, at all altitudes. This will be particularly useful in maintaining schedule integrity when convective weather arises.
    f5) Reduce workload and improve productivity of air traffic controllers.

3. BACKGROUND

3.1 The continuing growth of aviation places increasing demands on airspace capacity and emphasizes the need for the optimum utilization of the available airspace.

3.2 Growth in scheduled and GA aircraft is expected to increase point-to-point and direct routings. The increasing cost of fuel and operations also presents a significant challenge to all segments of the aviation community. This anticipated growth and higher complexity of the air transportation system could result in increased flight

delays, schedule disruptions, choke points, inefficient flight operations, and passenger inconvenience, particularly when unpredictable weather and other factors constrain airport capacity. Without improvements in system efficiency and workforce productivity, the aviation community and cost of operations will continue to increase. Upgrades to the air transportation system must leverage current and evolving capabilities in the near term, while building the foundation to address the future needs of the aviation community stakeholders. These circumstances can be partially alleviated by efficiencies in airspace and procedures through the implementation of PBN concepts.

3.3 In setting out requirements for navigation applications on specific routes or within a specific airspace, it is necessary to define requirements in a clear and concise manner. This is to ensure that both flight crew and ATC are aware of the on-board RNAV/RNP system capabilities and to ensure that the performance of the RNAV/RNP system is appropriate for the specific airspace requirements.

3.4 The early use of RNAV systems arose in a manner similar to conventional ground-based routes and procedures. A specific RNAV system was identified and its performance was evaluated through a combination of analysis and flight testing. For domestic operations the initial systems used VOR and DME for their position estimation. For oceanic operations, inertial navigation systems (INS) were employed.

3.5 These 'new' systems were developed, evaluated and certified. Airspace and obstacle clearance criteria were developed on the basis of available equipment performance. Requirements and specifications were based upon available capabilities, and in some implementations, it was necessary to identify the individual models of equipment that could be operated within the airspace concerned.

3.6 Such prescriptive requirements result in delays to the introduction of new RNAV system capabilities and higher costs for maintaining appropriate certification. To avoid such prescriptive specifications of requirements, the PBN concept introduces an alternative method for defining equipage requirements by specification of the performance requirements. This is termed Performance Based Navigation (PBN).

4. AFI PBN Implementation Objectives and performance measurement

Plan Objectives

4.1 The AFI PBN Implementation plan aims at

a) ensuring that the implementation of the navigation item of the CNS/ATM system is based on clearly established operational requirements.

b) explaining in detail the contents of the Regional Air Navigation Plan, relating to potential navigation applications.

c) Promoting PBN implementation harmonization.

AFI PBN Implementation Objectives

4.2 The strategic objectives of the AFI Performance-Based Navigation (PBN) implementation are aligned with ICAO's Global Air Navigation Plan (GANP) and regional air navigation implementation plans.

4.3 The regional PBN implementation objectives include:

Enhance Aviation Safety

a) Improve navigation accuracy and predictability of flight paths.

b) Reduce the risk of controlled flight into terrain (CFIT) through advanced RNAV and RNP procedures.
c) Support safer operations in challenging terrain and adverse weather conditions.

Increase Airspace Capacity and Efficiency

a) Optimize airspace design and route structures.
b) Enable more direct and flexible flight paths.
c) Reduce congestion and improve traffic flow management.
d) Support the accommodation of growing air traffic demand.

Improve Airport Accessibility

a) Provide access to airports where conventional navigation aids are limited or unavailable.
b) Enable all-weather operations through advanced approach procedures (e.g., RNP APCH and RNP AR).
c) Reduce diversions and cancellations

Reduce Environmental Impact

a) Shorten flight distances and optimize vertical flight profiles.
b) Reduce fuel consumption and greenhouse gas emissions.
c) Lower aircraft noise exposure through optimized arrival and departure procedures.

Improve Cost Effectiveness

a) Reduce dependence on ground-based navigation infrastructure.
b) Lower operating costs for airlines through fuel savings and increased efficiency.
c) Enable more cost-effective air navigation service provision.

Promote Harmonization and Interoperability

a) Establish regionally harmonized RNAV and RNP specifications.
b) Ensure seamless operations across States and regions.
c) Support interoperability between aircraft, air navigation service providers, and airspace users.

Support Air Traffic Management (ATM) Modernization

a) Serve as a key enabler for ATM operational improvements and Aviation System Block Upgrades (ASBU).
b) Improve predictability, flexibility, and overall network performance.
c) Facilitate strategic regional and national air navigation planning.

PBN implementation performance measurement

4.4 PBN implementation performance is measured through key performance indicators (KPIs) derived from the ICAO Assembly resolution A37-11 and that were adopted for the AFI region during the endorsement by APIRG/17 of the first version of this plan in 2010.

