PBN IMPLEMENTATION PROJECT

TMA AND APPROACH OPERATIONS

SHORT TERM

SAM REGION

Introduction

The purpose of this document is to detail the activities of the Short-Term Performance-Based Navigation Implementation Project for TMA and Approach Operations in the South American Region, through the application of RNAV-1/RNP APCH/RNP AR. It also specifies the results that shall be obtained in each of the activities of the plan.

States shall develop their own PBN implementation projects for TMA and approach operations, based on the Model PBN Project for TMA and Approach Operations. Project RLA/06/901 will support SAM States through the development of guidance material and Project RLA/99/901 will provide support in the areas of fleet navigation capacity and aircraft and operator approval documentation.

The Short-Term Action Plan for TMA Operations is shown in **Attachment 1**, and **Attachment 2** presents the Short-Term Action Plan for Approaches**.**

PBN Implementation– TMA and Approach Operations - Short-Term

1. Airspace Concept

The Airspace Concept provides the scheme of operations within an airspace and is developed to meet explicit strategic objectives, such as saf ety improvement, increase in air traffic, environmental impact mitigation capacity, etc. T he airspace concept shall include details about the practical organization of the airspace, based on user characteristics and on the CNS/ATM infrastructure that is available or to be implemented. Further details about the Airspace Concept can be found in the PBN Manual, Volume I, Chapter 2.

In the case of TMA operations, the airspace concept shall cover the implementation of SIDs and STARs that avoid arrival and departure conflicts and favour aircraft flight at optimum profiles, with the application of continuous descent approaches – CDA.

STARs must, insofar as possible, be linked to IFR approach procedures based on RNP APCH w/Baro-VNAV or, if there are clearly established operational benefits to be obtained, be based on RNP AR.

1.1. Establish and prioritize strategic objectives (safety, efficiency, the environment, etc.).

RNAV-1, RNP APCH and, in some cases, RNP AR, implementation in the SAM Region will address mainly the following Strategic Objectives:

a) Safety – RNAV-1 application in TMAs will allow for a separation between arrival and departure paths, thus avoiding conflicts among aircraft. The use of RNP APCH with APV/Baro-VNAV and/or RNP AR will reduce the risk of collision flight into terrain (CFIT).

b) Capacity – The use of RNAV-1 SIDs/STARs will make it possible to reduce the utilization of radar vectors and, as a result, will reduce airspace complexity and controller workload by improving the ATC capacity of the sectors and permitting a larger number of flight.

c) Cost-effectiveness – PBN implementation will enable a larger number of aircraft to fly their optimum flight profiles, primarily through CDA use, offering users a better cost-effectiveness ratio.

d) Efficiency – RNAV-1 application will improve operational efficiency, inasmuch as the establishment of well-defined arrival and departure points will make it possible to restructure the network of TMA incoming/outgoing routes, thereby reducing flying time. S TAR–approach interaction will create the necessary conditions for establishing optimum arrival paths from the en-route to the final approach phase.

e) Environmental Protection – Increased efficiency and fuel savings will reduce noxious gas emissions into the atmosphere. In addition, CDA application will help cut down on aircraft noise.

f) Access and Equity – Implementation of the RNP APCH approach procedure and/or RNP AR will permit access to aerodromes under adverse weather conditions. PBN implementation shall not impede the flight of unapproved aircraft in a given airspace unless absolutely necessary because of air traffic density. It is expected that access and equity will be provided for in this way.

g) Foreseeability – RNAV-1 navigation precision will make flight paths more foreseeable, facilitating aircraft separation and reducing the need for air traffic controller intervention in the case of possible aircraft diversions from the flight paths. STAR-approach integration will also enhance foreseeability.

h) Global Interoperability – RNAV and RNP application, as provided for in the PBN Manual, will guarantee global interoperability through the application of standard navigation specifications, thereby avoiding the need to obtain various aircraft and operator approvals in order to fly in airspaces that use the same navigation application.

i) ATM Community Participation – The success of PBN implementation will depend upon the effective participation of the ATM community, with a view towards guaranteeing that the operational requirements of both airspace users and service providers are met.

1.2. Collect air traffic data in order to understand air traffic flows.

Analysis of the main TMA arrival and departure flows is essential for prioritizing city pairs with a larger number of flights. The Excel spreadsheets used for the analysis of PBN en-route implementation can be obtained at the SAM Office website and used for analyzing the flows at the main TMAs in the SAM Region. It is important to note, however, that the air traffic sample used was the same as the one used for the CARSAMMA data collected between 13 and 28 January for RVSM safety assessment. This means that only flights between FL 290 and FL 410 were considered.

1.3. Analyze fleet navigation capacity.

The work to be carried out by ICAO and Project RLA/99/901, as mentioned in the PBN en-route Implementation Project, will cover PBN navigation specifications for the TMA.