4.5 PBN implementation KPIs for AFI include:

- KPI 1: Number of States with approved national PBN implementation plan
- KPI 2: Percent of area navigation routes which form part of the regional networks of ATS routes
- KPI 3: Number of FIRs with cross border Free Route Airspace implemented
- KPI 4: Percent of all international aerodromes' runway ends with PBN

approaches down to lateral navigation minima only (RNP APCH -LNAV)

- KPI 5: Percent of all international aerodromes' runways end with PBN approaches with barometric vertical guidance minima (APV -Baro VNAV)
- KPI 6: Percent of all international aerodromes' runway ends with PBN approaches with augmented GNSS vertical guidance minima (APV-SBAS)
- KPI 7: Percent of all international aerodromes' runway ends with PBN standard instrument departure integrating continuous climb operations (PBN SID/CCO)
- KPI 8: Percent of all international aerodromes' runway ends with PBN standard instrument arrival integrating continuous descent operations (PBN STAR/CDO)

5. Planning Principles

5.1 Planning for the implementation of PBN in the AFI Region shall be based on the following principles:

a) Pre- and post-implementation safety assessments will be conducted in accordance with ICAO provisions to ensure the application and maintenance of the established target levels of safety.
b) Continued availability and application of conventional air navigation procedures, to guarantee the operations by users that are not RNAV and/or RNP equipped and as a mitigation measure in case of unavailability of GNSS signal.
c) Implementation timelines at national level should be synchronized with regional targets and timelines.
d) The revision cycle of the regional PBN plan should align with the revision cycle of the GANP.

6. PBN Implementation requirements

6.1 Introduction of PBN should be consistent with the Global Air Navigation Plan. Moreover, PBN implementation shall be in full compliance with ICAO SARPs and PANS and support relevant ICAO Global Plan Initiatives.

6.2 The introduction of PBN should be supported by an appropriate navigation infrastructure consisting of an appropriate Global Navigation Satellite System (GNSS), self-contained navigation system (inertial navigation system) and conventional ground-based navigation aids in combination or standalone infrastructure.

Navigation Infrastructure requirements

6.3 In accordance with the AFI Air navigation plan volume II, Part III, all types of augmented GNSS are planned to be implemented in the AFI region in accordance with the AFI Regional GNSS strategy. However, the implementation of SBAS is under discussion between users and air navigation service providers in order to find a common understanding for a cost-effective implementation.

6.4 Four specific conditions have been agreed to be met prior to the implementation of SBAS in the AFI Region:
a) subjected to APIRG Conclusion 17/29: Need of an independent Cost Benefit Analysis;
b) full compliance with ICAO technical requirements;
c) case to case cost benefit agreement before implementation; and

d) civil aviation stakeholders, in particular governments, should guarantee that there will be no cross-subsidization of non-civil aviation users of SBAS. The user-pay principle is to be applied across all sectors.

6.5 GNSS supports both RNAV and RNP operations in the AFI region. GNSS augmentations include Aircraft-Based Augmentation System (ABAS), Satellite-Based Augmentation System (SBAS), Ground-Based Augmentation System (GBAS)

6.6 Other navigation infrastructure used in AFI includes INS, VOR/DME, DME/DME, and DME/DME/IRU. These navigation infrastructures may satisfy the requirements of RNAV navigation specifications, but not those of RNP.

6.7 INS may be used to support PBN en-route operations with RNAV 10 and RNAV 5 navigation specifications.

Requirements for en-route operations

6.8 Considering the traffic characteristics and CNS/ATM capability, en-route operations can be classified as Oceanic, Remote continental, and Continental en-route.

6.9 In principle, each classification of en-route operation (paragraph 5.1 above) should adopt, but not be limited to, a single RNAV or RNP navigation specification.

6.10 In areas where operational benefits can be achieved and appropriate CNS/ATM capability exists or can be provided for a more accurate navigation specification than that specified in this plan, States are encouraged to introduce the more accurate navigation specification based on coordination with stakeholders and affected States.

Requirements for Terminal operations

6.11 TMA operations have their own characteristics, considering the applicable separation minima between aircraft and between aircraft and obstacles. TMA operations also involve the diversity of aircraft with different missions (commercial, GA, military operations etc.), including low-performance aircraft flying in the lower airspace and conducting arrival and departure procedures on the same path or close to the paths of high-performance aircraft.

6.12 In this sense and as called for under APIRG/18 Conclusion 18/09, States shall develop their own national plans for the implementation of PBN in sovereign airspace. Such national plans should be based on the AFI Regional PBN Implementation Plan, seek the harmonization of the application of PBN and avoid the need for multiple operational approvals for intra- and interregional operations. Applicable aircraft separation criteria should also be considered.

Requirements for Instrument approaches

6.13 States are encouraged to introduce PBN approaches that provide Vertical Guidance to enhance safety.

6.14 Conventional approach procedures, conventional navigation aids (VOR, DME, NDB) and ILS should be maintained to support non-PBN capable aircraft and mitigate GNSS signal unavailability.

6.15 During early implementation of PBN, IFR Approaches based on PBN should be designed to accommodate a mixed-equipage (PBN and non-PBN) environment. ATC workload should be considered while developing approach procedures.

Requirements for ATM Operations

6.16 The Global ATM Operational Concept (Doc 9854) makes it necessary to adopt an airspace concept able to provide an operational scenario that includes route networks, minimum separation standards, assessment of obstacle clearance, and a CNS infrastructure that satisfies specific strategic objectives, including safety, access, capacity, efficiency, and environment.

6.17 In this regard, the following programmes should be developed:
a) traffic and cost benefit analyses
b) necessary updates on automation
c) operational simulations in different scenarios
d) ATC personnel training
e) Flight plan processing
f) Flight procedure design training to include PBN concepts and ARINC-424 coding standard
g) Enhanced electronic data and processes to ensure appropriate level of AIS data accuracy, integrity and timeliness
h) WGS-84 implementation in accordance with ICAO Annex 15
i) uniform classification of adjacent and regional airspaces, where practicable
j) RNAV/RNP applications for SIDs and STARs
k) Coordinated RNAV/RNP routes implementation
l) RNP approach with vertical guidance

7. STAKEHOLDERS

7.1 Coordination is critical with the aviation community through collaborative forums. This will assist aviation stakeholders in understanding operational goals, determining requirements, and considering future investment strategies. This, in turn, enables the aviation stakeholders to focus on addressing future efficiency and capacity needs while maintaining or improving the safety of flight operations by leveraging advances in navigation capabilities on the flight deck. RNAV and RNP have reached a sufficient level of maturity and definition to be included in key plans and strategies, such as this Plan.

7.2 The stakeholders who will benefit from the concepts in the Plan include airspace operators, air traffic service providers, regulators and standards organizations. As driven by business needs, airlines and operators can use the AFI Region PBN Plan to plan future equipage and capability investments. Similarly, air traffic service providers can determine requirements for future automation systems, and more smoothly modernize ground infrastructure. Finally, regulators and standards organizations can anticipate and develop the key enabling criteria needed for implementation.

7.3 The AFI Region PBN Implementation Plan also supports other CAA and government-wide planning processes, working on several fronts to address the needs of the aviation community. This Plan is a work in progress and will be amended through collaborative AFI Region States, industry efforts and consultations that establish a joint aviation community/government/industry strategy for implementing performance-based navigation. Critical initiative strategies are required to accommodate the expected growth and complexity over the next two decades. These strategies have five key features:

a) Expediting the development of performance-based navigation criteria and standards.
b) Introducing airspace and procedure improvements in the near term.
c) Providing benefits to operators who have invested in existing and upcoming capabilities.
d) Establishing target dates for the introduction of navigation mandates for selected procedures and airspace, with an understanding that any mandate must be rationalized on the basis of benefits and costs.
e) Defining new concepts and applications of performance-based navigation for the mid-term and Long term and building synergy and integration among other capabilities toward the realization of the AFI Region PBN goals.

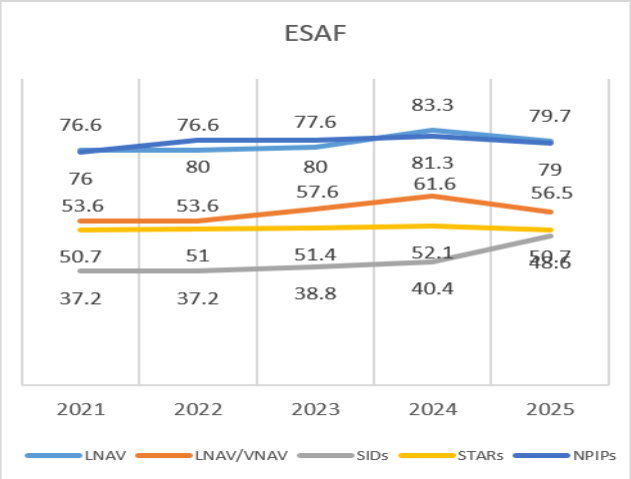
8. Safety Assessment & Monitoring Requirements

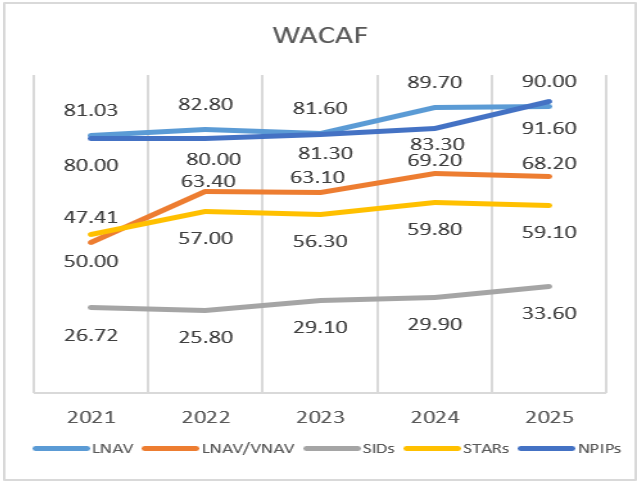
Need for a safety assessment

8.1 To ensure that the introduction of PBN applications within the AFI Region is undertaken in a safe manner, in accordance with relevant ICAO provisions, implementation shall only take place following conduct of a safety assessment by the implementing State or group of States that demonstrates that an acceptable level of safety will be met. This assessment may also need to demonstrate that residual levels of risk associated with specific PBN implementations are acceptable. Additionally, post-implementation periodic safety reviews should be undertaken by the implementing State or group of States, where required, in order to establish that operations continue to meet acceptable levels of safety.