There is a complete list of aircraft and avionics prepared by the FAA can be used to analyze fleet capacity for RNAV-1 and RNAV-2 specifications. This list can be found at: http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afs/afs400/afs470/media/AC90-100compliance.xls.

The appropriate GNSS-based navigation approach capacity shall be assessed for the RNP APCH specification.

For the RNP AR specification, the aircraft navigation capacity shall be assessed on the basis of clearly-established operational requirements, bearing in mind the flexibility of precision values in several approach segments that are normally between 0.3 and 0.1, as w ell as in accordance with the required functionalities for a specific airport, such as "radius to fix (RF) legs."

The Excel templates used in the flow analyses for PBN en-route implementation may be obtained at the SAM Office website and used for analyzing the capacity of the fleet flying in the main SAM TMAs. Complete information is available at the SAM Office website.

1.4. Analyze the ground-based communication, navigation (VOR, DME) and surveillance infrastructure for navigation specifications, in order to comply with the Navigation Specification and the navigation reversal mode.

The ground-based communication, navigation (VOR, DME) and surveillance infrastructure is of fundamental importance for RNAV-1, both to permit the application of this navigation specification and to guarantee the navigation reversal mode in case of loss of the GPS signal. Inasmuch as this is an RNAV specification that does not require on board performance monitoring and alerting systems, ATS surveillance can mitigate the requirement for greater route spacing in order to overcome possible navigation system failures undetected by the flight crew.

The DME/DME navigation infrastructure will need to be assessed to verify whether the RNAV-1 navigation specification can be applied or whether it will be necessary to take one of the following measures:

a) Use the inertial navigation system to cover possible gaps in DME coverage. In this case, it will be necessary to determine whether the aircraft fleet operating in the TMA is equipped with the inertial system.

b) Assess the cost-benefit of implementing DME stations, in order to provide adequate coverage for DME/DME operations. This option will depend upon the percentage of aircraft that have DME/DME navigation alone and the State back-up policy in case of loss of the GNSS signal.

c) Apply only GNSS to meet RNAV-1 requirements, considering the aspects cited in a) and b) above.

ATS surveillance is not required for RNP APCH approaches or RNP AR, but may be required if airspace complexity or the combined operation of approved and unapproved aircraft make it necessary.

1.5. Optimize airspace structure by implementing new SIDs and STARs and design instrument approach procedures (RNP APCH/APV Baro-VNAV or RNP AR) based on the strategic objectives of the airspace concept, considering airspace modelling, ATC simulations (in fast time and/or real time), live trials, etc.

Airspace structure will be optimized through the implementation of RNAV-1 SIDs and STARs that will provide well-defined TMA paths and arrival points, thereby avoiding air traffic conflicts and allowing users to fly their optimum flight profiles. For more complex airspaces, however, States should consider using the following tools:

a) Airspace modelling;

b) Fast-Time Simulation (FTS);

c) Real-Time Simulation (RTS);

d) live ATC trials

Use of these tools is not necessary for simple airspace changes like the implementation of a SID and/or a STAR. But for major changes in more complex airspaces, however, use of these tools can provide essential information for guaranteeing efficiency and safety. More information about these tools can be found in the PBN Manual, Volume I, part B, item 4.3.2.

The implementation of SIDs and STARs in an optimum configuration requires the spacing of TMA departure and/or arrival paths. In this respect, the State shall have trained personnel to make the necessary assessment or perform a comparative analysis, for example with other airspaces. Studies are being conducted by the Separation and Airspace Safety Panel (SASP) for the application of the aircraft separation protection areas for IFR procedures established in Doc. 8168. Approval of the proposal will facilitate appropriate TMA aircraft separation. It is important to highlight that some countries are already applying this aircraft separation methodology.

2. Prepare a performance measurement plan, including gas emissions, safety, efficiency, etc.

Performance-Based Air Traffic Management is organized based on the principle that ATM community expectations can best be met by quantifying such needs. Therefore, a series of performance objectives, goals and indicators shall be established that will make it possible to objectively justify projects for the improvement of air traffic management performance. **Attachment 6 to Appendix B** contains further details about Performance-Based ATM.

The estimated future performance of the ATM system will be of fundamental importance in guiding the planning of the improvements to be implemented. Research and development initiatives must be defined to foster the risk analysis of the following situations:

a) the consequences of keeping the current ATM status unchanged. In this case, the ATM system would be subject to changes outside the sphere of operation of the service provider, such as: air traffic growth, changes in fleet composition, etc.; and

b) the consequences of making changes that do not provide the expected improvement in system performance, therefore ceasing to meet the established performance goals.