9. Current status

PBN Implementation status up to 2025





2025	ESAF (in %)	WACAF (in %)	AFI (in %)
NPIP	91.6	91.6	91.6
En-Route area navigation (RNAV, RNP)	91.6	91.6	91.6
STARs	50.7	61.3	56
SIDs	48.6	33.6	41,1
CCO/CDO	18.4	18.4	18.4
RNP APCH	79.7	84.8	82.3
APV	56.5	70.8	63.65

AFI 25-Year Traffic forecast

9.1 Traffic forecasts have a special role to play in the planning and implementation processes; they represent the demand for future ATM. Global Air Navigation Plan (Doc 9750) requires that the Planning and Implementation Regional Groups (PIRGs) base their work on well-developed traffic density forecasts. Guidance on the preparation of traffic forecasts is provided in Manual on Air Traffic Forecasting (Doc 8991).

9.2 Forecast analysis presented in the table below was derived from the AFI Aviation infrastructure gap analysis conducted in 2024 based on a econometric model.

Year	2024	2030	2035	2050
Pax ATM	1.55m	1.92m	2.18m	2.95m
Cargo ATM	216k	296k	360k	590k
Total ATM	1.77m	2.22m	2.54m	3.54m
Average annual GR % (Pax ATM)		3.14%	2.50%	3.68%
Average annual GR % (Cargo ATM)		5.34%	4.73%	3.93%
Average annual GR % (Total ATM)		3.89%	3.35%	2.71%

Fleet readiness

9.3 Based on African commercial airline fleets currently in service:

- African commercial fleet: approximately 750-900 aircraft
- PBN-capable aircraft: approximately 700-850 aircraft
- Commercial fleet equipage rate: approximately 93-98%

9.4 Modern fleets operated by major African-based and non-based airlines in the AFI airspace and airports have near-100% PBN capability because RNAV and RNP functionality is a standard requirement for international IFR operations.

10. PBN strategies

10.1 This Plan provides a high-level strategy for the evolution of navigation capabilities to be implemented in three timeframes: near term (2027-2029), mid-term (2030-2032), and Long-term (2033 and beyond). The strategy rests upon two key navigation concepts; Area Navigation (RNAV) and Required Navigation Performance (RNP). It also encompasses instrument approaches, Standard Instrument Departure (SID) and Standard Terminal Arrival (STAR) operations, as well as en-route continental, oceanic and remote operations. The section on Long-term initiatives discusses integrated navigation, communication, surveillance and automation strategies.

10.2 The plan also incorporates the new navigation specifications and standards as laid down

in the new PBN Manual (5th edition of Doc. 9613). To avoid proliferation of new navigation standards, States and other aviation stakeholders in the AFI region should communicate any new operational requirements with ICAO HQ, so that it can be considered by the PBN SG.

10.3 The Strategy for implementation of GNSS in the AFI Region for the purpose of supporting PBN implementation will be developed as Appendix to this Plan. It is to be noted that the AFI GNSS strategy, while supporting implementation of the AFI Regional PBN Implementation Plan, may include other aspects related to the Global Air Navigation Plan beyond the current PBN requirements. The GNSS strategy may however, not defeat the purpose and intent of the Plan and shall be guided by the provisions of AASPG.

Near-term (2027-2029)

10.4 Initiatives in the near-term focus on investments by operators in current and new aircraft acquisitions; in satellite-based navigation and conventional navigation infrastructure, as well as AFI Region States investments. Key components include wide-scale RNAV and RNP implementation for en-route, terminal, and approach procedures.

10.5 The near-term strategy will also focus on expediting the implementation and proliferation of RNAV and RNP procedures. As demand for air travel continues at healthy levels, choke points will develop and delays at major airports will continue to climb. RNAV and RNP procedures will help alleviate those problems. Continued introduction of RNAV and RNP procedures will not only provide benefits and savings to operators but also encourage further equipage.

10.6 The near-term strategy will further strengthen the use of PBN in airspace design, with a particular emphasis on the implementation of free-route airspace, parallel route structures, and the expanded application of continuous descent operations (CDO) and continuous climb operations (CCO) to enhance efficiency and reduce controller workload.

10.7 ANSPs, as a matter of urgency, must adapt new flight plan procedures to accommodate PBN operations, particularly with respect to the correct completion of Fields 10 and 18.