The Key Performance Areas (KPA) involved in the case of simple implementations, like SIDs or STARs, are safety, efficiency and environmental protection. Safety can be measured qualitatively through a safety case. This possibility will be described more fully in the specific section on safety assessment. Efficiency and environmental protection are intrinsically related, inasmuch as an increase in efficiency normally results in a reduction in fuel consumption, thereby decreasing the amount of gas emissions released into the atmosphere. SID/STAR implementation must at least measure the expected saving in flying time and fuel consumption. It is important to stress that the implementation of a SID/STAR will not always result in a reduction in flying time, inasmuch as the purpose for its implementation could be, for example, to simplify TMA incoming and outgoing flows, thus reducing air traffic controllers and, consequently, increasing ATC capacity. In this case, a longer route could also create the necessary conditions for the use of continuous descent approach (CDA) procedures.

In more complex implementations, such as complete TMA restructuring, performance assessment will normally depend upon the use of specific tools like fast-time simulation (FTS), because a full and integrated assessment of the system will be needed that would be difficult to perform manually.

PBN implementation must consider at least the savings in flying time and fuel consumption, as well as the reduction of noxious gas emissions into the atmosphere. IATA has prepared a fuel saving calculation template that can be used to measure system performance. This template can be obtained at the SAM Office website.

3. Safety Assessment

3.1. Determine the methodology to be used for assessing airspace safety and route spacing, depending upon the navigation specification, considering airspace modelling, ATC (fast and real time) simulations, live ATC trials, etc.

The methodology for assessing airspace safety may be either quantitative or qualitative. An RSVM implementation and post-implementation safety assessment offers an example of a quantitative method. These quantitative methods are based on the Collision Risk Model (CRM) and require the use of experts in specific areas, such as statistics and mathematics. However, this safety assessment would be justified only in the case of major airspace changes, such as the complete restructuring of the most complex TMAs. Examples of collision risk models used in safety assessments can be found in DOC 9689 – Manual on the Planning Methodology for Determining Separation Minima.

A qualitative assessment based on operational judgment could be applied in the case of a SID and/or STAR implementation or of PBN application in less complex TMAs. This type of assessment must be documented through an SMS methodology-based safety case. ICAO Doc. 9859, Safety Management Manual, and Doc. CAP 760 (Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases) of the United Kingdom offer an example of systematic use of this methodology. The latter document can be found at: http://www.caa.co.uk/docs/33/CAP760.PDF.

The qualitative analysis mentioned in the previous paragraph can be used to conduct the safety assessment for the application of RNP APCH and RNP AR procedures, considering that the implementation of new approach procedures does not normally involve significant airspace changes.

3.2. Develop a data collection programme for airspace safety assessment.

In order to develop the data collection programme, the State must decide upon the safety assessment strategy, considering whether the assessment will be quantitative or qualitative. In the case of the complete restructuring of complex TMAs, the State shall collect the necessary data for the safety assessment and/or determination of the route spacing to be applied in the SAM Region.

3.3. Conduct the preliminary airspace safety assessment.

The preliminary airspace safety assessment shall be completed before the implementation date, in order to guarantee the necessary conditions for the start of the pre-operational phase, normally for a one-year period.

3.4. Prepare the final airspace safety assessment.

The final airspace safety assessment is usually performed one year after the implementation date, which will guarantee the start of the operational phase.

4. Establish a collaborative decision-making process (CDM)

The purpose of the collaborative decision-making process is to guarantee that all actors involved in the implementation process participate in the different phases of the project, thereby ensuring transparency and compliance with the interests of all users and service providers.

4.1. Coordinate planning and implementation needs with air navigation service providers, airports, regulators, users, aircraft operators and military authorities. States should guarantee the participation of the main stakeholders in PBN planning and implementation in TMAs. Representatives of the airlines, general aviation, military aviation, air navigation service providers, regulators, etc. should participate from the very beginning of the planning process.

4.2. Establish the implementation date.

The implementation date is one of the main aspects to be considered in the project, bearing in mind that it will eventually need to be adjusted to the interests of the various stakeholders.

4.3. Establish the documentation format at the State PBN website.

The Internet is an important mechanism for disseminating PBN documentation to all implementation stakeholders. The States should create an appropriate website to facilitate the dissemination of PBN activities.

4.4. Report advances in planning and implementation to the corresponding Regional Office.

States must report planning and implementation developments to the South American Regional Office in order to guarantee the necessary harmonization among SAM States and to encourage the exchange of experiences and lessons learned.

5. Automated ATC Systems

5.1. Assess PBN implementation in automated ATC systems, taking into account amendment 1 to the PANS/ATM (FPLSG).

The introduction of changes to the automated ATC system based on PBN implementation is intrinsically related to the need for the air traffic controller to differentiate between aircraft that are equipped for operations based on RNAV and RNP navigation specifications, and those that are not. That differentiation is particularly important in non-exclusionary operating environments that permit flights of aircraft both approved and not approved for a given air navigation specification. Changes in automated systems may vary in complexity, from the insertion of letters or codes in the flight progress strips and/or in the radar screen targets, to a complete change involving differentiated colours or an analysis before a flight plan is entered into the flight plan processing system, in order to guarantee that only approved aircraft can fill in an RNAV route or RNP procedure in the FPL.