10.8 Operators will need to plan to obtain operational approvals for the Navigation Specifications applicable during this period. They shall also review Regional PBN Implementation Plans from other ICAO Regions to determine whether additional operational approvals may be required to support international operations.

Oceanic and remote operations

10.9 As aircraft and system technologies evolve, a transition from legacy specifications such as RNAV 10 to more advanced specifications such as RNP 4 or RNP 2 is recommended, given their improved operational performance. Safety assessments shall be undertaken to evaluate reduced oceanic and remote longitudinal/lateral separation minima between aircraft approved for RNAV 10, RNP 4, RNP 2 and A-RNP operations.

10.10 In high-density oceanic/remote areas, AFI Region States should review the airspace concept and, where sufficient surveillance exists, transition from Oceanic Remote Operations to Continental En-Route Operations to enable RNAV 5.

Continental en-route operations

10.11 AFI Region States will review existing conventional and RNAV routes to transition to PBN RNAV 5, or where operationally required, RNAV 2/1.

10.12 The AFI Region will continue promoting the use of A-RNP, RNP 4 and RNP 2, and will encourage the application of RNP 0.3 for expanding helicopter operations to leverage their

enhanced accuracy.

Terminal operations

10.13 RNAV reduces conflict between traffic flows by consolidating flight tracks. RNAV 1 and RNP 1 SIDs and STARs improve safety, capacity, and flight efficiency, and also reduce communication errors.

10.14 States of the AFI region will continue to plan, develop and implement RNAV 1 SIDs and STARs at major airports and make associated changes in airspace design. In addition, AFI Region States will implement RNP 1 SIDs and STARs. RNAV 1 will be implemented where sufficient surveillance coverage exists, and RNP 1 where such coverage is not available.

10.15 The AFI region will also allow the use of RNP 0.3 for helicopters and RNAV 5 for the initial portion of arrival procedures outside 30 NM from the aerodrome reference point (ARP) or above minimum sector altitude (MSA).

10.16 Where operationally feasible, States should develop operational concepts and requirements for CDO and CCO based on FMS vertical guidance and apply time-of-arrival control based on RNAV and RNP procedures to reduce workload and increase fuel efficiency.

10.17 PBN SIDs and STARs will enable:
Reduction in controller-pilot communications
Reduction of route lengths to meet environmental and fuel efficiency requirements
Implementation of CCO and CDO trajectories to segregate arrival and departure flows
Seamless transition to/from en-route entry/exit points
Improved sequencing of departures and identification of automation requirements.

Approach operations

10.18 The application of RNP APCH is expected to be implemented at the maximum possible number of aerodromes. Conventional approaches should be maintained during the transition period for non-PBN-equipped aircraft.

10.19 States should promote APV operations (Baro-VNAV or augmented GNSS) to enhance safety and accessibility. Where no local altimeter setting exists and aircraft ≥ 5700 kg are not suitably equipped for APV, RNP APCH (LNAV only) should be promoted as an interim measure.

10.20 RNP AR APCH should be limited to runways where significant operational benefits can be achieved due to obstacles or terrain constraints.

10.21 States should also promote RNP 0.3 in arrival, initial, intermediate, and missed-approach segments, as well as for helicopter departures.

Summary table near-term strategy

Airspace	**Main navigation spécifications**	**Alternative Navpec**
En-route oceanic	RNAV 10, RNP 4	RNP 2
Remote continental	RNAV 10, RNP 4	RNP 2
En-route continental	RNAV 5, RNAV 2, RNAV 1	RNP 2, RNP 0.3

Terminal	RNAV 1 with surveillance	RNAV 5
	RNP 1 without surveillance	RNP 0.3
Approach	RNP APCH with baro-VNAV	RNP 0.3, with SBAS or GBAS
	RNP APCH (LNAV only)	
Note: *Where altimeter setting does not exist or aircraft of maximum certificated take-off mass of 5700kg or more, using an aerodrome are not suitably equipped for APV*		

Near-term implementation targets

a) RNP APCH (with Baro-VNAV) in 100% of instrument runways by 2029. Each instrument runway will have an associated RNP APCH (LNAV only)
b) RNAV 1 SID/STAR for 60% of international airports by 2028 and 70% by 2029 and priority given to airports with RNP Approach.
c) Review existing conventional and RNAV routes to transition to PBN RNAV 5 or where operationally required RNAV 2/1 by 2029.

Mid-term (2030-2032)

10.22 The mid-term period will be characterized by continued growth in air travel, increasing air traffic complexity, and evolving user expectations. While the hub-and-spoke model will remain predominant for major airline operations, demand for point-to-point services will expand, creating new markets for low-cost carriers, air taxi operations, on-demand services, and VLJs. Many airports will experience significant increases in unscheduled traffic, and destination airports supporting scheduled air carrier operations may face congestion and delays if capacity-enhancement measures do not keep pace with demand. As a result, additional airspace flexibility and more advanced PBN-enabled operational concepts will be required.