Modifications in automated ATC systems must take into account amendment 1 to the PANS/ATM. This amendment, resulting from the work of the ICAO Air Navigation Commission Study Group on Flight Plans, was approved at the 177th Session of said Commission and will enter into effect on 15 November 2012. States were informed of the approval of amendment 1 to the PANS/ATM through ICAO State Letter AN 13/2.1-08/50, of 25 June 2008. The amendment can be obtained at the SAM Office website.

This amendment involves significant changes in the insertion of alphanumeric codes relating to RNAV and RNP approval that are of key importance for PBN implementation. Considering current flight plan limitations, most of these codes will be inserted in field 18. In summary, the changes concerning PBN are as follows:

a) The name of FPL field 10 is changed to “Equipment and Capabilities”;

b) The letter “R” in field 10 will now mean “PBN Approval”. Navigation specifications for which the aircraft and operator are approved must be inserted in FPL field 18, using the following codes:

- RNAV SPECIFICATIONS

- ✓ A1 - RNAV 10 (RNP 10)
- ✓ B1 - RNAV 5 all permitted sensors
- ✓ B2 - RNAV 5 GNSS
- ✓ B3 - RNAV 5 DME/DME
- ✓ B4 - RNAV 5 VOR/DME
- ✓ B5 - RNAV 5 INS or IRS
- ✓ B6 - RNAV 5 LORANC
- ✓ C1 - RNAV 2 all permitted sensors
- ✓ C2 - RNAV 2 GNSS
- ✓ C3 - RNAV 2 DME/DME
- ✓ C4 - RNAV 2 DME/DME/IRU
- ✓ D1 - RNAV 1 all permitted sensors
- ✓ D2 - RNAV 1 GNSS
- ✓ D3 - RNAV 1 DME/DME
- ✓ D4 - RNAV 1 DME/DME/IRU

- RNP SPECIFICATIONS

- ✓ L1 - RNP 4
- ✓ O1 - Basic RNP 1 all permitted sensors
- ✓ O2 - Basic RNP 1 GNSS
- ✓ O3 - Basic RNP 1 DME/DME
- ✓ O4 - Basic RNP 1 DME/DME/IRU
- ✓ S1 - RNP APCH
- ✓ S2 - RNP APCH with BARO-VNAV
- ✓ T1 - RNP AR APCH with RF (special authorization required)
- ✓ T2 - RNP AR APCH without RF (special authorization required)

c) The letter “G” continues to be used in field 10 to mean “Equipped with GNSS.” The corresponding augmentations must be entered in field 18, using the NAV/ code.

5.2. Make the necessary changes in the automated ATC systems.

The introduction of changes in automated ATC systems is usually a complicated, expensive and slow process for most States. Consequently, only changes that are deemed essential for safety and efficiency must be implemented. The following main scenarios would be possible in the case of PBN implementation in the TMA:

a) Combination of conventional SIDs/STARs and RNAV-1 – In this scenario, use of the automated ATC system would enable the controller to assign the appropriate procedure, depending upon aircraft capacity, duly in advance. The system will also foster the necessary conditions for verifying whether the aircraft is effectively approved to fly RNAV-1 SIDs/STARs. This verification could be made by comparing air traffic samples with a database of approved aircraft. If aircraft separation depends upon RNAV approval, a greater degree of ATC automation would be needed to indicate to the air traffic controller which aircraft have RNAV approval and which do not.

b) RNAV-1 SIDs and STARs and routing of unapproved aircraft using radar vectoring – Like in the previous scenario, the air traffic controller must know the aircraft RNAV approval status in advance in order to provide radar vectoring to unequipped aircraft.

c) Exclusionary RNAV airspaces (with or without special exceptions –State aircraft, humanitarian flights, first delivery, etc.) – In this scenario, route spacing will depend upon aircraft RNAV approval, and ATC automation will be essential to indicate aircraft approval status to the air traffic controller.

6. Aircraft and Operator Approval

6.1. Analyze aircraft and operator approval requirements (pilots, dispatchers and maintenance personnel) as established in the PBN Manual, and prepare the necessary documentation.

The PBN Manual, Volume II, Part B, Chapter 3 stipulates the general requirements for aircraft and operator approval for RNAV-1. EUROCONTROL and FAA documents on this topic are:

a) EUROCONTROL – TGL-10 - Airworthiness and Operational Approval for Precision RNAV Operations in Designated European Airspace

b) FAA – AC 90-100A – U.S. Terminal and En Route Area Navigation (RNAV) Operations.

The PBN Manual, Volume II, Part C, Chapter 5 contains the general requirements for aircraft and operator RNP APCH approval. EUROCONTROL and FAA documents on this topic are:

a) EASA –AMC-20 Series – Airworthiness approval and operational criteria for RNP Approach (RNP APCH) operations (under development).

b) FAA AC 20-138A - Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors.

c) FAA AC 20-130A - Airworthiness Approval of Global Navigation Satellite System (GNSS) Equipment

d) TSO C115b - Airborne Area Navigation Equipment Using Multi-Sensor Inputs

The PBN Manual, Volume II, Part C, Chapter 6 sets forth the general requirements for aircraft and operator RNP AR approval. The FAA document on this topic is:

a) FAA AC 90-101 - Guidance for RNP Procedures with Special Aircraft and Aircrew Authorization Required

6.2. Publish national regulations for implementing RNP APCH and RNP AR for navigation specification RNAV-1.

Navigation specifications contained in the PBN Manual identify the requirements for operational and airworthiness approval for the use of RNAV or RNP applications. Provision must be made in national operational regulations for verifying compliance with these requirements, which may require specific operational approval.

Project RLA/99/901 is preparing the Latin American (LAR) Regulations, whose purpose is to harmonize the operational and airworthiness approval process in Latin America. Regional documentation provided through the LARs is expected to be available shortly. Coordination between this project and Project RLA 06/901 is fundamental for avoiding a duplication of efforts and facilitating the work of the States involved. Project RLA 99/901 could at least offer guidance material for adoption and publication by the States.

One option already in use by CAR/SAM States is to adopt documents of other States and International Organizations, as in the case of Interim Guidance 91 (RVSM) and Order 8400-12 (RNP-10).

6.3. Start the aircraft and operator approval process.

In order to meet the established implementation deadline, States must start the aircraft and operator approval process, and Project RLA 06/901 shall verify whether all States effectively initiate this process, in order to harmonize the activities of the States involved.

6.4. Establish a database of approved aircraft and operators and keep it up-to-date.

States shall establish a strategy for creating a database of aircraft and operators approved for RNP APCH and RNP AR RNAV-1 operations, similar to that created for RVSM implementation, taking into account the following objectives:

a) When TMAs are to be completely restructured, and mainly in the case of an exclusionary airspace, it will be necessary to rely on a minimum percentage of operations approved for RNAV-1. In this connection, the creation of the database is essential for analyzing the minimum percentage.

b) Verify whether the aircraft flying RNAV routes are effectively approved for RNAV-1, RNP APCH and RNP AR operations.

6.5. Verify operations using a continuous monitoring programme (aircraft and procedures).

Safety must be ensured through a continuous operational verification programme regulated by States.

7. Standards and Procedures

7.1. Assess the regulations for GNSS use and, where appropriate, proceed to their publication.

GNSS application is of key importance for all PBN navigation specifications, considering that some aircraft only have this equipment to meet the established performance requirements and that there are some specifications that only GNSS can meet.

The key issue is the State policy with regard to GNSS application as a means of navigation. In order for the system to be used fully, States must regulate its use as a primary means of navigation, even if this would require imposing some operational restrictions, such as, for example, requiring alternate aerodromes to provide for "conventional" approaches (VOR, NDB, ILS). Another aspect that should be considered is the need to establish a navigation reversal mode if the GNSS signal is lost, requiring the aircraft to be equipped with "conventional" air navigation systems.

States in the Region have already published some regulations for GNSS use. **Attachment 7 to Appendix B** shows the current status of these regulations in the SAM Region. Regulation of GNSS use is essential for all navigation applications.

The use of GNSS as a means of navigation is of key importance to meet RNAV-1 requirements, considering that some aircraft only have this type of RNAV equipment and that some TMAs may not have sufficient DME coverage to accommodate navigation based on this system. Consequently, SAM States should consider regulating the use of GNSS and make any changes they deem necessary.

For RNP APCH and RNP AR navigation specifications, GNSS is the only system that meets the requirements established in the PBN Manual.

7.2. Finalize WGS-84 implementation.

7.3. SID, STAR and Approach Ground Validation and Flight Inspection

A series of steps should be followed in preparing RNAV or RNP IFR procedures, starting with the generation of the data through their final publication and subsequent coding for use in the navigation database. The PBN Manual, Volume I, Part B, Appendix B contains information about the ground validation of IFR procedures. Quality control should be exercised in each design phase of the IFR procedures, in order to reach the necessary levels of precision and integrity. Doc. 8168 – PANS-OPS, Volume II, Part 1, Section 2, Chapter 4 (Quality Assurance) details the quality control procedures to be used.