10.23 The mid-term will leverage increasing aircraft capabilities based on RNAV and RNP, with corresponding benefits such as fuel-efficient profiles, improved access, increased capacity, and reduced delays. These incentives—providing clear advantages over non-RNP operations—will accelerate equipage and expand the use of RNP procedures.

10.24 To optimize efficiency and capacity gains enabled by RNAV and RNP, AFI Region States and industry stakeholders will expand the use of data communications (e.g., CPDLC) and enhanced surveillance capabilities such as ADS-C and ADS-B. Data communications will support the issuance of complex clearances with reduced errors, while enhanced surveillance will enable optimized track spacing and longitudinal separation in non-radar airspace.

10.25 Initial capabilities for flights to receive and confirm 3D clearances and time-of-arrival control based on RNP will be demonstrated in the mid-term, supported by data link. With data link implemented, flights will begin transmitting 4D trajectories (latitude, longitude, altitude, time), enabling stakeholders to develop concepts that leverage this capability.

Oceanic and remote operations

10.26 AFI Region States will work with international air traffic service providers to promote the application of RNP 10, RNP 4, and RNP 2 in additional sub-regions of the oceanic environment.

10.27 States should progressively transition toward RNP-based operations as the primary navigation framework in oceanic and remote airspace, supported by improved surveillance and data link capabilities, enabling reduced separation minima and more

flexible routing.

Continental en-route operations

10.28 AFI Region States will collaborate with international air traffic service providers to promote the application of **RNP 10 and RNP 4** in additional sub-regions of the oceanic environment.

10.29 By the end of the mid-term, enhanced en-route automation will allow assignment of RNAV and RNP routes based on specific knowledge of aircraft RNP capabilities. Collaborative routing tools will enable priority assignment and dynamic rerouting based on aircraft capability.

10.30 Conflict prediction and resolution must improve as airspace usage increases. RNAV and RNP path repeatability will support this objective. Mid-term automation tools will facilitate **RNP offsets** and other dynamic tracks to maximize airspace capacity.

10.31 By the end of the mid-term, en-route automation will incorporate more accurate and frequent surveillance reports through ADS-B, enabling offset maneuvers and closer route spacing.

10.32 States should begin harmonizing en-route RNP requirements region-wide to support seamless cross-border operations and reduce variability in equipage expectations.

Terminal operations

10.33 During this period, **RNP 1 or RNAV 1 will become required capabilities** for arrivals and departures at major airports, based on traffic volume and operational complexity. This will ensure throughput, access, and reduced controller workload while maintaining safety.

10.34 With RNAV 1 as the predominant form of navigation in terminal areas by the end of the mid-term, AFI Region States may remove conventional terminal procedures that are no longer expected to be used.

10.35 The majority of IFR helicopters are already equipped with TSO-C145()/146() systems and moving-map displays, requiring autopilot and stability augmentation for IFR certification. The AFI Region will leverage this capability to implement **A-RNP and RNP 0.3**.

10.36 Terminal automation will be enhanced with tactical controller tools to manage complex merges. With data communications, these tools will apply time-of-arrival control, altitude and speed constraints, and waypoint sequencing to optimize throughput.

10.37 Departures will also be sequenced more efficiently through PBN-enabled flow management tools.

10.38 States should prioritize terminal airspace redesign using PBN principles, including increased use of RF legs, fixed-radius transitions, and time-based metering to improve predictability and reduce tactical interventions.

Approach operations

10.39 Mid-term implementation priorities for instrument approaches will continue to focus on RNP APCH (APV) and RNP AR APCH, with full implementation expected by the end of the term.

10.40 Where no local altimeter setting exists and aircraft ≥ 5700 kg are not suitably equipped

for APV, RNP APCH (LNAV only) should continue to be promoted.

10.41 The introduction of GBAS and SBAS landing capabilities is expected to ensure a smooth transition toward high-performance approach and landing operations.

10.42 Proposed enhancement: States should begin planning for region-wide adoption of SBAS-enabled APV approaches as part of the AFI GNSS Strategy, ensuring interoperability with global augmentation systems.

Summary table mid-term strategy

Airspace	Main navigation specification	Alternative Navpec
En-route oceanic	RNAV 10, RNP 4, rnp2	
Remote continental	RNAV 10, RNP 4, RNP 2	
En-route continental	RNAV 5, RNAV 2, RNAV 1, RNP 2	RNP 2, RNP 0.3
Terminal	RNAV 1 with surveillance	RNAV 5
	RNP 1 without surveillance	RNP 0.3
Approach	RNP APCH with baro-VNAV	RNP 0.3, with SBAS or GBAS Expand RNP AR
	RNP APCH (LNAV only)	
Note: *Where altimeter setting does not exist or aircraft of maximum certificated take-off mass of 5700kg or more, using an aerodrome are not suitably equipped for APV*		

Mid-term implementation targets

a) RNAV 1 SID/STAR for 80% of international airports by 2031 and 90% by 2032, with priority given to airports with RNP Approach.
b) b) Review existing conventional and RNAV routes to transition to RNP 4 and RNAV 5, or where operationally required RNAV 2/1, by 2032.
c) By 2032, all major international airports should incorporate time-based metering and initial 4D trajectory exchange capabilities to support advanced sequencing and flow management.