Flight inspections must be made of the procedures and radio aids on which the procedures are based. Insofar as the procedure flyability is concerned, States must consider using flight simulators in order to verify whether the proposed procedures can properly serve the most critical aircraft in a given airspace/aerodrome.

7.4. Establish Navigation Database Validation Requirements and Procedures.

The integrity of navigation databases is a key safety element in a PBN environment, depending on the Navigation Specification requirements. Consequently, database integrity should meet the requirements set forth in documents DO 200A and/or EUROCAE ED 76 (Data Quality Assurance Process). The State must issue a Letter of Acceptance (LOA) documenting that the database provider meets the requirements of DO 200A and/or EUROCAE ED 76 or accept the LOAs issued by other States or International Organizations (FAA or EUROCONTROL).

7.5. Prepare the AIC model to report PBN implementation plans.

The AIC reporting PBN implementation, published approximately 2 years in advance, will give aircraft operators enough time to obtain approvals for RNP APCH and/or RNP AR RNAV-1 operations.

7.6. Publish the AIC reporting PBN implementation plans.

States must publish the AIC reporting PBN implementation plans.

7.7. Prepare an AIP Supplement model containing applicable standards and procedures, including the corresponding in-flight contingencies.

The AIP Supplement will contain specific operational standards and procedures for RNP APCH and/or RNP AR RNAV-1 implementation.

7.8. Publish an AIP Supplement containing applicable standards and procedures, including the corresponding in-flight contingencies.

7.9. Review the Procedural Handbook of the ATS units involved.

The Procedural Handbook of the ATS units gives a detailed account of their mode of operation, in an effort to harmonize the operational procedures applied by air traffic controllers. RNAV-1 implementation will require a review of these procedures, considering in particular:

a) Aircraft separation;
b) Contingency procedures;
c) New SID/STAR/approach procedures;
d) Radio aids that are essential for SID, STAR and approach procedures. For the approach, this is normally applied in cases when the missed approach is based on a ground-based radio aid.
e) New air traffic routing models (new air flow), including the SID/STAR/approach procedures used, radar vectoring, if required, and the systematic “feeding” of TMAs.

7.10. Update letters of agreement between ATS units.

Letters of agreement between ATS units (between ACCs or between ACCs and APPs) shall be updated to reflect the new airspace structure implemented, if appropriate, and the procedures mentioned in the previous paragraph.

7.11. Review practices and procedures for improving fuel consumption management and environmental protection.

This must be an objective to be sought at all SAM/IG meetings, in accordance with the environmental policy of ICAO and of the SAM States.

8. Training

8.1. Prepare a training and documentation programme for operators (pilots, dispatchers and maintenance personnel).

The documentation and training leading to the operational approval of an aircraft operator is normally part of the operational certification process that guarantees the use of an Air Navigation Application. E ach aircraft operator must develop a training programme to be approved by the civil aviation authority, in order to obtain approval for the use of an Air Navigation Application. The PBN Manual, Volume II, Parts B and C, contains some general training guidelines for aircraft operators that cover each Navigation Specification.

8.2. Develop a training and documentation programme for air traffic controllers and AIS operators.

The PBN Manual, Volume II, Parts B and C, contains some general training guidelines for air traffic controllers that cover each Navigation Specification.

8.3. Develop a training programme for regulators (aviation safety inspectors).

Aviation safety inspectors must receive the necessary training so as to be able to verify compliance with PBN specification norms.

8.4. Conduct training programmes.

States, service providers and aircraft operators must conduct the necessary training programmes within the stipulated period in order to ensure implementation by the established deadline.

8.5. Hold seminars for operators, indicating the plans and expected operational and economic benefits.

The main purpose for holding seminars targeting operators is to urge them to equip their aircraft within an appropriate period of time, in keeping with the established navigation specifications, showing them the objectives and benefits to be attained through said implementation.

9. Decision to Implement

At this point in the Action Plan, three basic questions must be answered:

a) Is the aircraft operator ready for the implementation? (9.1 and 9.2)

b) Is the air traffic service provider ready for the implementation? (9.1)

c) Is the implementation safe? (9.3).

A specific meeting must be held to assess these three key points and reach a final implementation decision.

When a final decision has been reached, each State must publish the relevant ATS documentation, including the trigger NOTAM, seven days before the planned implementation date, in order to confirm it.

9.1. Assess the available operational documentation (ATS, OPS/AIR).

9.2. Assess the percentage of approved aircraft and operators (overall equipment involved).

9.3. Review the results of the safety assessment.

9.4. Publish the trigger NOTAM.

10. Performance Monitoring System

Following the implementation of the navigation Application, the TMA will enter the pre-operational phase for a one-year period. At the end of this period, if the assessment is positive, it will be possible to move to the operational phase. D uring this period, a post-implementation operations monitoring programme must be established primarily to assess safety. A performance assessment system must also be implemented, as stipulated in item 2 of the Action Plan. B oth the safety and the performance assessment, as a whole, must be carried out on an ongoing basis.