Long-term (2033 and beyond)

10.43 The long-term operating environment will be characterized by sustained growth in air travel and increased air traffic complexity. No single solution—or simple combination of solutions—will be sufficient to address the inefficiencies, delays, and congestion expected from rising demand. AFI Region States and key stakeholders will therefore require an operational concept that fully exploits advanced aircraft capabilities and integrates navigation, communication, surveillance, and automation technologies.

10.44 Airspace operations in the long term will make maximum use of advanced flight-deck automation integrating CNS capabilities. RNP, RCP, and RSP standards will define these operations. Separation assurance will remain the principal task of air traffic management, supported by a combination of aircraft-based and ground-based tools. Tools for conflict detection and resolution, and for flow management, will be significantly enhanced to manage increasing traffic levels and complexity efficiently and strategically.

10.45 Strategic problem detection and resolution will rely on improved knowledge of aircraft position and intent, coupled with automated ground-based resolution tools. Pilot and controller workload will be reduced through substantial decreases in voice

communication and expanded use of data communications for clearances. Automated confirmation of flight intent from the flight deck to ground automation will further reduce workload.

10.46 With the necessary aircraft capabilities, procedures, and training in place, selected airborne separation assurance tasks may be delegated to pilots and flight-deck systems, particularly in IMC, where an aircraft may be instructed to follow a leading aircraft at a defined spacing.

10.47 Performance-based operations will exploit aircraft capabilities for enhanced electronic visual acquisition in low-visibility conditions, potentially increasing runway capacity and reducing runway occupancy times. Improved wake prediction and notification technologies may also support increased runway throughput by reducing reliance on conservative wake-separation buffers.

10.48 System-wide information exchange will enable real-time sharing of NAS constraints, airport and airspace capacity, and aircraft performance. Data communications between ATC automation and aircraft will become widespread—possibly mandated in the busiest airspace and airports. Direct exchange of data between ATC automation and the aircraft FMS will permit better strategic and tactical management of flight operations.

10.49 Aircraft will downlink position and intent data, including speed, weight, climb/descent rates, and turbulence reports. ATC automation will uplink clearances and information such as weather, metering, choke points, and airspace restrictions.

10.50 To ensure predictability and integrity of aircraft flight paths, RNP will be mandated in busy en-route and terminal airspace, while RNAV will be required in all other airspaces except oceanic. Standardized FMS functionalities and consistent crew operation will be essential to the success of this long-term strategy.

10.51 The most capable aircraft will meet requirements for low RNP values (RNP 0.3 or lower en-route), benefiting from improved access, shortest routes in IMC or convective weather, and the ability to transit constrained airspace with fewer delays.

10.52 Enhanced ground-based automation and real-time flight intent will make time-based metering a key feature of future flow-management initiatives, improving sequencing and spacing of flights.

10.53 Uniform use of RNP for arrivals and departures at busy airports will optimize traffic management. Controllers will maintain sequencing and separation but will intervene less frequently, focusing on monitoring flows and addressing issues identified by conflict-prediction algorithms.

10.54 Improved meteorological information will support better flight-path conformance, including time-of-arrival control at key merge points. RNP will also improve management of terminal arrivals and departures with seamless routing from en-route segments to runway thresholds.

10.55 Enhanced surface-movement tools will synchronize aircraft movement on the ground, improving coordination across active runways and optimizing taxi operations.

Summary of long-term key strategies (2032 and beyond)

The long-term strategy employs an integrated set of solutions designed to fully leverage advanced aircraft capabilities, enhanced automation, and system-wide information exchange.

The following consolidated bullets reflect both the original NPIP content and your proposed enhancements, harmonized into a single ICAO-style structure:

a) RNP with additional requirements (3D and 4D time-of-arrival control), forming the foundation for region-wide Trajectory-based operations (TBO).
b) Airspace operations will take advantage of advanced aircraft capabilities, including data communications, integrated displays, and FMS, with interoperability ensured across global CNS/ATM modernization initiatives (GBAS/SBAS, harmonized RNP/RCP/RSP standards).
c) Aircraft position and intent information will be directed to automated ground-based ATM systems, enabling strategic and tactical flight-deck-based separation assurance in selected situations.
d) Strategic and tactical flow management will improve through integrated airborne and ground information exchange, supported by full digital data-exchange environments (SWIM-based) for real-time collaborative decision-making.
e) Ground-based systems will maintain real-time knowledge of aircraft intent through accurate trajectory information available via data link, enabling advanced conflict-prediction and dynamic airspace-configuration tools.
f) Real-time sharing of National Airspace System (NAS) flight demand and other information will be achieved via ground-based and air-ground communication between air traffic management and operations planning/dispatch.
g) Overall system responsiveness will be achieved through flexible routing and well-informed, distributed decision-making, including dynamic airspace management and operator-preferred routing.
h) The system will rapidly adapt to changing meteorological and airspace conditions, supported by improved meteorological data and enhanced automation.
i) Airspace operations will leverage advanced navigation capabilities such as fixed-radius transitions, RF legs, and RNP offsets, with uniform RNP requirements mandated for high-density terminal and en-route airspace to ensure predictability and reduce tactical interventions.
j) Increased use of operator-preferred routing and dynamic airspace will support efficiency and flexibility.
k) Collaboration between service providers and operators will increase, enabling shared situational awareness and coordinated decision-making.
l) Operations at the busiest airports will be optimized through integrated capabilities for pre-departure planning, ground-based automation, and surface-movement management, including time-based metering and advanced sequencing tools.
m) RNP-based arrival and departure structures will provide greater predictability and seamless transitions between en-route and terminal segments.
n) Ground-based tactical merging capabilities in terminal airspace will be enhanced through automation and real-time trajectory management.
o) Integrated surface-movement optimization will synchronize aircraft movement on the ground, supported by improved meteorological and aircraft-intent information shared via data link, ensuring full alignment with future TBO and advanced surface-management concepts.

11. AFI PBN Implementation Targets (2027-2032)

Implementation Items	Area of applicability	Required navigation infrastructure	Baseline	Regional targets					
			2026	2027	2028	2029	2030	2031	2032
NPIP	Regulation	N/A	91.6%	95%	100 %	100 %	100 %	100 %	100 %
En-Route area navigation (RNAV10, RNAV5, RNP4)	En-route Oceanic and continental remote operations	GNSS DME/DME IRU	91.6%	95%	100 %	100 %	100 %	100 %	100 %
PBN STAR RNAV 1	Terminal Arrival Operations for all runway ends at all international aerodromes	GNSS DME IRU	56%	60%	65%	75%	80%	80%	90%
PBN SID RNAV 1	Terminal Departure Operations for all runway ends at all international aerodromes	GNSS DME IRU	41%	45%	55%	65%	70%	80%	90%
CDO	Terminal Arrival Operations for all runway ends at all international aerodromes	GNSS DME IRU	18.4%	30%	40%	50%	60%	75%	90%
CCO	Terminal Arrival Operations for all runway ends at all internationa	GNSS DME IRU	18.4%	30%	40%	50%	60%	75%	90%

	l aerodromes								
RNP APCH - LNAV	Approach procedures for all runway ends at all internationa l aerodromes	GNSS	82.3%	85%	90%	100 %	100 %	100 %	100 %
RNP APCH - LNAV/VNAV	Approach procedures for all runway ends at all internationa l aerodromes	GNSS	64%	80%	90%	100 %	100 %	100 %	100 %
RNP APCH - LPV	Approach procedures for all runway ends at all internationa l aerodromes	GNSS	TBC						

12. KEY RESEARCH AREAS

12.1 The aviation community must address several key research issues to apply these strategies effectively. These issues fall into several categories:

Navigation

a) To what extent can lower RNP values be achieved and how can these be leveraged for increased flight efficiency and access benefits?

b) How can RNAV5 specification be extended to remote continental airspace considering global availability of GNSS signal?

c) Under what circumstances RNAV should be mandated for arriving/departing satellite airports to enable conflict-free flows and optimal throughput in busy terminal areas?

Flight Deck Automation

a) What FMS capabilities are required to enable future concepts and applications?

b) How can performance-based communication and surveillance be leveraged in the flight deck to enable Long-term strategies such as real-time exchange of flight deck data?

Automation

a) To what extent can lateral or longitudinal separation assurance be fully automated, in particular on final approach during parallel operations?

b) To what extent can surface movement be automated, and what are the cost- benefit trade-offs associated with different levels of automation?

c) To what extent can conflict detection and resolution be automated for terminal ATC operations?

Procedures

a) How can time of arrival control be applied effectively to maximize capacity of arrival or departure operations, in particular during challenging wind conditions?

b) In what situations is delegation of separation to the flight crews appropriate?

c) What level of onboard functionality is required for flight crews to accept separation responsibility within a manageable workload level?

Airspace

a) What separation standards and procedures are needed to enable smoother transition between en route and terminal operations?

b) How can fuel-efficient procedures such as CDAs be accomplished in busy airspace?

Policy

a) How is information security ensured as information exchange increases?

b) What are the policy and procedure implications for increased use of collaborative decision-making processes between the service provider and the operator?

APPENDICES

APPENDIX A- Template of National PBN Implementation Plan (NPIP)
Link: AFI PBN

APPENDIX B – Useful links
Documentation of the African Flight Procedure Programme: AFPP - Documentation
Global PBN webpage: GLOBAL PBN