10.1. Develop a post-implementation monitoring programme for TMA and approach operations.

10.2. Implement a post-implementation monitoring programme for TMA and approach operations.

ATTACHMENT 1

SHORT-TERM TMA PBN ACTION PLAN (RNAV-1)
(GPIs 1, 4, 5, 7, 8, 10, 11, 12, 16, 21, 23)

1.	Airspace concept	Start	End	Responsible party	Remarks
1.1	Establish and prioritize strategic objectives (safety, capacity, environment, etc.)			States	
1.2	Collect traffic data in order to understand traffic flows in TMA airspace			States	
1.3	Analyze the navigation capacity of the aircraft fleet in the TMA			States	
1.4	Analyze ground-based means of communication, navigation (VOR, DME) and surveillance to meet navigation specifications and navigation reversal mode			States	
1.5	Optimize airspace structure, reorganizing the network or implementing new routes based on the strategic objectives of the airspace concept, taking into account airspace modelling, ATC simulations (fast time and/or real time), live tests, etc.			States	

2.	Develop a performance measurement plan	Start	End	Responsible party	Remarks
2.1	Draft a plan to measure performance, including gas emissions, safety, efficiency, etc.			States	
2.2	Implement the performance measurement plan			States	

3	Safety assessment	Start	End	Responsible party	Remarks
3.1	Determine the methodology to be used to assess airspace safety and route spacing, based on t he navigation specification, taking into account airspace modelling, ATC simulations (fast time and/or real time), live tests, etc.			States	
3.2	Develop a data collection programme to assess airspace safety			States	
3.3	Prepare the preliminary airspace safety assessment			States	

3	**Safety assessment**	**Start**	**End**	**Responsible party**	**Remarks**
3.4	Prepare the final airspace safety assessment			States	

4	**Establish a collaborative decision-making process (CDM)**	**Start**	**End**	**Responsible party**	**Remarks**
4.1	Coordinate planning and implementation requirements with air navigation service providers, regulators, users, aircraft operators and military authorities			States	
4.2	Establish the implementation date			States	
4.3	Establish the documentation format in the SAM PBN website			States	
4.4	Report planning and implementation developments to the corresponding Regional Office			States	

5	**ATC automated systems**	**Start**	**End**	**Responsible party**	**Remarks**
5.1	Assess PBN implementation in ATC automated systems, taking into account amendment 1 to the PANS/ATM (FPLSG).			States	
5.2	Implement the necessary changes in ATC automated systems			States	

6. Aircraft and operator approval	Start	End	Responsible party	Remarks
6.1 Analyze aircraft and operator approval requirements (pilots, dispatchers and maintenance personnel), in keeping with the PBN manual, and develop the necessary documentation.			States	
6.2 Publish national regulations for the implementation of the RNAV-1 navigation specification			States	
6.3 Begin the approval of aircraft and operators			States	
6.4 Establish and keep up to date a registry of approved aircraft and operators			States	
6.5 Verify the operation of the continuous monitoring programme (aircraft and procedures)			States	

7. Standards and procedures	Start	End	Responsible party	Remarks
7.1 Assess and, if applicable, publish the regulations on the use of GNSS.			States	
7.2 Finalize WGS-84 implementation			States	
7.3 Ground validation and in-flight inspection of SIDs and/or STARs			States	
7.4 Establishment of navigation database validation requirements and procedures			States	
7.5 Develop an AIC model to report PBN implementation plans			States	
7.6 Publish the AIC reporting PBN implementation plans			States	
7.7 Develop an AIP Supplement model containing applicable standards and procedures, including the corresponding in-flight contingencies			States	
7.8 Publish the AIP Supplement containing applicable standards and procedures, including the corresponding in-flight contingencies			States	
7.9 Review the Procedural Handbook of the ATS units involved			States	
7.10 Update the letters of agreement between ATS units			States	

7.	Standards and procedures	Start	End	Responsible party	Remarks
7.11	Review practices and procedures to improve fuel consumption management and environmental protection			States	

8.	Training	Start	End	Responsible party	Remarks
8.1	Develop a training and documentation programme for operators (pilots, dispatchers and maintenance personnel)			States	
8.2	Develop a training and documentation programme for air traffic controllers and AIS operators			States	
8.3	Develop a training programme for regulators (aviation safety inspectors)			States	
8.4	Conduct training programmes			States	
8.5	Conduct seminars for operators, explaining plans and expected operational and economic benefits			States	

9.	Implementation decision	Start	End	Responsible party	Remarks
9.1	Assess the available operational documentation (ATS, OPS/AIR)			States	
9.2	Assess the percentage of approved aircraft and operators (non-exclusionary airspace)			States	
9.3	Analyze the results of the safety assessment			States	
9.4	Publish trigger NOTAM			States	

10. Performance monitoring system	Start	End	Responsible party	Remarks
10.1 Develop a post-implementation monitoring programme for TMA operations			States	
10.2 Implement a post-implementation monitoring programme for TMA operations			States	
Pre-operational implementation date			States	
Definitive implementation date			States	

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ATTACHMENT 2
APPROACH PBN ACTION PLAN
GPIs 1, 12, 16, 21, 23

1.	**Airspace concept**	**Start**	**End**	**Notes**
1.1	Establish and prioritize strategic objectives (safety, capacity, environment, etc.)			
1.2	Analyze the navigation capacity of the aircraft fleet that operates at the airport			
1.3	Analyze ground-based means of communication, navigation (VOR, DME) and surveillance to meet the navigation specifications and the navigation reversal mode			
1.4	Design instrument approach procedures (APCH/APV Baro-VNAV RNP or RNP AR) based on the strategic objective of the airspace concept, taking into account airspace modeling, ATC simulations (fast time and/or real time), live tests, etc.			

2.	**Develop a performance measurement plan**	**Start**	**End**	**Notes**
2.1	Draft a plan to measure performance, including gas emissions, safety, efficiency, etc.			
2.2	Implement the performance measurement plan			

3.	**Safety assessment procedure**	**Start**	**End**	**Notes**
3.1	Determine the methodology to be used to assess airspace safety, based on the navigation specification, taking into account airspace modelling, ATC simulations (fast time and/or real time), live tests, etc.			
3.2	Develop a data collection programme to assess airspace safety			
3.3	Prepare a preliminary safety assessment for the application of the procedure(s)			
3.4	Prepare a final safety assessment for the application of the procedure(s)			

4	**Establish a collaborative decision-making process (CDM)**	**Start**	**End**	**Notes**
4.1	Coordinate planning and implementation requirements with air navigation service providers, regulators, users, aircraft operators and military authorities			
4.2	Establish the implementation date			

4	**Establish a collaborative decision-making process (CDM)**	**Start**	**End**	**Notes**
4.3	Establish the format and documentation of the SAM PBN website			
4.4	Report planning and implementation progress to the SAM Regional Office			

5	**ATC automated systems**	**Start**	**End**	**Notes**
5.1	Assess PBN implementation in ATC automated systems, taking into account amendment 1 to the PANS/ATM (FPLSG).			
5.2	Implement the necessary changes in ATC automated systems			

6.	**Aircraft and operator approval**	**Start**	**End**	**Notes**
6.1	Analyze aircraft and operator approval requirements (pilots, dispatchers and maintenance personnel) in keeping with the PBN manual, and develop the necessary documentation.			
6.2	Publish national regulations for the implementation of the navigation specification			
6.3	Begin the approval of aircraft and operators			
6.4	Establish and keep up to date a registry of approved aircraft and operators			
6.5	Verify the operation of the continuous monitoring programme (aircraft and procedures)			

7.	**Standards and procedures**	**Start**	**End**	**Notes**
7.1	Assess and, if applicable, publish the regulations on the use of GNSS.			
7.2	Finalize WGS-84 implementation			
7.3	Ground validation and in-flight inspection of approach procedures			
7.4	Establish the navigation database validation requirements and procedures			

7.5 Develop an AIC model to report PBN implementation plans			
7.6 Publish the AIC reporting PBN implementation plans			
7.7 Develop an AIP Supplement model containing applicable standards and procedures, including the corresponding in-flight contingencies			
7.8 Publish the AIP Supplement containing applicable standards and procedures, including the corresponding in-flight contingencies			
7.9 Review the Procedural Handbook of the ATS units involved			
7.10 Update the letters of agreement between ATS units			
7.11 Review practices and procedures to improve fuel consumption management and environmental protection			

8. Training	**Start**	**End**	**Notes**
8.1 Develop a training and documentation programme for operators (pilots, dispatchers and maintenance personnel)			
8.2 Develop a training and documentation programme for air traffic controllers and AIS operators			
8.3 Develop a training programme for regulators (aviation safety inspectors)			
8.4 Conduct training programmes			
8.5 Conduct seminars for operators, explaining plans and expected operational and economic benefits			

9. Implementation decision	**Start**	**End**	**Notes**
9.1 Assess the available operational documentation (ATS, OPS/AIR)			
9.2 Assess the percentage of approved aircraft and operators (non-exclusionary airspace)			

9.3 Analyze the results of the safety assessment			

10. Performance monitoring system	**Start**	**End**	**Notes**
10.1 Develop a post-implementation approach operations monitoring programme			
10.2 Implement a post-implementation approach operations monitoring programme			
Pre-operational implementation date			
Definitive implementation date			

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